Upland centipedes in North Wales with a review of the Welsh Chilopoda

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Abstract

Since Eason's (1957) paper on centipedes from Carnarvonshire there has been an accumulation of centipede records from various parts of Wales but relatively few are from upland areas. Recent records from Snowdonia included several species, including *Lithobius* (*Monotarsobius*) *curtipes*, from locations up to around 1,000m. We present a review of centipedes recorded from the 13 Welsh vice-counties which includes 41 species, 4 of which are from buildings or heated greenhouses, 4 apparently obligate halophiles from coastal sites and one doubtful. Wales has a variety of types of habitat including both lowland and montane rural areas and urban/industrial/post-industrial locations which no doubt contributes to the diversity of its chilopod fauna.

Introduction

The centipede *Lithobius curtipes* is not known in Britain from large numbers of past records, indeed in his *Cotteswold* paper of 1953, E.H. Eason (Eason, 1953) had referred to his record from Kildanes Scrubs, Gloucestershire in 1952 as only the third British record. The finding of it by RG at around 1,000m in Snowdonia, along with *Lithobius variegatus* and *Strigamia acuminata* at similar heights, prompted us to look at the occurrence of upland centipedes in North Wales and in Wales in general and to review the species recorded from the principality.

The highest point in the North Wales area, indeed in the whole of Wales, is Snowdon (Yr Wyddfa) at 1,085m (3,560ft) whilst the principality as a whole contains 188 locations in excess of 610m (2,000ft), Pen-y-Fan in the Brecon Beacons at 886m being the highest outside Snowdonia. By comparison, the highest point in England is Scafell Pike in Cumbria at 978m with Cheviot at 815m and Cross Fell in the Pennines 893m. The highest point in southern England is High Willhays on Dartmoor (621m). Scottish upland areas reach greater altitudes with Ben Nevis at 1,345m and 282 "Munros" (over 3,000ft = 914m) on the Scottish Mountaineering Club list. Whilst these altitudes are relatively low compared with many areas of Europe, Britain and Ireland are off the western (Atlantic) edge of the continent with a corresponding moister oceanic climate of warmer winters and cooler summers.

Records from North Wales

E.H. Eason (1957) published an account of the Chilopoda and Diplopoda of Caernarvonshire in which, as well as listing species, he quoted the highest altitude for species that were found above 180m. He used records collected by himself, by J.G. Blower, P.M. Butler and O. Gilbert with the highest altitude recorded being 460m at Clogwyn Mawr (PMB) for *Lithobius variegatus*, *Lithobius borealis* (recorded as *L. lapidicola*), *Geophilus carpophagus* and *Geophilus truncorum* (as *Brachygeophilus truncorum*).

Since the publication of this paper there has been an accumulation of centipede records from various parts of Wales which are now held by the Centipede Recording Scheme / Biological Records Centre, but, apart from some from South Wales and the Brecon Beacons and a handful from Montgomery and Radnor, relatively few are from upland areas.

In this account detail is included for species that have been recorded from higher altitudes but, to put this in context, we also include all centipede species for which we appear to have Welsh records together with comments on their occurrence. Records from the Eason paper are indicated (E), from RG collections (RG), from Welsh Peatland Invertebrate Survey (WPIS), and from other sources e.g. Centipede Recording Scheme data (O). Reference is made to Watsonian vice-counties 35 (Monmouthshire), 41 (Glamorgan), 42 (Breconshire), 43 (Radnorshire), 44 (Carmarthenshire), 45 (Pembrokeshire), 46 (Cardiganshire), 47 (Montgomeryshire), 48 (Merionethshire), 49 (Caernarvonshire), 50 (Denbighshire), 51 (Flintshire) and 52 (Anglesey). We use here the term "North Wales" to refer to vice-counties 48-52. The number of records from the latter is given as an approximate figure because of overlap of sites, duplication by different recorders or use of different names for the same site. Highest recorded altitudes for Britain and Ireland are those from Centipede Recording Scheme/BRC and are those current for records up to the end of 2018 unless indicated otherwise. See Table 1 for list of vice county records for Welsh centipedes.

Order Geophilomorpha

***Haplophilus subterraneus* Shaw, 1794**

Eason (1957) did not find this in Snowdonia although it was present on the Creuddyn. It is a species very widespread in Britain with many lowland Welsh records, but with no British/Irish locations known for it from above 366m. Records (O) are scattered across North Wales from all vice-counties (48-52) with the highest recorded altitude being only 140m at Beddgelert (1984). In the rest of Wales, it is recorded from all vice-counties (35, 41-47) and at an altitude up to 350m at Dol-y-Gaer (1989). It is often associated with human activity and can be found in soil in gardens and allotments.

***Hydroschendyla submarina* (Grube, 1869)**

This is an exclusively littoral species typically found in rock crevices at or below high water mark and has been recorded three times from the coast of Pembrokeshire (VC45): Westdale Bay and Watwick Areas (both 1957) and Ramsey Island (1999). It is not often recorded, probably because of its habits, but has been found in south-west England, Yorkshire, Ireland and Jersey.

***Schendyla dentata* (Brolemann & Ribaut, 1911)**

This small (12mm), soil dwelling parthenogenetic species was not identified from Britain until the 1960s since when it has been recorded on a number of occasions, always in more or less synanthropic sites such as parks, churchyards and waste ground and mostly in an area south of Norfolk to Shropshire, but also from Edinburgh and from Ireland. The only Welsh record is from the south, Bynea, Llanelli (VC44, 2008) where it was found by John Harper. It could probably turn up in other areas of Wales in appropriate habitats. The highest recorded altitude for Britain and Ireland is 180m.

***Schendyla nemorensis* (C.L. Koch, 1837)**

Described (E) as fairly common in Snowdonia and recorded from litter at Blaen Nanmor at 210m, also at Beddgelert and Nantmor, this species is widespread in Wales and in the British Isles generally, but rarer in the north and there are no British/Irish records from above 500m. It is a small species (up to 20mm) and easily missed. There are records from all Welsh vice counties 41-52 and 35 although not much more than 20 in total from our northern ones (E, O). The highest recorded location for it in North Wales is at Chirk Castle at 100m (VC50, 1996), whilst for the remainder of Wales it is Craig Cerrig-gleisiad, 400m (VC42, 2011). The highest recorded altitude for Britain and Ireland is 490m.

***Schendyla peyerimhoffi* Brolemann & Ribaut, 1911**

This is a species somewhat similar to the last but, in Britain and Ireland, at least, it appears to be exclusively littoral. There are North Wales records from Malltraeth (VC52, 1983, 1985) and from Foryd

Table 1: Welsh Centipedes: Vice County Records

X = Recorded; (X) Recorded inside Building/ Heated Greenhouse; ? = Doubtful Record

