Millipedes Recorded in the Grand Duchy of Luxemburg

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ABSTRACT

Knowledge of the occurence and distribution of millipedes in the Grand Duchy of Luxemburg is reviewed. To date 36 species have been recorded there. Regional variation is taken into account and the differences between the relatively higher Oesling, a palaeozoic massif of Devonian age, and the lower-lying Gutland of Secondary age are emphasised. Larger and longer-lived iteroparous species of millipedes are associated with open sites; the reasons for this are discussed. Comments are made on the phenology of some species.

RÉSUMÉ

Diplopodes répertoriés dans le Grand-Duché de Luxembourg.

Les peuplements de diplopodes édaphiques ont été étudiés dans plusieurs sites du Grand-Duché de Luxembourg. Une liste de 36 espèces répertoriées dans le pays est donnée. La répartition des espèces est liée aux diverses régions luxembourgeoises et surtout à la nature des roches mères. Le résultat des échantillonnages fait apparaître l'importance relative des iulides dans les sites ouverts. Les raisons en sont discutées. De nouvelles données sur la phénologie de certaines espèces sont commentées.

INTRODUCTION

A list of millipedes from the Grand Duchy of Luxemburg was published by Joseph HOFFMANN (REMY & HOFFMANN, 1959) and consisted of 36 species. None of the material collected at this time is to be found in the Luxemburg Natural History Museum. In 1982, occasional collecting began again and from 1988 onwards the Museum has carried out an intensive programme of pitfall trapping under the direction of Marc MEYER. Several invertebrate taxa are being studied. This paper is intended to compare recent millipede records with the list of species found by HOFFMANN (see Table 1) and takes into account regional variations which remain to be analysed in more detail in the next few years. Some trends are so apparent that they may be commented upon at this stage.

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TABLE 1. — Check-list of the 36 millipede species recorded in the Grand Duchy of Luxemburg during the 50's, compared with recent collections.

By HOFFMANN	RECENTLY
Polyxenus lagurus (Linné)	
Glomeris conspersa C. L. Koch	
Glomeris hexasticha intermedia Latzel	*Glomeris hexasticha intermedia*
Glomeris marginata (Villers)	*Glomeris marginata*
Blaniulus guttulatus (Fabricius)	
Proteroiulus fuscus (Am Stein)	
Choneiulus palmatus (Nemec)	
Nopoiulus kochii (Gervais)	
Archiboreoiulus pallidus Brade-Birks	*Archiboreoiulus pallidus*
Boreoiulus tenuis (Bigler)	
Nemasoma varicorne C. L. Koch	*Nemasoma varicorne*
Julus scandinavius Latzel	*Julus scandinavius*
Leptoiulus simplex glacialis (Verhoeff)	*Leptoiulus simplex glacialis*
Leptoiulus belgicus (Latzel)	
Leptoiulus bertkaui (Verhoeff)	
Allajulus nitidus (Verhoeff)	*Allajulus nitidus*
Cylindroiulus caeruleocinctus (Wood)	*Cylindroiulus caeruleocinctus*
Cylindroiulus latestriatus (Curtis)	
Cylindroiulus truncorum (Silvestri)	
Cylindroiulus punctatus (Leach)	*Cylindroiulus punctatus*
Brachyiulus pusillus (Leach)	*Brachyiulus pusillus*
Ommatoiulus rutilans (C. L. Koch)	*Ommatoiulus rutilans*
Ommatoiulus sabulosus (Linné)	*Ommatoiulus sabulosus*
Tachypodoiulus niger (Leach)	*Tachypodoiulus niger*
Craspedosoma alemannicum Verhoeff	*Craspedosoma rawlinsi* Leach
Craspedosoma simile Verhoeff	
Melogona gallica (Latzel)	*Melogona gallica*
Chordeuma silvestre C. L. Koch	*Chordeuma sylvestre*
Mycogona germanicum (Verhoeff)	*Mycogona germanicum*
	Orthochordeumella pallida (Rothenbühler)
Oxidus gracilis (C. L. Koch)	
Stosatea italica (Latzel)	
Brachydesmus superus Latzel	*Brachydesmus superus*
Polydesmus angustus Latzel	*Polydesmus angustus*
Polydesmus denticulatus C. L. Koch	*Polydesmus denticulatus*
Polydesmus inconstans Latzel	*Polydesmus inconstans*
Polydesmus testaceus C. L. Koch	*Polydesmus testaceus*

