

RECORDS OF MILLIPEDES IN CENTRAL SOUTHERN ENGLAND

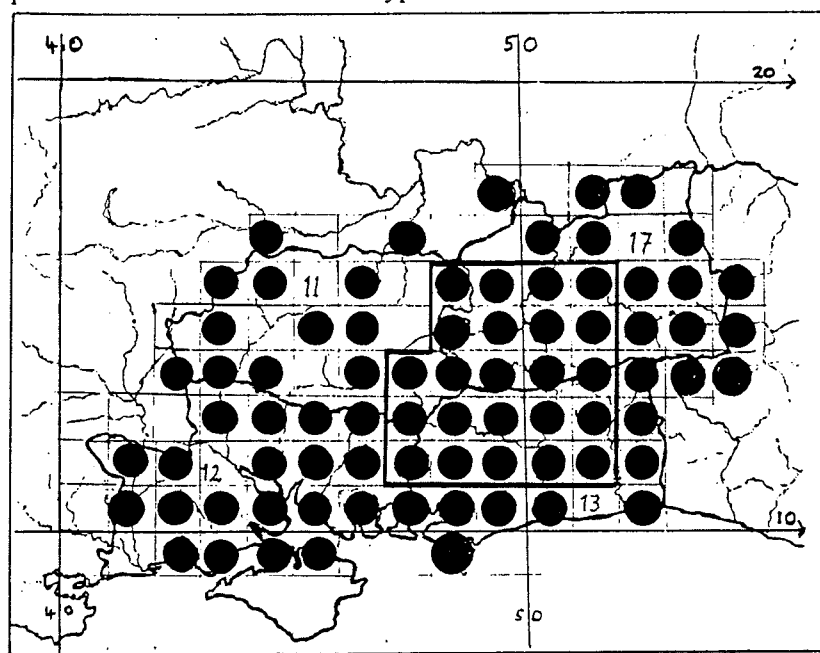
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INTRODUCTION

This report is based on the results of collecting millipedes in the South of England mainly between 1967 and 1975 (summarized in Kime, 1978) and also takes into account all other records for Watsonian vice-counties 11, 12, 13 and 17 kindly supplied by Paul Harding from the British Records Centre a couple of years ago. Also included are the new data published by the British Myriapod Group (1993) following the BMG field trip to Sussex, in order that the following maps should be as up to date as possible. There are omissions, mostly concerning data from the last two years, some of which are however mentioned in the text. Before 1967 there were very few published records indeed from this area.

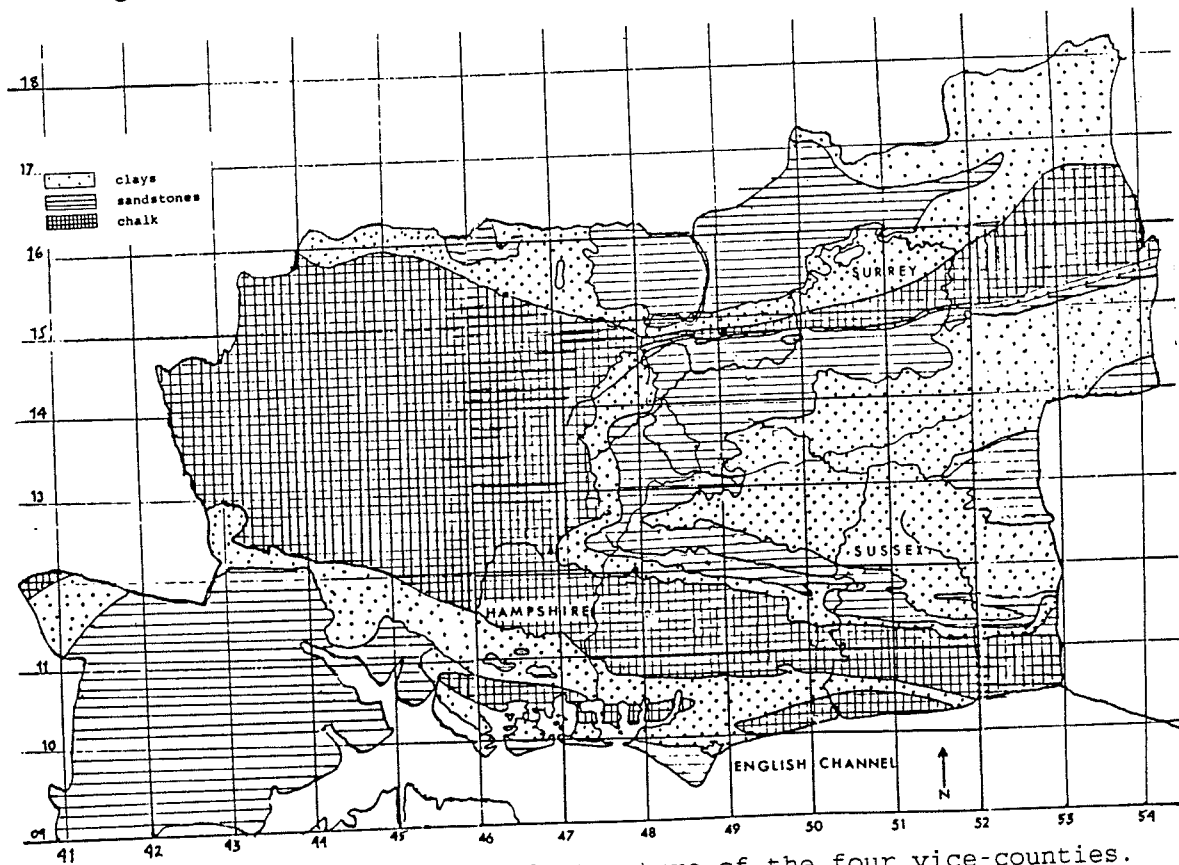
Map 1 shows all the 10 km squares from which I have noted records. The vast majority, which were recorded on a 1 km square basis, come from the area outlined by a bold line on the map: south west Surrey was intensively worked, together with some bordering parts of Hampshire and West Sussex, in such a way as to include detailed results from a full range of soil types present in Central Southern England. Whilst the Western Weald and the neighbouring chalk hills were the principal targets, the south west edge of the London basin, parts of the coast and the New Forest recieved a fair ammount of attention. The intensively farmed parts of North Hampshire were the least prospected: there was no collecting at all in some squares. In the main survey area hundreds of sites were visited and ecological data noted. The distribution of many millipede species was strongly linked to particular rock strata and soil types.



MAP 1. Cover map showing all 10km squares from which there are records.

Map 2 is a simplified representation of the geological nature of the four vice-counties included in the survey. Maps 3-37 show the distribution of 35 of the 37 species that were found out of doors. Hot house species obtained mainly from Kew Gardens are not considered here.

The following text reviews the distribution of the millipedes found, in the light of more recent knowledge of their distribution in the rest of Britain, Ireland and Continental Europe, particularly bearing in mind recent ecological work accomplished in Belgium, France and the Grand Duchy of Luxembourg across the Channel.



MAP 2. Simplified geological structure of the four vice-counties.

OCCURRENCE OF INDIVIDUAL SPECIES

Polxemus lagurus (Linné, 1758) (Map 3)

There are nine scattered records; it has not yet been located in West Sussex. The species has a large geographical range, and occurs in diverse habitats, as reported in Blower (1985). In addition to these habitats fairly recent work from Belgium suggests that it is often found under foliose lichens on tree trunks, as well as under loose bark.

Glomeris marginata (Villers, 1789) (Map 4)

A very abundant animal in these vice-counties, occurring in a wide range of habitats and attaining high population densities in deciduous woodland on chalk. It is a species with a strong Atlantic

orientation in Europe, although it reaches as far east as Poland on the coastal plain. Collecting in woods in Aquitaine, Brittany and Normandy indicates that it abounds in the west of France, but in Belgium it is less common in woodland than in southern England and has seldom been recorded at an altitude of over 300m, though it is found much higher in the South of France. It fades out eastwards in Germany and is not found in East Switzerland. Its distribution in Northern Europe certainly suggests that it is not tolerant of prolonged cold temperatures, and when the weather is cold in winter it does not occur on the surface of the ground or in the leaf litter in Belgium. Over most of continental Europe there are other species of the genus to take into account, some of which occur in the same biocenoses as *G. marginata* especially *G. hexasticha intermedia* which may compete with it and is certainly commoner than *G. marginata* in a number of forests on basic soil where population have been calculated.

Stygioglomeris crinata Brolemann, 1913

It is virtually certain that this small glomerid must occur here and there on the extensive chalk formations found in these counties. The amount of soil sampling in the survey was limited, and I did not find it, but I note a record for West Sussex in the list in the 1993 BMG Bulletin. We have done a fairly considerable amount of soil sampling on chalk in France and Belgium; Berlese extractions have yielded this species from a minority of sites in woodland. We think that soil depth and vegetation cover are perhaps important in determining in which sites it is likely to be found, as well as disturbance in the past. It is not a rare animal, but has a patchy distribution.

Polyzonium germanicum Brandt, 1831

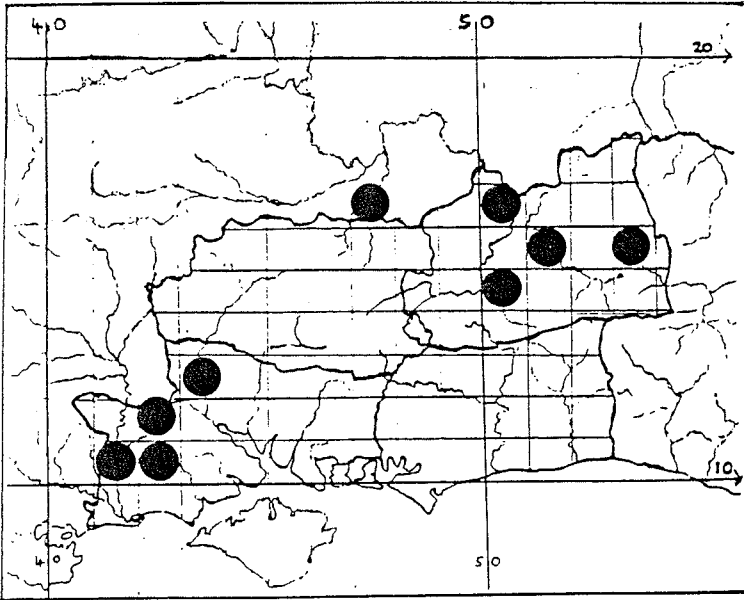
Blower (1958) states that there is a record from Surrey and he subsequently (1985) says that this record requires confirmation. We corresponded about this. I did not find it at all in these vice-counties and it does not appear in the BMG lists.

