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The Belgian Millipede Fauna (Diplopoda)

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Summary

The work done in the past on Belgian millipedes is briefly reviewed and previous publications on the subject are cited. A check-list of Belgian Diplopoda is given. Biogeographical districts of Belgium are indicated and the distribution of millipedes within these is noted. Each species is reviewed; its distribution in Belgium is related to its European geographical range and to knowledge of its ecology. Maps of distribution within Belgium are presented. There is discussion of the origins, evolution and community composition of the Belgian millipede fauna.

Key words: Diplopoda, Belgium, check-list, biogeography, ecology, faunal origins.

Introduction

The first list of Belgian millipedes to be published was that of PLATEAU (1872), comprising a dozen species. Further contributions to the fauna were made by PREUDHOMME DE BORRE (1884a,b); SCHOUTENDEN (1900); BEQUAERT (1913); SCHMITZ & BEQUAERT (1914); SCHUBART (1935a,b, 1938, 1939); LERUTH (1939) and DE QUEKER (1957).

The last Belgian list which covered the whole fauna was published by Irène DE QUEKER in 1962. DE QUEKER's paper lists all the previous publications on the subject, cites the localities in which the millipedes were found and contains a list of 46 species. However, five of these were marked as "probable" and to this day have not in fact been found. There were therefore 41 recorded species in Belgium in 1962. But, since *Cylindroiulus ellingseni* VERHOEFF 1912 is now regarded as a junior synonym of *Cylindroiulus vulnerarius* BERLESE 1888, this leaves 40 actually recorded species. DE QUEKER added a substantial amount of her own new data. Since 1962 there have been both extensive faunistic surveys and detailed ecological research into the millipede fauna. BRENY, BIERNAUX, BAURANT, PIERRARD and other colleagues at the Agricultural University in Gembloux made detailed studies of blaniulids and julids, including their ecology and economic importance (PIERRARD *et al.* 1963; BIERNAUX & BAURANT, 1964; BRENY, 1964; BRENY & BIERNAUX, 1966, BIERNAUX, 1968) culminating in a large dissertation (BIERNAUX, 1972) and the first Belgian millipede atlas concerning these two groups (BIERNAUX, 1971). Between 1977 and 1980 MARQUET made a huge collection of soil invertebrates taken from all regions of the country for the Belgian Royal Institute of Natural Science, the millipedes of which I identified and catalogued at the request of Dr Léon BAERT. My own collecting in Belgium began in 1974 and has continued to the present day. Detailed ecological studies were carried out from 1977 onwards, based in the laboratory of Professor Philippe LEBRUN at Louvain-la-Neuve, some of these with colleagues at Gembloux, and at the Belgian Royal Institute of Natural Science. These studies gave rise to a number of publications adding to the knowledge of the Belgian fauna (KIME & WAUTHY, 1984; BRANQUART, 1991; KIME, 1992; KIME *et al.*, 1992; BRANQUART *et al.*, 1995, KIME, 1997). A study of the saprophagous macrofauna of different types of humus in beech forests of the Ardennes was undertaken by DAVID *et al.*, 1993. More recently, ALDERWEIREILDT began working in this field at the University of Ghent, resulting in a paper on Houthulst Forest (ALDERWEIREILDT & KIME, 1997) and at Ename (ALDERWEIREILDT, 1997). One of ALDERWEIREILDT's students produced a thesis on the faunistics and ecology of millipedes in Flemish woodlands (VAN DEN HAUTE, 1999). This was based on a very large collection made in over 50 Flemish forests by Dr DE BAKKER of the Belgian Royal Institute of Natural Science, which is still being investigated. Recently, in 1999, the laboratory of Professor LEBRUN at the Catholic University of Louvain sampled 23 forests in the Ardennes on behalf of the Walloon Region; other similar studies are still continuing. As a result of these activities much material has accumulated, which will be placed in the collection of the Belgian Royal Institute of Natural Science. Work has continued in Belgian caves, resulting in recent publications involving diplopods e.g. DETHIER, 1998; DELHEZ, DETHIER & HUBART, 1999; DETHIER & HUBART, 2000.

The aim of this paper is to present an up-to-date check-list of Belgian millipedes and maps to show the recorded distribution of these species, together with an explanation of these distributions based on field work into their ecological requirements. There are about ten thousand

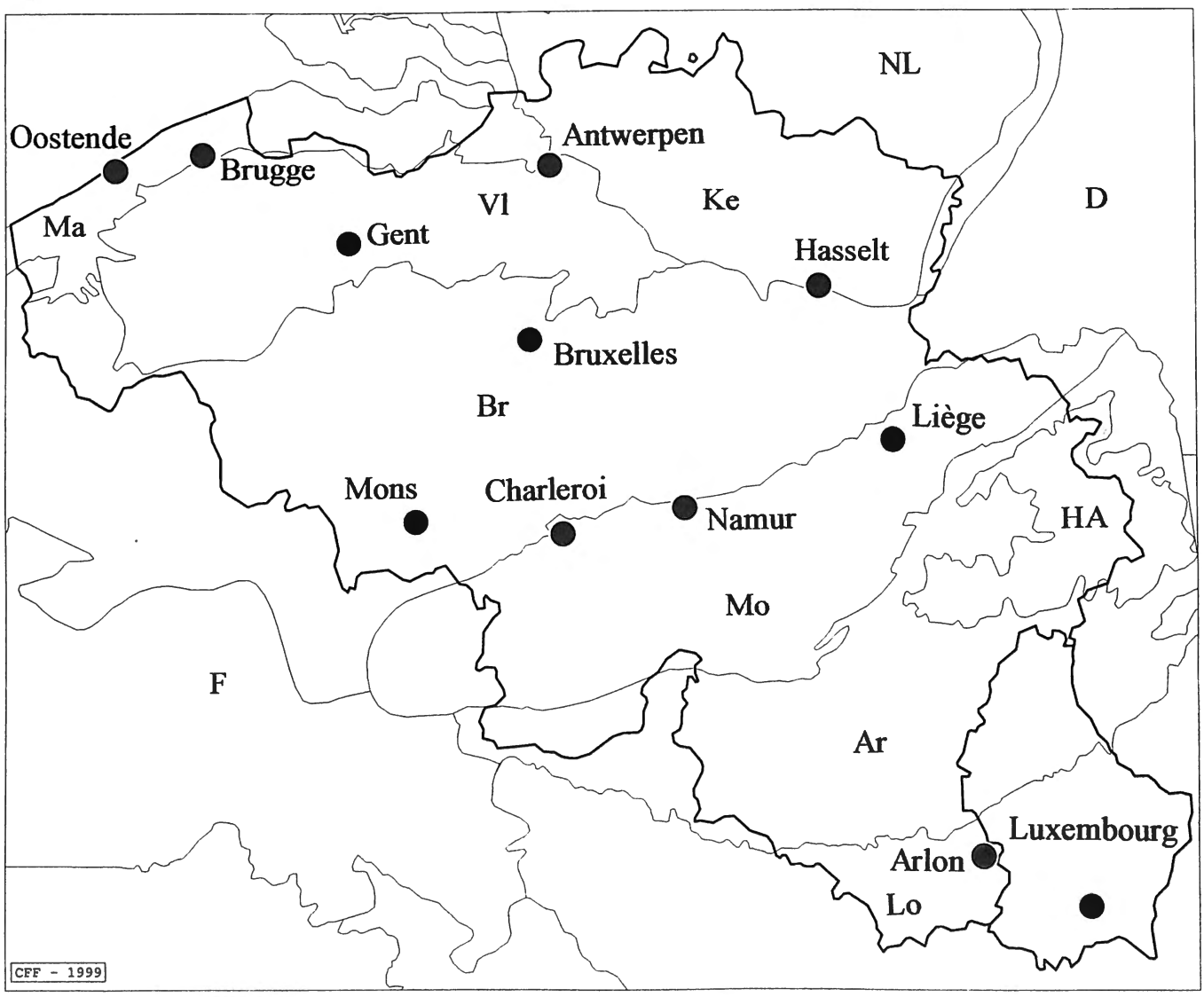
records of individual species in particular sites; the number of specimens of millipedes examined runs into six figures.

50 species have been identified in Belgium, in addition to which there are a few as yet unidentified immature or undescribed individuals of some more. Several species not yet found in the Country occur nearby.

Biogeographical districts

Although it is a fairly small country Belgium is divided into eight main phytogeographical districts which bridge the Atlantic and Continental zones of Europe. This being so, several species of myriapods reach the limit of their range of distribution within its boundaries. Belgium is geologically very varied; many different strata from the most recent Holocene back to the Cambrian period occur from sea level up to an altitude of about 700m, presenting a wide range of soils. Consequently there are marked climatic differences between some of the areas. As soil type and temperature are major factors influencing the distribution of millipedes (KIME & WAUTHY, 1984) there are significant differences between the millipede faunas of these various regions.

DUFRENE & LEGENDRE (1991), using correspondence analysis and meteorological, altitudinal, lithological, geological and pedological data, were able to divide Belgium into as many as thirteen geographically compact groups, with a gradient closely following the altitude component. There were strong regional trends in the ecological data set. Their first split in Belgium divided it along the Sambre-Meuse valley into the north-western Atlantic lowland province and the south-eastern Continental mainly upland province. This is a significant separation. Further divisions split the country more and more into



Map 1 — Biogeographical districts. Ma = Maritime District; Vl = Sandy-loamy Flanders; Ke = Campine; Br = Hennuyo-Brabançon Plateau; Mo = Mosan District; Ar = Ardennes; HA = High Ardennes; Lo = Belgian Lorraine.

Table 1 — Belgium: biogeographical districts (see map).

Name of district	Altitude	General nature of the countryside
Ma = maritime	0 to 5m	Holocene marine deposits (100-700 AD) Polders liable to flooding but protected by Dunes and embankments.
Vl = Flandrian	5 to 50m	Sands, clays or silts from the Eocene in the east to The Pleistocene in the west. A plain with shallow valleys.
Ke = Campine	20 to 120m	Sands, silts or peat from the Miocene and the Pliocene towards the southern edge of the plain, which is raised into a plateau in the north-east.
Br = Brabançon	50 to 200m	Sands or clays from the Eocene and, towards the north, the Oligocene. In the centre, Cambrian and Silurian outcrops at the heads of the valleys, large Carboniferous limestone formations to the south-west and in the south important outcrops of Cretaceous rocks in the vicinity of Mons and to the north-west of Liège. Countryside of low plateaux and hills.
Mo = Mosan	200 to 350m	Sandstones, limestones and schists of the Middle and Upper Devonian and the Carboniferous (coal measures in the north); Cretaceous formations east of Liège. Folded terrain: alternation of anticlines and synclines parallel to the Sambre-Meuse trench. Many quarries and caves.
Ar = Ardennes	350 to 550m	Sandstones, quartzites, schists and shales of the Lower Devonian. Countryside of plateaux dissected by deep valleys.
HA = High Ardennes	500 to 693m	Cambrian and Silurian quartzites, schists and shales. High plateaux, formerly dominated by peat bogs.
Lo = Lorraine	250 to 400m	Jurassic sands, clays, heavy loams and gritty limestones. A series of escarpments.

still homogeneous provinces which corresponded well with knowledge of the Belgian vegetation e.g. TOURNAY, 1968; DE LANGHE *et al.*, 1978. According to our analyses e.g. KIME *et al*, 1992, we are justified in basing the distribution of millipedes on the division of Belgium into the eight main biogeographical districts which are shown (Map 1) and listed in Table 1.

Area 1 is the maritime district (Ma) along the coast where some further differences are evident between the dunes and the polders. However, most of this zone is urban or farmland so that the number and scope of studies has been limited. Area 2 (Vl = Vlaanderen) is further inland and is a highly cultivated zone referred to as sandy-loamy Flanders or the Flandrian district. To the east of this is Area 3, the Campine (Ke = Kempen), restricted to the old River Meuse alluvial cone, where there are sandy heaths and acidic woodland on very poor soils. South of these zones is the rather higher and undulating Brabançon district (Br) or Hennuyo-Brabançon plateau, Area 4, mostly between 50 and 200m in altitude, a generally loamy zone of fertile farmland which ends to the north of the Sambre-Meuse valley. Area 5 is the Mosan district (Mo) which includes this valley; the trench of the Meuse constitutes a corridor from the south through higher ground, allowing the northward penetration of a number of taxa. In this region, to the south-east of the rivers Sambre and Meuse is the hilly and diverse Condroz-Fagne-Famenne country with a rich variety of Secondary sedimentary rocks including a fair amount of limestone, a zone which borders on the still higher and climatically harsher Ardennes region (Ar), Area 6, which is thickly forested, mainly on Primary strata. There are some regional differences within the Ardennes, the eastern Hautes Fagnes and other higher montane parts over 500m above sea level constitute Area 7, the High Ardennes (HA), including montane forest and peat bogs. Area 8, the Gaume or Belgian Lorraine (Lo), is part of the Paris basin, sedimentary in nature and of much the same altitude though more continental than the Condroz-Fagne-Famenne.

Apart from the variety of soils and biotopes a feature helpful to the study of millipedes in Belgium is the abundance of woodland, the primary habitat of these animals. This cover is relatively scarce in much of Flanders and parts of the Hennuyo-Brabançon Plateau but, elsewhere, is considerable.

For mapping purposes the Universal Transverse Mercator projection system is used. The territory includes 380

UTM squares of 10km side. This system was used by BIERNAUX (1971) for the first myriapod maps of Belgium. Almost every one of these 380 squares has been investigated, although some of them in a very superficial manner such as hand searching litter and dead wood when passing through.

After the following check-list of the millipedes known to occur in Belgium the regional distribution of each species will be considered in the light of the available knowledge of its ecological preferences. Reference will also be made to work in neighbouring countries and to the European distribution of the species.

Check-list of species

The list of species that follows is presented according to the general scheme of classification of HOFFMAN (1979). However, I have retained the genus *Brachydesmus,* which he included in *Polydesmus.* The species within a genus are presented in alphabetical order. Some taxa are recognised as subspecies. The check-list includes some widely used synonyms. The list includes only those species for which there are definite and precise data. Some authors, for example SCHUBART, 1934, have suggested the probable presence of species for which such information has not yet come to light.

POLYXENIDA

Polyxenidae

1 *Polyxenus lagurus* (Linnaeus, 1758)

GLOMERIDA

Glomerida

2 *Glomeris tetrasticha* Brandt, 1833
3 *Glomeris intermedia* Latzel, 1884
4 *Glomeris marginata* (Villers, 1789)
5 *Geoglomeris subterranea* Verhoeff, 1908
= *Stygioglomeris crinata* Brölemann, 1913
= *Geoglomeris jurassica* Verhoeff, 1915

JULIDA

Blaniulidae

6 *Blaniulus guttulatus* (Fabricius, 1798)
7 *Proteroiulus fuscus* (Am Stein, 1857)
8 *Boreoiulus tenuis* (Bigler, 1913)
9 *Choneiulus palmatus* (Nemec, 1895)
10 *Nopoiulus kochii* (Gervais, 1847)
= *Nopoiulus minutus* (Brandt, 1841)
= *Nopoiulus venustus* (Meinert, 1868)
11 *Archiboreoiulus pallidus* (Brade-Birks, 1920)
= *Boreoiulus pallidus*

Nemasomatidae

12 *Nemasoma varicorne* C. L. Koch, 1847
= *Isobates varicornis*

Julidae

13 *Julus scandinavius* Latzel, 1884
14 *Leptoiulus belgicus* (Latzel, 1884)
15 *Leptoiulus kervillei* (Brolemann, 1896)
16 *Leptoiulus simplex glacialis* (Verhoeff, 1894)
17 *Allaiulus nitidus* (Verhoeff, 1891)
18 *Cylindroiulus arborum* Verhoeff,1928
19 *Cylindroiulus caeruleocinctus* (Wood, 1864)
= *Cylindroiulus teutonicus* (Pocock, 1900)
20 *Cylindroiulus latestriatus* (Curtis, 1845)
= *Cylindroiulus frisius* (Verhoeff,1891)
21 *Cylindroiulus parisiorum* (Brolemann & Verhoeff, 1896)
22 *Cylindroiulus punctatus* (Leach, 1815)
= *Cylindroiulus silvarum* (Meinert, 1868)
23 *Cylindroiulus truncorum* (Silvestri, 1896)
24 *Cylindroiulus vulnerarius* (Berlese, 1888)
25 *Enantiulus nanus* (Latzel, 1884)
26 Brachyiulus pusillus (Leach, 1815)
= *Brachyiulus littoralis* Verhoeff, 1898
27 *Ommatoiulus rutilans* (C. L. Koch, 1847)
= *Schizophyllum rutilans*
28 *Ommatoiulus sabulosus* (Linnaeus, 1758)
= *Schizophyllum sabulosum*
29 *Tachypodoiulus niger* (Leach, 1815)
= *Tachypodoiulus albipes* (C. L. Koch, 1838)

CHORDEUMATIDA

Haaseidae

30 *Xylophageuma zschokkei* Bigler, 1912

Craspedosomatidae

31 *Craspedosoma rawlinsi* Leach, 1815
= *Craspedosoma simile* (Verhoeff, 1891)
= *Craspedosoma alemannicum* Verhoeff, 1910
32 *Nanogona polydesmoides (*Leach, 1815)
= *Polymicrodon polydesmoides*

Chordeumatidae

33 *Chordeuma sylvestre* C. L. Koch, 1847
34 *Melogona gallica* (Latzel, 1884)
= *Microchordeuma gallica*
35 *Melogona scutellare* (Ribaut, 1913)
36 *Melogona voigtii* (Verhoeff, 1899)
37 *Mycogona germanicum* (Verhoeff, 1892)
= *Orthochordeuma germanicum*
38 *Orthochordeumella pallida* (Rothenbühler, 1899)

Brachychaeteumatidae

39 *Brachychaeteuma bagnalli* Verhoeff, 1911

Opisthocheiridae

40 *Ceratosphys amoena confusa* Ribaut, 1920

POLYDESMIDA

Paradoxosomatidae

41 *Oxidus gracilis* (C. L. Koch, 1847)
= *Orthomorpha gracilis*

Polydesmidae

42 *Polydesmus angustus* Latzel, 1884
43 *Polydesmus coriaceus* Porath, 1870
= *Polydesmus gallicus* Latzel, 1884
44 *Polydesmus denticulatus* C. L. Koch, 1847
45 *Polydesmus germanicus* Verhoeff, 1896
46 *Polydesmus inconstans* Latzel, 1884
= *Polydesmus coriaceus* of a number of authors but not of Porath, 1870.
47 *Polydesmus testaceus* C. L. Koch, 1847
48 *Brachydesmus superus* Latzel, 1884

Macrosternodesmidae

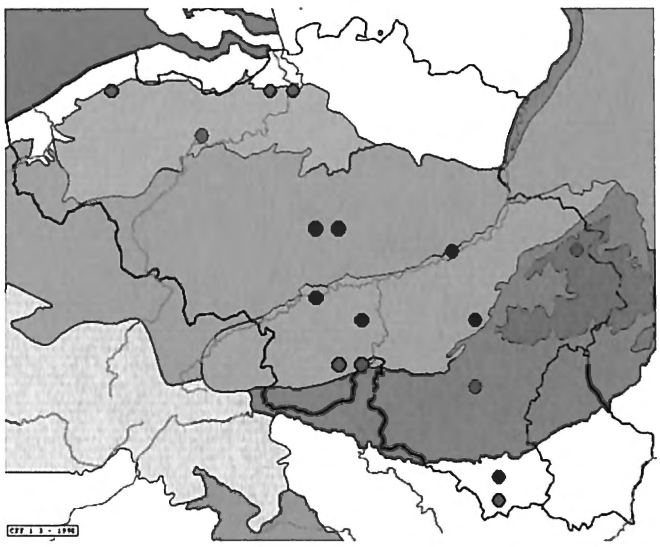
49 *Macrosternodesmus palicola* Brôlemann, 1908
50 *Ophiodesmus albonanus* (Latzel, 1895)

Distribution of Belgian millipedes

1. *Polyxenus lagurus* (Linnaeus, 1758) (Map 2)

Polyxenus lagurus is perhaps the most widely dispersed millipede in Europe, extending from the Mediterranean and the Azores to Lappland.

In Belgium captures of this small animal have been sporadic, even though, theoretically, it should occur throughout Belgian territory. As was reported in Switzerland (PEDROLI-CHRISTEN, 1993) this is supposedly because few of the methods of capture generally employed for millipedes are suitable for this species. On the whole *Polyxenus lagurus* has been obtained by chance, either in old damp walls in urban situations (Bruges, Ghent, Antwerp), sometimes in large numbers, or beneath the bark of dead trees and fallen boughs. Occasionally it has been successfully targeted, for example Dr. H. ANDRE (pers. comm.) found it regularly beneath foliose lichens (e.g. *Parmelia sulcata*) on tree trunks in seven sites that he examined. It was found by COLLARD (unpublished) under lichens on a big stone in a sphagnetum of the Hautes Fagnes (High Ardennes Region). LERUTH (1939) reported it from under stones in the entrance of the cave at Clermont-sous-Huy in the Province of Liège. To my knowledge, it has not fallen into pitfall traps in Belgium and, this far north, I have not obtained it from extractions of litter samples.