COMPARISON OF HOFFMANN'S DATA AND RECENT DATA

In the last ten years 23 of HOFFMANN's 36 listed species have been found again. With regard to this it is important to remember that nearly all the recent collecting has been achieved by pitfall trapping, and this probably accounts for the relatively low number of species found lately, in particular the blaniulids, some of which hardly ever fall into pitfall traps because of their hypogeal mode of life. Other species hardly ever or never taken in pitfall traps include *Polyxenus lagurus*, recorded by HOFFMANN, and the polydesmid, *Macrosternodesmus palicola*, as well as the glomerid, *Stygioglomeris crinita*, neither of which has been recorded at all from the Grand Duchy, and both of which are likely to occur in the calcareous areas. A discussion about the efficiency of pitfall traps in catching different species of millipedes is to be found in BRANQUART *et al.* (1995 and this volume). The other species found by HOFFMANN that have not been recorded recently are on the whole synanthropic or at the extreme limit of their geographical range. *Leptoiulus bertkaui* deserves special mention; HOFFMANN recorded it with reservations: he did find males on one occasion but could not find the species again. As the site

where he located it is in the drainage basin of the Rhine, it would not be particularly unexpected to find it.

HOFFMANN recorded *Craspedosoma rawlinsi* as two species, *Craspedosoma simile* and *C. alemannicum*, both described by VERHOEFF. This paper follows SPELDA (1991) in regarding them as subspecies at best. The gonopods are variable and it seems certain that we are looking at speciation in progress.

One species new to Luxemburg has been recorded. Seven adults of *Orthochordeumella pallida* were found at Weicherdange in the North.

Thus, in the light of present taxonomy, the list of species recorded in the Grand Duchy still stands at 36, though it will no doubt be added to in the future.

REGIONAL VARIATION IN SPECIES DISTRIBUTION

The northern part of the Grand Duchy is known as the Oesling, a dissected palaeozoic massif of Devonian age continuous with the Ardenne in Belgium and across the valley of the River Our which forms the frontier, with the Eifel in Germany. The plateau rises to about 550m above sea level, and the valleys are quite deep. The parent rocks are chiefly metamorphic schists and the soils tend to be mull-moder or moder brown earths, much of this area remaining forested. There are some small patches of limestone in this region.

The larger southern part of the country is called the Gutland and geologically belongs to the Secondary period. Lower-lying rocks shelve down to the Lorraine Plateau; these are Bunter sandstones, Muschelkalk, Keuper sandstones and Keuper marls of the Triassic, and Liassic sands and clays of the Jurassic period. While the Oesling tends to have oligotrophic acidic soils, the Gutland has rather warmer sands and extensive calcareous soils forming mulls in forests. But much of this land is cultivated and there are vines in the valley of the Moselle.

In the light of these observations, regional variations in species distributions are to be expected. Table 2 shows species that were found to be present in some stations in four different zones. The stations were sampled continuously from the end of the winter until the autumn by means of barber traps, which were emptied regularly, roughly every three weeks. Species lists for all the stations are likely to be incomplete at present, since only the one method of collecting was employed.

Most julids are liable to fall into pitfall traps, however, and relatively very few did so in the Oesling, which was dominated by polydesmids and glomerids in the traps, but which contains large populations of chordeumatids, active in the winter when the traps were not operational. Several species caught in the South were not caught in the Oesling; these include *Cylindroiulus caeruleocinctus, C. punctatus, Ommatoiulus sabulosus, O. rutilans, Melogona gallica* and *Polydesmus testaceus*. They are less common and some of them may be absent from the North, especially *O. rutilans*, which is at its northern limit in Luxembourg, although it penetrates the Ardenne massif in Belgium along the valley of the Meuse. The Gutland traps caught mainly julids which attained maximum numbers in the meso-xerothermic calcareous grasslands of the Keuper Marl.

Table 3 shows the numbers of julids caught in 22 of the sites where Barber traps were set from March/April until October. The numbers as they stand are not reliable for all quantitative calculations because the number of operational traps was not always the same on each site, some of the traps were damaged and specimens either lost or not caught, and the captures are from different years. They do nevertheless indicate some important qualitative trends and relative numbers of species on any one site, as pitfall trapping studies use to do (see GEOFFROY & CÉLÉRIER, this volume). The first 15 sites were sampled simultaneously by placing a series of traps from 4 metres on one side of a hedge to 4 metres on the other side. Thus there were four traps, one metre apart, at right angles to the hedge in the fields on either side, and there were

another four traps in the hedge itself. The traps in the hedge caught most of the millipedes. The last seven sites in Table 3 were more or less open calcareous grassland.

The results of the trapping lend further support to the view that the larger and longer-lived iteroparous species such as the julids shown in Table 3 are abundant in open habitats, see e.g. DUNGER & STEINMETZGER (1981), KIME (1992).

The open Keuper sites were dry in the summertime and a lot of large julids were caught in them. O'NEILL (1969) subjected seven species of millipede to desiccation and found that they differed significantly in their resistance to this stress; he attributed this to two factors, size and cuticular structure. He concluded from observations in the forests of Illinois that tolerant species are more numerous because of increased ability to disperse to new locations during unfavourable periods. These tolerant species were the larger : the numerous larger julids in Luxembourg, some of which are known to be thermophilous in summer, might well exemplify his argument.

