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THE DISTRIBUTION AND ECOLOGY OF CENTIPEDES IN NORRLAND, SWEDEN (CHILOPODA)

by

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ABSTRACT

The distribution and ecology of centipedes in Norrland (the northern part of Sweden) are investigated. The material comprises about 1200 samples from 926 different localities, most of it collected in a special faunistic and ecological survey. Some problems in the analysis of the material of this survey are pointed out. In Norrland ten species are found outdoors and another seven species occur indoors in the area. The geographical distribution and the constancy for different habitat factors for the seven common outdoor species are shown.

INTRODUCTION

There is little information on the centipede fauna of Norrland (the northern part of Sweden). Five species from a few localities have been recorded in the literature. Stuxberg (1871) reported *Lithobius forficatus* from the province Jämtland, and Von Porat (1889) reported *L. erythrocephalus* and *Geophilus proximus* from the same province. Forsslund (1945) found *Lithobius curtipes* in Västerbotten, and Tobias (1975) reported the same species from Lappland. The four species mentioned above, together with *Pachymerium ferrugineum*, have also been reported from Ångermanland by J. S. Andersson (1961).

The present study is based on a large collection of centipedes from Norrland obtained by H. W. Waldén in the "faunistic and ecological survey of certain terrestrial invertebrate groups in Sweden" (Waldén, 1969), as well as in a survey initiated by the exploitation of large river systems for water power plants (Waldén, 1971). The collection is preserved in the Natural History Museum of Göteborg.

The aims of this paper are:

- to start an evaluation of computer based analysis and to point out some problems in the interpretation of the material of the "faunistic and ecological survey".
- to present a summary of the distribution and ecology of species of centipedes found in Norrland.

THE GEOGRAPHICAL AREA

Norrland includes the following nine provinces: Gästrikland (Gstr.), Hälsingland (Hls.), Medelpad (Med.), Härjedalen (Hrj.), Jämtland (Jmt.), Ångermanland (Ång.), Västerbotten (Vb.), Norrbotten (Nb.) and Lappland (Lpl.) (fig. 1).

The climate of the area can be roughly described by the length of the vegetation growth period, which is roughly in accordance with the number of days with a mean temperature above + 3° C (Ångström, 1968) (fig. 2).

The majority of the area belongs to the northern coniferous forest region. In the eastern part there is a coastal area with sandy or clay soil, often cultivated. This area is mostly rather narrow, but is also following large river valleys (about 0 to 200 m above sea level). The main part of the coniferous forest region consists of moraine- or peat-formations, covered with spruce and pine forest often with elements of birch and other deciduous trees.

In the western part, at the slopes of the Scandinavian mountain chain, there is a mountain birch forest region, and higher up an alpine region. All but three of the localities are situated in the coniferous forest region, and none in the alpine region. Only one species (*Lithobius curtipes*) was found in the mountain birch region.

MATERIAL

This paper is based on totally 1207 samples from 926 different localities; 840 of these localities were investigated by Waldén in the surveys mentioned above. The collecting method was sifting of litter completed by hand collecting.