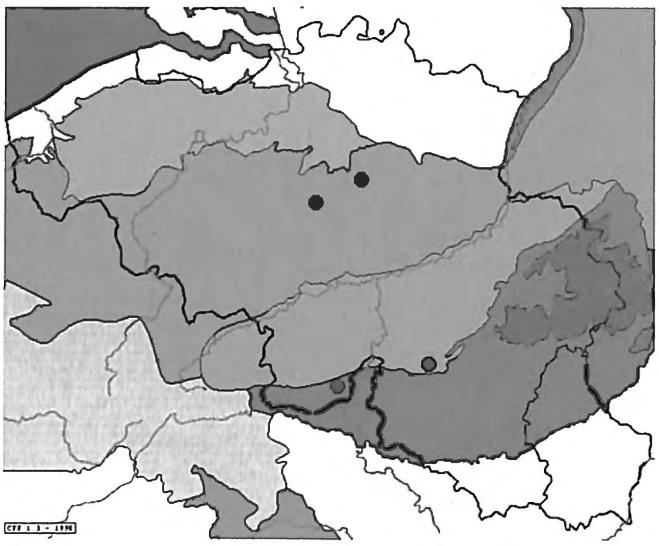
Map 2 — Distribution of *Polyxenus lagurus* (Linnaeus, 1758).

According to the map by ENGHOFF (1978) the frontier between the bisexual and parthenogenetic forms of *Polyxenus lagurus* is likely to pass through Belgium. Unfortunately the Belgian material that I have seen includes merely a few females and so it is not possible to elucidate this position at the present time. Altogether there are records from just 16 different 10km UTM squares in the whole Country. It is likely to be widespread.

2. *Glomeris tetrasticha* Brandt, 1833 (Map 3)

HOESS & SCHOLL (2001) demonstrated that at least two different taxa had long been described as *Glomeris connexa*, the two principal species involved being *G. tetrasticha* BRANDT, 1833 and *G. connexa* C. L. KOCH, 1847. The distribution of these is essentially Central European, from the Carpathians in the east as far west as Switzerland and the extreme east of France. In the literature records of *Glomeris connexa* extend from Spain in the west to western Russia and the Ukraine in the east. Many of these had been discounted before the paper by Hoess and Scholl appeared.

In Belgium, a female *G. "connexa"* was identified by SCHUBART (1935) from below stones at the entrance to the Grotte de Pré-au-Tonneau, a cave at Rochefort, which is in the south-east of the Province of Namur, dated 30. ix. 33. DELHEZ et al.(1999) cite the Grotte de Rochefort as well. Three further sites were given by DE QUEKER (1962), the first from a similar position to that of SCHUBART, under stones in the Trou Matricolo at Nismes, also in the Province of Namur, one example on 1. v. 54. and two more on 10. vi. 54. The other two records are from leaves in a ditch at Groenendael (4. vi. 54) and the foot of



Map 3 — Distribution of *Glomeris tetrasticha* Brandt, 1833.

a tree at Lubbeek (13. vi. 54), both in lowland Brabant. None of these animals is available for further inspection and these records cannot be confirmed.

It is likely that SCHUBART (1935), who followed Verhoeff's classification, found what is now regarded as *G. tetrasticha*. VERHOEFF (1938) regarded *G. "connexa"* i.e. *G. tetrasticha* as a glacial relict, therefore remnant populations in Belgium would not be altogether surprising. There are other examples to follow.

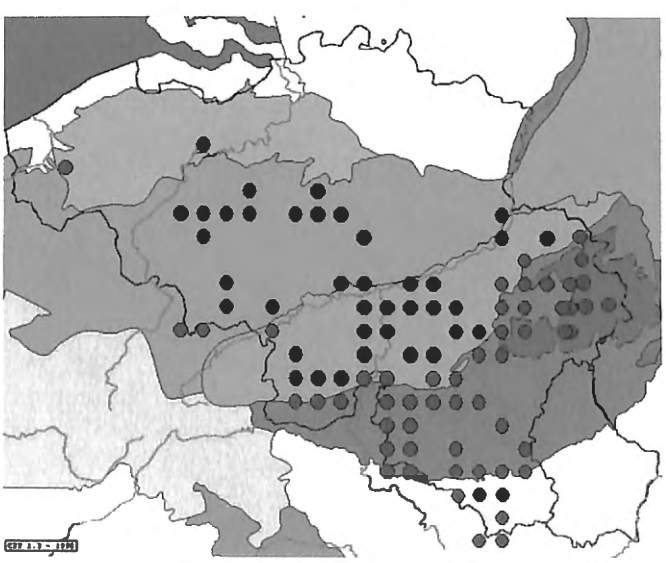
Because of the variability of patterned glomerids several of which may have four rows of pale spots on a dark ground their identification is sometimes very difficult and has led to a large number of erroneous reports of *G. "connexa"* from the Atlantic and other zones of Europe. The nearest previous record of "*G. connexa*" to Belgium was from near Cologne (THIELE, 1968). The map in HOESS & SCHOLL (2001) shows *G. connexa* no nearer than the Alps and *G. tetrasticha* no nearer than Baden-Württemberg. Nearly all the German records are really G. tetrasticha (SPELDA, pers comm.). I have not found an animal on the ground referable to either *G. connexa* or *G. tetrasticha* during thirty years of field work in Belgium. At the moment the presence of *G. tetrasticha* on the surface in Belgium is extremely doubtful. On Map 2 only the one or two underground records on the southern edge of the Mosan district are perhaps correct.

3. *Glomeris intermedia* Latzel, 1884 (Map 4)

G. intermedia occurs from northern Spain through virtually all of France into Switzerland, Benelux and a small part of Germany almost entirely west of the Rhine which it however crosses in the northern part of its range. It is the Atlantic vicariant of *G. hexasticha* which replaces it to the east in the Central zone of Europe.

G. intermedia is a very common animal in much of Belgium; it becomes sparse in Flanders which appears to be its northern limit. There are no records from the Campine and the sandy coastal area. This agrees with its distribution in the Netherlands (BERG, 1995) where it is confined to southern Limburg, and in Germany where it does not spread onto the northern coastal plain either. As it is an Atlantic species it might be expected to be common in the coastal parts of Belgium; It is unlikely to be the climate that is responsible for its absence from most of this area. More likely the soils in these chiefly sandy or highly cultivated areas are not suitable. The following species, *G. marginata,* is absent from Holocene soils too.

It is most plentiful in limestone areas, though by no means confined to them; it is however thought to be confined to woodland or very bushy places. Studies within Belgium e.g. KIME & WAUTHY, 1984; KIME *et al.*, 1992; BRANQUART *et al.*, 1995, have shown a number of preferences: its utilisation of the habitat is neither highly specialised nor is it a generalist. It is positively associated with mull humus, soils with high clay content, medium altitude and moderate temperatures, the latter particularly during the summer. It is highly typical of oakwood, especially Querco-carpinetum. The highest numbers were found in such woods on base-rich soils among which calcic mulls figured prominently. After this it was most frequent on mesotrophic mulls, then on oligotrophic or dystrophic mulls and some were found at low densities in moder humus. DAVID *et al.*(1993) recorded the species in beechwoods (Melico-fagetum and Luzulo-fagetum) in a detailed ecological study of such forests in the central Ardennes region. The humus types were mesotrophic and dystrophic mulls. They were situated in an area of Eodevonian schists and sandstones. Most of the suitable habitats for *G. intermedia* are found in central and southern Belgium, higher than the coastal and northern plains, up



Map 4 — Distribution of *Glomeris intermedia* Latzel, 1884.

to an altitude of about 560m in the Ardennes, where it is by far the commonest glomerid. It occurs in coniferous as well as deciduous forest. Soils on the highest strata in Belgium tend to be highly acidic and may be unsuitable. The association with clay may similarly be explained by the preference for basic and calcareous soils or soils on schists which all tend to be of the heavy type. Glomerids are "rollers" ecomorphologically, burrowing during cold periods in the winter and periods at the end of the summer when the leaf litter cover may have been consumed and it may be hot and dry on the ground. This ecomorphological type is associated with mull forests as it does not require thick litter for survival. It seems that population densities are low on some extremely heavy soils into which it may be difficult to penetrate (KIME & WAUTHY, 1984).

There have been some captures of *G. intermedia* in pitfall traps situated on grassland, although these have been close to forest and possibly reflect dispersal, mainly in summer. There is one record from below stones at the entrance to a cave (LERUTH, 1939).

In general, our conclusions are similar to those of CEDROLI-CHRISTEN (1993) from Switzerland, where the species unsurprisingly has a larger altitudinal range.

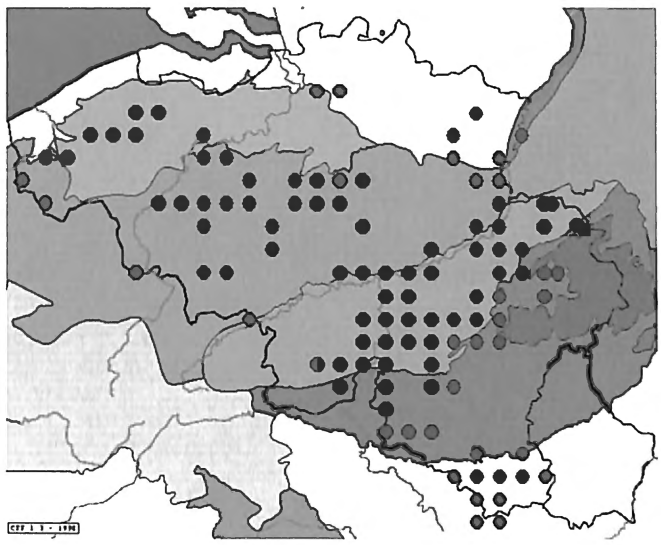
G. intermedia is extremely variable in appearance, frequently even within the population of one woodland. There are many different dorsal patterns of coloration and the ground colour itself is variable. Occasionally patterns are scarcely or not discernible; it is quite easy to confuse individuals with other species.

G. intermedia has been recorded from 93 different 10km UTM squares in Belgium, the eleventh most widespread millipede according to present records (Figure 2 shows the rank order of Belgian millipedes according to the number of 10 kilometer squares in which they have been found); this despite the fact that it has not yet been found in the Coastal area or the Campine.

4. *Glomeris marginata* (Villers, 1789) (Map 5)

The geographical range of *G. marginata* stretches from northern Spain to western Switzerland and Germany and just reaching Poland along the North sea coast. Its northern limit is from central Scotland and southern Norway to just north of the great lakes in Sweden (KIME, 1990). Within this range some upland and inland areas are too cold for it.

Glomeris marginata is found in all regions of Belgium with the exception of the coast. Again this ties in with its distribution in the Netherlands where it is not found in the dunes and polders, in fact nowhere on the recent Holocene deposits, but is restricted to the Pleistocene and older deposits above sea level in the south and east of the Country (BERG, 1995). We have not discovered it in the montane zone above 500m either, in the highest parts of the Ardennes. Indeed, it appears to be fairly scarce above 300m. The animal has an Atlantic distribution and is not found in locations where the winters are cold. It is evident from observations in France e.g. DAVID (1999)



Map 5 — Distribution of *Glomeris marginata* (Villers, 1789).

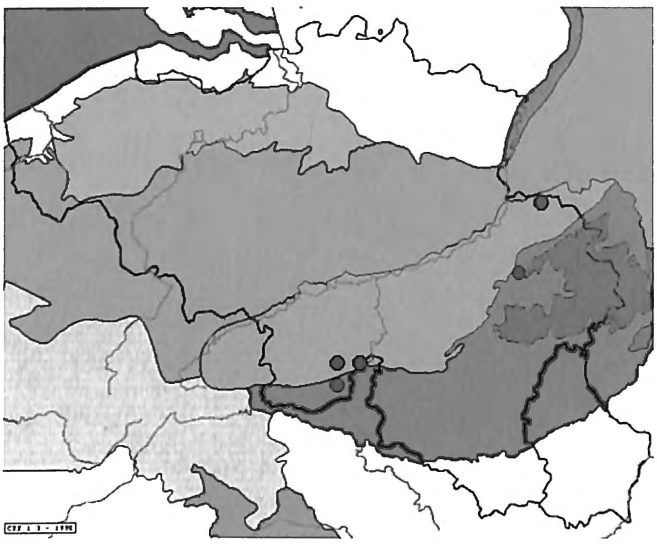
that it is abundant in thermophilous woodland on suitable soils, which are particularly those on limestone. While our earlier studies in Belgium (KIME & WAUTHY, 1984) showed it to be strongly linked with calcic mulls and clays, and subsequently oligotrophic mulls on heavy soils on schists as well (BRANQUART *et al.*, 1995), it was found in large numbers on sands with a high lime content by VAN DEN HAUTE (1999) in Flanders, who found that calcium content of the soil was absolutely the most important factor in determining its abundance. Although they share a number of preferences and often occur in the same habitat, *G. marginata* utilises the habitat more widely than *G. intermedia,* extending its range into non-wooded sites, occurring in grassland, farmland, cave entrances, parks, gardens and so forth. But it is on limestone that it contributes most importantly to the biomass of the soil macrofauna. As another burrower it is particularly associated with mulls, yet it has been found in mull-moders and even moders in smaller numbers.

G. marginata has been recorded in 105 of the Belgian 10km squares. It is most in evidence in the spring and usually in the autumn as well. It is eighth in rank in Belgium: acording to BLOWER (1985) this compares with fifth in England and Wales, third in Ireland and thirteenth in Scotland where it is absent from the north. It evidently responds to mild winter temperatures.

5. *Geoglomeris subterranea* Verhoeff, 1908 (Map 6)

This species has been found from France and Ireland in the west to Austria in the east. Many publications, including those in Belgium, have hitherto referred to it as *Stygioglomeris crinata* BRÖLEMANN, now supposed to be a junior synonym.

This strict calcicole has been found a few times in Belgium. It was first revealed in the Grotte de Remouchamps in the Province of Liège by DELHEZ in 1973



Map 6 — Distribution of *Geoglomeris subterranea* Verhoeff, 1908.

(DETHIER, 1998). In October, 1978, it was found by Berlese extractions of leaf litter and topsoil in a beech-wood on chalk at Remersdael very close to the Dutch frontier in south Limburg, an estimated population of 90 individuals per m -2. (KIME & WAUTHY, 1984). Subsequently it was discovered by the same technique in the calcareous part of the Viroin-Hermeton Natural Park in the south-west of the Province of Namur (BRANQUART & GASPAR, 1996). These authors showed that it was one of a small group of endogeic species capable of being sampled only by this method. It has been found at more sites in this area both by BRANQUART (pers. comm.) and by myself, along the valley of the Viroin from Nismes to Treignes and east to Vaucelles. My site in this region was a closed Querco-carpinetum, a calcic mull on limestone. Many other woodlands on calcareous formations in other parts of Belgium have been sampled without success. It seems to be a specialised species; there is more to find out about its ecological requirements. The records to date are from mulls on clay-loams. In both the sites that I investigated the dominant millipede was *Allaiulus nitidus*. Finally, in Belgium, all the animals were females.

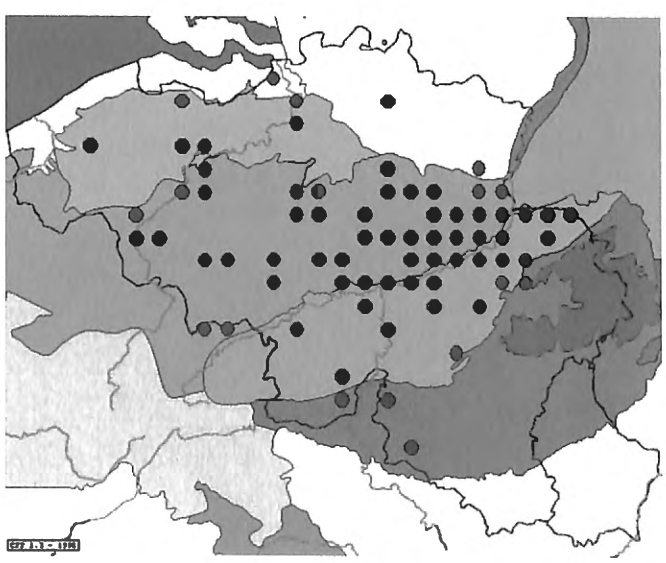
G. subterranea has been found in 5 UTM squares in the Mosan District (Sambre-Meuse and Condroz-Fagne-Famenne zones). It may be significant that all the known sites are close to the Meuse valley corridor.

6. ***Blaniulus guttulatus*** **(Fabricius, 1798)** (Map 7)

This animal has a wide distribution in Europe. While it is to a high degree synanthropic there is evidence from Belgium that it may be a natural component of the fauna in some situations, notably woodland on basic soils. Our sampling in a large number of forest sites (KIME et al, 1992) has shown that all the specimens of this species were found in soils with mull humus, about half of them being in calcic mulls. It was generally on heavy loam soils, although in addition to clay particles there was usually a moderate sand content as well.

BLOWER (1985) noted that it was the commonest blind julid in both woodland and open land in Britain, especially in good arable loams, that it was not frequent in base-deficient soils and generally absent from sandy soils. BRENY & BIERNAUX (1966) met with this species particularly in deep well-structured loamy cultivated soils, usually of high pH, and in gardens, noting the importance of compost and surface refuse. These authors discuss the ecology of the species and its importance with respect to attacks on a wide range of agricultural crops.It has a reputation as a pest of fruit and vegetable crops such as strawberries, sugar beet and potatoes. In fact it eats a wide range of organic matter; it has been found in excrement and in cadavers. In both the countryside and in towns *B. guttulatus* occurs regularly in gardens, parks, orchards and waste land.

BIERNAUX (1968), in a detailed study, came to the conclusion that *B. guttulatus a*voids soil layers with a water content lower than 11%, and dwells readily in a soil layer with more than 13% humidity. PIERRARD *et al.* (1963) showed that *B. guttulatus* burrowed downwards into the soil in autumn when the temperature of the soil in which it was situated fell below 4-6°C and that it migrated upwards again at the end of winter when the soil temperature was 4.5-5°C. KIME *et al.* (1992) reported that the animal showed a preference (over 70% of the individuals) for sites where the average annual temperature was between 8.8 and 9.1°C, relatively high for Belgium, and that it avoided the coldest parts of the country. The distribution map at present suggests that the animal is most common in the agricultural belts of Central Belgium, rare in the sandy maritime and the Campine zones and absent from the High Ardennes. The absence of records from the Gaume (Belgian Lorraine) is most likely due to a lack of prospection of synanthropic sites, but may be attributable



Map 7 — Distribution of *Blaniulus guttulatus* (Fabricius, 1798).

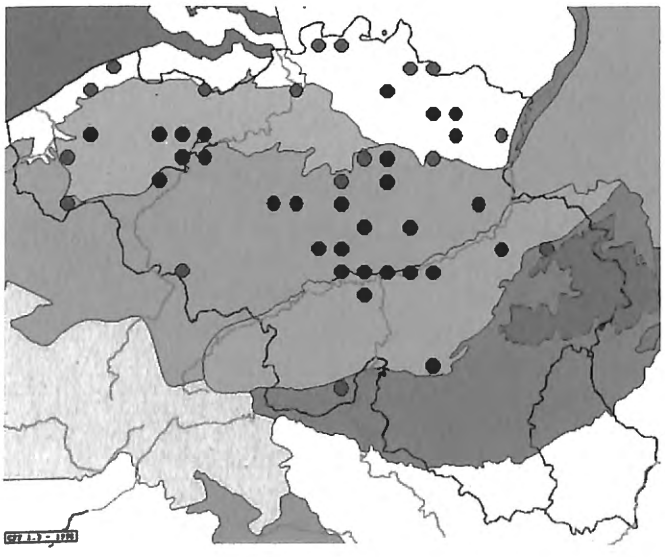
to its more continental position as well. The animal seems to be quite specialised. It is troglophile and attains high populations in several caves. The genus has an Atlanto-Mediterranean origin, which may help to explain its preferences.

