ANAMASTIGONA PULCHELLA (SILVESTRI, 1894) – FIRST BRITISH RECORDS FOR ENGLAND, SCOTLAND AND WALES (CHORDEUMATIDA: ANTHROLEUCOSOMATIDAE)

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INTRODUCTION

The genus *Anamastigona* comprises about 19 known species with a Mediterranean distribution mainly centred on Italy and Greece (Golovatch & Markov, 2011). Of these only *Anamastigona pulchella* (Silvestri, 1894), originally native to southern and central Italy, appears to have spread further afield. Its known distribution includes Southern France, Portugal and Madeira, and further north in central Germany and Northern Ireland.

The discovery of *A. pulchella* at four sites in Co. Down, Northern Ireland was reported by Anderson (1996). Subsequently, it has been found in a total of 19 sites within Northern Ireland, where it has proved to be well naturalised (RA, unpublished data). Although Anderson (1996) suggested it may be expected to spread to other parts of Ireland and western Britain, no additional localities outside of eastern Northern Ireland have been reported subsequently (Lee, 2006).

This paper reports the first occurrences of this species in England, Scotland and Wales. Known sites are detailed below.

FIRST RECORDS FOR ENGLAND

RHS Garden Wisley

In October 2011 SJG was sent some millipede specimens for confirmation that had been collected from Royal Horticultural Society's (RHS) Garden Wisley near Woking, Surrey (TQ06-59-, VC 17) by Dr. Sarah Al-Beidh as part of the RHS Plants for Bugs project. Among pitfall trap samples collected in August 2011 were two small immature stadia of a Craspedosomatidea millipede, both lacking their posterior segments. These had been provisionally labelled as *Craspedosoma rawlinsii* Leach, but seemed too small to be that species. Subsequent samples collected in December 2011 contained a mature male specimen and two females. At 9-10 mm in length these adults were too large to be *Anthogona britannica* Gregory, Jones & Mauriès, but too small to be *C. rawlinsii*. Examination of the male specimen revealed that the gonopods, paragonopods and the distinctive coxae of the 10th pair of legs matched those figured by Anderson (1996) of *Anamastigona pulchella* (Gregory, 2012). In 2012 and 2013 additional specimens, including mature males and females, were collected from pitfall traps and forwarded to SJG for examination. Table 1 indicates the numbers, and life stages, found in pitfall traps each month.

TABLE 1: RHS Garden Wisley; Number of individuals of *Anamastigona pulchella* collected in pitfall traps each month from 2011 to 2013

♂= Male, ♀= Female, vii/viii = stadia VII/VIII, x = no samples

Sample Site	Year	Month of sample collection							
		Aug	Sept	Oct	Nov	Dec	Jan	Feb	Apr
Howard's Field	2011	2vii	x		x	1♂ 2♀♀	3viii		
Deers Farm	2012	1vii	x		x	1♂		1♀	
Howard's Field	2012	1vii	x	1viii	x	2♂ 5♀♀			
Deers Farm	2013		x		x				1♀
Howard's Field	2013		x		x			1♀	1♀

Adult stadia IX, with 30 body rings, were recorded in December, February and April samples. Within the limited sample of 14 adults the percentage of males present was 40%. Males were 9-10 mm in length; 0.8-1.0 mm in height (ring 15 measured). In males the seventh pair of legs are particularly robust, noticeably larger than the proceeding leg pairs. In live animals (observed at Oxford and Glasgow) this leg pair is not used for walking, but held projecting sideways (Fig. 2). Females were slightly larger at 9.5-11 mm in length; 1.0-1.1 mm in height. In both sexes eyes comprise 15 to 17 well pigmented ocelli arranged in an acute triangular field (Fig. 1).

The most striking features of adult specimens were the extremely stout body setae and the very long legs (up to twice body width). Both features were very conspicuous in the coiled preserved specimens. However, care with identification needs to be taken in light of the discovery of the superficially similar *Hylebainosoma nontronensis* Mauriès & Kime in south Wales (Telfer, *et al*, in this Bulletin **28**:15-30). A more complete description of *A. pulchella*, including figures of male sexual characters, is given by Anderson (1996).

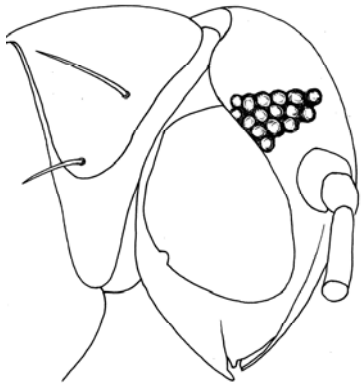

FIGURE 1: *Anamastigona pulchella* (Silvestri). Female specimen from RHS Garden Wisley, from pitfall trap dated 06.x.2012. Head, showing ocular field, lateral view (setae omitted).