TABLE 2. — Millipedes recorded in Barber traps in different regions of the Grand Duchy of Luxemburg. Cc = *Cylindroiulus caeruleocinctus*; Tn = *Tachypodoiulus niger*; Os = *Ommatoiulus sabulosus*; Or = *Ommatoiulus rutilans*; An = *Allajulus nitidus*; Js = *Julus scandinavius*; Cp= *Cylindroiulus punctatus*; Bp = *Brachyiulus pusillus*; Ls, Lsg = *Leptoiulus simplex glacialis*; Ap = *Archiboreoiulus pallidus*; Mg = *Melogona gallica*; Op = *Orthochordeumella pallida*; Cs = *Chordeuma silvestre*; Csp = *Craspedosoma* sp.; Gm = *Glomeris marginata*; Gh = *Glomeris hexasticha intermedia*; Pa = *Polydesmus angustus*; Pt = *Polydesmus testaceus*; Pd = *Polydesmus denticulatus*; Pi = *Polydesmus inconstans*; Bs = *Brachydesmus superus*.

SITE	MILLIPEDES RECORDED																				
	Cc	Tn	Os	Or	An	Js	Cp	Bp	Lsg	Ap	Mg	Op	Cs	Csp	Gm	Gh	Pa	Pt	Pd	Pi	Bs
OESLING:																					
DEVONIAN																					
Bauschelterbierg						+									+		+		+		+
Beim Weier															+	+	+		+		+
Wanterheck																+	+		+		
Hartschlaegden		+												+			+				
Gresbourg		+								+				+	+	+					
Weicherdange												+		+	+	+	+		+		
Sauerwisen																	+		+		
GUTLAND:																					
LIAS																					
Happfeldchen	+	+			+												+	+	+		
Hanner Weller	+	+			+												+				
Eiselsbierg	+	+													+						
Aucheler	+	+			+						+				+			+	+		+
Ehlerange						+		+													
Schuller	+				+																
Mondercange																		+			
GUTLAND:																					
MUSCHELKALK																					
Rampelsbierg	+	+					+			+	+				+				+		+
Froumbierg		+	+				+		+		+							+	+		+
Tueschaker	+	+			+						+				+		+	+	+		+
Haerebierg		+													+						
GUTLAND:																					
KEUPER																					
Rennpad	+	+	+			+															
Doulen	+	+	+	+		+					+							+			
Groebierg	+	+	+								+				+			+	+		
Sonnebierg	+	+	+		+	+					+		+		+	+		+	+		+
Aarnest	+	+	+		+	+					+				+			+		+	
Hunsdorf	+	+			+	+					+				+	+	+		+		
Kleibierg		+	+		+	+					+				+	+	+	+	+		+
Dennebierg	+	+	+	+	+	+												+			

TABLE 3. — Numbers of julids caught in pitfall traps. Species as in table 2; TOT = total number of julids per site. For species, see Table 2.

	Year	Soil type	Habitat Site description	Numbers of julids								
				Cc	Tn	Ls	Os	Or	An	Js	Cp	TOT
DEVONIAN												
Surre, Beim Weier	1989	Loam on schist	Hedge in grassland	-	-	-	-	-	-	-	-	0
Surre, Wanterheck	1989	Loam on schist	Hedge in grassland	-	-	-	-	-	-	-	-	0
Bavigne 1	1989	Loam on schist	Hedge in grassland	-	3	-	-	-	-	-	-	3
Bavigne, Gresler	1989	Loam on schist	Hedge in grassland	-	4	-	-	-	-	-	-	4
LIAS												
Clemency 1	1989	Clay	Hedge in grassland	1	27	-	-	-	1	-	-	29
Garnich	1989	Clay	Grass/hedge/arable	2	1	-	-	-	3	-	-	6
Kahler	1989	Clay	Hedge in grassland	1	6	-	-	-	-	-	-	7
Clemency 2	1989	Calcareous clay	Hedge in arable land	2	181	-	-	-	4	-	-	187
Boursdorf	1989	Calcareous loam	Grass/hedge/arable	14	240	-	-	-	-	-	1	255
Machtum	1989	Calcareous loam	Hedge in arable land	-	70	1	1	-	-	-	1	73
Oberdonven	1989	Calcareous loam	Hedge in grassland	4	123	-	-	-	2	-	-	129
Gostingen	1989	Calcareous loam	Hedge in arable land	-	34	-	-	-	-	-	-	34
KEUPER												
Junglinster, Rennpad	1989	Heavy clay	Hedge in grassland	22	1	-	2	-	-	5	-	30
Junglinster, Doulen	1989	Calc. colluvium	Hedge in grassland	168	189	-	6	1	-	2	-	366
Junglinster, Groebierg	1989	Leached loam	Hedge in grassland	30	110	-	3	-	-	-	-	143
Bech, Geyersknapp	1989	Calcareous clay	Grassland with juniper	102	8	-	2	156	-	18	-	286
Junglinster, Weimericht	1989	Calcareous clay	Grassland with bushes	133	144	-	155	87	2	4	-	525
Godbrange, Schleidelbierg	1989	Calcareous clay	Grassland	194	-	-	138	82	-	28	-	442
Altlinster, Dennebierg	1990	Calcareous clay	Grassland	315	1	-	99	13	6	59	-	493
Reckange, Billknapp	1990	Calcareous clay	Pasture & set-aside	299	18	-	18	-	-	9	-	344
Walferdange, Sonnebierg	1990	Calcareous clay	Grassland	278	116	-	11	-	37	45	-	487
Oberanven, Aarnescht	1991	Calcareous clay	Grassland/few pines	234	7		130	-	19	24	-	414