B. guttulatus has been recorded from 72 UTM squares in Belgium.

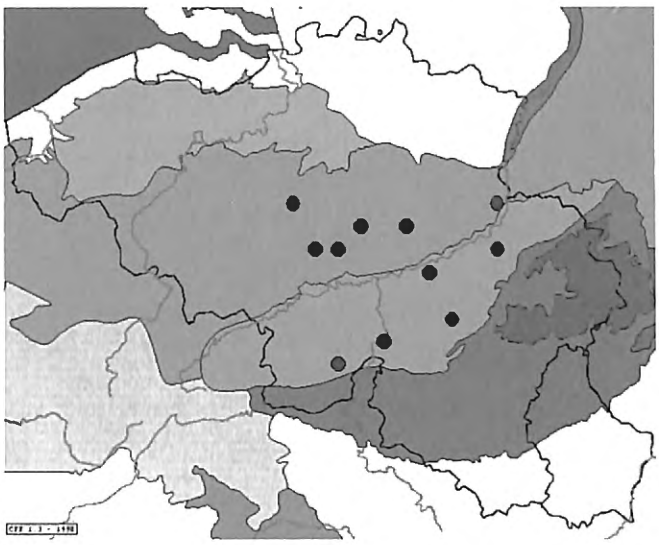
7. *Proteroiulus fuscus* (Am Stein, 1857) (Map 8)

This common northern European species probably occurs throughout Belgium. At the present time records are still patchy and there are few from the south of the Country, practically none from the Ardennes and Belgian Lorraine. It is not an abundant animal in Belgium, recorded from merely 46 UTM squares. My experience is that it is far less common in Belgium than in Britain. South of Belgium it has been seen sporadically in Luxemburg and in Lorraine in France; in France all the existing records are from the north and east (MAURIES, GEOFFROY, pers comm.; see map in KIME, 1990). It is missing from most of the French territory. However, it is known to be found in the montane zones of southern and western Germany and may be expected in the Ardennes. As elsewhere the animal is mainly discovered under bark of dead branches and trees, both deciduous and coniferous. A subcorticole, it walks to find suitable trees or fallen branches to colonise and so it is occasionally found in leaf litter; sometimes adult females have fallen into pitfall traps. It has not been found in Belgian caves. Males have only very rarely been found.

On the basis of UTM squares it is 18th in rank in Belgium; in Britain it was ranked sixth by BLOWER (1985) and in the Netherlands fifth by BERG (1995).



Map 8 — Distribution of *Proteroiulus fuscus* (Am Stein, 1857).



Map 9 — Distribution of *Boreoiulus tenuis* (Bigler, 1913).

8. *Boreoiulus tenuis* (Bigler, 1913) (Map 9)

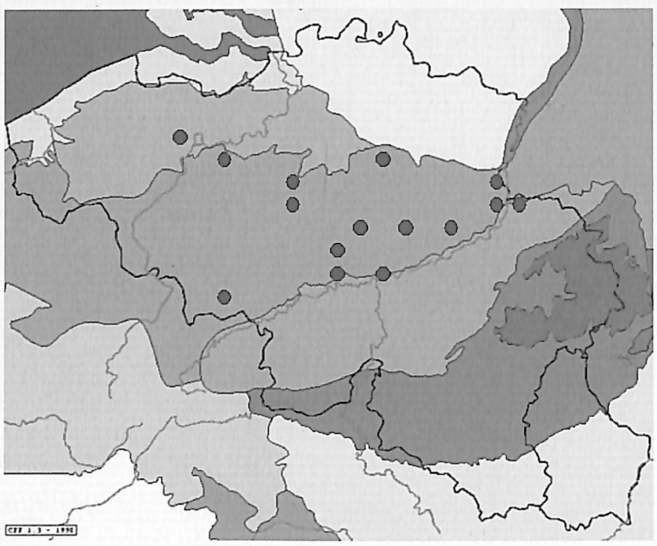
In Europe *B. tenuis* has an even more marked northern distribution than *Proteroiulus fuscus;* although it has spread to Britain and Ireland it has a central European orientation, there are not many records from France. These French records are from the northern and eastern departments.

All the existing records of *B. tenuis* in Belgium are from the two central belts of the Country, the Brabançon Plateau and the Mosan District. These areas, highly cultivated on the plateau, have been studied more than the others; there is not enough information to come to any firm conclusions about its Belgian distribution. BLOWER (1985) states that *B. tenuis* occurs in woodland, especially in base-rich soils, and in association with *Blaniulus guttulatus* in arable land. It is well known from crops of beetroot, where it may be a pest, as are *B. guttulatus* and *Archiboreoiulus pallidus* (BRENY, 1964; BRENY & BIERNAUX, 1966). It has been found on banks of clay deep in Belgian caves (SCHUBART, 1935, 1939) in the Provinces of Liège, Luxembourg and Namur, again mostly Mosan sites, otherwise it appears to be among the most synanthropic of the blaniulids.

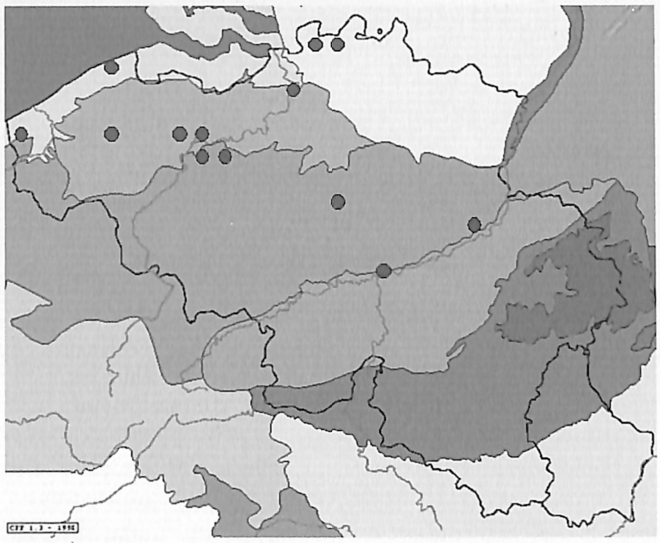
B. tenuis has been recorded from only 11 UTM squares.

9. *Choneiulus palmatus* (Nemec, 1895) (Map 10)

This blaniulid, widely-distributed in Europe and beyond (ENGHOFF, 1984), has been found in the Mosan District, the Brabançon District and the Flandrian District. It has been collected in a variety of biotopes under human influence, e.g. greenhouses, gardens, parks, nurseries, cemeteries, galleries of mines and spoil heaps. SCHUBART (1938) recorded it from a cave at Lanaye on the Dutch frontier. It usually occurs in the soil or above ground



Map 10 — Distribution of *Choneiulus palmatus* (Nemec, 1895).



Map 11 — Distribution of *Nopoiulus kochii* (Gervais, 1847).

under the bark or in dead wood of old trees. Occasionally *C. palmatus* has been found in forest litter. It has been captured in pitfall traps on calcareous grassland, as already noted by PEDROLI-CHRISTEN (1993). BIERNAUX (1972) cites an ant's nest and JEEKEL (1978) mentions a mole's nest in the Netherlands. There seems to be an association with fertile soils, in more natural situations these are frequently on basic and calcareous strata.It is sometimes an agricultural pest (PIERRARD & BIERNAUX, 1974).

C. palmatus has been recorded from 15 UTM squares in Belgium.

10. ***Nopoiulus kochii* (Gervais, 1847)** (Map 11)

Nopoiulus kochii is an anthropochorous species in much of Europe; it is particularly common in eastern Europe, indeed the genus is based in the Caucasus.

BIERNAUX (1972) suggests that it prefers light soils rich in humus such as are found in horticultural establishments in Flanders. DE QUEKER (1962) reported it from plant pots, manure heaps, rotting tree stumps, under bark, in litter and in the ground. In Switzerland FAES (1902) stated that it was abundant in numerous sites in the alluvial valley of the Rhône where he thought that it replaced *B. guttulatus*. PEDROLI-CHRISTEN (1993) reports it from pitfall traps sited in open grassland sites as well as parks and gardens. Though reported from caves elsewhere it has not yet been found in a Belgian cave.

It is strongly synanthropic and has not been discovered in soil samples from almost a hundred semi-natural forest stations in Belgium.

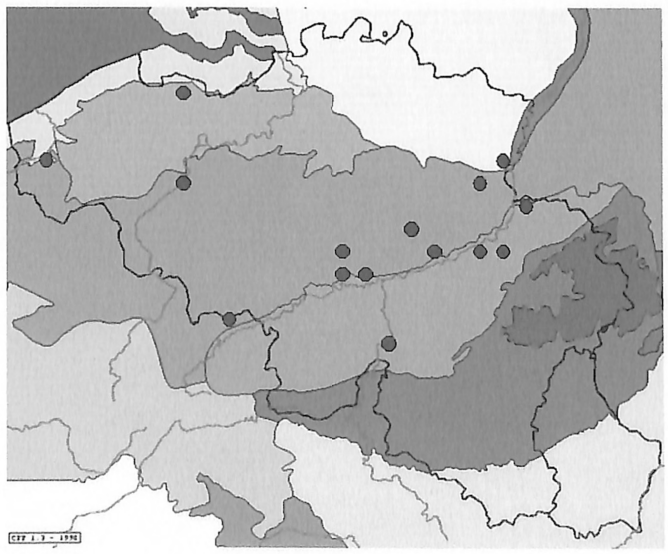
N. kochii has been located in lowland Belgium northwards from the Sambre-Meuse trench through the Brabançon and Flandrian Districts to the sandy coastal area, mainly in Flanders.

There are records from 13 UTM squares.

11. ***Archiboreoiulus pallidus* (Brade-Birks, 1920)** (Map 12)

This is another species commonly found in association with *Blaniulus guttulatus*, with which it apparently shares some ecological requirements. It was described by BRADE-BIRKS (1920) from a crop of beans and in subsequent detailed examinations of agricultural soils it has frequently been uncovered. It is now widely reported from Europe north of a line from Bordeaux to the Black Sea.

In Belgium it received much attention at Gembloux in view of its attacks on beetroot and several other crops in conjunction with *B. guttulatus* and *B. tenuis*. BIERNAUX & BAURANT (1964) described its vertical migrations, descending in autumn when the soil temperature fell below



Map 12 — Distribution of *Archiboreoiulus pallidus* (Brade-Birks, 1920).

5-5.3°C and moving up again in the spring when it experienced temperatures of 4.5-5°C. *A. pallidus* is not only endogeic but also troglophile; it has been found in several caves. It has been captured in pitfall traps placed in grassland.

It is much less evident in superficial and synanthropic situations than some of the other blaniulids. Yet, despite its late discovery *Archiboreoiulus pallidus* is probably a common species in base-rich soils, escaping detection because of its subterranean habits. In Britain FAIRHURST (1984) noted that four fifths of the records were from calcareous soils and the soils were predominantly loamy.

A. pallidus has been recorded from 15 UTM squares in Belgium, mostly from the Brabançon and Mosan Districts.

12. *Nemasoma varicorne* C. L. Koch, 1847 (Map 13)

Although N. *varicorne* is widely distributed in the cool temperate parts of Europe it is essentially a Central European species and is not particularly evident in Belgium.

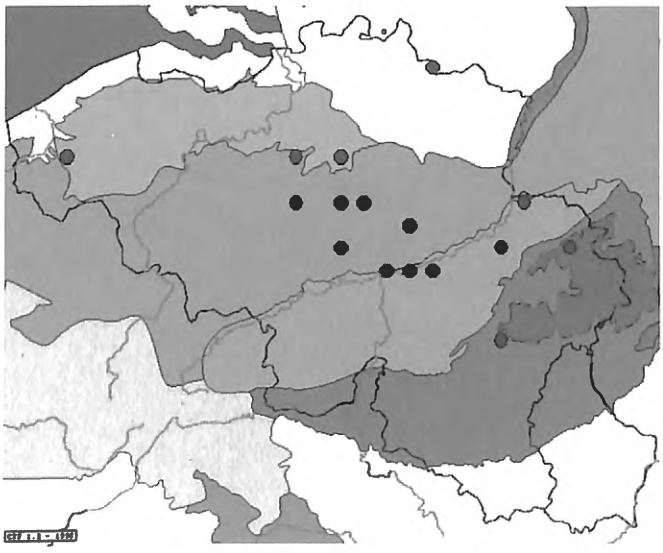
The optimum habitat of *N. varicorne* is under the bark of deciduous trees, with a high proportion on beech (*Fagus silvatica*). Individuals have been caught in traps on the trunks of trees in autumn and winter and in pitfall traps, even in grassland, during the winter, suggesting that they disperse during the latter season (KIME, 1997). In England females lay eggs singly during the spring and summer and it takes a minimum of two years for the juveniles to become adult, during which time they remain under the bark of the tree (BROOKES, 1974). The British populations belong to the parthenogenetic (thelytokous) form of the species, and as far as one can tell from the evidence so far the Belgian populations belong to the same form. It can be seen from the maps and observations of ENGHOFF (1976, 1994) that Belgium lies close to or on the boundary between the bisexual and thelytokous forms. The paucity of records in Belgium makes a judgment of the situation premature; there are no records from the coastal region or the South (Belgian Lorraine) and there are very few from the eastern Province of Liège which lies in the direction of the Central European bisexual form. As I found two males together with three females in a beechwood in the Grand Duchy of Luxemburg quite close to Belgium it is quite possible that both forms occur here.

Nemasoma varicorne has been recorded from only 17 UTM squares. I have not often encountered it in neighbouring parts of France either. In his atlas BERG (1995) indicates its presence in 21 squares out of the 473 in the Netherlands. Records suggest that it is more abundant in Britain than in the Low Countries.

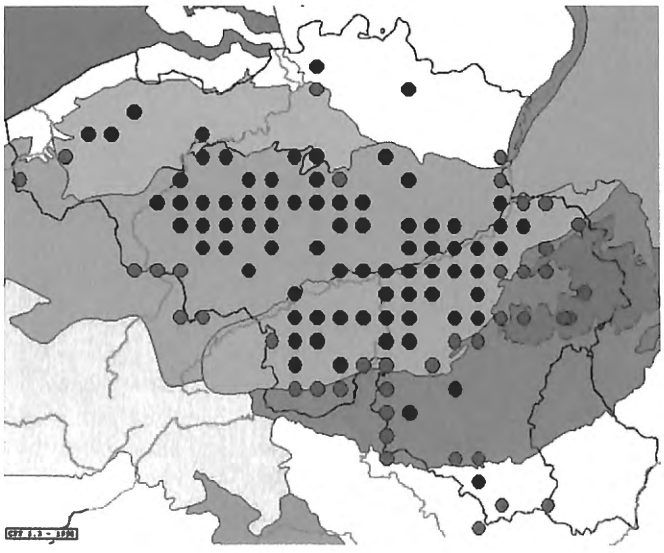
13. *Julus scandinavius* Latzel, 1884 (Map 14)

Julus scandinavius is a very common animal northwards from Switzerland and Austria to Britain, Ireland and southern Scandinavia. Abundant in Belgium, the species occurs in a variety of biotopes throughout the whole Country; while densities may be low in certain types of these, in others it occurs in large populations.

It is chiefly a species of woodland, particularly characteristic of acid soils on a sandy or loamy substrate, occurring frequently also in heathland, open grassland and sand dunes. While it has been found in calcareous grassland (*mesobrometum*) it appears to be effectively absent from forests on limestone, which, according to PEDROLI-CHRISTEN (1993), is the case in Switzerland; she describes it as eurytopic with a tendency to occur in woods. It is usually found in those Belgian forests with leached soils and moder humus, from the sandy coastal



Map 13 — Distribution of *Nemasoma varicorne* C. L. Koch, 1847.



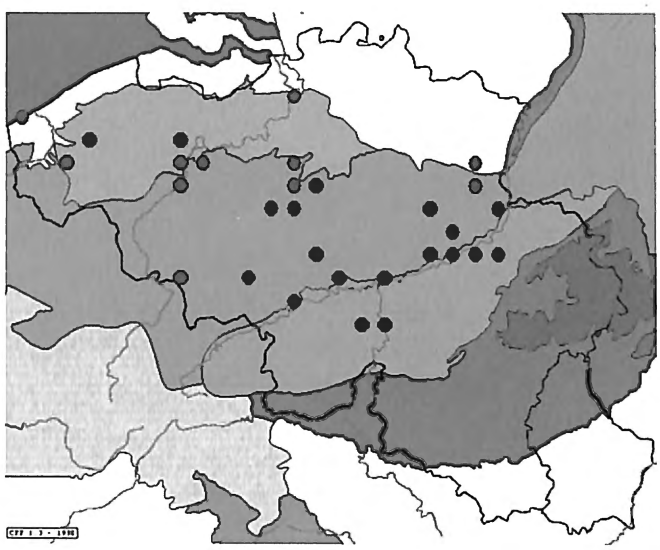
Map 14 — Distribution of *Julus scandinavius* Latzel, 1884.

areas to the higher forests in the Ardennes where it is often the dominant julid. Many authors associate *J scandinavius* with a thick litter layer; BARLOW (1957) relates this to its preference for high humidity and its avoidance of extreme conditions, traits which according to him do not agree with its wide ecological distribution. He considers that its very high mobility permits it to exploit a wide range of biotopes and find suitable resting places. It certainly falls very readily into pitfall traps in Belgium. Geographically, however, it's distribution is rather limited within Central and Northern Europe (KIME, 1990). *J scandinavius* was listed by KIME & WAUTHY (1984) as intermediate in specialization on habitat, neither a generalist nor a specialist.

Julus scandinavius has been recorded from 141 UTM squares in all regions of Belgium. Some of the most obvious strongpoints of distribution are the coastal dune areas, heathland with heathers and broom ranging into pine/birch/oak woodland and oakwoods in the sandy/loamy Flandrian District and the Brabançon Plateau. It is found in alder woods, coniferous forest and beech woodlands on non-calcareous strata up to about 560m in the Ardennes. It has not yet been discovered in the Hautes Fagnes, the highest area of forests and bogs in the High Ardennes. At a lower altitude it is found in raised bogs, along river banks and in damp meadows e.g. with meadowsweet (*Filipendula ulmaria*) (KIME, 1992). It is the fifth most widespread species in Belgium. This may be compared with first in rank in the Netherlands (BERG, 1995) and tenth in England & Wales (BLOWER, 1985).

14. *Leptoiulus belgicus* (Latzel, 1884) (Map 15)

LATZEL (1884) described this species from specimens sent to him by PREUDHOMME DE BORRE, who discovered them in Sint-Pieters-Leeuw and Genappe in the Province of Brabant. Despite its name this primarily Atlantic species reaches its northern limit in Belgium, where it is relatively scarce and essentially confined to the warmer coastal and lowland regions. Apart from supposed introduction into the Amsterdam area it is similarly confined to the south of Limburg in the Netherlands (BERG, 1995). It extends eastwards through Germany as far as Thuringia. It has a very patchy distribution. In Belgium *L. belgicus* seems to be most active in late summer and autumn, as in Switzerland (PEDROLI-CHRISTEN, 1993). From the variety of sites in which it has been recorded it is difficult to elucidate clear ecological preferences although it is sure that many of the sites were in warm and well-drained positions on limestone, light sandy loams or sand. Some were urban, as in Antwerp, some suburban waste ground or copses, as at Watermael-Boitsfort and Linkebeek, or orchards, as at Colonster; a majority were in more natural sites ranging from open calcareous grassland and rocky bluffs to bushy areas and quite humid closed forests, including alderwoods beside streams. Most of the records are from woodland or bushy areas. It has been found in a cave at Ramioul



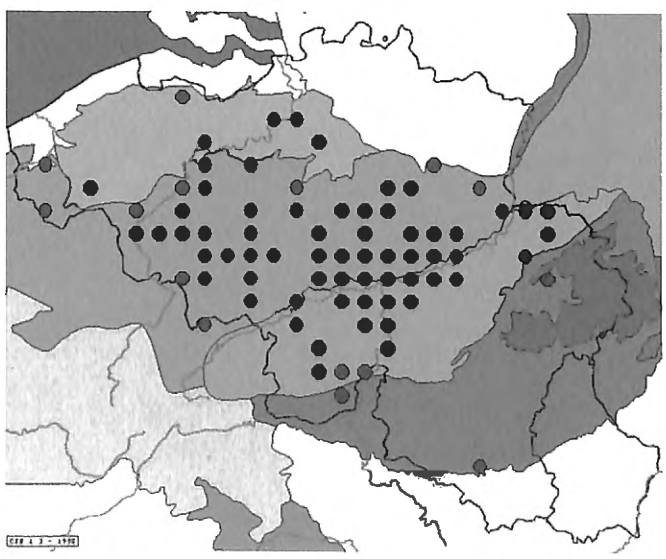
Map 15 — Distribution of *Leptoiulus belgicus* (Latzel, 1884).

(DETHIER & HUBART, 2000). It is known from old spoil heaps from former coal mines. In France I have found it on sandy river banks and in Wales on a sandy beach well below the coastal dunes.

L belgicus has been recorded from 30 UTM squares in those parts of Belgium that are mild during the winter. There are no records from the Ardennes or Lorraine and only one from the southern edge of the Campine.

15. *Leptoiulus kervillei* (Brolemann, 1896) (Map 16)

Leptoiulus kervillei has a more strictly Atlantic distribution than *L. belgicus*. So far there are no records from Germany. Its northern limit is once again in Belgium and Dutch Limburg; the Province of Liège is also its eastern



Map 16 — Distribution of *Leptoiulus kervillei* (Brolemann, 1896).

limit. Most of the records of this species are from Belgium, where it is more common than *L. belgicus* and at the same time more specialised on habitat. Other records are from western and northern France and southern Britain.