Vice-county:	35	41	42	43	44	45	46	47	48	49	50	51	52	Notes
Haplophilus subterraneus	X	X	X	X	X	X	X	X	X	X	X	X	X	
Hydroschenyla submarina						X								Littoral
Schendyla dentata					X									
Schendyla nemorensis	X	X	X	X	X	X	X	X	X	X	X	X	X	
Schendyla peyerimhoffi		X								X			X	Littoral
Henia brevis	X	X	X											
Henia vesuviana		X			X							X		
Strigamia acuminata	X	X	X	X	X	X	X	X	X	X	X	X	X	
Strigamia crassipes	X	X	X	X	X		X			X				
Strigamia maritima	X	X			X	X	X		X	X	X	X	X	Littoral
Geophilus alpinus	X	X	X	X	X		X	X		X	X	X	X	
Geophilus carpophagus s.l.		X	X	X	X	X	X	X	X	X	X		X	
Geophilus carpophagus s.s.	X	X			X					X				
Geophilus easoni	X	X	X	X	X	X	X	X	X	X	X	X		
Geophilus electricus	X	X	X	X			X		X	X	X	X	X	
Geophilus flavus	X	X	X	X	X	X	X			X	X	X	X	
Geophilus osquidatum	X	X	X	X	X		X				X	X		
Geophilus seurati		X			X					X				Littoral
Geophilus truncorum	X	X	X	X	X	X	X	X	X	X	X	X	X	
Cryptops anomalans	X	X		X							X			
Cryptops hortensis	X	X	X	X	X	X	X	X	X	X	X	X	X	
Cryptops parisi	X	X	X		X		X							
Cryptops cf *hispanus*		(X)												
Lithobius borealis	X	X	X	X	X	X	X	X	X	X	X		X	
Lithobius calcaratus		X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius erythrocephalus							?							
Lithobius forficatus	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius lapidicola										(X)				
Lithobius macilentus			X	X	X			X		X				Also 48/50
Lithobius melanops	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius muticus	X	X												
Lithobius piceus	X	X												
Lithobius pilicornis	X	X			X	X							X	
Lithobius tenebrosus							X							
Lithobius tricuspis	X	X												
Lithobius variegatus	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius crassipes	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius curtipes		X	X	X	X			X	X	X	X		X	
Lithobius microps	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lamyctes caeculus					(X)									
Lamyctes fulvicornis	X	X	X	X	X	X	X	X	X	X	X		X	
Scutigera coleoptrata	(X)													

Bay (VC49, 1996). The only other Welsh records seem to be from several sites on Gower (1973-1987) and from Nash Point (1979) (both VC41).

***Henia brevis* (Silvestri, 1896)**

Quite different in appearance to the next species, this is a relatively small, but elongate (19mm) synanthropic species, often found in habitats superficially similar to those of *Schendyla dentata*. It has been found as far north as Shropshire, but it is much more obviously synanthropic than *Henia vesuviana*. There are no records from North Wales, but in the south it has been found at Caerleon (VC35, 1984), Brecon Market and Lower Chapel (both VC42, 1988), Limeslade Bay, Mumbles (VC41, 2008), nr Llandegfedd Reservoir (Rangers Office, VC35, 2010) and St. Fagans (VC41, 2017). Highest recorded altitude for Britain and Ireland is 150m.

***Henia vesuviana* (Newport, 1844)**

As its name would suggest, this distinctive species is essentially a southern European species and most records are from synanthropic sites, mostly from southern Britain especially the south coast, but it has also been found in Yorkshire, Leicestershire and at Heysham, Lancs (where it occurred repeatedly inside a house). There is a single record from North Wales, Afon Dyfrdwy SSSI (VC51, 2004) (Cofnod) and three South Wales locations; Bewic, Llanelli (VC44, 2008), Anstee Court, Cardiff (VC41, 2015) and North Cornelly (VC41, 2017) (O), but given our present knowledge of its habits, we could predict that more Welsh records may well be made. The highest recorded altitude for Britain and Ireland is 250m.

***Strigamia acuminata* (Leach, 1814)**

There are records of this species from all Welsh vice-counties. It was listed (E) (as *Scolioplanes acuminatus*) from Beddgelert, Betws-y-coed (about 60m) and Capel Curig. The latter is without an altitude given although the area is at around 200m. It is also known from: VC48: Islaw Dref (120m, 1969), Coeddydd Maentwrog (1985); VC49: Deganwy (1956), Coedydd Afon Menai, (1985), Clogwyn Du'r Arddu (850m, 2016); VC50: Marford Sand Pit (2018); VC52: Newborough Forest (2015).

There are several records from Montgomeryshire (VC47) including Trannon Moor at 440m (1998) and from, amongst other South Wales locations, Chwarel-y-Fan (VC42, 650m, 1989) and Craig Cerrig-gleisiag (VC42, 400m, 2011) (O). We now add to these, recent records from Caernarvonshire (VC49, RG), Carnedd Dafydd, 1,013m, under *Rhacomitrium* fringed felsenmeer rocks (06.05.2019), Clogwyn du'r Arddu, 850m (12.05.2016) and Leadbrook Wood, 70m (12.05.2018) (all RG). The Carnedd Dafydd record (1,013m) is the highest recorded for the species in Britain.

English highest records where altitude has been recorded are from mid-west and north-west Yorkshire; 457m at Hell Gill (1980), 290m from Deer Park Wood, Marske (1981) and at 381m from South House Pavement near Horton in Ribblesdale (1984). Although there are more than 600 British records of *S. acuminata*, no very clear pattern of its ecology seems to have emerged other than a southern tendency and generally more or less rural locations. It has not been recorded from Scotland and there is a single record from Ireland with some doubt attached to it (Cawley, 2010).

***Strigamia crassipes* (C.L. Koch, 1835)**

This, a similar species to the preceding, seems not to have been reported from North Wales apart from a single record by Debbie Evans and Julian Thompson from Treborth Botanic Gardens in Cofnod files (VC49, 2010) although there are a number of records from the south (VCs 35, 41, 42, 43, 44, 46) with a record from 310m at Capel-y-ffin (VC42, 1987). In Britain, it does not seem to have been recorded from above this altitude.

***Strigamia maritima* (Leach, 1817)**

This common littoral species, found all round Britain and Ireland, is recorded from all the coastal Welsh vice-counties (VCs 35, 41, 44, 45, 46, 48, 49, 50, 51, 52).

***Geophilus alpinus* Meinert, 1870**

Formerly known as *Geophilus insculptus*, this was recorded (E) from Botwnnog, a lowland location on the Lleyn peninsula rather than in central Snowdonia. *Geophilus alpinus* is widespread and is often common in northern and eastern Britain, but there are no British/Irish records from over 500m.

Subsequent records from North Wales include: VC49: Nant Porth (1985), nr Betws-y-coed (1985), Rhydlanfair (1985), Sychant Pass (1988), Puffin Island (1988), Bardsey Island, including Cristin area (2012, 2013); VC50: Bettisfield Moss (1993); VC51: Y Ddol Uchaf (2010), Moel Hiriddig Dyserth (2010) and Cwm Churchyard, Dyserth (2010, 150m); VC52: Llangefni (2010) (O).

For the rest of Wales, there are records from vice-counties 35, 41, 42, 43, 44, 46 and 47 with an altitude record of 340m for Cray Reservoir (VC42, 1989). A very high proportion of these records are from vice-counties 35 and 41 which include the main urbanised areas of the south.

The highest recorded altitude for the species in Britain and Ireland is at 480m.

***Geophilus carpophagus* Leach, 1817**

Now split into two species, *Geophilus carpophagus s.s*. which is mostly associated with buildings, trees and sea shore and *G. easoni* Arthur *et al*., 2001, which is the typical reddish-brown "*carpophagus*" of rural sites such as woodland and moorland, found in leaf litter and under stones and seemingly distributed widely across Britain and Ireland. Eason described *Geophilus carpophagus* as the commonest centipede throughout Snowdonia with a number of localities including, as noted above, Clogwyn Mawr at 460m. With our present knowledge of the two species, it would be reasonable to suggest that this and almost certainly most, if not all, of the older *G. carpophagus* records or subsequent ones when the two species have not been distinguished probably refer to *Geophilus easoni*. These include records from all of the Welsh vice-counties with the exception of 35 (Monmouthshire) or 51 (Flint).