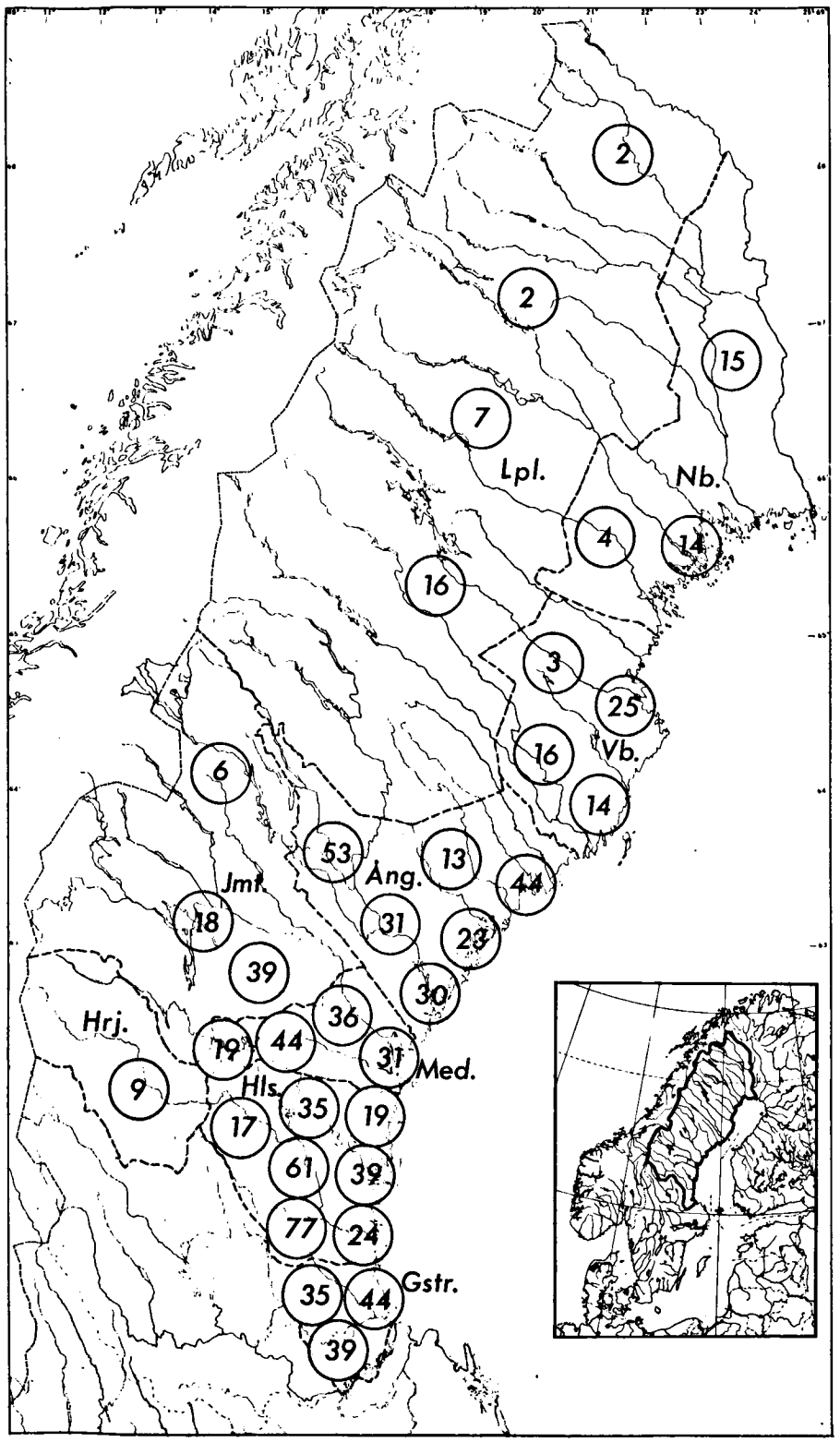

Fig. 1. The area investigated (Norrland) and numbers of outdoor localities for the different subareas. For explanation of the abbreviations, see table I.

