Bull. Soc. Nat. luxemb., 95 (1994) p. 349-357

Millipedes (Diplopoda) found in and around hedges in Luxembourg

by

Richard Desmond KIME [1])

Résumé: Une partie du projet "Etude systématique des écosystèmes luxembourgeois" du Musée national d'histoire naturelle de Luxembourg concernait les flore et faune des haies du Grand-Duché de Luxembourg. Cette contribution présente les diplopodes trouvés dans les pièges "Barber" utilisés dans le cadre de l'étude prémentionnée.

Introduction

The study of the flora and fauna of hedges in Luxembourg, part of the Project "Etude systématique des écosystèmes luxembourgeois" of the National Museum of Natural History in Luxembourg (Moes 1993), involved the use of pitfall traps and led to the capture of a significant number of animals. I was given the opportunity to study the myriapods which were almost entirely millipedes. 1775 individuals belonging to 17 species of diplopoda were identified, a few additional juvenile individuals could not with certainty be assigned to any particular species.

The sites have been described elsewhere e. g. Drugmand (1993), Walzberg (1993). There appears here only a list of them, numbered 1 to 16 (Table 1) for reference purposes.

An attempt was made to analyse the results. Computer analyses were heavily weighted by a few readily identifiable preponderant factors, and these analyses will be more successful when they include more sites from a larger number of biocenoses. A paper has already been read at the Ninth World Congress of Myriapodology in Paris in July 1993 (Kime, in press), relating to both the hedges and several other grassland sites. It was possible to arrive at a number of preliminary conclusions concerning the ecology, behaviour and phenology of the millipedes in particular, and these will be discussed to some extent in this paper.

[1]) Institut royal des Sciences naturelles de Belgique, rue Vautier 29, B-1040 Bruxelles, Belgique.

Table 1: Description of the 16 sites.

Hedge	Location	Geology	Coord. (GK-Lux.)
1	Rennpad/Junglinster	Keuper	84.6/86.6
2	Doulen/Junglinster	Keuper	87.2/86.1
3	Gröebierg/Junglinster	Keuper	88.1/87.7
4	Reischwisen/Junglinster	Keuper	87.7/88.1
5	Rampelsbierg/Boursdorf	Muschelkalk	103.5/91.8
6	Froumbierg/Oberdonwen	Muschelkalk	97.9/79.5
7	Tueschaker/Oberdnwen	Muschelkalk	96.9/78.6
8	Haerebierg/Gostingen	Muschelkalk	93.0/76.9
9	Happefeldchen/Clemency	Pliensbachian	59.4/74.6
10	hanner Wëller/Garnich	Pliensbachian	63.4/76.0
11	Eiselsbierg/Kahler	Pliensbachian	62.5/76.2
12	Aucheler/Clemency	Pliensbachian	56.9/73.1
13	beim Weier/Surré	Devonian inf.	51.1/106.9
14	Wanterheck/Surré	Devonian inf.	51.5/107.1
15	Hartschlaegden/Bavigne	Devonian inf.	57.2/109.8
16	Gresbourg/Bavigne	Devonian inf.	56.9/110.7

Results

Table 2 shows how many individuals of each species of millipede were recorded from each of the sixteen sites. Table 3 groups these figures into four columns based on the four geological zones of the survey, and includes the percentage of each species that was found in each zone: it also shows the relative numbers of each species as a percentage of the total catch. The composition of millipede communities is strongly influenced by the nature of the soil, and there are clearly some major differences between the zones. But there are other differences as well, including climatic, and it is known from past (Remy & Hoffmann 1959) as well as from present studies that the greatest number of species occurs on the calcareous Keuper and the Muschelkalk, then the Lias and the least on the Devonian. Having said this, it is nevertheless the case that two or three species have been recorded only from the Devonian, this region, the Oesling, being rather different from the rest of the Country, the Gutland. Hoffmann listed 36 species of diplopoda from Luxembourg, and two more have been added recently, though not from the hedges. From Table 3 it is also clear that a few species of millipedes dominate the results in the hedge survey, in the case of *Tachypodoiulus niger* Leach, overwhelmingly so. Table 4 shows how many millipedes of each species were caught in traps numbered 1 to 4 at each site, that is in a field on one side of the hedge: Table 5 shows how many millipedes of each species were caught in traps numbered 7 to 10 on the other side of the hedge: Table 6 shows the same for the traps numbered 5, 6, 11 and 12 in the hedge itself. Table 7 summarises the results in Tables 4, 5 & 6 for all sites, showing the total number of each species caught in the four traps in the hedges and in the 4 traps in the field on either side. Table 8 then shows, for each site, how many millipedes were collected altogether in the hedge, at 1 m from the hedge, at 2 m

Table 2: Number of millipedes of each species found in sites 1 to 16.