The greatest altitudes *for G. carpophagus s.l.* recorded in North Wales seems to be that above along with Drum Dhu at 500m (VC47, WPIS, 1989) and the Radnor Hills at 450m (VC43, 1987) being the highest in Wales. Records of 390m from the Pentland Hills (VC83) and 457m at Henhole in Cheviot all suggest the ability to survive in upland sites. These are all much exceeded by a 1983 record from Cumbria, Hobcarton Crag of 2,500 feet (762m), the highest recorded altitude for Britain and Ireland; almost certainly all these refer to *Geophilus easoni*.

Geophilus carpophagus* Leach, 1817 *sensu stricto

There are records from Gwylan Fach island off Aberdaron (1988), Llandudno (2011) and Bardsey Island (2012, 2013) (all VC49). Other Welsh records are from Llanarth (VC35, 2002), Gower (VC41, 1985), Flat Holm (VC41, 2017), Bynea (VC44, 1987, 2009), Cardiff Gate Services Area, M5 (VC41, 2014) and Porthcawl (VC41, 2014) (all O). The Cardiff Gate location was at about 70m.

It has been found at 150m in Sussex and Warwickshire which are the highest recorded altitude for Britain and Ireland: 150m.

***Geophilus easoni* Arthur *et al.*, 2001**

As explained, this species has only been recognised since its description in 2001 and, as such, apart from older records where there is sufficient information to distinguish them from the preceding with reasonable confidence, only clearly identified post-2001 records are included. There are more than a

dozen records from vice-counties 48, 49, 50 and 51 with an altitude near Beddgelert of 300m. Also from Penryn Quarry (VC49) at 330m and Cadair Idris (VC48) at 600m (RG).

For the rest of Wales there are at least one record from each of vice-counties 35 and 41-47 with an altitude recorded at Caernfell Valley (1989) of 350m (O). Just outside Wales, highest records include one from the Long Mynd, Shropshire at 500m. The species is clearly widespread in Wales. Highest recorded altitude for it for Britain and Ireland is 600m.

***Geophilus electricus* (Linnaeus, 1758)**

Generally regarded as a species of mostly synanthropic habitats, this character can mean that it might be found further north (and possibly at a higher altitude) in such situations. We have records from Llanrwst (VC50, 1966), Pont Buarth-glas (VC48, 1983), Penmon, Flagstaff Quarry (VC52, 1985), Nant Porth, Coed Afon Menai (VC49, 1985), nr Dinas Bach (VC49, 1996), Porth Dillaen (VC49, 2002), Marford Sandpit (VC50, 2010), Erddig NT (VC50, 2010) and Ffith Bay, Prestatyn (VC51, 2010). The Pont Buarth-glas location was at 152m.

In South Wales there are records from vice-counties 35, 41, 42, 43 and 46 with the highest recorded altitude of 280m at Gwar-henalt near Buith Wells (1988) (All O). The highest recorded altitude for Britain and Ireland is 350m.

***Geophilus flavus* (Leach, 1814)**

Described (E) (as *Necrophloeophagus longicornis*) from under stones on a mountainside at Pen-y-Gwryd at 260m and at Llyn Geirionydd as well as from a shore locality. We have records from all Welsh vice-counties except, it seems, Montgomeryshire (VC47) and Merioneth (VC48) with more than twenty-five from North Wales (VCs 49-52). The highest North Wales record with altitude data seems to be Eason's Pen-y-Gwryd one with the highest in Wales (and, it appears, Britain) being Foel Fawr (520m, VC44, 1988) (O). This is a widespread and often common species in Britain and, although with a seeming eastern bias; it is also widespread in Ireland.

***Geophilus fucorum seurati* Brolemann, 1924 (*Geophilus gracilis* Meinert, 1870)**

The species *Geophilus fucorum* was recorded by R.S. Bagnall from the South Devon Coast. *Geophilus fucorum seurati* was reported by J.G. Blower (1961) from Llandudno (VC49) as having been collected by P.M. Butler in 1952 and from the Isle of Man. It is another of our littoral geophilomorphs with South Wales records from VC41 (Horton, Port Eynon, Cardiff and Crofty) and VC44 (Penrhyngwyn).

***Geophilus osquidatum* Brolemann, 1909**

This is a species with a distinct south-western tendency in Britain. Recorded from south-west of a line from Flintshire to Kent, it was first listed as British by J.G. Blower (1961) from Worcestershire (1952), from Caswell Bay (VC41, 1959) and Somerset. The only records from North Wales were made in 2010 and are from Erddig (outdoors and in greenhouse, VC50, 2010, 70m) and the Hawarden area (VC51, 2010).

For the rest of Wales there are only about a dozen records of the species, nearly half of which are from VC41 (Glamorgan, including The Gower). Recorded from vice-counties 35, 41, 42, 43, 44 and 46 with a recorded altitude of 80m at Hay on Wye (1987) (all O). The highest recorded altitude for Britain and Ireland is 280m.

***Geophilus truncorum* (Bergsoë & Meinert, 1886)**

Described as a common species in Caernarvonshire both in the mountains and in woodlands, with a number of localities named including Clogwyn Mawr (460m) (E). A small animal (commonly only 12-14mm) and easily missed, this is very widespread in Britain and Ireland, almost always in rural areas and is a characteristic animal of moorland as well as in litter and under bark of dead wood in woodland.

It is recorded from all Welsh vice-counties with more than 40 records from North Wales from where the highest altitude record seems to be the Clogwyn Mawr one. For Wales as a whole, the highest recorded altitude is at Chwarel-y-Fan (VC42) at 650m whilst the highest recorded altitude for Britain and Ireland overall is at 770m.

Order Scolopendromorpha

Cryptops anomalans Newport, 1844

Considered to most likely be an introduction e.g. from southern Europe and very much an animal of synanthropic sites including towns and cities, this is our largest species of *Cryptops* at up to 50mm. Fairly widespread in south-east and south-west England, it has been found as far north as Sheffield and the highest altitude from which it has been recorded seems to be in Buckinghamshire at 250m.

From North Wales we have just one record, from Marford Sandpit, Denbighshire (VC50) recorded as at 50m (2010). There are only six locations for the remainder of Wales, from VC35 (Abergavenny, 1988 and Risca, 2014, 2015), VC41 (Swansea, 2008, Cardiff, 1984, 2015, Llanmaes, 2003) and VC43 (Llandrindod Wells, 1988). The highest recorded altitude for Britain and Ireland is 250m.

Cryptops hortensis (Donovan, 1810)

Described (E) as a common species in the oak and birch woods of Snowdonia, Eason reports it from Beddgelert, Blaen Nanmor and Nantmor. These would all appear to be "lowland" sites for this species which is often, but not exclusively, associated with human activity in Britain and relatively rare in much of Scotland. There are a number of records from across North Wales, including records from all vice-counties (VCs 48-52), but the highest recorded altitude was only 190m at Rhyd-Ddu, Merioneth. Correspondingly, there were also records from all of the other Welsh vice-counties (35, 41-47) with the highest altitude at Bwlch-y-Rhiw, Carmarthen at about 250m (O). The highest recorded altitude for Britain and Ireland for the species is 400m.

