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Entomobrya petri sp. nov.: A new species of springtail found in the British Isles

James I. McCulloch[1,2]

[1] Wellcome Sanger Institute, Wellcome Trust Genome Campus, Hinxton, Saffron Walden CB10 1RQ, United Kingdom
[2] Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, United Kingdom
[a] Email: jm72@sanger.ac.uk

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Abstract

A new species of elongate springtail (Collembola: Entomobryomorpha) is described from a churchyard in Edinburgh: *Entomobrya petri* **sp. nov.** Microscopic examination of specimens from another site in the UK supports that this new species represents the taxon previously referred to as "*Entomobrya* nr. *imitabilis*", which is widespread in the British Isles. As well as that of the examined specimens, the ecology and distribution of the morphospecies generally is discussed.

Keywords Entomobrya | new species | chaetotaxy | taxonomy | springtails

1 Introduction

There is a long history of Collembola recording in the UK, but since the start of this millennium several new species have become widespread in the country (Ardron 2009). These may be new to the British fauna, given their absence from 20th century collections and publications, as well as new to science. The majority of these novel species are globular springtails (Symphypleona), but at least one is a slender springtail (Entomobryomorpha). This is the species described and named in this paper, *Entomobrya petri* **sp. nov.**, from specimens collected in Edinburgh. Following the first photograph in 2015 (Shaw & Trewhella 2019), there are now records of this morphospecies throughout Great Britain and the Channel Islands. Specimens from the majority of these locations have not been examined microscopically and therefore may not belong to the same species *sensu stricto*, but specimens from Newcastle are found to be microscopically identical to the *E. petri* type specimens.

In the United Kingdom, this morphospecies has been referred to as "*Entomobrya* nr *imitabilis*" given the similarity of its pattern to *Entomobrya imitabilis* Stach 1963, a species described from a single specimen from China, since destroyed (Shaw & Trewhella 2019). This has been corrupted so that photographs and records have been published under the name *Entomobrya imitabilis* (*sensu stricto*) on biological recording platforms, despite there being no confirmed records of *E. imitabilis* since the original description. Photographs of this morphospecies have additionally been referred to casually as *Himalanura* nr *tundricola*, for instance on the website www.collembola.org, which has also resulted in classifications online as *Himalanura tundricola* Tshelnokov 1987 itself. However, this species does not have the distinctive flattened chaetae of *Himalanura*.

With the rise in recognised novel species, this is the first publication in an effort to ensure that all the UK's regularly recorded springtails have been taxonomically described. The geographic origins, routes of import, and potential ecological impacts of these taxa are almost entirely unknown; providing a taxonomic description of these species is a crucial initial step in answering these questions. This description also contributes to

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the recent significant advances made in the taxonomy of *Entomobrya* – a large genus with over 300 species, the majority in the Palearctic – catalysed by the publication of the relevant volume of the *Synopses on Palaearctic Collembola* (Jordana 2012). *Entomobrya* are dominant and conspicuous members of the epigeic, corticolous, and saxicolous collembolan fauna, and are likely to become an important system for studying the concordance between genomic species delimitation and current taxonomic characters like chaetotaxy and colour pattern.

2 Methods

33 specimens of this new species were collected using an aspirator from gravestones in Duddingston Kirkyard, Edinburgh, Scotland, and initially preserved in absolute ethanol. A selection of these specimens was then mounted in Euparal or Numount. Some were used for temporary slide mounts following clearing with 10 % sodium hydroxide. Specimens were manipulated and their pattern observed using a Brunel LBXZ stereomicroscope; chaetotaxy and other fine morphological characters were observed using 400x and 1000x magnification and phase contrast settings on a Brunel SP100 light microscope. The description of the species was focused on the set of important taxonomic characters proposed by Jordana & Baquero (2005).

In order to collate information on the ecology of the morphospecies generally, records under the aforementioned placeholder names were downloaded from iRecord (www.irecord.org.uk) and iNaturalist (www.inaturalist.org). Additional records were gleaned from Shaw & Trewhella (2019). A list of records is available as Table S1. Material consisting of 81 specimens of the *E. petri* morphospecies from Arthurs Hill, Newcastle-upon-Tyne, UK (latitude 54.979, longitude -1.6413, col. Alex McDermott-Roberts, 22.iv.2025) was also examined to determine the morphological similarity with the specimens from the type location.

3 Results

Entomobryidae Tömösvary, 1882
Entomobrya Rondani, 1861

Entomobrya petri sp. nov. McCulloch
urn:lsid:zoobank.org:act:45FB7BA8-27E6-4159-8E6A-05AFE8DD4BAE

Type material: Holotype on slide, collected from a gravestone, Duddingston Kirkyard, Edinburgh, UK, 27.ii.2025. Coordinates: latitude 55.941205, longitude -3.1493321. Four paratypes on slides, 16 paratypes in absolute ethanol, deposited in the Natural History Museum London. 12 further specimens were examined on temporary slides.

Etymology: This species is named after my father, Peter. The name may also be considered a double entendre on account of this species often being found on stone surfaces, such as gravestones and walls (the given name Peter is derived from the Ancient Greek *pétros*, meaning rock or stone).

