

OMMATOIULUS MORELETI (LUCAS) AND CYLINDROIULUS PYRENAICUS (BRÖLEMANN) NEW TO THE UK (DIPLOPODA, JULIDA: JULIDAE) AND A NEW HOST FOR RICKIA LABOULBENIOIDES (LABOULBENIALES)

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ABSTRACT

The schizophylline millipede *Ommatoiulus moreleti* (Lucas) and the cylindroiuline millipede *Cylindroiulus pyrenaicus* (Brölemann) (Julida: Julidae) are recorded new for the UK from a site near Bridgend, Glamorganshire, in April 2017. An unidentified millipede first collected in April 2004 from Kenfig Burrows, Glamorganshire, is also confirmed as being *C. pyrenaicus*. Both species are described and illustrated, enabling identification. *C. pyrenaicus* is reported as a new host for the Laboulbeniales fungus *Rickia laboulbenioides*. Summary information is provided on habitat preferences of both species in South Wales and on their foreign distribution and habitats. It is considered likely that both species have been unintentionally introduced into the UK as a consequence of industrial activity in the Valleys of south Wales.

INTRODUCTION

The genera *Ommatoiulus* Latzel, 1884 and *Cylindroiulus* Verhoeff, 1894 (Julida: Julidae) both display high species diversity (Kime & Enghoff, 2017). Of the 47 described species of *Ommatoiulus* the majority are found in North Africa and the Iberian Peninsula (*ibid*). Currently, just one species, *Ommatoiulus sabulosus* (Linnaeus, 1758), is known from Britain and Ireland, a species that occurs widely across northern Europe (Kime, 1999) and in Britain reaches the northern Scottish coastline (Lee, 2006). The genus *Cylindroiulus* occurs widely across Europe and with over 100 described species is one of the largest genera the family Julidae (Kime & Enghoff, 2017). Nine species are recorded from Britain and Ireland by Lee (2006) with the introduced *C. apenninorum* recently added to the British list by Barber & Read (2016).

This paper reports the discovery of two millipedes new for the UK, *Ommatoiulus moreleti* (Lucas, 1860) and *Cylindroiulus pyrenaicus* (Brölemann, 1897), both found during a series of collecting trips by EW and CO to Craig yr Aber, Glamorganshire.

OMMATOIULUS MORELETI (LUCAS, 1860)**Discovery**

During a fungal foray on 13th April 2017 by EW to Craig yr Aber, near Bridgend, Glamorganshire (SS855850, VC 41) a number of large, but unfamiliar, millipedes were encountered. Body colour varied from grey to almost black, with contrasting pink legs and antennae (Figs. 1A-C). The darkest individual, a female some 40mm in length, was collected and examined by CO who provisionally identified it as a species of *Ommatoiulus*, but distinct from our native *O. sabulosus* (Linné). CO returned to the site on 17th April and collected a male, two females and two immatures. The male

specimen was sent to SJG who identified it as *Ommatoiulus moreleti* (Lucas, 1860) using Akkari & Enghoff (2017) (identification confirmed by Henrik Enghoff).

This is the first recorded occurrence of this species in the UK.

Taxonomy

ORDER Julida Brandt, 1833

FAMILY Julidae Leach, 1814

TRIBE Schizophyllini Verhoeff, 1909

GENUS *Ommatoiulus* Latzel, 1884

***Ommatoiulus moreleti* (Lucas, 1860)**

syn. *Julus moreleti* Lucas, 1860

Ommatoiulus moreleti exhibits considerable variation of the male gonopods and has been the source of much taxonomic confusion. A full list of synonyms is given in Akkari & Enghoff (2012; 2017).

Diagnosis

Ommatoiulus moreleti is a distinctive robust millipede, typically darkly pigmented with contrasting pinkish legs and antennae (Figs. 1A-B). Mature male specimens may be readily identified from the distinctive profile of the gonopods in posterior view (Figs. 2C-D).

Using Blower (1985), it will key to *Ommatoiulus sabulosus* (Linné) due to the upturned telson and presence of fine traverse chasings on the prozonites on larger specimens (Figs. 2A-B). However, the relatively long telson could result in confusion with the tribe Julini, but these have a straight or down-turned telson and prominent fringing setae on the metazonites (glabrous in *Ommatoiulus*).