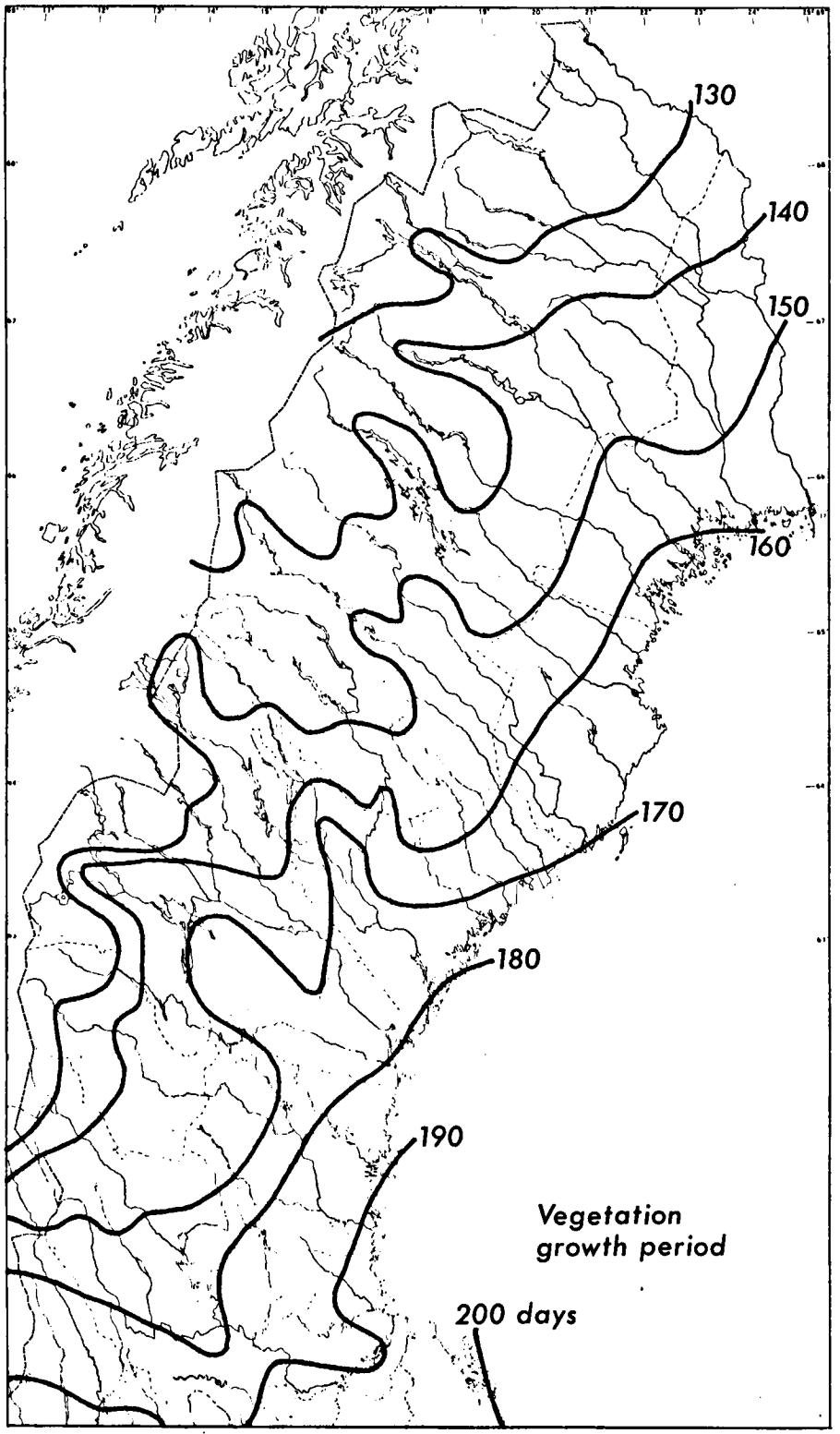

Fig. 2. The length of the vegetation growth period in days. Redrawn after Ångström (1968).

Every locality is carefully described with respect to location, vegetation, slope, surface morphology, etc. A locality was mostly defined as a fairly uniform habitat, but nevertheless it comprises a lot of microhabitats. On each locality both centipedes, millipedes, land molluscs and some insect groups were collected. Thus, this collecting method did not readily allow for notes concerning the microhabitats for the different species.

A brief study of the precision in the collecting method of the "faunistic and ecological survey" is presented in G. Andersson (1983), based upon material from S.W. Sweden. On the average about 50% of the species occurring in a locality were expected to be found in one investigation. Thus it is not possible to make qualitative comparisons between single localities.

METHODS

Data concerning the habitat etc. were registered and sorted with the help of a small home computer (Vic 20 with 24k extra memory). A program was constructed to count number of localities and constancy (% localities in which the species was found) for each species and selected habitat data or combinations of habitat data. For calculations of differences between constancy figures (paired comparisons) Yates χ^2 test was used. The capacity of the computer was insufficient to handle the whole material in an optimal way, but the procedure saved a great deal of time when sorting data. The following data (together with data about date and collector, not used here) were registered from the descriptions of the localities (all numerically coded):

1. Locality. Province and parish were coded. The descriptions were with a few exceptions much more precise, but this information is not used in this paper.
2. Habitat. The habitat was registered in one of ten habitat groups and if possible in one more specialized subgroup (totally 50 different code numbers). For the presentation here only eight different habitat groups are used (those listed in fig. 4 together with indoor localities).
3. Vegetation. The descriptions of the localities mostly contained a lot of information about the vegetation and an attempt was made to classify the main types (listed in fig. 5).
4. Slope and aspect of slope. The degree of slope (none; moderate; steep) and the aspect (N.; N.W.; W.; S.W.; S.; S.E.; E.; N.E.) was registered.
5. Influence of man. With the help of the description an attempt was made to classify the human influence on the locality in four groups: none; moderate; strong; totally man-made habitat.
6. Surface morphology. The localities were classified into groups according to recorded dominating surface structures: cliffs; boulders; stones; finer material. Calcareous; non-calcareous was also registered but not enough calcareous localities were recorded to make a comparison possible.

In several cases the description of a locality comprised more than one of the groups in some of the factors listed above (mostly concerning factors 2, 3 and 6), but only one group could be registered for each factor. I then tried to choose the most dominating group. This creates a source of error concerning species inhabiting the less dominant part of the locality. This will be further discussed below.

In the two surveys mentioned above there were about 500 additional localities where no centipedes were found. These localities are not included in the calculations in this paper. This may have changed the proportion between the constancy figures but probably it did not affect the rather brief analysis of the results presented here.

RESULTS

In total, 17 species were found — 7 of these only occurred indoors (table I). The indoor localities are not treated further here. It is difficult to say whether a certain habitat is over- or underrepresented in the material. Much more forest localities were investigated than open land localities. However, forests are also far more common in Norrland than open land. The number of localities for each species may therefore fairly well reflect how common the species actually is in Norrland (fig. 3).

The constancy for different groups of habitat, vegetation, slope and aspect of slope, influence of man and surface morphology for the seven most common species is shown in figs. 4-8. For habitats (fig. 4) all ten outdoor species are shown. In some cases two or more of the recorded groups are combined in the histograms. The coastal-inland distribution is shown in fig. 9. The geographical distribution of the outdoor localities is shown in fig. 1. A summary of the geographical distribution of the different species is presented in table I. The distribution will be more elaborately presented elsewhere.