Diagnosis: This species can be recognised as belonging to *Entomobrya* by the presence of 8+8 ocelli, two teeth and a basal spine on the mucro, bare intersegmental membranes, neither flattened chaetae nor dental spines, and an apical bulb on Ant IV. Among *Entomobrya*, this species is unique in its colour pattern, which is sexually monomorphic. The chaetotaxy is also unique among known species in this genus, with simplified formula 3-1-0-2-3/2-4/2-2/1-2-1/0-1-2-2-2.

Description: Body: length up to 2mm, not including antennae. In life and ethanol, the distinctive colour pattern has patches of dark pigment as well as areas which are much paler than the base colour (which ranges from straw to burnt orange), providing high contrast (Figs. 1A, 1B). Th II is predominantly this high-contrast white colouration – which appears to be derived from internal fatty tissue – bordered with black. Th III mostly black, with the white patches limited to the sides. Majority of Abd I contrasting white. Abd II has the hind edge black, extending into an irregular shape laterally, and also features a pair of white patches. Abd III has the base colour laterally, but with central three-quarters black with a pair of pale spots of variable size. Abd IV with the posterior edge dark, sometimes broken in the middle, with a further black patch on either side about one-third from the anterior edge, which may or may not be connected by a strip of pigment to the dark posterior edge. Abd V also dark on the posterior edge. Head with a band of dark pigment between the anterior vertices of the ocellar patch, projecting forward between the antennal sockets; otherwise unpigmented.