Description

This description is based on a single recently collected male specimen preserved in 70% isopropyl alcohol, with additional notes provided by field observations.

Size

The male examined is 35 mm in length by 3.0 mm in diameter (measured dorsa-ventrally). Females observed by EW and CO are slightly larger, up to 40 mm in length. This is significantly larger than *O. sabulosus*, where males reach 23 x 1.8 mm, females 33 x 2.8 mm (Blower, 1985).

Colour

Body colour is highly characteristic. Larger juveniles and adults (Figs. 1A-B) vary in colour from uniform grey with pinkish legs and antennae, through increasing darker shades to almost uniform black with contrasting burgundy legs and antennae. Immature specimens (Fig. 1C) are pale grey, often with a pair of indistinct dorsal stripes, but these are much less pronounced than seen in *O. sabulosus*.

Body rings

The male examined comprised 47 body rings (including collum and telson). Prozonites (Fig. 2B) bear irregular fine striations in addition to the usual distinct longitudinal striae of the metazonites, with the ozopores lying posterior to the suture. Metazonites are glabrous, lacking fringing setae. Telson (Fig. 2A) is produced into a long caudal projection (somewhat longer than seen in *O. sabulosus*), curving upwards towards its tip, which bears a distinct tuft of setae. All these characters are similar to those seen in *O. sabulosus* (Blower, 1985).



FIGURE 1: *Ommatoiulus moreleti* (Lucas) from Craig yr Aber

A) Mature specimen as found on underside of Beech log (the two small specimens are *Cylindroiulus pyrenaicus*); B) Defensively coiled specimens; C) Immature specimen. (images © Christian Owen)