A short recapitulation of facts for each of the seven common outdoor species derived from these figures is given here.

TABLE I

The distribution in different provinces and the number of localities for the different species found. I = indoors only. Gstr. = Gästrikland; Hls. = Hälsingland; Med. = Medelpad; Hrj. = Härjedalen; Jmt. = Jämtland; Ång. = Ångermanland; Vb. = Västerbotten; Nb. = Norrbotten; Lpl. = Lappland.

species	Gstr.	Hls.	Med.	Hrj.	Jmt.	Ång.	Vb.	Nb.	Lpl.	number of localities	
										outdoors	indoors
Haplophilus subterraneus (Shaw)	I									—	1
Schendyla nemorensis (C. L. Koch)	•	•								3	—
Pachymerium ferrugineum (C. L. Koch)	•	•	•			•	•	•		44	—
Geophilus electricus (Linnaeus)							I			—	1
G. proximus C. L. Koch	•	•	•		•	•	•	•	•	75	—
Necrophloeophagus longicornis (Leach)	•		•			I	I	I		4	5
Brachygeophilus truncorum (Bergsö & Meinert)	I									—	1
Cryptops hortensis Leach	I									—	1
Lithobius forficatus (Linnaeus)	•	•	•	•	•	•	•	I		151	12
L. melanops Newport								I	I	—	2
L. lapidicola Meinert		I			I				I	—	4
L. tenebrosus fennoscandius Lohmander	•	•	•		•	•	•			32	—
L. erythrocephalus C. L. Koch	•	•	•		•	•	•			194	—
L. curtipes C. L. Koch	•	•	•		•	•	•	•	•	619	—
L. microps Meinert	•	I	•		I			I		2	5
Lamyctinus coeculus (Brölemann)						I				—	1
Lamyctes fulvicornis Meinert	•	•	•	•	•	•	•	•		50	—
Total number of localities										905	21

Pachymerium ferrugineum

A coastal species, not found in Jämtland, most common in Norrbotten. Mostly found on open ground (meadows and wooded pastures) and man-made habitats, seldom in forests. Mostly in localities with sparse vegetation or mosses-lichens, seldom in localities with *Vaccinium*. Mainly found in localities with rocks or stones, seldom in localities with boulders. Most often found in localities with human influence. There is no preference for slope or flat ground and not for any special slope direction.

Geophilus proximus

Evenly distributed in the whole area investigated. Mostly in meadows and man-made habitats, seldom in woodland but then preferring deciduous forest. Mainly in localities with grass or no vegetation, seldom in *Vaccinium* localities. Chiefly in localities with stones, sand or rocks but seldom in boulder-localities. Mostly found in localities with human influence. No preference for slope or any slope direction.

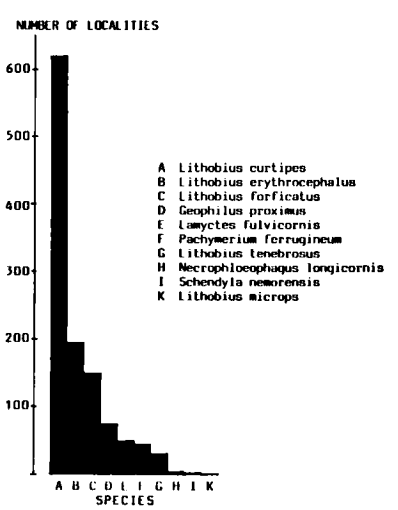

Fig. 3. Number of localities in which the ten outdoor species are found.

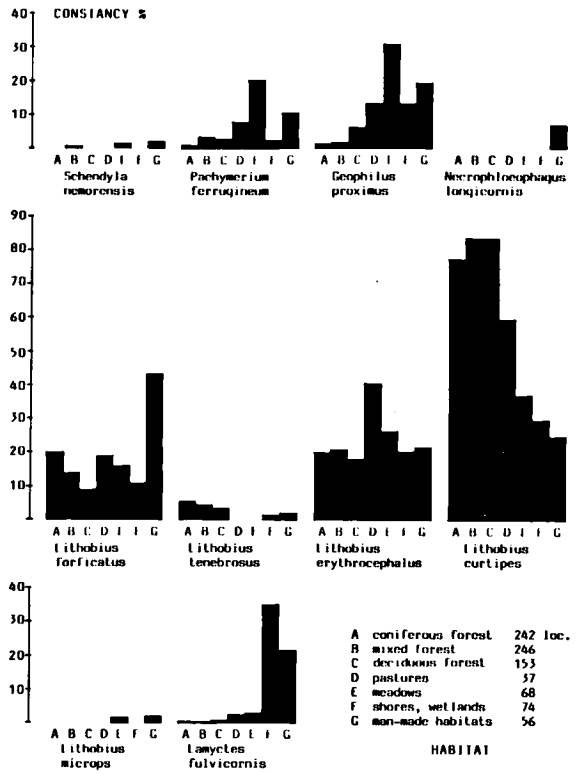

Fig. 4. Constancy (%) for different habitats for the ten outdoor species.

