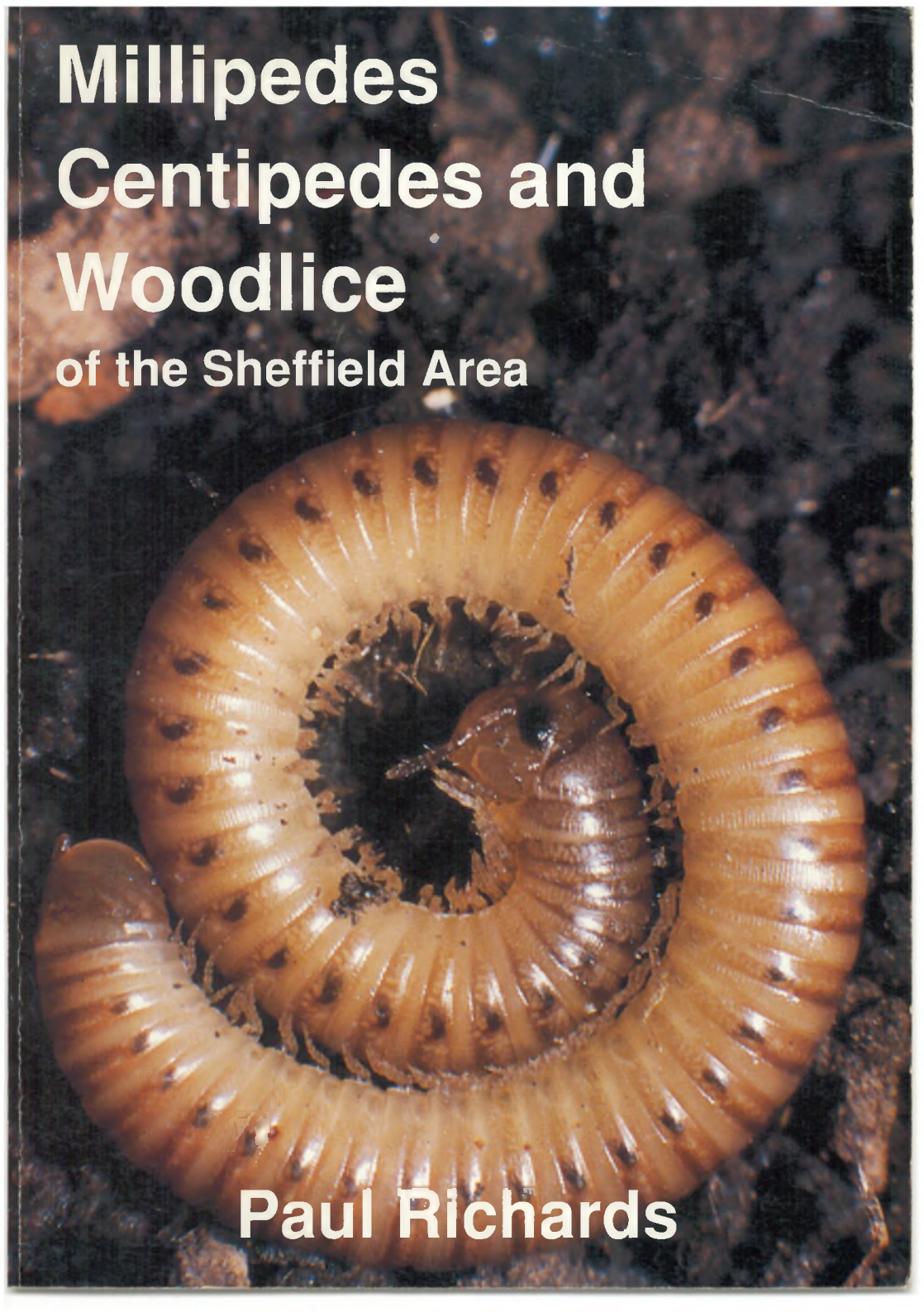
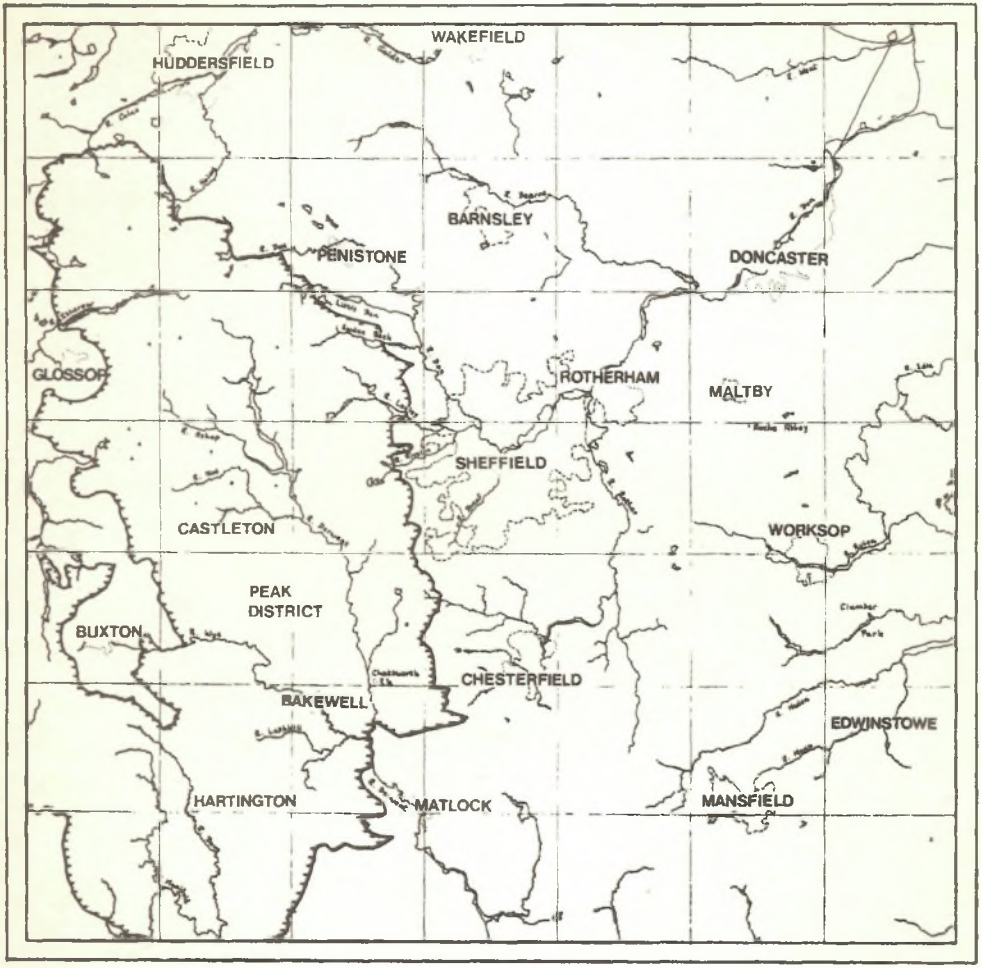
Millipedes Centipedes and Woodlice

of the Sheffield Area



Paul Richards



Sheffield and its surrounding region as studied by the Sorby Natural History Society. The approximate boundaries of the Peak District National Park are also indicated.

MILLIPEDES CENTIPEDES AND WOODLICE

OF THE SHEFFIELD AREA

J P RICHARDS

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PREFACE

"Of these hideous and angry insects we know little, except the figure and noxious qualities. Though with us there are insects somewhat resembling them in form, we are placed at a happy distance from such as are really formidable. With us they seldom grow above an inch long; in the tropical climates they are often found above a quarter of a yard".

Thus were the 'scolopendra' and 'gally worm' introduced by Oliver Goldsmith in 1864 in his 'History of the earth and animated nature, Book 1: Insects of the first order'. Clearly a man of the 'creepy-crawly' school of taxonomic description! More recently millipedes and woodlice have been described as "fascinating and, dare I say it, endearing creatures" (Hopkin & Read 1992; Hopkin 1991) and "very interesting animals ... eminently accessible and obliging ... very useful" (Sutton 1972).

It has to be said that the animals referred to in this publication do indeed creep, crawl and generally behave in a manner inconsistent with furred and feathered vertebrates. The majority do not possess irridescent courtship embellishments, nor do they display humorous anthropomorphic behaviour. They largely cannot be identified through binoculars and no glossily illustrated picture guide could adequately serve for identification of all species. However, despite these apparent barriers to popular acceptance Millipedes, Centipedes and Woodlice provide one of the most rewarding areas of zoological investigation in the 1990s.

Why? Because the appearance of recent publications linked with a thriving network of local and national biological recording means that the study of these creatures is not only possible but exciting and useful. All of these groups have benefited from the appearance of excellent identification guides which in my opinion make them some of the easiest animals in this region to accurately identify. Much like dragonflies and hoverflies in the 1980s this has produced a boom in interest because we actually now know what we're looking at! Study of these groups has been further encouraged by the production of national distribution atlases. These have enabled naturalists to determine regional rarity value for species and contribute to conservation debates for these neglected animals. Additionally, such maps have provided a baseline against which new distribution data can be compared. This has resulted in 'under-recorded' areas being studied in order to give a progressively more accurate picture of our invertebrate fauna. Most exciting of all is that this renewed effort in what is still a relatively new field of investigation is producing countless new discoveries. Known ranges are being extended, new species and sub-species are turning up, new ecological and behavioural information is coming to light and amateur naturalists are finding themselves at the forefront of knowledge by barely searching past their doorstep.

For millipedes alone the number of known species for this area has increased by 65% in the last 10 years. Can the ornithologists say that?! It takes a willingness to look more closely at the world around us to find a wealth of fascinating and unimagined life-forms waiting to be discovered.

"... I need only mention Arachnida, Myriapoda. Crustacea and Annelida. Who will take charge of these 'neglected orders' and tell us more of their wonderful forms and life histories? ..." - H. Franklin Parsons, 1878 'Neglected orders' The Naturalist.

You perhaps?

J P Richards 1995

CONTENTS

INTRODUCTION

The drawing together of Millipedes, Centipedes and Woodlice into a single volume is in many ways an artifical grouping. The primary reason for doing so is simply because they are the orders of current interest to the author for which the local mapping scheme has reached a point whereby publication has some value. That is, where recent recording effort has produced either sufficient data to afford significant distribution analysis or a new baseline from which future work can proceed. The grouping of these orders is based largely on the arbitrary circumstance that they are all found in the same habitats using common collecting techniques. Accordingly, study of these orders often goes hand in hand with the recording of molluscs, spiders, pseudo-scorpions etc.

Taxonomy

All the creatures we shall be considering belong to the phyllum ARTHROPODA. They have calcified exoskeletons, jointed legs and a segmented body. However, it is here that any relationship ends since it is generally considered that these common characteristics arose independently along different evoluntionary lines (Richards and Davies 1978).

Millipedes, Centipedes, Woodlice and some other crustacea were separated as a taxonomic group in their own right originally by Fabricius in 1793. The name MYRIAPODA was coined by Latreille (1810) who later removed the crustaceans from this taxon (Eason 1964).

The term Myriapoda is now variously used as a 'Class' level taxon or as a general term for multi-legged arthropods belonging to the four classes, Diplopoda, Chilopoda, Symphyla and Pauropoda. The latter scheme will be employed here. All are entirely terrestrial and breath by means of tracheae. The body is not divided into thorax and abdomen but consists of numerous leg-bearing segments. The number of legs may be anything between six (in newly hatched individuals) and 750 (in the millipede *Illacme plenipes*).

The *DIPLOPODA* or millipedes have two pairs of legs per body segment and robust mandibles for eating dead vegetation. The *CHILOPODA* or centipedes possess a single pair of legs per segment and large poison claws with small mandibles adapted for a carnivorous existence. The *SYMPHYLA* and *PAUROPODA* are small, rather difficult to identify and completely un-recorded locally. In general appearance they look like pale juvenile centipedes or small springtails. For further information on these neglected classes see Edwards (1959), Hopkin and Roberts (1988) and Barber, Blower and Scheller (1992).

Woodlice or terrestrial *ISOPODA* belong to the Class *CRUSTACEA*. The name refers to the uniformity of the legs ('equal-feet'), in contrast with the modifications seen in other crustaceans. These are normally thought of as aquatic but the isopods have successfully made the transition to land. Different modifications have enabled the isopods to survive out of the water such as the flat, stable body and walking rather than swimming limbs. The mouthparts are able to bite and chew rather than filter feed and structures have developed for the internal fertilization of eggs (Oliver and Meechan 1993). Unlike the myriapods, the isopod body is differentiated into two main zones, the *pereon* and the *pleon*.

Habitat

A variety of similar physiological requirements ensure that these diverse animals inhabit the same kind of niches. They are all dependent on high levels of humidity and despite their various adaptations for resisting dessication are mostly tied to dwelling in moist habitats,

such as soil, leaf litter, under bark, logs and stones. It is simplest to think of them all as predominantly soil dwelling but attracted to localized areas of higher humidity and food sources, such as leaf litter or rotting logs. Stones or pieces of refuse may present a barrier to further progress, a source of calcium, or a daytime refuge at which individuals may acumulate. It is important to remember that these microhabitats may not be the preferred home of these animals but simply the easiest place to find them from the collector's point of view. Soil-sampling, sieving and other quantitative techniques will give a better impression of a species' natural preferences.

The most significant factors governing species distribution are climate, soil chemistry, availability of habitat, and biological interactions. Extreme climatic conditions are probably the biggest controlling factor on invertebrate populations, simply because severe weather can affect the reproductive success, survival or dispersal of an entire population in a single blow. In more normal circumstances the range of temperatures and rainfall for a given area throughout the year will allow the life cycles to be completed for some and not for others depending on their levels of tolerance and adaptation. By mapping monthly isotherms (areas of equal mean temperatures) and annual isohyets (sites of equal rainfall) across the country it is possible to divide the British Isles into four quadrants (Hopkin 1987). For example the south-west generally experiences warmer weather with fewer frosts, but high rainfall. Whereas the south-east experiences hot summers, cold winters and lower rainfall. The interesting thing from a Sheffield point of view is that these quandrants overlap very much in the Sorby recording area (see inside front cover). The January isotherm and mean rainfall divide the area east-west while the summer temperatures shows a north-south gradient. This is further compounded (and partially caused) by the increase in altitude from east to west. Such variety of climate across the region makes for interesting diversity of species, many of which may be at the current extreme of their range (from any direction).

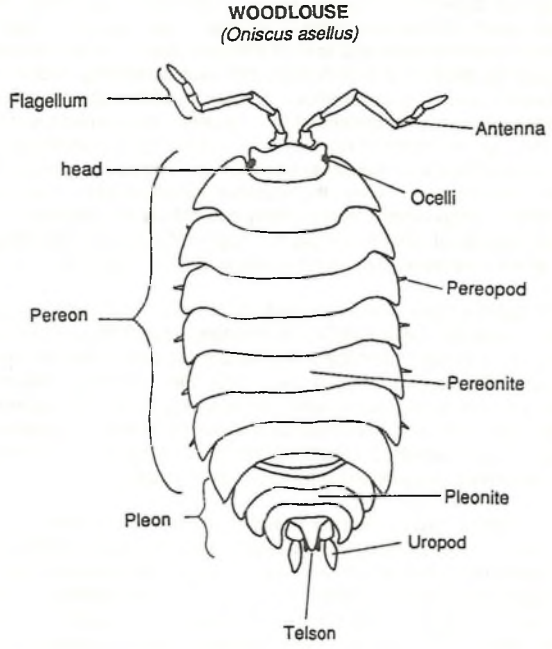
Climatic influences are obviously related to the time of year. The wetter, milder months of spring and autumn being the most suitable to creatures dependent on moisture. These seasons are generally the most productive as specimens are active at the surface and more easily found. The spring is also frequently the breeding season for ground invertebrates, the result of which are adults the following spring or autumn. The wide variety of life cycles, longevity and physiological adaptation, however, means that there are millipedes, centipedes and woodlice around at all times of the year. This is one of the appealing things about their study; there is no real 'close season'.

The fauna of the Sheffield area is further enriched by the occurrence of Carboniferous Limstone to the south-west in Derbyshire and Magnesian (Permian) limestone to the east. The subsequent base-rich soils in these areas provide the calcium salts required by myriapods and isopods for integration into the cuticle of their exoskeleton. Species vary in their tolerance of acid conditions. Those which can cope best are able to avoid competition from those which cannot. The species which are tied more to calcareous environments often find their requirements are met by areas in which man has exerted his influence, for example through the mortar in brickwork. Such 'synanthropic' sites produce a fairly sheltered environment in which introduced species or those at the edge of their range can survive virtually independent of the local climate (Eason 1964). Gardens, quarries, churchyards, buildings, roadside verges, tips, greenhouses etc. provide shelter and food for species which may not occur in nearby 'natural' habitats. Dispersal is also rapid to and from such sites as material is moved around by man.

The distribution of one species of myriapod or isopod may influence the distribution of another. There is little definitive evidence that species of invertebrates directly compete with one another within a niche. However, several would seem to have abrupt delineations between their ranges where possibly the influence of other pressures makes interspecific competition a significant factor. In Tasmania such distinct myriapod 'territories' have been studied to the extent that virtually the very log of overlap can be determined (R. Mesibov,

pers. comm.). Factors affecting the eastern distribution of the centipede *Lithobius variegatus* would be a rewarding study in this context.

Species of other organisms may influence the distribution of ground invertebrates. This may be by direct infection from micro-organisms or through parasitism. The latter is known from dipteran larvae and nematodes in woodlice. The so called 'millipede killing flies', *Pelidnoptera spp.* occur locally, but their hosts are yet to be identified. Centipedes are only rarely parasitised. Parasitism and predation do not seem to be important factors in their population density (Eason 1964). Symbiosis is another means by which distribution is determined by another species. The most obvious example being that of the ant woodlouse *Platyarthrus hoffmanseggi* which is restricted to the vicinity of ant colonies (Hames 1987).



Collecting techniques

Because of their common habitat requirements, myriapods and isopods are generally collected together using similar techniques. The most straightforward and productive is simple hand searching. Most species can be found by turning over logs and rocks. Lifting bark, searching through leaf litter and moss or digging into the soil will reveal most of the others. The use of progressively finer sieves is very effective for separating animal from habitat as is sorting of habitat samples in plastic trays (black or white backgrounds show up different species). For smaller, more difficult species or for quantitative assessments traps or funnels can be employed. The simplest form is the pitfall trap, whereby a plastic cup or similar is placed in the ground with the lip flush to the surface. Passing animals fall in to be

collected later. If traps are left dry, trapped carnivores are liable to eat everything caught with them. A liquid preservative (such as antifreeze or propylene phenoxetol with formalin) will ensure that all specimens remain intact. Plain water can be used, with a drop of detergent to break the surface tension, but it needs to be emptied daily before specimens decompose. A wire mesh over the trap will prevent any unnecessary vertebrate deaths. The Tulgren funnel is used for extracting all invertebrates from a sample by their natural aversion to light and heat. A lamp is placed over a funnel containing a layer of leaf litter etc. and the livestock works its way into a collecting vessel at the bottom away from the light source.

The most difficult part of collecting is the actual picking up of the specimen. Some centipedes and woodlice are incredibly quick and will escape the second a stone is turned. The rapid extension of a wetted finger is probably the only way to catch them. Flimsy, storks-bill forceps or a wetted paint brush are also good ways of picking up small specimens unharmed.

Preservation and Identification

Many of the characters used for identification are very small and will require microscopic examination. This is largely impossible in living specimens. For this reason it is often necessary to collect and preserve specimens for later examination and subsequent reference. The simplest and least cruel method is to put live specimens directly into a preservative such as 70% alcohol. The real value of a collected specimen is in the data that goes with it. For this reason it is essential that specimen tubes are labelled (inside) with details of where found, when and by whom. Labels on the outside can often fall off and be separated from the specimen as can 'codes' which mean nothing without the associated note book. Information should be placed in the preservative, written with waterproof (and alcohol proof) ink on good quality paper.

One advantage of studying these animals is that often no further preparation, pinning or dissection is required. 'Clearing' with lactic acid may be required to see certain characters in Geophilid centipedes and woodlouse and millipede genitalia may need to be dissected out in some critical species. In general however, most characters simply require close examination with a hand lens or microscope. The following keys have in general been designed for the identification of living specimens using a x10 or greater hand lens. A microscope would certainly make life easier and is almost essential for the majority of centipedes. The use of a folded piece of 'cling-film' to hold live specimens motionless makes examination in the field much easier (E&A Purshouse, pers. comm.). With practice the majority of species covered in this book can be identified accurately in the field and the need for reference specimens will diminish. The coverage of species by no means represents a comprehensive guide to the British fauna, but rather a basic introduction to the species encountered locally. The keys are offered as a crib-sheet to simplify the tracking down of our known fauna. This should not be considered as a substitute for the excellent works of Blower (1985), Eason (1964), Hopkin (1991) and Oliver and Meechan (1993) etc. but as a complementary regional guide. A complete understanding of the respective group can only be found in these and other works covering the whole British Isles and new species to the Sheffield area will only be recognised by reference to them.

RECORDING

There has been active recording of millipedes, centipedes and woodlice nationally for over twenty years. The British Myriapod Group (BMG) and British Isopod Study Group (BISG) produce regular newsletters and journals ('Bulletin of the British Myriapod Group' and 'Isopoda') devoted to furthering knowledge and interest in these animals. Through the Biological Records Centre at the Institute of Terrestrial Ecology, Monkswood, provisional atlases have been produced giving species distribution maps for the British Isles. For the woodlice and centipedes these include analyses of habitat data which was provided on standard recording cards (Harding and Sutton, 1985; Barber and Keay, 1988).

In the Sheffield area information has largely been compiled by the Rotherham and Sheffield Biological Records Centres, based in their respective Museums. Little in the way of specific surveys have been conducted for these groups but incidental information has accrued as a product of general faunistic studies. Until recently the Rotherham area was considerably better recorded than anywhere else locally due to a woodland survey conducted in the seventies. This is particularly true for centipedes which still remain grossly under-recorded elsewhere. Despite some more recent additions there has been little change to our local knowledge since the paper by Addey in 1978.

Whereas virtually no one has heavily studied centipedes in this region, there have been some recorders who have dabbled with woodlice and millipedes. This has mainly resulted in woodlouse records for Barnsley, and millipede records for Sheffield and North Derbyshire (Ely, 1977). In the last ten years this bias has largely been rectified by widespread recording in other areas (see SITES). Millipedes have received the most attention and there are now well over 2,600 records for these alone (Richards, 1991). In fact, whereas there were only 20 species of millipede known from the Sorby recording area in 1985 (Garland, 1985) there are now 33. This is purely the result of effort and enthusiasm for an under-studied group.

With the arrival of several excellent identification guides and atlases it has become a much easier task to study myriapods and isopods. These will hopefully stimulate a greater interest in these animals and consequently add further records to the current databank. The maps within these pages are up to date, as of June 1995. It is sincerely hoped that they will be completely out of date as soon as possible! Records of millipedes, centipedes and woodlice should initially be sent to your local biological records centre or local recorder for that group. This data is currently compiled within the Sorby recording area (see inside front cover) by:

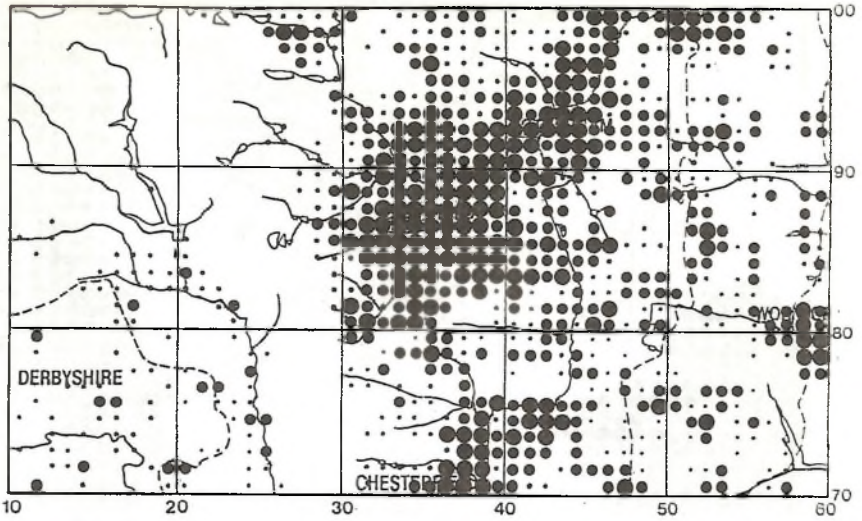
Paul Richards, Biological Records Centre
Sheffield City Museum
Weston Park, S10 2TP

Records are then forwarded to the appropriate national schemes. Specimens for identification or checking should also be sent to the above address in the first instance. The information required for each record is:

- Name of species if known
- Date found
- Where found (including a grid reference if possible)
- Name of collector

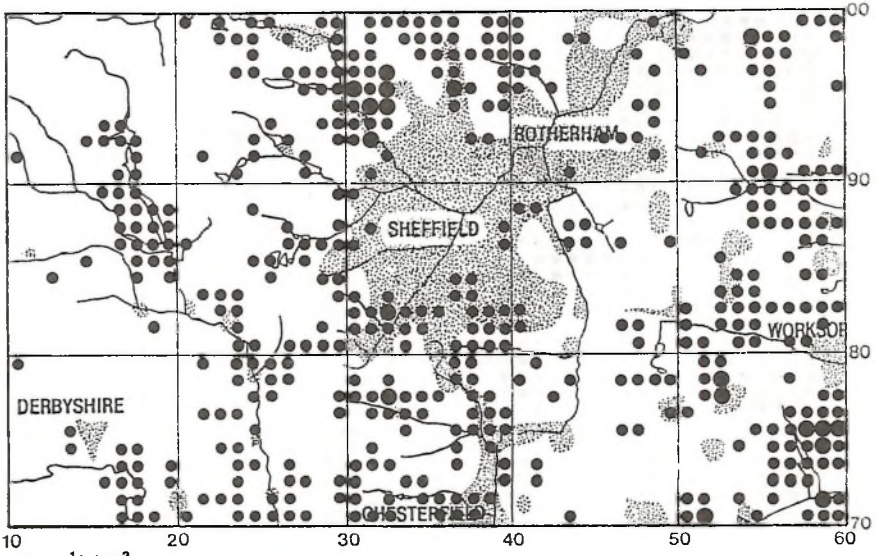
Additional data is always useful, such as type of habitat / microhabitat, altitude, type of soil, abundance, behaviour etc.