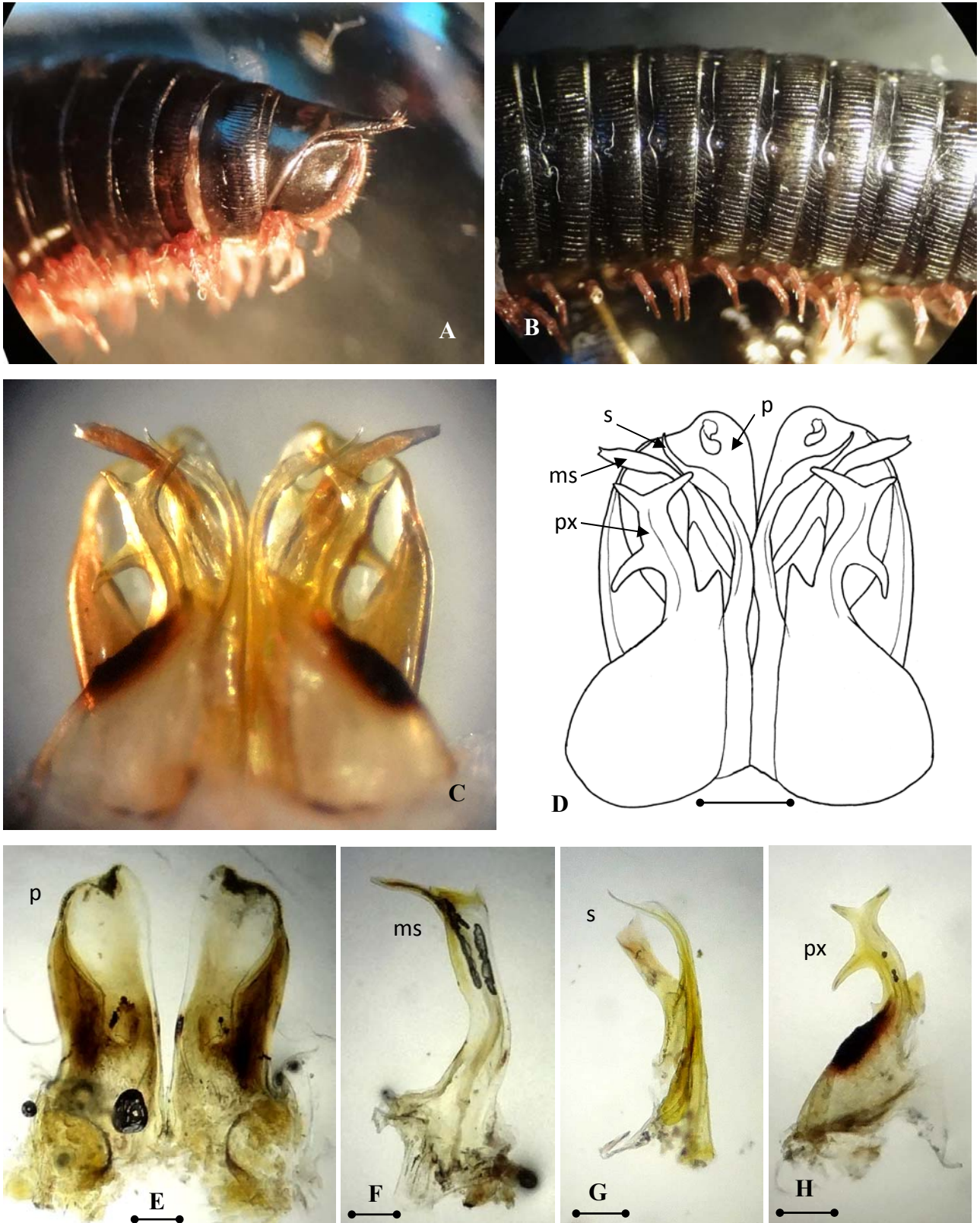


FIGURE 2: *Ommatiulus moreleti* male, from at Craig yr Aber

A) Telson); B) Mid body rings; C-D) Gonopods, posterior view; E) Promerites; F) Mesomerite; G) Solenomerite; H) Paracoxite, all posterior view (E-H cleared in clove oil). Scale bars 0.2 mm

Male: gonopods (leg pairs 8 and 9)

The gonopods are almost entirely retracted into the body. In posterior view (Figs. 2C-D) the gonopods are of highly characteristic shape. The paracoxite (px; Figs. 2C-D & 2H) is antler-shaped, bearing three tapered processes. Behind the paracoxite (i.e. anteriorly), the mesomerite (ms), which is as long as the promerite (p), and the shorter solenomerite (s) both curve outwards. The anterior promerites (p, Fig. 2E) are more or less parallel-sided. The mesomerites and solenomerites (Figs. 2F-G), when dissected out, are also of characteristic shape.

Male: secondary sexual characters

In keeping with other species of the genus (Akkari & Enghoff, 2017), males have the mandibular stipes vertically expanded into rounded lobes; leg-pair 1 considerably reduced in size and modified into a pair of hooks; and postfemoral and tibial pads are present on the subsequent leg-pairs.

Female characters

Female vulvae were not examined.

Occurrence in South Wales*Location*

Despite being a large and conspicuous species, this millipede has only been recorded from a discrete area (c. 400m by 250m) of the southern part of the Craig yr Aber woodland. Searches beyond this area have not found additional specimens.

Habitat

The first specimens, collected in spring, were found beneath rotten logs and among leaf-litter in a narrow strip of Beech *Fagus sylvatica* woodland (some 50m wide) within a larger conifer/mixed woodland matrix (Fig. 3). Here the ground flora is dominated by Bluebells *Hyacinthoides non-scripta*. Subsequent surveys found this species throughout adjacent conifer blocks among *Polytrichum* sp. mosses and within rotten logs. Specimens were also observed climbing the sun-lit side of Beech trunks and collected from within rot-holes and from low branches of Beech, Holly *Ilex aquifolium*, and other woody species. This wide vertical range is similar to that seen in the other British schizophylline millipedes, *O. sabulosus* and *Tachypodoiulus niger* (Leach). In November the species proved elusive, but could be found in small numbers sheltering beneath, and within, pieces of dead wood.

