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DISTRIBUTION PATTERNS IN BRITISH CHILOPODA

by

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ABSTRACT

Twenty-one nonmaritime species of chilopod are recorded from northern Britain and a further fourteen from the South. All the northern species are characteristic of northern Europe with the exception of *Lithobius variegatus* Leach but the remainder include both Lusitanian and central European species.

An examination of distribution patterns in relation to climate suggests that spring/summer temperatures may be significant in influencing occurrence except for *L. variegatus* where January isotherms show a better correlation although problems arise when altitudinal effects are examined. It is suggested that urban areas acting as "heat islands" may permit some species to occur in areas where they would otherwise be absent.

INTRODUCTION

Isolated from the European mainland the chilopod fauna of Britain may be predicted to consist of a species list broadly similar to adjacent mainland areas such as the Netherlands, Belgium and France together with what is usually described as a Lusitanian element of species of the French Atlantic coast and Iberia. It may be anticipated that certain widespread European species may be absent.

Accumulated distributional data collected since the publication of Eason's standard work (Eason, 1964) and in particular records from the Myriapod Survey Scheme (Barber & Fairhurst, 1974) permit a more detailed analysis of distribution than hitherto. Rather more than 8,000 individual records have been obtained but certain parts of Wales and much of Scotland are still very imperfectly known. For Ireland there are insufficient recent data to comment in detail on its fauna (Barber, 1984a). Lithobiids, especially the larger species, are most frequently recorded due to their tendency to occur in more easily sampled microsites often in apparently large numbers compared with the frequently soil-dwelling geophilomorphs. Approximately 1,200 records have been made for both *Lithobius forficatus* and *L. variegatus* whilst the number for *Brachygeophilus truncorum* and *Geophilus carpophagus* are approximately 450 and 430, respectively.

Many of the records are based on visits to individual sites on one or only a small number of occasions, so species will clearly have been missed. Andersson (1983) estimated that litter sifting and hand sorting would on average find 50% of the species in a locality each time. The comparatively large number and wide scatter of records however gives a fairly clear picture of the general distribution for many species rather than simply that of recorders.

SPECIES WIDESPREAD IN BRITAIN

If a line is drawn approximately from the Mersey to the Wash, only 21 nonmaritime and 3 maritime chilopod species are recorded north of this, all the nonmaritime, with the exception of *Lithobius variegatus* Leach, being members of the fauna of the Netherlands and Scandinavia. The total number of species would appear to decline northwards until for the Shetland Islands only 8 are recorded in total (unpublished data from collections made in 1974 by the University of Edinburgh and Institute for Terrestrial Ecology, Grange over Sands). In contrast, a further 14 species are recorded from outdoor sites in various parts of southern Britain.

Table I summarises the nonmaritime species recorded from various areas of Britain and certain European countries. *Lithobius erythrocephalus*

C. L. Koch (general European), *Lithobius tenebrosus* Meinert (Scandinavia) and *Geophilus proximus* C. L. Koch (Scandinavia, Netherlands) have not been reliably recorded from the British Isles. *Pachymerium ferrugineum* (C. L. Koch), a species widespread in Europe from Scandinavia to the Mediterranean region has only been found once in Britain, possibly a chance introduction, on the South coast of England (Lewis, 1960). It has not been found on the French Atlantic coast.

Of the commoner British species, *Lithobius crassipes* L. Koch (map 3) is almost ubiquitous in northern and eastern Britain although not recorded from Shetland and not occurring in synanthropic sites. It occurs in both upland and lowland sites but upland areas in Caernarvonshire (Eason, 1957) and Devon have *L. borealis* Meinert instead. In Kent and Surrey both *L. borealis* and *L. crassipes* are patchily distributed whilst *L. microps* Meinert is very common; in Devon and Cornwall *L. crassipes* would seem to be largely or entirely absent, as is also *L. curtipes* C. L. Koch and *L. macilentus* L. Koch. This latter species has an extremely patchy distribution; possibly its parthenogenetic habits would permit it to spread easily from foci when it reached an area by chance.