Cryptops parisi Brolemann, 1920

More likely to be a "native" species, at least in south-west England than *C. anomalans*, this is widespread in Britain with odd records as far north as Aberdeen. It seems to be widespread, especially in disturbed sites and especially in vice-counties 41 (Glamorgan) and 35 (Monmouth), less so perhaps, in VC44 (Carmarthen). From VCs 42 and 46 there are only one or two records each and none at all so far from VCs 43, 45 and 47 or from any North Wales locations. The highest altitude recorded was 280m at Groes-faen Quarry (VC35) which is the highest recorded altitude for this species in Britain and Ireland.

Cryptops cf *hispanus* Brolemann, 1920

In 2007, Ian Morgan collected some specimens of *Cryptops* from a heated greenhouse at Singleton Park, Swansea (VC41). These included *C. hortensis*, *C. parisi* and a specimen which John Lewis (Lewis, 2011) identified as closely related to *Cryptops hispanus*, originally described from Spain, and may have been that species. No subsequent collecting in the relevant greenhouse seems to have taken place.

Order Lithobiomorpha

Lithobius (*Lithobius*) *borealis Meinert,* 1868

Recorded (E) as *Lithobius lapidicola* and referred to as the commonest of the smaller lithobiids in Snowdonia with several records including Clogwyn Mawr (460m). There are about 20 further records for the four vice counties 48, 49, 50 and 52 (O), but the highest altitude given was only 300m apart from a relatively more recent record (RG, 01.05.2011) from Cwm Cneifio (VC49) at 640m.

Elsewhere in Wales there is at least one record from each of the vice-counties 41-47 and 35 and there are many records from across Britain (up to Shetland) at altitudes up to 770m in Cumbria and also in Ireland (up to 850m on Slieve Donard). It is in some areas the common upland *Lithobius* (e.g. Shetland, Hoy) whilst in others (e.g. Cheviot, Orkney Mainland) this seems to be *Lithobius crassipes* both of which can occur at more than 700m. The highest recorded altitude for Britain and Ireland is 850m

***Lithobius* (*Lithobius*) *calcaratus* C.L. Koch, 1844**

This species was not recorded in the Caernarvonshire paper (E), but there were a series of records of it between 1949 and 2002 with at least one from each of the vice-counties 48-52 (O) including some from the peatland survey (WPIS), but none were reported from altitudes above 200m. However, there is a recent record from Minera Quarry at 325m (VC50, 2018) (RG). There are also records from Montgomery (VC47) at 350m (Roundton Hill) and 440m (Trannon Moor) altitude and records from all of vice counties 41-46, but not, it seems, from 35 (Monmouthshire) (O).

Said to be often associated with dry situations and sometimes found on moorland as well as elsewhere, this is recorded up to 600m in Britain, but is apparently absent from Ireland.

***Lithobius erythrocephalus* C.L. Koch, 1847**

There are old records of this, fairly widespread European species, from Northumberland, Midlothian and Cardiganshire (VC46) and Eason (1964) comments that "although British records are so few there is no reason to doubt their authenticity, and this species may well be indigenous". The Cardiganshire record is by M. Thompson (1924) from pasture land in the Aberystwyth area in 1920-21 where he reports a single example from soil 3-9 inches (7.6-22.9cm) deep. The only other centipedes he lists are *Geophilus flavus* (as *Geophilus longicornis*), *Geophilus truncorum* (as *Brachygeophilus truncorum*) and *Lithobius forficatus*. It is surprising that no other small/medium sized lithobiid was recorded from the survey. There have been no records made within the last 90 years of *L. erythrocephalus* from anywhere in Britain or Ireland.

***Lithobius* (*Lithobius*) *forficatus* (Linnaeus, 1758)**

Described (E) as a common species throughout the county of Caernarvonshire, this could also be said of its occurrence throughout most of Britain and Ireland. Recorded from under stones on mountainside at Pen-y-Gwryd at 260m as well as elsewhere. It has been found at more than 700m, but is far less common in such areas than *Lithobius variegatus* and is often associated with present or past human activity. The highest recorded locations in Britain (O) appear to be from Cumbria: Great Gable, 899m (1992), 792m (1980); Hobcarton, 762m (1980) and Kirk Fell, 747m (1980). In North Wales it has been recorded at 600m at Clogwyn Du'r Arddu, Snowdon (1995), in South Wales at 616m, Black Mountain (1993) and in Yorkshire at 617m at Fountains Fell (1982).

Being a relatively large and very common species, it is frequently recorded and the Centipede Recording Scheme has more than ten thousand records, the highest of any species, and, of these, more than 4,000 are with altitude data. In recent years North Wales records include Penrhyn Quarry (2015) at 362m and Cwmorthin (2016) at 346m (RG), but most are from much lower altitudes. It is recorded from all Welsh vice counties.

***Lithobius* (*Lithobius*) *lapidicola* Meinert, 1872**

The first British record of this was from a greenhouse at the Royal Botanic Gardens Edinburgh in 1986 (coll: C. Rawcliffe, det: E.H. Eason) and there was a subsequent greenhouse record from Abbotsbury, Dorset in 1996. In 1988 it was found outdoors above the beach at Sandwich Bay in Kent and subsequently from the Suffolk (1994) and Essex (2004) coasts. There have been other greenhouse records. In 2010 it was identified (conf. M. Zapparoli) from a small heated botanical greenhouse at Treborth, Bangor (VC49, 2010).

Note: this is not the *Lithobius lapidicola* of E.H. Eason's *Centipedes of the British Isles* (1964) and earlier British workers which is now known as *Lithobius borealis*.

***Lithobius* (*Lithobius*) *macilentus* L. Koch, 1862**

Recorded (E) as *Lithobius aulacopus* from Betws-y-coed and from the banks of the River Conway. Subsequently reported (O) from Cwm Idwal (VC49, 1985) and near Cerrigydrudion (VC48/50, 1985). In South Wales there are records from Lower Chapel (VC42, 1963, 1971), Old Radnor Wood (VC43, 1971), Carreg Cennen (VC44, 1985, 1987, 1997) and Llanfair Caereinion (VC47, 1983). The Carreg Cennen site was at 250m.

There are records of this, apparently parthenogenetic (in Britain) species, scattered across England, Wales and Scotland. The highest recorded altitude for it for Britain is 480m.

***Lithobius* (*Lithobius*) *melanops* Newport, 1845**

This is a species often associated with human activity that may often be found in parks, domestic gardens, urban waste ground, industrial sites, quarries, etc, and also on the coast. Records from inside unheated greenhouses or even inside houses are also known. It can sometimes be found in rural or upland areas where there are remains of old industrial or extractive industry. Because of its habits it is likely to be easily transported by human activity and this is the likely reason for it being recorded from the Falkland Islands, for instance.

It is recorded from all Welsh vice-counties with around thirty reports from North Wales, the highest recorded one being 442m at Tan-y-Pistyll (VC50, 1983). Elsewhere in Wales it was found at Trannon Moor (VC47, 1997) at 440m and Brecha Forest (VC44, 2014) at 340m. Highest recorded altitude for Britain and Ireland is 600m.

***Lithobius* (*Lithobius*) *muticus* C.L. Koch, 1847**

This was for a number of years, following its rediscovery in Britain in the 1950s in the Oxford area, Hampshire and West Sussex and subsequently in other counties, thought to be confined more or less to south-east England (S.G. Brade-Birks had a record in his notebook of finding it in Kent in 1920). It is almost always found in rural or semi-rural locations, typically deciduous woodland.