Associated species

The most abundant millipede present is *Cylindroiulus pyrenaicus* (Brölemann) (the discovery of which is detailed below). *Hylebainosoma nontronensis* Mauriès & Kime, *Ceratosphys amoena confusa* (both recent additions to the UK fauna – Telfer. *et al.*, 2015) and an unidentified chordeumatidan were also collected. The remaining millipede fauna was unremarkable; *Polydesmus angustus* Latzel, *Cylindroiulus punctatus* (Leach), *Proteroiulus fuscus* (Am Stein) and a single *T. niger*.

Of the associated centipedes, *Lithobius pilicornis* Newport and *L. piceus* L. Koch were the most frequently encountered species. These two species have very restricted distributions in Britain and have only recently been discovered in South Wales (Barber, 2009). The widespread woodland species, *Lithobius variegatus* Leach and *Strigamia crassipes* (C.L. Koch) were also present.

Foreign distribution and habitats

O. moreleti is native to continental Portugal and southern Spain where its distribution is related to the availability of deep litter, often provided by Pine *Pinus* and Oak *Quercus* trees, but also by dense shrubs and heath and undisturbed grassland (Bailey & de Mendonça, 1990). However, *O. moreleti* has been spread through commerce and has been introduced to the Macaronesian Islands, Bermuda, South Africa and south-eastern Australia (Akkari & Enghoff, 2012; 2017). In South Africa it is recorded from various natural habitats and synanthropic sites, such as gardens. In south-eastern Australia, where it is known as “Portuguese millipede”, it has become a pest of fruit and vegetables (*ibid*).



FIGURE 3: Beech *Fagus sylvatica* dominated woodland strip where both *O. moreleti* and *C. pyrenaicus* occurred in good numbers.

***CYLINDROIULUS PYRENAICUS* (BRÖLEMANN, 1897)**

Discovery

On 19th April 2004 GJ collected a small well pigmented millipede, bearing both a projecting telson and projecting ventral scale, from the banks of the River Kenfig at Kenfig Burrows, Glamorganshire (SS792833, VC 41). Subsequently, GJ collected two additional specimens from a domestic garden at North Cornelly close to the River Kenfig (SS813819, VC 41) just a few kilometres upstream (Table 1). These specimens were forwarded to Paul Lee (organiser of the BMIG Millipede Recording Scheme), but unfortunately were immature and could not be allocated to species (although referable to a species of *Cylindroiulus/Allajulus* that was unknown in Britain (Paul Lee, pers. comm. to GJ). This discovery appears to have slipped from the collective consciousness of many myriapodologists in the UK until Barber & Read (2016) reported the discovery of *Cylindroiulus apenninorum* in southern England and raised the possibility that these Welsh specimens could be referable to the same species.

On 17th April 2017 while searching for male specimens of the then unidentified *Ommatoiulus moreleti* at Craig yr Aber CO also collected two specimens of a much smaller millipede (Fig.1A) which had a very obvious projecting telson and ventral scale. Unfortunately, these were immature, but additional specimens collected by CO on 1st May 2017 included two males and a number of females. One male was sent to SJG who provisionally identified it as *Cylindroiulus pyrenaicus* (Brölemann, 1897). The second male, bearing a Laboulbeniales fungus, was sent Henrik Enghoff (University of Copenhagen) who confirmed the millipede's determination.

Subsequently, five specimens collected by GJ on 19.iv.2007 from the banks of the river Kenfig at Kenfig Burrows were examined by SJG. The presence of a male confirmed that these too were *C. pyrenaicus*. Thus, after more than a decade, the puzzle of the 'two-tailed' millipede from south Wales finally had been solved.

These are the first British and Irish occurrences of *C. pyrenaicus*, and are listed in Table 1.

Taxonomy

ORDER Julida Brandt, 1833

FAMILY Julidae Leach, 1814

TRIBE Cylindroiulini Verhoeff, 1930

GENUS *Cylindroiulus* Verhoeff, 1894

***Cylindroiulus pyrenaicus* (Brölemann, 1897)**

syn. *Iulus pyrenaicus* Brölemann, 1897

Diagnosis

Cylindroiulus pyrenaicus is a relatively short and stout, well pigmented, millipede that lacks body setae. It is distinctive in bearing both a projecting telson and ventral scale. In Britain and Ireland, this combination of characters is otherwise only seen in *C. apenninorum* and *Enataiulus armatus*. The former is much larger, reaching 30mm or more in length (Barber & Read, 2016) and the latter has conspicuous fringing setae on the metazonites (Blower, 1985), which are glabrous in *Cylindroiulus* sp. (Table 2). Male gonopods are characteristic in lateral or mesal view (Figs. 4D-E).