BUILT UP AREAS



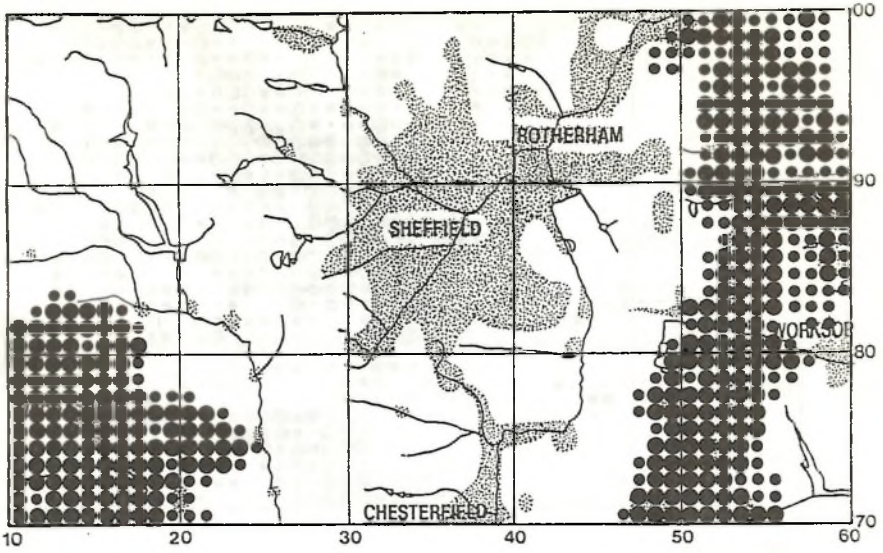
● > ½ km²
● < ½ km²
· several buildings

MAJOR DECIDUOUS WOODLAND



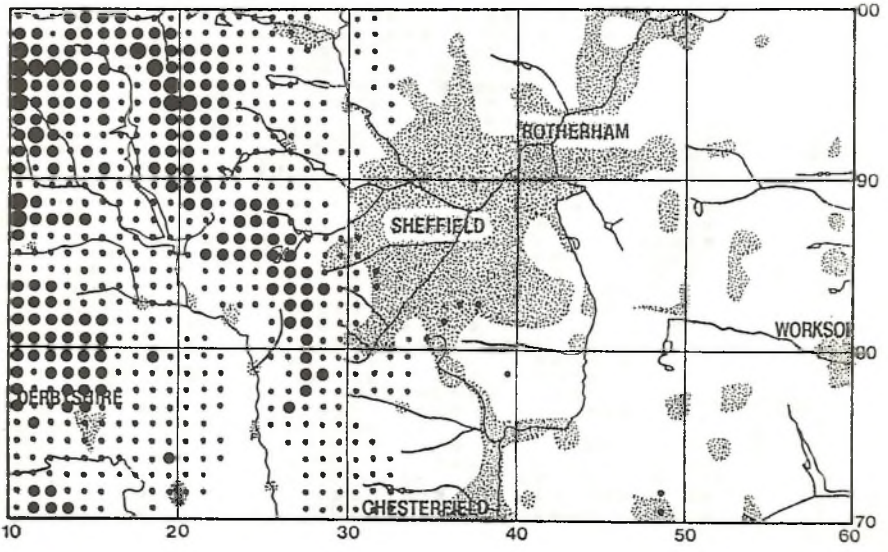
● > ½ km²
● < ½ km²
small woods not mapped

LIMESTONE AREAS



● > ½ km²
● < ½ km²

MINIMUM ALTITUDE



● 1500 - 2000 ft
● 1000 - 1500 ft
• 500 - 1000 ft

MILLIPEDES

There are currently 33 species of millipede known from the Sheffield area. New species will certainly turn up while one or two others are already thought to have been lost. The British fauna comprises around 56 species. General characteristics for all species are fairly consistent, with the most obvious being the double pairs of legs on each body ring (or DIPLOSEGMENT). This feature gives the class DIPLOPODA its name. In Britain there are six orders within this class of which five are now known locally (Richards 1991c).

From a taxonomic point of view, millipede families can be arranged according to the degree of fusion there is between the various parts of the exoskeleton. The STERNITES, PLEURITES and TERGITES are fused to form a single ring in MONOZONIAN families while there is progressively more articulation between these units in the TRIZONIA and PENTAZONIA (see diagram). It is, however, simpler in the present context to divide the millipedes according to shape into 'bristly, pill, snake and flat-backed' forms.

The bristly millipede, *Polyxenus lagurus* is uniquely covered in hollow, serrated bristles called TRICHOMES and unlike other millipedes has a soft exoskeleton. There are two local 'pill' millipedes which are capable of rolling into a tight sub-spherical ball, like an armadillo. Snake millipedes have a more or less cylindrical cross-section and may roll into a planar or helical spiral to protect the underside and head. The remaining species have lateral projections (or PARANOTA) and a generally flattened dorsal surface giving a flat-backed appearance.

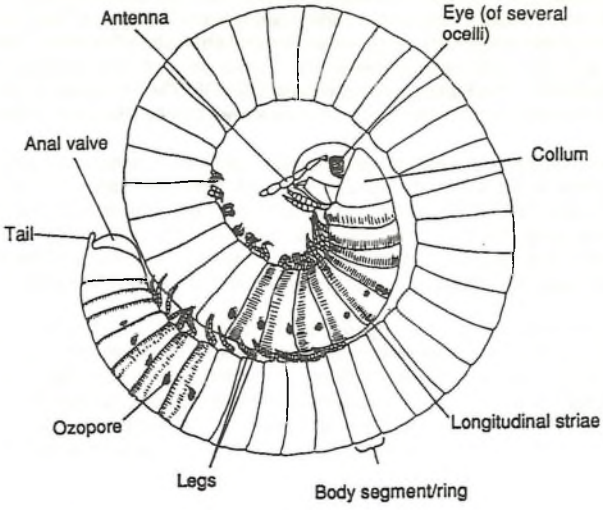
All millipedes are primarily designed for pushing. The large number of legs enables them to give greater force to the push. The large first tergite or COLLUM in many species is used as a wedge to deliver the full force of the push between soil particles and leaf litter layers. The whole of the back is used in the same way in the flat-backed species, while the rigid interlocking segments prevent the body from shortening or buckling under stress (Manton 1954).

There are a number of particular features which are useful in distinguishing between species. Size, colour and shape are a remarkably straightforward means of diagnosis. The defence glands (OZADENES) along the side of the body may be variously coloured orange, blood red, dark brown or even greenish, and aid in identification. All millipedes can be divided according to whether the first tergite (COLLUM) overlaps the head or whether the first segment seems to fit into the back of the head. Those snake-like forms with the overlapping collum can further be divided depending on the extent of the longitudinally engraved striae which are found on each segment. In some small species these are confined to the lower half of each ring. In others the grooves are present over the whole arch of the segment.

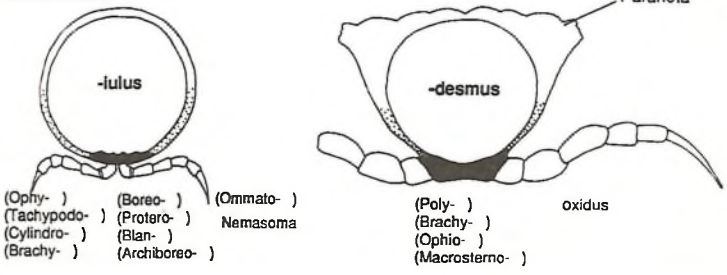
A most distinctive feature is the presence or absence of eyes or the number and pattern of ocelli. As an individual grows, the number of ocelli per eye increases and can be a helpful guide as to the age (or STADIUM) of the specimen. The last segment or TELSON may possess a characteristically shaped tail projection or even tiny spinnerets for producing silk which can easily be seen with a hand lens.

As with most invertebrate groups, sexual characters and genitalia structure are very specific diagnostic features. Often such structures are held within the cuticle and need to be dissected out to see them properly. However, in many millipedes these can be seen quite clearly behind the sixth or seventh pair of legs. In the *Polydesmus* species these are particularly large and obvious. Even the females have external sculpturing (EPiGYNES) behind the second pair of legs which is distinctive.

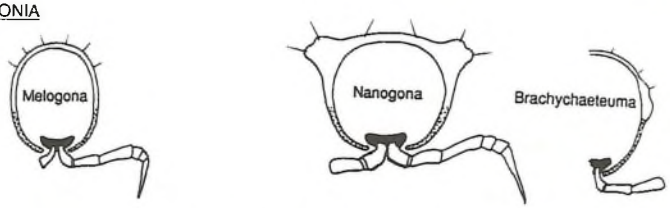
'SNAKE' MILLIPEDE
(Cylindroiulus punctatus)



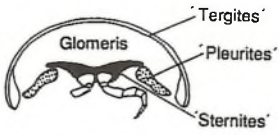
MONOZONIA



TRIZONIA



PENTAZONIA



(Stygioglomeris)

Secondary sexual modifications often mean that certain leg pairs appear to be absent in adult millipedes. This feature is helpful in determining the sex of a millipede. The genitalia of all Diplopods are found in the third body ring and open just behind the second pair of legs. In the bristly millipede sperm is indirectly transferred to the female via a web of silk threads spun on a nearby surface. All other male millipedes transfer sperm via modified limbs known as GONOPODS. These reproductive organs are not strictly 'genitalia' but will often be referred to as such. In the pill millipede, *Glomeris marginata* the gonopods are formed by the last three pairs of legs and sperm is transferred to the female via a small pellet of soil. In all other Diplopod orders the gonopods are formed from the eighth or ninth pair of legs on ring seven. This means that it is relatively straightforward to determine the sex of adult millipedes according to whether there is a gap (due to a missing leg) around ring seven in males. In females there is only a gap after the second pair of legs. In some millipedes further characters help to demonstrate the gender such as small modified first legs in some male snake millipedes or more robust legs in male flat-backs. An unusual feature of some snake millipede species (*Ommatoiulus, Tachypodoiulus Blaniulus* etc.) is that maturity occurs in males before the final stadium. A sexually mature male may then moult to produce an immature stage which may or may not moult to produce a subsequently mature individual. These non-functional adults are known as INTERCALARY stages.

Millipedes lay their eggs in nests of faecal material or silk. These begin to mature immediately and hatch into a legless 'pupoid' which moults to produce the first stadium with six legs. These also possess a small number of legless rings at the rear. At the next moult these acquire legs and a further legless 'proliferation zone' may occur. This succession of moults and leg proliferation proceeds until the individual attains its full complement of legs. The frequency and number of moults varies between species but may be anything up to fifteen. The age of a specimen can be calculated by counting the segments or by the number of eyes which are also increased with each moult. Some millipedes have a specific number of segments in the adult while others are variable. Each moult takes place in a special chamber constructed rather like the egg nest. Although some species mature within a year, most take between one and a half and four years before they can reproduce. Some species continue to reproduce for a number of years, some die soon after mating, while in others it is only the male that dies. This leads to interesting population dynamics throughout the year where there may be periods with no adults or few males around. PARTHENOGENESIS is known in some millipede species, whereby reproduction can take place in the absence of males. In fact, males of *Stygioglomeris crinita* have never been found.

The following key should help to identify the majority of local species. Females and immature stadia of certain species may prove unidentifiable using this key but may be possible by reference to Blower (1985). Even then, males may be required for absolute confirmation (eg. *Brachychaeteuma spp.*). Unless otherwise stated, measurements refer to total body length (L). Where number of segments is given this refers to all body rings including collum and telson.

A KEY TO THE MILLIPEDES OF THE SHEFFIELD AREA

1. a Soft bodied. Pale amber coloured with tufts along sides and two brushes at the back. 2-3mm (Fig. 1)
Very distinctive. Bristly millipede — Polyxenus lagurus

Fig. 1

b Hard bodied. No tufts — 2

2. a Can roll into a tight ball when disturbed — 3

b Cannot roll into a tight ball (may roll into a spiral, Fig. 3) — 5

Fig. 2

Fig. 3

3. a 7 pairs of legs. Dull, rough surface. Several small segments at end of body (Fig 2). — Woodlouse Armadillidium sp.

b 17 to 19 pairs of legs. Smooth, shiny (black, brown or white), a single large last body segment.
Pill Millipede — 4

4. a Larger (7mm+) with eyes. Usually dark with lighter markings at edges of body segments or in patches along the back. (Fig. 4) — Glomeris marginata

b Very small (2-3mm) without eyes. Virtually colourless (Fig. 5) — Stygioglomeris crinita

Fig. 4

Fig. 5

5. a Snake-like with cylindrical cross section (Figs 6 & 7) 13

b Flat-backed or with rounded humps on sides of body segments (Figs. 8 to 10) (may be difficult to see in Brachychaeteuma) 6

Fig. 6

Fig. 7

Fig. 8

Fig. 9

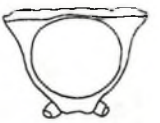


Fig. 10

6. a With eyes (may be difficult to see in Brachychaeteuma). Each segment with 6 hairs (Figs 8 & 9) 7

b Without eyes 9

7. a Flat-backed appearance. Evenly coloured, light brown (Fig. 11) Nanogona polydesmoides

Fig. 11

b More rounded. Humps along side of body. 8

8. a Larger (over 15mm). Obviously with eyes. Deep reddish brown with light mottling. Craspedosoma rawlinsii

b Small (less than 9mm). Up to 3 barely visible eyes. Cream to white. Males required for certain identification of species. (Fig. 12) Brachychaeteuma bradeae/bagnalli

Fig. 12

9. a Larger (more than 8mm) brown or cream with obvious flat back. Back elaborately sculptured with bumps and tubercles (Fig 10). 10

b Tiny (less than 5mm). Creamy-white/colourless. 11

10. a Larger animals (more than 10mm), brown. Adults with 20 segments. Polydesmus spp. 12

b Smaller (8-10mm). Light brown to off-white. Short hairs on back. Adults with 19 segments (easily mistaken for immature polydesmid). Brachydesmus superus

11. a Tiny (3-4mm L, 0.3-0.4mm W). Colourless (dark gut may be seen through cuticle). Back is rough textured and dull. The sides of each segment have 3 tiny teeth (Fig. 13). Macrosternodesmus palicola

b Small (4.5-5mm L, 0.5-0.8mm W). Ivory White. Back smooth and shiny with 3 rows of hairs across each segment. Edges not toothed (Fig 14). Oohiodesmus albonanus

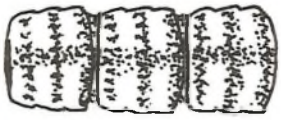


Fig. 13

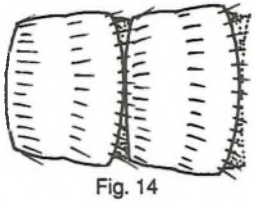
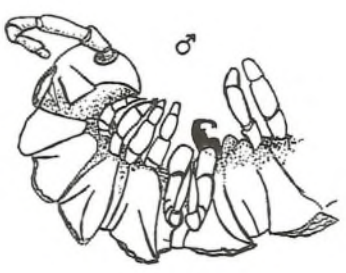


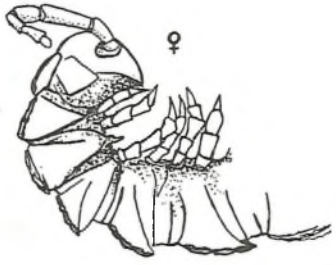
Fig. 14

* Brachychaeteuma spp. May key out here if the eyes have been overlooked. Sides with rounded humps (Fig 8) rather than a flat back (Fig 9) 5-8mm. 8

12. Polydesmus species are identified by differences in their genitalia structure. Male "gonopods" are found where the 8th pair of legs should be. Female "epigynes" are located on the front underneath edge of the 3rd segment behind the 2nd pair of legs.

Side view of P. angustus





Side view of isolated male genitalia:

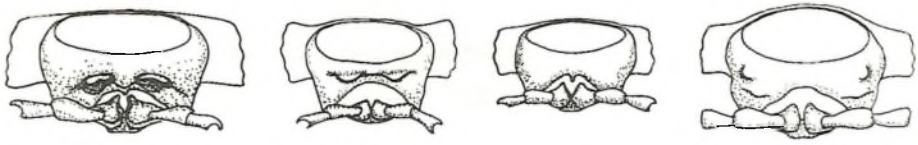
Polydesmus angustus

P. denticulatus

P. inconstans

P. gallicus

View of female epigynes from underneath:



Polydesmus angustus | P. denticulatus | P. inconstans | P. gallicus

13. a Without eyes. Yellow, orange or red spots along body. 14

b With eyes. 16

14. a Longitudinal grooves only on lower parts of body segment. Very thin (less than 1mm W). 15

b Longitudinal grooves extend all around body segment. Larger (more than 1mm W). With short pointed tail. (Fig. 15) Cylindroiulus vulnerarius

Fig. 15

15. 3 species for which microscopic examination is required for certain identification. The following characters may help.

	Hairs on body ring	colour of spots	male gonopods	
a	Very long	Yellow to orange (retained in alcohol)	Pear shaped 	Archiboreoiulus pallidus
b	Long	Bright blood red	Parallel sided 	Blaniulus guttulatus
c	Very short indeed	Orange-red	Distinctive 	Boreoiulus tenuis

16. a Small (6-7mm). White to yellowish. Adults with 28 segments (Fig. 16). Melogona scutellare

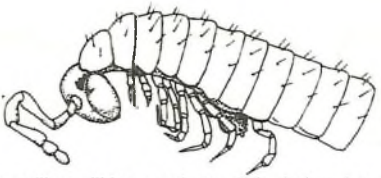


Fig. 16

* The rare Melogona gallica will key out here. It is darker, larger (7-10mm), with more eyes and 30 segments.

b Larger more than 30 segments in adult. 17

17. a Last body segment produced into a tail or projection which may have a transparent tip. 18

b Last body segment without a projecting tail. 23

18. a Tail distinctly clubbed. May have spots along body (Fig 17) Cylindroiulus punctatus

Fig. 17

b Tail with pointed tip 19

19. a Tip of tail curved upwards (Figs. 18 & 19) 20

b Tail or tail-tip down-turned (Figs. 20 & 21) 21

20. a Dark brown with two orange stripes along whole length of body. No hairs on body segments except tip of tail. (40-52 segments in adults). (Fig. 18) Ommatoiulus sabulosus

b black with white legs. Hairs on rear edges of all body segments and along length of tail. (Fig. 19) Tachypodoiulus niger

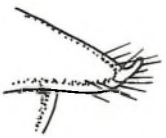


Fig. 18

Fig. 19

21. a Tail straight with underside of tip concave, appearing to turn downwards (Fig. 20). Darkly coloured, brown or black. 22

b Whole tail bends downwards (Fig. 21). Lightly pigmented, brown, lilac or greenish. Allajulus nitidus

Fig. 20

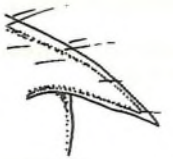


Fig. 21

22. a Females (gap behind 2nd pair of legs). Require microscopic examination. Ophyiulus pilosus/Julus scandinavius

b Males (gap behind 7th pair of legs):
First pair of legs sickle-shaped (Fig. 22) Ophyiulus pilosus

First pair of legs almost absent. 2nd pair with blade-like projection (Fig. 23) Julus scandinavius

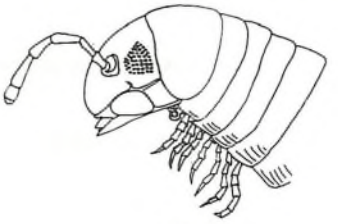


Fig. 22

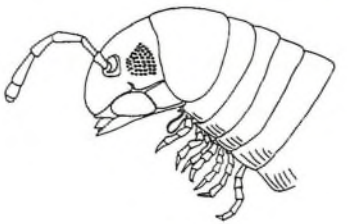


Fig. 23

23. a Small (7-13mm). Brown with two yellow stripes along length of body. Tip of tail pointed but short. 27-31 segments in adult. (Fig. 24) Brachyiulus pusillus

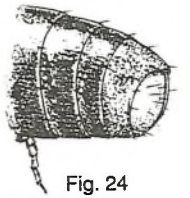


Fig. 24

b Without yellow stripes. 24

24. a Moderately stout to large (more than 8.5mm L & 0.8mm W). Tip of tail rounded, but not projecting. 3 hairs on anal valves. (Figs. 25 & 26) 25

Fig. 25

Fig. 26

b Very thin. Brown with dark spots along sides of body (less than 13mm L and 0.8mm W). Longitudinal grooves only on lower parts of segments. 26

25. a Large (20-30mm L). Eye patch kidney shaped. Brown-black. (Fig. 27) Cylindroiulus caeruleocinctus

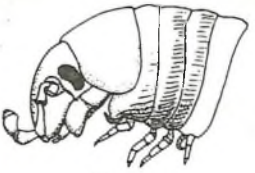


Fig. 27

b Smaller (8.5 - 16mm L). Cylindroiulus latestriatus/britannicus*

*These two species cannot be separated without close examination of the genitalia.

26. a Eyes arranged in an equilateral triangular group (Fig 28) Nemasoma varicorne

b Eyes arranged as a very acute triangle, of 8 to 10 ocelli in one row with 2 or 3 in a second row (Fig 29) Proteroiulus fuscus

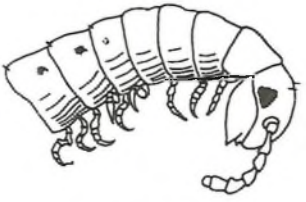


Fig. 28

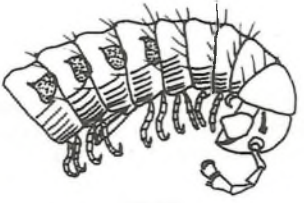


Fig. 29

(Modified from "Key to species of millipede found in Yorkshire" D T Richardson 1980)

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Archiboreoiulus pallidus			○	●	○	○	○		○	○	○	
Blaniulus guttulatus	○	○	●	●	●	○	○	○	○	●	●	○
Boreoiulus tenuis	⊖	●	●	○	●	●	○	○		○	○	○
Brachychaeteuma bagnalli												●
Brachychaeteuma bradeae		◌		●	●							●
Brachydesmus superus	●	○	●	●	●	○	○		●	●	●	●
Brachyiulus pusillus	○	○			●							●
Cylindroiulus britannicus	●		●	●	●	●	●		●	●	●	●
Cylindroiulus caeruleocinctus					○			○				
Cylindroiulus latestriatus			●			●					●	
Allajulus nitidus					●	●	.	.	.	.		
Cylindroiulus parisiorum					.	.	.	.	.	.		
Cylindroiulus punctatus	○	○	○	●	●	○	○	⊖	○	○	○	○
Cylindroiulus vuinerarius		◌			○	●					●	
Glomeris marginata	○	○	●	○	○	○	○	○	○	○	○	○
Julus scandinavius	●	○	●	●	●	●	●	●	●	●	●	●
Macrosternodesmus palicola	○	○	●	●	●	○					●	○
Melogona gallica					●	●						
Melogona scutellare	○	●	●	●	●	○	○				●	●
Nanogona polydesmoides	○	○	⊖	⊖	⊖	⊖	○	●	●	●	●	○
Nemasoma varicorne		○	●	○	○	●	●	○	○	○		
Ommatoiulus sabulosus	⊖		⊖	○	○	○	○	○	○		○	○
Ophiodesmus albonanus			○	●	●	○					○	
Ophyiulus pilosus	●	●	●	●	●	●	●	○		●	●	●
Oxidus gracilis			●									
Polydesmus angustus	●	●	●	●	●	●	●	○	●	●	●	●
Polydesmus denticulatus			○		●	○	○		○			
Polydesmus gallicus	●	○	●	●	●	●	●			●	●	●
Polydesmus inconstans	○			●	○	●	●	○			●	
Polyxenus lagurus	○				●	●						
Proteroiulus fuscus	○	●	○	●	●	○	●	○	○	○	⊖	⊖
Stygioglomeris crinita				○	○						○	○
Tachypodoiulus niger	⊖	○	●	●	●	●	○	○	○	○	⊖	●

KEY

○ Record (maturity unspecified)

⊖ Immature specimen

● Adult specimen

◌ Dead specimen

. No precise date

Annual Frequency Chart

Showing occurrence of millipede species by month. Based on all records received for the Sheffield area. Maturity of specimen is only indicated where this was specified in the original record. This does not represent definitive seasonality of species but does indicate those months in which identifiable specimens have been found.

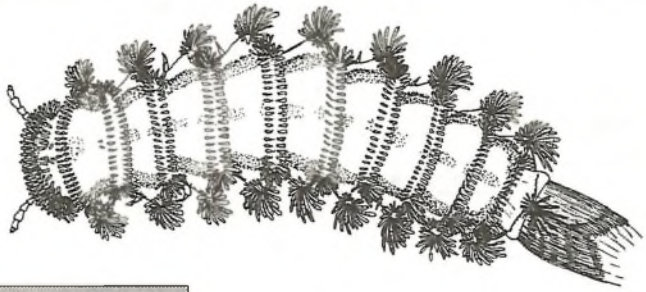
Polyxenus lagurus (Linné)

Map 1

The Bristly Millipede

The bristly millipede is unlike any other British species and quite unmistakable. It has no hardened exoskeleton but is instead furnished with rows and tufts of filamentous "bristles". Being a mere 2-3 mm in length and amber-brown in colour it could be taken for a small beetle larva but for the tufts at the rear end which almost seem to shine as they reflect the light. *P. lagurus* is most often found under the bark of dead trees but may be encountered in leaf litter, under stones, on old walls or under church rendering. It has even been found above 2800m in the Sahara desert!

The only local record is from under very dry dead hawthorn bark at Spinkhill, North Derbyshire (Richards 1991). There is only a single recent record for Yorkshire (Richardson 1990). The national distribution is distinctly south-eastern with various other widespread isolated records. *P. lagurus* has been sought for many years in the Sheffield area and is genuinely very rare. Further work to the east of the region in appropriate dead wood sites will probably prove rewarding. Standing dead Elms has been suggested as a possibly productive source.



Glomeris marginata (Villers)

Map 2

Pill Millipede

Through its habit of rolling up into a tight ball, the pill millipede is often mistaken for a woodlouse. In the Sheffield area, however, Woodlice which roll into a ball (*Armadillidium* spp.) are few and far between. Local "pill-bugs" are therefore much more likely to be millipedes. *G. marginata* has a shiny brown or black appearance with pale edges to each body segment. Straw coloured individuals are also frequently seen locally. The large first segment is obvious in a curled up individual as is the single large last segment. In Woodlice this hind-most area consists of 5 small segments rather than a single large one. Juvenile *G. marginata* have four pale patches on each segment which can give a passing resemblance to the woodlouse *Armadillidium pulchellum*.

G. marginata is widespread across the region. It is found primarily in leaf litter and under logs and stones. It may occasionally be found under loose bark. Its tendency to roll when curled up means that it rarely occurs above ground level unless actively walking. Outside of its preferred limestone grassland and woodland habitats *G. marginata* is largely confined to broadleaved woodland in rural settings. Despite this generalisation its presence or absence in some locations can be very surprising. Further records of this easily identified species would help to shed light on the fine details of its distribution.

Stygioglomeris crinita (Brolemann)

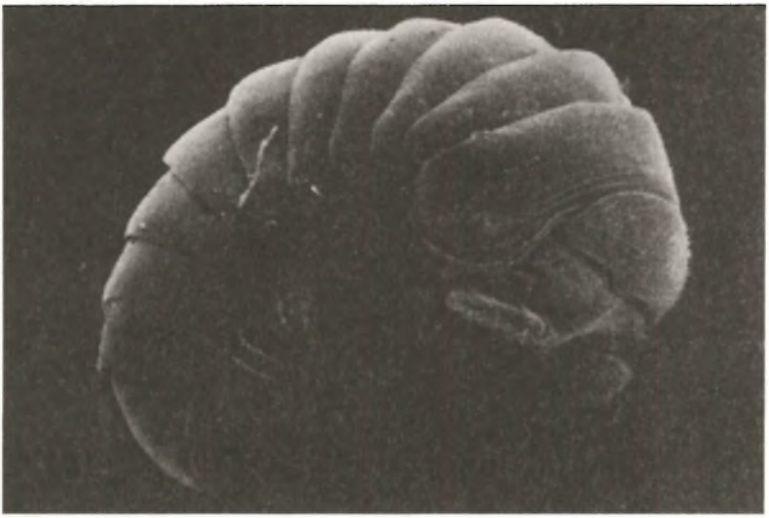
Map 1

(*Geoglomeris jurassica, Stygioglomeris crinata*)

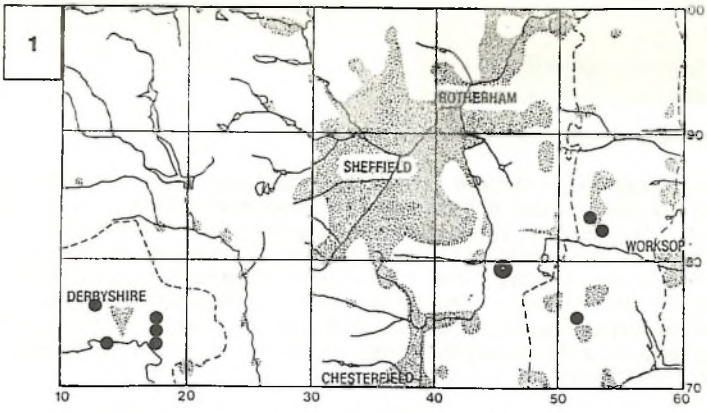
An exceedingly difficult millipede to find. The small number of records reflect a genuine scarcity but also the fact that this species is never found by the casual (or intense!) observer. Serious intent is required for locating this tiny, round, colourless beast and distinguishing it from a sand grain! Whether due to an example of convergent evolution or some coincidental mechanism, in its chosen habitat *S. crinita* shares a resemblance with a number of other "mimics". Small insect eggs, tiny *Punctum pygmaeum* snails, the aforementioned sand grains, chips of limestone and other nymphal millipedes. Its habit of curling into a ball and remaining motionless for some minutes means that it cannot even be detected by movement.