Species/Sites	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Allaiulus nitidus	0	0	0	0	0	0	2	0	1	3	0	4	0	0	0	0
Cylindroiulus caeruleocinctus	22	168	30	0	14	0	4	0	1	2	1	2	0	0	0	0
Cylindroiulus punctatus	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Julus scandinavius	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptoiulus simplex	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Ommatoiulus rutilans	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ommatoiulus sabulosus	2	6	3	2	0	1	0	0	0	0	0	0	0	0	0	0
Tachypodoiulus niger	1	198	110	2	240	70	123	34	29	1	6	181	0	0	3	4
Archiboreoiulus pallidus	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
Brachydesmus superus	0	0	0	0	2	16	2	0	0	7	0	1	1	0	0	0
Polydesmus angustus	0	0	0	0	0	1	4	0	1	6	0	0	9	9	1	0
Polydesmus denticulatus	0	0	3	0	5	23	3	0	4	7	0	113	7	29	0	0
Polydesmus testaceus	0	38	21	0	0	8	5	0	5	7	0	2	0	0	0	0
Craspedosoma rawlinsi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2
Melogona gallicum	0	6	3	0	3	5	9	0	0	0	0	17	0	0	0	0
Glomeris hexasticha intermedia	0	0	0	0	0	0	0	0	0	0	0	0	12	39	0	1
Glomeris marginata	0	0	2	0	35	0	5	1	0	0	3	7	14	0	0	1

Table 3: Number of millipedes of each species found in each geological zone.

Species	Keuper	Muschelkalk	Lias	Devonian	Total	%
Allaiulus nitidus	0	2	7	0	9	0.5
Cylindroiulus caeruleocinctus	220	18	6	0	244	13.2
Cylindroiulus punctatus	0	2	0	0	2	0.1
Julus scandinavius	7	0	0	0	7	0.4
Leptoiulus simplex	0	1	0	0	1	0.05
Ommatoiulus rutilans	1	0	0	0	1	0.05
Ommatoiulus sabulosus	13	1	0	0	14	0.8
Tachypodoiulus niger	310	467	219	7	1003	56.5
Archiboreoiulus pallidus	0	2	0	1	3	0.2
Brachydesmus superus	0	20	1	1	22	1.2
Polydesmus angustus	0	5	7	19	31	1.7
Polydesmus denticulatus	3	31	119	36	189	10.6
Polydesmus testaceus	59	13	7	0	79	4.5
Craspedosoma rawlinsi	0	0	0	7	7	0.4
Melogona gallicum	9	17	17	0	43	2.4
Glomeris hexasticha intermedia	0	0	0	52	52	2.9
Glomeris marginata	2	41	10	15	68	3.8

Total individuals per zone	624	620	393	138
% individuals per zone	35	35	22	8
Number of species per zone	9	13	9	8

from the hedge, at 3 m from the hedge and at 4 m from the hedge. Since there were four Barber traps in each hedge, and just one at each distance on either side,. the average number of millipedes per trap is given in brackets. These results are not entirely reliable quantitatively, since a number of traps were damaged or otherwise put out of action. Ideally, twelve traps were emptied of their samples on eight occasions, i. e. there were 96 trap harvests per site. The last column in Table 8 shows how many of these were achieved successfully. Note that site 9 was especially adversely affected, though a fair range of species was captured early in the year. Table 9 summarises the results in Table 8, again by geological region.

Table 4: Number of the seventeen species of millipedes caught in traps 1, 2, 3 and 4 at each site.