Description

Size

Body is relatively short and stout. The two males examined are 12 mm and 13 mm in length by 1.0 mm in diameter. Females examined were between 15-18 mm in length by 1.3-1.5 mm in diameter.

Colour

Fresh specimens (Fig. 4A) are brown mottled with white; the pattern giving the impression of being darker dorsally and paler laterally. The head is mostly pale with a dark brown band between the eyes. The collum and anal rings also pale, the latter (Fig. 4B) contrasting with the darkened pre-anal ring. Legs are noticeably paler than the body. Specimens collected in 2007 had faded noticeably after a decade in alcohol, becoming a more uniform pale brown.

Body rings

Both males were stadia VII, with 7 rows of ocelli arranged in a rounded triangle, and with 41 body rings (including collum and telson). The four females examined in detail were also stadia VII with 40 or 41 body rings. All with three apodous posterior body rings.

Metazonites with distinct longitudinal striae. In common with other *Cylindroiulus* species, frontal setae on head and fringing setae on metazonites are absent and the ozopores lie on the suture between prozonites and metazonites. Anal valves with three pairs of setae (as seen in *C. britannicus* (Verhoeff) and *C. latestriatus* (Curtis)). Telson (Fig. 4B) is produced into a stout caudal projection that is slightly down-turned towards the tip and ventral scale also projecting, relatively stout, and about half length of telson. Both the tip of the telson and the ventral scale bear a pair of setae (though broken off in some specimens). In Britain and Ireland, this combination of projecting telson and anal scale is otherwise only seen in *C. apenninorum* and *E. armatus*. The key differences between these species are listed in Table 2.

Male: gonopods (leg pairs 8 and 9)

Male gonopods are of characteristic shape (Figs. 4D-E). Promerite and mesomerite of similar length, together forming a rather short and squat structure. Opisthomerite with prominent triangular coxal process and with brachite evenly rounded like the tip of a thumb. Flagellum well developed.

TABLE 1: The first British records of *Cylindroiulus pyrenaicus* in chronological order

GHJ – Greg Jones; SCW – Simon Warming ham; CO – Christian Owen

* Material examined for this paper; # still present on site in 2017

Locality	Grid Ref	VC	Number of specimens	Date of collection	Collector
River Kenfig, Kenfig Burrows	SS792833	41	1	19.iv.2004	GHJ
Heol Maendy, North Cornelly	SS813819	41	1	2.v.2004	GHJ
Heol Maendy, North Cornelly	SS813819	41	1	29.iv.2006 #	GHJ
River Kenfig, Kenfig Burrows	SS794831	41	*1♂ 3♀ 1juv	19.iv.2007 #	GHJ, SCW
Craig yr Aber, nr Bridgend	SS855851	41	*2 juvs	14.iv.2017	CO
Craig yr Aber, nr Bridgend	SS856849	41	*2♂♂ 10♀♀	01.v.2017	CO

TABLE 2: Comparison of some characteristics of *Cylindroiulus pyrenaicus* (*from Brölemann, 1897) with *C. apenninorum* (from Barber & Read, 2016) and *Enantiulus armatus* (from Blower, 1985)

Character	<i>C. pyrenaicus</i>	<i>C. apenninorum</i>	<i>E. armatus</i>
Maximum size	18 (*20) mm x 1.5 mm	33 mm x 3 mm	15.1 mm x 1.05 mm
Colour	Medium to dark brown	Typically medium to dark brown	Light amber to olive green
Body rings	40 – 41 (*41)	45 – 53	Up to 51
Setae on body rings	Absent	Absent	Present
Male first legs	Comma shaped, Fig. 4C	Comma shaped	More angular and “elbow” shaped
Current known occurrence in Britain	South Wales	Isle of Wight & Plymouth, Devon	South Devon & Cornwall