S. crinita is very strongly linked with calcareous soils. It is most easily found by turning moss covered limestone rocks or searching carefully through limestone scree in the Derbyshire dales. One record is from 4 cm deep in wet streamside mud. Even the most careful searching may lead to disappointing results. An alternative is to use a Tulgren funnel to encourage the specimens to leave their soil hiding place. These simply work by means of a light suspended over a funnel of "habitat" which encourages the animal to avoid the light and heat and fall into the collecting vessel beneath. Remember to use a dark background to be able to pick out the pale millipede. These millipedes tend to be found between the rock and soil or a little way into the soil. The humidity seems to be particularly important and in my experience *S. crinita* will be too far down in the soil for detection once the surface begins to dry. In very wet conditions *S. crinita* may be found in the moss itself. The hunting image required is that of a tiny (1-2 mm diameter) curled snail shell. The cuticle is white to colourless with the dark gut contents showing through as a dark stripe and patch. At least a x10 hand lens is required to distinguish from the far more abundant snails.

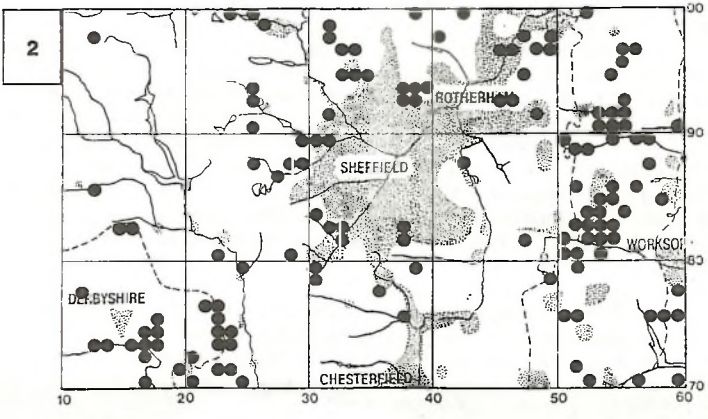
Juveniles of *Glomeris marginata* can be distinguished from *S. crinita* by the pattern of brownish patches running in 4 lines along their length. There are also 3 grooves at the curved edge of each segment which are unique to *Stygioglomeris*.



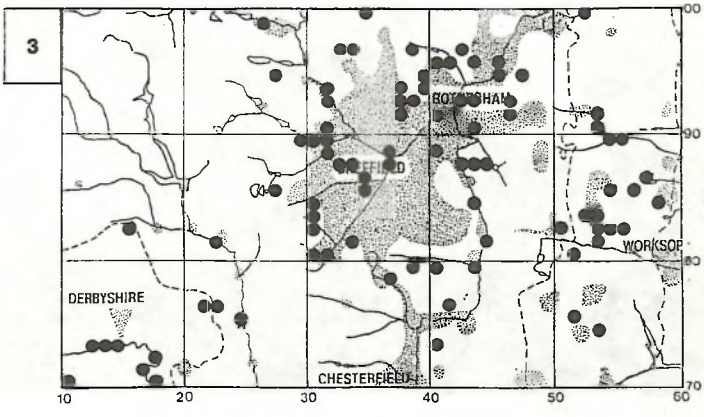
Stygioglomeris crinita clearly showing the etching at the edge of each tergite. The apparent 'eyes' are in fact the U-shaped openings of the Tömösváry olfactory organs. (Cressbrook Dale).



● Polyxenus lagurus ● Stygioglomeris crinita



Glomeris marginata



Nanogona polydesmoides

Craspedosoma rawlinsii

Although not known from the present mapping area this handsome millipede does occur in the Doncaster district and may await detection elsewhere. At 15 mm in length and attractively coloured red-brown and amber it is unlikely to be overlooked. It has a north-easterly distribution with Yorkshire records mainly coming from pitfall traps in acid moorland or bogs. Elsewhere found in damp woodland litter.

Nanogona polydesmoides (Leach)

Map 3

(*Polymicrodon polydesmoides, Atractosoma polydesmoides*)

A common millipede of mainly synanthropic (associated with man) habits. This burnt-orange slender species has a flat-backed appearance, 30 segments in the adult and distinct eyes in a triangular pattern. Across each segment are 6 hairs which are especially long and noticeable in the juvenile stages. Although often found in woodland *N. polydesmoides* is typically encountered in urban settings often under rubbish and planks of wood. Also one of the most frequently encountered species in caves. Autumn and late summer are the best times to find adults although they are active throughout the winter.

Brachychaeteuma bradeae (Brolemann & Brade-Birks)
Brachychaeteuma bagnalli Verhoeff

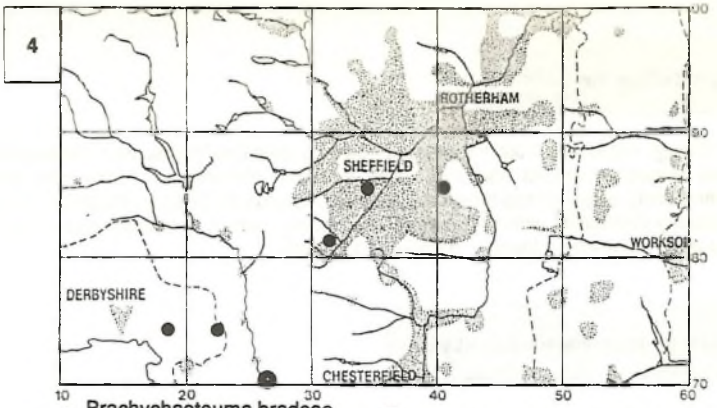
Map 4

The two species of Brachychaeteuma found locally present a great challenge to anyone wishing to study millipedes. They are rare, difficult to find and pose a number of identification problems. They can be included in the "small white jobs" category and require very close examination to separate them from other species. Up to 9 mm in length, pale cream in colour with indistinct lobes along the side of the body give a superficial resemblance to *O. albonanus, M. palicola and M. scutellare* with which they are frequently associated. The first body segment (Collum) locates into the back of the head rather than forming a shield overlapping the rear part of the head as occurs in many millipedes.

Blower (1985) suggests that neither species possess more than three eyes, situated behind each antenna. However, the majority of *B. bradeae* examined locally have four pale amber eyes on each side.

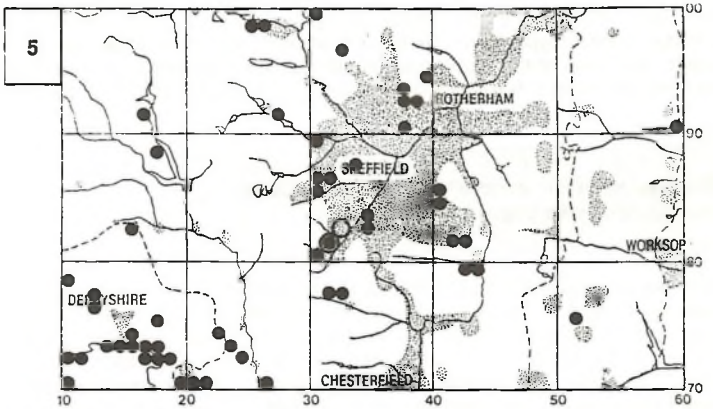
The only way of separating these two species is by subtle differences in the male genitalia. Females and immature stages cannot therefore be determined to species. For mapping purposes any uncertain records have been allocated to the more frequent species, *B. bradeae.* Due to their close similarity further taxonomic study may yet reduce *B. bradeae* and *B. bagnalli* to a single very variable species (Blower 1986).

Brachychaeteumids are very much soil dwellers but can be found under well embedded stones or wood and at the lower levels of leaf litter. On the continent many records are from caves. Although able to roll up completely, they tend to almost bend and tuck the head end under in the manner of a question mark or musical F-clef. The other small species with which they are associated tend to curl up more tightly.



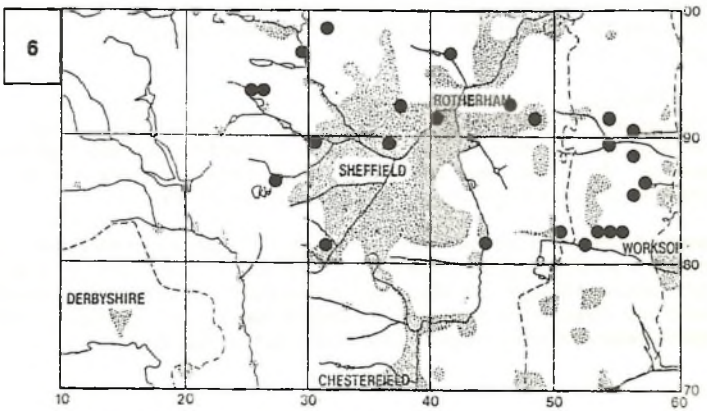
● Brachychaeteuma bradeae + unidentified Brachychaeteuma spp.

● Brachychaeteuma bagnalli



● Melogona scutellare

○ Melogona gallica



Nemasoma varicorne

Local records are all from synanthropic sites, except for two under stones in Coombs dale. Many mature gardens to the south and west of Sheffield could well harbour these species and would best be searched between December and May. The single specimen of *B. bagnalli* was found under a log pile at Chatsworth house.

Melogona scutellare (Ribaut)

Map 5

M. scutellare has a very interesting history in the Sheffield region. Prior to 1989 there was a single known record for this species from Cressbrook Dale. Between 1989 and 1991 a further 14 specimens were found almost exclusively in Derbyshire. Since 1993 an additional 46 records have been added, predominantly in Sheffield! It is unlikely that this represents any sudden extension of range but has more to do with a change in collecting techniques. The pre-1993 records are exclusively from under stones and leaf litter, the recent records are from among carpets of damp moss. What was previously considered to be a Derbyshire Limestone speciality is now known from both natural and synanthropic sites right across the region. By peeling back damp moss from stones, logs, woodland and dalesides *Melogona* can be found virtually at will throughout the wetter times of the year. It is usually seen gliding through the mossy tangle or may curl up momentarily when disturbed before rushing off at high speed over the nearest lump of soil.

Very similar in appearance to the previous *Brachychaeteuma* species, *M. scutellare* is up to 8 mm in length and ivory in colour but has a distinct triangle of eyes and no humps or processes sticking out from the body. The long clubbed antennae are quite noticeable. As with the previous species the first body segment (collum) does not overlap the head. There are only 28 segments in the adult unlike its close relative, the darker coloured *M. gallica* which has 30 segments and more numerous eyes.

Melogona gallica (Latzel)

Map 5

The first confirmed record for this species locally is from Ecclesall Woods, Sheffield in June 1995. It was found in moist leaf litter of more than two inches deep. Shallower, drier litter was less productive. Very similar in appearance to *M. scutellare* but larger due to the possession of 30 rather than 28 body segments. *M. gallica* is also noticeably darker in colour with an overall mottling of amber. The eyes are more numerous, occurring as seven rows of 3 or 4 ocelli, the pattern appearing less acutely triangular than *M. scutellare*. In both species the hairs on the body segments increase in length towards the tail, but in *M. gallica* these are considerably thickened and distinctive.

Within the wood this species was found in both Yorkshire and Derbyshire vice-counties but is yet to be recorded from anywhere else in these counties. It has a definite westerly distribution, with the nearest location being Delamere forest in Cheshire. There is a suggestion that it may be extending its range northwards (Richardson 1990) and large specimens of *Melogona* should be checked carefully for the 30 rings of *M. gallica*. Studies of this species in Belgium, suggest that *M. gallica* shows a preference for clay soils at low altitude. In Belgium it is found commonly in moist leaf litter in both calcareous and non-calcareous situations, but has preference for the latter in Britain. There seems to be no reason why this species should not be found elsewhere locally as the location of the Ecclesall Woods specimens suggest resident status rather than a synanthropic introduction.

Nemasoma varicorne C L Koch

Map 6

(*Isobates varicornis*)

Nemasoma varicorne and the following four species are all small thin and threadlike in form with a smoothly round cross-section. The collum overlaps the back of the head and the finely engraved chasings across each body segment are confined to the lower half only. *N. varicorne* and *P. fuscus* have eyes while the three 'Blaniulids' are blind.

The patch of eyes in *N. varicorne* form an equilateral triangular pattern as distinct from the acute triangle found in adult *P. fuscus* or the single line found in *Choneiulus palmatus* (a species as yet unknown from this region). In addition to the different eye pattern *N. varicorne* is thinner (the name literally means "thread-like body") than *P. fuscus*, is paler in colour and has orangey spots along its sides rather than red. They are both found almost exclusively under the bark of both coniferous and deciduous trees. Local records would indicate a tendency for *N. varicorne* to occur more frequently under willow bark or adjacent to water. (Agden bog, Langold Lake, Greasbrough Dam, Shortbrook marsh, Denaby Ings etc.)

Records are also confined to the North-east of the region in areas showing a long continuity of habitat such as Anston Stones Wood, Lindrick Dale and Firbeck. Further records are needed of this infrequent species to add more detail to our understanding of its habitat preferences.

Proteroiulus fuscus (Am Stein)

Map 7

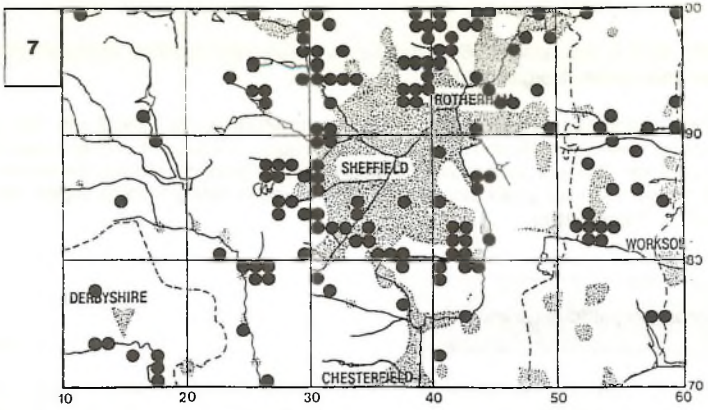
A common and widespread species found under bark and in rotting logs and stumps. May be seen virtually anywhere in the region where there are mature trees. The only exception being the upland coniferous plantations where there has been little history of woodland continuity.

P. fuscus is a dark brown, thin species with dark red/brown spots (ozadenes) along the sides. The adult eye pattern comprises a single row of about 7 ocelli with a second row of two or three above. This acute triangular pattern contrasts with the equilateral triangle of *N. varicorne*. In addition to *N. varicorne*, *P. fuscus* also bears a superficial resemblance to *Choneiulus palmatus* and *Cylindroiulus parisiorum*, neither of which are yet known from the immediate Sheffield area. *C. palmatus* differs in having more than 10 very long setae fringing each segment with only a single line of ocelli for eyes and *C. parisiorum* by its paler colouring and the fine chasings on each segment extending over the whole arc of each segment.

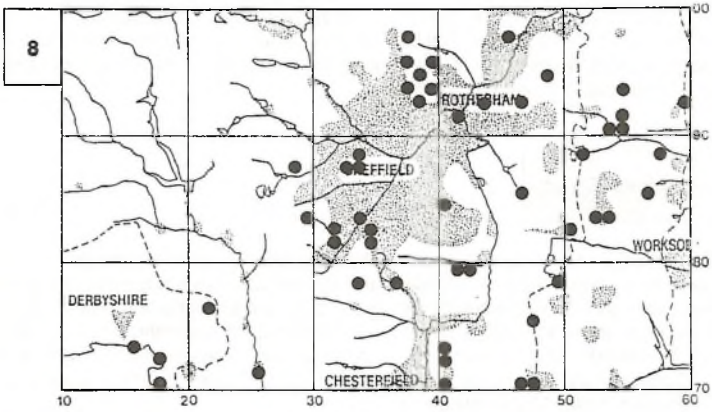
Blaniulus guttulatus (Fabricius)

Map 8

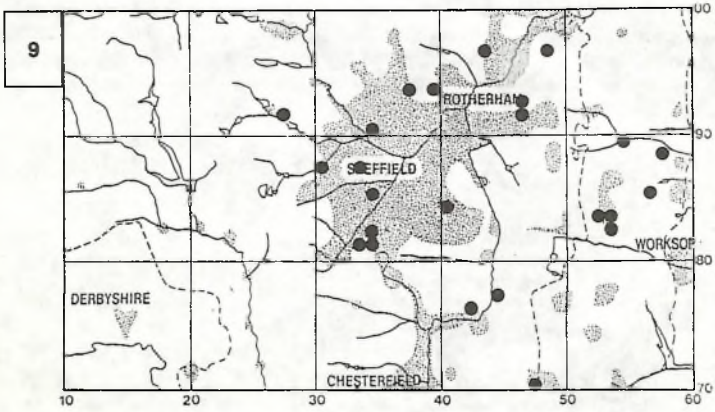
A blind, pale millipede with bright red spots along its sides. Very thin and only around 13 mm in length *B. guttulatus* often curls into a flat spiral clearly showing the rings of red spots. This is a species of grassland, cultivated fields and gardens and may constitute one of the few pest species when found in large numbers as it will attack seedlings and potato tubers



Proteroiulus fuscus



Blaniulus guttulatus



Archiboreoiulus pallidus

when other food is unavailable. *B. guttulatus* has even been reported eating other dying millipedes and carrion (Morgan 1988).

Its Sheffield distribution follows a SW - NE pattern which would fit well with its known preference for base rich soils and aversion to sandy soils. It has not been recorded above 250 m locally and shows a distinct bias towards suburban gardens and woodlands where it is usually found in the soil under stones. It is often found in rotting windfall apples and one record is from Badger dung.

Archiboreoiulus pallidus (Brade-Birks)

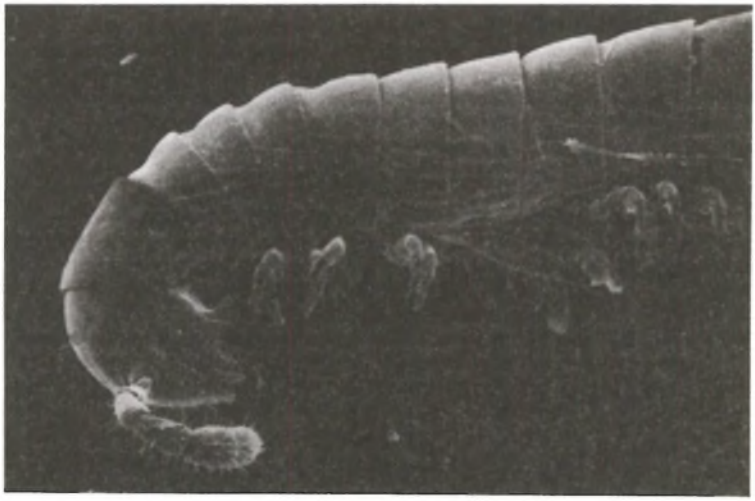
Map 9

Very similar to, and often associated with the following species, *B. tenuis*. Both can be separated from *B. guttulatus* by the paler yellow-orange spots along the sides. *A. pallidus* is distinguished by the much longer hairs around each body segment. This species is much scarcer than the other two blind blaniulids but the reasons for this are a mystery. Blower (1985) suggests that *A. pallidus* shows a preference for calcareous soils nationally, yet there are no records at all from the carboniferous limestone in Derbyshire. It has been found locally in ditches, leaf litter, rotting oak and under stones and wood. In habitats ranging form ancient woodland and plantations to heathland, farmland and synanthropic urban sites. Your guess is as good as mine!

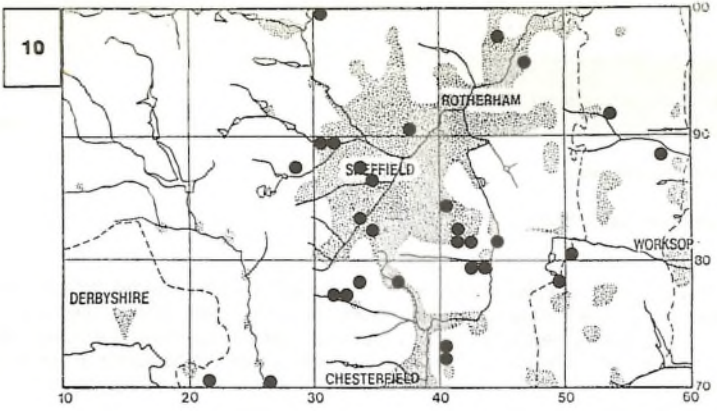
Boreoiulus tenuis (Bigler)

Map 10

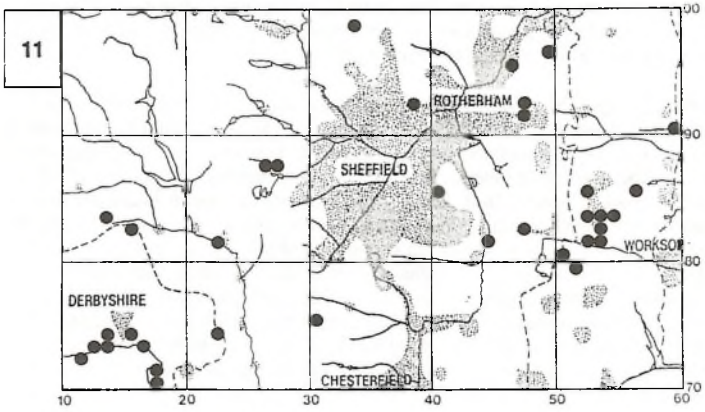
This is the smallest of the spotted snake millipedes, distinguished by the combination of orange spots and short, barely discernible hairs around each body segment. Very much a soil dwelling animals it is most often found under rocks and logs and occasionally leaf litter. All local records are either from deciduous woodland or synanthropic sites such as gardens, churchyards and rubbish tips. Often abundant where present, *B. tenuis* is widespread at lower altitudes in the above habitats. This species is almost always present where *O. albonanus* and *M. palicola* are recorded.



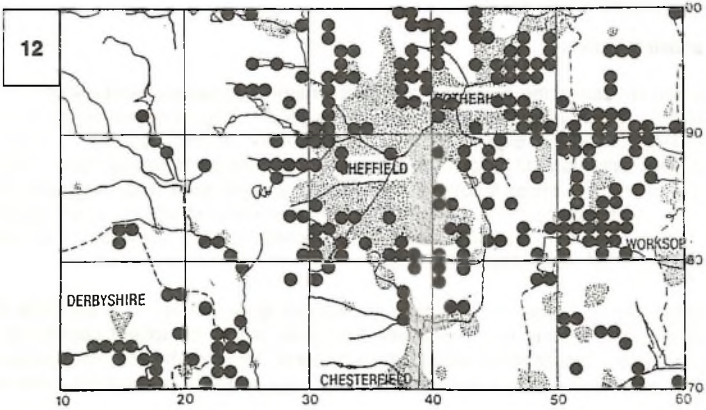
The distinctively shaped male gonopods and the very short hairs on the body separate this *Boreoiulus tenuis* from the similar *Archiboreoiulus pallidus*. (General Cemetery, Sheffield.)



Boreoiulus tenuis



Ommatoiulus sabulosus



Tachypodoiulus niger

Ommatoiulus sabulosus (Linné)

Map 11

Striped snake millipede

(*Schizophyllum sabulosum)*

The following eleven species display what may be considered to be the 'typical' millipede form, that is, relatively large cylindrical, snake-like forms, often found coiled into a tight spiral. The first body segment overlaps the head and the longitudinal grooves on each segment are not restricted to the lower half but extend over the complete arc of the body. The simplest identification feature is the extent and shape of the projection or tail on the last body segment.

O. sabulosus is a large dark brown animal (up to 30 mm in length) with a pair of striking orange stripes running the length of its body. The tip of the short tail is turned upwards and the only hairs on the body surface are confined to the end of this tail. This species could only be mistaken for *B. pusillus* which has stripes but virtually no tail or a young *T. niger* which has hairs at the rear edge of each segment.

Along with *T. niger* this is a very active species which will wander into a wide range of habitats, often climbing walls and trees. It is accordingly widespread in the region but rarely common. The highest concentration of records comes from deciduous woodland on limestone. There are also several records from very wet habitats such as Willow carr and *Juncus* tussocks in upland bog. Equally this species has been found in very dry soil in exposed Birch/Bracken scrub on the edge of acid moorland. Normally *O. sabulosus* shows a preference for sandy soils (including dunes), coniferous woodland and heathland, being replaced by *T. niger* in limestone areas (Blower 1985). It would seem that in the absence of its preferred habitat locally, *O. sabulosus* has colonised the richest ancient habitats available to it regardless of any possible competition from other species. It would be interesting to conduct further work in the sandy areas of North Nottinghamshire to observe in more detail the distribution of this species in a more typical locality.

Tachypodoiulus niger (Leach)

Map 12

Black snake millipede

The current specific name *niger* and continental name *T. albipes* describe well the fact that this species is black with white legs. Indeed the generic name literally means "swift-footed snake millipede" which expresses the mobile nature of this species. It shares the characteristic upturned tail tip of *O. sabulosus* but in contrast to this species, *'Tachy' niger* has hairs along the whole length of the tail and around each body segment. This is a particularly useful character in juvenile *T. niger* specimens which can often appear to be faintly striped. Adult *T. niger* are, however, unmistakable as a large (up to 35 mm) shiny black millipede with contrasting white legs.

In common with *O. sabulosus*, *T. niger* will wander quite widely. It is the most common species locally and may be found over the whole region in upland coniferous forests, limestone dales, broadleaved woodland, grassland, wetland, heaths, in houses and up trees. *T. niger* has in fact been reported at 'sugar solution' painted on trees to attract

moths (J D H Brown pers. comm.). The author has frequently found both *T. niger* and *O. sabulosus* resting during the day high up under the leaves of a variety of plants, especially thistles. *T. niger* is the most frequently encountered millipede in the home and such an invasion may occasionally constitute a pest (Read & Wheater 1989).

It can be found under stones, logs, bark leaf litter and rubbish, in soil, rotting wood and grass, but is rarely very abundant. The vast majority of records are from spring with more towards the end of the summer. *T. niger* has only been recorded in December once.

Allajulus nitidus (Verhoeff)

Map 13

(*Cylindroiulus nitidus*)

A. nitidus can be distinguished from the previous species by the slightly longer down-turned tail and much paler colouration. The ground colour may vary from very light brown to greenish-brown or lilac. A dark band between the eyes often gives a mask-like appearance.

This is a generally rare animal, discovered for the first time locally in Abbeydale Wildlife Garden in 1994. It was found under a rotting black poplar log in May. This species is particularly subterranean in habit which may account for the paucity of records. Hopkin and Read (1992) show the vertical distribution of this species in the soil and litter layer throughout the year and suggest autumn and spring as being the best times for locating it at the surface. Richardson (1990) points to its presence 30 to 100 cms beneath the surface under deeply embedded boulders. The only adjacent records are from carboniferous limestone in West Yorkshire and south-west Derbyshire. Soil sampling in the Derbyshire dales may prove fruitful in the quest for this scarce species.

Cylindroiulus caeruleocinctus (Wood)

This robust species has yet to be recorded in the mapping area but occurs nearby in Wentbridge (SK 4917) and Mansfield (SK 5660). It is predominantly a south-easterly species but may occur somewhere between these two localities to the east of Sheffield along the Magnesian limestone belt. Other workers suggest churchyards, calcareous grassland (Gregory 1995), cultivated calcareous soils, potato fields and log piles (Blower 1985) as suitable habitats. A specimen was recently taken from a plant-pot in Stannington (SK 3088) but since it had just arrived from the West Midlands and had not touched Sheffield soil it is not considered an authentic record!