Species/Sites	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Allalulus nitidus	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Cylindrolulus caeruleocinctus	14	35	13	0	2	0	0	0	1	1	1	2	0	0	0	0
Cylindrolulus punctatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Julus scandinavius	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptolulus simplex	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Ommatolulus rutilans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ommatolulus sabulosus	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Tachypodolulus niger	1	69	40	1	12	11	3	0	5	1	0	25	0	0	1	0
Archiboreolulus pallidus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachydesmus superus	0	0	0	0	0	2	1	0	0	?	0	0	0	0	0	0
Polydesmus angustus	0	0	0	0	0	0	2	0	0	4	0	0	2	3	1	0
Polydesmus denticulatus	0	0	0	0	1	8	2	0	3	?	0	45	2	8	0	0
Polydesmus testaceus	0	11	7	0	0	2	2	0	3	?	0	1	0	0	0	0
Craspedosoma rawlinsi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
Melogona gallicum	0	2	0	0	0	6	1	0	0	0	0	0	0	0	0	0
Glomeris hexasticha intermedia	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0
Glomeris marginata	0	0	0	0	4	0	3	0	0	0	0	3	1	0	0	0

Table 5: Number of the seventeen species of millipedes caught in traps 7, 8, 9 and 10 at each site.

Species/Sites	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Allalulus nitidus	0	0	0	0	0	0	2	0	0	1	0	1	0	0	0	0
Cylindrolulus caeruleocinctus	2	93	10	0	10	0	4	0	0	0	0	0	0	0	0	0
Cylindrolulus punctatus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Julus scandinavius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptolulus simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ommatolulus rutilans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ommatolulus sabulosus	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tachypodolulus niger	0	69	5	0	76	23	9	10	2	0	0	22	0	0	1	1
Archiboreolulus pallidus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Brachydesmus superus	0	0	0	0	0	11	0	0	0	?	0	0	1	0	0	0
Polydesmus angustus	0	0	0	0	0	1	1	0	1	2	0	0	2	1	0	0
Polydesmus denticulatus	0	0	1	0	0	11	1	0	3	?	0	62	2	0	0	0
Polydesmus testaceus	0	12	1	0	0	4	1	0	2	?	0	0	0	0	0	0
Craspedosoma rawlinsi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melogona gallicum	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Glomeris hexasticha intermedia	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	0
Glomeris marginata	0	0	0	0	27	0	0	0	0	0	0	0	1	0	0	1

Table 6: Number of the seventeen species of millipedes caught in four traps in the hedge at each site.

Species/Sites	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Allalulus nitidus	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0
Cylindrolulus caeruleocinctus	6	40	7	0	2	0	0	0	0	1	0	0	0	0	0	0
Cylindrolulus punctatus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Julus scandinavius	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptolulus simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ommatolulus rutilans	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ommatolulus sabulosus	0	1	1	2	0	1	0	0	0	0	0	0	0	0	0	0
Tachypodolulus niger	0	69	65	1	152	36	111	24	22	0	6	136	0	0	1	3
Archiboreolulus pallidus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Brachydesmus superus	0	0	0	0	2	3	1	0	0	?	0	1	0	0	0	0
Polydesmus angustus	0	0	0	0	0	0	1	0	0	0	0	0	5	5	0	0
Polydesmus denticulatus	0	0	2	0	4	4	0	0	0	?	0	6	3	21	0	0
Polydesmus testaceus	0	15	13	0	0	2	2	0	0	?	0	1	0	0	0	0
Craspedosoma rawlinsi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Melogona gallicum	0	2	3	0	1	0	8	0	0	0	0	17	0	0	0	0
Glomeris hexasticha intermedia	0	0	0	0	0	0	0	0	0	0	0	0	4	32	0	1
Glomeris marginata	0	0	2	0	4	0	2	1	0	0	3	4	12	0	0	0

Table 7: Total number of each of the seventeen species of millipedes caught in the hedge (B) and on either side of the hedge (A and C).

Species	A	B	C
Allaiulus nitidus	2	4	3
Cylindroiulus caeruleocinctus	69	56	119
Cylindroiulus punctatus	0	1	1
Julus scandinavius	5	2	0
Leptoiulus simplex	1	0	0
Ommatoiulus rutilans	0	1	0
Ommatoiulus sabulosus	7	5	2
Tachypodoiulus niger	159	626	218
Archiboreoiulus pallidus	0	1	1
Brachydesmus superus	3	7	12
Polydesmus angustus	12	11	8
Polydesmus denticulatus	69	40	80
Polydesmus testaceus	26	33	20
Craspedosoma rawlinsi	3	4	0
Melogona gallicum	8	31	4
Glomeris hexasticha inter.	4	37	11
Glomeris marginata	11	28	29

Discussion

The seventeen species captured were on the whole well-known species, all of which had been recorded in Hoffmann's list. However, *Leptoiulus simplex glacialis* (Verhoeff) deserves special mention since it is known from the Alps, the Jura, the Black Forest, the Vosges, the Eifel and the Ardennes, and was recorded by Hoffmann and again recently at a number of places in the Oesling, in humid areas at quite high elevation - mostly at about 500 m above sea level. The record from the Froumbierg in Oberdonven, on Muschelkalk, is therefore at first sight surprising, and is the first record from the Gutland. As it happens the species has more recently still been discovered in a similar situation in Belgium (Branquart, pers. comm.) and so its range is wider than was previously believed.