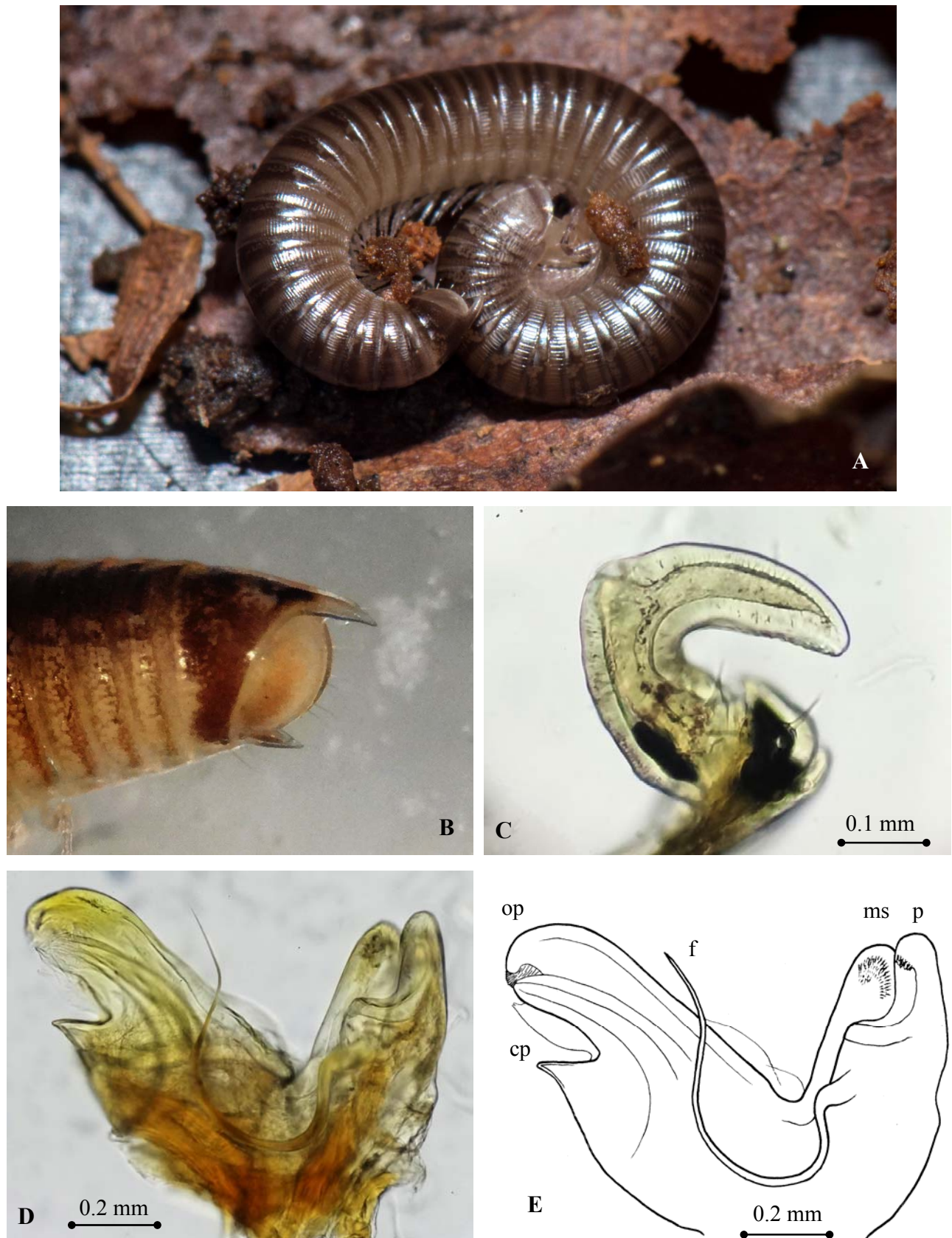


FIGURE 4: *Cyldroiulus pyrenaicus* from at Craig yr Aber

A) Female, habitus (image © Keith Lugg); B) Male posterior body rings showing apododous segments, projecting telson and projecting ventral scale; C) Male first pair of legs; D) Male gonopods (cleared in euparal), mesal view; E) Male gonopods, mesal view (op – opisthomerite; cp - coxal projection; f – flagellum; ms - mesomerite; p – promerite)

Male: secondary sexual characters

In keeping with other species of the genus the stipites of mature males are expanded and leg-pair 1 considerably reduced in size and modified into a pair of hooks (Fig. 4C).