Once seen this is a quite distinctive species but could initially be mistaken for *Ophyiulus/Julus* or *T. niger*. It is large (up to 29 mm in length) and generally stout in appearance, the width remaining constant from front to rear. The eyes are grouped in an almost kidney-shaped pattern and the rear half of each body segment shows a brassy metallic lustre. The most distinctive character, however, is the absence of any projecting tail.

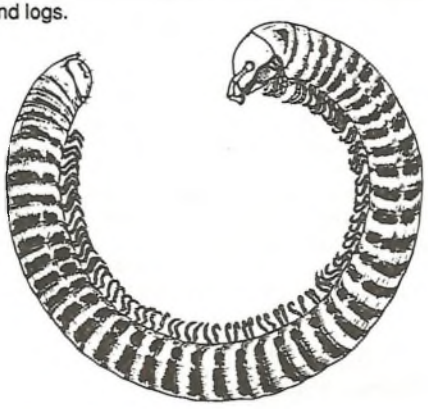
Cylindroiulus vulnerarius (Berlese)

Map 13

This very rare millipede was recently discovered new to Yorkshire in the University botanical gardens in Broomhill, Sheffield (Richards 1991a). It occurs in the soil under well embedded edging stones and under a decaying log. It is never abundant but continues to thrive to the present day.

Individuals show a pale-coffee ground colour with orange-red spots along the sides. The head and tail often appear to be much paler than the rest of the animal. Older specimens take on an olive tinge. It is distinguished from all other species by the short pointed tail and the complete absence of eyes.

Recent recording has shown *C. vulnerarius* to be much more widespread across the country in largely synanthropic sites such as compost heaps, garden centres and botanical gardens. In captivity this species has been found to be quite active during the day on the surface of leaf litter and logs.



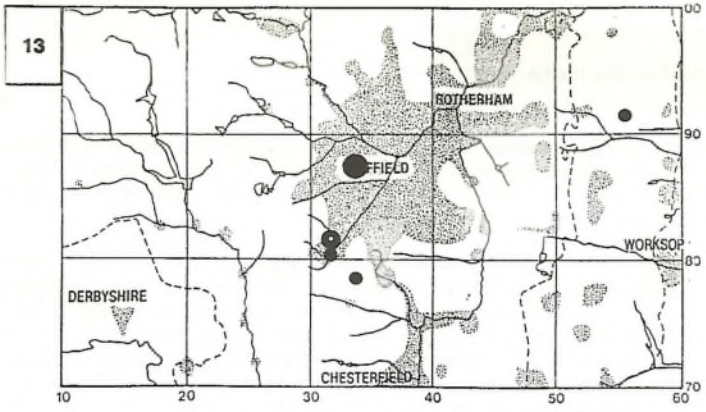
Cylindroiulus punctatus (Leach)

Map 14

Club-tailed snake millipede

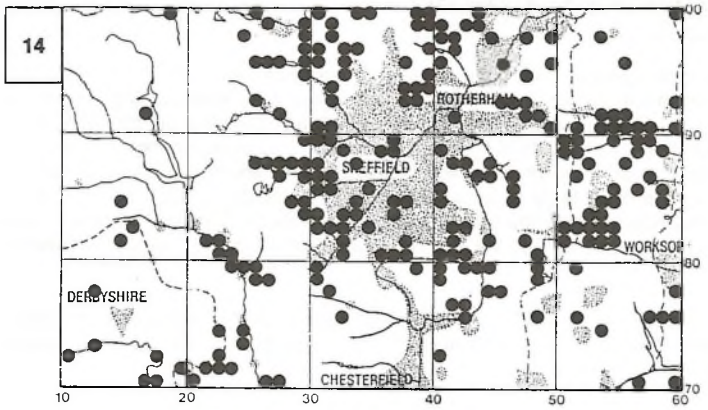
This is the commonest British millipede and the second most frequently recorded in the Sheffield area. It is recorded across the whole of the region including the acid uplands to the west. Its presence is almost always linked to wood. It is primarily found under bark and in rotting logs but occurs frequently in leaf litter and under planks and other human refuse. During the drier summer months *C. punctatus* is found at the deeper, more moist soil levels.

C. punctatus may be any shade of brown with darker brown spots along the sides. The most distinctive feature is the club-shaped tail which separates it from all other British species. In younger stages the tail may be quite reduced, but this species can be separated with practice from the similar *C. britannicus/latestriatus* by the more numerous and distinct longitudinal grooves around the surface of each body segment.

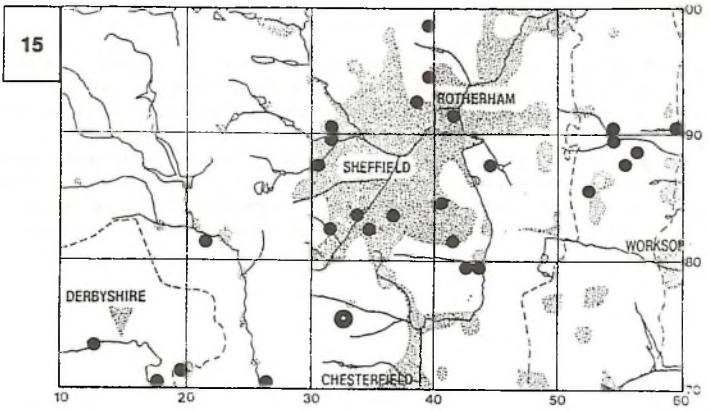


● Allajulus nitidus ● Brachyiulus pusillus

● Cylindroiulus vulnerarius



Cylindroiulus punctatus



● Cylindroiulus britannicus ● Cylindroiulus latestriatus

Cylindroiulus latestriatus (Curtis)

Map 15

This and the following species, *C. britannicus* are very similar in appearance and need to be confirmed by detailed examination of the genitalia. They both resemble a small (15 mm) slender *C. punctatus* but lack any form of projecting tail. The grooves across each segment are also finer and more widely spaced.

C. latestriatus is rare in the Sheffield area, normally being confined to coastal habitats where it usually occurs in plant roots in sandy soil. The single mapped occurrence is for a specimen from the Cordwell Valley unusually found in bracket fungus. Two further Derbyshire records are from a disused limestone quarry and a limestone dale. Both found in grassland micro-habitats. This fits with the distinction that *C. latestriatus* is virtually never found in dead wood or leaf litter whereas *C. britannicus* is always associated with these niches. *C. latestriatus* can be further distinguished by its darker, less conspicuous spots (ozadenes).

Cylindroiulus britannicus (Verhoeff)

Map 15

Almost indistinguishable from the previous *C. latestriatus* this species requires microscopic examination for certain identification. *C. britannicus* is however solely confined to the vicinity of dead wood or leaf litter. It is frequently encountered under bark with *C. punctatus* from which it is distinguished by its complete lack of a projecting tail. *C. britannicus* also tends to be a richer brown colour with conspicuous red spots (ozadenes) along its side. *C. britannicus* is more likely to be confused with the slightly smaller (12 mm) and paler *C. parisiorum* which shares the same habitat and red spots. This latter species however has at least five pairs of hairs on the anal valves as opposed to three pairs in *C. britannicus* and *C. latestriatus*.

C. britannicus occurs in deciduous woodland right across the region but is probably under-recorded. Although less ubiquitous than *C. punctatus* it will no doubt prove to be widespread and common.

Cylindroiulus parisiorum (Brolemann & Verhoeff)

Although not yet found within the mapping area, this species has been recorded locally near Hartington (SK 1561) from pitfall traps. It could easily be overlooked as it is intermediate in appearance between *N. varicorne* and *C. britannicus*. It can be recognised by the combination of no projecting tail, more than five pairs of hairs on the anal valves, longitudinal grooves which extend over the upper part of the body segments and rich red spots over a pale coffee ground colour. Elsewhere this species has been recorded from deep within well rotted wood, under stones in magnesian limestone woodland litter (Richardson 1990) and under the bark of large 'parkland' beech and oak trees (Gregory 1995).

Julus scandinavius Latzel

Map 16

(*Iulus scandinavius, Julus terrestris*)

A large dark brown millipede which could easily be mistaken for *O. pilosus* or *T. niger*. The latter species can be ruled out by the presence of a long tail with a slightly downcurved tip in *J. scandinavius* and the absence of the contrasting white legs found in *T. niger*. *O. pilosus* shares the down-curved tail and is in many respects indistinguishable but for subtle differences in size, colour and male characters. *J. scandinavius* has generally fewer segments and a wider body than comparable *O. pilosus* specimens which are also somewhat hairier. It is similar in colour but does not possess the paler mottling just above the legs which is seen in *O. pilosus*. Adult males can be separated by the form of the first two pairs of legs. In male *J. scandinavius* the first pair are so reduced in size as to be virtually absent while the second pair possess large blade-like downward projections. This gives the appearance of only six pairs of legs before the gap. The projection is actually gripped in the jaws of the female during copulation and may therefore be partly missing in males which have mated (Blower 1985). In *O. pilosus* there is no projection on the second pair of legs and the first pair are much less reduced but instead developed into a hook shape. Females can be identified by their relative size in proportion to their age or by detailed examination of the genitalia. Live females can be distinguished by viewing them from above as they walk. In *O. pilosus* the legs can barely be seen, but in *J. scandinavius* they clearly stick out at the sides as it walks along.

Widespread across the whole region, this species is noticeably more abundant to the west of Sheffield where it extends into the more acid upland moors, heathland and conifer woods. This can be seen more clearly beyond the mapping area published here. Its preference is for deciduous dead wood and leaf litter in the less base rich areas, although it does occur in small numbers on Limestone, usually associated with the more prolific *O. pilosus*. It can often be found under damp moss and is frequently recorded from pitfall traps.

Since eggs are laid in the spring and produce adults in three years which die after breeding, there are very few adults to be found by late summer. Spring and early summer is therefore the optimum time to find readily identifiable specimens.

Ophyiulus pilosus (Newport)

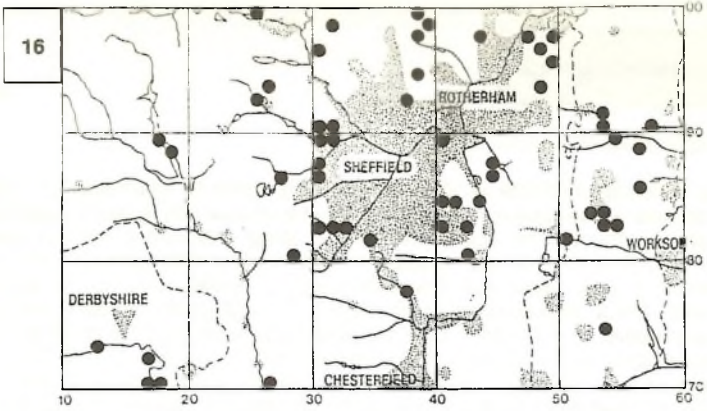
Map 17

(*Ophyiulus fallax*)

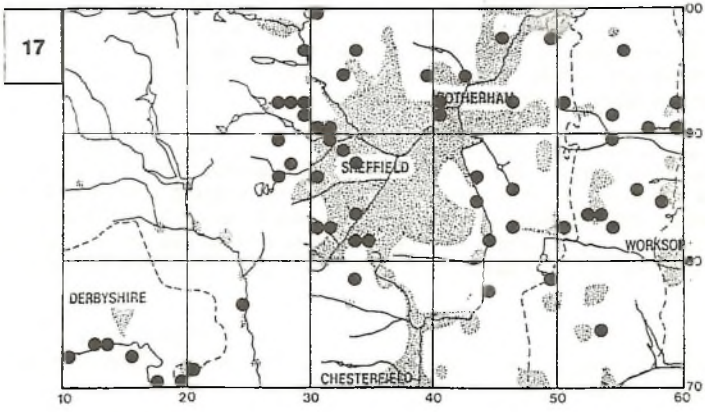
This species is easily confused with *J. scandinavius* because of their identical tails with down-curved tips. Details for separating the two are given in the previous description.

O. pilosus is the more common of the two species and in addition to deciduous woodland can be found in farmland and synanthropic sites such as tips and garden compost heaps. It is found under stones more often than *J. scandinavius* and is much more abundant than this species in the calcareous regions. *O. pilosus* occurs sporadically in acid heathland and coniferous plantations but is very much replaced by *J. scandinavius* in these locations.

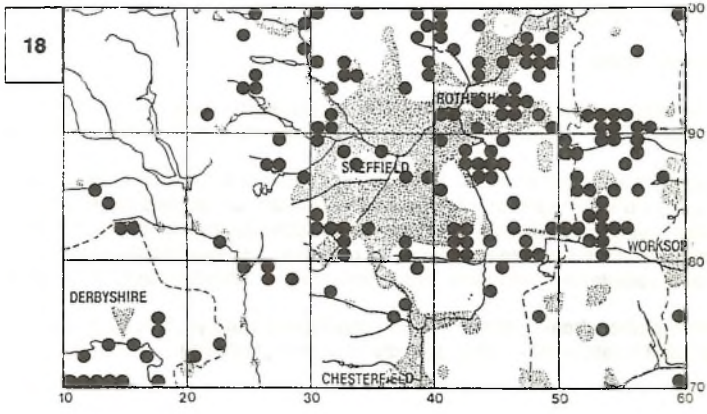
O. pilosus differs from *J. scandinavius* in only having a two year life cycle but is also scarce as an adult in late summer when they die after spring breeding.



Julus scandinavius



Ophyiulus pilosus



Polydesmus angustus

Brachyiulus pusillus (Leach)

Map 13

This is a very distinctive species with two pale cream stripes down the length of the body. It is a very small (9 mm) version of *O. sabulosus* but has only a very slightly protruding tail. It is unlikely to have been overlooked or misidentified and must therefore be considered as a genuine rarity in the Sheffield area. The three mapped records are from pitfall traps at Maltby Far Common and under stones in gardens at Dronfield Woodhouse and Dore, Sheffield. A further local record is known from Will Pits (SK 7416). It has an eastern and coastal distribution nationally (BMG 1988) and an easterly sandstone bias in the rest of Yorkshire (Richardson 1990). Further work in grassland to the east of Sheffield will hopefully add further records of this very attractive animal.

The remaining eight species of millipede can roughly be described as 'flat-backed'. The sides of each segment are produced across the top into keels called 'paranota'. They vary greatly in size but all are blind.

Polydesmus angustus (Latzel)

Map 18

This is the most common flat-back in the region and the third most recorded species of millipede in Britain. It is a large (20 mm) robust species frequently found under logs and in leaf litter. As with all four of the local *Polydesmus* species identification depends on examination of the genitalia. This is relatively straightforward as each species is quite distinctive and with practice the males at least can be determined in the field.

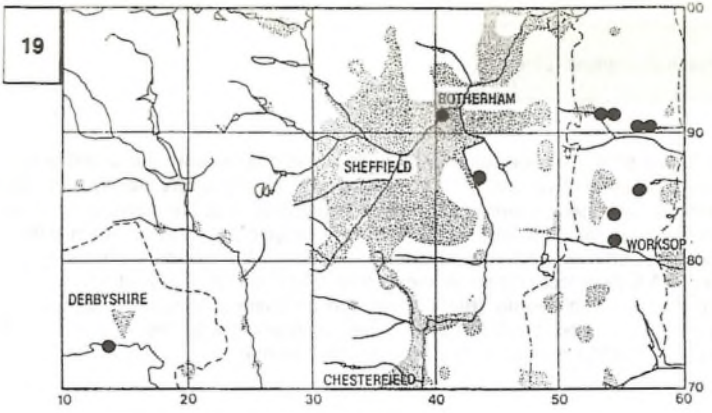
It can primarily be found in woodland but records confirm its presence in heathiand, grassland, urban waste ground, upland bog, farms and gardens across a wide range of geology. Its powerful legs enable it to push through litter layers and run swiftly (22 mm per second according to Manton, 1954) and it would seem to be considerably surface active. This may explain its frequent presence in pitfall traps. When initially located however *Polydesmus* species tend to sit still for some time before trundling off and their general dull brown appearance makes them rather inconspicuous.

Polydesmus inconstans (Latzel)

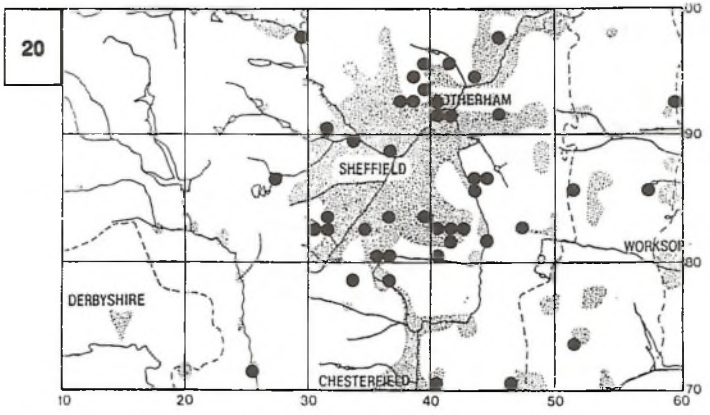
Map 19

(*Polydesmus coriaceus*, Blower 1958)

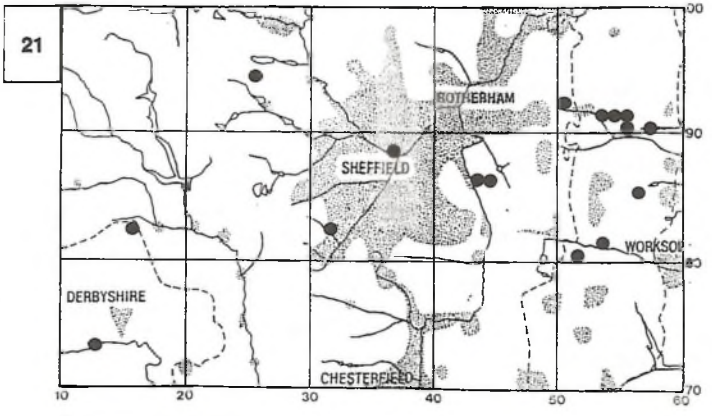
This species is distinctly smaller (15mm) than the previous one and has very well defined sculpture across the back of the paranota. Generally uncommon in the Sheffield area, the majority of records are from the eastern Magnesian Limestone belt. Most records arise from grassland sampling under stones, turf or in pitfall traps. Since this method of collecting has rarely been employed locally *P. inconstans* may yet prove to be far more widespread across the region. Records would indicate that the summer months are the most productive.



Polydesmus inconstans



Polydesmus gallicus



Polydesmus denticulatus

Polydesmus gallicus (Latzel)

Map 20

(*Polydesmus coriaceus*, Porat 1870)

This large flat-back could be mistaken for *P. angustus* but examination of adults (with 20 body segments) will show that the genitalia are quite distinct in the two species. This species is uncommon north of Sheffield but occurs quite commonly in urban sites within the region. It is almost exclusively restricted to synanthropic habitats, never straying far from buildings, refuse or some other man made feature. Further study within built up areas will certainly prove this species to be ubiquitous within the Sheffield conurbation.

Polydesmus denticulatus (C L Koch)

Map 21

Another small species but wider and slightly paler-red than *P. inconstans*. The distinctive wing-like process on the male genitalia (gonopods) may sometimes be broken off and make separation of these two species difficult.

No clear pattern emerges from local records of this species. It occurs widely but only in small numbers and has only been recorded three times in the last ten years. Most records are from the Magnesian Limestone, probably in grassland although the details of these finds are unknown. Carboniferous Limestone quarries account for three further records, while urban wasteground and acid upland ditches provide further examples. Pitfall trapping has produced several records and may be a more effective way of finding this species than simple hand searching.

Brachydesmus superus (Latzel)

Map 22

Similar in appearance to a *Polydesmus* but much smaller (10mm) and paler in colour. The sculpture on the back of the paranota is quite distinct with obvious short hairs. Adults only possess nineteen segments in contrast with twenty in *Polydesmus* species. Therefore care must be taken to separate immature *polydesmus* spp. from adult *B. superus*. The gonopods of adult males lie forwards close to the underside of the body and are less obvious than in *Polydesmus* species. Adult females are less easy to recognise but possess a ridge which runs laterally behind the second pair of legs.

This species is widespread across the region with a concentration of records in the Magnesian Limestone. This matches the national distribution where it is found widely in arable farmland, gardens and woodland but is particularly abundant in limestone districts. Local records also reflect these habitats but present a strong synanthropic bias in the non-calcareous sites.

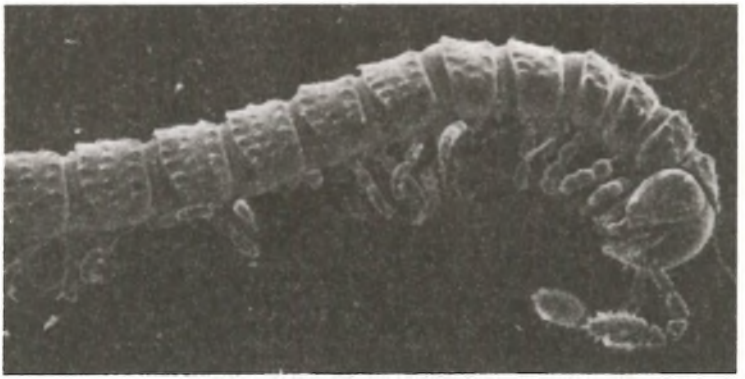
Macrosternodesmus palicola (Brolemann)

Map 23

The tiniest of millipedes and easily overlooked. No more than 4mm long and 0.4mm wide, with virtually no pigment, this soil dwelling species looks more like a plant rootlet than an animal. On close examination the flat-back is seen to be covered with small bumps from which very short hairs arise. From above, the edges of the paranota appear as three stepped teeth. The lack of pigment gives a pale white appearance with the dark gut contents showing through.

This is probably the most under-recorded species in the country. Every local record is associated with man. The majority are from gardens, cemeteries and urban refuse. Woodland records have all occurred at roadsides, adjacent to buildings or in small tips. It is always found at or beneath the soil surface which is usually damp and friable but not wet. Despite national trends, there is no local evidence to suggest that *M. palicola* has a preference for calcareous soils unless the synanthropic sites are all base rich at a micro habitat level. Further work in the limestone areas may prove otherwise.

The secret to finding such small subterranean millipedes is to not simply turn a stone, but to turn the stones under stones. Small clumps of soil should also be taken and crumbled still further. A one inch ball of soil may contain four or five small millipedes within it. Once located, *M. palicola* can be found to be very abundant and further searching will often reveal associated species such as *O. albonanus* and *B. tenuis* in addition to some of the small woodlice such as *H. mengei*, *H. danicus* and *T. pygmaeus*. Most frequently encountered between November and May.



The surface of each tergite in *Macrosternodesmus palicola* is roughly textured. (Male, Holbrook).

Ophiodesmus albonanus (Latzel)

Map 24

Easily mistaken for the previous species, *M. palicola* but slightly larger and of a more creamy, ivory colour. The paranota are more obvious, completely smooth and shiny and each possess three rows of quite noticeable hairs. Adults of *O. albonanus* have twenty body segments whereas *M. palicola* has only nineteen. This species also bears some resemblance to the *Brachychaeteumids* with which it may be associated but the obvious paranota are distinct from the small side humps of these latter species.

O. albonanus is very frequently associated with *M. palicola* and similarly is only recorded locally from synanthropic sites. The majority of records are from under rubble (house bricks as well as limestone) in tips or at the base of walls. It has also been frequently located down to eight inches deep in garden and allotment soils. The first local specimen was found in damp Horse Chestnut leaf litter in 1989. Most often encountered during April and May.

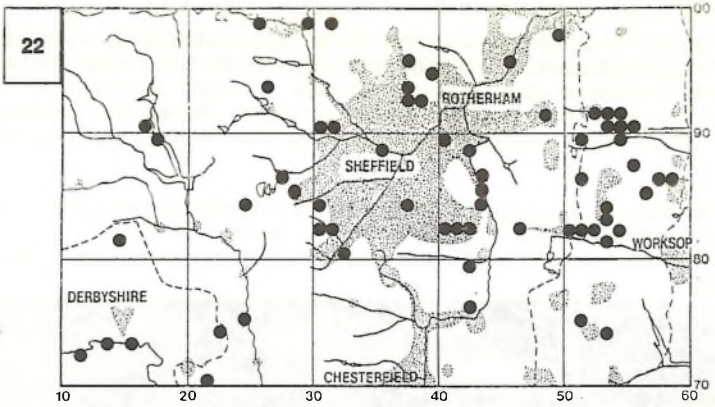
Due to its small size this species is undoubtedly under-recorded in the Sheffield area, but does appear to be genuinely scarce compared to *M. palicola*. Its habit of curling up into a tight spiral when disturbed doesn't help matters and takes some experience to recognise as a millipede.

The surface of each tergite is smooth and shiny in *Ophiodesmus albonanus* (Male, Broomhill).

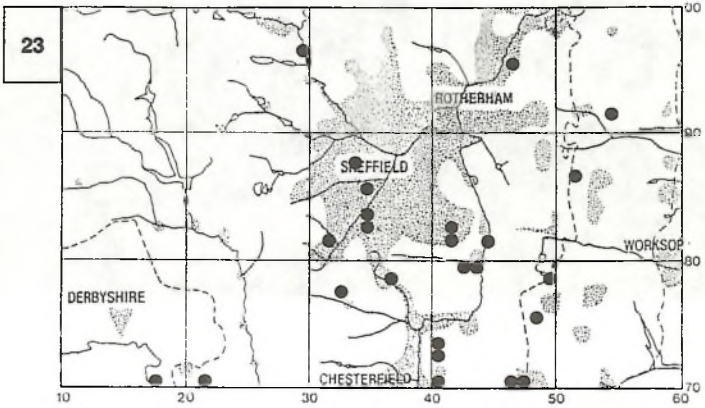
Oxidus gracilis (C L Koch)

This can hardly be regarded as a native species as it only occurs in Britain in heated greenhouses and compost heaps where appropriate temperatures are maintained for it to overwinter. The single local record is from Weston Park greenhouse in 1972 where a thriving population was found to exist. Unfortunately due to repeated fumigation and the current disrepair of the glasshouse this species can no longer be found at this site. It is widespread in Britain and is likely to crop up in other heated venues in the region, but as yet these have not been well studied.

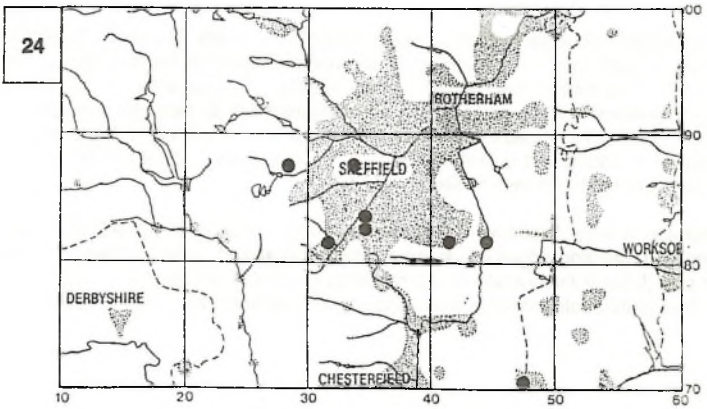
If found it is a very distinctive flat-backed species. The paranota are shiny brown with prominently projecting edges which are a contrasting amber colour. Unlike all other species of this size (20mm) the surface of the paranota is smooth with prominent hairs at the front edge. The amber coloured antennae, legs and tail are also all distinctly long.