Insufficient data are currently available for *L. curtipes* to draw conclusions on its distribution; *L. calcaratus* C. L. Koch is a typical but rarely dominant species of acid moorland and heath; *L. melanops* Newport has a marked tendency for synanthropic sites, like *L. calcaratus* it occurs throughout Britain. Andersson (1983) describes an inverse correlation between *L. curtipes* and *L. microps* in Göteborg; there would seem to be a "small nonurban lithobiid" niche occupied by different species in particular sites.

Schendyla nemorensis C. L. Koch, *Geophilus insculptus* Attems, *G. carpophagus* Leach, *Necrophloeophagus longicornis* (Leach) and *Brachygeophilus truncorum* (Bergsö & Meinert) are widespread throughout Britain. *G. carpophagus* is a very characteristic animal of all types of acid heath and moor. Data on *Strigamia crassipes* (C. L. Koch) and *S. accuminata* (Leach) are insufficient for clear conclusions, older records of the two not necessarily being reliable, but the latter seems to have a more northerly limit than the former.

Geophilus electricus (Linnaeus) is very patchily distributed and often associated with human activity, a pattern which seems to be similar to that elsewhere in northern Europe.

LITHOBIUS VARIEGATUS LEACH

This is the common large lithobiid of nonurban sites throughout most of western Britain and Ireland. It is also present in the Channel Islands and has recently been recorded from Brittany (A. N. Keay, in litt.). Eason and Serra (in litt.) have shown that the species is identical with *Lithobius rubriceps* Newport (= *L. insignis* Meinert) a species of the Iberian peninsula, southern Italy, Sicily, Tunisia and Morocco.

Lewis (1964) suggests that this species is less tolerant of climatic extremes than *L. forficatus* (Linnaeus) including possibly dryness of climate. Eason (unpub.) has drawn attention to the relationship between the eastward limits of the species (map 2) and the 3.33° C (38° F) January isotherm and there would seem to be some agreement with this at least for eastern England. However, the situation is undoubtedly more complex.

Detailed studies show the species to be extremely patchily distributed at the edge of this range. In Northumberland and the Scottish borders, the species is almost completely absent from all types of site both lowland and upland (Barber, 1984b) but is present in the upper part of Coquet Dale at up to 400 m and in areas South and West. In Cumbria it occurs in upland areas up to 750 m and is a widespread and common species.

Highland areas show marked differences in climate compared with the surrounding lowlands: lower temperatures (of the order of 6°C per 1000 m), greater precipitation and humidity and freezing temperatures above 600 m on most winter nights (Chandler & Gregory, 1976). This means that a difference of 3-4° in temperature, comparable to the difference between the ex-

treme East and the extreme South-West, would occur between the coast and the mountains in certain areas of Britain including those described. Any relationship between distribution and winter temperatures is clearly not a straightforward one.

The tendency of this species apparently to favour upland areas may in fact be more due to the fact that it does not occur in urban and suburban sites in general, areas from which a substantially higher proportion of lowland, compared with upland, records are made.

SPECIES FROM SOUTHERN BRITAIN

Although the January isotherms in Britain run approximately North-South, those of the spring and summer are approximately East-West (maps 12, 13), a pattern which fits in roughly with the distribution of many animals. Rainfall follows a more or less East-West pattern with much of central Britain being relatively drier (map 14). Mean annual relative humidity is highest in coastal areas and lowest in central England (map 15), a pattern which does correlate obviously with species distribution. Presumably local humidity is important but the overall differences across Britain of $< 70\%$ to $> 80\%$ are not obviously so.