Craspedosoma rawlinsi Leach, 1815 (Map 5)

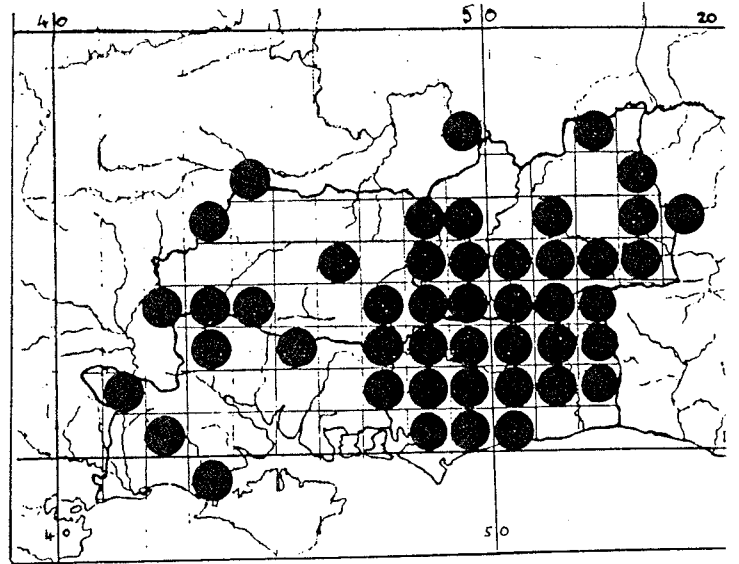
Apparently uncommon, at least during the time of the survey. There are only two records, both from sandstone hills in south west Surrey. In Belgium it is a common animal, particularly in relatively cold situations at an altitude of above 250m and on soils with an acid reaction, features true of hills in the Hindhead area where it was found by Tony Barber. It also appears to be commoner in areas of Britain which are colder in winter, like the Eastern Counties, and, concordantly, it is very common in southern Scandinavia and parts of Germany and Switzerland. Records from France are very scarce indeed, except from the east; this correlates with its absence from south west England (I believe that the 19th Century record from Cornwall has been disowned). But there are several records from South Wales!

Nanogona polydesmoides (Leach, 1815) (Map 6)

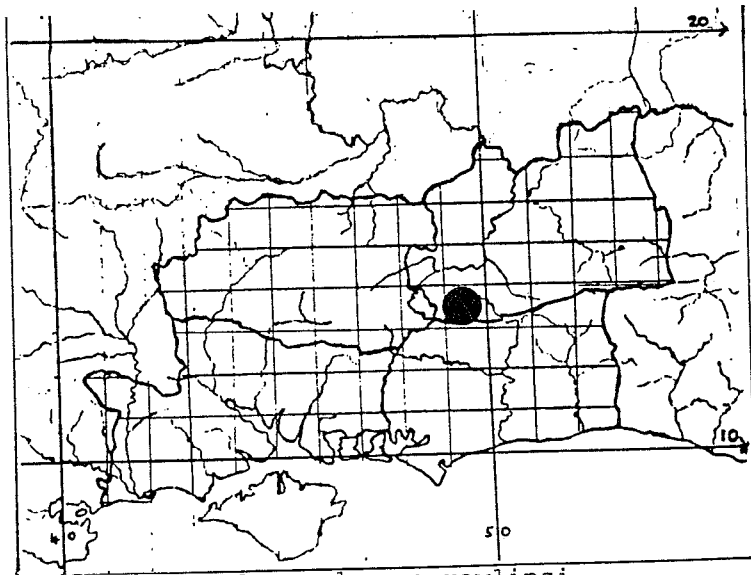
Quite widespread in these counties: it is more common to the west than to the east, and has a very marked Atlantic orientation on the Continent, being almost entirely confined to France, and even there not recorded from Alsace-Lorraine. There are two records from the south of Belgium, and an isolated race occurs in the North of Italy. On the continent most of the southern records are from caves, and, if only for this reason, it is strongly associated with limestone areas. In southern



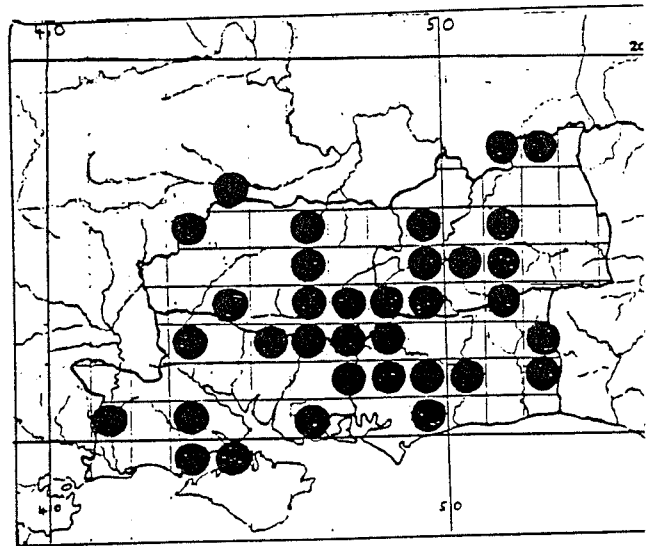
MAP 3. *Polyxenus lagurus*.



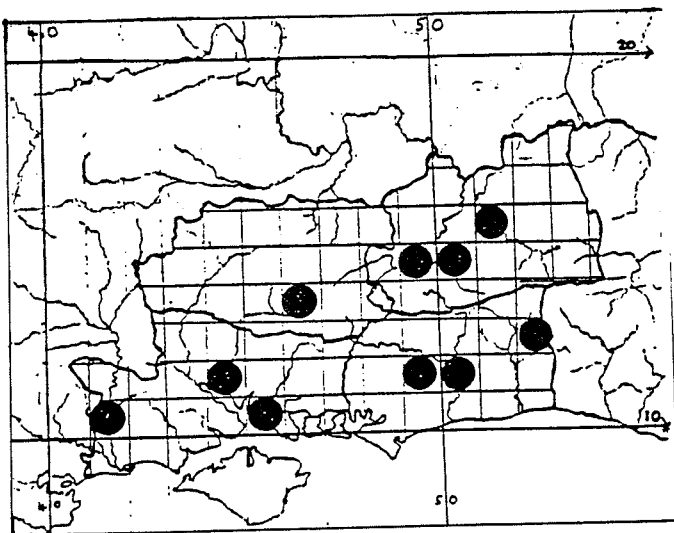
MAP 4. *Glomeris marginata*.



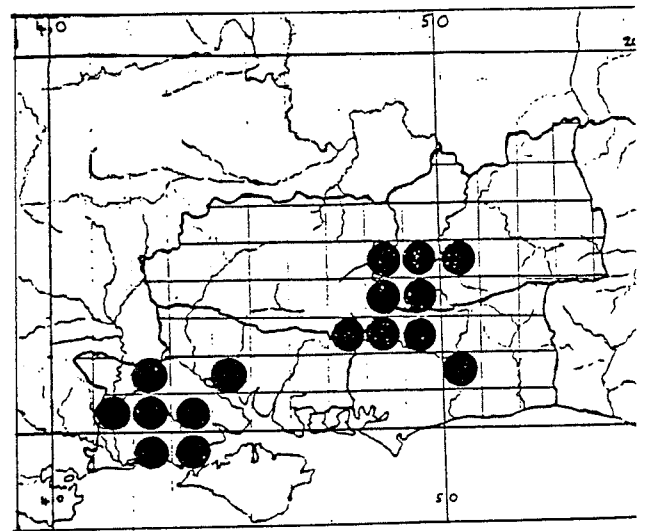
MAP 5. *Craspedosoma rawlini*.



MAP 6. *Nanogona polydesmoides*.



MAP 7. *Brachychaeteuma melanops*.



MAP 8. *Chordeuma proximum*.

England I formed the impression that it was most common on chalk formations. Blower (1985) has already noted that it is more common in limestone districts.

Brachychaeteuma melanops Brade-Birks, 1918 (Map 7)

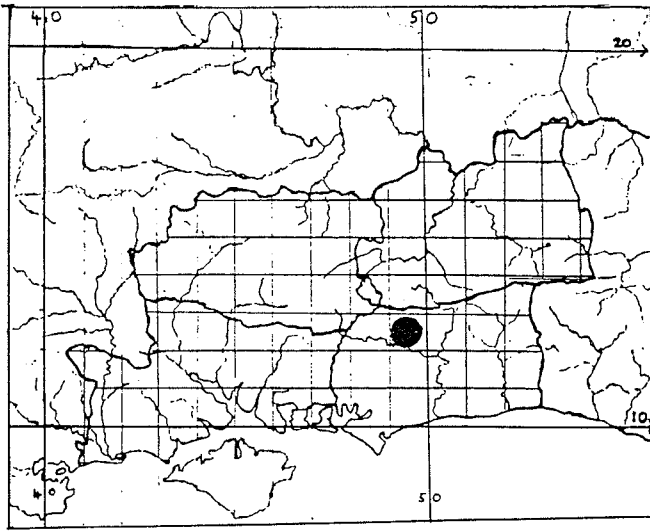
This fairly small species has turned up quite regularly in the Southern Counties in recent years and there are records from all four vice-counties under review, from ten different 10km squares. The records are generally from base-rich areas; most of mine were from chalk formations. Urban, suburban and rural habitats were listed. Thus the synanthropic tendency remarked upon by Steve Gregory (1993) is further supported here. One record was from a garden, confirming his suspicions that it would occur in them. On the other hand some were completely "wild" in rural woodland away from villages. On the continent the species is known only from France, where it is apparently confined to the milder parts of the Atlantic zone: these areas have not yet been thoroughly investigated. In Belgium the only member of the genus so far found is *B. bagnalli* which occurs in several widely dispersed caves and in suburban woodlands round Brussels, very close to habitation. There appears to be very little overlap in the ranges of *B. melanops* and other members of the genus: this could be due to a shortage of records of course.