Brachydesmus superus



Macrosternodesmus palicola



Ophiodesmus albonanus

CENTIPEDES

Of around 45 known British species, only 21 have been recorded in the Sheffield area. This is largely the product of under-recording but many species are confined to southern or coastal habitats and are unlikely to appear here. The morphology of British centipedes is a little less diverse than that of the millipedes, although four distinct orders are recognised. The SCUTIGEROMORPHA are only rarely reported in the British Isles and these highly distinctive long-legged animals have only been recorded as alien imports locally. Of the three orders recorded in the Sheffield area, the SCOLOPENDROMORPHA are represented by a single species, recognisable by its twenty-one pairs of legs. The LITHOBIOMORPHA are the stout species with fifteen pairs of legs. The thread-like GEOPHILOMORPHA may have over one hundred pairs of legs but this is very variable between species. No adults have fewer than thirty-five pairs.

The class CHILOPODA are as distinct from the Diplopoda as they are from any insect order. Their carnivorous lifestyle has ensured that any morphological adaptations are quite unlike those of the herbivorous millipedes. In millipedes the second pair of jaws are fused to form a lower lip, in centipedes this lip is formed from the first pair of limbs, hence the name chilopoda - 'lip-leg'. The other obvious difference is that where millipedes have two pairs of legs per body segment, the centipedes have only one. Further modifications of the head as an offensive weapon and hunting instrument make the distinction quite clear. The geophilomorpha are generally soil dwelling predators with extensive articulation between body segments allowing for tremendous flexibility in confined spaces. They are even able to walk backwards guided by the sensitive 'antennae-like' hind legs. The opposite is true of the lithobiomorpha which are much more rigid to allow for fast running without unwanted sideways flexion. This reflects their much greater surface activity as they hunt at speed for small invertebrates. The locomotion in scolopendromorpha not surprisingly falls somewhere between these two styles. They are blind like the geophilids and somewhat flexible, yet able to run at speeds similar to the lithobids.

Centipede reproduction is only partially understood. All the reproductive organs are situated at the hindmost end of the body. Males are generally thought to place a capsule of sperm on a web of silk from which the female retrieves it via her intromitent organs, the gonopods. This may take place throughout the spring, summer and autumn but the sperm may be held by the female over the winter before fertilising her eggs the following spring (Eason 1964). Both the geophilids and scolopendra lay their eggs in an excavated 'brood cavity' and the mother tends them until they are able to fend for themselves. She remains coiled around her offspring for several weeks as they hatch and mature, protecting them from fungal attack and desiccation. Even within the eggs the tiny centipedes possess the adult complement of limbs. Many other characters are also complete at this early stage, however, the number of glandular pores on the coxae of the last legs continues to increase as the animal grows. The number and arrangment of these COXAL PORES is useful for identification and may be misleading in immature specimens. Maturity comes after about three years and an individual may die subsequent to breeding. Others may survive reproduction and continue to live for a year or more.

The lithobids contrast by laying and abandoning single eggs. Their only protection is a coating placed on them by the parent to which soil particles adhere and disguise the egg. On hatching there are four larval stages which last for several weeks and possess fewer than the adult complement of legs. Once the full fifteen pairs of legs has been achieved there are a further four or more stadia to pass through before maturity is reached. This may take two years or more during which time other characters such as the number of ocelli or antennal segments are still reduced. When finally mature two further moults may occur allowing the centipede to live for another three years or more. After each moult the centipede will often look quite violet for a few hours.

Immature lithobids can prove difficult to identify because of the development of key diagnostic features. The geophilids have more adult characters but their small size make identification difficult. One feature peculiar to *Geophilus* species is the so called CARPOPHAGUS STRUCTURE. This can be seen on the underside of the front body segments, most noticeably around segments 9 to 12. It varies in extent and clarity depending on age and species. In simple terms the structure comprises a pit along the front edge of the segment, and a small peg at the rear of the preceeding segment. Combined with a distinctive triangular or diamond-shaped patch of pores in front of the peg the whole pattern of the segment is quite diagnostic of the species. This arrangement is most easily seen in specimens that have been 'cleared'.

The identification of centipedes can present a number of problems for the beginner which make them rather more difficult to name than the other groups discussed in this volume. The primary difficulty (assuming that you have been able to at least catch the beast) is in the size of the characters used for identification. Many require high magnification examination with a microscope rather than a hand lens. In some cases it is also preferable to treat the specimen with clearing agents (eg 60% lactic acid) in order to more easily see the relevant structures - coxal pores in particular. This inevitably means that field identification of live specimens is virtually impossible if an absolutely certain determination is required. This has largely been responsible for the paucity of centipede records over the years.

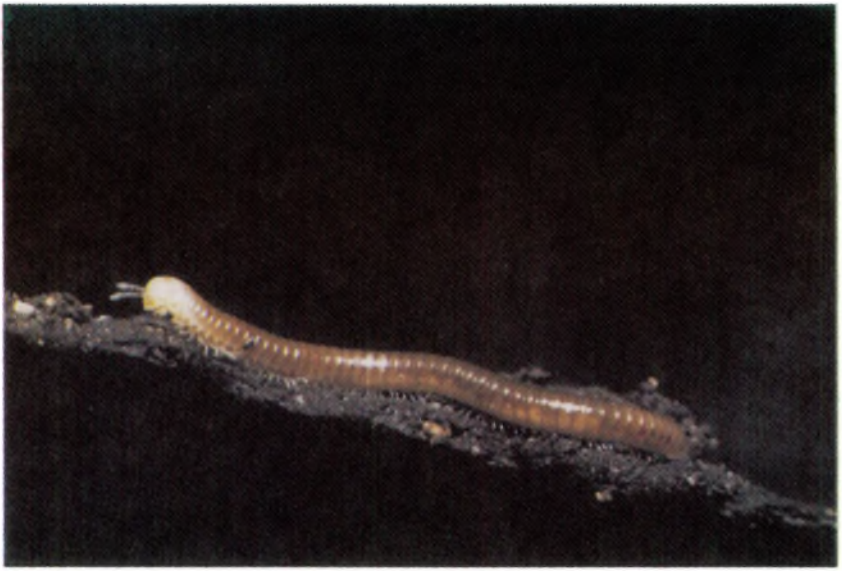
The following keys are designed to hopefully overcome some of the difficulties found in the identification of our local species. The format of the keys is that of charts of characters, the combination of which can be used to determine the species. This can make field identification more straightforward, though many of the characters will still be rather difficult to observe with a simple hand lens in a moving specimen. The reduced number of species in the keys also make them easier to use but it should be stressed that ultimately without reference to a more complete key new species to the region may easily be overlooked. For complete coverage of the British centipedes please refer to Eason (1964) from which much of the information in these keys is taken, or for Geophilomorpha, Keay (1995) and Barber & Keay (1995).

Please note that the length measurements given are of approximate guidance only, since a variety of factors such as preservation, age, body contraction and moulting may affect this figure. Figures in brackets refer to rare extremes. Coxal pore number will also vary with age so that an older small species may resemble a young large species. The combination of other characters, however, should separate the species. Where certain features are particularly characteristic of a species they are marked with an asterisk.

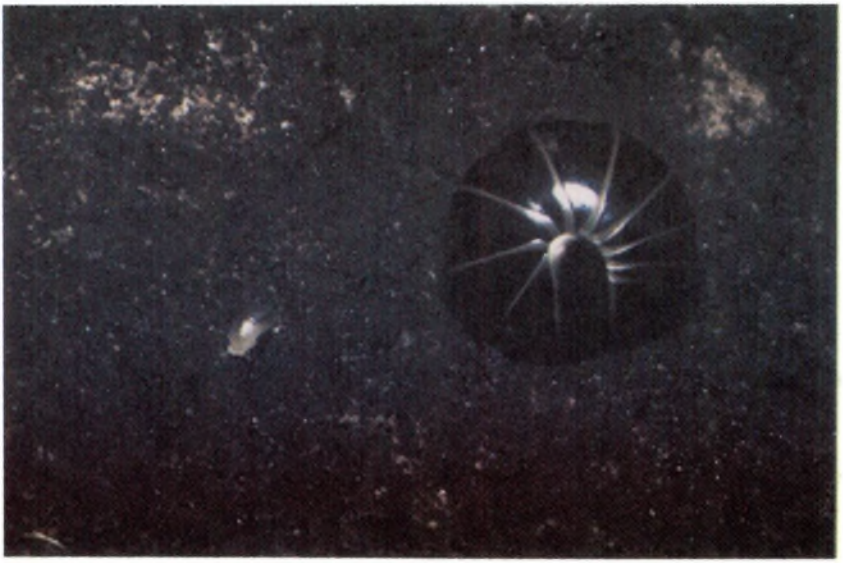
Keys to Centipedes of the Sheffield Area

KEY A

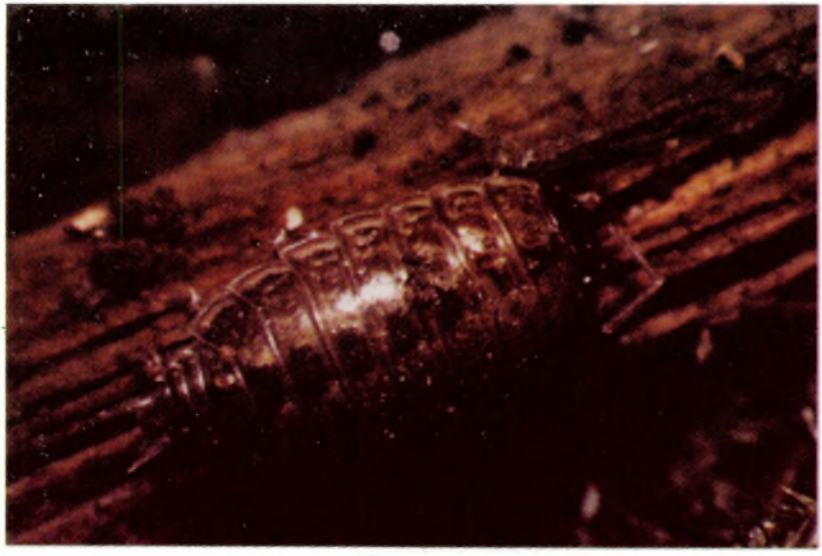
i	15 pairs of legs	**Lithobiomorpha** - Key B
ii	21 pairs of legs	**Scolopendromorpha** - Cryptops hortensis
iii	More than 35 pairs of legs	**Geophilomorpha** - Key C



The scarce, blind snake millipede
Cylindroiulus vulnerarius



The tiny white millipede
Stygioglomeris crinita with its larger relative ***Glomeris marginata***



The Common Striped Woodlouse
Philoscia muscorum

Armadillidium nasatum passing a mating pair of flatbacked
Polydesmus angustus

Front view of
Cylindroiulus caeruleocinctus

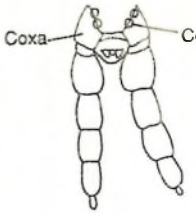
Haplophilus subterraneus
A common soil centipede

The Rosy Woodlouse
Androniscus dentiger

Haplophthalmus mengei showing the extra projections on the third pleonite

Cryptops hortensis
21 pairs of legs

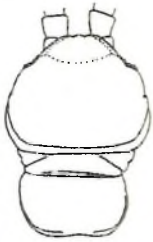
Necrophlocophagus flavus
Geophilomorph - more than
35 pairs of legs



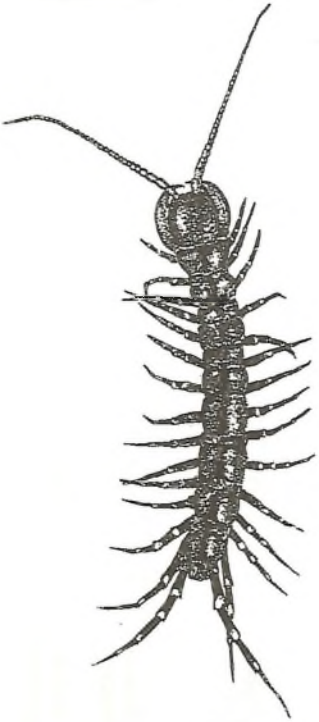
Schendyla nemorensis
No claw on last leg

Geophilus oligopus
Claw on last leg

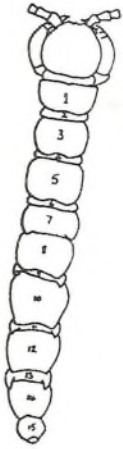
Underside of Lithobiid
head showing forcipular
teeth (5+6)



Head of Lithobius
muticus



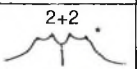
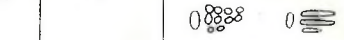
Striped centipede
Lithobius variegatus
15 pairs of legs



Tergites of Lithobiid
showing projections
on T7,9,11,13

1 or 2 claws on
15th leg of Lithobiid

Male and Female
Lithobiid. Underside
of last segment

KEY B	ADULT BODY LENGTH (MM)	PROJECTIONS ON TERGITES 7	9	11	NUMBER OF OCELLI IN ADULT	SEGMENTS OF ANTENNAE	FORCIPULAR TEETH	CLAW OF 15TH LEG	FURTHER INFORMATION
Lithobius variegatus	16 - 24	●	●	●	13 - 18	35 - 46	6+6 -- 7+7	1	Rear legs banded* 'striped centipede'
Lithobius forficatus	18 - 30		●	●	20 - 30	35 - 43	5+5 -- 6+7	1	
Lithobius melanops	11 - 17		●	●	10 - 13	32 - 42	2+2	2	
Lithobius macilentus	10 - 14		●	●	7 - 9	39 - 45	2+2 	2	Always female = L. aulacopus
Lithobius piiicornis	20 - 35			●	20 - 40	29 - 31	3+4 -- 5+6	1	Rare, Dark brown/red 15th legs long 2 spines underneath last coxae*
Lithobius calcaratus	10 - 15				7 - 9	39 - 50	2+2	2	Brown/grey - black Projection on 15th femur in ♂
Lithobius muticus	10 - 15				10 - 14	34 - 43	2+2 -- 3+3	1	Dark brown, Male with wide forward-facing head*
Lithobius crassipes	9.5 - 13.5				9 - 13	18 - 21	2+2 -- 3+3	1	 Pattern of ocelli separates crassipes from curtipes
Lithobius curtipes	8 - 11				6 - 9	19 - 20	2+2	1	 curls up when disturbed
Lithobius microps	5.5 - 9.5				3 - 4	23 - 28	2+2	1/2	curls up when disturbed = L. duboscqui
Lamyctes fulvicornis	8 - 10.5				1*	25	3+3	3*	Chestnut - dark brown. Always female. No spines on legs*

KEY C	ADULT BODY LENGTH (MM)	PAIRS OF LEGS	CLAW ON LAST LEG	PORES ON COXA OF LAST LEG	CARPOPHAGUS STRUCTURE	FURTHER INFORMATION
Haplophilus subterraneus	50 - 70	77 - 83*		Many all over 	No	Yellowish with darker head
Schendyla nemorensis	14 - 20	37 - 43		2 underneath 	No	Colourless to pale yellow, head darker
Strigamia crassipes	40 - 50	49 - 53	Yes	15 - 30 underneath 	No	Red
Strigamia acuminata	20 - 30	37 - 41	Yes	10 - 15 underneath 	No	Red
Geophilus carpophagus	40 (-60)	45 - 55	Yes	6 - 12 underneath 		Reddish-Brown
Geophilus electricus	30 - 40	65 - 73	Yes	4 - 6* above 6 - 12 underneath 		Pale yellow with darker head
Geophilus oligopus	25 - 40	45 - 53	Yes	5 - 8 underneath including 1 isolated 		Pale yellow with darker head. = G. Insculptus Brolemann 1930
Necrophloeophagus flavus	30 - 45	49 - 57	Yes	6 - 10 underneath 	No	Bright yellow with distinctly dark head. = N. Longicornis
Brachygeophilus truncorum	12 (-20)	37 - 41	Yes	2 underneath 		Pale yellow with slightly darker head 3 depressions under each of the anterior segments

GEOPHILOMORPHA

There are 9 species recorded locally from this Order. They all possess more than 35 pairs of legs but no eyes and have a long, thin appearance. They may be yellow to red-brown and are found in soil, under logs, rocks or bark and in decaying wood.

Haplophilus subterraneus (Shaw)

Map 25

This is one of the most readily identifiable centipedes due to its large number of legs (77+ pairs). It is generally orange-yellow and very long (up to 70 mm) but is often found curled up in a loose knot (see colour plate). The uncountable number of pores all over the coxae of the last leg will confirm this species.

As the specific name suggests, *H. subterraneus* is often found in soil, but may also be seen on the surface or in leaf litter layers. In the south and west of Britain this species occurs in 'natural' sites such as woodland but further north it is increasingly of synanthropic habit. This is reflected by local records which are predominantly from gardens and other urban grassland sites. It is apparently the only British centipede with the occasional omnivorous habit of damaging root-crops (Eason 1964). This unusual behaviour seems to have labelled all long, thin centipedes as harmful "wire-worms". In many cases it is more likely that the offending centipede found with a devoured potato was attracted to the moisture or was eating the pests that were causing the damage!

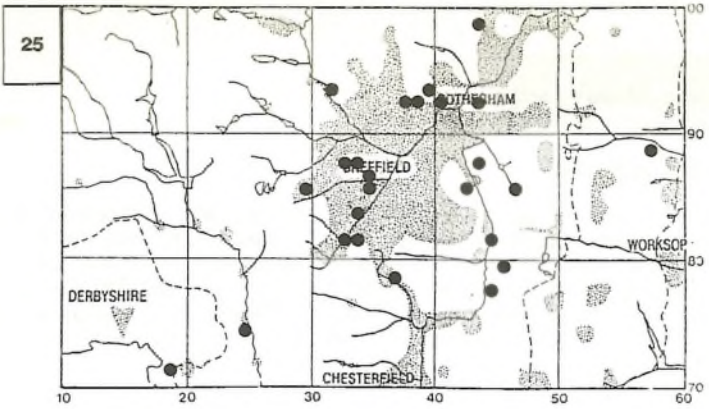
Schendyla nemorensis (C L Koch)

Map 26

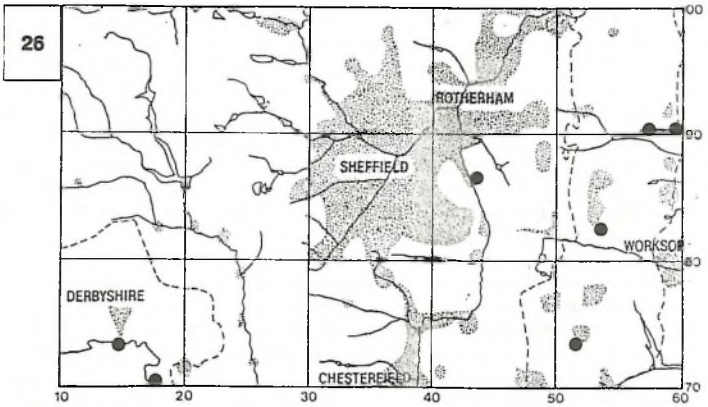
A very small (14-20 mm in length) colourless or pale yellow centipede with a slightly darker head. There may be a minute spine, but no claw on the last leg and only two barely discernible coxal pores. Due to its small size and generally 'immature' appearance this species has probably been under-recorded locally. The few records represent a wide range of habitats including Limestone dale, ancient woodland and Peat bog. National data shows no marked geological preference (Barber and Keay 1988) but 85% of local records are from calcareous areas. Searching in dead wood and mature bracket fungi should prove productive in recording this species.

Strigamia crassipes (C L Koch)

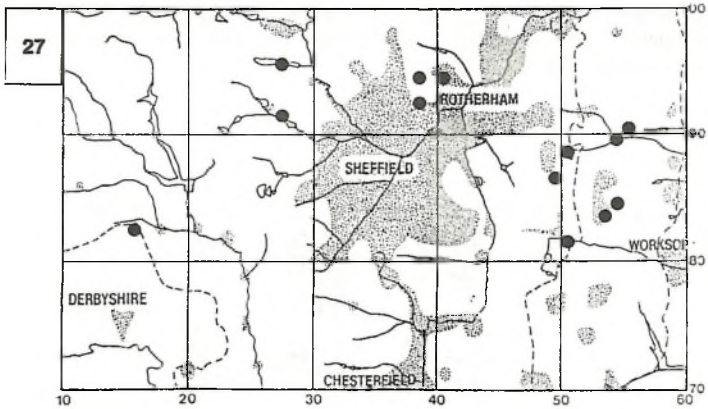
This species is generally uncommon but widespread in the south of Britain. The nearest record is from Thorne Waste (44/7517) but further recording may yet find it within the local mapping area. If differs from the very similar *S. acuminata* by being almost twice the length with correspondingly more numerous legs (49+) and a rather more extensive distribution of coxal pores. This species has been reported as producing illumination similar to a glow-worm.



Haplophilus subterraneus



Schendyla nemorensis



Strigamia acuminata

Strigamia acuminata (Leach)

Map 27

(Scolioplanes acuminatus)

All local records for this species are from rural sites, primarily woodland with a small proportion from damp grassland. Leaf litter and dead wood are the most common micro-habitats. Both *S. acuminata* and *S. crassipes* are orange-red in colour and stout bodied, with the smaller, *S. acuminata* tapering slightly more towards the head. The coxal pores of *S. acuminata* are fewer in number (up to 15) but the difference in body length and fewer legs is the most obvious differences between these species.

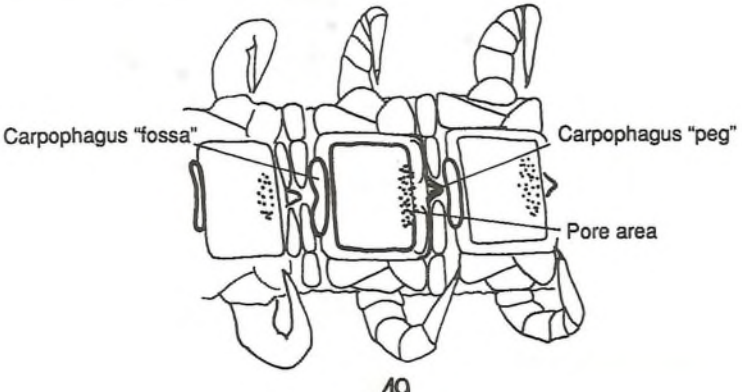
Geophilus carpophagus Leach

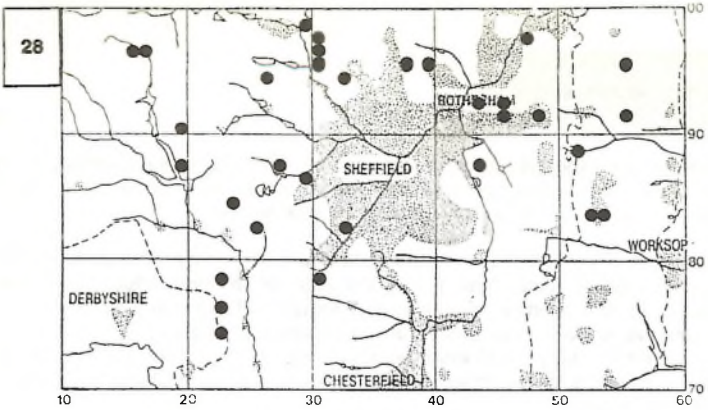
Map 28

This is one of the more striking geophilomorph species. Red-brown in colour and growing up to 60 mm in length, it is hard to miss when seen crawling up a tree trunk or over a garden wall (Blower 1987). It is much more commonly seen in rural situations, but is also the only species of geophilomorph to be found in houses (Eason 1964). Those individuals which exist in the more synanthropic, urban sites tend to be larger, possessing more body segments (Eason 1979, Lewis 1985). Local records show a wide distribution across the region at all altitudes under rocks and dead wood. indeed *G. carpophagus* is a characteristic species of upland moor and can be found in distinctly acid conditions such as heather moorland and upland conifer plantations. Other records are from gardens, factories, a limestone dale and a quarry.

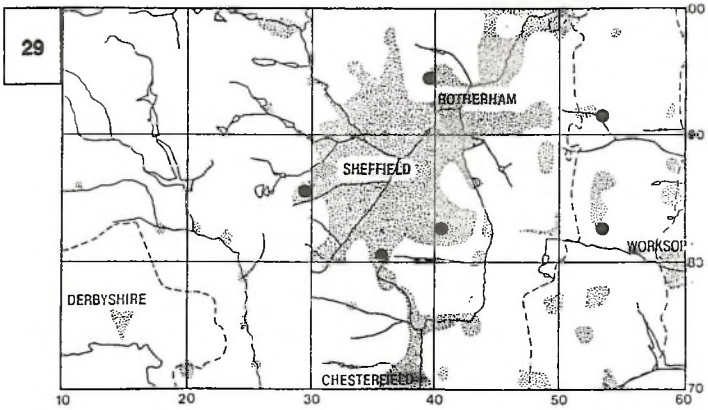
This species is known as a "glow-worm in some parts of the country due to its ability to phosphoresce. This ability was noted as far back as 1658 by Muffet;" "Our countryman Bruerus (a skilful and laborious searcher of nature) reports that he hath seen here in England Scolopenders [centipedes], and kept them, that shined in the night and in mossy and broomy grounds shined with their whole body: who was no lier [sic], and I willingly give credit to him; and so much the rather, because Oviedus saith he observed the same..."

The specific name *carpophagus* is used to describe a structure found on the underside of *Geophilus* and *Brachygeophilus* centipedes. This "carpophagus structure" is characteristic but can best be seen in specimens which have been rendered slightly transparent ("cleared") by lactic acid. This structure is generally most noticeable around segments 9 - 12 where a pattern of pits and pores occupies the centre of the segment between the legs. The structures are illustrated in Key C.

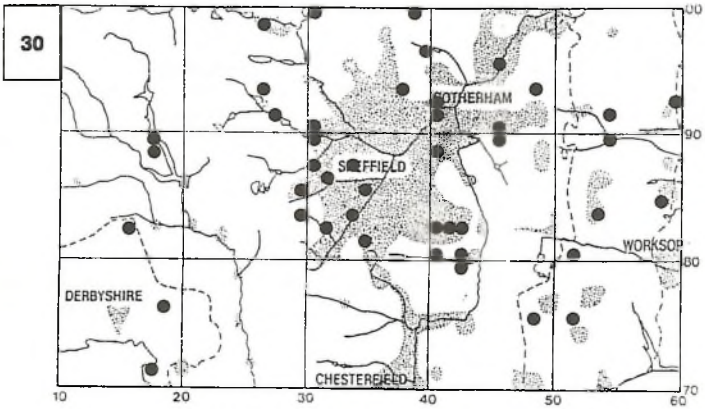




Geophilus carpophagus



Geophilus electricus



Geophilus oligopus

Geophilus electricus (Linn.)

Map 29

This slender, pale species has more legs than any other *Geophilus* species (65-73 pairs). It is also distinctive in having pores on both the upper and lower surface of the hind coxae. The carpophagus structure is also characteristic (see Key C).

G. electricus is uncommon but widespread nationally and locally. This probably reflects its subterranean habits rather than a true indication of its abundance. It is most often recorded under stones and in soil in suburban locations. Digging in gardens and allotments may show this to be a much more common species than the map suggests. All local records are for February - April which possibly indicates a migration towards the surface in spring and hence easier recording. Despite its name, it is doubtful that *G. electricus* shows any phosphorescence.

Geophilus oligopus (Attems)

Map 30

Geophilus insculptus (Brolemann 1930)

This is another slender pale yellow species with a darker head. Distinguishable from other similar centipedes by the form of the carpophagus structure (see Key C) and the arrangement of coxal pores. Of the 5-8 pores on the underside of the hind coxae one is always located a little away from the main group.

G. oligopus is one of the most common centipedes across the whole of the Sheffield area. It is usually found under rocks, logs or leaf litter but has been taken in soil samples at 15 cm and often occurs in pitfall traps. Most habitats have yielded this species including gardens, grassland, woodland, limestone dales and upland heath. It is interesting to note that the only records for summer months (June - September) are from pond sites or pitfall traps, implying an attraction to localised water sources.