Subadult stadia VIII with 28 body rings and between 7-8 mm in length. Ocelli indistinct, but about 12 in number. These were collected in October and January samples. Stadia VII with 26 body rings and 5 mm in length (one undamaged specimen) were recorded in August samples. Ocelli very indistinct, but about 8 or 9 in number.

Oxford

In summer 2013 SJG collected two mature females (30 body rings) of a conspicuously 'long-legged' Craspedosomatidea millipede while undertaking a survey of the invertebrate fauna at Trap Grounds, Oxford (SP502081, VC 23). The specimens were found in a pitfall trap set between 4-19th June 2013 in secondary woodland that has developed over rubble dominated soil derived from flattened spoil heaps. Although the trapping area is relatively dry, it lies adjacent to several wetland areas dominated by sedges *Carex* sp.

Both specimens were 11 mm in length, 1.1 mm in height (body ring 15) and with eyes comprising 16 to 17 ocelli. Direct comparison with female specimens collected from RHS Garden Wisley indicated that these were also examples of *A. pulchella.* They were associated with the millipedes *Brachyiulus pusillus* (Leach) (male examined), *Ophyiulus pilosus* (Newport) and *Polydesmus coriaceus*.

On 5th November 2015 many live specimens of *A. pulchella* were seen at Trap Grounds, beneath dead wood and among leaf litter, especially in low-lying damp areas. The sample collected included two male specimens.

Trap Grounds is one of the last remaining un-built spaces along the Oxford Canal between the city centre and the northern suburbs. It supports a rich mosaic of habitats, including reed bed, grassland and mature deciduous secondary woodland. Until the 1990s it was used as an unofficial rubbish tip and today is surrounded by housing on three sides. The flora includes many introduced 'garden escapes', but the invertebrate fauna includes several species of county or regional importance.

FIRST RECORDS FOR SCOTLAND

Glasgow

In November 2012, while conducting an invertebrate survey of a Glasgow city centre graveyard known as Glasgow Necropolis (NS606654, VC 77), MBD collected one adult female specimen of an unfamiliar Craspedosomatidea millipede. The specimen was found while hand searching in leaf litter below trees at the perimeter of an area of in-filled ground known as the Coup. Further adult specimens (stadium IX) were found in pitfall traps set on the Coup during October/November 2012 and the presence of males allowed confirmation of the first recorded occurrence of *Anamastigona pulchella* in Scotland (Davidson, 2013). The pitfalls were set in an area of moss, grass and tall herbs that has developed on top of an infill of rubble/rock, miscellaneous waste materials and some soil. A nearby area of steep rough grassland (the Slope) also produced *A. pulchella* from pitfall traps.

FIGURE 2: *Anamastigona pulchella* (Silvestri). Male specimen from Glasgow Necropolis. Note the particularly robust 7th leg, which is not used for walking. (image © Mike Davidson 2013)

TABLE 2: Glasgow Necropolis; Number of individuals of *Anamastigona pulchella* from pitfall traps and hand collection.

♂=male; ♀=female; vi/vii/viii = Stadia VI/VII/VIII, x = no sampling undertaken

Year & method	Month of sample collection											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012 pitfalls	x	x	x	x	x	x	x	x	x	27♂; 10♀		
2012 pitfalls	x	x	x	x	x	x	x	x	x		21♂; 9♀	
2012 by hand											1♀	
2013 pitfalls	x	x	x	2♀		5vi 5vii			1♂; 13viii; 1 vi		6♂	
2013 pitfalls	x	x	x		5♀		1 vii			23♂; 1♀; 1vii;1vi		
2013 by hand				1♀					1vii		2♂ 3♀	
2015 by hand		1♂ 2♀										

Table 2 shows the periods when *A. pulchella* was found, either in pitfall material or by hand collecting, and also indicates the life stage of the specimens which were collected. The numbers combine material from both sites (Coup and Slope). The pitfall traps were operated from October 2012 to December 2012 and again from April 2013 to November 2013.

By combining the pitfall trapping program and samples from hand collecting we can make some observations on the life history of *A. pulchella* in Glasgow. It seems that adult females are present from October until at least April, while adult males were first recorded in September and persist until at least February. The earliest stadia collected were VI/VII in June-August although small numbers of these stages were found in the autumn along with VIII and adults (IX).

As observed by Anderson (1996) the more active males are generally more abundant in the pitfall traps than the females.