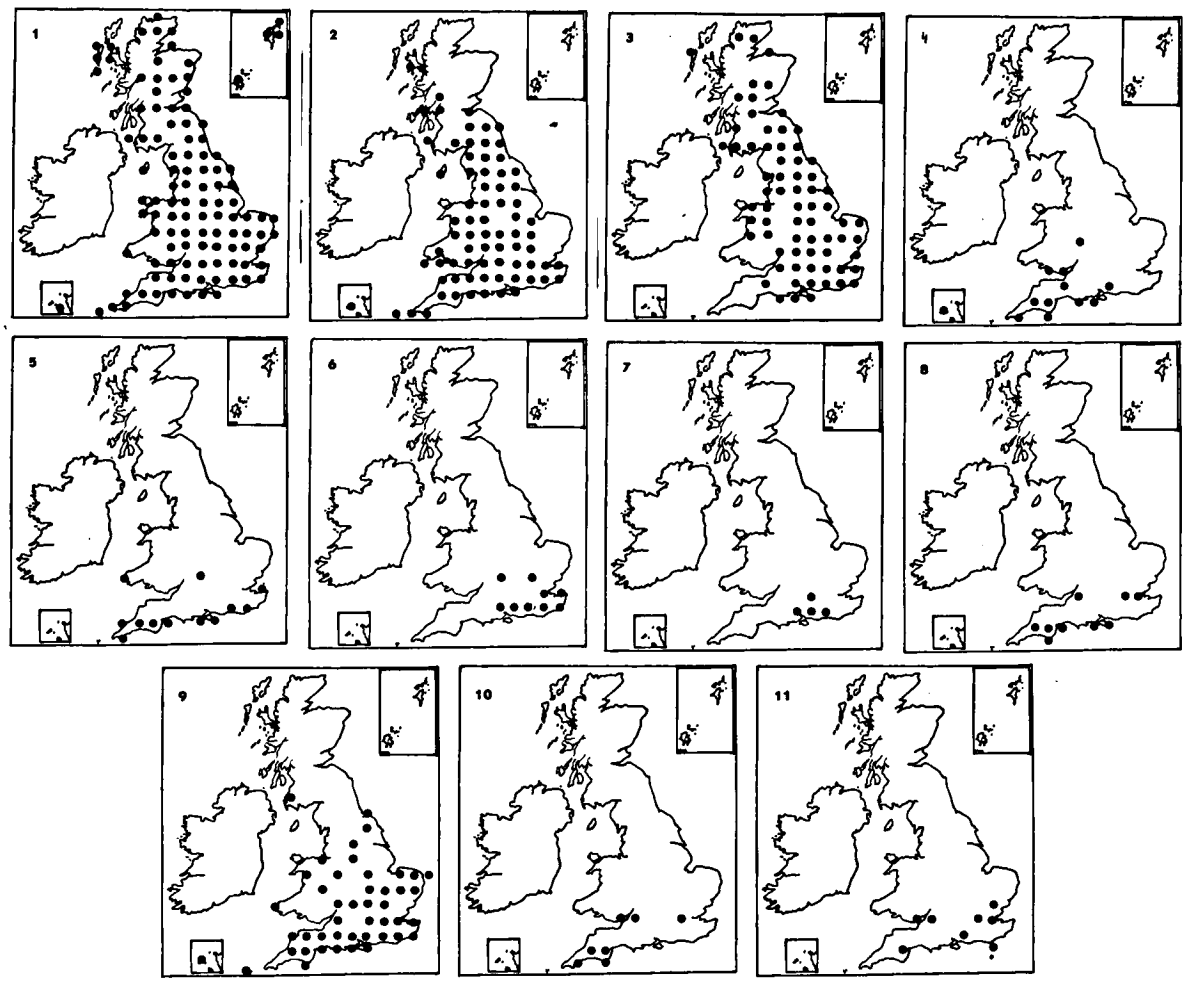
South-West and West southern Britain has a climate of relatively high rainfall, humidity and temperature, sometimes described as Euoceanic (Bendelow & Hartnup, 1980). The extreme South-West (West Cornwall, Pembroke) shows these conditions even more strongly. South-East England with its high summer temperatures but relatively colder winters and lower rainfall has a climate closer to that of the nearby continent.