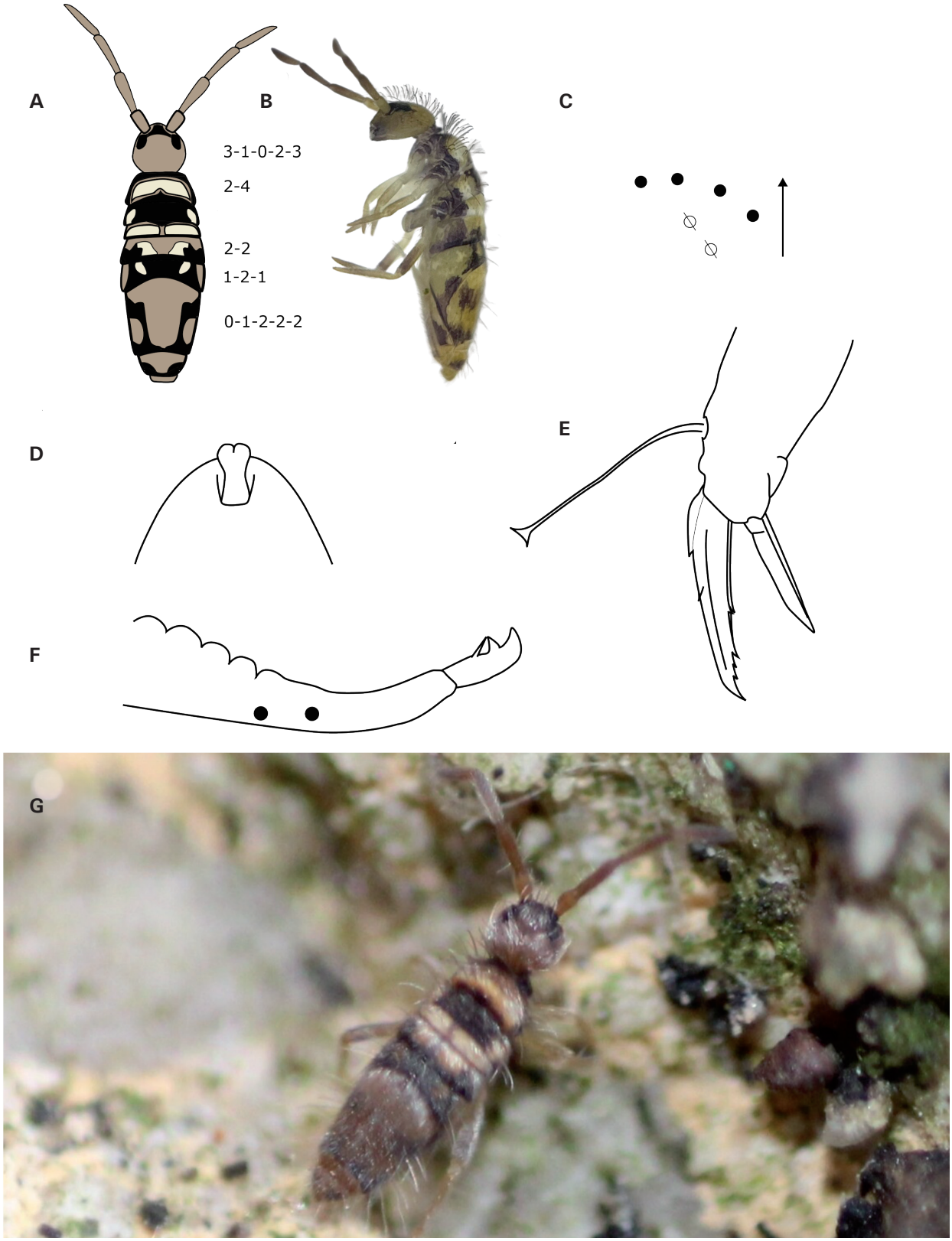

Figure 1. (**A**) Dorsal pattern, with simplified chaetotaxy formulae for the head, Th II, and Abd II-IV. (**B**) Photograph of the lateral pattern. (**C**) The manubrial plate, with four chaetae (filled circles) and two pseudopores. Left side of the manubrium, viewed posteriorly. (**D**) Bilobate apical vesicle of Ant IV. (**E**) Tibiotarsus: smooth tenent seta, claw, and empodium. The claw in this case has three unpaired internal teeth, some individuals have two. (**F**) Mucro and the apex of the dens. (**G**) A live specimen of the *E. petri* morphospecies from Greater Manchester (Alfie Felton), pattern and pigmentation identical to specimens from examined populations.

Length ratio of Abd IV/III ~ 5 at midline. An example of the arrangement of chaetae on the collophore is as illustrated in Fig. 3A.

Head: 8 ocelli, ocelli GH smaller than EF (Fig. 4A). Ratio of the length of antennae to the head: 2.4. Length ratio of Ant I/II/III/IV: 1.0/2.1/2.1/2.5. Apical vesicle of Ant IV bilobate (Fig. 1D). All labial chaetae along the posterior edge ciliate, those anterior smooth. All postlabial chaetae ciliate (Fig. 2A). Labral papillae with two to three projections (Fig. 2B). Maxillary lobe with basal chaeta subequal in length to apical chaeta, sublobal plate with three chaeta-like processes (Fig. 2C). Labial papilla E notably truncate at the apex (Fig. 2D).

Leg: Single smooth tenent hair on the tibiotarsus by the claw expanded at the tip. Claw with four or five internal teeth: two medially on each of the two ventral lamellae, paired, two to three further teeth aligned towards the apex, unpaired. Dorsal tooth between the base of the claw and the most basal internal pair of teeth, the first unpaired tooth on the ventral edge positioned at ~80% of the length from the base. Lateral teeth present, ~80% of the length between the base and the most basal internal pair of teeth (Fig. 1E). Internal edge of the claw not ciliate. External edge of the empodium smooth, not serrate. Trochanteral organ with circa 18 smooth spine-like chaetae arranged as a right-angled triangle (Fig. 3B).

Furca: Manubrial plate with four chaetae in a shallow crescent, plus two pseudopores (Fig. 1C). Mucro with two teeth, subequal in length, but the proximal tooth slightly narrower. Single basal spine on the mucro reaching the tip of the proximal tooth (Fig. 1F).

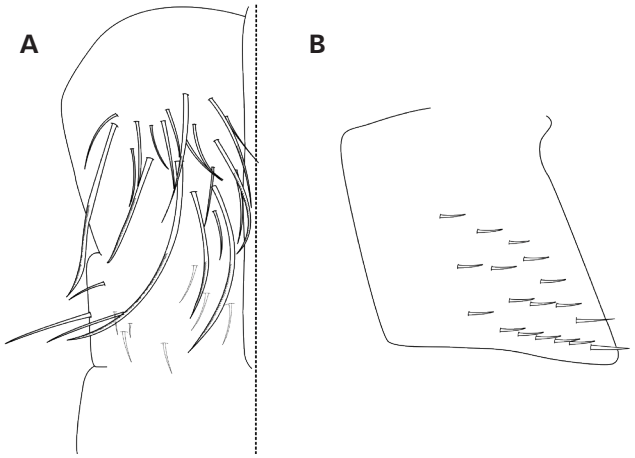

Figure 3. (**A**) Chaetal arrangement on the collophore, viewed anteriorly. (**B**) Trochanteral organ.