Table 2 shows some big differences in the numbers of certain species from site to site and Table 3 shows equally important differences when these results are grouped into the geological areas on different types of substrate. The latter is much easier to explain, since several species have a regional distribution within the confines of Luxembourg, connected with marked pedological or climatological preferences. For instance, *Cylindroiulus caeruleocinctus* (Wood) has never been recorded from the Oesling and attains very large population sizes on the calcareous grasslands of the Keuper formations. This is known from extensive sampling outside this survey and was reported on in Paris (Kime, in press). Yet it is difficult to explain why the numbers of this species caught in sites on the Keuper (1, 2, 3 and 4

Table 8: Number of millipedes caught in the hedges and at different distances from the hedge at each site.

Stations	No. in hedge	1m from hedge	2 m from hedge	3 m from hedge	4 m from hedge	No. of samples
1	8	2	5	5	11	
	(2)	(1)	(2.5)	(2.5)	(5.5)	67
2	128	105	54	56	64	
	(32)	(52.5)	(27)	(28)	(32)	86
3	93	47	20	4	8	
	(23.25)	(23.5)	(10)	(2)	(4)	72
4	3	1	0	0	0	
	(0.75)	(0.5)	0	0	0	69
5	167	19	73	13	25	
	(41.75)	(9.5)	(36.5)	(6.5)	(12.5)	80
6	46	33	20	8	21	
	(11.5)	(16.5)	(10)	(4)	(10.5)	63
7	129	19	6	3	2	
	(32.25)	(9.5)	(3)	(1.5)	(1)	69
8	25	12	0	0	0	
	(6.25)	(6)	0	0	0	62
9	23	3	5	9	3	
	(5.75)	(1.5)	(2.5)	(4.5)	(1.5)	24
10	4	2	11	2	2	
	(1)	(1)	(5.5)	(1)	(1)	72
11	9	1	0	0	0	
	(2.25)	(0.5)	0	0	0	60
12	167	76	31	28	27	
	(41.75)	(38)	(15.5)	(14)	(13.5)	68
13	24	12	3	1	3	
	(6)	(6)	(1.5)	(0.5)	(1.5)	81
14	58	12	2	5	0	
	(14.5)	(6)	(1)	(2.5)	0	96
15	3	3	2	0	0	
	(0.75)	(1.5)	(1)	0	0	80
16	6	2	1	0	1	
	(1.5)	(1)	(0.5)	0	(0.5)	81

Table 9: Number of millipedes caught in the hedges and at different distances from the hedges grouped by geological region.

	No. in hedge	1m from hedge	2 m from hedge	3 m from hedge	4 m from hedge
Sites 1-4	232	155	79	65	83
Keuper	(15)	(19)	(10)	(8)	(10)
Sites 5-8	367	83	99	24	48
Muschlekalk	(23)	(10)	(12)	(3)	(6)
Sites 9-12	203	82	47	39	32
Lias	(13)	(10)	(6)	(5)	(4)
Sites 13-16	91	29	8	6	4
Devonian	(6)	(4)	(1)	(1)	(0.5)

of this survey) were 22, 168, 30 and 0 respectively. There might be some connection with agricultural activity, the animal being predominantly an inhabitant of grassland, but this is speculation, and there is no information on any chemical treatment of the ground in the vicinity. There is no immediately obvious natural factor involved. The animal is already known from agricultural ground and hedges (Haacker 1968, Thiele 1968, Blower 1985, Pedroli-Christen 1993). Table 7 shows that the greatest numbers

of this species were caught in the fields, and that it does occupy the hedges as well. In a similar vein, from what is known generally, *Ommatoiulus sabulosus* (Linné) is common on the Keuper, and also occurs on the Muschelkalk, while *Polydesmus testaceus* C. L. Koch occurs in calcareous sites throughout the Gutland, neither species having been recorded in the Oesling. The survey results conform well with this, though, once again, there are differences between the sites on the same geological formation in the case of *Polydesmus testaceus*. Site 4 was inexplicably poor altogether, only four millipedes were received from this site, collected in September and October. In general, at the other sites, the largest numbers were caught in the spring and the early summer. With respect to site 4 there is likely to be some major hidden factor involved.