Necrophloeophagus flavus (De Geer)

Map 31

(Necrophloeophagus longicornis)

This nationally common and widespread species demonstrates how under-recorded centipedes are locally. There are currently fewer than twenty known sites for this species, ranging from moorland, woodland, suburban garden and limestone dale, recorded at all times of year. One interesting feature from this limited information is the relatively high proportion of records from acidic upland sites. It will be interesting to see whether this bias is maintained after further recording across the region.

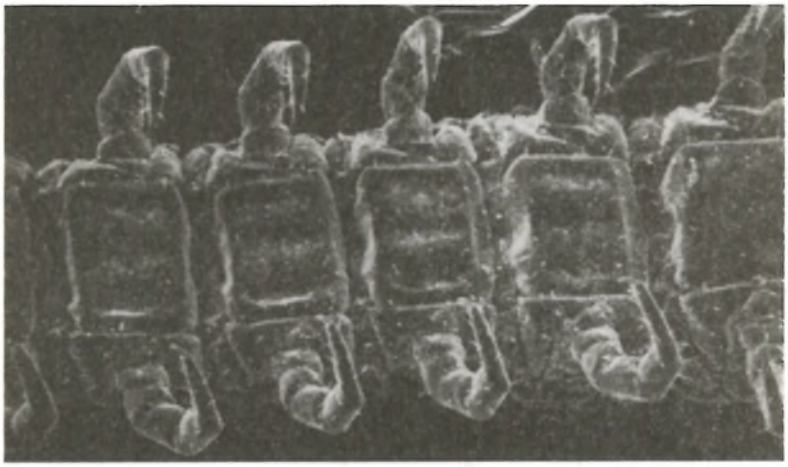
N. flavus resembles the *Geophilus* species but has a brighter yellow appearance with a distinctly darker red-brown head and no carpophagus structure. The 6-10 coxal pores are grouped together in two approximate rows on the underside only. It will probably be encountered most frequently under rocks and dead wood, but could occur anywhere.

Brachygeophilus truncorum (Bergsoë & Meinert)

Map 32

This is a tiny (12 mm) pale yellow species which can only be mistaken for *S. nemorensis* or a juvenile *Geophilus*. The most distinctive feature is the presence of a carpophagus structure (see *G. carpophagus*) and three longitudinal depressions which lie side by side under the first few body segments. These are best seen under the microscope with direct 'raking' light casting three shadows between the legs, but are not seen in 'cleared' specimens.

This is a widespread species occurring in a variety of habitats but is most often seen under the bark of dead wood. Records are therefore predominantly from woodland but gardens, acid heath and hedgerows are also represented by local records. One specimen was found in a fox scat inside a cave and this species has also been collected in pitfall traps.



Carpophagus structure of *Brachygeophilus truncorum* showing the additional 3 depressions on each segment. (Miller's Dale).

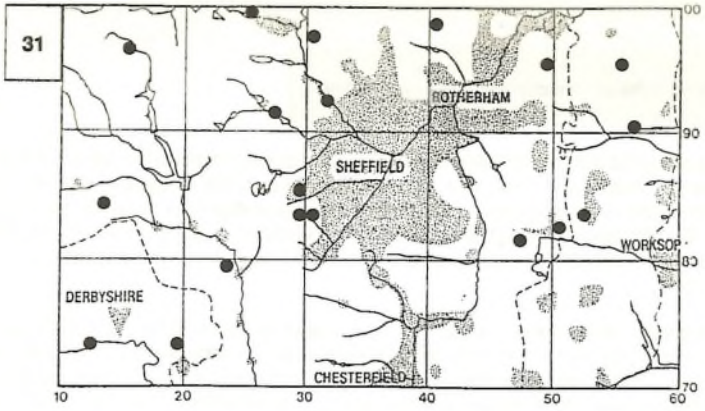
SCOLOPENDROMORPHA

To this order belong the large poisonous centipedes of the tropics. They are characterised by possession of 21 pairs of legs, the hind pair being noticeably long and stout.

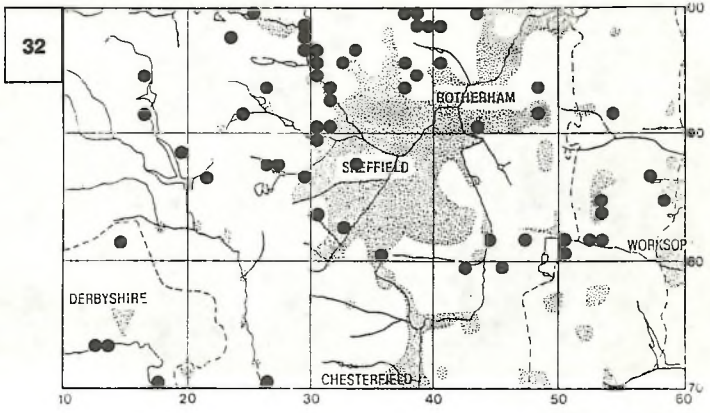
Cryptops hortensis Leach

Map 33

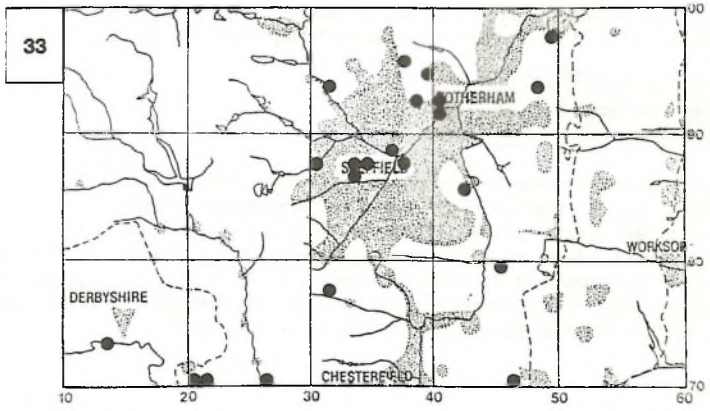
Of the three British species of scolopendromorph, this is the only one to be recorded in the Sheffield area. It is medium sized (20 mm) and orange with no eyes. The most distinctive feature is the number of legs (21 pairs) by which *Cryptops* species can be readily recognised in the field. Any particularly large specimens of *Cryptops* should be passed to an expert for checking as the other two species, *C. anomolans* and *C. parisi* may yet be recorded locally. *C. anomalans* may be up to 50 mm in length and is quite capable of penetrating human skin with its large jaws (Barber & Keay 1988)!



Necrophloeophagus flavus



Brachygeophilus truncorum



Cryptops hortensis

C. hortensis has only been recorded from synanthropic sites in the Sheffield area but these vary from waste ground and gardens to urban woodland and inhabited areas of the dales. Under logs, bark, rocks or refuse are the most usual microsites. There are very few records of this species north of Sheffield, with just a scattering through Yorkshire (Richardson 1993). The other *Cryptops* species are very southerly in their distribution but also occur in synanthropic locations further north.

LITHOBIOMORPHA

These are probably what most people will think of as centipedes. Fast running, relatively short and stout with 15 pairs of legs in the adult. Although they vary considerably in size the general form is very similar. Important characters for identification include the number of antennal segments, colour and the shape of the tergites (plates on the upper surface of each segment). These tergites alternate in length which makes for a more rigid body than the geophilomorphs and is better for fast running rather than burrowing into soil. Lithobiids are also enabled for fast running and hunting by the presence of eyes, the number of which can be diagnostic. Between the jaws (Poison-claws or forcipules) on the underside of the head are what are known as forcipular teeth. The number on each side can be a useful character, for example, five teeth on the left side and six on the right is denoted as 5 + 6 and can only be one of two species. All but one species of Lithobiomorph belong to the same genus, *Lithobius*.

Lithobius variegatus Leach

Map 34

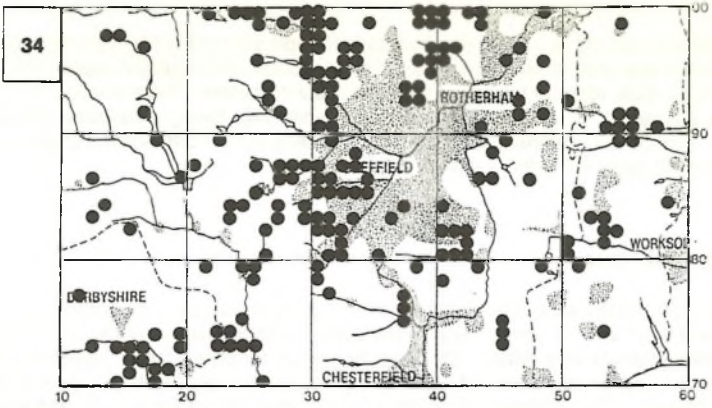
Striped Centipede

This is the most distinctive British centipede and can be readily identified in the field by its colour. It is a pale orange-brown with darker (sometimes violet) marbling and an interrupted dark stripe down the centre of the tergites. The legs, particularly at the rear, are pale and dark banded (see back cover). It is a large animal (up to 24 mm) with projections on the hind angles of tergites 7, 9 and 11, and up to seven forcipular teeth on each side.

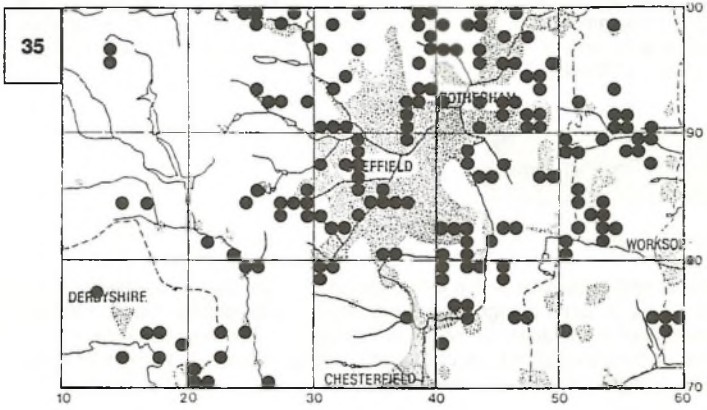
It is primarily a woodland species and is accordingly most often found under bark, logs and rocks and in leaf litter. Due to its camouflage, it often remains motionless when first disturbed. It is also the only centipede known to climb trees. It is common locally wherever there are trees but is only occasionally found in urban or synanthropic sites. It occurs widely at high altitudes in heath, moorland and conifer plantations.

L. variegatus was once thought to be endemic to Britain but is now also known from other parts of western Europe (Kime, Lewis & Lewis 1987). It has a fascinating national distribution with a very marked westerly bias. Yorkshire is completely divided in half with *L. variegatus* recorded commonly in the west but virtually non-existent in the east. Apart from a single record for Thorne Moors there are no records at all of *L. variegatus* to the east of the Sheffield mapping area (60 line). We are therefore well placed to investigate this phenomena by determining exactly where *L. variegatus* does and does not occur at this extreme easterly point of its range. As Douglas Richardson says in his review of Yorkshire Centipedes (1993):

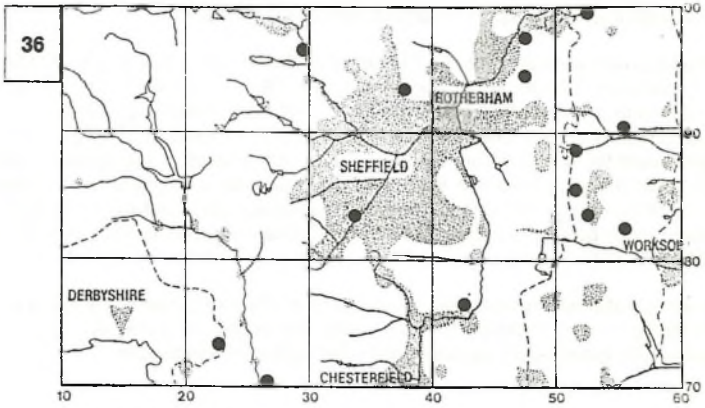
"No one has satisfactorily answered the question of the distribution of *Lithobius variegatus* in the county - there could be a Ph.D. round the corner for someone having the right approach. The ground work has been done, the field is now wide open."



Lithobius variegatus



Lithobius forficatus



Lithobius melanops

Lithobius forficatus (Linné)

Map 35

This centipede will be known to most people as it is very large (up to 30 mm), very common and is often seen in gardens and buildings. Its size and overall chestnut-brown colour are distinctive but other characters should be checked to avoid confusion with other species (see *L. pilicornis*). *L. forficatus* has projections at the corner of the ninth and eleventh tergites, up to 30 eyes on each side and more than 35 antennal segments.

This species can be found virtually anywhere but especially under stones and dead wood where it races off rapidly when disturbed. It is the most frequently recorded species of centipede and is distributed widely across the Sheffield region. There are fewer records at the higher altitudes to the west which may be due to competition from the more common *L. variegatus* since *L. forficatus* certainly occurs at these altitudes elsewhere. Such competition might also be a factor in the greater frequency of *L. forficatus* in the east of the country. Surely someone must fancy that Ph.D.?!

Lithobius melanops Newport

Map 36

A medium-sized (11-17 mm) chestnut-brown species with an occasional dark central stripe. It could be mistaken for a small *L. forficatus* because of the projections on tergites nine and eleven but it has considerably fewer eyes (10-13) and only 2+2 forcipular teeth. Additionally there are two claws on each of the last pair of legs whereas there is only one claw in *L. forficatus*. (see also *L. macilentus*).

This species is known to enter houses but there are no such records locally. Indeed, despite a national tendency towards urban sites the majority of records in the Sheffield area are from rural woodlands. This observation is however based on remarkably few records. The widespread scattering of known sites would suggest that it is largely under-recorded. In fact this species had not been found in Sheffield until as recently as 1991. National data would suggest that under stones, dead wood and bark are good places to look for this species, in gardens, quarries and roadside verges (Barber & Keay 1988).

Lithobius macilentus L Koch

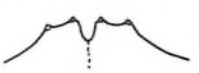
Map 37

Lithobius aulacopus

In many respects this species resembles *L. melanops* with much overlap in their characteristics. *L. macilentus* is generally slightly smaller however (10-14 mm), with fewer eyes on each side (7-9). The greatest distinction can be seen in the forcipular teeth. Both species possess 2+2 but in *L. macilentus* these are widely spaced with the centre two produced further forwards than the outside two. In *L. melanops* the outer two are slightly further forwards and have broad 'shoulders', whereas the 'shoulders' are non-existent in *L. macilentus*, the outer edge of the teeth sloping away immediately (see illustration). No males of *L. macilentus* have been found in Britain.

This species shows a very scattered distribution nationally which is well reflected on the local map. It is recorded widely across the region but is only common in one or two localities eg. Anston Stones Wood, SK 5383 (Addey, 1978). The majority of records are from under stones and leaf litter in woodland but it also occurs in grassland. The scatter of records is puzzling since there seem to be few obvious geological, altitude, habitat or climatological factors in common between the sites. It may be due simply to insufficient recording but is probably a consequence of this species' ability to reproduce parthenogenetically. An individual arriving in a suitable habitat will slowly be able to colonise an area as off-spring radiate outwards. It would make an interesting study to examine the extent of the current populations and determine their micro-habitat requirements as they disperse. (See also *Lamyctes fulvicornis*).

Forcipular teeth



L. macilentus

L. melanops

Lithobius pilicornis Newport

Map 39

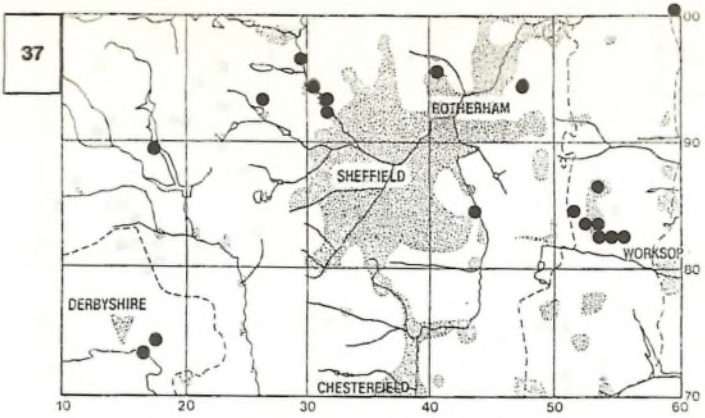
This is the largest Lithobiid found in Britain, the single Sheffield specimen measuring 46 mm from head to hind leg (30 mm body). The deep red-brown colour and long back legs make it hard to miss but its speed makes it equally hard to catch! The only local specimen was taken in April 1992 from under a plank of wood in a car park in central Sheffield (SK 3487). It was initially assumed to be a large *L. forficatus* but closer inspection revealed a number of obvious differences. The simplest of these being the very reduced number of antennal segments (31) and the absence of a projection on the ninth tergite. The two spines found underneath the coxa of the 15th leg are also characteristic of *L. pilicornis*.

Normally *L. pilicornis* is restricted to southern coasts. It is particularly common in Devon and Cornwall. It shows a tendency towards urban and synanthropic sites and although obviously introduced in this region it may still occur at other sites locally. The only other recent northern record for this species is from a railway embankment in Wakefield (Keay, 1987).

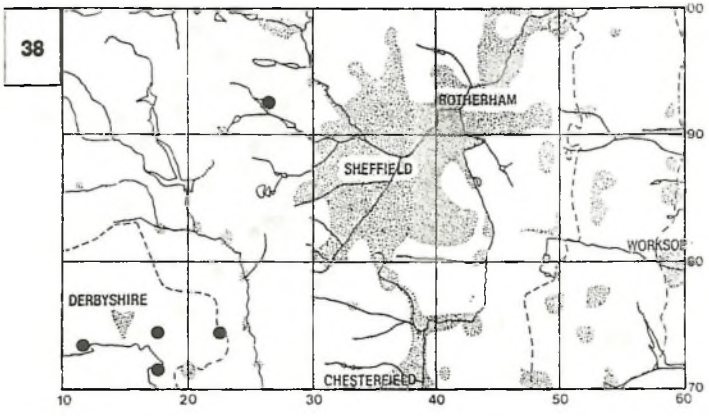
Lithobius calcaratus C L Koch

Map 38

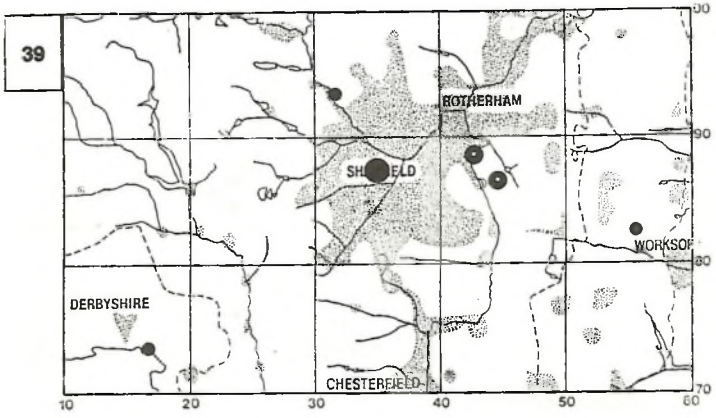
The small to medium-sized Lithobiids can be quite difficult to identify initially, but the combination of seemingly similar characters is usually sufficient to separate the species. *L. calcaratus* is probably the darkest species to be found locally, having a grey-brown, almost black, appearance. It is likely to have the greatest number of antennal segments (39-50) and possesses a distinct accessory claw on the tip of the 15th leg. Male specimens can be readily distinguished by a hairy wart-like spur on the swollen femur of the 15th leg. This spur or "calcar" gives rise to the specific name.



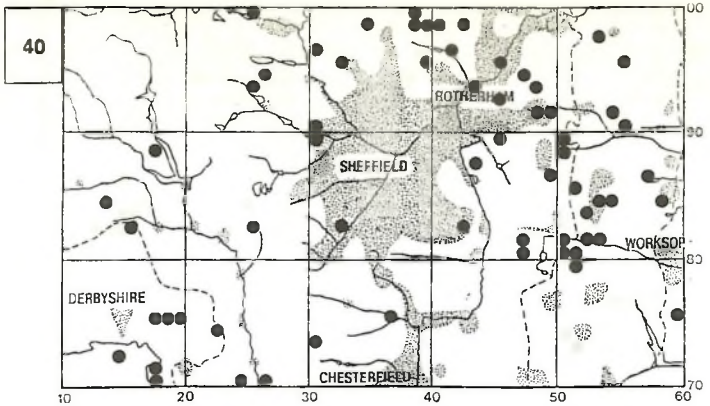
Lithobius maciientus



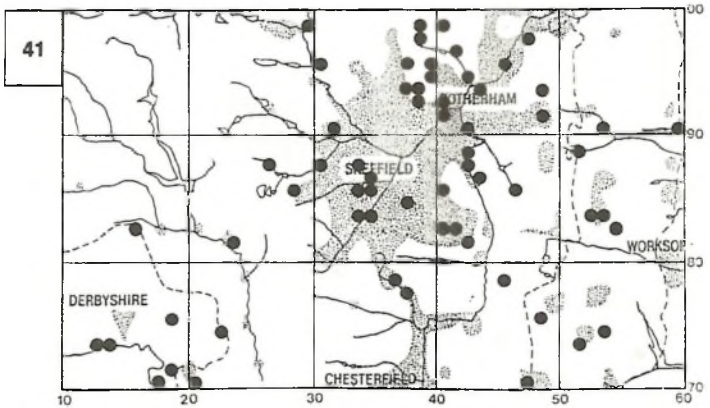
Lithobius calcaratus



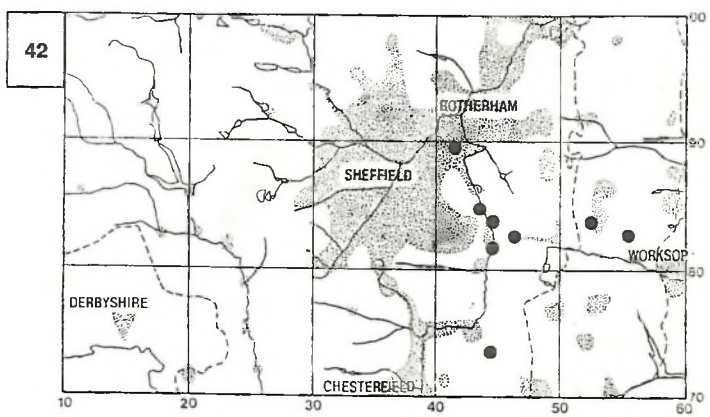
● Lithobius muticus ◉ Lithobius curtipes ● Lithobius pilicornis



Lithobius crassipes



Lithobius microps



Lamyctes fulvicornis

From looking at the local distribution map, one might be forgiven for assuming that the specific name is derived from an affinity for calcareous soil. National data, however, indicates a preference for acidic conditions, this species being characteristic of moorland and heath. The few local records are from under stones and among moss in grassland. More searching among conifers, heather and bracken may reveal this species to be much more common to the west of Sheffield than is currently recognised.

Lithobius muticus C L Koch

Map 39

This species can be fairly indistinguishable from the previous one, *L calcaratus*. They are the same size (10-15 mm) and the normally dark-brown *L. muticus* can appear to be almost black. *L. muticus* has more eyes (10-14) and fewer antennal segments (34-43). Male specimens can be recognised by the rather wide head in which the eyes face more towards the front than in other species. In this species it is the 14th tibiae of the male which possess a slightly hairy lump on the upper side - although this is nothing like as noticeable as the spur in *L. calcaratus*.

The four local records are way out of the normal south-easterly distribution for this species. Yet the widespread occurrence would suggest that this species could still be found elsewhere in the region and beyond. All records were from under stones, two in deciduous woodland, one in grassland and one from an overgrown quarry (Addey 1978). Only this latter site shows any kind of synanthropic association.

Lithobius crassipes L Koch

Map 40

Lithobius curtipes C L Koch

Map 39

These two chestnut-brown species are so similar in appearance that they can be treated together. Characters shown in Key B overlap to such an extent that it is often necessary to rely on the arrangement of eyes to distinguish the species. The ocelli in *L. crassipes* are generally arranged with a single large one at the rear with the remaining smaller ones in two or three rows in front. The pattern in *L. curtipes* appears to be rather random but consists of a small ocellus at the rear, preceded by a larger one. The remaining 6 or 7 smaller ocelli are grouped as an incomplete circle with one ocellus in the centre. Key B shows diagramatic forms of these arrangements. Males of *L. curtipes* possess a flattened projection at the end of the 15th tibiae which is distinctive. This species also has a tendency to curl up when disturbed unlike *L. crassipes* which runs away (Addey 1978).

L. crassipes is one of the commonest centipedes in rural and suburban areas around Sheffield. As with Lithobiids in general it is found in a wide variety of microhabitats, usually under stones or dead wood. Records are from marshes, grassland, woodland, dales and heaths, but few synanthropic sites.

L. curtipes on the other hand is a considerable local rarity. It is only known from Catcliffe and Treeton, in carr and ancient woodland respectively. It has been suggested that this is a species specifically of ancient woodlands. (Barber & Keay 1988).

Further examination of known ancient sites locally would be valuable in determining the indicator status of this species.

Lithobius microps Meinert

Map 41

Lithobius duboscqui

This is a common and widespread species but one which is often overlooked due to its small size (5.5-9.5 mm). Its habit of curling up when initially disturbed may cause confusion with *L. curtipes*. On close inspection, however, *L. microps* is very distinctive in having only three (occasionally four) eyes on each side of the head. The accessory claw on the last leg may sometimes be so small that there may appear to be only one. However, when well-developed this double claw is helpful to distinguish between the other small Lithobiids.

This species has occurred locally in virtually all habitat types except moorland. It is most frequently found in gardens and other urban sites in the soil or under leaf litter, rocks, refuse etc.

Lamyctes fulvicornis Meinert

Map 42

This is the only British species of Lithobiomorph which does not belong to the genus *Lithobius*. There are a number of differences but the most obvious are the possession of a single eye on each side of the head and the presence of three claws on the 15th leg. There are also no spines on the legs, a feature so characteristic in *Lithobius* species. The dark-brown appearance and refusal to curl up when disturbed help to separate *Lamyctes* from the small *Lithobius* species in the field (Eason 1964).

L. fulvicornis only occurs in Britain as females. By reproducing parthenogenetically such a species is able to colonise a suitable habitat quite readily should it be introduced, as no other individual of the same species has to be present. This may account for the very scattered distribution of *L. fulvicornis* locally and nationally. As with the other parthenogenetic centipede, *Lithobius macilentus*, it would be interesting to study the extent to which *L. fulvicornis* has been able to disperse and the factors limiting its colonisation. The sites for which *L. fulvicornis* has been recorded coincide with sites for *Lithobius macilentus*. The Sheffield sites follow the former River Rother washlands with *L. fulvicornis* recorded from pitfall traps in wet meadows and marshland. In Rotherham the very rich Lindrick/Anston Stones Wood area on the magnesian limestone has produced these species from grassland and waste ground. The wetland sites also coincide with the railway line which may provide limestone as well as a means of dispersal. These sites are also known for their calcicolous woodlice (see *Armadillidium nasatum* and *A. vulgare*). Evidently these areas would benefit from further investigation and may shed light on the ecology of a number of species.

In contrast with local records, the national picture is of *L. fulvicornis* as an upland heath/moorland species. To the west of Sheffield where transportation routes are minimal the initial introduction seems yet to have taken place. Further recording may prove otherwise.

WOODLICE

There have been 15 species of woodlouse recorded in the Sheffield area of a possible 37 known to Britain. Most people will be familiar with these ubiquitous animals in and around their homes. Many will be surprised by the variety of species that occur locally. Despite various colloquial names like cud-worms, bibble-bugs, cheese-pigs, coffin-cutters, monkey-peas, penny-pigs, sink-lice, tiggy-hogs, grammerzows, sow-bugs and slaters, only one or two species are really noticed and all these names refer to the same things. In general form woodlice are fairly consistent but vary widely in size, colouration and sculpturing enabling them to be identified fairly readily.