However, there have been a number of subsequent scattered reports from various parts of England (Cheshire, Lancashire, Staffordshire, South-west Yorkshire, Nottinghamshire, Worcestershire, Northumberland) and in 2004 John Harper recorded it in South Wales from near Cwmbran (VC35) and there are now also records from the Bridgend area (VC41, 2017/18) by Chris Owen and others.

The highest recorded altitude for it in Britain and Ireland is 240m.

***Lithobius* (*Lithobius*) *piceus* L. Koch, 1862**

Until comparatively recently this species was thought to be more or less confined to an area of Hampshire, Sussex and Surrey in south-east England although there had been old records, in 1913, and of questionable status, from Northumberland and Durham by R.S. Bagnall. However, in 2001 John Harper recorded it from near Pontypool (VC35) at 200m and it has subsequently been found at other sites in South Wales (VCs 35 and 41) by Christian Owen and subsequently by Steve Gregory (VC35) and Derek Whiteley (VC35).

The highest recorded altitude for Britain is 320m from Maerdy Colliery spoil heaps (VC41, 2016) (it has not been recorded from Ireland).

***Lithobius* (*Lithobius*) *pilicornis* Newport, 1844**

In parts of south-west England, notably some sites in West Cornwall, this species occurs in typically "wild" sites such as woodland, but as a synanthropic animal there are scattered records from urban or

similar areas as far north as Edinburgh. It probably out-competes *Lithobius forficatus* in suitable sites being a somewhat larger animal.

There is a single record from North Wales, Amlwch Port (VC52, 20m, 2010) which probably fits into this latter category. In South Wales, it may be "native" in areas in the west such as Pembrokeshire (VC45); it is also recorded from Monmouthshire (VC45), Glamorgan (VC41) and Carmarthen (VC44), a total of nearly 20 records, more than half of which are from VC41, which includes Maerdy Colliery spoil heaps at 320m (VC41, 2016). The Big Pit Museum (Coity Tip) at 400m (VC35, 2018) is the highest recorded altitude for Britain and Ireland.

***Lithobius* (*Lithobius*) *tenebrosus* Meinert, 1872**

There are old records of this from Durham and Cornwall whose status is unclear. In 1988 a single 9.5mm male was collected by Andy Keay from Aberystwyth in 1988 (VC46). There have been no other modern British records.

***Lithobius (Lithobius) tricuspis* Meinert, 1872**

This species was first published as British following its discovery at Drewsteignton, Devon in 1964 and it was thought for many years that VC3 (South Devon) was its only British location with a number of records from there, all from more or less rural sites. There was an unconfirmed cave record from Somerset in 1975 and query Dorset and Isle of Wight records. It was discovered in Wales at Groesfaen (VC41) in 2010 by Christian Owen and there appears to be a well-established population in the area with further records from various sites in vice-counties 35 and 41. The highest recorded altitude for Britain is 320m from Maerdy Colliery spoil heaps (VC41, 2016).

***Lithobius* (*Lithobius*) *variegatus* Leach, 1813**

In Britain this distinctive species shows a marked western and rural tendency; there are areas of eastern England and of Scotland where it appears to be largely or entirely absent even though a total of more than 7,000 records have been made across Britain and Ireland. It was once thought to be endemic to Britain and Ireland, but it is now known to be widespread in the Channel Islands (Guernsey, Jersey, Alderney, Sark, Herm) and has been recorded from Brittany as well as Iberia. Eason describes it in Caernarvonshire as far commoner than *L. forficatus* and found frequently at all altitudes. Amongst a number of locations he gives Clogwyn Mawr (460m), southern slopes of Snowdon Range (460m) and Llyn Llydaw (430m). It is, in fact, a common animal in rural Wales with a large number of records from all vice counties.

The Centipede Recording Scheme holds more than 3,000 records of this species of which there is altitude data and more than 70 which are from 500m or more. It would not be appropriate to list all these, but from North Wales (VCs 48, Merioneth and 49, Caernarvon) we have Elidir Fach (700m, 2003, JB), Cwm Cwnion (650m, 2001, JB), Llyn y Caseg-fraith (650m, 2001, JB), Llwytmor Bach (670m, 2000, JB), Cwmglas Bach (690m, 2002, JB), Cwm Cneifon (650m, 2003, JB), (all from VC49; those marked JB were recorded by J.H. Bratton) and Coed y Brenin (VC48, 600m, 1991). There are also upland records from Radnor (540m), Brecon (650m) and Carmarthen (616m) and in England, Shropshire (500m), Mid-west and North-west Yorkshire (617m and 530m) and South Northumberland (549m). Cumbria, including the Lake District, has the highest records with 820m from Moor House (VC69) and Helvellyn and Fairfield (VC70) at 800m as well as several more at more than 700m.

Further upland records (RG) we now add are: VC48: Aran Fawddwy (884m, 10.05.2019); VC49: Cadair Idris (605m, 29.06.2017), Y Aryg (880m, 22.04.2019), Pen yr Helgi Du (880m, 27.12.2018), Glyder Fawr (987m, 09.09.2018; 931m, 02.09.2018), Glyder Fach (905m,02.09.2018), Mynydd Perfedd (810m, 26.05.2018), Foel-goch (830m, 26.05.2018) and Y Garn (923m, 09.09.2018; 930m, 26.05.2018).

The highest recorded altitude for Britain and Ireland is the Glyder Fawr one (987m).

***Lithobius* (*Monotarsobius*) *crassipes* L. Koch, 1862**

In England this is probably more common in the east and north, largely, but not entirely eastern in Scotland and seemingly virtually confined to the northern half of Ireland. Eason (1957) reported it as "notably absent from Snowdonia", but recorded it from the Great Orme. For North Wales, there are about 25 records including reports from all vice-counties 48-52. The highest location recorded for the species is at Tan-y-Pistyll (VC48, 442m, 1983) (O).

Records from the rest of Wales are from all vice-counties, 35 and 41-47, the highest recorded altitude being 650m at Chwarel-y-Fan (VC42, 1989). The highest British records for the species were at 779m at Grizedale Pike summit and 770m at Hopegill Head summit (Cumbria) by S.P.Hopkin in 1986. Upland records also include 762m at Hobcarton Crag in Northumberland (1983) (O). It was found to be extremely widespread in the upland area of the Cheviot, up to at 720m at Auchope Cairn on the England/Scotland border (Barber, 1984). It is possible that some of the earlier Welsh records might have been specimens of the extremely similar *Lithobius curtipes* before it was recognised how widespread the latter was in the principality.

***Lithobius* (*Monotarsobius*) *curtipes* C.L. Koch, 1847**

This species was first recorded from Cambridgeshire, very distinctly not an upland county, by Brade-Birks (1934) as cited in Blower (1955) who reported it also from Yorkshire (VC62) and noted Eason (1951) who had found it in Warwickshire in 1950. The species was recorded from Hampshire, from East Sussex and from Oxfordshire in the 1950s. Eason (1957) had recorded it from Betws-y-Coed, Trefriw and Botwnnog, all more-or-less "lowland" locations for specimens collected in 1954 and 1956. The first from South Wales were from VC42 (Brecon area) in 1963. None of these have an altitude given

There are now scattered records, often from woodland, right across England and Wales although only a small number of records exist from south-west England with none, so far, from Cornwall. In the north of England it seems very limited, being recorded only from southern Westmorland (2 locations) and north-east Yorkshire. From Scotland there are two records only from the south-east, from near Dunbar and from Selkirk. No records exist for Ireland.