Chordeuma proximum, Ribaut, 1913 (Map 8)

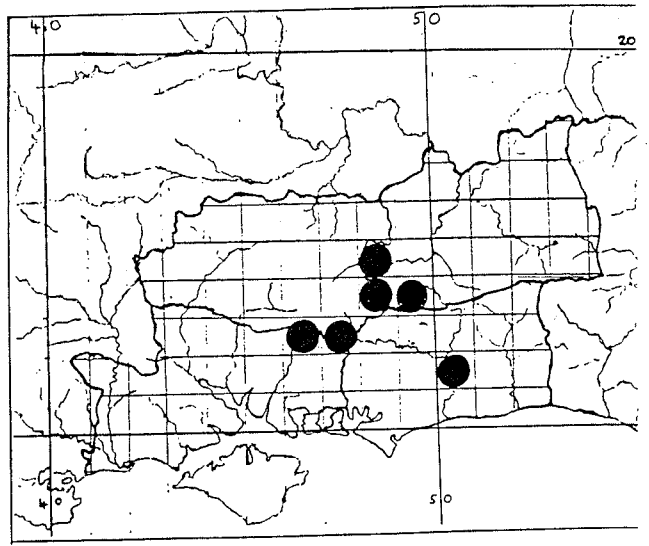
This is another markedly Atlantic species confined to the western half of France on the Continent, where it extends southwards from Normandy to the Pyrenees. It is locally common on sandstone in the Western Weald and in the New Forest area. During the survey it was almost always found in thick acidic litter in pinewoods, pine/oak/birch woodlands or heaths with bracken and heather: in this region it is strongly correlated with podsols. It similarly occurs in markedly acidic woodlands in Normandy. Further south in the Périgord it has been found in damp litter at the bottom of limestone cliffs, and, back in England, it was found in an oak wood on clay south of Bently in East Hampshire, in VC12. This appears to be a previously unpublished record, an omission on my part!

Melogona gallicum (Latzel, 1884) (Map 9)

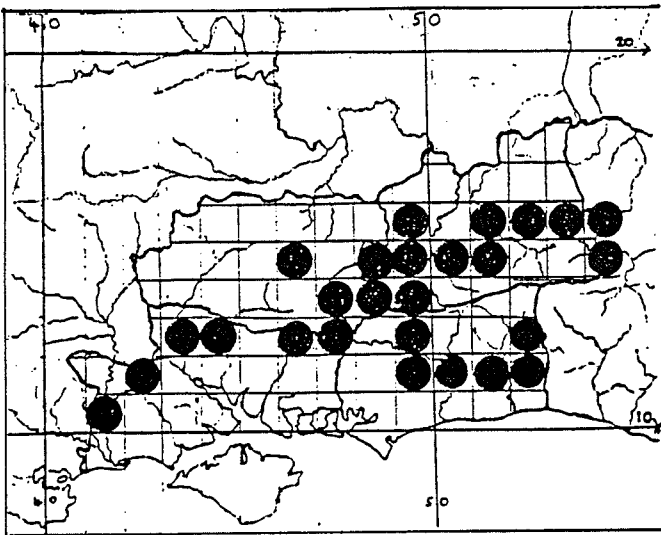
Rather remarkably found only once during the survey, on Telegraph Hill in west Sussex, in a beech/oak/holly wood on Hythe Beds sandstone. Records have accumulated for the West of Britain since it was first found in Wales by Dr. Eason (1957) in 1956, including VC12, Hampshire North. It is however, apparently scarce in south east England, as far west as Hampshire. This is interesting because it is the commonest millipede in Belgian forests and has been found on several occasions in Normandy across the channel; it extends eastwards to the Rhine and southwards to the Pyrenees. Because of its abundance in Belgium we have been able to analyse its ecological preferences statistically (Kime *et al.* 1992). It tends not to occur in soils with very few clay particles (below 8% clay), the highest populations were found in sites with between 8% and 20% clay (up to 385 specimens per square metre) and it occurred in stations with over 35% clay in the soil. 74% of the animals were found at an altitude of between 100 and 200m above sea level, where the mean average temperature was fairly mild, around 9°C and the climate not too continental. The effect of altitude is a rather particular one in Belgium because different rock strata occur in bands at different altitudes, resulting in a marked zonation (see Dufrene & Legrendre, 1991). The coastal plain in Belgium has a high sand content and is warmer and drier than the hilly areas. Climatically the coastal plain is more comparable with the Weald than the rather humid Belgian forests that cover large areas of ground above 100m, and where the rainfall is



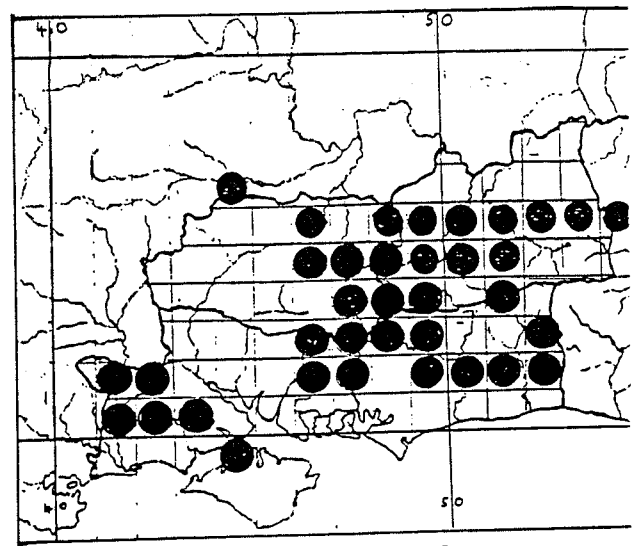
MAP 9. *Melogona gallicum*.



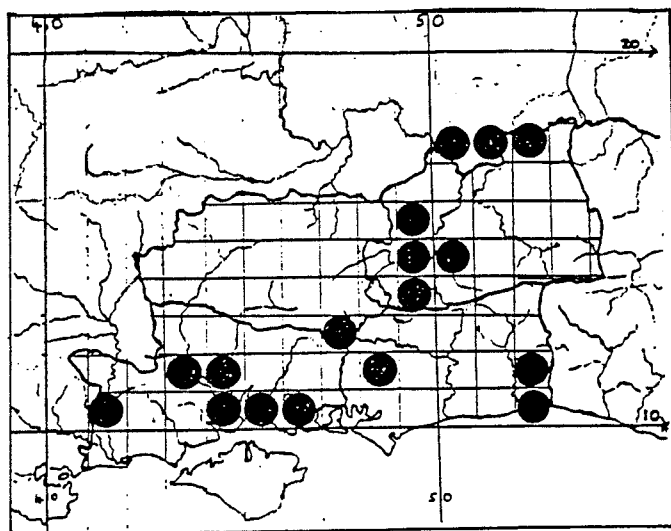
MAP 10. *Melogona scutellare*.



MAP 11. *Nemasoma varicorne*.



MAP 12. *Proteroiulus fuscus*.



MAP 13. *Blaniulus guttulatus*.

significantly higher. Above 300m *M. gallicum* is rare, and has not been found in forests above 500m: these regions are sub-Atlantic and Montane respectively (Ellenberg, 1988). The species reaches the limit of its geographical range in Belgium, and does not occur in the Netherlands, except in the extreme south east near Maastricht (Jeekel, 1978). It is another Atlantic species, although it occurs much further east than the previous two, and nearly all the French records are in the northern half of the country. The data in the British Myriapod Survey report (Fairhurst, 1984) indicate that most of the records are from litter in deciduous woodland on non-calcareous loams: in the moister west where *M. gallicum* is more common, most of the soils are non-calcareous. In Belgium it is found in litter on calcareous and non-calcareous soils alike, it is present in almost every woodland (except in very sandy locations) up to 300m in altitude. Small numbers have fallen into pitfall traps in a number of calcareous grasslands, perhaps during dispersal. As a general comment I would say that south east England is unusually dry for the Atlantic zone, and thus has very low numbers of chordeumatids which are associated with moist habitats. It has already been noted that *Chordeuma proximum* occurs in deep litter in the study area, and this litter is invariably moist at the bottom.

Melagona scutellare (Ribaut, 1913) (Map 10)

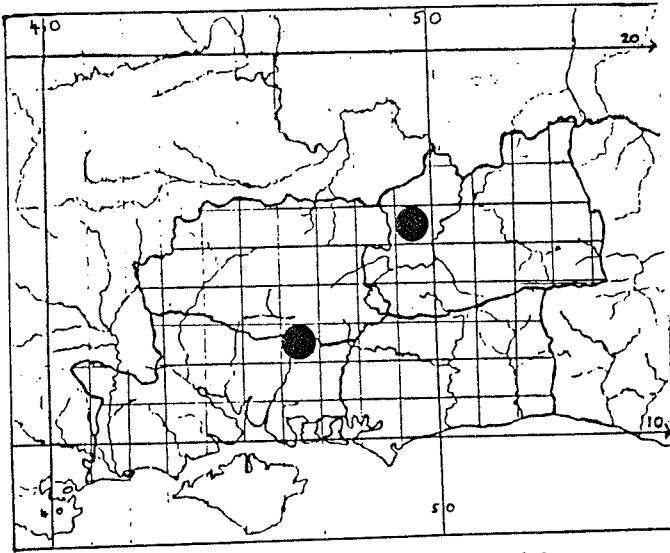
There are eight records from the Western Weald and the Hampshire and Sussex Downs, on a range of soils from greensand to chalk. A have a new vice-county record for West Sussex, where I found this species in an ashwood on May 1st 1994. Continental records are scarce, mainly from the Western Alps in France, Switzerland and Italy. There is also a single record from the Pyrenees. It has not been recorded in lowland France, and not at all in Belgium, Luxembourg, Holland or Germany. Its distribution is therefore markedly discontinuous, and most of the records are from Britain.