Lithobius forficatus

Outdoors found with decreasing frequency from S. to N. Missing in Norrbotten and Lappland. Mostly in man-made habitats, but in forests significantly more in coniferous than in deciduous forests. Mainly in localities with sparse vegetation. No differences for different surface structures. Mostly in localities influenced by man. No preference for slope or any slope direction.

Lithobius tenebrosus fennoscandius

An inland species, missing in Norrbotten and Lappland, most common in Jämtland. Not found in open habitats and most common in coniferous forests but the material is insufficient for statistical calculations. Small or no differences in vegetation and surface morphology. Not preferring slopes, but on slope localities more common on W. slopes.

Lithobius erythrocephalus

A southern and coastal species with a sharp borderline in Ångermanland/Västerbotten, but also most common in Ångermanland. Most common in pastures and meadows but fairly often found in most of the habitats. No special preference for any vegetation. Mostly in localities with rocks. Mainly in localities with moderate influence of man (significant difference from both no influence and strong influence). Not preferring slope more than flat ground, but on slope localities mostly on S. slopes, seldom on N. slopes.

Lithobius curtipes

An inland species. The most common one in all provinces but more sparse in Jämtland and Ångermanland. A woodland species, mostly in localities with *Vaccinium* and boulders. Significantly more common in localities with no human influence. Mostly in localities with slopes, but not preferring any special aspect of slope.

Lamyctes fulvicornis

Most common in Jämtland. Although wetlands and man-made habitats (the most common habitats for this species) were overrepresented in Jämtland (27% against 13% for the whole material), *L. fulvicornis* was found in 75% of these localities in Jämtland and only in 31% of these localities in the whole area. Mostly found in localities with sparse vegetation, seldom in localities with *Vaccinium*. Mainly on fine material, seldom in localities with boulders. Mostly in localities influenced by man and chiefly on flat ground.

SOME ZOOGEOGRAPHICAL REMARKS

About 10 000 years ago the whole area investigated was still covered by ice. When the ice melted the animals may have colonized the area from the south or from the east (Finland). According to Palmén (1949) there are six species

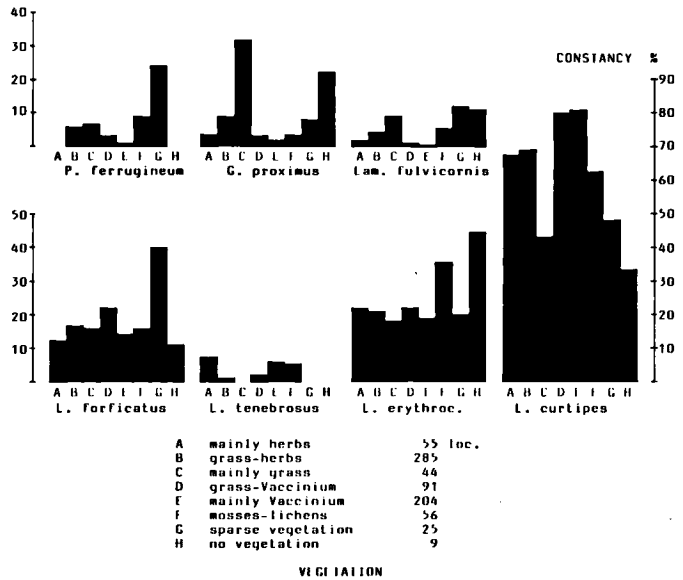

Fig. 5. Constancy (%) for different types of vegetation for the seven common species.

occurring in northern Finland: *Pachymerium ferrugineum*, *Geophilus proximus*, *Lithobius forficatus*, *L. tenebrosus*, *L. curtipes* and *Lamyctes fulvicornis*. Of these species *L. tenebrosus* and *L. forficatus* are not found in Norrbotten and Lappland and thus there is a gap between the Swedish and Finnish populations. The other four species probably have a more or less continuous distribution over the border and there could have been a colonization from the east to the northern part of Sweden. This seems to be a probable route of invasion for *L. curtipes*, which is most common in the whole northern area, but shows decreasing frequency southwards in Sweden. In spite of its northern limit of today, *L. tenebrosus fennoscandius* could also be a probable invader from the east (Lohmander,