Only two orders of crustacea contain species able to live entirely on land. The terrestrial isopoda (suborder ONISCIDEA) and the AMPHIPODA. The woodhopper, *Architalitrus dorrieni* is the only terrestrial amphipod known from Britain but does not occur in northern England. It is thought to have been introduced with sub-tropical plants from New Zealand, so may yet turn up under artificial conditions (Smithers & Barber 1993).

As already described, woodlice have acquired a variety of adaptations to enable what was previously an aquatic animal to colonise terrestrial habitats. They remain, nonetheless, rather limited in their ability to conserve water. Neither the millipedes, centipedes or woodlice have a waxy waterproof cuticle like the insects (with the exception of certain desert species, Hopkin & Read 1992). They heavily rely on behavioural responses to avoid situations in which water loss will occur. In woodlice this generally means remaining in areas of high humidity or refuges during the day, when levels of moisture are usually lower. Activity may correspondingly be confined to the more humid hours of darkness.

It is particularly noticeable that smaller species are more nocturnal and retiring than the larger day-active species. This is because a smaller individual has a greater surface area in relation to its volume and is more vulnerable to water loss across the body surface.

A variety of simple locomotory responses ensure that woodlice remain within suitable environmental conditions. One behavioural feature of woodlice is that with an increase in humidity they show a decrease in activity and speed, but tend to change direction more. These responses mean that a woodlouse will remain in a damp area rather than move away from it. Combined with this are responses to avoid light and to make as much contact with their surroudings as possible, (Sutton 1972). This behaviour means that woodlice will soon find crevices to hide in, or bunch together to avoid drying out.

Eggs and young woodlice are very susceptible to desiccation. To combat this, eggs are held in a water filled 'brood pouch' (or MARSUPIUM) beneath the mother which partially simulates the aquatic condition. After hatching, the young woodlice remain in the pouch until they are sufficiently mature to fend for themselves. These individuals (known as 'mancas') moult twice more until they possess the full complement of seven pairs of legs. At subsequent moults as the woodlouse grows there is little change in the overall appearance. This means that many species are identifiable even as quite immature specimens. These juveniles moult at regular intervals to become sexually mature adults within a year. These moults continue with less frequency in the adult depending on environmental conditions and may be noted in the 'two-tone' appearance of individuals undergoing this process. This occurs because the rear half is shed two or three days before the front half, producing an animal of different size and colour at each end. The average lifespan is around two to four years. (Oliver and Meechan , 1993).

Like millipedes, woodlice feed primarily on dead plant matter only occasionally turning to living seedlings when circumstances demand. They do however turn more readily than millipedes to scavenging on animal remains. This tendency can be used to good effect in

the cleaning of skeletal material in Museums where other insect scavengers are unwelcome! Woodlice are also well known for eating their own droppings (COPROPHAGY). This enables them to recycle vital elements such as copper back into their system. Even where food is plentiful, a woodlouse may die if it is prevented from eating its own faeces (Sutton 1972). Woodlice are themselves eaten by a variety of animals including beetles, toads, shrews, birds and spiders, including one genus, *Dysdera* which preys exclusively on woodlice. Up to 40% of all woodlice that are eaten are consumed by centipedes (Hopkin 1991).

The general morphology of a woodlouse is shown in the illustration (page 3). There are however, certain characters which are particularly useful in distinguishing one species from another. An initial guide is the number of segments at the end of each antenna. This FLAGELLUM may consist of two or three distinct sections or several barely discernable ones which taper to a bristly tuft.

The number and colour of ocelli in each eye is diagnostic. The colour may be lost if preserved in alcohol so this should be noted where relevant while the animal is alive. In *Trichoniscus* species the three ocelli fuse together in adults but are separate in juveniles. This provides a distinction between adult *T. pygmaeus* and juvenile *T. pusillus* of the same size.

The overall colour and shape are straightforward guides to identification, although in some species colour can be quite variable and again may be lost in alcohol. The outline of the body may be generally continuous from head to telson or there may be a 'junction' where the hind body (PLEON) narrows relative to the fore body (PEREON). The seven limbs of the pereon are known as PEREOPODS and are used as walking legs. The six limbs of the pleon are called PLEOPODS and are modified to function as gills or reproductive organs. In the most terrestrial species (eg. *Porcellio, Armadillidium, Cylisticus* etc.) the gills have developed as PLEOPODAL LUNGS which can be seen as white patches on the underside of the pleon in live specimens. Male genitalia structures are very diagnostic of species but are beyond the scope of this book (see Oliver and Meechan 1993). The last pair of pleopods form UROPODS. The outer branch (EXOPODITE) may play a part in repelling predators, as a sensory instrument or even as a means of shedding excess water from the surface of the woodlouse. The shape of the uropods can be quite distinctive between species.

The following key covers those species of woodlice which are known from the Sheffield area or which are likely to occur but are as yet unrecorded. The characters used are those which are readily observable with a x10 hand lens. It is best used with live specimens, since many colour features are lost when preserved in 70% alcohol. All measurements in brackets refer to maximum adult length. A number of species are marked with an asterisk* indicating that identification of these specimens should be checked by an expert in case it belongs to a species not covered by this key. Woodlice collected from heated greenhouses should always be checked for 'aliens'! For a more complete guide to the identification of British woodlice please refer to Hopkin (1991) from which this present key was modified, or Oliver and Meechan (1993).

A KEY TO WOODLICE OF THE SHEFFIELD AREA

1 a) Uropods broad and flattened or absent. (Fig. 1) Body deeply arched and capable of rolling into a tight ball. - 2

b) Uropods long and pointed or spear-shaped. (Fig. 2) - 6

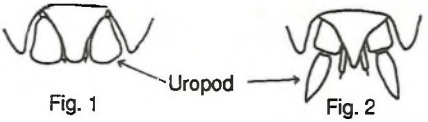


Fig. 1 Fig. 2

2 a) More than 7 pairs of legs. One large segment at rear, with no apparent uropods when uncurled. Very shiny. (Fig. 3) - Pill Millipede

b) 7 pairs of legs. At least 5 thin segments (pleonites) at rear,plus uropod structures (Fig. 4) - Pill Woodlice 3

Fig. 3 Fig. 4

3 a) Solid dark patch on last fore-body segment (7th pereonite) (Fig. 5) - 4

b) No dark patch on 7th pereonite - 5

Fig. 5

4 a) Small species (5 mm uncurled). Scutellum extends as a ridge all around the face. (Fig. 6) Attractively coloured dark brown with yellow and orange mottling. Leaves a slight gap when rolled up. - Armadillidium pulchellum

b) Larger species (9 mm uncurled). Scutellum a central ridge on forehead. Dark brown to black with yellow or greenish mottling. Rolls into a tight ball. (Fig. 7) - Armadillidium pictum*

* This is a very rare woodlouse (RDB3) of limestone pavement and scree in North Yorkshire and Cumbria which could possibly be found in Derbyshire.

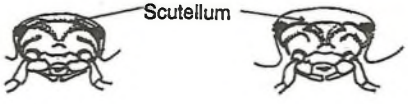


Fig. 6 Fig. 7

5 a) Scutellum formed into a distinct projection on forehead. Antennae remain outside when rolled into a ball. Grey-brown colour with darker bands along length (20 mm uncurled). More often in greenhouses than outdoors. (Fig. 8) - Armadillidium nasatum

b) Scutellum a central ridge on forehead. Antennae are tucked inside when rolled into a ball. Usually dark grey in colour but very variable (18 mm). (Fig. 9) - Armadillidium vulgare

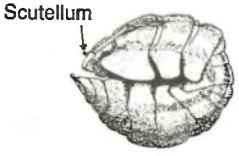


Fig. 8

Fig. 9

6 a) Tip (flagellum) of antennae composed of 2 segments (one of which is very small in white woodlice) (Fig. 10) - 7

b) Tip of antennae composed of more than 2 segments (several which are hard to distinguish tapering to a point,or 3.) (Fig. 11) - 12

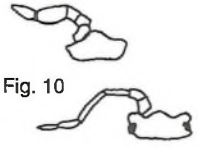


Fig. 10

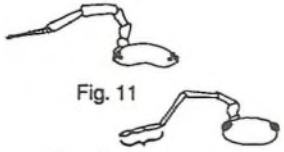


Fig. 11

7 a) First section of flagellum very short, second swollen. No eyes. Small (4 mm), oval and completely white. Only found with ants. - Platyarthrus hoffmannseggi (Fig. 12)

Fig. 12

b) Two clear segments to flagellum. With eyes. Larger (15 mm). - 8

8 a) Outline of body discontinuous. (Fig. 14) Purple-grey in colour with a bluish 'bloom'. White legs. Often in manure heaps and farmyards (12 mm). - Porcellionides pruinosus*

b) Outline of body continuous (Fig. 15) - 9

9 a) In cross-section body is strongly arched and able to roll into a slightly flattened ball. The antennae are left sticking out, as are the long tubular uropods. Underneath the body there are 5 pairs of white 'lungs'. (15 mm) (Fig. 13) - Cylisticus convexus

b) Body not so strongly arched and unable to roll into a ball. Only 2 pairs of white 'lungs'. - 10

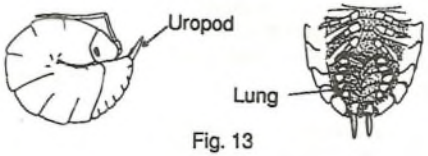


Fig. 13

10 a) Body colour slate-grey or grey-brown with small raised bumps on surface - 11

b) Body grey, brown or greenish with distinctly darker, black head and dark stripe. The central stripe is usually bordered by yellow blotches. (12 mm) (Fig. 15) - Porcellio spinicornis*

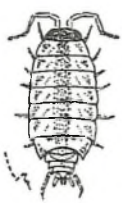


Fig. 14

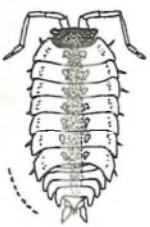


Fig. 15

11 a) Telson elongate and rounded at tip. Body broadly oval (width exceeding half of length). (15 mm) (Fig. 16) - Porcellio dilatatus*

b) Telson pointed at tip. Body narrower (width half of length). Normally overall matt slate grey with rough surface. Occasionally orange with dark speckles. Often found in houses. (17 mm) (Fig. 17) - Porcellio scaber

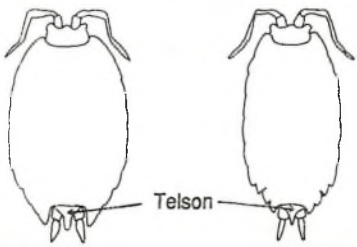


Fig. 16 Fig. 17

12 a) Tip of antennae composed of 3 distinct segments. Large species (over 8 mm) - 13

b) Tip of antennae composed of several small indistinct segments tapering to a point with fine bristles. Small species (less than 6 mm). - 14

13 a) Outline of body discontinuous. No lobes on side of head. Colour variable brown, green, yellow or red always with dark central stripe. Rear legs long. Fast moving. (11 mm). (Fig. 14) - Philoscia muscorum

b) Outline of body a continuous line. Lobes on head in front of eyes. Shiny grey with pale edges. Two rows of yellow patches along back (16 mm). Can be separated from P. scaber by absence of white 'lungs'. (Fig. 18) - Oniscus asellus

Fig. 18

14 a) Outline of body continuous. Each segment of fore body (pereon) with small longitudinal ridges. White/cream. - 15

b) Outline of body discontinuous. Fore body smooth or with tiny spines or bumps. Cream, purple-brown or pink. (Fig. 21) - 16

15 a) With 2 distinct projections on 3rd segment of hind body (Pleon) (Fig. 19)
- Haplophthalmus mengei/montivagus**

* Requires examination of male genitalia for separation of species.

b) With no distinct projections on 3rd segment of hind body (Pleon) (Fig. 20) - Haplophthalmus danicus*

Fig. 19

Fig. 20

16 a) Body smooth and shiny. White to red-brown or purple. Eye of 3 closely grouped ocelli (up to 5 mm). - 17

b) Body and head covered in tiny spines or bumps. Eye of a single ocellus (up to 16 m). - 18

17 a) Tiny, 2.5 mm. White to cream with no darker pigment. Eyes of 3 closely grouped ocelli. - Trichoniscus pygmaeus*

b) Small, 5 mm. Mottled red-brown to purple. Eyes of 3 closely grouped ocelli. (Fig. 21) Very young T. pusillus may lack pigment and resemble T. pygmaeus. However, juvenile T. pusillus have widely spaced ocelli rather than fused as in adult specimens. - Trichoniscus pusillus

Fig. 21

18 a) Eyes of a single black ocellus. Whole body a striking pink with a central yellow stripe (6 mm). (Fig. 22) - Androniscus dentiger

b) Eyes of a single large reddish-brown ocellus. Body a matt reddish-brown with tiny bumps over the surface. Telson and uropods white. (4 mm) (Fig. 23) - Trichoniscoides albidus*

Fig. 22

Fig. 23

Androniscus dentiger (Verhoeff)

Map 43

Rosy Woodlouse

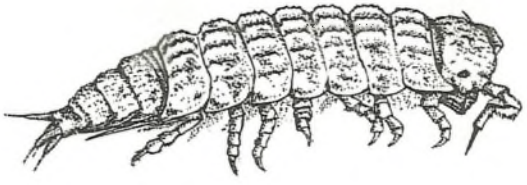
Despite its small size (6mm) this is probably our most distinctive woodlouse. As its English name suggests, it is bright pale pink to red in colour with a yellow and black stripe running down the middle of its back. This stripe is expanded towards the tail (see colour plate). Young *A. dentiger* can be distinguished from *T. pygmaeus* by the single large eye in contrast to the three closely set ocelli of the latter species. Also the dorsal surface of *A. dentiger* is covered in rows of small bumps whereas *T. pygmaeus* is virtually smooth.

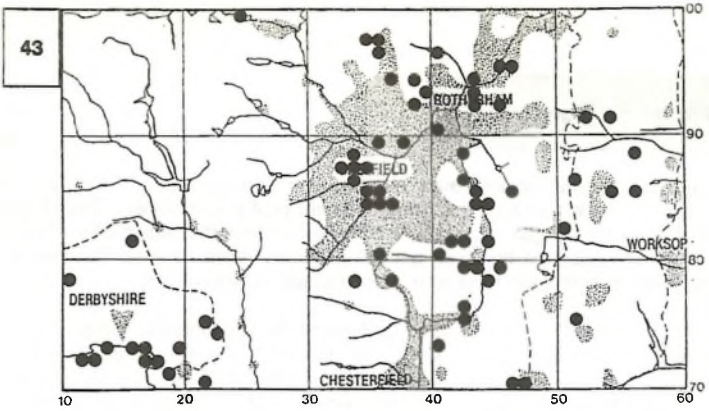
The habitat preferences of this species are clearly demonstrated on the map, although slightly exaggerated by the band of acid moorland south-west of Sheffield. The vast majority of records to the east are from synanthropic sites such as cellars, gardens, churchyards, railway lines and rubbish tips. This includes those found on the Magnesian Limestone. The records from the Carboniferous Limestone to the west, however, are from more natural sites, predominantly daleside scree. A few could be considered to be synanthropic from disused railway lines and quarries but on the whole the Derbyshire population does appear to indicate a more natural distribution for this species.

Haplophthalmus danicus (Budde-Lund)

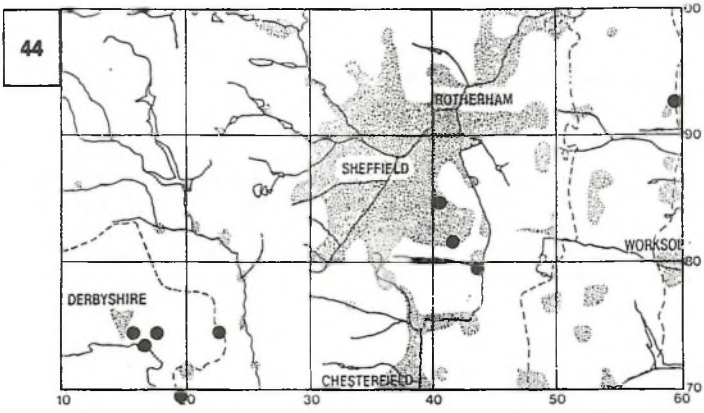
Map 44

These minute (less than 5mm) woodlice are certainly under-recorded in this region. *Haplophthalmus* species are recognised as pale cream, elongate, with no junction between fore and hind body (pereon and pleon) and eyes of a single black ocellus. The body sculpture takes the form of longitudinal ridges across each segment. *H. danicus* is distinguished from other *Haplophthalmus* species by the lack of a prominent projection on the third hind body (pleon) segment. The two local *Haplophthalmus* species are known from very few sites due more to their subterranean habitats than to their genuine scarcity. Of the two, *H. danicus* has a much more south-easterly distribution in Britain and seems to be at the edge of its range in the Sheffield area. This may be due to a preference for hot summers and cold winters with low rainfall (Hopkin 1987) linked to calcareous geology. Of the local records, all of those found in limestone areas were under stones or logs in the soil whereas those elsewhere were in damp rotting logs by streams or ditches. Normally they are found in ones or twos but where conditions are favourable they occur in large numbers. This was the case on a rotting log by a stream at Wickfield Heath (SK4084) where it is estimated that over 500 individuals were present.

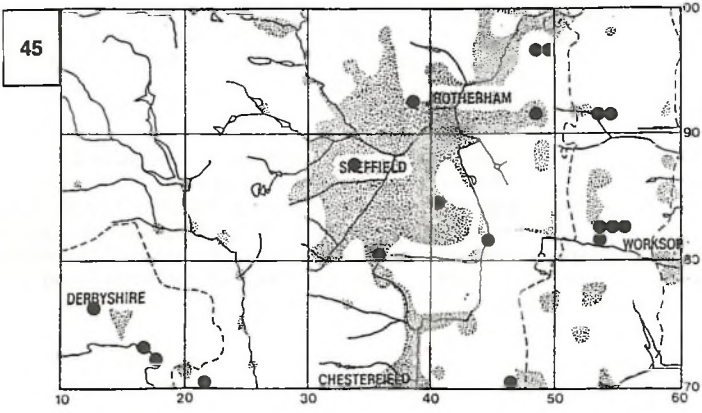




Androniscus dentiger



Haplophthalmus danicus



Haplophthalmus mengei
+ Haplophthalmus females

Haplophthalmus mengei (Zaddach)

Map 45

Very similar but slightly smaller than *H. danicus*. Distinguished by the two obvious projections in the middle of the third pleon segment (see colour plate). This character is also shared by *H. montivagus* a species as yet unknown from this region which can only be separated by characters of the male genitalia. As all males have so far proved to be *H. mengei*, records of females have also been included as this species.

Records for *H. mengei* show a greater preference for synanthropic habitats than does *H. danicus*. In fact the distribution matches well that of *A. dentiger*, where eastern records are strongly synanthropic, but the preference in western Derbyshire is for more natural habitats. This national distribution contrasts with that of *H. danicus* with a more north-westerly pattern. It is suggested that this may reflect an intolerance in this species to high summer temperatures in the south-east (Hopkin 1987) rather than any interspecific competition.

Haplophthalmus montivagus (Verhoeff)

Externally indistinguishable from *H. mengei* and has yet to be recorded in the Sheffield area. Since this species has only recently been recognised as occurring in Britain (Hopkins and Roberts 1987) its distribution is not yet fully determined. It is therefore necessary to have any male *Haplophthalmus* specimens with a projection on the pleon, checked by an expert. When searching out male specimens it should be noted that they tend to be slightly smaller than the females and should not be disregarded as unidentifiable juveniles.

Trichoniscoides albidus (Budde-Lund)

This species has not been recorded in the Sheffield area, but is known to occur nearby to the east and may simply have been overlooked locally. It looks very much like a dull, matt finish *T. pusillus* but the surface of the body is covered with small bumps and the uropods and tip of the tail (telson) are white. The eyes are of a single large brown ocellus and the antennae are quite short. When disturbed *Trichoniscoides* species creep away slowly in contrast to the rapid movement of *T. pusillus*. *T. albidus* can often be found in very wet circumstances such as under stones by streams and in ditches. It can be found in completely waterlogged soil by sieving (Harding and Sutton 1985).

Two further rare *Trichoniscoides* species may occur locally. *T. helveticus* and *T. sarsi* are similar in appearance to *T. albidus* but lack the strong bumpy sculpture and white tail. They are both white with pink-orange patches at the hind end and eyes of a single red ocellus. These species can only be confirmed by examination of the male genitalia. Little detail is known about these species but one or both appear to be active in very cold conditions and may come to the soil surface after a frost. *T. helveticus* has been found in ancient woodlands. *T. sarsi* is known only from synanthropic sites.

Trichoniscus pusillus (Brandt)

Map 46

A small (5mm) red-brown woodlouse with some pale mottling and a smooth shiny body surface. The colour may vary from iridescent purple (caused by a viral infection) to almost white in immature individuals. The eyes are composed of three black ocelli which are fused together in adults but separate in juveniles. Adult *T. pygmaeus* are similar to young *T. pusillus* but have fused ocelli.

This is a very widespread species in the Sheffield area and is probably the most common woodlouse although it is less often recorded than the larger species. It can be found predominantly on the soil surface or in leaf litter (Harding 1985) but occurs in most damp habitats under stones, logs or human refuse. When disturbed *T. pusillus* runs quickly which can help to distinguish it from other slower, similar species.

Trichoniscus pygmaeus (Sars)

Map 47

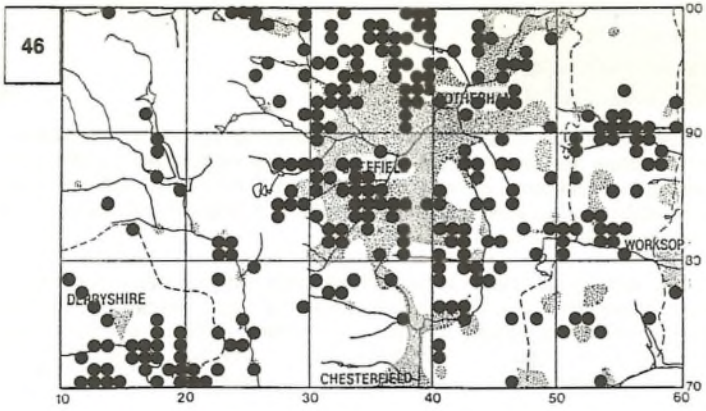
At a maximum length of 2.5mm this is the smallest woodlouse to be encountered locally. It is a creamy white in colour, occasionally with a darker cream central stripe towards the rear half. This gives the appearance of a tiny, pale *A. dentiger*. One gravid female specimen from Bolsover (SK4770) had a bright orange appearance. Each eye is composed of three fused black ocelli, unlike juvenile *T. pusillus* in which the three ocelli are separate. *T. pygmaeus* moves away quite slowly when disturbed, in contrast to the swift running *T. pusillus*.

This species is widespread in the Sheffield area but due to its small size is very under recorded. Over 90% of local records are from a variety of synanthropic sites. The remainder are from ancient woodland, an old hedgerow and several from limestone dales. It is most often found in damp soil under stones and logs or in leaf litter.

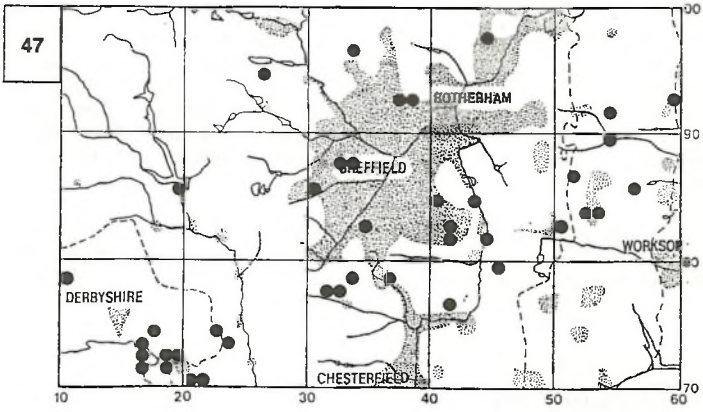
Cordioniscus stebbingi (Patience)

This alien species has been recorded from a plant pot in Lodge Moor, Sheffield (SK2986) in which a population thrived for over 5 years. It has only previously been recorded in Britain from heated greenhouses. It is very small (up to 3mm) and similar in colour to an adult *T. pusillus* but with rows of spine-tipped bumps. The eyes are of three tightly fused ocelli.

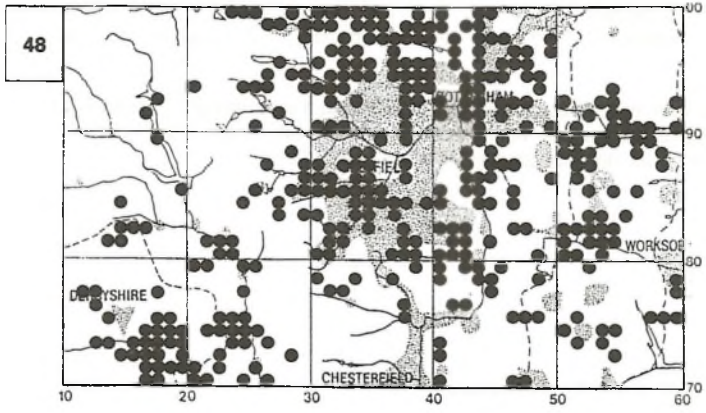
Species from hothouses should always be checked by an expert. At least ten non-native or non-naturalised species have been recorded from hothouses in Britain (Oliver and Meechan 1993) and new species could be found at any time.



Trichoniscus pusillus



Trichoniscus pygmaeus



Oniscus asellus

Oniscus asellus (Linnaeus)

Map 48

Common Shiny Woodlouse

This is the most commonly recorded woodlouse in the Sheffield area. It occurs virtually anywhere damp, especially in deciduous woodland and limestone dales. It is normally found in large numbers under stones, logs, planks of wood, flower pots, leaf litter, compost heaps or anything else which will provide shelter from the desiccating rays of the sun. *O. asellus* is much more tolerant of acidic conditions than most woodlice and can be found high up on the heather moorlands.

O. asellus is very distinctive shiny dark grey with paler grey edges and yellowish patches along the back (see back cover). Young specimens are less shiny and may be mistaken for the equally common *P. scaber*. However, the end section (flagellum) of the antennae in *O. asellus* comprises three sections whereas there are only two sections in *P. scaber*. the overall colour may vary from the usual grey to brown, yellowish or even orange, though these are much less common.

O. asellus has recently been recognised as having two distinct forms in Britain, *O. asellus asellus* and *O. asellus occidentalis*. The main differences are exhibited by the male genitalia (Bilton 1994) but with experience they can be recognised by the overall body shape. *O. asellus occidentalis* has so far only been found in the extreme west of Europe including south-west Britain and examination of local Sheffield specimens has only produced *O. asellus asellus*. Despite the good spread of records on the map, this species is still considered to be under-recorded, since it is so common that it should occur in the majority of 1km squares.

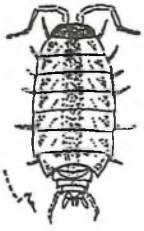
Philoscia muscorum (Scopoli)

Map 49

Common striped woodlouse

This is an attractive medium sized (11mm) woodlouse with three sections to the flagellum, a distinct step between the outline at the fore body and the hind body and a dark stripe down the centre of its back. The legs are long and it can run very quickly when disturbed. It is generally shiny, greenish brown with yellow mottling and slightly reddish edging (see colour plate). However, reddish, greenish or yellowish individuals are not uncommon.

This species is widespread in the Sheffield area in a wide range of habitats. Although it can be found under virtually any kind of shelter it is most frequently encountered under pieces of wood in synanthropic sites, woodland and limestone dales. In the latter habitat it is often found in scree and among grassland turf.