Nemasoma varicorne C.L. Koch, 1847 (Map 11)

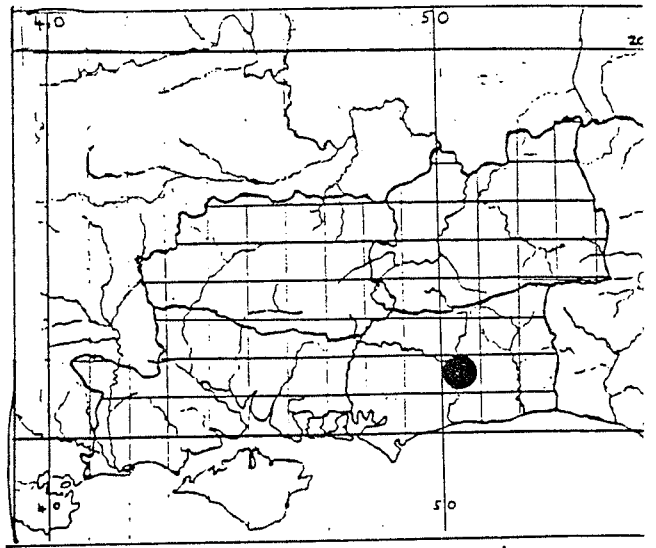
This animal was very abundant in some districts, particularly in old beechwoods, and often in isolated trees in pasture, almost always under the bark of dead branches. Two females were recently (December 1993 and January 1994) caught in pitfall traps set in open grassland in Belgium, indicating dispersal in winter. Although it has a wide distribution in Europe, I find it much less often in Belgium than in Britain, while data from France are scarce and inconclusive at present. Many of the forests that I have investigated on the Continent have been vigorously managed, involving the removal of dead wood and this can obviously account for a shortage of sub-cortical millipedes. On the other hand, there are large areas of semi-natural forest in Belgium, and searching some of these was in vain as well. It is true that in Surrey, Sussex and Hampshire I visited many old woods, for instance on scarp slopes, that are too steep ever to have been cultivated, where there was an abundance of dead timber, or on commons where old trees were similarly neglected, and these were the most fruitful areas.

Proteroiulus fuscus (Am Stein, 1857) (Map 12)

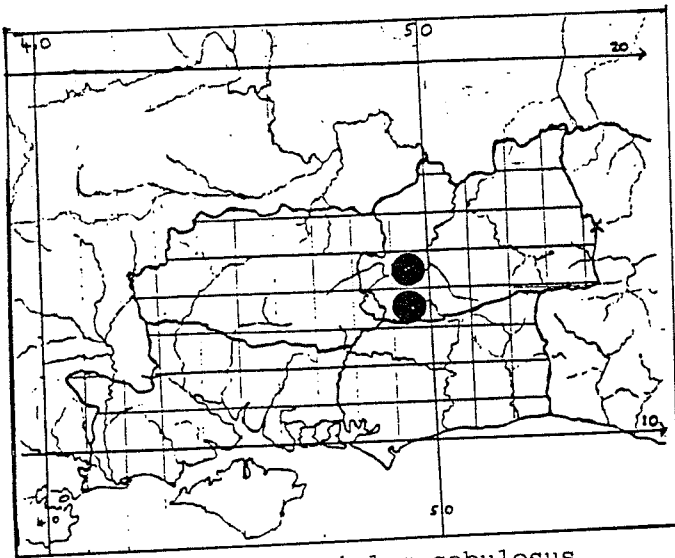
Even more common than the preceding species, occurring throughout the wooded areas and extending into pine and silver birch woods on dry heath on the poorest soils, such as on Bagshot sands where it was sometimes the only millipede recorded. Again, data from the continent are more scattered, and it certainly becomes less common as you go south. In Southern France there are no records at all from low altitude. But this species extends northwards to Iceland and most of



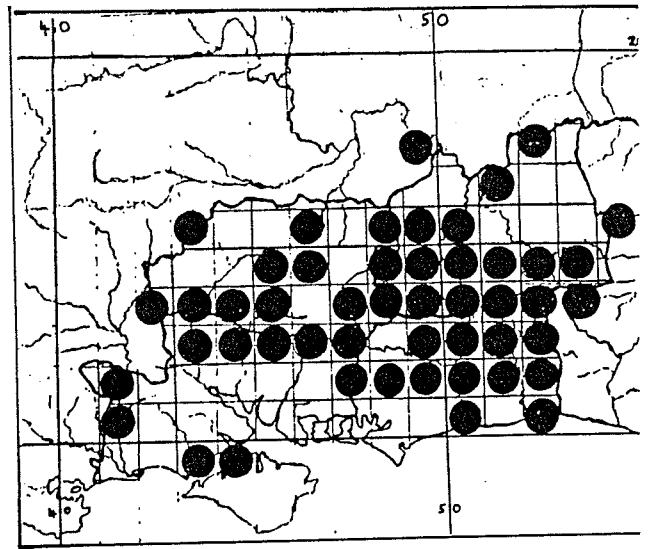
MAP 14. *Archiboreoiulus pallidus*.



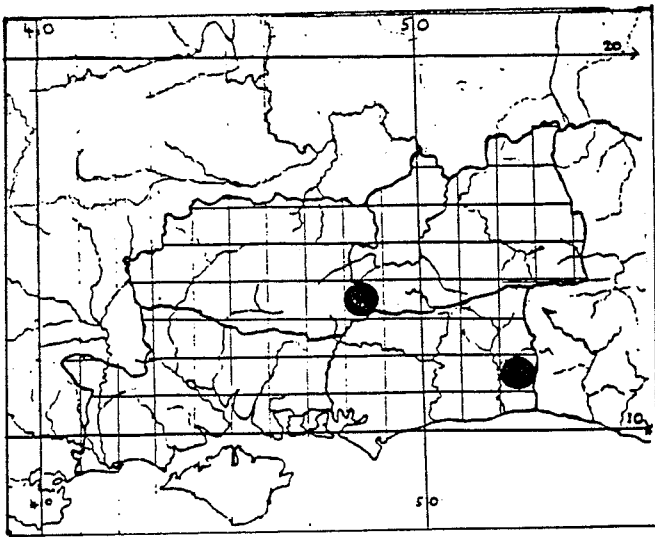
MAP 15. *Boreoiulus tenuis*.



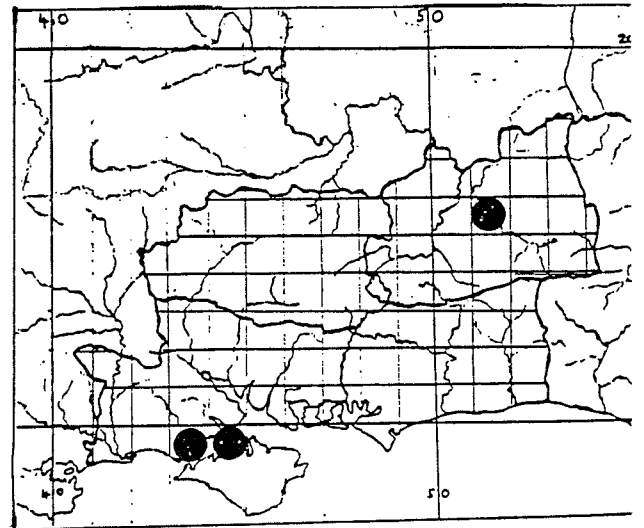
MAP 16. *Ommatoiulus sabulosus*.



MAP 17. *Tachypodoiulus niger*.



MAP 18. *Allaiulus nitidus*.



MAP 19. *Cylindroiulus londinensis*.

Scandinavia, being found as far north as the Arctic circle. Naturally, almost all of the records made during the survey indicate its presence below bark, but it was occasionally found in litter, and has fallen into pitfall traps on the Continent.

Choneiulus palmatus (Nemec, 1895)

There are records for this species for Surrey and West Sussex in the 1993 BMG list, but I do not have the data. I did not find it between 1967 and 1975, although I have found it regularly in Belgium since then.

Nopoiulus kochii (Gervais, 1847)

There are not yet any data for this area. I find it in Belgium. Despite past nomenclatural confusion there are plenty of established records all across Europe as far as Russia.

Blaniulus guttulatus (Fabricius, 1798) (Map 13)

Known to be very common in the South of England; its synanthropic tendencies are also beyond doubt. Because I scarcely employed soil sampling in my survey, and because the emphasis was placed on the examination of wild sites rather than urban sites and gardens (of which there are some), it is under recorded in the region. In semi-natural woods in Belgium which were investigated partly by means of soil extractions all the specimens obtained came from soils with mull humus, and almost all of them were situated on limestone. The dominant trees in these woods were beech, oak and hornbeam. Blower (1985) states that *B. guttulatus* favours base rich soils. We did not find this species at all in the part of Belgium with the lowest mean annual temperatures (below 8.3°C). Randomisation tests based on the Shannon-Weaver function (free test, Edgington, 1986) indicated that these results were not due to chance. In Britain, it is absent from the north of Scotland of course. In Eastern Europe *B. guttulatus* is entirely synanthropic, and, though human activity has spread this species to many lands, it is possible that it originated as part of the forest fauna of relatively mild West-European forest growing on good soils.

Archiboreoiulus pallidus (Brade-Birks, 1920) (Map 14)

Tony Barber found this animal on the municipal dump in Guildford in 1968, and I subsequently found it in two beechwoods on chalk in Hampshire. As in Britain, continental records are mainly from calcareous sites. East of the Atlantic zone it is synanthropic, and so there may be a scenario similar to that of *Blaniulus guttulatus*. In Belgium and Luxembourg we have obtained it by the use of both Barber traps and Berlese extraction in base rich areas.

Boreoiulus tenuis (Bigler, 1913) (Map 15)

I have just one record from another beechwood on chalk, this time on Rewell hill, near Arundel, in West Sussex. Fairhurst (1984) states that it appears to be rare in the south. In Europe, it has much the same distribution as *Archiboreoiulus pallidus*. There are recent records for Hampshire North and Surrey in the 1993 BMG list.

Ommatoiulus sabulosus (Linné, 1758) (Map 16)

There are only three records from these vice-counties, two of them from the survey. Both of these latter were from the sandstone outcrops in Surrey. Its possible scarcity is surprising in view of its known distribution, its ecological preferences, and its status as a common European species. It has about the largest range of any European millipede, having been found in almost every country, and there is no obvious reason why it should be less common in south east England than in other parts of Britain, as it is widespread in the warmer parts of the Continent.

In Belgium it is common in sandy areas (Biernaux, 1969) and we have found it in over half the calcareous grassland sites that have been extensively sampled by pitfall trapping. Sandy and chalky habitats do share a number of features, especially with respect to drainage and temperature, and particularly in open situations. In the Grand Duchy of Luxembourg, it has been recorded in almost all the investigated sites in the lower-lying southern half of the country, most of which are calcareous (Kime, in press). There are large numbers of records from France where it is very common, especially in the south, but its populations are known to fluctuate considerably over a period of time. It sometimes reaches plague proportions locally. It was reported from Brittany by Blower (1987) and Lewis & Kime (1988). However, we did not find it (Kime *et al.*, 1987) in Normandy, further east, in an admittedly not very extensive survey of 22 sites, most of which were visited in the autumn; while the animal is most active in the summertime. It wanders a lot and Barber traps provide a very effective means of catching it.