Species recorded largely or exclusively from the south-western areas include *Geophilus osquidatum* Brölemann, *Lithobius pilicornis* Newport, *Lithobius tricuspis* Meinert, *Cryptops parisi* Brölemann, *Schendyla peyerimhoffi* Brölemann & Ribaut, and *Chalandea pinguis* (Brölemann). Of these *G. osquidatum* is widespread across a large area from mid-Wales to Hampshire (map 4) whilst *C. pinguis* is known only from a small area in North Devon. A number of other species of animals have such a southwestern pattern, for instance the diplopods *Chordeuma proximum* Ribaut and *Microchordeuma gallicum* (Latzel) both of which are widespread in southern and western Britain (Kime, 1978) whilst *Chordeuma sylvestre* C. L. Koch is known only from Cornwall (J. G. Blower, pers. comm.). Of the British isopods (Harding, 1976) *Metaponorthus cingendus* (Kinahan) and *Armadillidium depressum* Brandt are further examples of southwestern animals, the latter, interestingly, not having been recorded from Ireland; *Ligidium hypnorum* (Cuvier), by contrast, is southeastern.

L. pilicornis is widespread in South-West Devon and in Cornwall, especially in urban areas, with synanthropic records from a number of sites on the South coast of England and inland (map 5). It tends to replace *L. forficatus* almost entirely in those locations in which it is found but its distribution is very patchy with distinct colonies in sites whilst a nearby location, less than 100 m away, will have only the latter species. Geoffroy (1983) comments on competition between these two species in alpine sites, where *L. forficatus* occurs at high altitudes when *L. pilicornis* is absent. *L. pilicornis* is essentially a species of South-West Europe, Alps, French West coast, Pyrenees and Iberia and is reportedly the commonest chilopod in Navarre (R. D. Kime, pers. comm.).

L. tricuspis, first described from Britain by Eason (1965), has been found in a variety of habitats, frequently woodland (but also including a cliff top and a suburban ruin), from a small area of South Devon and despite extensive collecting it has not been found in adjacent areas. It is a widespread European species, occurring as far North as Limburg, the Netherlands. It may possibly occur in Ireland (Eason, 1965). There are no immediately obvious reasons for its apparent present British distribution.

Species largely recorded from South-East England include *Lithobius muticus* C. L. Koch



Maps 1-11. 50 km distribution maps for selected species (Irish data not included): 1, *Lithobius forficatus*; 2, *Lithobius variegatus*; 3, *Lithobius crassipes*; 4, *Geophilus osquidatum*; 5, *Lithobius pilicornis*; 6, *Lithobius muticus*; 7, *Lithobius piceus*; 8, *Chaetechelyne vesuviana*; 9, *Cryptops hortensis*; 10, *Cryptops parisi*; 11, *Cryptops anomalans*.

and *Lithobius piceus* L. Koch. The former species is widespread in deciduous woodland in southeastern counties (map 6) having apparently been first recorded by Brade-Birks (unpublished and 1934). It is a species of much of Europe including East and southern Netherlands so that its British pattern is quite consistent.

L. piceus, a woodland species from much of central and western Europe (including parts of the Netherlands) is a common animal of deciduous woodland in a small area of Surrey, Sussex and Hampshire (map 7). It does not become as large as either *L. forficatus* or *L. variegatus* but is larger than other lithobiids of the area. Its distribution pattern, like that of *L. tricuspis* is difficult to explain although it would be tempting to suggest that it represents the remains of a once more extensive occurrence.

Chaetechelyne vesuviana (Newport) is a widespread species of the Mediterranean region and western Europe with one synanthropic record from the Netherlands. In Britain it is widespread in South Devon being recorded from both rural and urban sites and is similarly so in the Isle of Wight. There are synanthropic records from elsewhere in the South (map 8). The related *C. montana oblongocribellata* Verhoeff

has scattered records across southern England, mostly from gardens.

SYNANTHROPIC SPECIES

Enghoff (1973) notes that the peak of species diversity for both diplopod and chilopod fauna in Denmark is in urban/suburban localities and many chilopods are clearly synanthropic on the edge of their range. *Clinopodes linearis* (C. L. Koch) as an example has been recorded several times in England from gardens and similar sites and is known as a synanthrope throughout northern Europe including Scandinavia (table I).