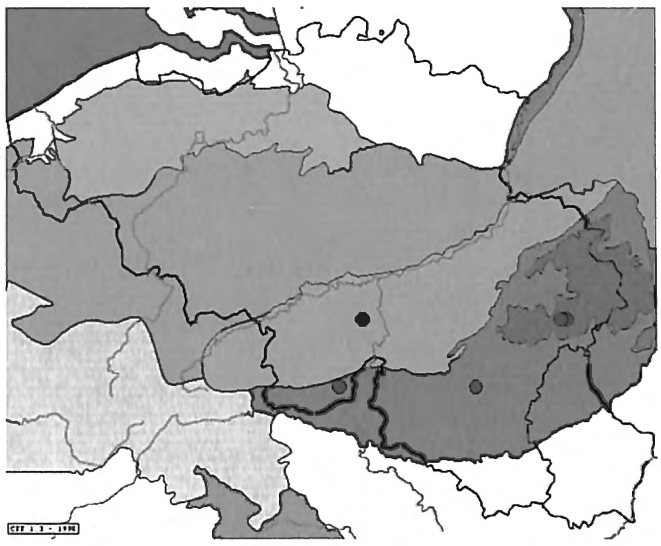
It lives in woodland with mull or mull-moder humus on soils rich in silt. Many of the suitable habitats are on calcic mulls. It is most common on the "limon" soil of the Hennuyo-Brabançon plateau, becoming more scarce northwards through Flanders and has not been recorded from the sandy coast. There are no records either from the mainly sandy and more continental Campine in the north-east. Southwards it is common in the Mosan District (Sambre-Meuse Valley and parts of the Condroz), reaching the margins of the Ardennes. It has not been found in almost the whole Ardennes region and it is scarce in Belgian Lorraine. Nor has it been found on heavy clay soils. It has been collected from old spoil heaps that have been recolonised by forest in the former mining areas. Finally, *L. kervillei* shows a marked preference for those parts of Belgium with the highest average temperatures and the mildest winters (KIME & WAUTHY, 1984).

L. kervillei has been recorded in 78 UTM squares, so far much more than in any other country. Despite being confined to the milder parts of Belgium it is so common in the favourable areas that it attains twelfth position in rank order of UTM squares.

DE QUEKER (1957) described a new species, *Leptoiulus vanoyei,* from Belgium. This name is a junior synonym of *L. kervillei* (BIERNAUX, 1972).

16. *Leptoiulus simplex glacialis* (Verhoeff, 1894) (Map 17)

This millipede has an unusual distribution; it is widespread in the western Alps where it reaches an altitude of 2900m and it is very common in the Jura (PEDROLI-CHRISTEN, 1993). Below the open alpine and subalpine levels it tends to be strictly confined to damp forests. It is commonly found in the Black Forest, especially in coniferous woodland (SPELDA, 1999) and it occurs across the Rhine in the Vosges. But it occurs much further north as far as the River Main to the east of the Rhine and to the west of the Rhine in the Saarland (SAHLI, 1955), in the Eifel (THIELE, 1968) and in Luxemburg (REMY & HOFFMANN, 1959). It was first found in Belgium in a raised bog on the Fagne du Rouge Ponceau near St. Hubert (KIME, 1992). In the last decade it has been obtained from several sites at the same altitude of about 550m in the vicinity of Vielsalm and Sankt-Vith. Most of these sites were in coniferous forests but some were in beechwoods, as is the case in the Jura. More surprising has been the discovery of *L. simplex glacialis* by Dr. Etienne BRANQUART at a much lower altitude in the Viroinval and near Sosoye to the west of the Meuse in the Province of Namur, the most north-westerly locality for the species. I have found this animal lower down as well, but along the banks of the Moselle in the Grand Duchy of Luxemburg. Its geographical limits in Belgium are not yet predictable.



Map 17 — Distribution of *Leptoiulus simplex glacialis* (Verhoeff, 1894).

The taxon has an unusually large recorded altitudinal range of 2750m.

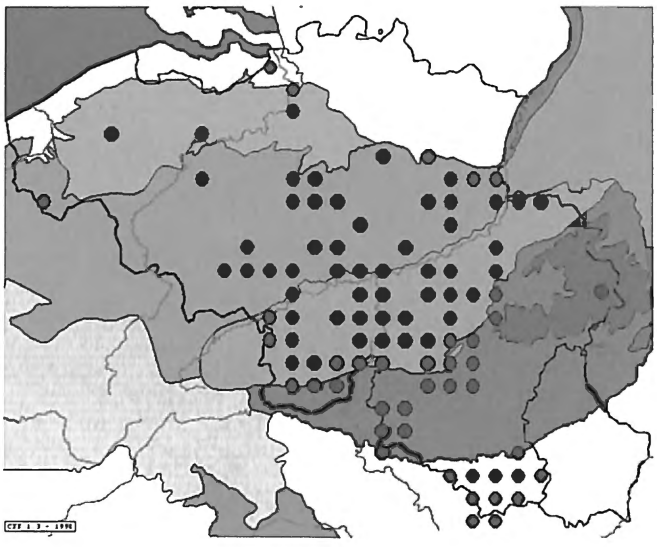
SPELDA (1999) explains the complicated taxonomic history of this animal.

Leptoiulus simplex glacialis has been found in 5 UTM squares in Belgium.

17. *Allajulus nitidus* (Verhoeff, 1891) (Map 18)

Allajulus nitidus is a common species from the Alps north and north-westwards to southern Scandinavia and Britain.

It is a very common millipede in many parts of Belgium, for instance the Condroz-Fagne-Famenne region and the Sambre-Meuse Valley together comprising the Mosan District and on the Brabançon Plateau. It is also well represented in Belgian Lorraine. In the Ardennes it occurs mainly at lower altitude on brown earths and is very rare in the acidic woodlands on higher ground, although it has been found in beechwoods at about 500m. THIELE (1968) associated it with beechwoods in the Rhineland. It is rare, or even absent from some sandy areas, particularly the Campine and towards the coast. Pedologically, it correlates with high clay content of the soil and with active calcium; in fact it is found in mulls, especially calcic mulls, and is essentially a closed deciduous woodland species on fairly heavy soils which, while humid, are usually nevertheless adequately drained (DAVID, 1982,1990; PEDROLI-CHRISTEN, 1993). It is particularly associated with oak, and to a lesser extent beech. *A. nitidus* does occur on lighter, neutral to fairly acidic soils, usually with oak and/or beech and occasionally pine. It burrows readily and is adapted to mull conditions. It is an important decomposer of leaf litter (HAACKER, 1968; DAVID, 1987); on some mulls it is the dominant millipede. It apparently avoids very wet and very acidic



Map 18 — Distribution of *Allajulus nitidus* (Verhoeff, 1891).

sites. Our findings in Belgium are in general agreement with detailed studies elsewhere (THIELE, 1968; HAACKER, 1968; GEOFFROY, 1981; DAVID, 1982, 1990; PEDROLI-CHRISTEN, 1981, 1993; SPELDA, 1999).

Allajulus nitidus has been found in 93 UTM squares.

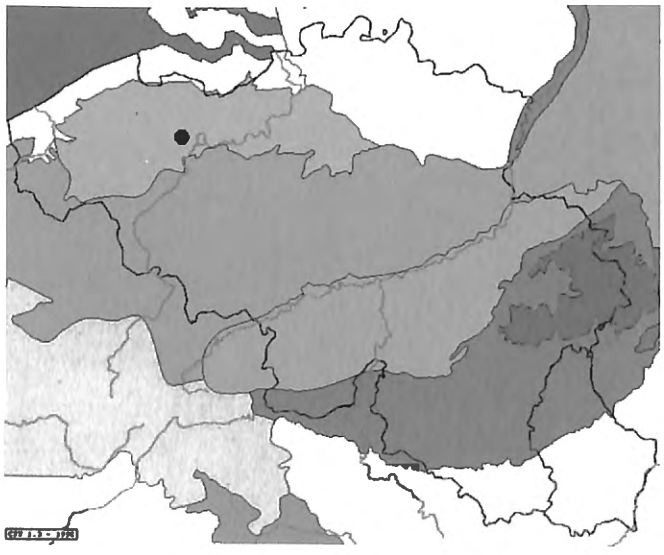
18. ***Cylindroiulus arborum* Verhoeff, 1928** (Map 19)

BIERNAUX (1971, 1972) records capturing 24 specimens of this East European and Balkan species, including four adult males, from Drongen on three different occasions in 1969. They were in a very humid greenhouse with rich leaf compost and presumably were accidentally introduced into the Country.

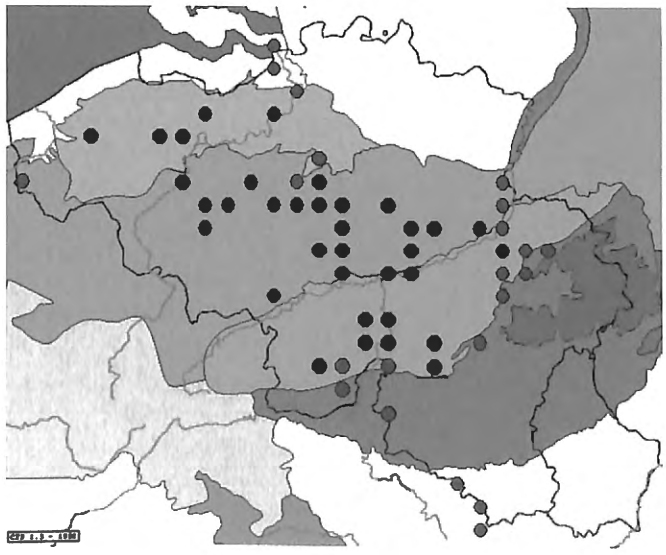
19. ***Cylindroiulus caeruleocinctus*** (Wood, 1864) (Map 20)

This is another much studied species, often under the name of *Cylindroiulus teutonicus* (POCOCK, 1900) or even more often *C. londinensis* (LEACH,1815). The former name is a junior synonym and the latter has been repeatedly used in error, because LEACH's original species is a quite distinct animal confined to the mild parts of the Atlantic zone in Spain, France, Britain and Ireland. *C. londinensis* has not been found in Belgium. In Europe *C. caeruleocinctus* is widely distributed in the Atlantic, Central and Baltic zones.

C. caeruleocinctus is predominantly a species of open habitats, particularly grassland; it reaches maximum numbers on calcareous swards (KIME, 1997). Its abundance in such habitats has led to the supposition that it is calcicolous; whilst there is a high degree of correlation with basic soil this is not strictly true. It has evident synanthropic tendencies, occurring in gardens, parks, cemeteries, orchards, waste places and cultivated ground, with strong populations in both urban and rural situations (BIERNAUX, 1972; PEDROLI-CHRISTEN, 1993). In England DAVIS (1979, 1982) found it to be the commonest species to fall into pitfall traps in London gardens. FAIRHURST (1984) found the optimum habitat to be loamy arable soil; 81% of all sites were calcareous. BRENY & BIERNAUX (1966) reviewed the possible depredations of this species in agriculture. In cultivated ground BIERNAUX (1972) states that C. caeruleocinctus feeds mainly on organic matter in the soil, frequently silty, which it ingests. HAACKER (1968), working in the Rhine-Main Region of Germany, mentioned earth as the main component of the faeces; he found also remains of broad leaves, grass and moss. The proportion of grass was higher than in the other 13 species involved in the study. Haacker concluded that it was a ''Stenotope Feldart'' narrowly linked to open



Map 19 — Distribution of *Cylindroiulus arborum* Verhoeff, 1928.



Map 20 — Distribution of *Cylindroiulus caeruleocinctus* (Wood, 1864).

habitats; also that it was moisture-loving. There is general agreement among authors that it both aestivates and hibernates quite deep in the soil, showing a pronounced activity peak in the spring with a lesser peak in the autumn. With respect to its habitat our pitfall trapping results in the more natural sites in Belgium are highly significant. Many thousands of individuals have been captured in several calcareous grasslands and almost no individuals obtained from over one hundred sampled forests. It occurs in hedges and small woods (PEDROLI-CHRISTEN, 1993; KIME, 1994) but is almost never found in forests. There are several records from woodland in SE England (KIME, 1996). I have obtained it from soil samples in grassland and gardens, both in lawns and flower beds. There are a few records from caves, generally near the entrance (LERUTH, 1939).

There are records of *C. caeruleocinctus* from 57 UTM squares in Belgium. Although there may well be limiting factors in the Ardennes and the Campine the absence of records from most parts of these regions may be due to the fact that the majority of the prospections undertaken were in forest.

20. *Cylindroiulus latestriatus* (Curtis, 1844) (Map 21)

C. latestriatus chiefly occurs in dune systems and coastal grassland on a sandy substrate. It is distributed along the western and northern Atlantic coasts from Portugal to Norway, including islands in the Atlantic. It also occurs throughout the North Sea and Baltic areas as far as Finland and Russia near St. Petersburg. Going north and east into the Gulf of Bothnia and the Gulf of Finland it becomes more and more synanthropic, occurring in greenhouses, compost heaps, etc. It is a remarkable pioneer species and on continental Europe it is found sporadically associated with human activity well into Russia and the Ukraine in the east. It has been recorded away from Europe as far as South Africa, North, Central and South America, St. Paul Island in the Antarctic and Easter Island in the Pacific. In NW Europe, while it occurs chiefly in dunes and grassland, BLOWER & GABBUTT (1964) recorded it from deciduous leaf litter in woodland on sandy soil near the coast. In Britain it does occur in some rural sandy locations inland, but in general the inland records are synanthropic. The association with sand is very marked.

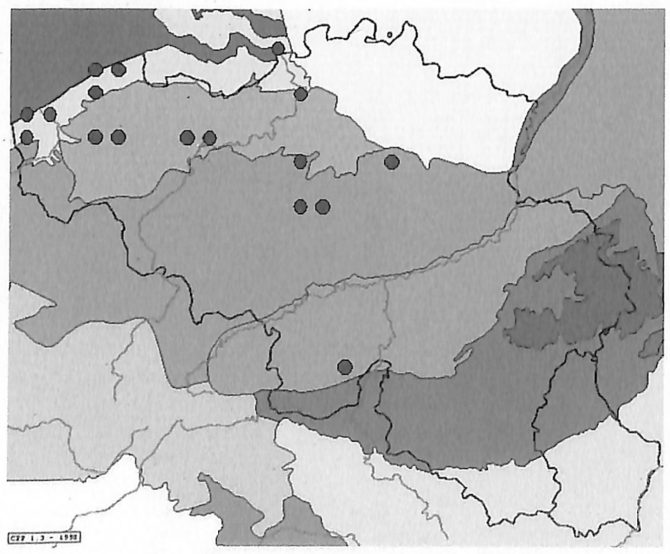
Not surprisingly, Belgian records of *C. latestriatus* come almost entirely from the sandy coast and from sandy parts of Flanders. It is abundant on the coast where the dunes have been fixed by plants, including grass, scrub and patches of woodland. It is found in agricultural land as well and is particularly found in horticultural establishments in the vicinity of Ghent where plants such as azaleas are reared on very light soil, containing the humus upon which it feeds (BIERNAUX, 1972). It occurs in the Brussels area, mainly in gardens and waste places, and there is a record from the Viroinval in the south of the Mosan district.

C. latestriatus has been located in 17 UTM squares in Belgium.

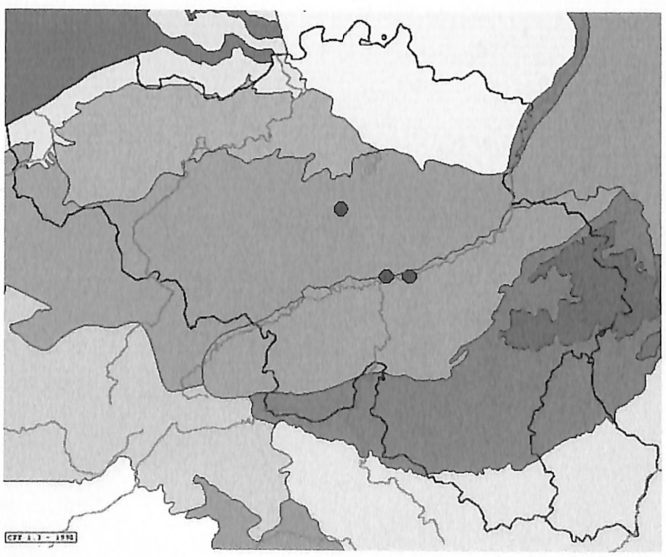
21. *Cylindroiulus parisiorum* (Brölemann & Verhoeff, 1896) (Map 22)

An infrequently encountered species, *C. parisiorum* is usually found in hollow decaying trees, in soft wood or under loose bark; otherwise it is found in synanthropic situations. The more easterly occurrences in Europe are of the latter kind, in gardens, parks, graveyards or greenhouses. It is in western regions (Britain, Belgium, Switzerland) that it occurs as a subcorticole in rural sites.

There are only three places in Belgium where it has been found; these are as follows:-



Map 21 — Distribution of *Cylindroiulus latestriatus* (Curtis, 1844).



Map 22 — Distribution of *Cylindroiulus parisiorum* (Brôlemann & Verhoeff, 1896).

Grez-Doiceau, Brabant, 2.v.1954, in a tree trunk (DE QUEKER, 1962)

Champion, Namur, 3.v.1970, 11.x.1970, under bark (BIERNAUX, 1972)

Haltinne, Namur, 2.v.1975, under bark in a pile of logs at the edge of a wood (KIME, 1992).

At least one adult male was present at each site.

Grez-Doiceau is on the Brabançon Plateau; Champion and Haltinne are near the River Meuse.The records are in three different UTM squares.

22. *Cylindroiulus punctatus* (Leach, 1815) (Map 23)

Essentially an Atlantic species, but reaching lowland Germany, the Polish coast and southern Scandinavia as far as Finland, *C. punctatus* is one of the most abundant millipedes in Western Europe.

In Belgium, as in Britain (BLOWER, 1985), it is the commonest millipede found under the bark of trees and in dead and decaying wood; it may be found a few metres above the ground. It migrates vertically and may be found in leaf litter and the soil especially from autumn until the spring. Major ecological studies of its ecology and behaviour were undertaken by, amongst others, BARLOW (1957), BRENY & BIERNAUX (1966), BANNERJEE (1967a, b), HAACKER (1968) and GEOFFROY (1981). Wood and leaf litter both seem important as food. It is hygrophile and may accumulate in rather deep decomposing leaf litter and the underlying humus on sandy soils in particular, and it extends into sandy heathland (BLOWER, 1985). It may be found in all types of woodland; there is evidence that it is commoner in small woods and open woodland than in large closed forests (BIERNAUX, 1972; FAIRHURST, 1984). It is found in parks, orchards, gardens and hedges. In Belgium we have found an association with low altitude, higher winter temperatures, loamy soils, high soil nitrogen, high soil moisture and moderately thick litter, i.e. mull and mull-moder (KIME & WAUTHY, 1984; KIME et al., 1992). It appears to avoid the heaviest clay soils. SCHUBART (1934) cites an association with various ant's nests. It has long been recorded from Belgian caves , e.g. LERUTH (1939).

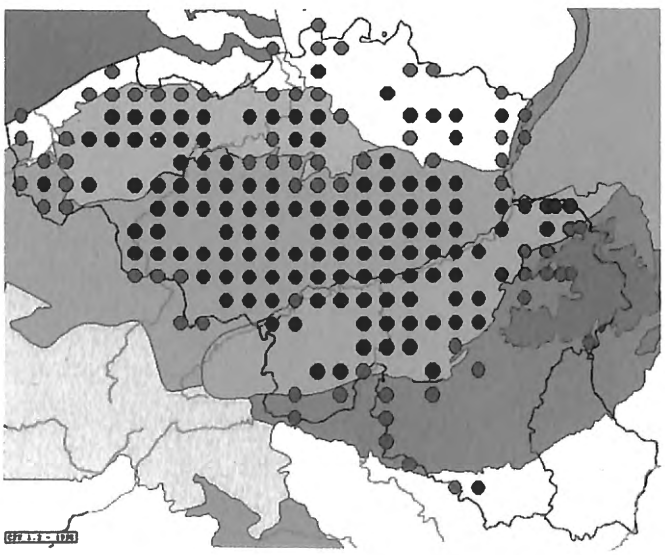
C. punctatus has been recorded in 203 UTM squares in Belgium, more than any other millipede. It is found in all regions but is apparently very rare and often absent from sites in the higher and harsher parts of the Ardennes, certainly within the extensive forests.