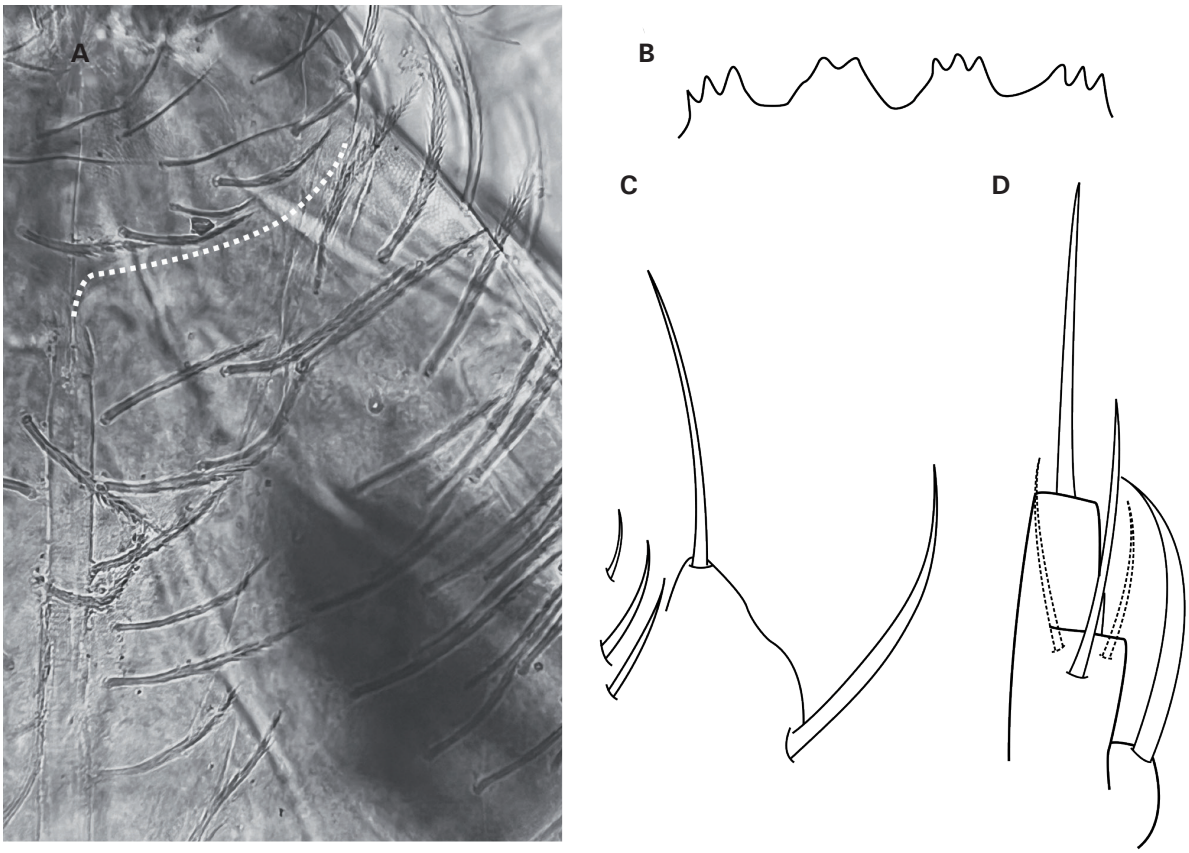

Figure 2. The mouthparts. (**A**) Labial and postlabial chaetotaxy at 400x magnification. The dotted line separates the labial triangle from the mentum. (**B**) Labral papillae. (**C**) Maxillary palp and sublobal plate. (**D**) Labial papilla E.