Of the three *Cryptops* species recorded from Britain, *C. hortensis* Leach is the most widespread, with a marked preference for man-influenced habitats (map 9); all northern records are synanthropic. *C. parisi* Brölemann is widespread in South-West Devon, notably but not exclusively in urban areas with scattered records from elsewhere (map 10). All records of *C. anomalans* Newport are from urban and suburban locations, mostly in the South-East (map 11).

Lithobius microps Meinert and *Haplophilus subterraneus* (Leach) are both species common in the South but markedly synanthropic and eventually more or less absent in the North, the latter species also apparently synanthropic in Kent and Surrey (South-East) where the former is widespread in woodland.

Urban areas are characteristically "heat islands" with, on a calm clear night, a temperature 5° or more above the surrounding countryside (Chandler & Gregory, 1976). This is due to their slower loss of heat (as a function of building density) and also results in a proportionately lower relative humidity. Such a situation would clearly favour species otherwise preferring a more southern or warmer region assuming they were able to tolerate the other effects of human activity. Clearly species intolerant of such activity would not show such a pattern, e.g. *L. tricuspis* and *L. piceus*.

MARITIME SPECIES

Strigamia maritima (Leach) has been recorded many times and is likely to occur all round the British coast in suitable sites; *Hydroschendyla submarina* (Grube) has occurred in a number of sites from Yorkshire to Devon. The latter species has probably been overlooked because of its tendency to occur lower on the shore in rock crevices and its superficial similarity to the preceding.

Geophilus fucorum seurati Brölemann has been found in various locations (Lewis, 1962); it is widespread in southwestern estuaries.

Schendyla peyerimhoffi was first described for Britain by Lewis (1961) from Plymouth and from Sussex. Although Misioch (1979) questions the validity of the species there is undoubtedly a distinct form, agreeing with Lewis's description and most easily recognised by the crenulate concavity of the forcipule and small size of the telopodites of the last legs, found under stones and in similar sites just above high water in muddy estuaries in South Devon, Cornwall and Wales. It is often associated with, although not in the same microsite as, *S. maritima* and *G. fucorum seurati*. It has also been found in the Scilly Isles, inland in Portugal and coastal in Morocco. It may well be that its habits have caused it to be overlooked elsewhere but at present it would seem to represent another member of the southwestern group of species.

OTHER SPECIES

Species not mentioned above (apart from the ubiquitous *Lithobius forficatus*: map 1, and the widespread but rarely common *Lamyctes fulvicornis* Meinert) have been recorded once or on only a small number of occasions.

Brachyschendyla dentata Brölemann & Ribaut has been found in soil from synanthropic sites in Surrey, Plymouth, the Netherlands and Denmark. It was originally described from France; no doubt its small size has led to it being overlooked elsewhere. *Geophilus pusillifrater*