Over the years of the Centipede Recording Scheme more records of the species continued to come in but, even so, the total now included, with those listed here, remains at much less than 200 for the whole of Great Britain with less than two thirds having altitude data. This compares with more than two and a half thousand records for the somewhat similar looking *Lithobius crassipes*. Superficially the records seemed to give a general impression that *L. curtipes* was something of a "lowland" species found in woodland, etc and, maybe, even favouring ancient woodland. However, in 1987, one of the present authors (ADB) was much surprised to find the species under stones at 616m on Black Mountain, South Wales (VC44). Discussion with one or two colleagues indicated that this was not an isolated occurrence and other collections show that the species seems to be found in a variety of rural habitats, both lowland and upland. The highest record prior to the last ten years was this one, although Ian Morgan had recorded it from Mynydd Du (VC44) in 1987 at 600m and, from North Wales, Adrian Fowles (WPIS) had collected it from 250m at Merddwr (VC50) in 1988 and there was also an older (1971) record from Glan Fedwen (VC47) at 396m. The lowest altitude we have recorded was at Oxwich at 15m (VC41, 1982).

In 2016 collections made by RG led to *L. curtipes* being identified from Clogwyn Coch at 700m and 720m (29.09.2016) and at Y Gribin, Glyders at 700m (12.05.2016), both in the Snowdon Range and recent studies reveal it as being characteristically present in upland sites in scree and felsenmeer in Snowdonia up to more than 1,000m. See Figs 1-4. These include: VC48: Aran Fawddwy (under *Rhacomitrium* fringed rocks, 884m, 10.05.2019); VC49: Carnedd Dafydd (under small stones on felsenmeer, 1,024m, 06.05.2019), Carnedd Llewelyn (950m, 04.06.2012), Y Garn (felsenmeer, 923m,

09.09.2018), Glyder Fawr (felsenmeer, 950m, 09.09.2018; 987m, 02.09.2018), Y Gribin, Glyders (slate scree, 790m, 29.09.2016), Foel-goch (felsenmeer, 720m, 26.05.2018) and Clogwyn Coch (under rocks, 720m, 20.05.2017; 12.05.2016). Carnedd Dafydd (1,024m) is the highest recorded altitude for Britain for this species.

Figure 1: Y Gribin, Glyders (and Nant Ffrancon behind), 29.09.2016, 790m.

Figure 2: Y Gribin, Glyders, 29.09.2016, 790m, showing *Lithobius curtipes* habitat within slate scree.

Figure 3: Y Gribin, Glyders, 29.09.2016, 790m, showing *Lithobius curtipes* habitat within slate scree, and the high Carneddau mountains in the background**.**

Figure 4: Y Garn, 09.09.2018. Site where two specimens of *Lithobius curtipes* were found in felsenmeer at 923m.

Other North Wales records include: Trawsfynydd (VC48, 200m, WPIS, 1988), Merddwr (VC50, 250m, WPIS, 1988), Cors Erddrieniog (VC52, 60m, WPIS, 1988) and Fairy Glen near Betws-y-coed (VC49, 1985) (O). Records from the remainder of Wales include: Mynydd Du (VC44, 450m, 500m, 600m, 1987), Near Colbrem (VC42, 200m, 1989), Dyffrynoedd Nedd a Melite (VC42, 200m, 1990), Gors Coch (VC43, 450m, 500m, 600m 1989) and Glan Fedwen (O).

English locations at 150m or more (O) include: Cumbria: Burns Beck Moss (180m, 2001), Hutton Roof Crag (150m, 2001); Shropshire: Poles Coppice, 200m (1998), Ercall Quarry, 225m (1999); Southern England: Hilcot Wood, Glos, 200m (1999), Asham Woods, Somerset, 150m (1986), Lydeard Hill, Somerset, 320m (1988), Powerstock Common, Dorset, 150m (2000), Wychwood Forest, Oxon, 160m (1989), Cowleaze Wood, Oxon, 250m (1992) and Wytham Wood, Berks, 150m (1982).

Scottish locations are near Wester Kershope, Selkirk at 300m (1987) and Woodhall Dene, East Lothian at 125m (1990) (O).

In other parts of Europe such as France, Belgium and the Netherlands, its distribution seems fairly limited or it is described as rare. It is also known from Austria, Czech Republic, Germany, Hungary, Lithuania, Poland, Romania, Slovakia, Switzerland, Ukraine and Northern Russia. Its occurrence in the far north of Europe is notable with the species being found right up to the northern coastline of Norway (Finnmark), although largely absent from western Norway and eastern areas of Denmark (Andersson *et al*., 2005; Bergersen *et al*.; 2006, Palmen, 1949). The only other European centipedes extending regularly this far north are *Geophilus proximus* and *Pachymerium ferrugineum*. These same three species extend across the Kola Peninsula and around the White Sea Area (Palmen, 1949; A. Przhiboro, *pers. comm.*, I. Zenkova, *pers. comm.*). Zenkova (2016) describes *L. curtipes* as a "polyzonal eurytopic" species on the Kola Peninsula and Korobushkin *et al.* (2016), citing Zalesskaja (1978), describe it as the most common and abundant species in the European part of Russia.

***Lithobius* (*Sigibius*) *microps* Meinert, 1868**

Eason (E) described a form of this species, (then known as *Lithobius duboscqui)*, as var. *caernensis* from Betws-y-Coed, but the only specimens of the typical form he reported were from the Little Orme (i.e. outside Snowdonia). *L. microps* is widespread across Britain and Ireland, but the only Scottish records seem to be from the south-east and east. It is a small (9.5mm) species commonly associated with human activity. As a species*, L. microps* is frequently found in domestic gardens and other synanthropic sites, but sometimes in more "wild" ones notably in south-east England and can be abundant.

It is recorded from all Welsh vice-counties with about 50 records from the northern ones and significantly more in the south, reflecting possibly the degree of settlement as well as collecting activity and, maybe, a lesser degree of abundance for climatic or other reasons. As far as altitude is concerned, the highest record from North Wales, from Carrog (VC48, 2011), was only 150m, although that for the rest of Wales it was Tarren yr Esgob (2005) in vice-county 42 at around 500m and probably the highest recorded altitude for Britain & Ireland.

There have been a number of subsequent records of *caernensis* including recent ones from the Isle of Wight by S.J. Gregory although no more have been noted from Wales.

***Lamyctes emarginatus* Newport, 1844**

This is a rather seasonal species (late summer, autumn, winter), and is often considered to be associated with damper habitats (including, in Wales, river shingle), but also with moorland and cultivation, waste areas and derelict industrial sites. There are a considerable number of records across both North and South Wales (all vice counties, except VC51) with recorded altitude from 10 m or less up to 650m (Snowdon, 1989, VC49; Chwarel-y-Fan, 1989, VC42). Many of the records were contributed by the

peatland survey (WPIS). It is clearly a species that can occur at moderate altitudes as well as lowland ones where suitable habitats exist. The highest recorded altitude for Britain and Ireland is 727m.

It is possible that some of our records may, in fact, be of the very similar species *Lamyctes africanus* (Porat, 1871), specimens of which have been found in outdoor localities in Denmark and Germany in recent years. In 1986, specimens were collected from heated greenhouses at the Royal Botanic Garden, Edinburgh by Charles Rawcliffe and identified by E.H. Eason. There are also greenhouse records from other European countries.

***Lamyctes caeculus* Brolemann, 1899**,

A small (5mm), blind species, this has been found in greenhouses in Northern Europe has been recorded from the large glasshouse at the National Botanic Garden of Wales (VC44, 2004). It is also known from the Eden Project in Cornwall, Cambridge Botanic Gardens, Whipsnade Zoo (Butterfly House) and from Glasgow.