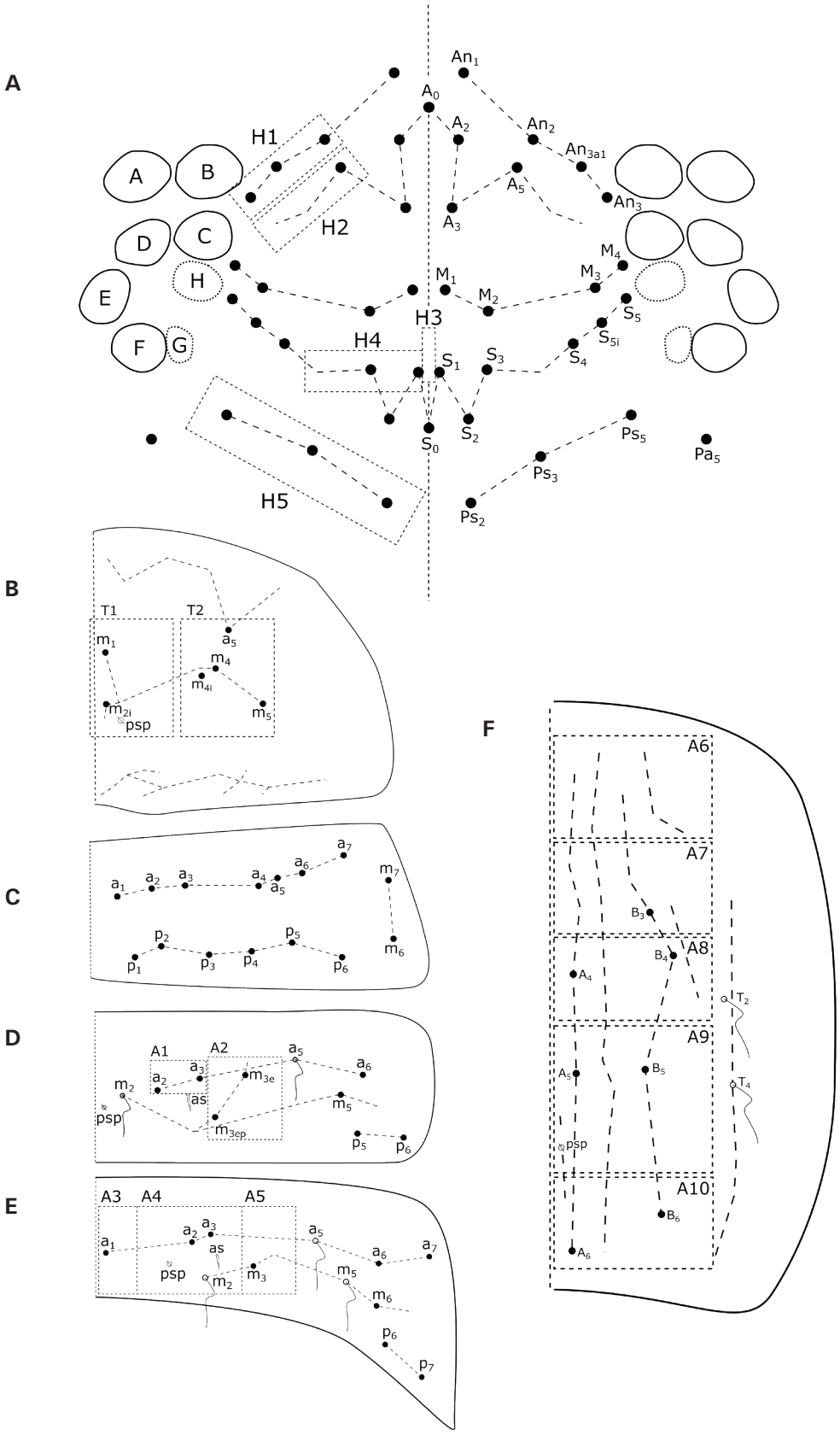

Figure 4. Chaetotaxy of the head, thorax, and abdomen. (**A**) Head. (**B**) Second thoracic segment. (**C**) Third thoracic segment. (**D**) Second abdominal segment. (**E**) Third abdominal segment. (**F**) Fourth abdominal segment.

Figure 5. (**A**) Records of the *Entomobrya petri* morphospecies from the United Kingdom and the Channel Islands up to 11.iv.2025, with the type locality of *Entomobrya petri* sp. nov. represented by the diamond point. Most other records are not supported by microscopic examination. (**B**) One of the gravestones in Duddingston Kirkyard, Edinburgh, 27.ii.2025, from which the holotype and paratypes were collected. This particular gravestone was especially replete with this species.

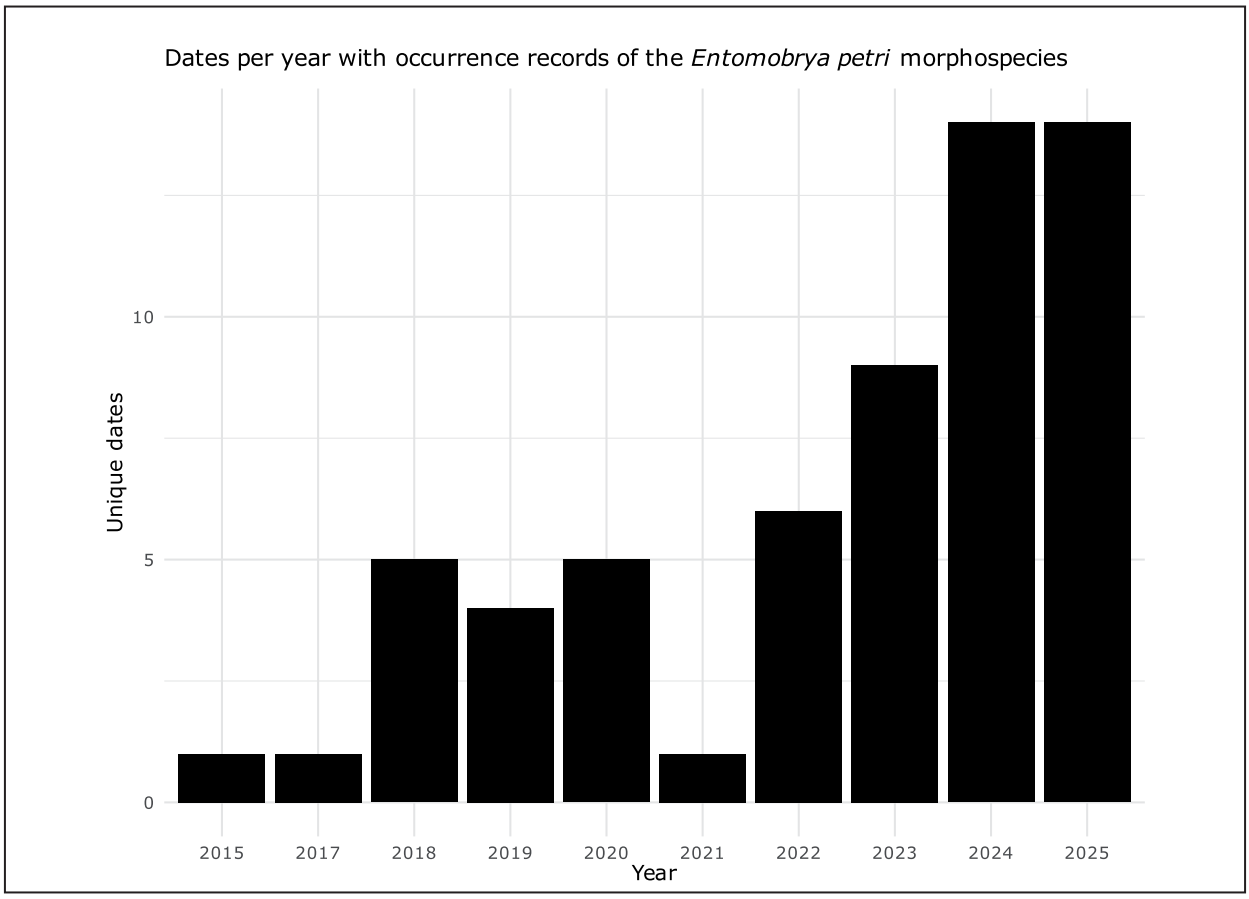

Figure 6. Unique dates each year on which the *Entomobrya petri* morphospecies was recorded from the British Isles. Number for 2025 correct until 11 April.