A small number of adults (from pitfall and hand collecting) were measured giving the following approximate size ranges allowing for distortion: Males 9.5-10.5 x 0.8-0.9 mm. General habitus shown in Fig. 2. Females 10.5-11.5 x 1.0 mm. These are similar to the sizes given by Anderson (1996) for material from Northern Ireland and the English specimens. The number of ocelli in adult stadium IX varied from 15-18.

Observations from hand collecting indicated that the species was present in large numbers in and below the moss on the Coup. Also on the edge of this area were some spoil heaps of a clay soil/hard core type material. In February 2015 adult *A. pulchella* were easily found by digging amongst this aggregate and seemed to be living in the voids.

Other millipede species found along with *A. pulchella* at the Coup and Slope include *Melogona scutellare* (Ribaut), *Melogona voigti* (Verhoeff), *Allajulus nitidus* (Verhoeff), *Cylindroiulus*

britannicus (Verhoeff), *Brachydesmus superus* Latzel, *Choneiulus palmatus* (Nimec), *Archiboreoiulus pallidus* (Brade-Birks), *Brachyiulus pusillus* and *Ophyiulus pilosus*.

Glasgow Necropolis was established in the 1830s around a disused quarry. It has the usual array of ornamental trees and shrubs and extensive areas of mown grass, but of more interest are some of the less manicured steep slopes, the disused quarry face and the coup. It is not known where the waste material dumped in the coup originated but, as well as from the Necropolis, it is likely to have come from across the city including other cemeteries, parks and gardens. As there are good transport links between SW Scotland and N. Ireland it seems possible that transfer between the two areas has taken place either via waste transfer or the horticulture trade. It is well worth exploring more sites in SW Scotland for *Anamastigona pulchella*.

FIRST RECORDS FOR WALES

Cardiff

On 7th January 2013 RA discovered a single female specimen of *A. pulchella* in Bute Park, Cardiff (ST171774, VC 41) while searching for slugs. It was found among Sycamore *Acer pseudoplatanus* leaf-litter under stones in deciduous woodland on the banks of the River Taff. The woodland is patchy with open and/or bare areas where people walk their dogs and some disturbance, turning of stones, etc., was seen. General features of the site (deep wet leaf litter in proximity to water) nevertheless accord with observations in Ireland. Four additional specimens, associated with *Propolydesmus testaceus* (C.L.Koch, 1847), were found by CO and Ben Rowson on 27th October 2014. These specimens have been retained in the Cardiff Museum's collection.

At 56 hectares, Bute Park is one of the largest urban parks in Wales and comprises a broad mix of urban woodland, playing fields, an arboretum and other horticultural features along the River Taff corridor.

Abergavenny

On 15th November 2014 CO collected a male and female specimen of *A. pulchella* from Abergavenny (SO305141, VC 35) while searching for additional sites for the millipedes *Hylebainosoma nontronensis* Mauriès & Kime and *Ceratosphys amoena* Ribaut, both recently recorded in Britain (Telfer, *et al*, in this Bulletin **28**:15-30). The two specimens of *A. pulchella* were readily sieved from deep leaf litter beside a wall bordering a green lane lined with mature trees, including Beech *Fagus sylvatica*, Horse Chestnut *Aesculus hippocastanum* and Oak *Quercus*, adjacent to domestic gardens. A subsequent visit to site on 29th November 2014 produced two more specimens, but this time the species was much more difficult to find. These latter two specimens were preserved in absolute alcohol for genetic barcoding.

DISCUSSION

In Northern Ireland *A. pulchella* seems to do best in old woodlands, especially those on National Trust properties where there have been plenty of opportunities for unintentional introduction. Here it favours deep, stable leaf litter containing dead wood and larger fleshy fungi in shaded damp places. The emphasis is on damp localities. Some of the records relate to water-logged alder carr on lakeshores or on river banks. There is a single record for a garden centre and it is possible that this species may get moved to new sites with plant pots, etc. So far in Northern Ireland it has not been seen in domestic gardens.

This is in keeping with British observations where *A. pulchella* has been found associated with mature trees or deciduous woodland, especially in areas with deep accumulations of leaf litter. All British sites are heavily synanthropic and, with the exception of RHS Wisley Garden, all are less intensively managed 'wild' areas within towns or cities. The Oxford and Glasgow sites were both former rubbish tips where waste material (including garden rubbish) is likely to have been imported from elsewhere (a possible source of introduction). The Oxford and Abergavenny sites lie adjacent to domestic gardens. Plant material (another possible source of introduction) has been widely introduced to RHS Garden Wisley and to Bute Park.