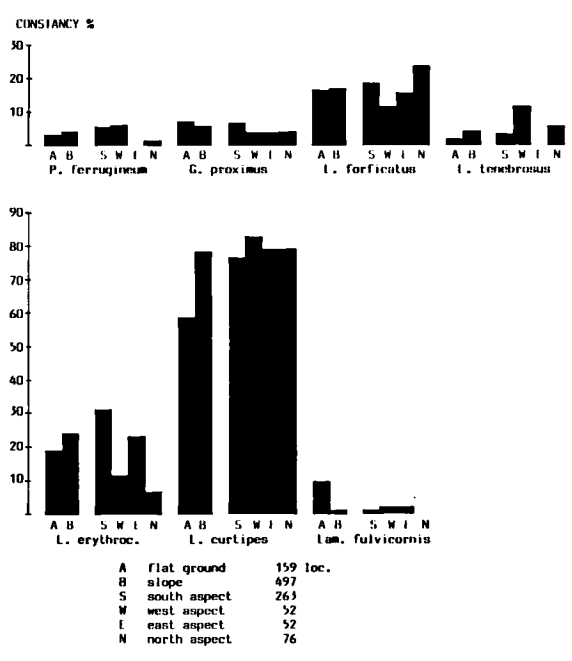

Fig. 6. Constancy (%) for flat ground, slope and different aspects of slope for the seven common species.

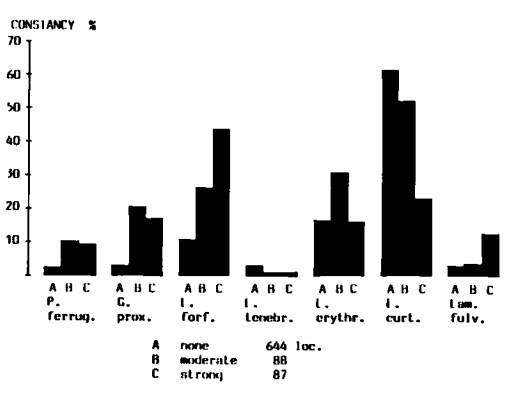

Fig. 7. Constancy (%) for different degrees of human influence for the seven common species.

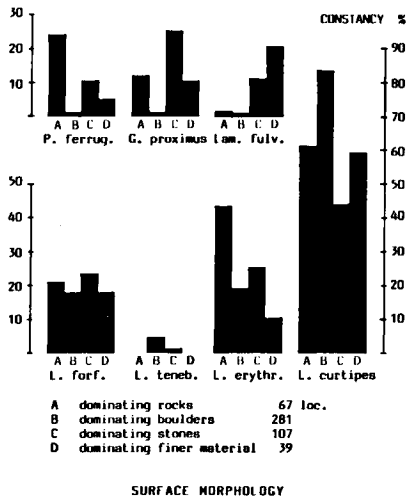

Fig. 8. Constancy (%) for different types of surface morphology for the seven common species.

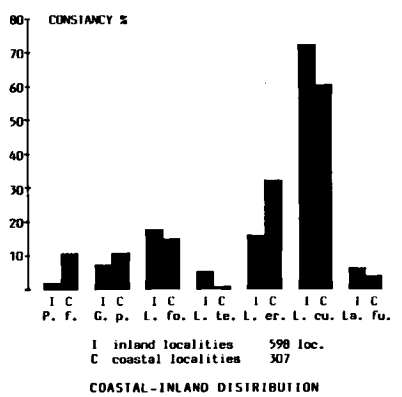

Fig. 9. Constancy (%) for coastal and inland localities for the seven common species.

1955). This subspecies (the only one found in Scandinavia) has an eastern distribution (Lohmander, 1948), is rare in Norway (Meidell, 1979) and is completely missing in Denmark according to Enghoff (1983). *G. proximus*, which is found in the Kola peninsula as well, is thought to be an eastern invader too (Lohmander, 1957).

L. forficatus is a widespread species. It is easily transported by man (e.g. introduced to South America (Eason, 1964) and Australia (Attems, 1949)). In the vicinity of Göteborg, which is an area strongly influenced by man, it is the outstandingly most common species (G. Andersson, 1983). It is also the only one of the seven common species in Norrland which is found indoors in the area. *L. forficatus* is probably more or less anthropochorous in Norrland.

SIMILARITY IN HABITAT SELECTION

The similarity in habitat selection for the different species can be shown in a dendrogram. The similarity is calculated as follows (Fairhurst & Armitage, 1979):

$$S = \frac{2\sum_{h=1}^{n} (\text{lower value of } a_h \text{ and } b_h)}{\sum_{h=1}^{n} a_h + \sum_{h=1}^{n} b_h} \; 100$$

wherein S = similarity in percent, a_h = number of localities of species a in habitat h, and b_h = number of localities of species b in habitat h.

The corresponding dendrogram is shown in fig. 10. The three rarest species (*Schendyla nemorensis*, *Necrophloeophagus longicornis* and *Lithobius microps*) form a clearly defined group, bound to meadows and man-made habitats. *Geophilus proximus* and *Pachymerium ferrugineum* form one group and *L. erythrocephalus* together with *L. forficatus* another. *L. curtipes*, the very common forest species, shows the smallest similarity with the other species in this group. *Lamyctes fulvicornis*, the species of shores and man-made habitats, also shows small similarity with the others.