Chaetotaxy: simplified chaetotaxy formula 3-1-0-2-3/2-4/2-2/1-2-1/0-1-2-2-2. Head chaetotaxy as shown in Fig. 4A. Thorax chaetotaxy as in Fig. 4B and 4C: area T1 of Th II with two macrosetae (m_1 and m_{2i}); T2 with four macrosetae (a_5, m_4, m_{4i}, and m_5). Abdomen chaetotaxy as in Figs. 4D-F. Area A1 of Abd II with two macrosetae (a_2 and a_3), area A2 also with two (m_{3ep} and m_{3e}). Area A3 of Abd III with a_1 present; A4 with two macrosetae (a_2 and a_3) and trichobothrium m_2 present; A5 with only m_3 present. On Abd IV, area A6 without macrosetae; A7 with only macroseta B_3 present; A8 with two macrosetae (A_4 and B_4), A9 with two macrosetae (A_5 and B_5), and A10 also with two (A_6 and B_6). Laterally, T_2 and T_4 present as trichobothria on Abd IV.

Ecology: The type specimens were collected from gravestones (Fig. 5B). Large numbers could be found in the impressions of the epitaphs, especially in the part of the graveyard without overhanging trees. Here they were found in coexistence with *Entomobrya intermedia* and one or two undescribed species of katiannid belonging to the unnamed genus currently referred to as Katiannidae genus. nov.

The distribution and ecology of *E. petri* sp. nov. as a morphospecies

71 records of this morphospecies from the British Isles have been published online or in the literature up to 11 April 2025 (Fig. 5A). These have been recorded under four different names: *Entomobrya* nr *imitabilis*, *Entomobrya imitabilis*, *Himalanura* nr *tundricola*, and *Himalanura tundricola*. *E. petri* sensu stricto lacks the specialised flattened chaetae of *Himalanura*, and it can be separated from *E. imitabilis* and *E. spectabilis* using the characters referenced in the Discussion. However, its pattern is also distinctive, and is shared by numerous specimens appearing in macrophotographs from across the UK, which have been designated here as belonging to the *Entomobrya petri* "morphospecies". Specimens belonging to this morphospecies from Newcastle-upon-Tyne, northern England, have been microscopically examined and were found to be identical to the type specimens of *E. petri*, providing further evidence that this is a widespread species in the UK.

The first of the photographs of the *E. petri* morphospecies is from Llangollen, north Wales, on 15 January 2015 (Shaw & Trewhella 2019). This record was followed by one from Pembroke, south Wales, in 2017, and several records from Jersey and Guernsey in 2018. Since then, records have been increasing in number almost every year (Fig. 6). Most of these records are from anthropogenic situations, with a bias towards walls, gravestones, and other stone features. The morphospecies has also been photographed on other anthropogenic substrates, including window frames, bin lids, and indoors. The only known record from a non-human-associated habitat is from a conifer woodland in Guernsey (Andy Marquis).

4 Discussion and conclusion

Table 1 displays the set of characters proposed by Jordana & Baquero (2005) for identifying and describing *Entomobrya*, with the according values for *E. petri* sp. nov. as well as a selection of similar species, including common UK species (*E. nivalis*, *E. intermedia*, and *E. multifasciata*), similarly-patterned non-UK species (*E. katzi, E. atrocincta*, *E. nigrocincta*, and *E. imitabilis*), and *E. fourcesensis*, a recently described species with similar chaetotaxy (Grove & Delhem 2023). *E. fourcesensis* is similar to *E. petri* in many regards, though can be distinguished by the position of the dorsal tooth on the claw, the number of setae present in area A8 of Abd IV, the ratio of Abd IV to Abd III (greater in *E. petri*), and the colour pattern. The pigmentation of *E. fourcesensis* is more uniform and consistent between the thoracic and abdominal segments of a given individual compared to that of *E. petri*, in which the degree of pigmentation varies greatly between each segment.

With regard to chaetotaxy, *E. petri* is unique among Palaearctic species with formulae of 2-2 macrosetae on Abd II and 1-2-1 macrosetae on Abd III in having Th II with 2-4 macrosetae. *E. petri* can also be distinguished from the 15 North American species treated in Katz et al. (2015) by the combined presence of macroseta Ps_3 on the head, and a_1 and a_2 on Abd III. It can be distinguished from species recorded from Brazil by the empodial lamella not clearly excavate but truncate, presence of the Ant IV apical bulb, and the mucronal teeth subequal in size (Viana et al. 2024).