Order Scutigeromorpha

***Scutigera coleoptrata* (Linnaeus, 1758)**

Unlike any of our other species in appearance, this, the so-called "house centipede", is periodically reported from inside buildings in Britain including homes, offices, factories, a golf-club clubhouse and even a hospital. There seem to have been increasing numbers of records in recent years, but whether this is due to increased frequency of occurrence or of easier recognition and reporting is not clear. The only Welsh record we can find is from Newport Docks Office (VC35) in June 2013. In Jersey and Guernsey it may be found outdoors as well as indoors and there is a recent English record of it being seen on the outside wall of a bungalow at night.

Discussion

There are obviously a variety of factors which affect the distribution of animals and plants and clearly centipedes are no exception. Probably some of the main ones are the tolerance or otherwise of human activity/urbanization on their environment; climate in its various aspects, both macroclimatic effects such as temperature and microclimates such as microsite humidity; food availability for these generalist carnivores; presence or absence of free-water (osmotic effect); freezing and other factors. Much time has been taken up in informal discussions on centipede distribution patterns at field meetings and elsewhere, but there still remain puzzles. One of us (Barber, 1985, 1992) described some of the patterns as then seen in our chilopod fauna and presented some climatic maps of Britain in an attempt to possibly understand some of these patterns.

Altitude

As far as the upland Snowdonia pattern is concerned, we have, in recent recording and with the limited data, found an apparent pattern of *Lithobius variegatus* & *Lithobius curtipes* at altitudes up to around 1,000 metres along with a record of *Strigamia acuminata*. This seems to be reflected, at least to some extent in upland South Wales. Obviously, even if we do not clearly understand the reasons for the individual species distribution, these animals must be able to tolerate the conditions of temperature, exposure, etc. at such altitudes. According to Chandler & Gregory, in 1976, (cited in Barber, 1985), a 1,000m increase in altitude led to a temperature drop of the order of 6^{o}C and with greater precipitation and humidity compared with surrounding lowland and freezing temperatures on most winter nights above 600m.

L. variegatus is a species which seems to be confined to Britain & Ireland (including the Channel Islands), part of Western France and to Iberia, and which, in Britain, shows a very distinct western

tendency. It is in Scotland, apart from some isolated records, to a large extent mostly confined to the western coastal areas which would seem to fit with the south-north January isotherms. However, in Cumbria it certainly occurred up to 820m where one would expect a significant temperature drop compared with the lowlands and in Cheviot it is extremely patchy in occurrence without any obvious reasons, but was recorded at 400m at Coquet Dale (Barber, 1984 and other data). As can be seen above, it is widespread and common in Wales.

L. curtipes is a somewhat enigmatic species. It occurs across England, rather unpredictably patchy in location (with current knowledge), seemingly getting scarcer further north, with two reports from southern Cumbria and similarly from south-east Scotland. However, there are no records from the rest of Scotland. As noted, nevertheless it does occur in mainland Europe right up to the White Sea where it must be subject to far more extreme low temperatures

Hence, we have in Wales an upland region where both species exist, presumably occupying different niches. North of this *L. curtipes* occurrence peters out; to the south and east we have more lowland areas.

Strigamia acuminata, where altitude has been recorded, has been found at between 1 and 1,013m, the latter being recently established, but occurrence at 200 – 400 m is noted in a number of cases, up to 650m in South Wales. Interestingly, in the analysis of "horizon" data in the Provisional Atlas (Barber & Keay, 1988; Barber, 1992) this species, along with the two other darker species (i.e. reddish brown rather than yellow or white), *Strigamia crassipes* and *Geophilus carpophagus* s.l. (along with the frequently subcortical *Geophilus truncorum*) were less common than the paler ones in deeper soil horizons. Whether this is, in any way related to their habits is not easy to say but, although the highest record for *S. crassipes* is only 310m, that for *G. carpophagus* s.l. (i.e. almost probably *G. easoni*) is 762m and for definite *G. easoni* 600m. With *G. truncorum* (recorded up to 770m), *G. easoni* is a frequent centipede in moorland areas.

Two species of *Lithobius,* of roughly the same size as *L. curtipes* (11mm), also stand out as occurring in upland areas, *L. borealis* (12.5mm) (recorded up to 850m) and *L. crassipes* (13.5mm) (up to 791m). Although *L. crassipes* tends to be possibly more eastern and *L. borealis* maybe more western, it is not, at present, too obvious why areas have one rather than the other, or why *L. curtipes* is so much the small/medium "upland" *Lithobius* in montane Wales rather than one of these, which are both also recorded there. We have limited information about our upland areas which are more difficult to access and can be more difficult to collect from and more of such records will clearly be very welcome. It might also be worthwhile to look further at the occurrence, upland and lowland, of *L. crassipes* and *L. borealis* (and *L. curtipes*) in Britain and Ireland.

Synanthropy

Synanthropy refers to living in proximity to and benefiting from human activity and relates to both vertebrates and invertebrates and also plants and to communities as a whole. This has been explored in the context of two indicators of synanthropy for bird species by Guetté *et al*. (2017). The first of these differentiated species along a continuum from urban "avoiders" to urban "dwellers", the second, in relation to building density between "losers" and "winners" at increasing density. While it would not be easy to apply these, especially the second, to centipedes without clear numerical data, certainly the concepts can inform our thinking if we consider "urbanization" in broad terms and are also aware of the potential impact of previous human activity such as at upland former mine sites. The synanthropic habitat potentially offers both benefits and risks and clearly different species of centipede, for reasons, mostly not understood, occupy different positions along the spectrum of avoiders to dwellers.

We also need to recognize that species may have different degrees of "synanthropy" depending on location where in one part of Britain the species occurs in the "wild" whilst in another it is highly

dependent on human activity as in *Lithobius lapidicola*, found occasionally in heated greenhouses, but also above the shore, in the "wild" on the coasts of Kent, Suffolk and Essex. We may also wish to distinguish somewhat between species that are solely synanthropic in a particular area (obligate synanthropes) and those that seem to occur in rural sites as well. For instance, *Cryptops anomalans* seems to be an obligate synanthrope throughout Britain (and almost certainly an introduction) whereas *Schendyla nemorensis* seems to occur in both urban and rural sites whilst the similar sized *Geophilus truncorum* is very largely an "avoider".

As far back as 1973, Henrik Enghoff (Enghoff, 1973), writing about myriapods from suburban localities around Copenhagen, concluded that the myriapod fauna of these areas was dominated by probably introduced species and noted that the chilopod and diplopod fauna of Denmark reached the peak of its diversity in the types of biotope covered by his investigation (heavily man-influenced). "Thus, the changing of the environment by man is not always detrimental to the diversity of the fauna."

Blackburn *et al.* (2002), in their study of an area of north-west England, commented that there was a pronounced synanthropic trend in geophilomorphs, absent in lithobiomorphs. The species they had recorded were *Haplophilus subterraneus, Schendyla nemorensis*, *Geophilus electricus*, *Geophilus flavus* ("intermediate": 10-50 individuals, 4-12 sites), *Geophilus alpinus* and *Geophilus truncorum* ("common", 100+, 20+ sites). (There was also a single individual of *Strigamia acuminata*.) They concluded that it might be premature to consider these as introductions and that it was difficult to distinguish natural range expansion from the effects of human activity, but that northward migrating propagules could survive near or in heat islands. Also, clearly, synanthropes are much more likely to be accidentally transferred by human activity.