DISCUSSION

Norrland is to a great extent covered with forest, but only two of the seven species analysed prefer woodland: *Lithobius tenebrosus fennoscandius* and *L. curtipes*. There is little difference between coniferous and deciduous forest for either of these two species. The only

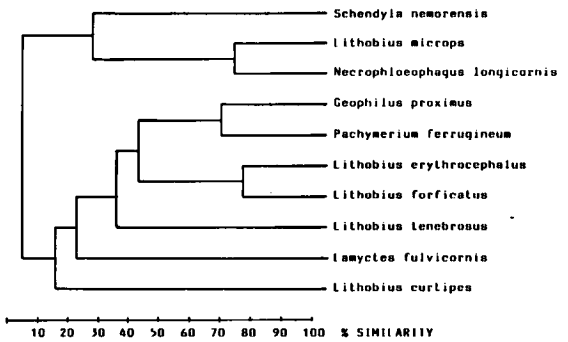

Fig. 10. Dendrogram for similarity (%) in habitat selection for the ten outdoor species.

species significantly more common in deciduous than in coniferous forest is *Geophilus proximus*, and the only species more common in coniferous than in deciduous forest is *Lithobius forficatus*. *L. forficatus* and *L. erythrocephalus* are common in woodland but yet more common in man-made habitats and pastures, respectively. *Lamyctes fulvicornis*, although found in all groups of habitats, predominates on shores of lakes and streams and also in man-made habitats.

The two geophilid species, *Pachymerium ferrugineum* and *Geophilus proximus*, are mostly found in open land. Concerning vegetation and surface morphology they show rather different patterns. *P. ferrugineum* is mostly found in localities with sparse vegetation or mosses-lichens. The same tendency is shown by *L. erythrocephalus*. These two species are also the only ones most often found in localities with rocks. *G. proximus* on the other hand is mostly found in localities with grass or no vegetation and in localities with stones.

P. ferrugineum is described as a non-woodland species (Lohmander, 1923; Palmén, 1949; Eason, 1964). Thus I looked once again at the descriptions of the 17 forest localities where this species was found. At least 11 of these localities have open, mostly rocky, parts included. There is a reason to suspect that *P. ferrugineum* has inhabited just these open parts of these localities, which nevertheless I have classed as forest localities, and thus this species should be even more common in open habitats. However, this is not substantiated here. A description of a locality with a couple of microhabitats included is thus less usable for analysis of the habitat preference of the species unless the exact microhabitat for each species found is recorded. For example: if it is known that a certain species is mostly found on e.g. open rocks, and if open rocks are included in the description of the locality, then it is enticing to presume that the species must have been found there. But one may not use this assumption as an evidence for rock-preference for that species because a circular argument develops then. In such a case one also easily hides new information about the habitat preference of the species. As a consequence of this the analysis of the influence of different more specific habitat factors on the species must be rather brief for the centipede material of the "faunistic and ecological survey".

Four species are definitely synanthropic: *P. ferrugineum*, *G. proximus*, *L. forficatus* and *Lamyctes fulvicornis*. *L. forficatus* is the only one of these which is found indoors as well, being apparently spread by man. This species is also the most common one in localities with strong human influence. *L. curtipes* shows the opposite picture: it is much more common in natural habitats. *L. tenebrosus fennoscandius* shows indications for this phenomenon as well (also stated by Palmén, 1949). *L. erythrocephalus* is apparently favoured by moderate human influence. This species is significantly more common in such localities than in natural or in strongly influenced localities. But the most common habitats for *L. erythrocephalus* (pastures and meadows) are also mostly moderately influenced by man (fig. 11). Thus the preference for localities with moderate human influence is in this case nearly identical to preference for pastures and meadows.

South slopes have climatically favourable conditions that would be valuable for species inhabiting this northern region (see e.g. J. S. Andersson, 1961). The three rare species (*Schendyla nemorensis*, *Necrophloeophagus longicornis* and *Lithobius microps*) were all found in similar habitats: churchyards, market gardens, parks

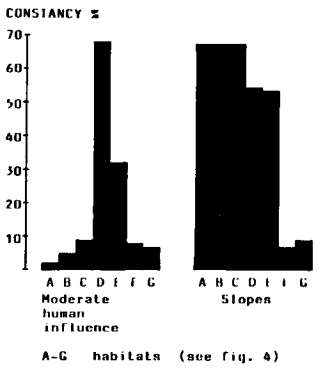

Fig. 11. Constancy (%) for different habitats for localities with moderate human influence and slope localities.

and open rocks. Three of the nine outdoor localities comprised S. slopes, the rest of them were on flat ground. Tolbert (1975) found that S. slopes were most preferred by insects and arachnids investigated with pitfall traps, and that 32 out of 34 species were significantly more abundant on one or more of the eight aspects of slope.