The most abundant species in the survey, *Tachypodoiulus niger* Leach, is found throughout the Country, and is more or less eurytopic, but is known to achieve maximum numbers on calcareous soils, is considered to be xerophilic, and is often associated with forests (Haacker 1968, Thiele 1968, Blower 1985, Haupt 1990, Pedroli-Christen 1993). Table 7 shows that the greatest numbers were found in the hedges in this survey. It occurred in all the sites except the two (13 and 14) in Surré.

Melogona gallicum (Latzel), *Glomeris hexasticha intermedia* Latzel and, to a lesser extent, *Glomeris marginata* (Villers) are regarded as forest species (Pedroli-Christen 1993), and all three occurred in reasonably large numbers. It seems that the hedges are suitable habitats for the forest species and might be important as corridors for their movement. *Melogona gallicum* is an abundant Atlantic species (Kime 1990) which has not been found in the Oesling: *Glomeris marginata* has been found in all parts of Luxembourg: the survey results correspond with these statements. However, the survey yielded *Glomeris hexasticha* intermedia only from the Devonian sites in the Oesling, where it is common, yet it occurs in woods in other parts of the Country. Pedroli-Christen (1993) finds it mainly in hilly and mountainous regions in Switzerland, in forests, woods, and large hedges. It may be less tolerant of hedges in lower, warmer, dryer locations. The results for this species are interesting.

Polydesmus denticulatus C. L. Koch was well represented in the samples, the third most abundant species; it is tolerant of a wide range of habitats and is very active in summer (Pedroli-Christen 1993). It is able to tolerate waterlogged conditions on heavy soils, and even submergence (Zulka 1992), yet occurs on open calcareous ground in summer (Kime, in press). It was one of the two species occurring in significant numbers that fell more frequently into the Barber traps situated outside the hedges (the other being *Cylindroiulus caeruleocinctus*). *Polydesmus angustus* Latzel occurs throughout Luxembourg, but prefers moist humus on well-drained substrates (Kime 1990, Pedroli-Christen 1993) which may explain its absence from the hedges on the Keuper marls and its relatively low numbers in the Gutland hedges. It is a very common species in Western Europe (Kime 1990). The survey revealed *Brachydesmus superus* Latzel almost entirely on the Muschelkalk: there may be a reason for this, though it occurs in all regions of the Country. Few species in the survey occurred in significant numbers, and some of them that are reported in Tables 2 and 3 from only one site or part of the Country have been found in all regions. It may be interesting that they are not common in hedges.

Brief references follow concerning the ecology of the remaining species found in small numbers in the hedge project. *Allaiulus nitidus* (Verhoeff) is a woodland species occurring in mull humus, especially calcic mulls (David 1988, Kime 1990). *Cylindroiulus punctatus* (Leach) is a species which is very common in the Atlantic zone, and which spends much of its life cycle in dead wood: hibernation occurs in the soil and there are vertical as well as horizontal movements (Banerjee 1967).

Julus scandinavius Latzel is a very common animal in NW and Central Europe which has been recorded from all regions of Luxembourg. It has been found mainly in forests, but not on calcareous rock, on the other hand it has frequently been taken in calcareous grassland, ocurs in other grassland, heaths and on sand dunes, and also in marshes and on mountains (Schubart 1934, Barlow 1957, Thiele 1968, Blower 1985, Kime 1990, Pedroli-Christen 1993). It has been found in nearly all the calcareous grasslands sampled in Luxembourg.

Ommatoiulus rutilans (C. L. Koch) is a thermophilic and xerophilic species at the northern end of its range in Luxembourg. It occurs in a number of well-exposed calcareous grasslands in the south of Luxembourg.

Archiboreoiulus pallidus (Brade-Birks) has been recorded from time to time in various parts of the northern half of Europe as far south as Switzerland (Blower 1985, Pedroli-Christen 1993). It has been located mainly in calcareous soils and frequently on agricultural ground, where damage to crops has been reported; it was extensively studied in Belgium (Biernaux 1972). *Craspedosoma rawlinsi* Leach has fallen into pitfall traps only on the Devonian formations of the Oesling, where it is very common. It is a hygrophile species active at low temperatures in winter (Haacker 1968). It has been recorded, however, from most areas of Luxembourg. Remy (in Remy & Hoffmann 1959) recorded it as two separate species, *C. alemannicum* Verhoeff and *C. simile* Verhoeff, which are now regarded as subspecies *C. rawlinsi alemannicum* and *C. rawlinsi rawlinsi* respectively (Spelda 1991). Computer analyses of the quantitative results were heavily influenced by the known differences between the Oesling and the Gutland, with their climatological and pedological differences, and by the numbers of the very common species. They very much reinforce the main arguments in this discussion.