Tachypodoiulus niger (Leach, 1815) (Map 17)

One of the four most common species in the area, as in Britain generally (Blower, 1985). Quite eurytopic in the survey area, but especially abundant in woodland on chalk, again as reported elsewhere e.g. Pedroli-Christen (1993). It is abundant throughout most of north west Continental Europe (Kime, 1990).

In quantitative analyses of the Belgian woodland arthropod fauna over 75% of the individuals of *T. niger* were collected from calcic mulls, though it occurred in a great variety of woodland up to 550m in altitude. Stations higher than this were peaty and acidic, and it was not recorded. It was caught in the vast majority of calcareous grasslands sampled in both Belgium and Luxembourg, and not captured in bogs, marshes, moorland and heathland. Transects across 16 hedges in Luxembourg, in 14 of which it occurred, showed that it was much more abundant in the hedges than outside in the open fields (Kime, 1994), and, again it was virtually always recorded in woods on limestone in the Grand Duchy. It is absent from low ground in the south of France, which suggests that it may be limited by high summer temperatures. It occurs to heights of well over 2000m in the Alps (Pedroli-Christen, 1993).

Allainulus nitidus (Verhoeff, 1891) (Map 18)

It was first collected in the region south of Haslemere in Surrey by Tony Barber in 1967, uncharacteristically from a sandstone area, since it is more often recorded on limestone. The second discovery in 1993 by the British Myriapod Group at Woodmanstone Church in West Sussex was not on limestone either. Geoffroy (1981) and David (1987) wrote about the ecology of *A. nitidus* in detail, having studied it in France, also on non-calcareous soils. David associated it with mull humus. In Belgium it is a common woodland species and, as with *Tachypodoiulus niger*, we have

found over 75% of our specimens in calcic mulls. In England, in the survey area, I searched many calcic mulls without finding it - it was sent to me from a few places on the North Downs in Kent by Tony Barber notwithstanding. In Belgium we established a connection between *A. nitidus* and high clay content of the soil, the species is infrequent on sandy ground. Its optimum habitat is apparently woodland with mull humus and a "good" base-rich soil. 90% of our Belgian specimens occurred in regions where the mean maximum summer temperatures were below 21.1°C, that is to say, in the cooler zones in summer. In France *A. nitidus* has a strong north east orientation, perhaps also connected with temperature.

Cylindroiulus londinensis (Verhoeff, 1891) (Map 19)

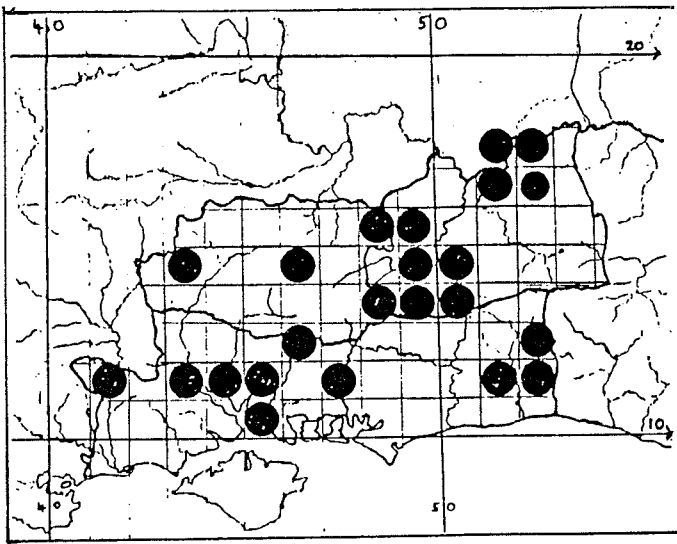
Although I have found this conspicuous animal many times I did not record it at all in the survey area; the records on the map are from John Sankey on Box Hill in Surrey (where I unsuccessfully looked for it) and from Dick Jones in Hampshire South. The 1993 British Myriapod Group list gives Hampshire North as well. I expected to find it on the North and South Downs, since it often occurs on chalk, including the North Downs in Kent, but I did not. As it is so hard to overlook I concluded that it was rare in the area. It is a truly Atlantic species recorded on the Continent only from northern areas of Spain, and France west of the rivers Rhone, Saone and Seine. Other continental reports of the species are erroneous, resulting in nomenclatural confusion (see Blower, 1985), and refer to *C. caeruleocinctus* which occurs widely. In parts of the West of France *C. londinensis* is very common indeed, for example in oak woods on the extensive limestone formations. Only this much is certain at present. Much of Western France remains to be surveyed.

Cylindroiulus caeruleocinctus (Wood, 1864) (Map 20)

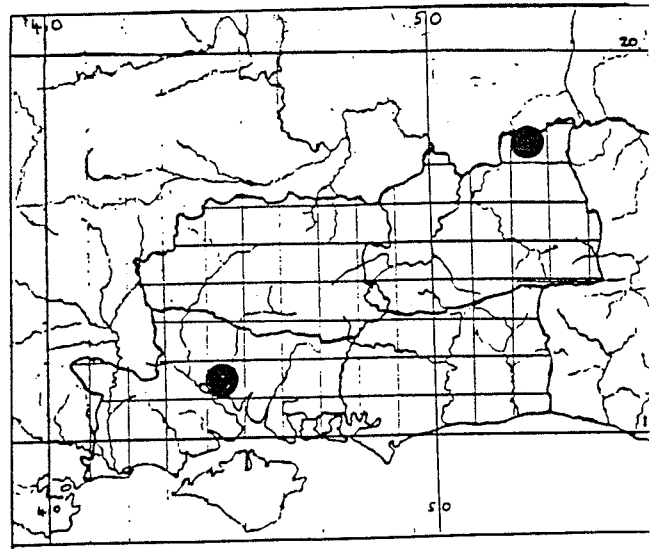
The survey in 1967-1974 revealed the relative abundance of this species in Surrey, where it was placed sixth in rank order, and it is widespread and frequently encountered in Hampshire and Sussex as well, although I did not find it in West Sussex until recently, when I looked at the sandstone ridges in the east of the county. Its association with calcareous soils, and also with cultivation and urban sites, is well known. I have found it in garden lawns in Belgium, where it is common, away from towns and cultivation I have found only one single specimen in a forest, on the other hand it was caught in pitfall traps in every calcareous grassland sampled, often in hundreds, and in one case thousands. This helps to explain its apparent south east orientation in Britain, as suggested by Blower (1985), who pointed out its association with Jurassic limestone and chalk. It is very common on these rocks, but in the south east it is also abundant on Lower Greensand where it occurs in the rather open and rather dry woods; I suspect that this reflects its ability to withstand the relatively dry conditions, and that it should not be regarded as a strict calcicole. Its presence in woodland in the south-east may be due to its adaptation to their periodic dryness, just as the rarity of chordeumatids may indicate their lack of tolerance of the same phenomenon. A recent survey of calcareous grasslands in the Grand Duchy of Luxembourg has shown that *C. caeruleocinctus* is the most abundant species recorded there.

Cylindroiulus vulnerarius (Berlese, 1888) (Map 21)

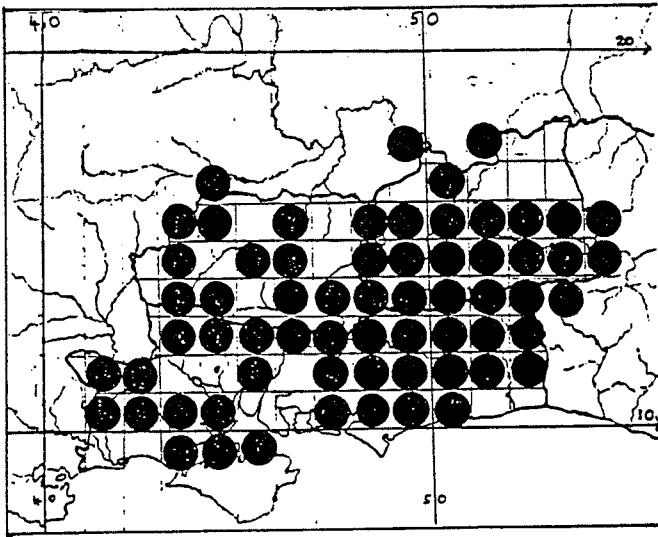
Found in south west London by Adrian Rundle and in Southampton (VC12 by Dick Jones. A native of Italy, it has been recorded frequently in Holland and Belgium in sites associated with human activity, in particular horticulture, and suburban woodland. I often find it round and in



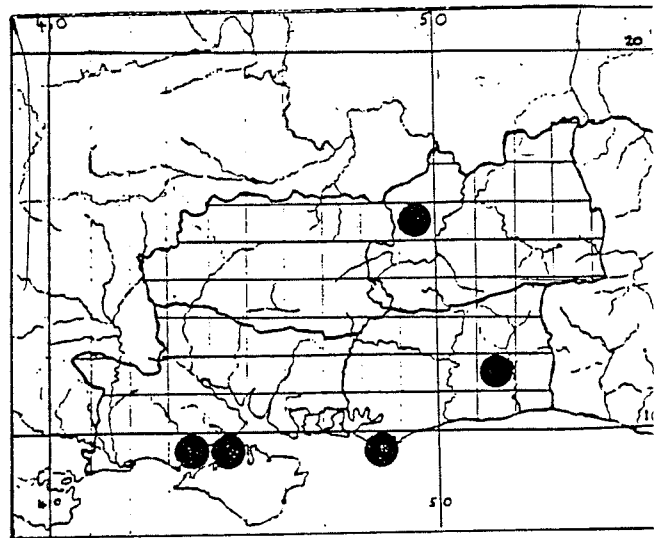
MAP 20. *Cylindroiulus caeruleocinctus*.



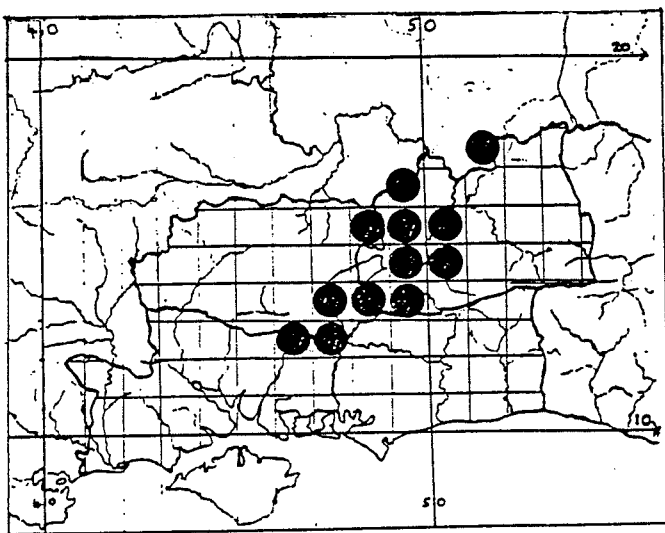
MAP 21. *Cylindroiulus vulnerarius*.