Of the species we have noted as occurring in Wales, it will be noted that most geophilomorphs would seem to fit in the category of having distinct synanthropic tendencies. The most obviously less so are *G. truncorum* with its strongly negative association with pH and *Geophilus easoni*, not recorded in the Blackburn *et al.* study. The two terrestrial species of *Strigamia*, as commented above, do not seem to fit any obvious pattern of distribution other than absence from the northern part of Britain.

Although Blackburn *et al*. refer to a pronounced synanthropic trend as absent in lithobiomorphs, *Lithobius forficatus*, *L. melanops* and *L. microps* are known to commonly occur in synanthropic sites (as does *L. pilicornis* where it occurs in Wales). Scolopendromorphs were not included in the study, but experience of our three "outdoor" *Cryptops* species indicates that we could place them in order where *C. anomalans* seems to be exclusively synanthropic in Britain, *C. parisi* appearing less so and possibly "native" in south-west England and *C. hortensis* clearly native in at least parts of southern Britain where it can be found in woodland etc. (it has also been recorded from limestone pavement). Wesener *et al.* (2016) suggest that, in Germany, *C. anomalans* as "most likely introduced from the Mediterranean" whereas *C. hortensis* and *C. parisi* are referred to as "naturally occurring".

Wales is a country where there is a sharp contrast between areas where heavy industry and extensive settlement have taken place, with the former leaving a legacy of abandoned derelict buildings, spoil tips, waste at least in some parts and rural areas where agriculture and low levels of settlement are characteristic with tourism and informal recreation. The uplands, especially, have large areas of land where low-intensity sheep farming is characteristic and montane locations with little human activity other than walking and climbing. The two inland national parks are typical of this latter. With this diversity comes a wide variety of niches for centipedes to occur in. It would be simplistic to say that developed areas of, say, Monmouthshire and Glamorgan would, for instance, favour *Cryptops* species, *Lithobius pilicornis*, *Lithobius forficatus*, *Geophilus electricus*, *Lithobius melanops*, etc., whilst Snowdonia (away from extractive industry, etc.) favours *Lithobius variegatus*, *L. crassipes*, *L. curtipes, L. borealis*, *Geophilus easoni* and *G. truncorum*, but patterns like this certainly occur.

Heated greenhouse species

These are clearly living in a highly artificial environment and are not necessarily related at all to the local "outdoor" fauna, having been brought in at some time with plants or compost or similar. Correspondingly they can, potentially, be transferred with plants, compost, etc. to other greenhouses. In this category, in Wales, we list *Cryptops* cf *hispanus*, *Lamyctes caeculus* and *Lithobius lapidicola* (in this part of its range, apparently). The Eden Project in Cornwall, as well as *L. caeculus,* records *Cryptops doriae*, *Mecistocephalus guildingii* Newport, 1843 and *Tygarrup javanicus* Attems, 1929. The latter is relatively small (20mm) and apparently parthenogenetic and, presumably, can be spread easily and is known from Kew Gardens and other sites. Possibly these, or other species, could turn up in Wales.

Survivors?

It is interesting that, in addition to the anticipated species in parts of South Wales, we have now found others that seem away from other known colonies of the species. These include *Lithobius piceus* (south-east England), *Lithobius tricuspis* (South Devon) and *Lithobius muticus*, all three of which seem to be on the "avoiders" end of the synanthropy spectrum and which are widespread in Europe. Two potential reasons for their occurrence as these apparently isolated populations are either that they are introductions brought in at some time and have succeeded in establishing themselves or that they are, in fact, vestiges of a one time much more widely distributed population across (southern) Britain. The fact that they are "rural" species maybe tends to give credence to the latter.

Halophiles

As noted, there are four halophilic geophilomorphs (from three different families) known from the Welsh coast. The seashore is a rich and continuously refreshed habitat providing a food web in which centipedes, invading it from above the beach, can participate, assuming they can cope with the saline environment, waves and tides. Colonisation of the sea-shore by centipedes has happened a number of times at different places around the world (Barber, 2011).

Other possible species

The "British List" (Barber, 2009) includes a number of species not referred to above, most of these seem to be restricted to a fairly limited area, but past experience indicates that this is not necessarily a reason why they might not be found in Wales in the future. Some, maybe all, are likely "introductions", but may be well established, including in rural areas. These include *Haplophilus souletinus* (Brolemann, 1907) (Falmouth area), *Eurygeophilus pinguis* (Brolemann, 1898) (North Devon and West Cornwall) and *Lithobius lucifugus* L. Koch, 1862 (identified from several synanthropic sites across southern Scotland). Two small (12-13mm) geophilids are known only from a few sites in the south of England, *Arenophilus peregrinus* Jones, 1989 (Scilly, West Cornwall) and *Nothogeophilus turki* Lewis, Jones & Keay, 1988 (Scilly and Isle of Wight). *Geophilus pusillifrater* Verhoeff, 1898, possibly halophilic, another small (13mm) species is known from Scilly, Cornwall, Sussex and the Channel Islands.

Pachymerium ferrugineum (C.L. Koch, 1835), a rather large (50mm) and distinctive species, widespread in Europe, turns up from time to time in shingle on the south-eastern coasts of England and has now been recorded from Guernsey (Barber, Gregory & Marquis, 2020). *Stenotaenia linearis* C.L. Koch, 1835 is a relatively large geophilid (55mm) recorded from synanthropic sites (and occasionally greenhouses) and is widespread in the London area as well as occurring elsewhere and could well be found in such habitats in Wales. *Lithobius peregrinus* Latzel, 1880, a vagrant species of similar superficial appearance to *Lithobius forficatus*, has been recorded from two ports, Sheerness (probably now extinct) and Harwich.

Dicellophilus carniolensis (C.L. Koch, 1847), a central European species was recorded in the early years of the 20th century from greenhouses, but has never become established in Britain. *Schendyla monoeci* (Brolemann, 1904) was recorded from a greenhouse in Cornwall in 1944. Examination of a surviving slide of a specimen has indicated that it was definitely not this species, but most likely an immature *Geophilus* (L. Bonato, *pers. comm*.). The existence of *Lithobius agilis* C.L. Koch, 1847 recorded from Armagh and Donegal and subsequently in Cornwall more than 70 years ago remains questionable as a British or Irish species.

Conclusions

Wales has been shown to contain a large proportion of the British species of centipede in a diversity of habitats. Factors likely to affecting their occurrence in different areas include, almost certainly, climatic ones and the existence of particular species at higher altitudes say, 600m to 1,000m or more probably reflects their tolerance of the more extreme local climate. However, the precise way in which distribution of species such as *Lithobius variegatus* and *Lithobius curtipes* is determined and reasons for the existence of *Lithobius curtipes*, *Lithobius borealis* or *Lithobius crassipes* in particular upland/moorland locations in the British Isles remains unclear. The Welsh upland species seem to represent a near unique situation in the island of Britain where an overlap of the areas of occurrence of *L. variegatus* and *L. curtipes* occurs in upland habitats.

With the history of past heavy industry and mining in various parts of the country as well as urbanization, synanthropy, the ability to thrive in or at least tolerate heavily human influenced habitats is clearly another factor causing the diversity of species in Wales and the length of its species list.

There is clearly a need for more upland records to explore these, generally, relatively poorly worked and difficult of access habitats, not only in Wales, but in northern England and Scotland. It would also be interesting to know how far other groups of invertebrates parallel the situation in the centipedes of Snowdonia.

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