However, it is remarkable that only one of the seven more common species (*L. erythrocephalus*) is significantly more common in S. slopes than in other aspects of slope. This species is also common on flat ground. *L. curtipes* is the only species that significantly shows preference for slopes, but on the other hand there is no difference between the aspects of slope. The localities with slope are mostly also forest localities (fig. 11). Thus the preference for slope in *L. curtipes* may just be another way to show preference for forest. *L. tenebrosus fennoscandius* also indicates preference for slopes, especially the W. aspect, but the number of specimens is too small to show statistical significance. All other species show no significant preference for any aspect of slope.

The analysis given above of *L. erythrocephalus* in localities with moderate human influence and *L. curtipes* on slope localities could be made owing to the computer-based technique. However, there are many difficulties in the evaluation of the data recorded in the faunistic and ecological survey. There are close relations between most of the factors registered, but the limitations of the available computer precluded multivariate analysis.

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REFERENCES

ÅNGSTRÖM, A., 1968. Sveriges klimat: 1-157 (Generalstabens Litografiska Anstalt, Stockholm).

ANDERSSON, G., 1983. The chilopod fauna in the vicinity of Göteborg — a comparison between collecting results obtained in the 1920s and the 1970s. Acta ent. fenn., **42**: 9-14.

ANDERSSON, J. S., 1961. The occurrence of some invertebrate animal groups in the south bluffs in northern Sweden. Oikos, **12**: 126-156.

ATTEMS, C., 1949. Die Myriopodenfauna der Ostalpen. Sber. öst. Akad. Wiss., (Abt. 1) **158**: 79-153.

EASON, E. H., 1964. Centipedes of the British Isles: 1-294 (F. Warne, London).

ENGHOFF, H., 1983. Oversigt over skolopendrernes udbredelse i Danmark (Chilopoda). Ent. Meddr., **50**: 1-6.

FAIRHURST, C. & M. L. ARMITAGE, 1979. The British Myriapod Survey, 1978. In: M. CAMATINI ed., Myriapod biology: 183-194 (Academic Press, New York/London).

FORSSLUND, K.-H., 1945. Sammanfattande översikt över vid markfaunaundersökningar i Västerbotten påträffade djurformer. Meddn. St. Skogsförsöksanstalt, **34** (5): 341-364.

LOHMANDER, H., 1923. Göteborgstraktens myriopoder. In: L. A. JÄGERSKIÖLD ed., Bohusläns och Göteborgstraktens djurvärld: 376-408 (Göteborgstraktens natur, Göteborgs Litografiska Aktiebolag, Göteborg).

——, 1948. Lithobius nigrifrons fennoscandius n. ssp. (Chilopoda, Lithobiidae). Annls. ent. fenn., **14**: 97-99.

——, 1955. Faunistiskt fältarbete 1954 (utmed Götalands nordgräns, östra hälften). Årstr. Göteborgs naturhisto. Mus., **1955**: 30-97.

——, 1957. Faunistiskt fältarbete i Nord- och Västjylland 1954 och 1956. Årstr. Göteborgs naturhisto. Mus., **1957**: 29-86.

MEIDELL, B., 1979. Norwegian myriapods: Some zoogeographical remarks. In: M. CAMATINI ed., Myriapod biology: 195-201 (Academic Press, New York/London).

PALMÉN, E., 1949. The Chilopoda of eastern Fennoscandia. Annls. zool. Soc. zool. bot. fenn. "Vanamo", **13** (4) "1948": 1-45.

PORAT, C. O. VON, 1889. Nya bidrag till Skandinaviska halföns Myriopodologi. Ent. Tidskr., **10**: 33-48.

STUXBERG, A., 1871. Bidrag till Skandinaviens Myriopodologi. II. Sveriges Chilopoder. Öfvers. K. Vetensk-Akad. Förh. Stockh., **1871**: 493-512.

TOBIAS, D., 1975. Zur Kenntnis von Lithobius curtipes C. L. Koch (Chilopoda: Lithobiomorpha) in Nordschweden. Ent. Tidskr., **96**: 24-26.

TOLBERT, W. W., 1975. The effects of slope exposure on arthropod distribution patterns. Am. Midl. Nat., **94**: 38-53.

WALDÉN, H. W., 1969. En faunistisk-ekologisk detaljinventering av vissa djurgrupper inom den lägre markfaunan (with English summary: A faunistic and ecological survey of certain terrestrial invertebrate groups in Sweden). Fauna Flora, Stockh., **64** (2): 54-73.

——, 1971. Om landmolluskfaunan i Tärnasjöområdet i Lycksele lappmark, jämte några inledande ord om de biologiska undersökningarna i de norrländska älvdalarna 1959-1968. Fauna Flora, Stockh., **66** (2): 53-66.