Platyarthrus hoffmannseggi (Brandt)

Map 50

Ant Woodlouse

As the common name suggests this species is usually associated with ants, being found either in the nest or under stones near to ant nests. It is small (4mm) but very obvious as a pure white, roundly oval, blind woodlouse with short antennae which twitch rapidly as it runs. The national distribution of this species largely reflects the south-easterly distribution of its hosts, primarily *Lasius flavus, Lasius niger* and *Myrmica rubra* (Hames 1987). Locally, the distribution of this species follows very closely the eastern band of Magnesian limestone. There are no records for the Derbyshire Carboniferous limestone despite the presence of the appropriate ant species. How much this distribution can be attributed to calcareous soil, ants, altitude or climate (Hopkin 1987) will only be determined through further detailed study of this species within the region.

The following five species are all capable to a greater or lesser extent of rolling into a ball when disturbed. They can be distinguished from the pill millipede, *Glomeris marginata* by the characters described under that species.

Armadillidium nasatum Budde-Lund

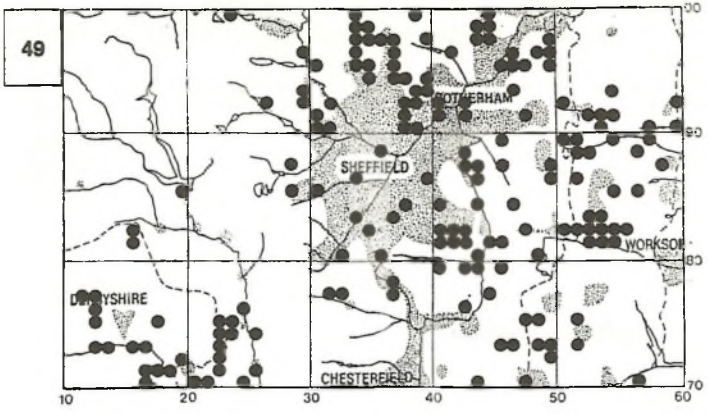
Map 51

This species can initially be identified by its inability to roll completely into a tight ball. It leaves a small gap from which the antennae protrude and lie over the back of its body. A very noticeable squared-off projection can also be seen sticking up between the antennae. The general colour is grey-brown with broad pale bands running from head to tail (see colour plate).

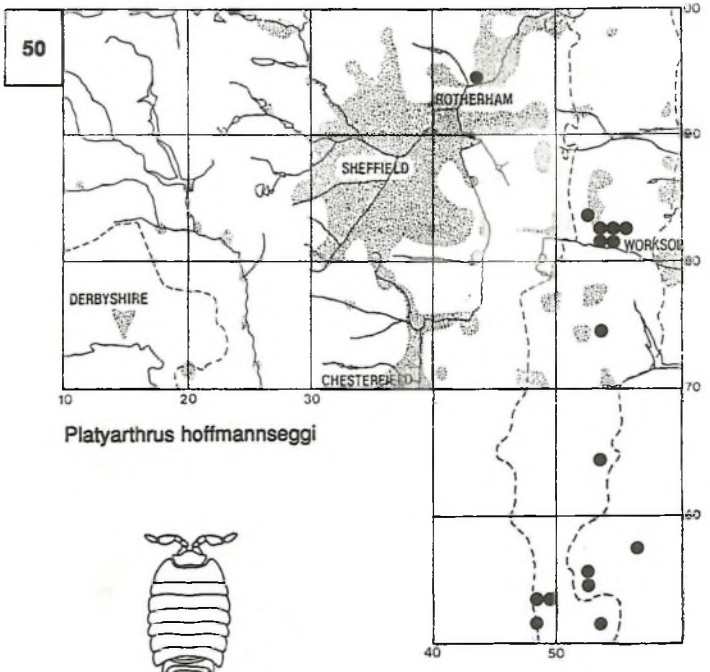
This is a southern species for which the more northerly records come from garden centres and greenhouses. The first Sheffield record was from a plant pot in the City Museum in 1979. A further population was found in greenhouses in the University Botanical gardens. Most recently this species has been found under stones in grassland at Woodhouse Washlands Nature Reserve. This is probably the most northerly outdoor site for this species. It occurs here with the other large pill woodlouse *Armadillidium vulgare.* It is suspected that the presence of these species is due to the railway line which runs adjacent to the site. This provides a local source of limestone with which these species are normally associated.

Armadillidium pictum Brandt

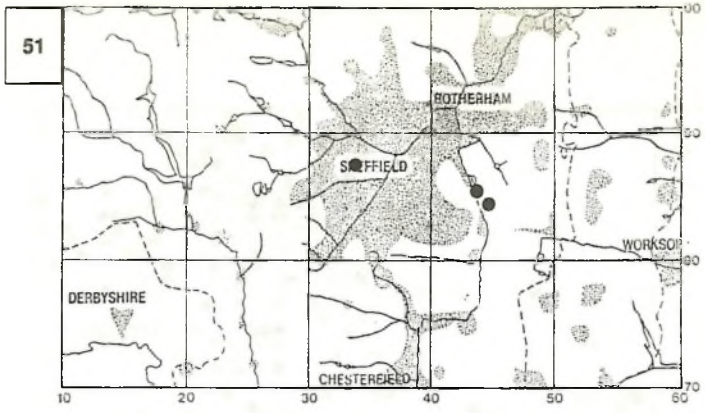
This very rare species has yet to be found in the Sheffield area. It occurs in remote rocky upland sites adjacent to woodland on a variety of geology. It is usually found under stones or moss but may occur deep within the soil. It closely resembles *A. pulchellum* but is almost twice its size. The hind angle of the first body segment protrudes strongly backwards unlike the blunt angle of *A. pulchellum*. The nearest records are from the Lake District and Lancashire but if this species is truly native (Harding & Sutton 1985) it may yet be found in the Peak District.



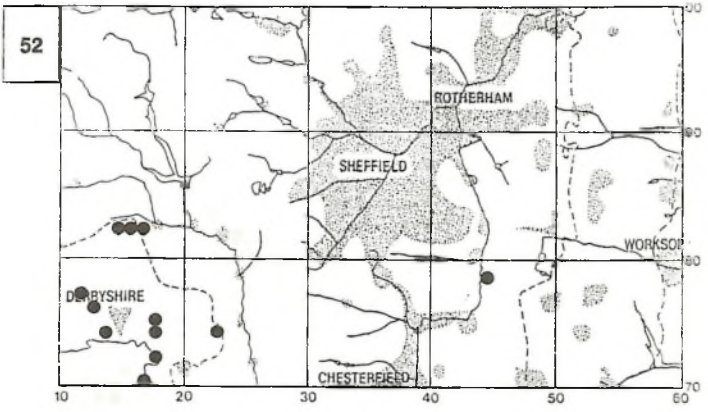
Philoscia muscorum



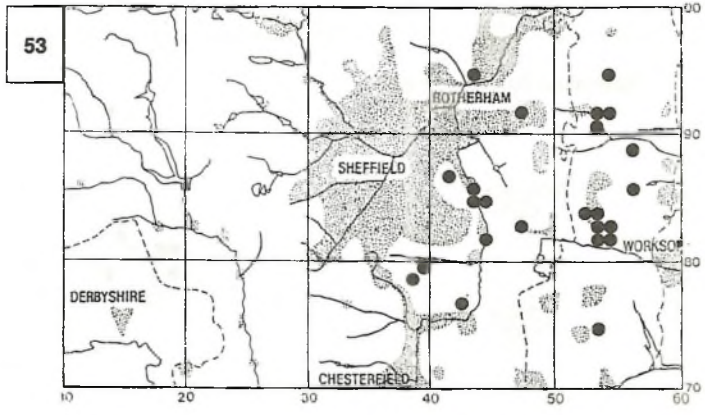
Platyarthrus hoffmannseggi



Armadillidium nasatum



Armadillidium pulchellum



Armadillidium vulgare

Armadillidium pulchellum (Zenker)

Map 52

This is an extremely attractive woodlouse which can be easily overlooked due to its small size when curled into a ball (3 mm). It is a shiny dark brown in colour, mottled with yellow orange and paler brown. The rear edge of each segment is usually bordered with orange and there is a solid dark patch on the outer edge of the last fore-body segment (7th pereonite). This last character is shared by the larger (9 mm) but similarly coloured *Armadillidium pictum*. *A. pulchellum* can be distinguished by its smaller size and the blunt rear corner of the first body segment. When rolled up *A. pulchellum* tends to leave a slight gap rather than forming a tight sphere.

Locally this species is entirely restricted to the Derbyshire carboniferous limestone dales where it is found widely among scree or under mats of moss and low herbs. The single synanthropic record is from Renishaw Park where it can only be assumed to have been introduced. The Derbyshire dales are one of the best places in Europe to find this species and it can be considered as one of the specialities of the region.

Armadillidium vulgare (Latreille)

Map 53

Common pill woodlouse

People from south and eastern parts of the country often think of woodlice as large slate-grey creatures which roll up into a tight ball. That is because this species, *A vulgare* is common in gardens and often active in daylight in those areas. In Sheffield, however, the sight of a pill woodlouse is something of a rarity. The map of local records can be divided from North to South by the 5 0 line. Records to the West are from heavily disturbed, synanthropic sites such as disused tips, collieries, railway lines and canals. Records to the east on the magnesian limestone belt are more numerous and predominantly from natural habitats. *A. vulgare* has not been found in the Derbyshire carboniferous limestone where it is replaced by *A. pulchellum*. This trend is also repeated in similar upland carboniferous limestone grassland areas such as the Burren in ireland and the Craven area of Yorkshire (Harding & Sutton 1985). Beyond the local mapping area, *A vulgare* is found to be more widespread to the south-east in Nottinghamshire in grassland, quarries and gardens.

The general slate-grey appearance of *A. vulgare* may occasionally be replaced by a brighter, brown, red and yellow mottling. This should not be mistaken for *A. pictum* which has a dark patch on the 7th pereonite. Both of these species roll into a very tight ball within which the antennae are held withdrawn.

Cylisticus convexus (De Geer)

Map 54

This species has a strongly arched back and can curl (with some persuasion) into a rather flattened ball much like the *Armadillidium* species. In common with *A. nasatum* it leaves its antennae sticking out over its back but in contrast to all other "Pill" woodlice. *C. convexus* has long tubular uropods which also stick out. By looking underneath the hind body, five pairs of white 'lungs' can be seen which locally are unique to this species. The colour is

generally pale brown-grey with lighter patches along the back and edges of the fore-body. The uropods contrast with the overall grey appearance by being buff or yellow.

The natural habitat for this species seems to be exposed, disturbed coastal sites (Harding & Sutton 1985). All the local records are from similarly disturbed synanthropic sites such as factories, tips and collieries. Although rare in the Sheffield area there is no reason to suppose that *C convexus* will not turn up regularly on urban waste ground, disused quarries and industrial sites. This species is distinctive enough to be found should anyone be searching in these less popular environments.

Porcellio dilatatus Brandt

Porcellio species are all large (12-17 mm in length) and have only two segments at the end (flagellum) of the antennae. *P. dilatatus* has yet to be recorded locally but may have been overlooked due to its similarity to *P. scaber*. *P. dilatatus* is more broadly oval in shape and has a distinctively rounded tip of the telson. It is an even brown-grey in colour with slight pale streaking and a distinctive sheen which can be recognised with experience (Hopkin 1991).

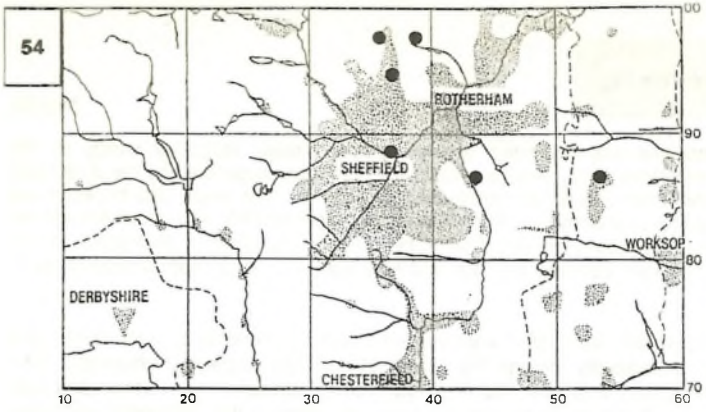
Another rare species which may possibly be found locally is *P. laevis*. This is similar to *P. dilatatus* but may be larger and has a very smooth body surface unlike any other *Porcellio* species which have rough tuberculate surfaces.

Porcellio scaber Latreille

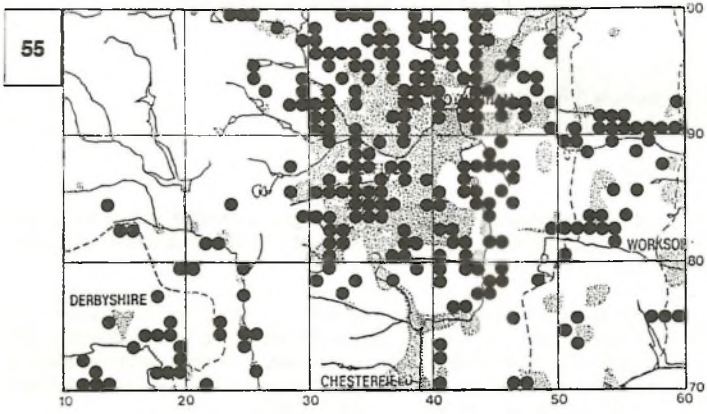
Map 55

Common rough woodlouse

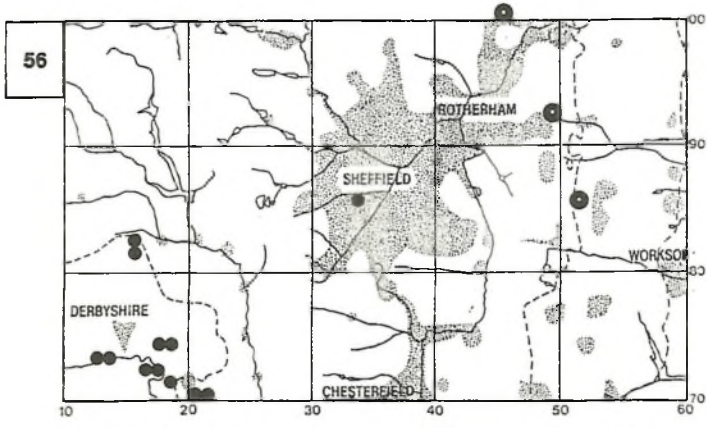
This species should be familiar to everyone. It is the second most commonly recorded species locally and the most likely to be found in houses. It is usually a uniformly dull slate-grey in colour with a roughly tuberculate surface, often with a brown base to the antennae. Occasionally paler, speckled yellow or orange forms occur. Juveniles of *P. scaber* and *O. asellus* can most readily be distinguished by the number of segments in the antennal flagellum - two in *Porcellio*, three in *Oniscus*. Additionally, *O asellus* does not have the two pairs of white 'lungs' found under the hind body of *Porcellio* species. *P. scaber* is most often encountered under rocks, wood or bark but may be found in a wide variety of situations. Locally the trend is for a higher proportion of *P. scaber* in synanthropic sites than *O. asellus*, but a higher proportion of *O. asellus* in woodland and rural sites. Much overlap occurs and generalisations are difficult but, for example, compost heaps in urban Sheffield will predominantly contain *P. scaber* whereas similar sites in rural Derbyshire may largely shelter *O. asellus*. Urban gardens adjoining woodland may present equal proportions of each. *P. scaber* is often thought of as being more tolerant of drier habitats than *O. asellus* which may be borne out by its presence in centrally-heated homes. However, there are few records for dry upland heath and moorland areas in which *O. asellus* seems to predominate. This is also supported by the national data on distribution. It seems more likely that acidity or altitude is more of a controlling factor in these extreme locations. Further studies of even these most common species would therefore be worthwhile for understanding this mechanism more clearly. Indeed, despite the large number of records for *P. scaber*, it is reasonable to say that it is one of the most under-recorded species in the area and well worth noting.



Cylisticus convexus



Porcellio scaber



● Porcellio spinicornis ◉ Porcellionides pruinosus

Porcellio spinicornis Say

Map 56

This is an attractive and distinctive species almost entirely restricted locally to the carboniferous limestone of Derbyshire. Adults can easily be recognised by the dark head and parallel sided body with a dark stripe down the centre. This stripe runs between two rows of distinctive yellow blotches. *P. spinicornis* can often be difficult to move but will run very quickly when it chooses to. The smaller, but superficially similar *P. muscorum* can be recognised by the step between the fore and hind body. This junction is continuous in *P. spinicornis*.

P. spinicornis is always associated with limestone, either directly in daleside scree and drystone wails, or indirectly through the mortar of buildings, especially churches. The single Sheffield record was from the back yard of a hardware shop, associated with building materials. It may be quite ubiquitous around homes in the Derbyshire dales and has has even been reported from coal bunkers and lofts (Whiteley, 1995). A good way to find this species is to look at night when it can often be seen in good numbers walking up wails and buildings. Where *P. scaber* tends to be found at the base of walls, *P. spinicornis* is more likely on the top or higher parts of such sites (Harding and Sutton 1985).

Porcellionides pruinosus (Brandt)

Map 56

(*Metoponorthus pruinosus)*

This medium-sized (10 mm) species is generally purple grey in colour with a distinctive dusty-purple 'bloom' and obvious white legs. The outline of the body is discontinuous, with a 'step' between the fore and hind body.

The three local records are from disturbed synanthropic sites, a quarry, railway line and reclamation site. This species is more normally associated with dung heaps, compost and farm buildings. The lack of local information for this species is almost certainly down to under-recording of these suitable habitats. A survey of dung-piles isn't as unpleasant as it sounds and would add greatly to our local woodlouse knowledge!

Presented here is a list of local sites which are known to be rich in ground invertebrates. This has come about largely due to intensive recording at these sites and does not necessarily represent a definitive assessment of habitat quality. There will inevitably (it is hoped) be sites which prove to be even richer than these, but for the beginner or 'twitcher' the following areas should provide much of interest. Most will provide a good variety of species, some will produce local rarities and one or two could reveal new species altogether.

Anston Stones Wood. Lindrick Dale (SK5382)

This is such a rich area for invertebrates generally that it comes as no surprise to find a correspondingly high concentration of myriapods and isopods. The combination of ancient woodland, grassland and limestone is irresistable but combine this with a damp, temperate, lowland setting and you have heaven. The tiny pill millipede *Stygioglomeris crinita* is to be found here. As are the equally small woodlice *Haplophthalamus mengei* and *Trichoniscus pygmaeus* along with the pill woodlouse *Armadillidum vulgare*. The two very locai parthenogenetic centipedes *Lithobius macilentus* and *Lamyctes fulvicornis* occur and this is of course the area in which *Lithobius variegatus* begins to decline. Why?

Castleton. Derbyshire

With Cavedale, Pindale and the woodland at Townhead (SK1582) you are presented with some very rich, user-friendly limestone habitat. At least eleven species of millipede can be found including the spectacular *Ommatoiulus sabulosus*. Woodlice are particularly varied in the scree of the dales and *Armadillidium pulchellum* is around, although not common. The cliffs under Peveril Castle are home to many *Porcellio spinicornis*, huddled in tight cracks during the day, but up and about after dark. Centipedes are poorly recorded but the small *Lithobids* will surely be interesting.

Chatsworth. Derbyshire (SK2670)

Around the house, gardens and woodland almost anything could turn up. Please remember to ask permission before up-ending the compost heap and flower beds though! A good colony of *Brachychaeteuma bagnalli* in a log pile is the only local site for this tiny millipede. Very little work has been done on the grassland but so far the ancient parkland has produced little of interest.

Coombs Dale

An excellent dale for insects and myriapods alike. *Stygioglomeris crinita* must be there somewhere. Only a female *Brachychaeteuma* has been found thus far so more work is necessary to pin down the species. The first part of the dale (SK 2374) from Stoney Middleton is probably the most productive, with many damp, moss covered boulders strewn around in the undergrowth. Woodlice from this area include *Haplophthalmus danicus* and *Armadillidium pulchellum*. The centipede *Lithobius calcaratus* is also to be found here.

Cressbrook Dale

Perhaps better known for its orchids and Wheatears this dale is simply packed with interest for those with a penchant for stone-turning. The northern, Litton end (SK1774) is the home of both pill millipedes (*S. crinita and G. marginata*) and the almost ubiquitous dales woodlouse *Armadillium pulchellum*. The small dark centipedes *Lithobius macilentus* and *L. calcaratus* are also found under the same stones.

Ecclesall Wood (SK3281)

This site is a bizarre mix of poor species diversity with occasional super-rare discoveries! The number and abundance of known species is remarkably low. The woodlice and centipede records are unremarkable and yet in the general vicinity of the woods there are species recorded from nowhere else. *Melogona gallica* seems to occur naturally, while *Allajulus nitidus* and *Ophiodesmus albonanus* occur in more synanthropic sites. The acid nature of this ancient woodland may restrict some species but its suburban setting may yet produce even more surprises as man exerts his influence.

Millers Dale (SK1573)

It is evident that virtually any of the Derbyshire limestone dales will produce numerous unusual species for this region. Millers Dale is currently the best recorded and therefore apparently the richest. In addition to the pill millipedes and woodlice, the two tiny *Haplophthalmus* species of woodlice also occur here in rotting logs. The lone western record for *Polydesmus inconstans* is from this dale and the scarce centipedes *Lithobius muticus, L. macilentus* and *Schendyla nemorensis* have all been found.

Westfield Plantation (SK4282)

There are no particular rarities known from this wood but the quantity and diversity of species make it worthy of attention. The most unusual things found in and around the site are the minute millipede *Macrosternodesmus palicola* and the woodlouse *Haplophthalmus danicus*. The beauty of this site is that within a very small area virtually all of the common local species can be unearthed in good numbers. One day in April every log turned revealed, on average, five pairs of *Polydesmus* millipedes plus any amount of snake millipedes, woodlice and centipedes. Not a spectacular site but along with others such as Little Matlock Wood (SK3089), Scholes Coppice (SK3995) and Shirtcliffe Valley (SK4185) it is an ideal place to begin looking for these animals. Damp conditions in spring will present the best 'selection'.

Wickfield Heath (SK4084)

A suburban oasis of relict heath, grassland and woodland presents an interesting and accessible site. The most notable record from this site is a large colony of *Haplophthalmus danicus*, but it is generally rich with both *Trichoniscus pygmaeus* and *Melogona scutellare* found in leaf litter, and all three blind blaniulid millipedes present.

Naturally there are many more sites locally than those listed above which will be rich in myriapods and isopods. As previously stated, there is a great deal of recording yet to be done before a true picture of diversity and distribution is seen. The above sites will give a good introduction to the subject. For further extending our local knowledge other new areas of searching await. These include urban and suburban gardens which as a habitat have barely been looked at and yet harbour some of the most interesting species. Farmyards and cultivated land are particularly under-recorded. For the possibility of unusual and alien species, greenhouses (especially the heated variety) and garden centres cannot be beaten. These have hardly been investigated in this region, but beware - the keys contained in this volume will be insufficent to ensure that new species are not overlooked.

On a general note, whole areas of Barnsley, Chesterfield and Nottinghamshire are completely without records for these groups. The animals are there but no-one to record them. Is there anybody out there?!

CONSERVATION AND MANAGEMENT

The Sheffield area supports a wide variety of millipedes, centipedes and woodlice. Due to geographical location the majority of these are common and widespread throughout the British Isles. However, several relatively uncommon species do occur, while others may be occurring at the very edge of their range of tolerance. For these latter species it is important to recognise their vulnerability and where possible to protect the micro-habitats in which they thrive. There are no species (with the possible exception of *Armadillidium pulchellum*) which rely on local sites for their overall survival, but this does not mean that their conservation in a local context is unimportant. All species are contributing to the richness of the local fauna whether they are common elsewhere or not. It has been shown that the very survival of a species outside of its normal range may be of great value in assessing habitat requirements as that colony has had little chance to adapt to its immediate environment.

The occurrence of some species may also help to indicate habitat quality or succession. The small number of species, ease of identification, and slow dispersal rate all suggest that the groups considered here would make excellent "indicator species". Further work in sites of known 'quality' may prove this to be the case. The ecological role of Myriapods and Isopods is well-known and the benefits to the ecosystem and man are inarguable. It is therefore hardly necessary to justify the existence and conservation of species simply because they are hard to find or do not appeal to popular taste. Fortunately many of the sites known for less common invertebrates already enjoy some degree of protection due to more conspicuous groups of organisms (Barber and Keay 1988). However, within these and other non-protected areas, important microhabitats are highly vulnerable. Synanthropic habits, preference for disturbed or decayed sites and ignorance of conservation workers can prove costly for many species. A tendency for 'tidiness' and aesthetics often means that unsightly human debris is removed, taking the invertebrates with it. A local example of this occurred on the only known site for the bristly millipede. The site was protected from open-casting entirely due to the presence of invertebrates. Some months later it was discovered that the single log on which *P. lagurus* occurred had been removed, probably because it hindered access! A similar fate may befall *Armadillidium nasatum* as it only occurs in a few 'clinker boulders' in Woodhouse Washlands. Hay cutting of this grassland site will no doubt be hindered by such 'obstacles'. Equally, the highlighting of such sites can itself prove hazardous to the population sheltering there, from the inquisitive and acquisitive.

There are three main problems associated with the conservation of the groups discussed in this volume. First of all it is hard to find the species, and until further recording has been carried out, assign a rarity value to them. Secondly the physical protection of what are often unnatural and impermanent sites is difficult. Finally, convincing conservation agencies and members of the public that these species are worthy of protection is of limited success. The only real solution is for greater education and promotion of the value and needs of these animals. A quantum leap in attitude may be required to turn "Creepy-crawlies" into "Farmers' friends"(!) and the latest cuddly toy craze(!) but until such time, myriapods and isopods are destined to remain the Cinderellas of the nature reserve. If non-native species such as Dormice can receive protection then why shouldn't endemic, indigenous and even other long established species do so?

It is probably pointless to list management requirements for millipedes, centipedes and woodlice until their conservation is first recognised as important. For now it is largely up to the individual myriapodologist to ensure that local conservationists are aware of any interesting species and clearly identify their microhabitats. In return environmental managers should recognise the place of ground invertebrates in conservation and provide or protect appropriate habitats. Urban sites will inevitably be subject to change but habitat

destruction need not be inevitable if "improvement" schemes recognise the value of synanthropic as well as natural elements. Rotting logs, stones, human refuse, leaf-litter and compost should be recognised as potential refuges and food sources for these animals. Localised high humidity or calcium levels could also be encouraged. Some disturbance may be beneficial but constant interference may cause desiccation or physical damage to the site and to the animals.

In an attempt to identify the more uncommon species in the Sheffield area, the following list shows those species for which there are fewer than 10 known sites (number in brackets). Since this may represent oversight in recording as well as genuine scarcity, all 19 species should be assigned provisional local red data book status (p LRDB).

Polyxenus lagurus	(?)	*Lithobius muticus*	(4)
Lithobius pilicornis	(1)	*Allajulus nitidus*	(4)
Brachychaeteuma bagnalli	(1)	*Geophilus electricus*	(6)
Cylindroiulus vulnerarius	(1)	*Stygioglomeris crinita*	(6)
Melogona gallica	(2)	*Cylisticus convexus*	(8)
Lithobius curtipes	(2)	*Lithobius calcaratus*	(8)
Brachyiulus pusillus	(3)	*Schendyla nemorensis*	(8)
Cylindroiulus latestriatus	(3)	*Haplophthalmus danicus*	(9)
Porcellionides pruinosus	(3)	*Ophiodesmus albonanus*	(9)
Armadillidium nasatum	(3)		

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"I lost my husband to an up-turned log!"

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PROJECT 2000/2000 SORBY INVERTEBRATE GROUP

This publication constitutes part of Project 2000/2000 - an attempt to publish 2000 maps of local invertebrates by the year 2000.

Above: Striped Centipede ***Lithobius variegatus*** and Common Shiney Woodlouse ***Oniscus asellus asellus***

Front Cover: Snake Millipede ***Cylindroiulus punctatus***

Photographs: Paul Richards

Sorby Natural History Society
Sheffield City Museum