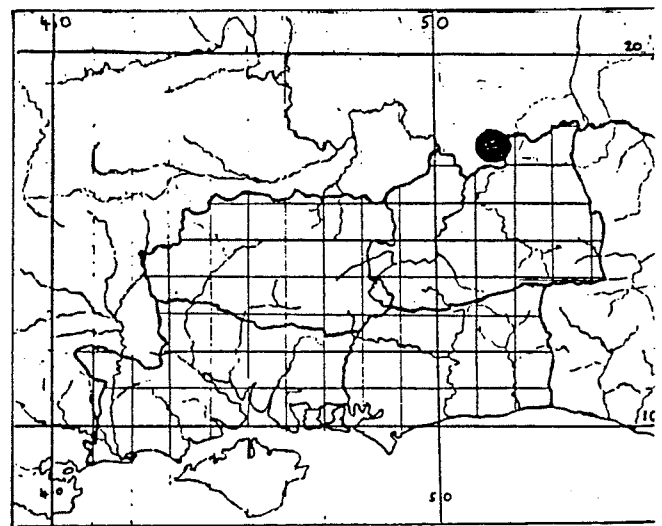
MAP 22. *Cylindroiulus punctatus*.



MAP 23. *Cylindroiulus latestriatus*.



MAP 24. *Cylindroiulus britannicus*.



MAP 25. *Cylindroiulus truncorum*.

Brussels. There seems to be a good chance of finding it in synanthropic sites. Yet, records from West European countries other than those mentioned are so far very few.

Cylindroiulus punctatus (Leach, 1815) (Map 22)

This animal is so common, first ranked in order, that its distribution map is nearly as complete as the cover map (Map 1), and it probably occurs in every square. Although it lives in dead wood for much of the year, we have not found *C. punctatus* in forests on the heaviest soils in Belgium; over 65% of the specimens occurred on soils with between 8% and 20% clay particles. In forests 61% of the animals occurred on mulls and 33% on mull-modders, and 87% were found on base-rich soils (Kime *et al.*, 1991). Looking back over British data I see that I did not find *C. punctatus* in some deciduous woods (mainly oak) on the heavy clay in the Weald where I recorded *Polydesmus coriaceus gallicus* or *P. denticulatus* both of which I associated with damp situations on heavy ground. *C. punctatus* occurred in a much higher proportion of well-drained sites. Finally, most of the *C. punctatus* in Belgium were found at an altitude lower than 200m above sea level. It has not yet been found in the highest parts of the Ardennes, and frequents the zones that are mildest in winter. This tallies with its frequency near the Atlantic Ocean and the North Sea, and its absence from Central European mountains and Eastern Europe.

Cylindroiulus latestriatus (Curtis, 1845) (Map 23)

Three coastal records and two inland, the latter from a garden on sandstone in Sussex and from logs on a sandy substrate in a Surrey pasture. This millipede is known from the Canary Islands, the Azores and European coasts from Portugal to the Faeroes, Norway, Sweden, Finland and Russia, as well as inland, where it is mainly synanthropic. It has been readily introduced into many countries (see Blower, 1985). In Belgium it occurs in sandy areas along the coast as well as inland as well. There are not many French records; these are almost all coastal.

Cylindroiulus britannicus (Verhoeff, 1891) (Map 24)

This turned up regularly during the survey, 13th rank order, though I cannot find a record from West Sussex, from where it is now listed. It was found mainly in or below dead wood, sawdust, or leaf litter. It has not yet been recorded from Spain, France or Belgium, and it mainly synanthropic from Holland eastwards to Russia. Blower (1985) lists Belgium from some source, but I have been quite unable to find any reference to it, and certainly no Belgian specimens. Verhoeff (1891) named *Julus britannicus* accurately; Britain and Ireland are definitely its headquarters. The fact that it is absent from the Atlantic zone of continental Europe leads to one speculation that it survived the ice age in a Hibernian refugium. It is unlikely to have been obliterated by competition in the whole Atlantic zone. The French millipede list now runs to 281 species, so it is unlikely to figure significantly on this, even if it is found one day from France. Coastal records from Portugal, Madeira and the Azores are possibly introductions, like those from America, South Africa and New Zealand. Or the former might just be relict populations which escaped the glaciations.

Cylindroiulus parisiorum (Brolemann & Verhoeff, 1896)

Not yet recorded from Surrey, Hampshire or Sussex. In Belgium it occurs "wild" in dead trees, other continental records are again generally synanthropic. Most of the records of this species are British too!

Cylindroiulus truncorum (Silvestri, 1896) (Map 25)

Another discovery of Dr. Adrian Rundle from the Royal Botanic Gardens at Kew. The species has been introduced into a number of North European countries from the Mediterranean region. In some places in Belgium it has become numerous and on one occasion swarmed and was reported to the authorities by the resident whose property it infested. It occurs in my own garden.

Haplopodoiulus spathifer (Brölemann, 1897)

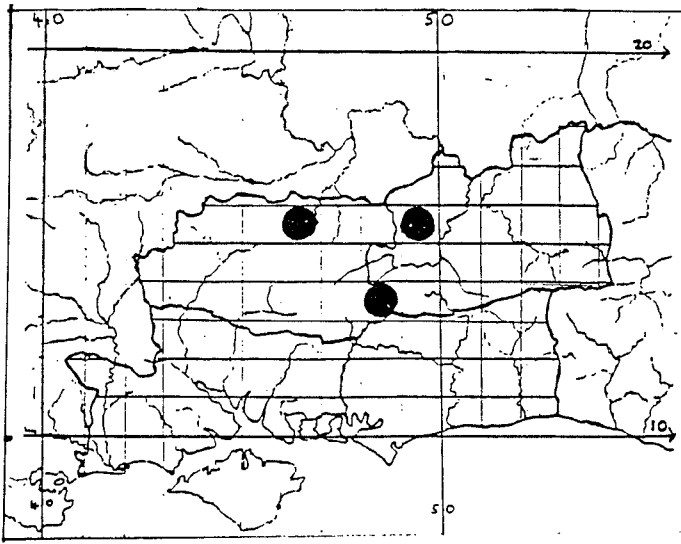
Listed from West Sussex in the BMG list. Supposedly an introduction from the Pyrenees, but it is not absolutely certain. I have found "pyrenean" and "alpine" species in ancient forests in Belgium. The intervening areas in France have been but poorly prospected so far, and some of these animals have bigger ranges than we presently suppose.

Julus scandinavicus Latzel, 1884 (Map 26)

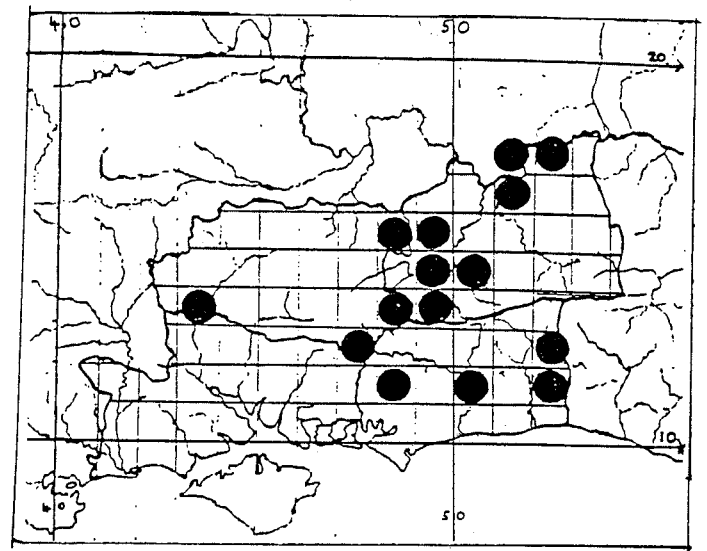
The relative scarcity of this species in south east England has been previously reported (Kime, 1978; Blower, 1985); it seems to be less common than in most parts of Britain. There are not many records from France either, other than the east: its main area of distribution on the Continent is northwards from the Alps to Norway and Sweden. With one exception continental records are from East of the longitude of Dover. It is a very common species in Belgium and Luxembourg, as well as further east, and has been discovered in a large number of different habitats. It is one of the most frequently encountered species in pitfall traps, and has been taken in heathland, meadows (from dry calcareous to marshy in nature), by rivers and ponds, in a raised bog, in hedges and several types of woodland, but never on woodland on limestone. Pedrolí-Christen (1993) likewise signals its absence from calcareous woodland in Switzerland. The woodland sites in Belgium all had high levels of silt in the soil, some were also sandy and frequently acidic: open sites were often sandy, including dunes on the coast. While it falls readily into pitfall traps, extractions from soil samples have shown very low densities in most habitats, and it is possible to overlook it in places where it does occur. Only in a few woods have we found densities such as that described by Gordon Blower (1970) in Cheshire. Having said this, it is still very remarkable that I found *J. scandinavicus* only twice in eight years in the survey area in Southern England, on both occasions on sandy heaths in Surrey, and that there is only one other record from the vice counties, from Great Sorrel Copse, Chineham, N. Hampshire. As far as I am aware there are still no records at all from either Hampshire south or West Sussex, and only one from East Sussex made during the British Myriapod Group visit in 1993. I see that it is at present ranked tenth in Suffolk (Lee, 1994) and has been recorded in about a third of the 10km squares in that county and not yet in the Brecklands. On the face of it this is a very different situation to that south of the Thames. There is scope for future study!