Table 9 shows that on the whole the millipedes were centred on the hedges, with the average number caught per trap declining even over 4 metres. However, this was less true, if true at all, on the Keuper formations where there are more millipedes in the open, and there was even a suggestion of an ecotone effect with most captures occurring 1m from the hedge. In any event, hedges are useful as millipede habitats.

Acknowledgements

I am grateful to the field workers of the Marc Moes project and to Marc Meyer for the provision of the millipedes, and I am grateful to Didier Drugmand for his computer analyses of my results, following his programme for staphylinid beetles in the same site.

Bibliography

Banerjee, B., 1967. - Seasonal changes in the distribution of the millipede Cylindroiulus punctatus (Leach) in decaying logs and soil. - J. anim. Ecol. 36: 171-177.

Biernaux, J., 1972. - Chorologie et Etude biologique comparée de deux familles de Myriapodes-Diplopodes belges: les Blaniulidae et les Iulidae. - Dissertation, Faculté des Sciences Agronomiques de l'Etat, Gembloux.

Blower, J. G., 1985. - Millipedes. - Synopsis of the British Fauna, 3, London: 242 p.

David, J. F., 1988. - Les peuplements de diplopodes d'un massif forestier tempéré sur sols acides. - Thèse de doctorat, Muséum National d'Histoire Naturelle et Université de Paris VI: 225 p.

Drugmand, D., 1993. - Note générale concernant les stations retenues pour l'étude des invertébrés. In: Les haies au Grand-Duché de Luxembourg. - Trav. sci. Mus. nat. hist. nat. Lux. 20: 63-68.

Haacker, U., 1968. - Deskriptive, experimentelle und vergleichende Untersuchungen zur AutÖkologie rhein-mainischer Diplopoden. - Oecologia 1: 87-129.

Haupt, J., 1990. - Ecology of Diplopoda in northern Hesse. - Proc. 7th. int. congr. myriapod. E. J. Brill, Leiden: 247-253.

Kime, R. D., 1990. - A provisional atlas of european myriapods, Part 1. - Fauna Europaea Evertebrata, EIS, Luxembourg: 109 p.

Kime, R. D., in press. - Millipedes recorded in Luxembourg of Luxembourg. - Proc. 9th. int. congr. myriapod. Paris.

Moes, M., 1993. - Floristische und phytosoziologische Beschreibung der Heckentypen Luxemburgs. In: Les haies au Grand-Duché de Luxembourg. - Trav. sci. Mus. nat. hist. nat. Lux. 20: 3-62.

Pedroli-Christen, A., 1993. - Faunistique des Mille-pattes de Suisse (Diplopoda). - Centre suisse de cartographie de la faune, Neuchâtel: 167 p.

Remy, P. & Hoffmann, J., 1959. - Faune des Myriapodes du Grand-Duché de Luxembourg. - Archives de la Section des Sciences de l'Institut Grand-Ducal 26: 199-236.

Schubart, O., 1934. - Tausendfüssler oder Myriapoda I. Diplopoda. - Tierwelt Deutschlands 28: 318 p.

Spelda, J., 1991. - Zur Faunistik und Systematik der Tausendfüssler (Myriapoda) Südwestdeutschlands. - Jh. Ges. Naturkde. Württemburg 146: 211-232.

Thiele, H. -U., 1968. - Die Diplopoden des Rheinlandes. - Decheniana 120: 343-366.

Walzberg, C., 1993: Etude des invertébrés des haies luxembourgeoises, notamment en relation avec la présence de la pie-grièche écorcheur (Lanius collurio). In: Les haies au Grand-Duché de Luxembourg. - Trav. sci. Mus. nat. hist. nat. Lux. 20: 69-106.

Zulka, K. P., 1992. - Myriapods from a central european rivers floodplain. - Proc. 8th. int. congr. myriapod. Ber. nat.-med. Verein Innsbruck suppl. 10: 189 p.