23. *Cylindroiulus truncorum* (Silvestri, 1896) (Map 24)

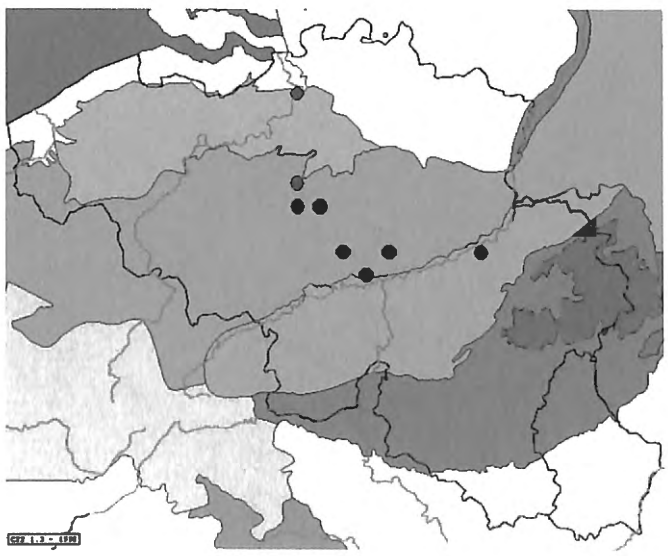
Supposedly an introduced species, *Cylindroiulus truncorum* is found in synanthropic habitats, greenhouses, woodpiles, gardens, parks, school grounds, cemeteries, spoil heaps, horticultural nurseries, botanical gardens and so forth. Thought to be of North African origin (SCHUBART, 1934, 1946) it is now widely found in northern European countries, as well as further afield in North and South America (SCHUBART, 1946).

HAACKER (1968) found that it spread out into surrounding woods, that it ate mainly leaves and that it preferred high or fairly high humidity, suiting it to our regions. In Belgium it is often plentiful when found. Very high numbers have been found on some recolonising spoil heaps in industrial areas; there was an infestation of house walls in Cortil-Wodon, Hesbaye, in the autumn of 1990.

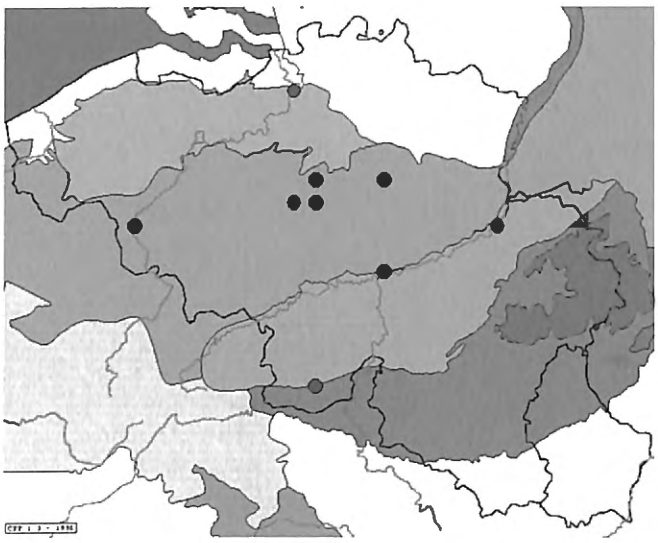
C. truncorum has been recorded from 8 UTM squares in Belgium, almost entirely in the central belts. As most of our investigations have taken place in rural areas this may be a significant underestimate of its abundance.



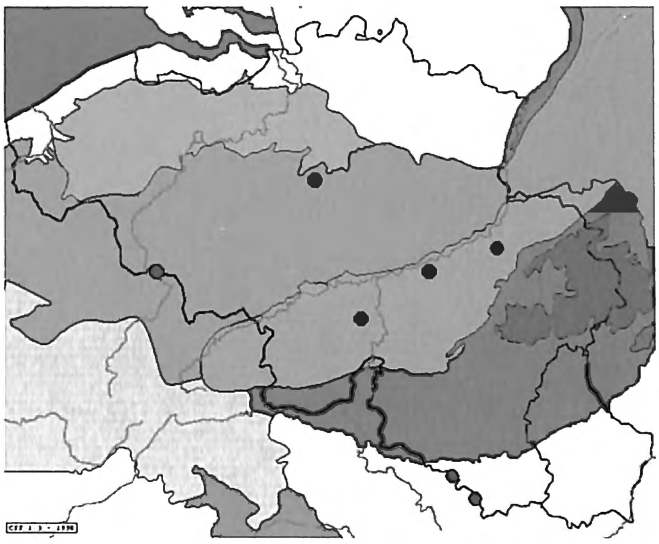
Map 23 — Distribution of *Cylindroiulus punctatus* (Leach, 1815).



Map 24 — Distribution of *Cylindroiulus truncorum* (Silvestri, 1896).



Map 25 — Distribution of *Cylindroiulus vulnerarius* (Berlese, 1888).



Map 26 — Distribution of *Enantiulus nanus* (Latzel, 1884).

24. ***Cylindroiulus vulnerarius*** **(Berlese, 1888)** (Map 25)

C. vulnerarius is another species, this time of presumed Italian origin, that has been introduced into synanthropic habitats in northern Europe. There are many scattered records, a substantial number of them from Belgium and the Netherlands.

In Belgium it has been found in the ground, in dead wood buried in the ground and on the surface, under a lawn, in manure heaps, in garden compost and under debris. Its habitat seems to be wood and rich decaying organic matter in contact with the soil. Recently it has been found in caves at Pétigny and Liège in the Mosan district (M. DETHIER, pers.comm.). Its presence in a rural cave gives rise to the possibility that it is a relict species in Belgium.

Like *C. truncorum* it has been located mainly in urban or suburban areas in those parts of the central belts of Belgium that have received most attention. It has been recorded many times but so far from only nine UTM squares.

25. ***Enantiulus nanus*** **(Latzel, 1884)** (Map 26)

This animal has a central European distribution and is at the western edge of its range in Belgium. From here, eastern France and Switzerland it ranges east to the Ukraine and Bulgaria.

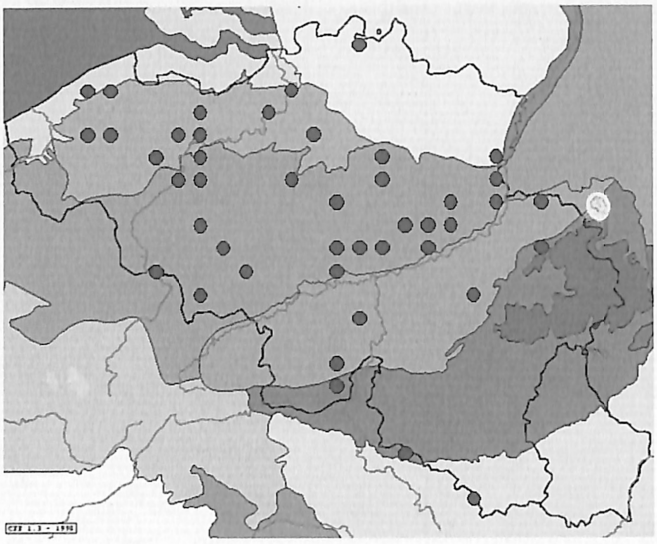
There are only a few records of its presence in Belgium; the first was made as recently as 1971 at Lacuisine in the Province of Luxembourg (BIERNAUX, 1972). The eighteen specimens were found in the deciduous litter of a large forest. The second site to be discovered was a poplar plantation by a canal at Peruwelz in Hainault, the most westerly locality known in Europe, where I found it in fairly wet litter and flood debris, together with *Brachyiulus pusillus*, in April, 1983. Specimens from three further localities in Wallonia were sent to me by Dr. Etienne BRANQUART of the University of Gembloux and it was then found in a wooded area in Brussels. The latest discovery was in a cave at Hony-Tilff (''résurgence de la grotte de Rosière'') in March, 2000 (DETHIER & HUBART, 2000).According to SCHUBART (1934) *E. nanus* is generally found in deciduous woods and bushy places; it avoids synanthropic biotopes. PEDROLI-CHRISTEN (1993) reports it from a variety of biotopes in Switzerland including a bushy meadow and a cave, yet repeats the emphasis on humid environments such as alluvial forests, marshes and bogs. VOIGTLÄNDER (1987) demonstated a preference for relatively high humidities and temperatures in Germany, while SPELDA (1999) mentions moorland biotopes in Baden-Wurttemburg. In Lorraine (in France) I have taken it from deep litter in an escarpment beechwood on limestone.

E. nanus is known from 7 UTM squares in Belgium, confined at present to fairly low altitudes in the Brabançon District, the Mosan District and Belgian Lorraine.

26. ***Brachyiulus pusillus*** **(Leach, 1815)** (Map 27)

B. pusillus has been recorded from most parts of Europe although some of the eastern records are now thought to be of *Brachyiulus bagnalli* BRÖLEMANN, 1924. It is found in a variety of biotopes which are generally humid and often close to water.

In Belgium most records come from pastures and agricultural land in low-lying areas. It has seldom been reported from the Ardennes or Belgian Lorraine; the vast majority of the records are from north of the Sambre-Meuse trench. These indicate that it lives chiefly in the soil, including sandy soil close to the water table, under surface debris and in the litter of open and marshy woodland. There are records from gardens and completely agricultural sites such as fields of maize (BIERNAUX,



Map 27 — Distribution of *Brachyiulus pusillus* (Leach, 1815).

1972). While it has fallen into pitfall traps in pastures major surveys of forests have usually failed to locate it.

B. pusillus is known from 44 UTM squares in Belgium.

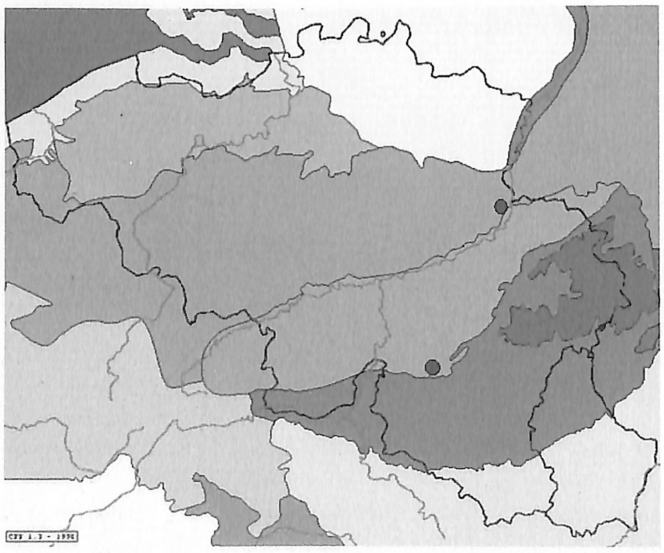
27. *Ommatoiulus rutilans* (C. L. Koch, 1847) (Map 28)

Ommatoiulus rutilans is at its northern limit in Belgium and would probably not occur at all were it not for the incised valley of the Meuse which has allowed it to penetrate north of the Ardennes. As it is there are only two known sites where it occurs today, both on thermophilous calcareous grassland. It was recorded from sixteen communes in the Brussels region and once near Namur by PREUDHOMME DE BORRE (1884b) and in the Forêt de Soignes near Brussels by SCHOUTENDEN (1900). It has not been found in any of these places since 1900. Moreover, in view of what we know of the ecology of *O. rutilans,* with the possible exception of Rhisnes near Namur, these localities do not offer suitable habitats for the species, which is thermophilous, xerophilous and submediterranean in distribution. Therefore these records remain something of a mystery. PREUDHOMME DE BORRE (1884) also listed *Ommatoiulus sabulosus* and *Tachypodoiulus niger* and it is very unlikely that there was confusion with one of these. None of his specimens is available for examination.

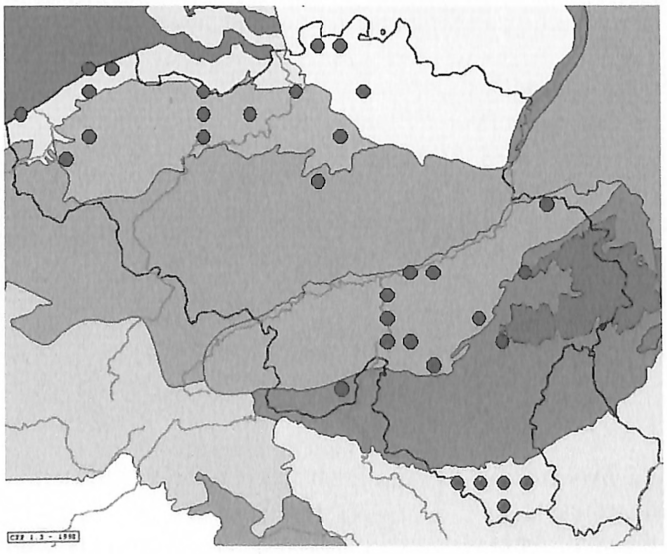
Ommatoiulus rutilans has been recorded from eight UTM squares of which only two are certain today.

28. *Ommatoiulus sabulosus* (Linnaeus, 1758) (Map 29)

This very well known and widely distributed European species has an obviously patchy distribution in Belgium. Records are fewest from the Ardennes and from the loamy cultivated Brabançon District and plentiful from the maritime dunes, sandy Flanders and from sandstone and limestone formations in the Mosan District and the Gaume (Belgian Lorraine). In the Low Countries the work of BARLOW (1957) and BIERNAUX (1969) clearly demonstrated its ecological preference for open or lightly wooded, warm and in particular well-drained sites. It is extremely vagile and has been reported from many biotopes, to the point where it is regarded as a ubiquitous species; for instance BARLOW (1957) states "a eurytopic species, occurs both in open terrain and in woods and shows relatively little preference for different habitats". It should be remembered, however, that Barlow carried out his work in the coastal dunes of Holland. Our studies in Belgium suggest that it is quite strongly restricted to certain biotopes including the dunes in which it may be



Map 28 — Distribution of *Ommatoiulus rutilans* (C. L. Koch, 1847).



Map 29 — Distribution of *Ommatoiulus sabulosus* (Linnaeus, 1758).

found throughout the year. It is the adults that wander the most in the summer months when they appear resistant to desiccation. The young stadia and indeed the adults in winter seem to prefer relatively moist conditions and live below litter or in the superficial layers of well-drained soil. The animal feeds on decomposing litter (especially birch), rotting wood and humus and fungal mycelia: lichens, mosses, grasses and algae are also accepted (BARLOW, 1957; BRENY & BIERNAUX, 1966). Strongpoints of distribution in Belgium are described in detail by BIERNAUX (1969). First there are the dune areas, once these are covered by pioneering vegetation. They may be bushy (Hippophaeto-Ligustretum) or well wooded (birch, willow, poplar). The species also occurs in cultivated ground and particularly the sandy horticultural areas around Ghent. It is found in alder woods (Alnetum). It is noticeable that it frequents open woods with clearings, bushy zones, hedges and copses rather than completely open terrain or closed forest. In a recent survey of 23 forests in the Ardennes in which thousands of millipedes were captured by pitfall trapping throughout the spring and the summer when the species is active not a single specimen of *Ommatoiulus sabulosus* was encountered. In this instance it is not the harshness of the climate that is likely to be responsible as *O. sabulosus* occurs as far north as Finland and northern Russia and reaches an altitude of 2900m in the Alps (PEDROLI-CHRISTEN, 1993). Its absence must be related to the closed forest system or the soil. We did not find it in earlier forest surveys (KIME & WAUTHY, 1984; BRANQUART et al., 1995), suggesting that it is altogether rare in forests.

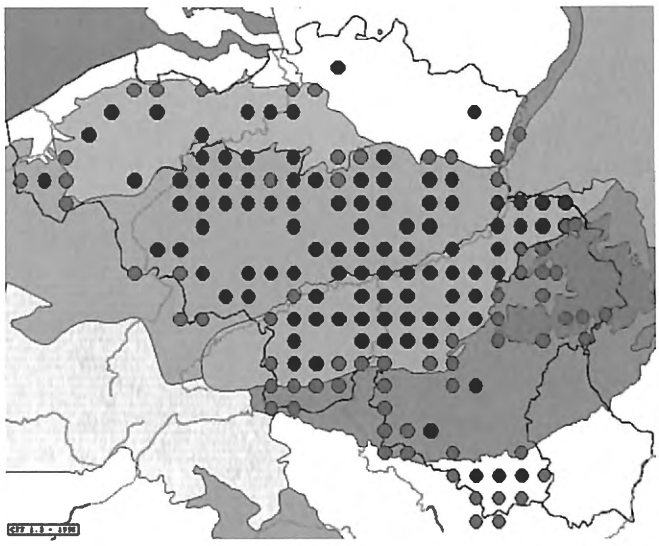
In the Mosan region *O. sabulosus* has been captured in traps set in some dry calcareous grasslands (Xerobrometum) and found in neighbouring woodland, mainly oak with pine and birch. In Belgian Lorraine it occurs in pinewoods with broom (*Sarothamnus scoparius*) on sandstone. Another habitat is old spoil heaps in the coalfields of Hainault. These well-drained thermophilous areas seem to be another strongpoint in Belgium. Soil pH does not seem to be as important an edaphic factor as soil permeability, although there might be an association with calcium. BIERNAUX (1972) makes the point that O. sabulosus is usually found on sloping and not on level ground.

The evident population fluctuations in this species (see e.g. SAHLI, 1986) apply also to Belgium; it seems that it bursts out of its basic strongholds from time to time. In some years large numbers have been reported, including infestations of property.

O. sabulosus has been recorded from only 33 UTM squares in Belgium.

29. *Tachypodoiulus niger* (Leach, 1815) (Map 30)

Tachypodoiulus niger, which has an extended Atlantic distribution from northern Spain to Germany, is one of the commonest species in Belgium. It reaches maximum density on limestone (KIME *et al.*, 1992) and is only scarce along the coast, in the sandy Campine region and



Map 30 — Distribution of *Tachypodoiulus niger* (Leach, 1815).

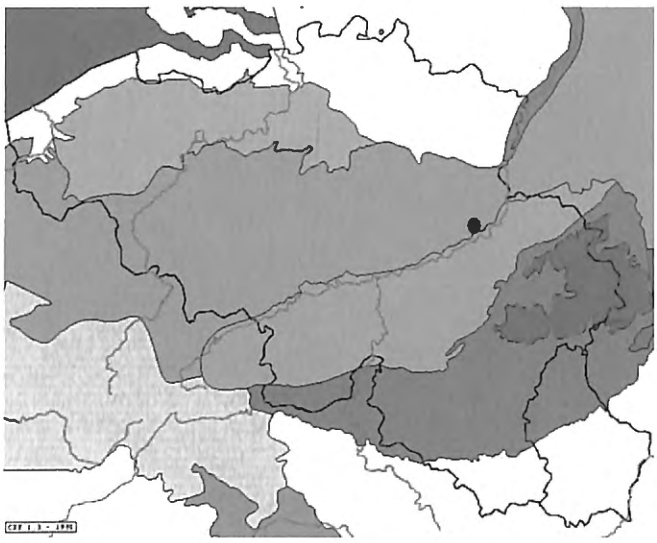
in the higher more acidic parts of the Ardennes. It is strongly associated with woodland, although it is highly mobile, quite eurytopic and found in other biotopes. It enters houses and has often been found in caves. It is to some degree petrophile, lacking in both dunes and polders, although FAIRHURST (1970) reported its occurrence on sand dunes in Lincolnshire on the east coast of England. In the Netherlands it is markedly confined to the south and east, on Pleistocene soils; with the exception of some records from Zeeland (BERG, 1995) it does not occur on Holocene soils there either. According to HAACKER (1968) it also prefers low humidity, a pH above 4.4 and is a detrivore mainly of litter, with some wood and moss as well. It is most often found in litter or under dead bark, climbing trees readily.

T. niger has been recorded from 178 UTM squares in Belgium, placing it second in rank order.

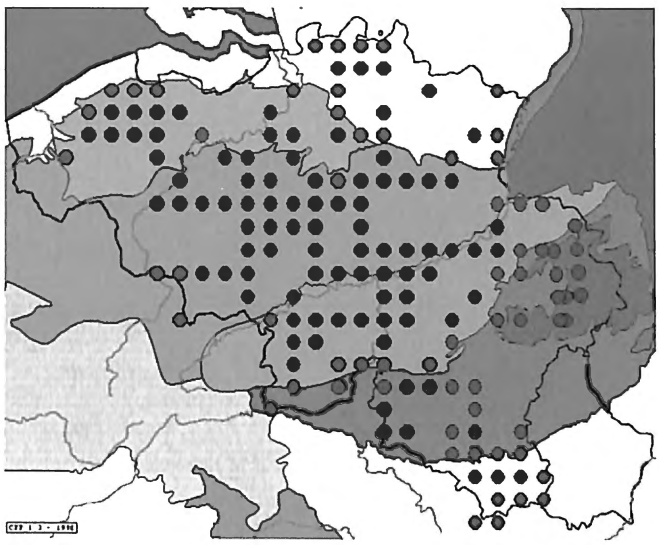
30. *Xylophageuma zschokkei* Bigler, 1912 (Map 31)

Xylophageuma schokkei is a millipede that was thought by VERHOEFF (1938) to be a French endemic which had survived the ice age west of the Rhine in the Vosges. After 1970 it was repeatedly located in Switzerland (PEDROLI-CHRISTEN, 1993). It is very common in the southern Vosges and the eastern Jura Mountains and has been found further west in France in the Argonne Forest in the Meuse Department (BROLEMANN, 1935) and lately by myself in Château Regnault Forest in the French Ardennes only a few kilometres from the Belgian frontier, with which the forest is contiguous. It is very probable that it will be located in the south of the province of Namur.