The idea that *A. pulchella* is introduced into Britain and Ireland is supported by genetic analysis of a specimen from Abergavenny, south Wales (accessible via iBOL (www.boldsystems.org) under the BOLD process ID GBMYR432-15). The classical barcode fragment, mitochondrial cytochrome c oxidase subunit 1 (CO1), comprising the full length of 658 base-pairs, proved to be identical with a specimen of *A. pulchella* from Lago di Como, northern Italy (within its native range) and with two specimens from Saxony-Anhalt, Germany (where it is believed introduced) (J. Spelda, pers. comm.).

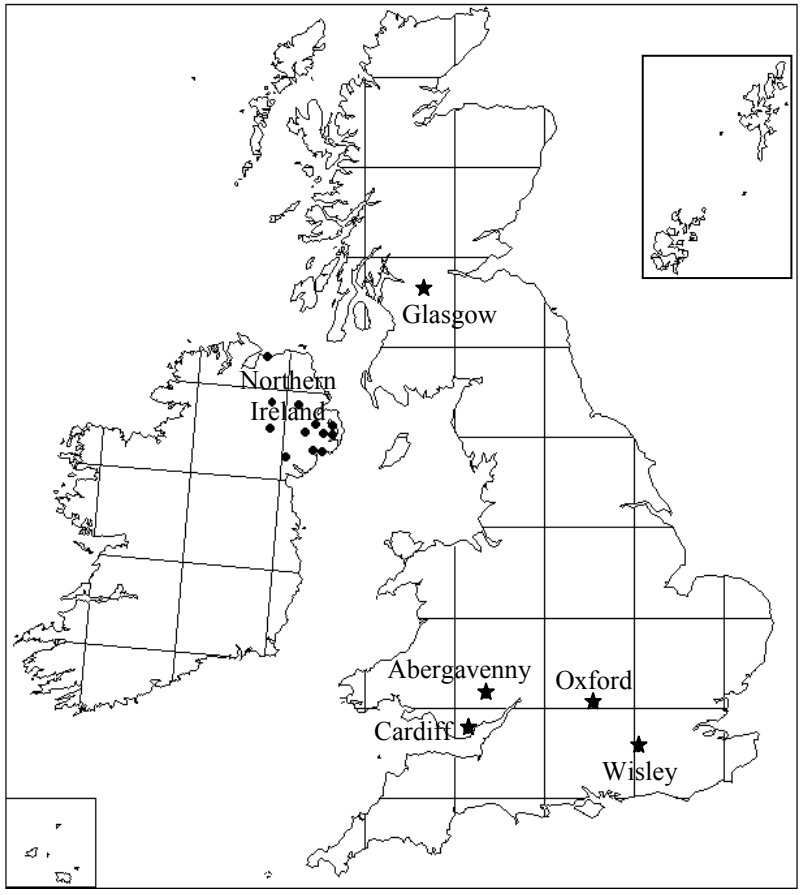

FIGURE 3: Known distribution of *Anamastigona pulchella* Silvestri in Britain and Ireland.
All known records up to April 2015 are plotted at 10km resolution.
★ = First British records reported herein.

In common with other Chordeumatida millipedes *A. pulchella* is mature in the winter months. At RHS Garden Wisley immatures were first trapped in August (probably July/August in Glasgow) with sub-adults appearing in October. Adults were recorded at least by October (Glasgow), through November (Glasgow, Abergavenny), December (RHS Garden Wisley, Glasgow), January (Cardiff), February to April (RHS Garden Wisley, Glasgow). The presence of mature females in June (Oxford)

suggest this gender may persist into the summer. This is in keeping with observations in Northern Ireland (Anderson, 1996), where immature stadia were observed in late-summer/early autumn, with adults appearing in early October until February. At RHS Garden Wisley three immatures were also recorded in January. An overlap of generations was also noted by Anderson (1996) who recorded an early instar in late February. This may indicate a longer than annual lifecycle.

The widely scattered locations of *A. pulchella* across England, Scotland and Wales (Fig. 3) may indicate a number of recent accidental introductions, possibly via the horticultural trade. In Oxfordshire extensive surveys of Diplopoda were undertaken during the 1990s (Gregory & Campbell, 1996), including pitfall trapping in several major towns, including Oxford. The occurrence of *A. pulchella* (or indeed any other species of Craspedosomatidea millipede) was not reported then, which supports the idea that it may be a recent arrival in Oxfordshire.

Observations in Northern Ireland indicate that the species continues to spread across the eastern counties, but its dispersal has been very slow. So far it remains unrecorded in western counties or in the Republic of Ireland. The recent cold or very cold winters in Northern Ireland do not appear to have affected populations adversely. This is supported by its discovery in Glasgow, which may experience even colder winters. The good transport links between Northern Ireland and Scotland may have provided a route for translocation between the two countries. It is expected that *A. pulchella* will be found at other sites in Britain and it will be interesting to see if *A. pulchella* spreads to other areas.

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