Female characters

Female vulvae were not examined.

Occurrence in South Wales*Location*

Current observations suggest that *C. pyrenaicus* is confined to the lower catchment of river Kenfig (which is about 18km in total length). Kenfig Burrows lies close to where the River Kenfig meets the sea (The Bristol Channel). The North Cornelly garden is situated about two kilometres upstream of this, while Craig yr Aber is another 5km further upstream beside the Nant Craigraber, a tributary of the River Kenfig. There is also a report (John Harper, pers. comm. to GJ) of a similar ‘two-tailed’ millipede at Cefn Cribwr, south of Craig yr Aber, which also drains into the Kenfig catchment. Considering that the observations of this species have been made on a number of occasions, between 2004 and 2017, and at several locations (Table 1) then it appears that *C. pyrenaicus* is well established in this area of south Wales.

Habitat

The first specimens of *C. pyrenaicus*, collected in 2004 (Table 1), were from the bank of the River Kenfig under bark of rotten logs that had been washed downstream by winter floodwater. The species was still present in 2017, with many specimens (male and female) seen within a rotten log in the same general area as the original 2004 and 2007 records. A few other specimens were found under a small piece of plastic and a house brick near the entrance to an abandoned building. The specimens from North Cornelly have been collected from beneath flower pots on a patio in a domestic garden on several occasions between 2004 and 2017, suggesting that it is able to survive in synanthropic habitats. Specimens of *C. pyrenaicus* at Craig yr Aber were found in the same general area (but slightly more widespread) in which *O. moreleti* was found. In the Beech woodland strip (Fig. 3) it was the most frequently encountered millipede, found in large numbers in rotten wood and among Beech leaf litter. It was less numerous in the surrounding conifer plantation but still present in rotten logs and among moss throughout the site.

Associated species

At Craig yr Aber *C. pyrenaicus* was associated with the same species of millipede and centipede reported for *O. moreleti* (above). In the North Cornelly garden the myriapods recorded included *Cylindroiulus britannicus* (Verhoeff), *C. punctatus* (Leach), *Leptoiulus belgicus* (Latzel) (which has a predominantly south-western distribution in Britain (Lee, 2006)) and *Lithobius melanops* Newport. Few millipedes were seen at the River Kenfig site, but those noted were *Polydesmus angustus* Latzel, *C. britannicus* and *Ommatoiulus sabulosus* (Linné).

Foreign distribution and habitats

Cylindroiulus pyrenaicus is known from the French and Spanish sides of the Pyrenees and the Montagne Noire (south-west Massif Central) in southern France (Kime & Enghoff, 2017). It favours Beech *Fagus* forest, but also has been recorded from mixed deciduous woodland and conifers, including Pine *Pinus* plantation. Typically it is found among deep litter and moss or under bark and within dead wood (*ibid*).

These habitats and associated microsites are in keeping with observations of this species in South Wales.

Very recently *C. pyrenaicus* has been reported from several sites within three departments in north-west France (Unpublished data; A. Racine and F. Noël; J-J. Geoffroy, pers. comm.), which raises the possibility of a disjunct distribution for this species in France, where it was previously thought to be endemic to the Pyrenees (Kime & Enghoff, 2017).

A NEW HOST FOR *RICKIA LABOULBENIOIDES* (LABOULBENIALES)

One male and at least three females of *Cylindroiulus pyrenaicus* collected by CO from Craig yr Aber on 1st May 2017 were found to be infected with a Laboulbeniales fungus, which was confined to the anterior legs close to the head. This was identified by Henrik Enghoff as *Rickia laboulbenioides* De Kesel *et al.*, 2013. This is the second British record for this fungus and a new host millipede species. Previously, the only confirmed British record of *R. laboulbenioides* is from Berkshire, England, found on *C. punctatus* (reported in Santamaria *et al.*, 2016). However, Irwin (1989) reports the occurrence of unidentified Laboulbeniales on specimens of *C. britannicus* (Verhoeff) collected by the Welsh Peatland Invertebrate Survey.