The pattern most closely resembles that of *Entomobrya imitabilis*, as illustrated in Jordana (2012), modified from Stach (1963), but with irregular patches of dark pigment on the second abdominal segment laterally; fifth abdominal segment with pigment concentrated in the posterior corners; and head unpigmented behind the eyes. Further, *E. imitabilis* has three internal and no dorsal teeth on the claw (four or five and one in *E. petri*), and the trochanteral organ differs: circa 18 spike-like chaetae in *E. petri* in a filled right-angled triangular configuration, but circa 10 chaetae arranged only on the arms of the angle in *E. imitabilis* (Jordana 2012). The pattern also resembles that of *E. spectabilis*, but *E. petri* is mostly unpigmented on the first abdominal segment and the sixth abdominal segment, and has differing pigment localisation on the head. Further, *E. spectabilis* has just a single unpaired

Table 1. Set of characters for identifying *Entomobrya*, as proposed by Jordana & Baquero (2005), with the corresponding observed values for *E. petri* **sp. nov.**, as well as *E. fourcesensis* (from Grove & Delhem 2023), *E. katzi* (from Baquero, Jordana & Ortuño 2022), *E. atrocincta* (from Ramel et al. 2008), *E. nigrocincta* (from Jordana 2012), *E. nivalis* (from Jordana & Baquero 2005), *E. intermedia* (from Jordana 2012), *E. multifasciata* (from Jordana 2012) and *E. imitabilis* (from Jordana 2012) for comparison. Dashes refer to information not available in these published sources.

Character	Location	Description	Range of values	*E. petri* **sp. nov.**	*E. fourcesensis*	*E. katzi*	*E. atrocincta*	*E. nigrocincta*	*E. nivalis*	*E. intermedia*	*E. multifasciata*	*E. imitabilis*
Ch.1	H1 (Head)	An_2-An_3	1-6	3	3	3	3	3	3	3	3	-
Ch.2	H2	A_5-A_7	1-3	1	1	2	1	1	1	1-2	1	-
Ch.3	H3	S'_0	0-1	0	0	0	0	0	0	0	0	-
Ch.4	H4	S_1-S_3-S_4	0-3	2	3	1-2	2	2	3	3	2	-
Ch.5	H5	Ps_2-Ps_3-Ps_5	0-3	3	2-3	2	2	2	2	2	2	-
Ch.6	labral papillae	simple and smooth (1), wrinkled or with some projections (2), a chaeta-like projection (3)	1-3	2	2	1	2	2	2	1	2	-
Ch.7	ocelli G and H size	=E and F (1), < E and F (2)	1-2	2	2	2	2	2	2	2	1	2
Ch.8	apical antennal retractile bulb	no bulb (0), bulb simple (1), bilobate (2), trilobate (3)	0-3	2	2	1(2)	1	1	2	1	2(1)	-
Ch.9	ratio Ant/Head	> or = 3 (1), > or = 2 < 3 (2), < 2 (3)	1-3	2	2	1	2	2	1	1	2	-
Ch.10	anterior dorsal mane Th II Mc	with Mc type 1 (1), without Mc or type 2 (2)	1-2	1	-	-	1	-	1	1	-	-
Ch.11	T1	chaetae number m_1-m_{2i2} or > 4 (5)	0-5	2	2	3	2	2	4	3-4	2	-
Ch.12	T2	chaetae number a_5, m_4-m_5 or > 8 (9)	0-9	4	4	5	3	3	4	4-5	3	-
Ch.13	smooth chaetae on tibiotarsi	not or 1 on tibiotarsus III = 0, double file = 1	0-1	0	0	0	0	0	0	0	0	-
Ch.14	claw internal teeth	1(1), 2(2), 3(3), 4(4), 5(5)	1-5	4-5	4	4	4	4	4	4	4	3
Ch.15	claw dorsal tooth	absent (0), basal (1), internal teeth level (2), between pair teeth and base (3)	0-3	3	1	1	2	2	1	1	3	0
Ch.16	claw internal edge	without (0) or with ciliation (1)	0-1	0	0	-	0	-	0	0	-	-
Ch.17	external empodium	smooth (0), serrate (1)	0-1	0	0	1	0	0	0	0	0	0
Ch.18	A1 Abd II	a_2-a_3	0-2	2	2	2	1	1	2	2	2	-
Ch.19	A2 Abd II	m_3 series chaetae number	0-7	2	2	2	2	2	3	4	2	-

Table 1 continued.