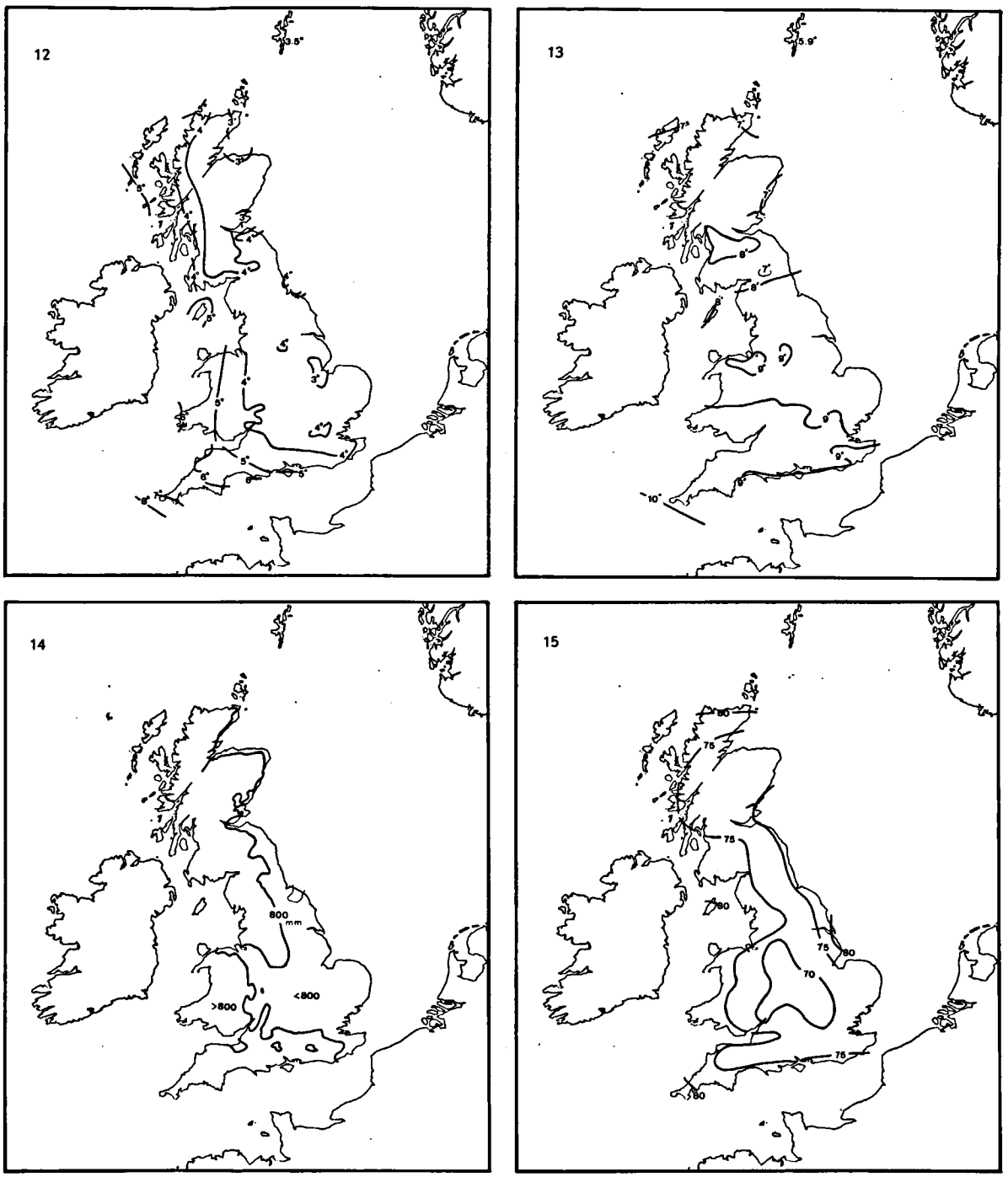
TABLE I

Nonmaritime chilopod species recorded from various areas: +, pre-1948 records; Ø, 1913 record, ssp. *britannicus* Bagnall, status unknown; S, known to be solely synanthropic.