Of the four genera of Laboulbeniales known to occur on millipedes, *Rickia* Cavera, with 161 described species, is the largest and parasitizes a wide variety of hosts in addition to Diplopoda (Santamaria, Enghoff & Reboleira, 2016). *Rickia laboulbenioides* was described relatively recently from infected *Cylindroiulus latestriatus* (Curtis) collected in The Netherlands and Belgium (De Kesel *et al.* 2013). Subsequently, it was found in the Iberian Peninsular, Denmark and Italy parasitizing *Cylindroiulus latestriatus* (Curtis), *C. punctatus* (Leach), *C. perforatus* (Verhoeff) and *C. dahli* Demange.

It is probably overlooked in Britain and could prove to be more widespread in both distribution and the range of host species it parasitizes. Ten species of *Cylindroiulus* have been previously recorded in Britain and Ireland (Lee, 2006; Barber & Read, 2016).

NATIVES OR INTRODUCED?

Recent fieldwork has indicated that the Valleys of south Wales support a number of unexpected species. Recent work on Molluscs has revealed several species new to Britain; the slugs *Arion cf. iratii* Garrido, Castillejo & Iglesias, *Arion cf. fagophilus* (de Winter), Ghost Slug *Selenochlamys ysbryda* Rowson & Symondson and semi-slug *Daudebardia rufa* (Draparnaud) (Rowson & Symondson, 2008; Rowson *et al.*, 2014; 2016). Among myriapods, the centipedes *Lithobius tricuspis* Meinert and *Lithobius piceus* L.Koch and the millipede *Propolydesmus testaceus* (C.L. Koch) otherwise have disjunct distributions elsewhere in the UK (Barber, 2009; Lee, 2006). Recently, the millipedes *Ceratosphys amoena confusa* Ribaut, 1920 and *Hylebainosoma nontronensis* Mauriès & Kime, 1999 were discovered new to Britain (Telfer, *et al.*, 2015). Subsequently, three additional chordeumatidan millipedes, *Typhlopsychrosoma* Mauriès, 1982 sp., *Turdulisoma* Mauriès, 1964 sp. and *Cranogona dalensi* Mauriès, 1965, have been discovered in the same region of south Wales (unpublished data: see www.bmig.org.uk/checklist/millipede-checklist). Some, such as the Ghost Slug *S. ysbryda* of Crimean origin, are considered introduced to Britain, but in the case of other species which are native to western Europe it is less easy to be sure.

Following the discovery of coal in the previous century, much of South Wales had become highly industrialised by the 19th century. Railways, ports, ironworks and other industry were constructed in many areas. The major port towns of Port Talbot and Bridgend lie a few miles west and east, respectively, of the Kenfig/Craig yr Aber area and an extensive open cast coal, partially restored,

lies just south of Craig yr Aber. Port Talbot Steelworks, founded as late as 1902, imported 300,000 tons of iron ore per annum by 1930, and rising to 3,000,000 tons per annum by 1960 (<https://en.wikipedia.org/>). Thus, there are plausible pathways for introductions from other countries into South Wales.

Given that *O. moreleti* has been introduced far from its original Iberian range into several other parts of the world, e.g. becoming a pest in Australia (Akkari & Enghoff, 2012; 2017), it seems highly probable that it has been introduced into South Wales. In the case of *C. pyrenaicus* the situation is less clear. However, given that its current known distribution is centred on the Pyrenees and in light of the importation of iron ore from the Basque Country (western Pyrenees) into South Wales (Telfer, *at al*, 2015), then it seems plausible that *C. pyrenaicus* could also have been introduced.

It is considered that on balance the evidence favours that both *O. moreleti* and *C. pyrenaicus* have been introduced to Britain, beyond their natural range, probably in recent decades, and have become established in a small area of south Wales. It will be interesting to see if either is recorded further afield.

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Franck Noël and Jean-Jacques Geoffroy kindly alerted us to the recent discovery of *C. pyrenaicus* in north-west France.

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