Ophiulus pilosus (Newport, 1842) (Map 27)

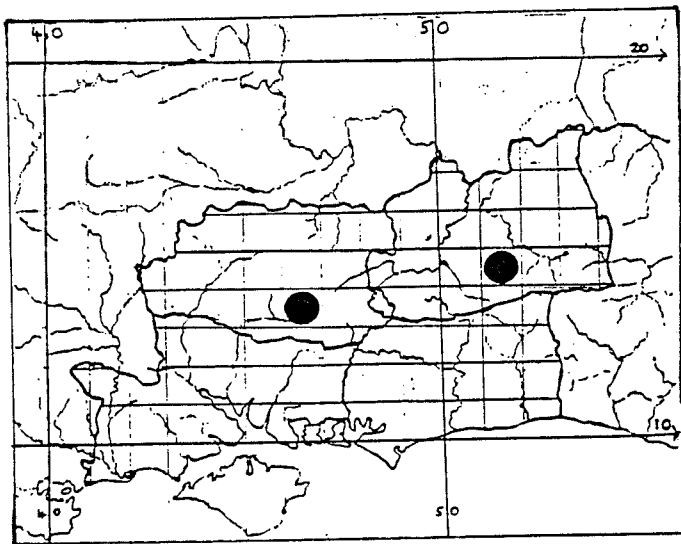
This is a millipede with a rather patchy distribution in the study area. It has a very interesting and unusual distribution in Europe. While it is very common in Britain and Ireland, countries which have supplied a significant proportion of the data for the species, there are no records from mainland France, Luxembourg, Belgium and almost the whole of the western half of Germany. Apart from a couple of isolated records from Holland, it occurs in the central and eastern countries from southern Scandinavia as far south as Italy and Croatia. It has been reported from Corsica as



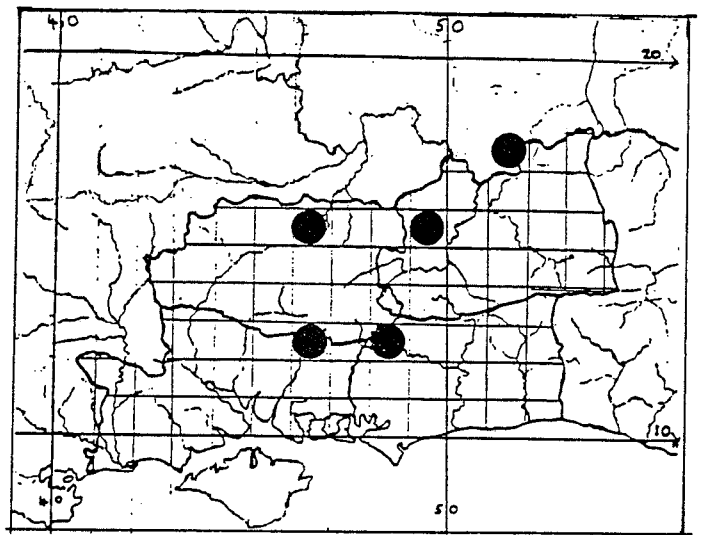
MAP 26. *Julus scandinavicus*.



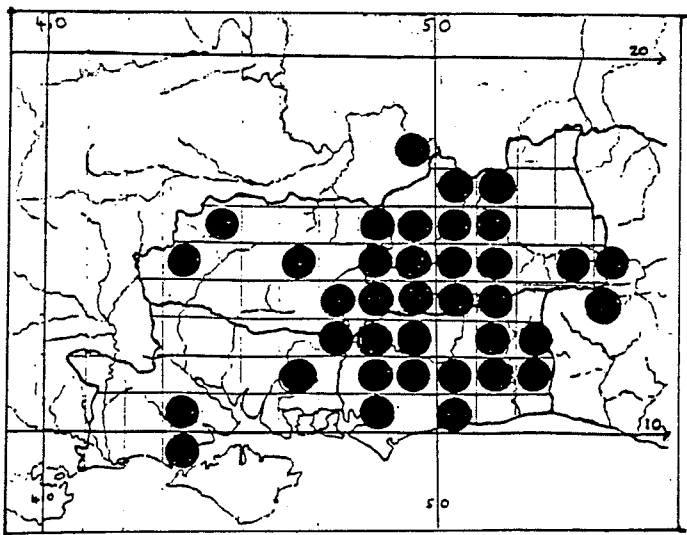
MAP 27. *Ophiulus pilosus*.



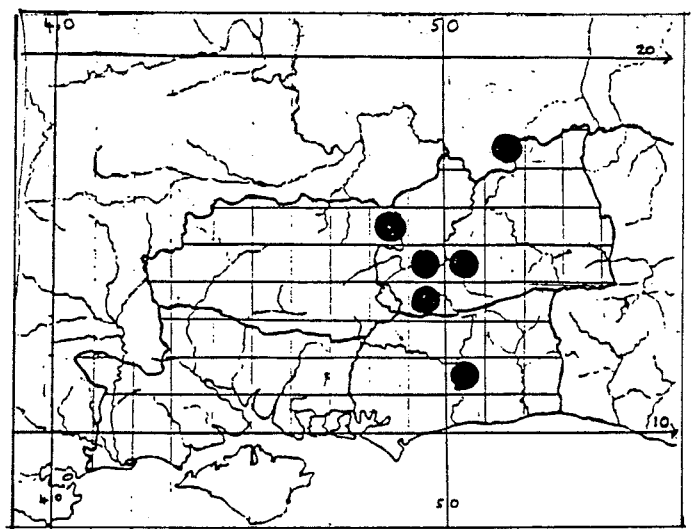
MAP 28. *Leptoiulus kervillei*.



MAP 29. *Brachyiulus pusillus*.



MAP 30. *Polydesmus angustus*.



MAP 31. *Polydesmus inconstans*.

well. There are several isolated populations, and a comparative study ought to prove worthwhile undertaking. Its virtual absence from Atlantic Continental Europe makes one compare it with *C. britannicus*. But in this case it must have also survived the glaciations in Italy at least.

Leptoiulus belgicus (Latzel, 1884)

Known from the south-west, west and the Channel Islands; it has not been found in this part of England. It has a western distribution on the Continent which nevertheless extends into eastern Germany.

Leptoiulus kervillei (Brolemann, 1896) (Map 28)

Only two records. On the Continent it is found in west and north France, Belgium and the southern tip of the Netherlands, a restricted Atlantic distribution. Its habitat is quite specialised; it is associated with high silt content of the soil and lives in mull litter, mainly calcic mulls, and below 300m in altitude except in the south of its range in the Pyrenees.

Brachyiulus pusillus (Leach, 1815) (Map 29)

Scattered records, mainly from grassland, and probably under recorded in my survey which concentrated on woodland. In Belgium and Luxembourg we have found it in pitfall traps set in grassland, especially low-lying pastures, and not in Berlese extractions from woodland.

Polydesmus angustus Latzel, 1884 (Map 30)

The second most abundant species in my survey, common throughout the west of Europe as far south as the Pyrenees and the Italian Alps. Undoubtedly eurytopic, yet ordination procedures indicate a preference for lighter (well drained) soils, and obviously litter or especially debris to shelter under.

Polydesmus testaceus C.L. Koch, 1847

Recorded from a cave in Surrey by Hazleton & Glennie (1962), presumably in the north Downs. It is a well known calcicole in Western Europe, common in grassland on chalk and limestone, and occasionally found in woods. In view of its presence in Cornwall, Kent and Essex, logically it should occur on the extensive chalk formations in all four vice-counties under consideration here, even if it is at the northern limit of its range. It is very easily obtained by pitfall trapping in spring and summer when it moves about on the surface of the ground at night.

Polydesmus inconstans Latzel, 1884 (Map 31)

Specimens were obtained from time to time in grassland, arable farmland and woodland, though not yet from Hampshire South. In Belgium and Luxembourg it is common in some of the calcareous grasslands sampled, but in a minority of them and was obtained during a survey of woodlands using Tüllgren funnels from two base rich sites in deciduous forest. It attains quite large populations on some sites on limestone.

Polydesmus coriaceus Porath, 1870 *gallicus* Latzel, 1884 (Map 32)

A western species confined to Ireland, Britain, west and north France, lowland Belgium, northern Spain and Portugal, with Madeira and the Azores. Sub-species are recognised in the south where it is very variable. Our form, *gallicus*, occurs everywhere to the north of the Pyrenees. It is common in parts of the survey territory, with an apparent preference for clay soils and usually found in damp oak woods, pastures (usually under logs) and shady escarpment woodlands. In these mild areas it is active all the year round.

Polydesmus denticulatus C.L. Koch, 1847 (Map 33)

I have met with this species sufficiently often to consider it locally common; it is usually found near the water table or in rather wet woodland in these counties. Most of my British records were from oak woods, especially on clay in the Weald.

In Belgium it has occurred in Tüllgren samples from near streams in four oak woods, in pitfall traps near ponds and in a raised bog. It has also been collected from flood plains and polders, often in agricultural land. It can withstand being submerged in water (Zulka, 1992). Remarkably, it has been caught in pitfall traps on dry calcareous grassland in Luxembourg, during the summer months, occurring in large numbers. It was also taken in upland pastures in the same country. *P. denticulatus* has a large geographical range in Europe, where it is regarded as eurytopic, reaching 2382m in altitude, with a marked peak of activity in July (Pedroli-Christen, 1993).

Brachydesmus superus Latzel, 1884 (Map 34)

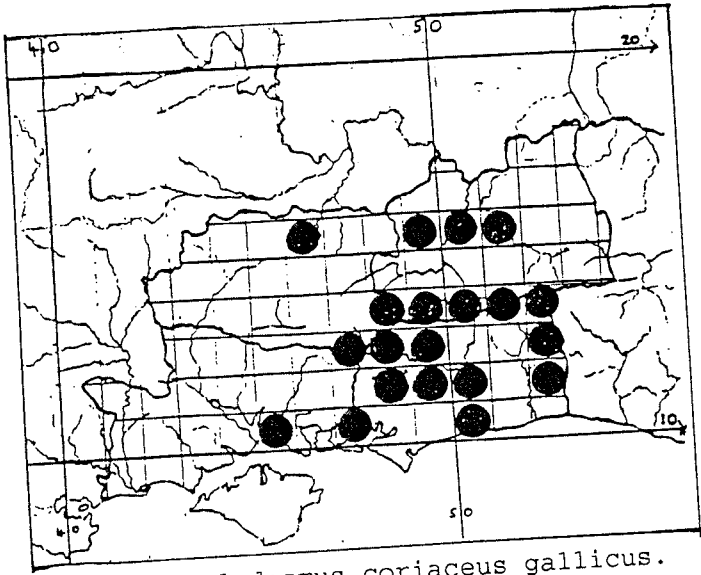
A common animal in most European Countries, *B. superus* occurs widely in cultivated land and wooded areas. It has appeared in almost exactly two thirds of the woodland sites sampled by Tullgren extractions in Belgium, from calcareous and non-calcareous soils alike, which is unusual, but reached high densities particularly on limestone (over 400 individuals per square metre). It has been caught in pitfall traps in calcareous grassland and is common on the Muschelkalk formation near the River Moselle in the east of Luxembourg. Although it is widespread, or because it is, there is still much to learn about its precise requirements. Statistical analyses suggest some temperature preferences, but these are not very obvious in the field.