Character	Location	Description	Range of values	*E. petri* sp. nov.	*E. fourcesensis*	*E. katzi*	*E. atrocincta*	*E. nigrocincta*	*E. nivalis*	*E. intermedia*	*E. multifasciata*	*E. imitabilis*
Ch.20	A3 Abd III	a_1	0-1	1	1	1	1	1	1	1	1	-
Ch.21	A4 Abd III	above m_2 chaetae number	0-3	2	2	0	1	1	0	0	2	-
Ch.22	A5 Abd III	m_3-m_4 series chaetae number	0-4	1	1	1	1	1	1	1	1	-
Ch.23	A6 Abd IV	A_1-D_1 chaetae number; > 8 (9)	0-9	0	0	0	0	0	0	0	0	-
Ch.24	A7 unpaired chaeta	A_{03}	0-1	0	0	-	0	-	0	0	-	-
Ch.25	A7 Abd IV	A_2-E_1 chaetae number; > 9 (10)	0-10	1	1-5	4	2	2	3	5-6	2	-
Ch.26	A8 unpaired chaeta	A_{04}	0-1	0	0	-	0	-	0	0	-	-
Ch.27	A8 Abd IV	A_{4a}-C_{2a} chaetae number; > 5 (6)	0-6	2	3	1	3	3	0	0	3	-
Ch.28	A9 unpaired chaeta	A_{05}	0-1	0	0	-	0	-	0	0	-	-
Ch.29	A9 Abd IV	A_5-B_5 chaetae number; > 6 (7)	0-7	2	2	2	2	2	2	2	2	-
Ch.30	A10 Abd IV	A_6-B_6 chaetae number; > 5 (6)	0-6	2	2	2	2	2	2	2	2	-
Ch.31	A11 Abd IV	T_1 as trichobothrium	0-1	0	-	-	0	-	0	-	-	-
Ch.32	A12 Abd IV	T_2 as trichobothrium	0-1	1	-	-	1	-	1	-	-	-
Ch.33	A13 Abd IV	T_4 as trichobothrium	0-1	1	-	-	1	-	1	-	-	-
Ch.34	A14 Abd IV	T_6 as trichobothrium	0-1	0	-	-	0	-	0	-	-	-
Ch.35	ratio Abd IV/III	2 < R < 4 (1), R > 4 (2)	1-2	2	1	1-2	2	2	1	1	2	-
Ch.36	manubrial plate	chaetae number; > 10 (11)	0-11	4	4	4(5-6)	4	4	3	3	4	-
Ch.37	manubrial plate	pseudopores 1-2	1-2	2	2	2	1	2	2	2	2	-
Ch.38	mucro	sub-apical tooth, without (0), normal (1), big (2), smaller (3)	0-3	1	1	-	1	1	1	1	1	1
Ch.39	mucro	basal spine, absent (0), present (1)	0-1	1	1	-	1	1	1	1	1	1

internal tooth on the claw, and the external tooth is basal rather than between the paired internal teeth and the base as in *E. petri*.

Providing a taxonomic description of *Entomobrya petri* is an important step in explaining the recent changes in the springtail assemblages of the UK. Although the phenomenon of likely non-native, mostly undescribed springtails colonising and growing in abundance seems to be most evident in the UK (Ardron 2009), it is interesting that specimens resembling the *E. petri* morphospecies have also been photographed in Iberia (for example in Arbea & Almeida 2022, p.23, labelled as *Willowsia* sp.). Specimens from Iberia have not been examined, so their relation to *E. petri* sensu stricto cannot be determined and is conjectural, but it is not impossible that *E. petri* is also present in that region. In fact, the greater diversity of Collembola in Iberia and lower density of collembologists in this region during the 20th century makes it harder to be certain that *E. petri* is also not native there and that Iberia is not the source of the introduction of this species into the UK. If this is the case, *E. petri* would not be the first springtail species apparently colonising the UK from continental Europe in recent years; *Fasciosminthurus quinquefasciatus* was recently found at several sites in south-west England, though whether this species colonised naturally via wind dispersal, was imported with trade, or is an overlooked native has been debated (Hutchinson & McCulloch 2024). With climate change, the UK may be becoming more tolerable to continental species. Indeed, *E. petri* appears to thrive in relatively dry environments on stones and walls. Nevertheless, specimens belonging to this morphospecies from outside of the British Isles need to be examined microscopically to have greater confidence in the origins of this species, if it is indeed non-native.

Figure 6 shows the marked rise in records of the *Entomobrya petri* morphospecies in the UK since 2015. This may reflect greater awareness of the morphospecies by recorders and macrophotographers, but it is considered more likely that this increase in records represents a genuine growth in the population and distribution of this morphospecies in this country. This is because of the distinctiveness of the colour pattern of this morphospecies compared to other British springtail species and the popularity of online fora for identification requests, meaning that photographs of this morphospecies would be relatively unlikely to be passed off as something else. However, it is remarkable that in the ten years following the first British record of this species, it appears to have spread across the whole length of the Isles, from the Channel Islands in the south to Aberdeenshire in the north. This is especially true given that springtails are small, flightless invertebrates. Phoresy has not yet been observed in extant species, though evidence of phoretic associations between Collembola and insects in the fossil record suggests it is possible (Robin et al. 2019). Alternatively, perhaps springtails are adept at wind dispersal, as has been supported by their presence among the "aerial plankton" (Worland et al. 2007). The distribution expansion may also have been catalysed by multiple independent introductions. It has been proposed that the other presumably non-native, still undescribed Collembola have been imported via the horticultural trade, yet the *E. petri* morphospecies is rarely found on either plants or soil. It will be hard to gather direct evidence in support of a particular route of import or mechanism of spread, but population genomics analyses may indicate the number of introductions and their recency.

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