A damaged female thought to be of this species was captured in the Puits Ruwet, a well at Ramioul in Liège Province, in August 1998. It was sent to Dr. J.-P. MAURIES at the Paris Natural History Museum who was inclined to



Map 31 — Distribution of *Xylophageuma zschokkei* Bigler, 1912.



Map 32 — Distribution of *Craspedosoma rawlinsi* Leach, 1815.

agree with the identification (DETHIER & HUBART, 2000). A male has not yet been found.

X. zschokkei becomes adult at the end of the summer and is found in cool and humid forests, usually in the litter, often in contact with dead wood, including under the bark. It has been found in moss and in peat bogs outside the forest (PEDROLI-CHRISTEN, 1977). The stations for which there are data lie between 370m and 1240m above sea level. The forests in which it was found in France were deciduous or mixed, frequently with beech (*Fagus*), some being more or less pure summit beech-woods, on granite or limestone. Oak (*Quercus*), ash (*Fraxinus*), birch (*Betula*), hazel (*Corylus*) and conifers (*Pinus*, *Picea*) were evident in some sites. Ground vegetation commonly included *Vaccinium, Pteridium, Erica, Luzula* and *Rubus*.

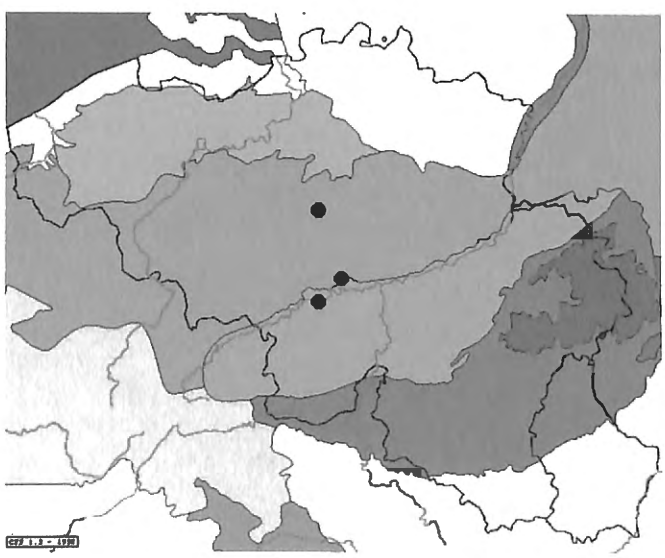
31. ***Craspedosoma rawlinsi* Leach, 1815** (Map 32)

This Central European species occupies a range from eastern France to Belarus and from Yugoslavia to southern Scandinavia and to Britain and Ireland; it is common throughout Belgium at all levels of altitude. The subspecies *rawlinsi* and *alemannicum* are both present, the latter mostly in the south. It is found primarily in forest but occurs in other situations e.g. heaths, moors, raised bogs, river banks and damp meadows e.g. with *Filipendula ulmaria*. HAACKER (1968) found that it prefers high humidity and that it is active at low temperatures. In Belgium it becomes adult in October and is indeed active until the following spring. It consumes mostly litter. It seems to particularly flourish in damp forests with a thick litter layer. We also found an association with high sand, high soil moisture, high nitrogen and low calcium (KIME & WAUTHY, 1984; KIME *et al.*, 1992). Most of our Belgian records are from acidic sites. It is found in similar sites in Switzerland (PEDROLI-CHRISTEN, 1977) and Germany (SPELDA, 1999).

C. rawlinsi has been recorded from 157 UTM squares in Belgium, making it the third most widespread species in the Country.

32. ***Nanogona polydesmoides* Leach, 1815** (Map 33)

Nanogona polydesmoides is a strictly Atlantic species found almost entirely in France, Britain and Ireland, and which just reaches Belgium. There is a patch of the species in the north of Italy and a record from the west coast of Norway.



Map 33 — Distribution of *Nanogona polydesmoides* Leach, 1815.

In Belgium it occurs south of Charleroi in some woodlands on limestone (Mosan District) and in woodland fringes in the south of Brussels (Brabançon District), usually under debris on the surface of base-rich ground.

N. polydesmoides is known from 3 UTM squares in central Belgium.

33. *Chordeuma sylvestre* C. L. Koch, 1847 (Map 34)

Chordeuma sylvestre is a petrophile species at its northern limit in Belgium. It is common to the south and east through eastern France, SW Germany and Switzerland to Italy. It is essentially a central European species, occurring also in Austria. There are records from SW England (Blower, 1985).

As far as is known it does not reach the Belgian coast and it reaches the Netherlands only in the hilly ground of southern Limburg. Nevertheless it is a common woodland animal in most of Belgium. *Chordeuma sylvestre* does not appear to be very specialized on habitat; although it generally lives in leaf litter it may be found on a wide variety of soil types from acidic peat bog (Pedroli-Christen, 1977) to calcareous woodland (Dunger & Steinmetzger, 1981). It occurs equally in deciduous and coniferous woodland, bushy areas and at higher altitudes on moors and bogs. As it is hygrophile a good litter cover is a principal requirement; in Belgium it is commonest on soils with such a layer and these are frequently acidic but it may be found even in calcic mulls on chalk. Soil texture and acidity are apparently less important limiting factors than soil moisture (Kime & Wauthy, 1984). While David (1990) found an association with clay Van Den Haute (1999) found it also on wet sandy loam. Owing to its hygrophily it is known from many Belgian caves (Leruth, 1939; Dethier & Hubart, 2000).

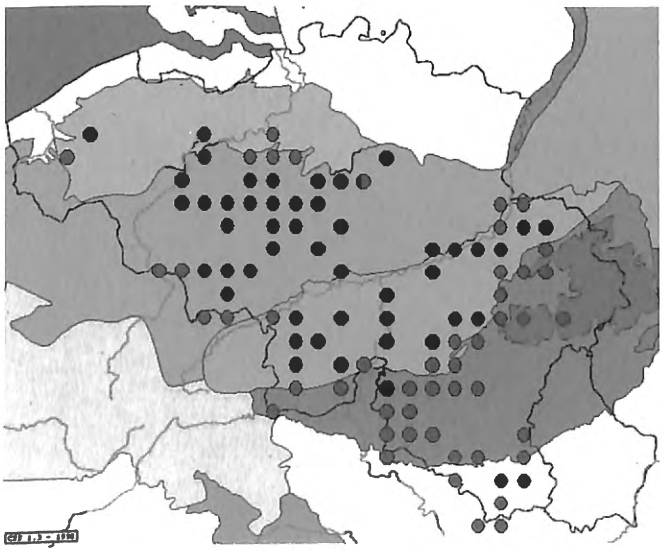
Chordeuma sylvestre has been found in 97 UTM squares in Belgium. It has not been observed in the sandy Maritime area or the Campine. It is common from the Brabançon Plateau southwards and is the ninth species in order of rank in Belgium.

34. *Melogona gallica* (Latzel, 1884) (Map 35)

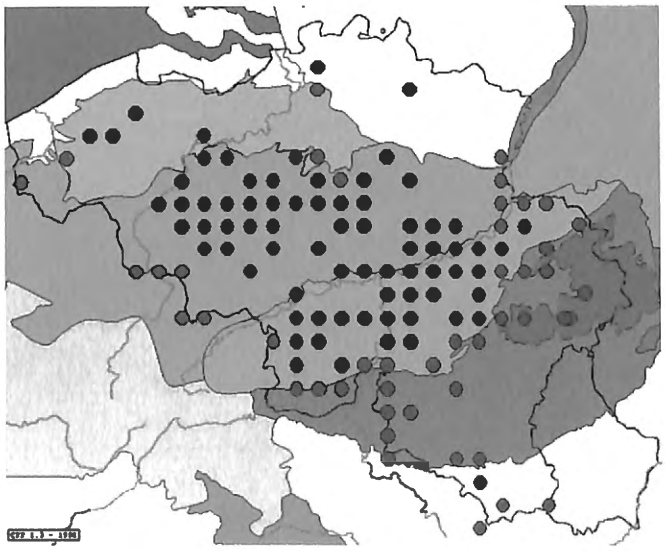
This western European species which extends from the Atlantic zone into the Central zone about as far as the River Rhine is one of the most common in Belgium. East of the Rhine it is almost entirely replaced by *M. voigtii*. It is probably the least specialized of Belgian forest species (Kime & Wauthy, 1984), using the habitat even more largely than *Chordeuma sylvestre,* yet shows the same geographical limitations, running out northwards and not known to be present in the dunes and the Campine. Some aversion to sandy soil has been indicated (Kime *et al.*, 1992). It has not yet been found higher than 560m above sea level in Belgium. Apart from that it can be found in most wooded areas, including hedges, largely irrespective of the type of vegetation.

Experience shows that *M. gallica* is more common in NE France and Belgium than in more meridional parts of France such as Poitou-Charente and the Perigord. An association with lower temperatures has been registered in Belgium (Kime & Wauthy, 1984) and, exceptionally for a chordeumid, even though it may have been introduced, it occurs in Norway. It is an annual species (David, 1984), well-suited to cool temperate forests.

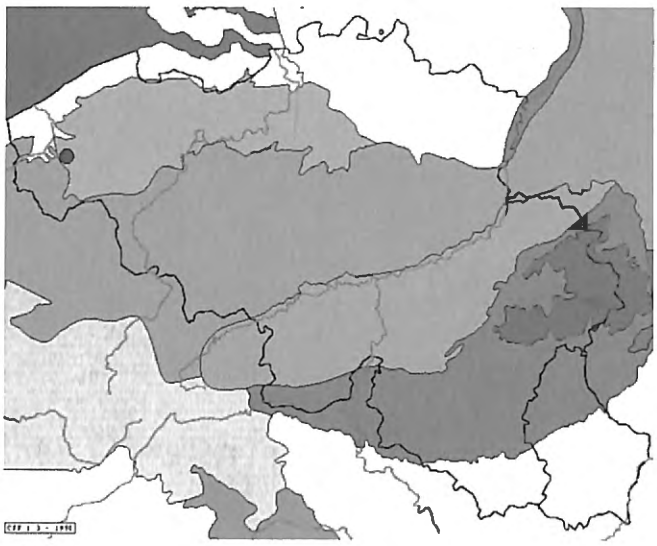
M. gallica is known from 121 UTM squares, placing it seventh in rank order at the moment, surely higher than in any other country.



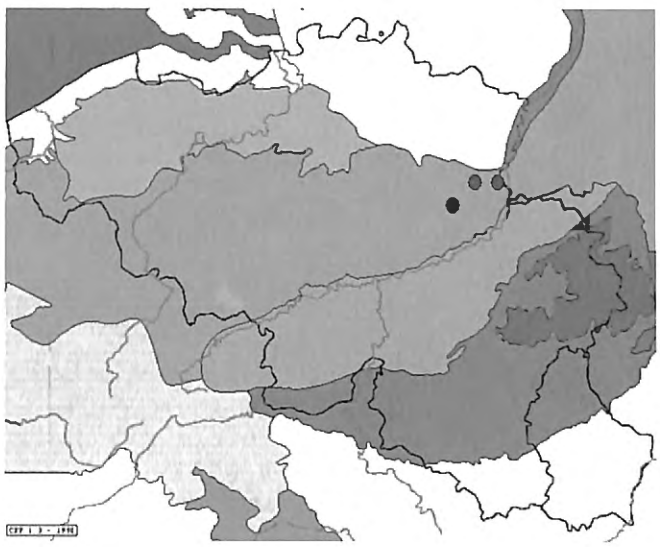
Map 34 — Distribution of *Chordeuma sylvestre* C. L. Koch, 1847.



Map 35 — Distribution of *Melogona gallica* (Latzel, 1884).



Map 36 — Distribution of *Melogona scutellare* (Ribaut, 1913).



Map 37 — Distribution of *Melogona voigtii* (Verhoeff, 1899).

35. ***Melogona scutellare* (Ribaut, 1913)** (Map 36)

Melogona scutellare has a fragmented distribution in Switzerland, Italy, France, Great Britain and Ireland. To this we may now add Belgium; it was discovered by VAN DEN HOUTE (1999) in Houthulst Wood in West Flanders.

Most finds of this animal have been in Britain (BLOWER, 1985) where it is quite a common species in woodland litter and soil and is known from other more open sites such as meadows, screes, gardens and waste places. A majority of the sites are calcareous (FAIRHURST, 1984; FAIRHURST & ARMITAGE, 1979).

Houthulst Wood is a mixed deciduous woodland of mostly oak standing about 15 m above sea level, on a glei soil of sandy loam relatively rich in calcium. It was extensively sampled between 1974 and 1980 and again in 1982 (KIME & WAUTHY, 1984; KIME, 1992); a later list of millipedes was given by ALDERWEIRELDT & KIME (1997). This list included *M. gallica* and did not include *M. scutellare.* VAN DEN HOUTE found a male *M. scutellare* in 1997. It may have been overlooked in the previous surveys which included unidentifiable juvenile stadia. This is the first record of *M. scutellare* on the Continent north of the Jura. In addition, most of the Continental records are from mountains, up to 2315m (PEDROLI-CHRISTEN, 1993).

36 ***Melogona voigtii* (Verhoeff, 1899)** (Map 37)

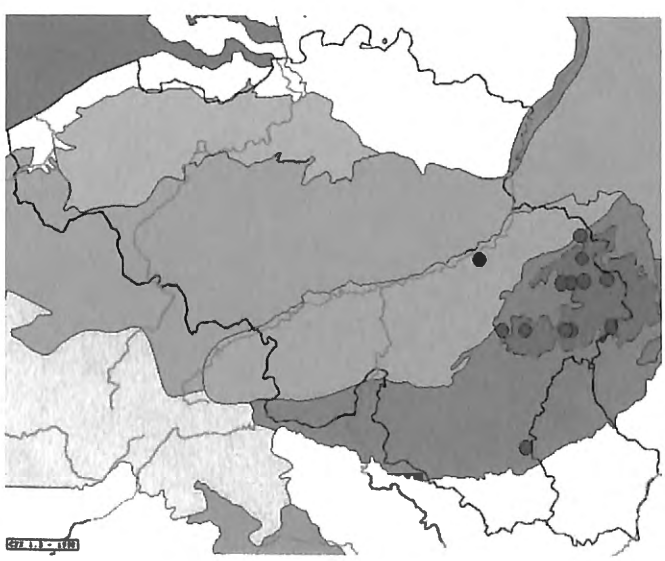
Melogona voigtii is a Central European species extending from Belgium to Poland and from Switzerland and Austria to Sweden, Denmark and Scotland. Just as *Melogona gallica* has some stations east of the Rhine *M. voigtii* has some to the west of this river, in Belgium and the Netherlands. In Belgium the two species overlap in the Province of Limburg where there are three records of *M. voigtii* to date, to the west of the Meuse. The first was from a cave at Vechmael-lez-Oreye (LERUTH, 1939), the second in humus at Zichen-Zussen (DE QUEKER, 1962) and the third in the litter of an oak/birch wood at Rijckhoven.

According to SPELDA (1999) this mainly woodland species is the member of the family least susceptible to dessication and with a tendency to occur in calcareous places.

M. voigtii is known from 3 UTM squares in Belgium at the extreme eastern end of the Brabançon Plateau.

37. ***Mycogona germanicum* (Verhoeff, 1892)** (Map 38)

Mycogona germanicum also has a central European distribution which stretches from Belgium, Luxemburg and



Map 38 — Distribution of *Mycogona germanicum* (Verhoeff, 1892).

the Vosges in the west to the Czech Republic and Poland in the east. Most of this area consists of the hilly parts of Germany. It was first reported from Belgium by DE QUEKER (1962) who found identifiable males at Eupen and Bevercé in the Province of Liège.

It favours humid woods with plenty of cover (SCHUBART, 1934) and demonstrates a preference for coniferous forest (SPELDA, 1999). In the last twenty years it has been found in over thirty different sites in the eastern Belgian provinces of Liège and Luxembourg. The lowest site was an oak/birch/beech forest at 220 m above sea level, and there was an oak forest at 360m; the vast majority of sites were situated higher than 500m in montane coniferous or beech forests in the eastern High Ardennes. As in Germany the highest proportion of sites were coniferous forests, mainly spruce and Douglas fir.

M. germanicum has been recorded in 13 different 10km UTM squares in Belgium, in the east only.

38. *Orthochordeumella pallida* (Rothenbühler, 1899) (Map 39)

Orthochordeumella pallida has an unusual distribution. Described originally from the Alps and found from France to Bavaria, there is a large disjunct population in NE France, Belgium, Luxemburg and the Rhineland of Germany and at least one other in the Massif Central of France, apart from the subspecies *cebennicum* described from the Cevennes (BROLEMANN, 1935). It is possible that the species will be found in the intervening territory between the French populations, in any event the animal has a considerably greater range than was even quite recently supposed.

The first certain record of *Orthochordeumella pallida* in Belgium was from the entrance of a cave, the Trou Manto at Ben-Ahin in the Province of Liège, in the winter of 1938 (SCHUBART, 1939; LERUTH, 1939). Two previous records of females in 1932 and 1935 from other caves (SCHUBART, 1935a, b) provisionally listed with doubt as *Orthochordeuma germanicum,* were supposedly also *Orthochordeumella pallida* (SCHUBART, 1939). There are further records from Belgian caves (DETHIER & HUBART, 2000).

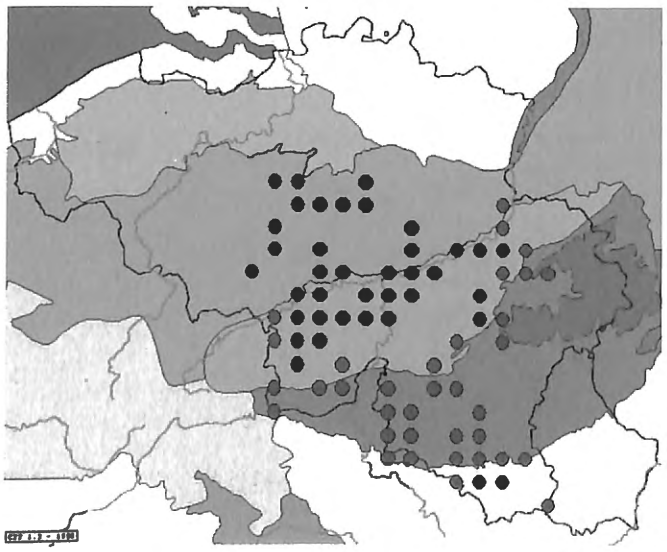
DE QUEKER (1962) reported it from eleven communes where she found it in litter, under bark, under stones and in the ground. It is now seen to be a common animal in most of Belgium from the latitude of the Brussels Region southwards. It is absent from the north and so far from the Netherlands.

O. pallida is a typical woodland species. At first we associated it with silty soils and oakwoods (KIME *et al.*, 1992). However, most Belgian forests contain some oak trees. In the last few years it has become increasingly obvious that the species occurs in fairly pure beech forests and in a few pure stands of spruce in the montane zone. PEDROLI-CHRISTEN (1993) signals its presence in numerous Swiss habitats, principally in the montane and subalpine zones but also including open ground above the tree line, up to 2740m in altitude. Even if it may be tolerant in some respects, on a fairly small scale it has a noticeably patchy distribution which may be linked to soil texture and related edaphic factors.

Orthochordeumella pallida has been noted from 73 UTM squares in Belgium. This places it thirteenth in rank, making it a significant member of the Belgian millipede fauna.

39. *Brachychaeteuma bagnalli* Verhoeff, 1911 (Map 40)

On the Continent this animal is found in an intermediate position between *Brachychaeteuma melanops* BRADE--



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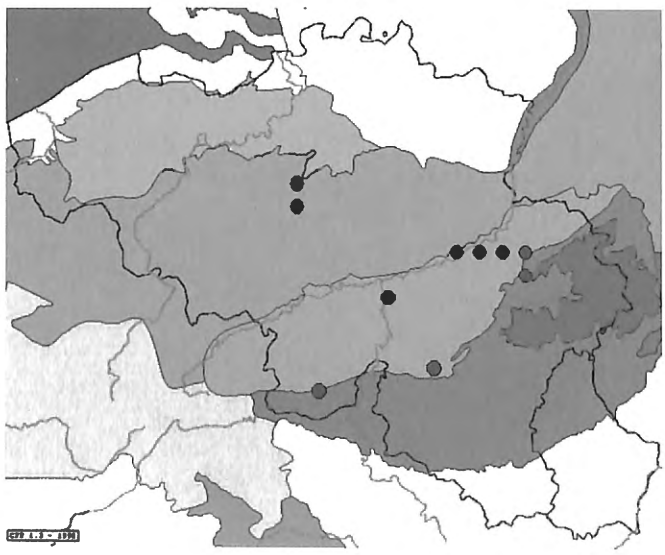


Map 40 — Distribution of *Brachychaeteuma bagnalli* Verhoeff, 1911.