	Shetland Is.	Scotland (C. & N.)	Borders, Northumbria	Yorkshire	Cumbria	East Midlands	Welsh borders	Southern England & S. Wales	Iceland (Eason, 1970)	E. Fennoscandia (Palmén, 1949)	Norway (Meidell, 1977)	Faeroes (Hammer & Henriksen, 1930)	Göteborg (Andersson, 1983)	Suburban Copenhagen (Enghoff, 1973)	N.W. Germany (Jeekel, 1964)	Netherlands (except S. & E.) (Jeekel, 1977)	Netherlands (S. & E.) (Jeekel, 1977)	Wuppertal (Albert, 1978)	Bausenberg/Eifel (Becker, 1982)
Haplophilus subterraneus			S	x		x	x	x		S				x	x	x	x		
Schendyla nemorensis	x	x	x	x		x	x	x		x	x		x	x	x	x	x	x	x
Chaetechelyne vesuviana								x								S			
Ch. montana oblongocribellata								x											
Strigamia accuminata				x		x	x	x							x	x	x	x	x
St. crassipes		+		x		x	x	x			x	+	x	x	x	x	x	x	x
Pachymerium ferrugineum								x		x	x		x		x	x	x		
Clinopodes linearis			+	+				S		S			x	x	S	S	S		
Geophilus carpophagus		x	x	x	x	x	x	x			x		x		x	x	x		
G. electricus			x	x		x	x	x		S	x		x	x	x	x		x	x
G. osquidatum								x											
G. insculptus	x	x	x	x	x	x	x	x			x		x	x		x	x		
G. proximus										x	x		x			x			
Necrophloeophagus longicornis		x	x	x		x	x	x		x	x		x	x	x	x	x	x	x
Brachygeophilus truncorum	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		
Chalandea pinguis								x											
Cryptops anomalans								S								S	x		
C. hortensis		S	S	x		x	x	x		S	x		x	x		x	x		
C. parisi								x		S						x	x	x	x
Lithobius variegatus		x	x	x	x	x	x	x											
L. forficatus	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		x
L. piceus			Ø					x							x		x	x	x
L. pilicornis								x								S			
L. melanops	x	x	x	x		x	x	x	x	S	x	+	x	x	x	x	x		
L. borealis	x		x	x	x			x			x	+	x		x				
L. dentatus C. L. Koch															x		x	x	x
L. tricuspis								x									x	x	x
L. agilis C. L. Koch															x		x		
L. macilentus		x	x	x		x	x	x			x						x	x	x
L. erythrocephalus									x	x	x		x		x	x	x		
L. calcaratus		x	x	x	x	x		x					x		x	x	x		x
L. pelidnus Haase															x		x		
L. muticus								x									x		x
L. pusillus Latzel																	S		
L. aeruginosus L. Koch																	x		x
L. crassipes		x	x	x	x	x	x	x		x	x		x	x	x	x	x	x	
L. curtipes				x		x		x		x	x		x		x	x	x	x	
L. microps		S	S	x		x	x	x		S	x		x	x	x	x	x	x	x
L. tenebrosus										x	x		x						
Lamyctes fulvicornis	x	x	x	x	x	x		x	x	x	x	+	x	x	x	x			

Verhoeff was described from Sussex by Lewis (1961) and a specimen of the same species as his has been found near Lands End, Cornwall (by R. Jones); it was previously reported from Yugoslavia.

In addition to these *Brachyschendyla monoeci* Brölemann was found in a greenhouse in Cornwall by Turk and *Nesoporogaster souletina brevior* Eason is described from a garden in the same county. *Scutigera coleoptrata* (Linnaeus) has from



Maps 12-15. Climatic maps of Great Britain (based on Chandler & Gregory, 1976): 12, isotherms: January mean (°C); 13, isotherms: April mean (°C); 14, annual rainfall: 800 mm isohyet; 15, relative humidity: mean annual values (percent) at 15.00 hrs.

time to time been recorded from inside buildings. *Scolopendra* spp. are occasionally imported, a mecistocephalid (? *Tygarrup*, det. E. H. Eason) has been found in hothouses at the Royal Botanic Gardens, Kew, and there are old records of *Dicellophilus carniolensis* (C. L. Koch) from greenhouses and a garden. There are no modern records of *Schendyla zonalis* Brölemann & Ribaut.

CONCLUSIONS

In the absence at the present time of any obvious indication of soil factors such as pH being significant in chilopod distribution, it would seem that the presence of any species in a particular location is the result of several sets of factors:

a. Competition with similar species for the particular niches occupied by the species.
b. Availability of suitable microsites and presumably prey for these nonspecific carnivores. In a particular area it is common to find a species in a wide variety of sites, although many species probably depend on woodland to provide suitable shelter and prey.
c. Human influence; this has a twofold effect, excluding some species whilst at the same time encouraging others. Buildings of various types, including ruins, may be significant islands of distribution.
d. Historical factors such as climatic change in the recent or distant past or chance introductions of species.
e. Some overall distributional factors which determine the particular species combination for that area of Britain. These seem likely to be climatic. The decline in numbers of species further North, the survival of species outside their normal range in synanthropic habitats and the presence of distinct southwestern and southeastern species suggest temperature factors, possibly in combination with some other effect such as rainfall. Of the possible temperature effects, spring/summer mean temperatures would seem to be important for some species but for *Lithobius variegatus* January mean may be the dominant effect. In the latter case, however, local altitudinal variation and consequent climatic effects do not fit easily into this pattern.

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