Macrosternodesmus palicola Brolemann, 1908 (Map 35)

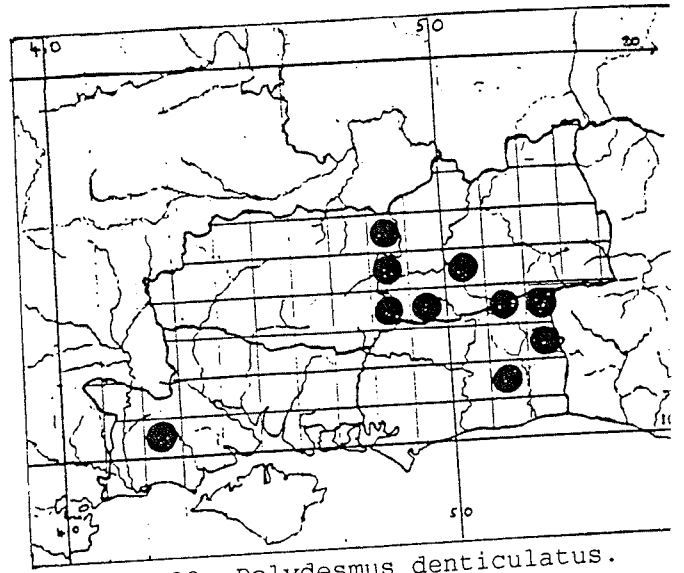
A calcicole located several times on chalk in Sussex, Surrey and Hampshire, generally in the beech woods which grow on the Downs. There used to be few continental records, but it is now turning up very regularly in samples from limestone, and is proving to be a common animal on such strata. It has obviously escaped attention because of its small size. There are also some synanthropic sites given in the literature.

Ophiodesmus albonamus (Latzel, 1885) (Map 36)

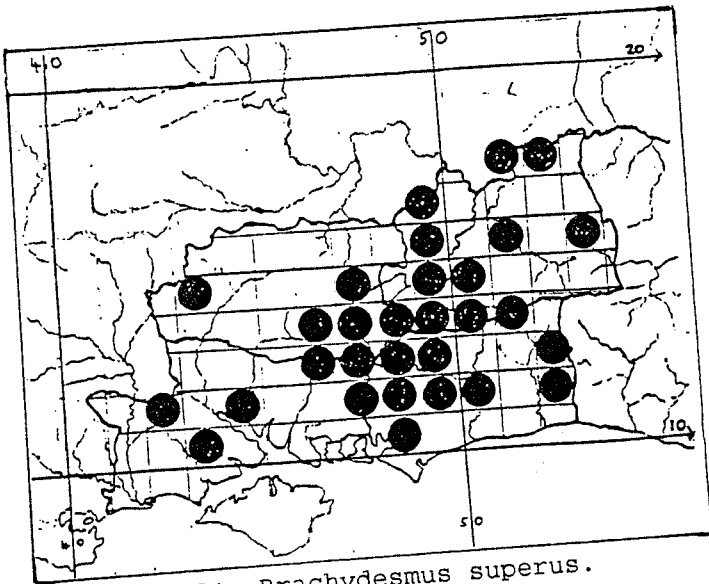
This is also turning up here and there in all vice-counties. On the continent it has been found much less often than *M. palicola*. In twenty years I have only found it twice, once in Belgium and once in France in association with a species new to science! There are over twice as many records from



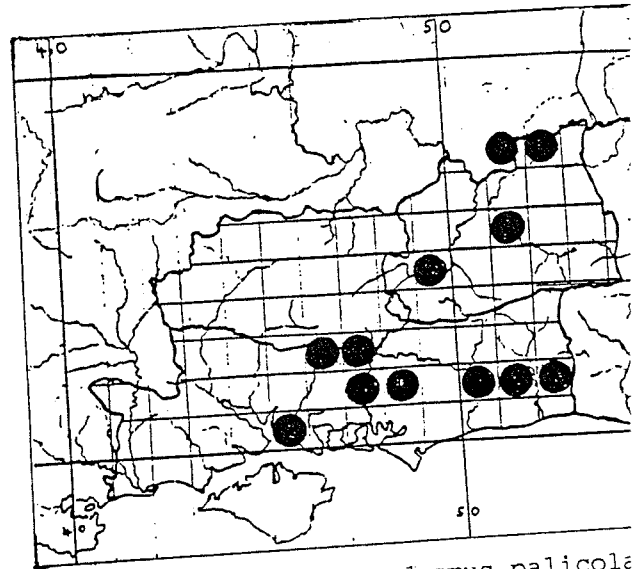
MAP 32. *Polydesmus coriaceus gallicus*.



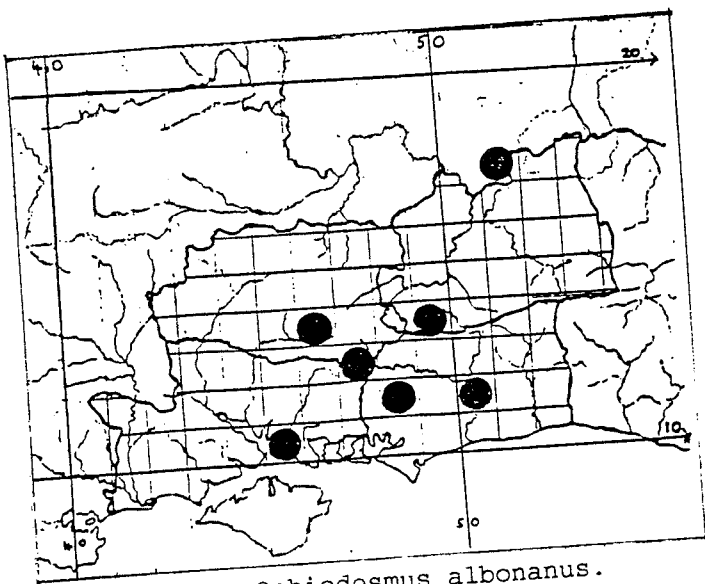
MAP 33. *Polydesmus denticulatus*.



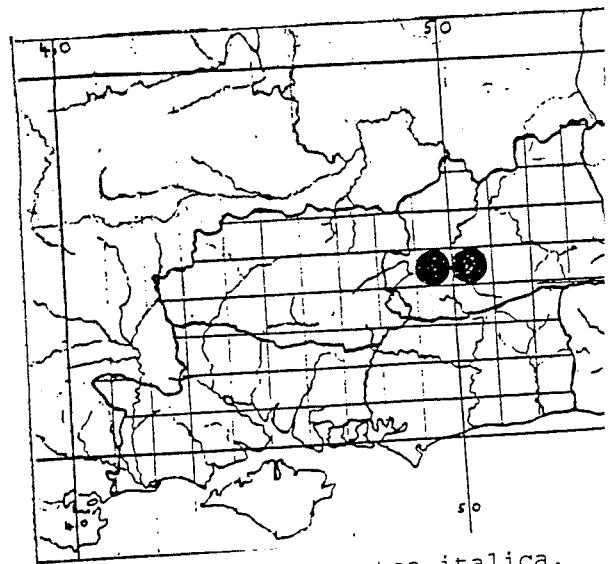
MAP 34. *Brachydesmus superus*.



MAP 35. *Macrosternodesmus palicola*.



MAP 36. *Ophiodesmus albanus*.



MAP 37. *Stosatea italica*.

Britain as there are from the continent where it has been found from France to Sweden. The Hampshire, Sussex and French specimens were found on chalk.

Stosatea italica (Latzel, 1886) (Map 37)

A native of the Mediterranean region, *S. italica* has been discovered in the Paris Basin in France, in the Netherlands, Luxembourg and Switzerland, as well as in Britain and Ireland. It was found at Valkenburg near Maarstricht in the Netherlands and was another species erroneously reported from Belgium, probably because Schubart did not doubt that it would occur there.

S. italica was collected on a number of occasions in Guildford in 1967: subsequent monitoring of these calcareous and synanthropic sites failed to reveal it again, just as Jeekel (1978) failed to find it again near Maarstricht.

CONCLUDING REMARKS

The distribution patterns of millipedes are interesting and of course relate to their evolutionary history. In Britain, they are just about entirely due to events since the last glaciation, the fauna being chiefly composed of pioneer species with a generally large distributional range. Because species spread northwards, there is a large Atlantic element in the British list. At the moment it is difficult to see how some species spread north because they have not been recorded in France, e.g. *Cylindroiulus britannicus*, *Ophiulus pilosus*, *Anthogona britannicum*, whilst others e.g. *Chordeuma silvestre* are 'in the wrong place' and apparently introduced. On the continental scale there is a very strong inference that the geographical range of millipedes is greatly dependent on temperature, for example the Atlantic species do not occur in areas where it is cold in winter. At the regional and local level we can predict distribution patterns on the basis of factors that relate to the soil, in particular soil texture, type of humus, water and mineral content. It was the very fact that the soils are so varied in the Western Weald that led to this choice of study area.

It is encouraging that millipede distributions can be predicted in a given region on the basis of soil analysis. It promotes confidence in our science. Further, it may be possible to assess the amount of disturbance that a particular habitat has had. It is the case that the most species-rich habitats are often the least disturbed, for instance steep scarp slopes which have never been cultivated (these are often on calcareous soils because of the number of calcicolous millipedes). The presence of a complete set or guild of millipedes may indicate no or negligible disturbance and might indicate sites worthy of protection in Nature Conservation. This evaluation can be made at most times of the year. It has to be added that some suburban and urban areas contain many synanthropic species and may be rich in different niches, especially where vestiges of original vegetation persist. In this way the longest lists may come from the edges of cities. In Belgium this is true of Brussels: then Brussels has also received the most attention.

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Institute of Terrestrial Ecology. There were too many collectors involved in these records for me to mention them all individually, but I notice that a substantial number of records were his own, a lot more were from Dick Jones and Adrian Rundle provided a batch from south west London.

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