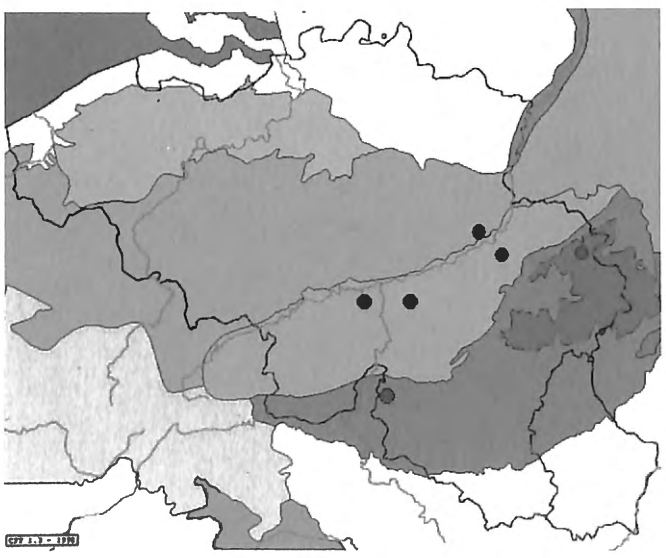
BIRKS, 1918 to the west and *B. bradeae* (BRÖLEMANN & BRADE-BIRKS, 1917) to the east: it is known only from Belgium, eastern France and Westphalia in Germany. All three species occur in Britain, where it was first found (VERHOEFF, 1911).

B. bagnalli was recorded from seven Belgian caves in the provinces of Liège and Namur during 1933 and 1934 (SCHUBART, 1935a,b; LERUTH, 1939). It lives not just near the entrances but in deep galleries where it is found on layers of clay. There have been several new finds, some in caves previously prospected without success (DETHIER & HUBART, 2000). It is apparently well-adapted as a troglophile. There are other perhaps exclusively cavernicole species of this genus in France. In Britain *B. bagnalli* has been collected from habitats on the surface, including gardens and waste places (BLOWER, 1985). It has synanthropic tendencies. In Belgium, too, in the last 25 years, it has been found on several occasions on the surface or from soil extractions in the suburbs of Brussels. These sites are on base-rich ground with e.g. *Clematis vitalba*, usually in small patches of woodland or bushy places near gardens or along railway embankments.

B. bagnalli has been recorded from 10 UTM squares in Belgium. It has been found only underground in some limestone areas of the Mosan District, only above ground in the Brussels region of the Brabançon District.

40. *Ceratosphys amoena confusa* Ribaut, 1920 (Map 41)

Ceratosphys amoena was thought to be an endemic of the Central Pyrenees, with an outpost on the Montagne Noire. It was a surprise to find it in Belgium where it is well-established in a number of forests in proximity to the Meuse more than 750km NNE of the Montagne Noire. Five subspecies of *C. amoena* have been described.



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MAURIES (1966) discusses their distribution. The Belgian specimens were sent to Dr. Mauriès for confirmation of their identity; they correspond to the ssp. *confusa* which is the one on the Montagne Noire and a small part of the northern Pyrenees. There are other invertebrate taxa, including centipedes, which have disjunct distributions involving Belgium and the Pyrenees e.g. *Lithobius microps exarmatus*, *L. tricuspis var. mononyx* (EASON, pers. comm.).

The stations discovered for this species are the following:

1. Arbre, Namur Province. Oakwood with hornbeam on heavy loam; mull moder.
2. Gesves, Namur Province. Oakwood with hornbeam on medium loam; calcic mull.
3. Bourseigne Neuve, Namur Province. Oakwood with hornbeam on sandy loam; mull.
4. Angleur, Liège Province. Oakwood with beech on sandy loam; dysmoder.
5. Eupen, Liège Province. Oak forest on silty soil at Petit Bongard.
6. Flémalle, Liège Province. Puits Ruwet. A limestone cavity in woodland.

The loamy soils all had a high silt content, Arbre had above average clay content as well. In five of the six stations *C. amoena* was associated with *Orthochordeumella pallida,* which also shows a clear preference for silty soils. It may be significant that all the sites are close to the Meuse or its tributaries. All the subspecies of *C. amoena* live in forest litter. The Belgian populations are small and scattered, most of them have been located by pitfall trapping.

Ceratosphys amoena has been found in 6 UTM squares, the stations being scattered along the Sambre-Meuse trench and associated valleys in the Mosan District.

N.B. A female, presumed to be of this genus, was found at Kasterlee in a small oakwood on the edge of the Campine, in lowland Belgium, during a survey by the Belgian Royal Institute of Natural Science. This specimen was sent to Dr. Mauriès who said that the vulvae were not exactly typical of *C. amoena*. Unfortunately a male still has not been found at the Kasterlee site which is just off the Langenaart, a road in the south of the commune. It is difficult to imagine what else this specimen might be if it was not an unusual specimen of *C. amoena*. The genus is essentially Iberian, the sixteen described species all coming from the Pyrenees or further south.

41. *Oxidus gracilis* (C. L. Koch, 1847) (Map 42)

This synanthropic and thermophile species has been found on a number of occasions in greenhouses, apartments and other buildings where it is able to survive the winter, usually in the larger Belgian cities.

O. gracilis has been recorded in 4 UTM squares.

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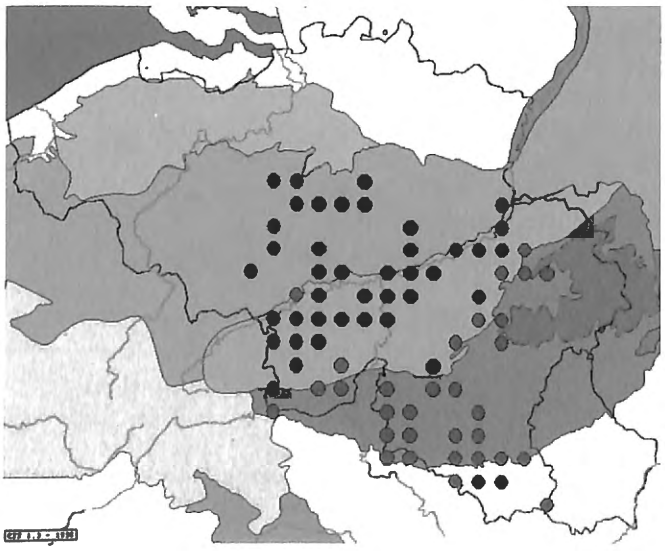

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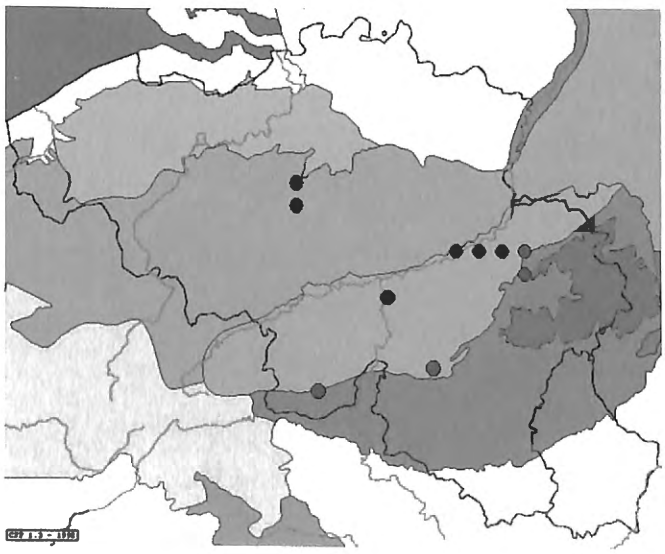

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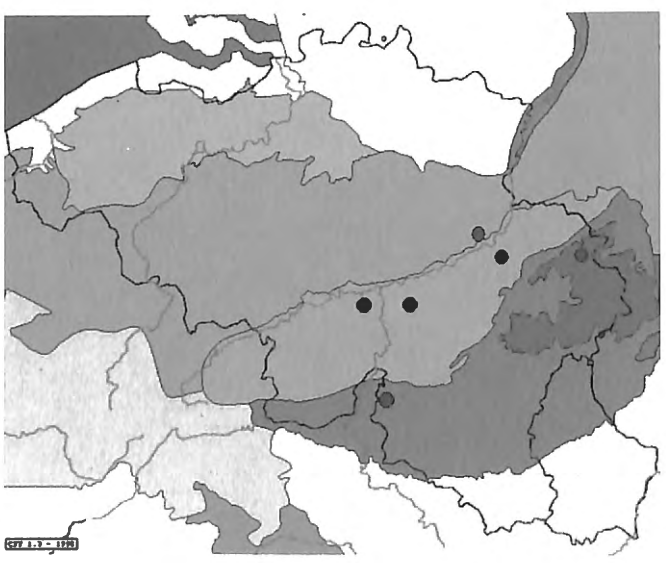

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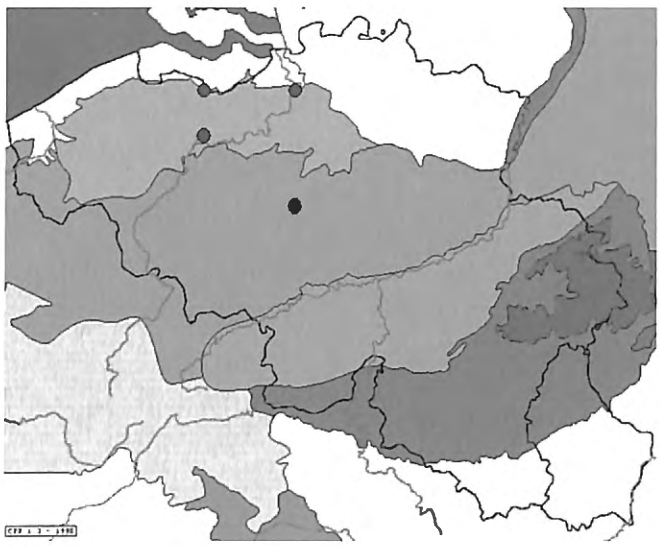


Map 42 — Distribution of *Oxidus gracilis* (C. L. Koch, 1847).

42. *Polydesmus angustus* Latzel, 1884 (Map 43)

Polydesmus angustus is by far the most commonly recorded polydesmid in Belgium, found throughout the Country. It has an extended Atlantic distribution from the Pyrenees to Norway and east as far as The Czech Republic and Austria.

Although *P. angustus* occurs in every part of Belgium there is no mention of it being found on the sand dunes along the coast and it is rare on Holocene soils in the Netherlands (Berg, 1995). Nor is it recorded from the north coast of Germany where the vicariant *P. complanatus* (Linnaeus, 1761) occurs east of Hamburg. Nevertheless it is an active and highly mobile wanderer, the most eurytopic of Belgian polydesmids.

Most commonly *P. angustus* is found under surface debris, particularly wood, under bark and in leaf litter. As well as being a typical forest species it is common in open areas and well-known in gardens and farms where it is often implicated in damage to certain crops (Brade-Birks, 1930; Blower, 1985). It is found in caves, sometimes penetrating a long way from the entrance (Leruth, 1939).

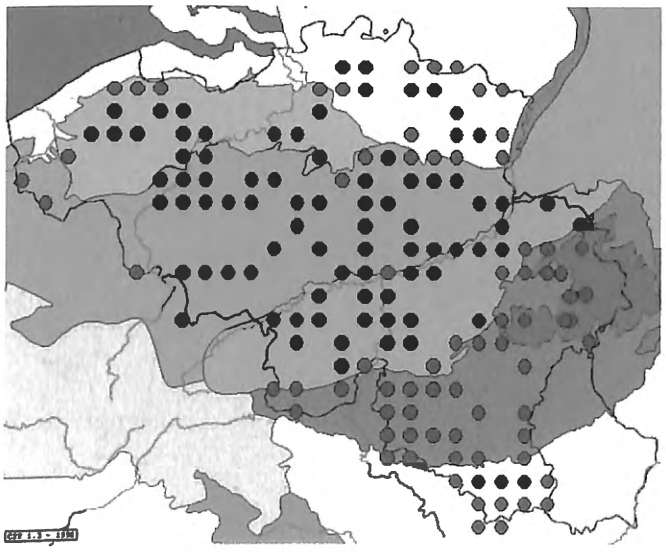
Haacker (1968) emphasised the importance of humidity to the species, in the Rhine-Main area of Germany he recorded it as a woodland species – a view shared by Schubart (1934) – feeding on litter and decaying wood. In Belgium it is very common in humid woods with moderately thick organic layers. We have found it abundant on light soils, including *Callunetum,* and while we have encountered it in most woodlands it does, however, seem very scarce on calcic mulls. We associated it with low clay and high silt (Kime & Wauthy, 1984) and David (1990) similarly linked it to silty soil with a not very acid humus and found a positive relationship with sand. Drainage may be a factor governing its distribution, it preferring damp but not waterlogged resting places.

P. angustus has been listed from 157 UTM squares in Belgium, third equal in rank.

43. *Polydesmus coriaceus* Porath, 1870 (Map 44)

This species has an Atlantic distribution from Macaronesia and Portugal to Britain and Ireland; it reaches its eastern limit in Belgium, only just crossing the Meuse near Liège and near the French border.

P. coriaceus is associated with clay soils, at least in the northern part of its range (Fairhurst & Armitage, 1978; Kime, 1978). It may be found on other soils with impeded drainage or close to the water table, usually in woodland, but like the preceeding species it may occur under logs in open places such as pastures. In Belgium Van Den Haute (1999) reported it from sandy and loamy soils



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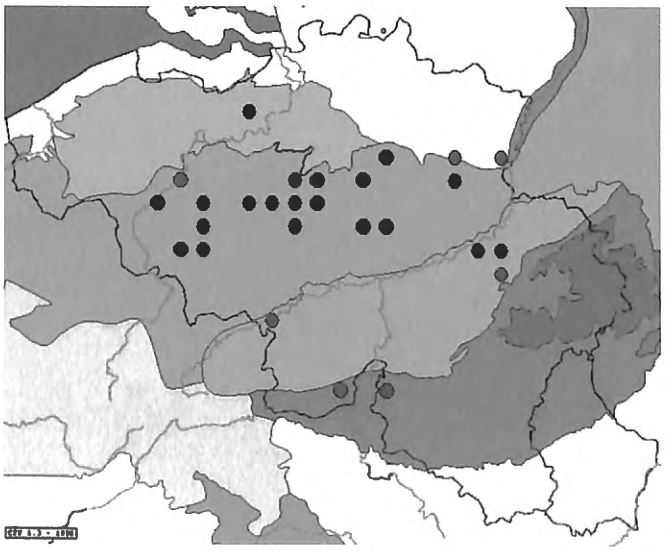


Map 44 — Distribution of *Polydesmus coriaceus* Porath, 1870.

which were covered with very damp litter. It is quite certainly hygrophile. It has been located in a cave (HUBART & DETHIER, 1999).It has been recorded from a variety of habitats in northern Spain where it appears to be very common.

P. coriaceus is known to occur in 27 UTM squares almost entirely from the Hennuyo-Brabançon Plateau and the Mosan District. Its northern and eastern limits are on the edge of the Campine and it has not been found beyond the edge of the Ardennes. There are also no records from the Lorraine region, which experiences lower winter temperatures than the first three regions mentioned.

44. *Polydesmus denticulatus* C. L. Koch, 1847 (Map 45)

Polydesmus denticulatus is the species with the broadest European distribution within the genus.

It has a northern bias, occurring from Ireland and France in the west to Russia, the Ukraine and Bulgaria in the east, with many records from Scandinavia. It has the reputation of being a versatile species, common from biotopes as varied as inundation floodplains, polders, raised bogs, agricultural land, xeric grassland and Boreal, Alpine and cool temperate forests, from sea level to nearly 2400m.

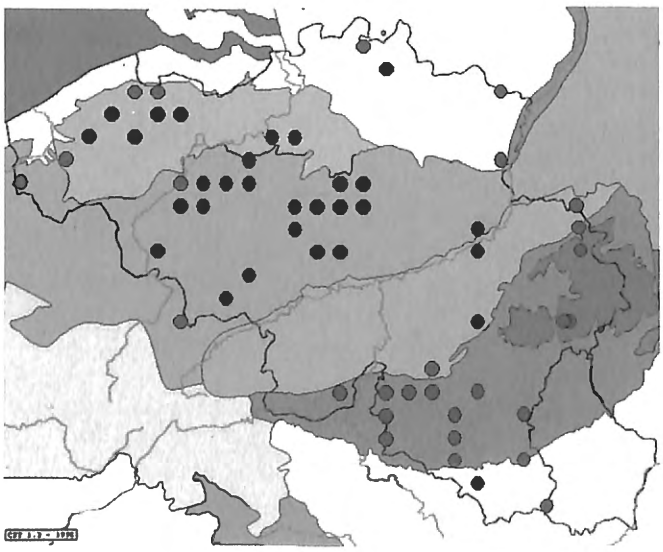
In Belgium it has not been recorded as much as *Polydesmus angustus*, with which it is often found. It is rare in beech forests and common in many oak and birch woods, which may have to do with drainage. If most records are from acid sites it is also found on calcareous strata, either woodland or grassland. It seems to be most abundant in low-lying forests on the plain in Flanders (VAN DEN HAUTE, 1999), regularly in very humid or wet situations near the water table. In this respect it should be noted that it is by far the most common polydesmid in the Netherlands (BERG, 1995). It may be submerged in winter (ZULKA, 1996). It lives chiefly in litter and basically should be a woodland species, a fact recognised by BLOWER (1985). In summer it wanders actively and may be found in open habitats such as calcareous grassland where large numbers have been trapped. It is particularly reported from open habitats in Germany, Switzerland and Austria (SCHUBART, 1934; THIELE, 1968; PEDROLI-CHRISTEN, 1993; THALER, 1987). It is to a degree synanthropic, at least in some regions.

P. denticulatus has been reported from 58 UTM squares in all parts of Belgium except the coastal dunes.

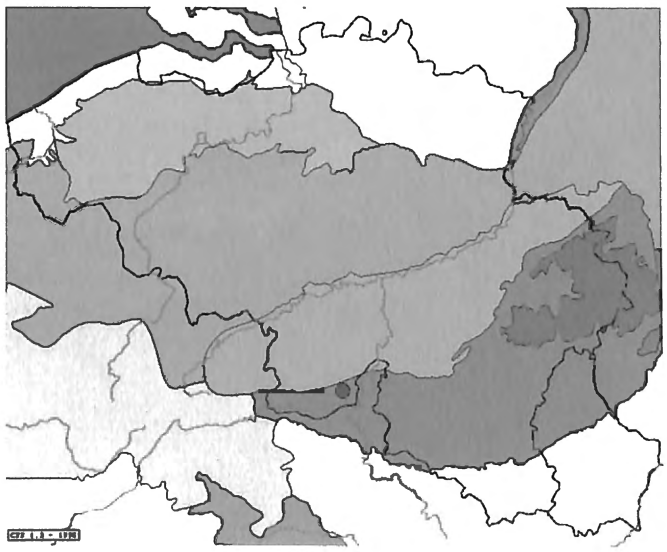
45. *Polydesmus germanicus* Verhoeff, 1896 (Map 46)

This small and perhaps relatively rare animal has been found only about a dozen times altogether, in Germany, Switzerland, France and Belgium. It is the smallest member of the genus in these countries, smaller even than *Brachydesmus superus*, and males are not much in evidence. Without counting the segments it might be mistaken for *Brachydesmus*, although in adult females the epigynes are distinctive (TADLER & THALER, 1993). It is more than likely that it has been overlooked on a number of occasions. It is most likely to be obtained by soil sampling and pitfall trapping.

Polydesmus germanicus may be a petrophile species (SCHUBART, 1934), it has been found under stones and in rocky places, several times on limestone. It was discovered in such a place, a xerobrometum at Treignes in Belgium (Province of Namur, Mosan District) by Dr Etienne BRANQUART. To date this is the only record.



Map 45 — Distribution of *Polydesmus denticulatus* C. L. Koch, 1847.



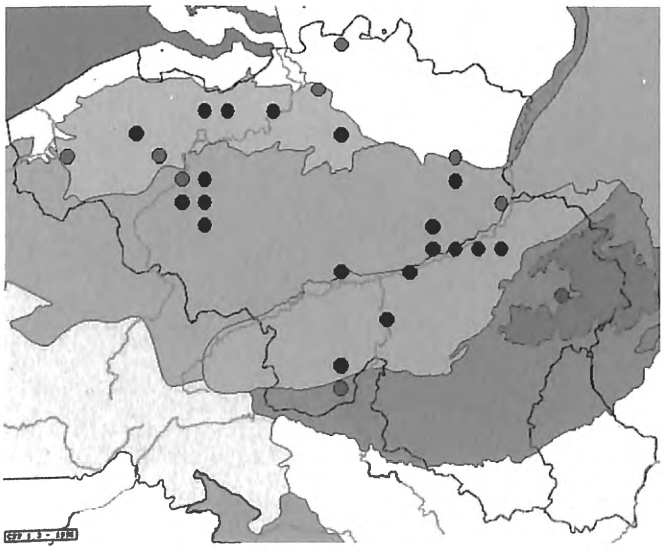
Map 46 — Distribution of *Polydesmus germanicus* Verhoeff, 1896.

46. ***Polydesmus inconstans* Latzel, 1884** (Map 47)

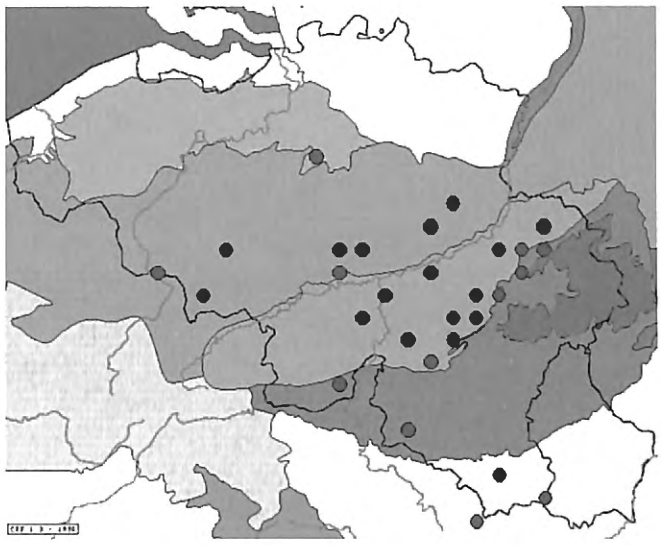
Polydesmus inconstans has a more or less Atlantic distribution from Spain to Norway, at the same time extending far to the north and east as a synanthropic species, reaching Iceland and the River Volga. Its Atlantic character may be inferred from its absence in virtually all of Baden-Württemberg (SPELDA, 1999) and its restriction to the Valais in western Switzerland (PEDROLI-CHRISTEN, 1993).

Apart from its association with human activity it is still a wide-ranging animal, found in a variety of biotopes. It is perhaps more likely to be encountered in open terrain than elsewhere. It is common in grassland, especially calcareous grassland but including grassland on sandy soils and notably metal-polluted *Calamagrostis* grassland in Belgium: it is common in quarries and on spoil heaps. DAVIS (1978) described it as the commonest millipede in some English limestone quarries. SCHUBART (1934) includes gravel pits and banks of bodies of water. It is often found on cultivated ground. FAIRHURST (1984) lists a large range of habitats and, while showing a variety of substrates, states that it prefers loose rich soils. He mentions sand dunes where we have not yet found it in Belgium. It is found in woodland; I have noted poplar plantations, alder, sycamore, oak, ash, birch and mixed deciduous woods. the chief microsites are under stones or dead wood, in litter and, in open sites, in grass tussocks.

In Belgium, *Polydesmus inconstans* seems to be commonest in Flanders and down to the Sambre-Meuse valleys. Its distribution is patchy; there are no records from the coast, practically none from the Ardennes and, surprisingly none at all yet from Belgian Lorraine - there are plenty of records from the neighbouring Grand Duchy of Luxemburg. It has been recorded in only 28 UTM squares in Belgium.



Map 47 — Distribution of *Polydesmus inconstans* Latzel, 1884.



Map 48 — Distribution of *Polydesmus testaceus* C. L. Koch, 1847.

47. ***Polydesmus testaceus* C. L. Koch, 1847** (Map 48)

Polydesmus testaceus has an extended Atlantic distribution from SW France to the Czech Republic and it shows a southern bias, being found along the Mediterranean Riviera coasts of France and Italy and reaching only as far north as the southern counties of England and the Nordrhein-Westfalen region of Germany. Is is thermophile.

P. testaceus is absent from the north of Belgium. This absence may be explained partly by the fact that it is petrophile and thus missing from Quarternary soils (SCHUBART, 1934), and because it is also calcicolous, which effectively precludes it from the Ardennes as well. It has been recorded from many caves.

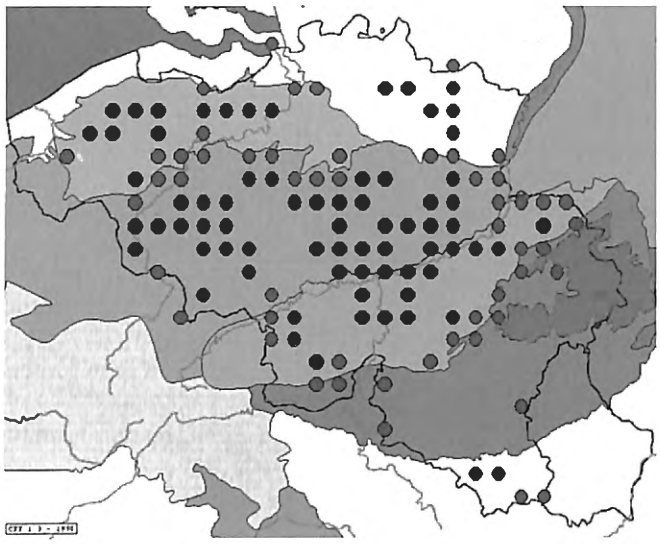
The first records in Belgium were all in caves (LERUTH, 1939). Subsequently DE QUEKER (1962) found it under stones, wood and in woodland litter. It occurs in damp woodlands although rarely in large forests, conforming with the findings of PEDROLI-CHRISTEN (1993) in Switzerland. THIELE (1968) found it in damp forests in the Rheinland. Most captures have been from open sites, especially grassland where the species is conspicuous in both mesobrometum and xerobrometum. It possibly favours ecotonal areas, woodland borders, clearings, hedges, etc. *P. testaceus* has been occasionally observed in gardens and on cultivated land.

There are records from 29 UTM squares in Belgium, all in base-rich sites.

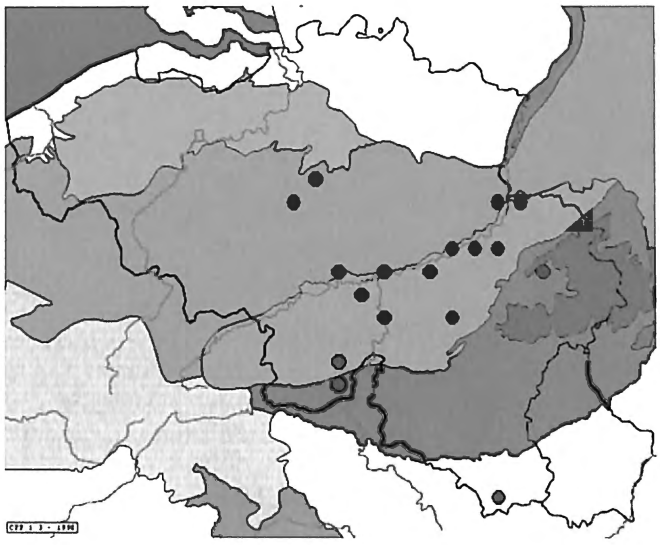
48. ***Brachydesmus superus* Latzel, 1884** (Map 49)

Brachydesmus superus is a small polydesmid which is widespread in Europe. It is one of the best known species in cultivated land where it is sometimes a nuisance, feeding on crops.

BLOWER (1985) states that *Brachydesmus superus* is



Map 49 — Distribution of *Brachydesmus superus* Latzel, 1884.



Map 50 — Distribution of *Macrosternodesmus palicola* Brölemann, 1908.

very numerous in limestone woodland and limestone districts generally. Belgian data support this, although its numbers in soil samples vary considerably from place to place; in some limestone woodlands we have not found it at all. The bulk of the records come from cultivated areas with a high nitrogen count where it is the most common polydesmid, spending much of its time underground. SCHUBART (1934) cites its occurrence in molehills, which are usually in rich soil. BIERNAUX (1968) discusses its behaviour in fields of sugarbeet, on the roots of which it feeds. *B. superus* is found in Belgian caves.

B. superus occurs in all parts of Belgium. Subject to the coverage being adequate the distribution map suggests that the animal is less abundant in the poorer soils of the coast, the Campine and the Ardennes. It has been found in 126 UTM squares. It is a generalist that may occur nearly everywhere, at present sixth in rank, bearing in mind that synanthropic situations are under-represented.

49. *Macrosternodesmus palicola* Brölemann, 1908 (Map 50)

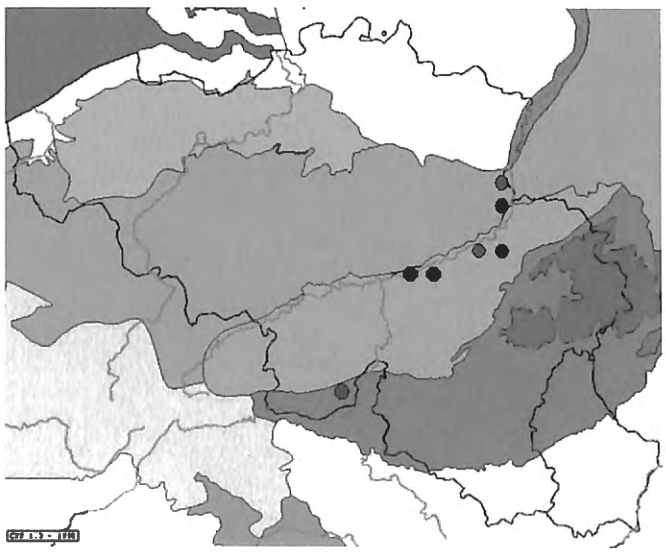
This species has been found from the Pyrenees to Norway in the Atlantic zone with some mostly synanthropic occurrences further east.

This small species is well represented in oak/hornbeam and beechwoods on chalk and limestone in Belgium. About three-quarters of the located sites were on calcic mulls. It is easily able to penetrate into the ground during unfavourable periods; it is found in the humus and litter mainly during the winter and early spring. There are a couple of suburban localities on basic soil around Brussels. It has been found on layers of humid clay in Belgian caves (LERUTH, 1939).

M. palicola is known from 17 UTM squares, almost entirely from the Mosan District.

50. *Ophiodesmus albonanus* (Latzel, 1895) (Map 51)

Ophiodesmus albonanus has a very similar distribution to *Macrosternodesmus palicola,* again with the bulk of the records in calcareous sites and some in other synanthropic locations. In Belgium it is apparently a much rarer species however. There is only one record from a cave (DETHIER & HUBART, 2000) and it is known from only seven UTM squares in the vicinity of the Meuse.



Map 51 — Distribution of *Ophiodesmus albonanus* (Latzel, 1895).

Unconfirmed reports of millipedes in Belgium

Two millipedes have been cited from Belgium in the past without localities or any present proof of their existence in the Country. Their eventual discovery is likely.

Cylindroiulus britannicus (Verhoeff, 1891).
BLOWER (1985) includes Belgium in the list of countries from which this millipede comes. I can find no other mention of this species occurring in Belgium and there are no Belgian specimens in the national collection. Nor have I found it in thirty years of collecting. Before 1985 it had been reported from most countries in NW Europe, including neighbouring Holland and Germany, where it occurs chiefly in greenhouses (JEEKEL, 1978, SCHUBART 1934). On the Continent it is mainly synanthropic. There are no records from neighbouring France or Luxemburg.

Stosatea italica (Latzel, 1886).
This is similarly cited from Belgium in BLOWER (1985). It was reported from the Netherlands as well, at Valkenburg in the south of Limburg close to the Belgian frontier by SCHUBART (1934) who wrote "Wohl auch in Belgien und Luxemburg". It was subsequently found in Luxemburg (REMY & HOFFMAN, 1959) but has not yet been reported within Belgium.

Discussion

While this paper covers all Belgian records, during the last twenty years the emphasis has been placed on field work in Belgian forests. Some detailed publications concerning these have appeared

(KIME & WAUTHY, 1984; BRANQUART, 1991; KIME, 1992; KIME *et al.*, 1992; DAVID *et al.*, 1993; BRANQUART *et al.*, 1995; KIME, 1997; ALDERWEIREILDT, 1997; ALDERWEIREILDT & KIME, 1997; VAN DEN HAUTE, 1999) and further detailed analyses are envisaged. Hundreds of sites have been examined and it seems worthwhile to mention the types of millipede communities that are found there. The forest sites have varied from nearly natural ancient forest to entirely artificial plantations; most of them, however, have been in long established woodland and give some insight into the fauna of the native vegetation of the area.

The check-list shows the presence of five orders of Diplopoda in Belgium. In rank the most important order is the Julida (24 species), followed by the Chordeumatida (11 spp), the Polydesmida (10 spp), the Glomerida (4 spp) and finally the Polyxenida with only one species. Several pioneer and synanthropic species are included in the Julida which tends to exaggerate their dominance. Among the most widespread 15 species in Belgium there are 6 julids, 4 chordeumatids, 3 polydesmids and 2 glomerids. This corresponds quite well with the balance of species found in Belgian forests and is indicative of the transitional position of Belgium with respect to the Atlantic and Central European faunas (KIME, 2000; KIME & GOLOVATCH, 2000). Most Belgian forests contain between one and six julids, one and four chordeumatids, one to three polydesmids and one or two glomerids. The highest, harshest and most acidic forests may have no julids whereas forests on base-rich soils at low altitudes may have as many as nine species. The harshest forests have however one or two chordeumatids present, while most forests contain three or four, the most diverse occasionally having five. Chordeumatids are found in large numbers. *Craspedosoma rawlinsii* is more or less ubiquitous, *Melogona gallica* is abundant except in the high Ardennes and in the sandy areas towards the Dutch border, while *Chordeuma sylvestre* and *Orthochordeumella pallida* are very common except in the north, often occurring together. *Mycogona germanicum* has strong populations in the High Ardennes. It is this species and *Craspedosoma rawlinsii* that are the only species present in much of the Hautes Fagnes. Polydesmids are missing only from a few of the harshest sites, there are usually two, especially *Polydesmus angustus* followed by *P. denticulatus* in the Ardennes or on sandy/acidic substrates lower down. On limestone *Brachydesmus superus* and *Macrosternodesmus palicola* are important species. Most forests contain *Glomeris intermedia* and/or *Glomeris marginata;* the former is far more widespread at higher altitudes.

Table 1 shows how widespread the different millipedes are in Belgium, according to existing records. The rank order in Table 1 is based on the number of UTM squares in which the species has been found, it is not the order of abundance of records. On the whole, naturally, the most widespread species are among the commonest. It may be that the results are skewed in favour of forest-inhabiting species.

It is difficult to quantify the records exactly because they vary from just the mention of a species in a particular commune on the one hand to quantitative data collected every two weeks at the same site during a whole calendar year on the other. At the same time population densities vary considerably; species that are absent from part of the country may be very common elsewhere. One such species with frequently high population densities that springs to mind is *Melogona gallica* in forests, which is absent from the north, and another is *Cylindroiulus caeruleocinctus* in grassland, especially calcareous grassland (KIME, 1992; 1997).

From general biogeographical data it can be seen that the most widespread species in Belgium are either Western European (Atlantic) species - which in many cases extend further towards the east through Germany - or else Central European species which in most cases extend north-westwards to the United Kingdom. On the whole much less important than these are a few widely distributed European species and some pioneer species from the south. Remarkably, about seventeen species arrive at the limit of their geographical range within the borders of Belgium; these are again mainly Atlantic (at their eastern limit) or Central European species (at their western limit). They are shown in TABLE 2 with the regions in Belgium in

Table 1 — All species with definite Belgian records, with the number of 10km UTM squares in which they have been located

Species	Number of squares	Rank
Cylindroiulus punctatus	202	1
Tachypodoiulus niger	178	2
Polydesmus angustus	157	3=
Craspedosoma rawlinsi	157	3=
Julus scandinavius	141	5
Brachydesmus superus	126	6
Melogona gallica	121	7
Glomeris marginata	104	8
Chordeuma sylvestre	97	9
Allajulus nitidus	93	10
Glomeris intermedia	91	11
Leptoiulus kervillei	78	12
Orthochordeumella pallida	72	13
Blaniulus guttulatus	71	14
Polydesmus denticulatus	58	15
Cylindroiulus caeruleocinctus	57	16
Brachyiulus pusillus	44	17
Proteroiulus fuscus	43	18
Ommatoiulus sabulosus	33	19
Leptoiulus belgicus	30	20
Polydesmus testaceus	29	21
Polydesmus inconstans	28	22
Polydesmus coriaceus	27	23
Cylindroiulus latestriatus	17	24=
Macrosternodesmus palicola	17	24=
Nemasoma varicorne	17	24=
Archiboreoiulus pallidus	16	27=
Polyxenus lagurus	16	27=
Choneiulus palmatus	15	29
Mycogona germanicum	13	30=
Nopoiulus kochii	13	30=
Boreoiulus tenuis	11	32
Brachychaeteuma bagnalli	9	33
Cylindroiulus truncorum	8	34
Cylindroiulus vulnerarius	7	35=
Enantiulus nanus	7	35=
Ophiodesmus albonanus	7	35=
Ceratosphys amoena	6	38
Geoglomeris subterranea	5	39=
Leptoiulus simplex glacialis	5	39=
Oxidus gracilis	4	41
Cylindroiulus parisiorum	3	42=
Melogona voigtii	3	42=
Nanogona polydesmoides	3	42=
Ommatoiulus rutilans	2	45
Glomeris tetrasticha	1 or 2?	46
Cylindroiulus arborum	1	47=
Melogona scutellare	1	47=
Polydesmus germanicus	1	47=
Xylophageuma zschokkei	1	47=

Table 2 — Species at the limit of their range in Belgium, with the districts in which they are found.

Species	Biogeographical districts in which they are present							
	Ma	Vl	Ke	Br	Mo	Ar	HA	Lo
Glomeris tetrasticha				(+)	+			
Glomeris intermedia		+		+	+	+	+	+
Enantiulus nanus				+	+			+
Leptoiulus kervillei		+		+	+	+		
Leptoiulus simplex					+	+	+	
Ommatoiulus rutilans				+	+			
Xylophageuma zschokkei					+	(+)		
Nanogona polydesmoides				+	+			
Melogona gallica		+	+	+	+	+	+	+
Melogona voigtii				+				
Chordeuma sylvestre		+		+	+	+	+	+
Orthochordeumella pallida				+	+	+	+	+
Mycogona germanicum					+	+	+	
Brachychaeteuma bagnalli				+	+			
Ceratosphys amoena					+	+	+	
Polydesmus coriaceus		+	+	+	+	+		
Polydesmus germanicus					+			
	0	5	2	11	16	9	7	5

which they have been found. In fact there may turn out to be more than seventeen because there are several species that have been recorded in French departments adjacent to Belgium, in the Grand Duchy of Luxemburg or in the Netherlands that have not yet, but might be, found in Belgium.

It can be seen that the central parts of Belgium figure strongly in this table, especially the Mosan District which has all of these species bar one, *Melogona voigtii*, which occurs in very close proximity to it. The Meuse Valley is an important ecological corridor.

While introduced pioneer species are responsible for some differences between the Belgian list and the lists of neighbouring countries, even if these are ignored all of the surrounding countries still contain species which have not yet been recorded in Belgium. There are eighteen unrecorded species which have been found less than 100km from the border. In turn, Belgium has one species at the western end of its range that has not been found in France, six species which have not been found in Germany, eleven not found in Luxemburg and twelve not yet recorded from the Netherlands. In the case of these last three countries most of the species concerned are Atlantic and a few are relict species; they are at their northern or eastern limit in Belgium. The difference with particularly Luxemburg is likely to be diminished by further work in the field.

Some Belgian millipedes merit special mention either because their distribution does not conform to previous expectations or because they seem to be of particular significance in the fauna. Those that do not conform, apart from evident introductions, are presumably relict species. The most evident of these is *Ceratosphys amoena,* recorded from numerous sites in the Midi-Pyrenees of France. It may have had a much larger distribution before the glacial period and is one of a number of Pyrenean elements in the Belgian fauna. The Belgian populations are small and scattered.

Another important example of disjunct distribution is *Orthochordeumella pallida* with an Alpine distribution from Savoy in the west to the Bavarian Alps and the Tyrol in the east and extensive populations some way off centred on the Massif Central and the Ardennes, although this last population is very extensive stretching from the eastern edge of Normandy to the Rhineland, so far as is known. There is a large well-investigated area in Alsace and Baden-Württemberg between this population and the Alps from which it appears to be entirely missing. It is a common animal in southern Belgian forests.

Brachychaeteuma bagnalli has a very disjunct distribution, known from caves in the Mosan district of Belgium, Westphalia and the Rhone Valley near Lyon in France and from superficial habitats in Belgium, Britain and Ireland.

All three of these last-mentioned species are chordeumatidans which may well have survived the Quaternary glacial periods in Belgium.

The strange distribution of another chordeumatid, *Melogona scutellare,* may be relevant to this discussion. It is a western Alpine species with a totally disjunct range in Britain, with one recent find in lowland Belgium.

Some other possibly relict species have already been mentioned e.g. *Glomeris tetrasticha, Cylindroiulus vulnerarius. Nanogona polydesmoides* might be added as the Mosan populations are a long way from the known Atlantic populations in France.

The checklist of 50 Belgian species presented here is certain to be enlarged in the future. Even now some sites from which immature individuals of presumed new species have been taken are under investigation.

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