CRAWFORD (1979) noted that millipedes that live in deserts are usually large giving them more resistance to loss of water. Furthermore, REMMERT (1981) studied body size of terrestrial arthropods in relation to the abiotic parameters of their milieu, and concluded that for spiders and winged insects at least, the average body size, and the numbers of animals were governed by the relative humidity of the biotope.

The results from Luxemburg may reinforce these views strongly by statistically demonstrating the same phenomenon in Diplopoda. With regard to particular species and the environmental factors temperature and relative humidity, there is also accordance between these results in Luxemburg and the detailed works of PERTTUNEN (1953), BARLOW (1957), HAACKER (1968) and PEDROLI-CHRISTEN (1977, 1993) for *Julus scandinavius*, *Ommatoiulus*

sabulosus, *O. rutilans* and *Tachypodoiulus niger* in particular, which feature considerably in this study. Equally indicative is the absence, or near absence, of other species for which the parameters have been studied and which require more humid or stable environments to be found in closed forests. The most abundant millipede in the traps, *Cylindroiulus caeruleocinctus*, is described as hygrophile by HAACKER. Yet in Belgium, Luxemburg and Switzerland quantitative results indicate that it is largely found in open habitats, with peak numbers occurring in the spring. According to HAACKER, it may burrow in dry weather: a smaller peak is reported by PEDROLI-CHRISTEN in the autumn. HAACKER and later BLOWER (1985) have also correlated the presence of *C. caeruleocinctus* with a high pH value: the Luxemburg figures support this too. However, *C. caeruleocinctus* occurs in open woods on acidic sandstone soils in S. E.England, where the rainfall is relatively low, and where there are very few chordeumatids, and so it is possible that this reflects its tolerance of dry environments, and that its abundance on calcareous soils does the same. The same is true of *Allajulus nitidus*, which is common on calcic mulls, yet occurs on sandstone. It is considered to be hygrophile too (HAACKER, 1968), and burrows during the summer as well (GEOFFROY, 1981). The largest Western European julid, *Cylindroiulus londinensis*, not found in Luxemburg, is another case in point.

The dominance of julids in periodically dry environments may be due to their resistance to desiccation and/or their ability to burrow. The humid forests tend to be dominated by rapid-breeding semelparous species, reflecting their potential mathematical advantage in favourable conditions.

PHENOLOGY

Since the traps were set from March or April until October, and caught mainly adults, the numbers of chordeumatids recorded were disproportionately small. Adult *Orthochordeumella pallida* were trapped at Weicherdange between the middle of March and the beginning of May, 1989, the last one obtained was in a trap set on April 13. They occurred again in traps set from September 16 until October 6, and from October 6 until October 27, when operations ceased. At Clemency, 10 *Melogona gallica* (9 males, 1 female) were caught before April 25, 6 more males between then and May 29, and a last male between May 29 and June 19. No more were obtained before operations ceased on October 2. Results were similar in all the other sites where *M. gallica* was found. There was a remarkable preponderance of males. *Chordeuma silvestre* was also obtained in the spring on the Sonnebierg; adults of this species were captured by hand in two forests on October 17, 1982. On the same day *Craspedosoma rawlinsi/alemannicum* was similarly taken by hand in three forests. In the pitfalls traps, 26 segment specimens were caught in August, 28 segment specimens in September, and 28 segment specimens were caught by hand on October 12, 1991.

Looking at the polydesmids, adult *Polydesmus angustus* and *P. testaceus* were found in every month of trapping. *P. testaceus*, common in the South, appears to have a spring peak at least in a number of sites, but more results will be obtained and subject to analysis. *P. denticulatus* shows spring and summer activity in the Oesling, and a marked burst of summer activity in the South, where mainly wandering males were trapped during the warmest period of the year in dry calcareous grassland sites with the highest summer temperatures in the country. This was rather unexpected since *P. denticulatus* has a distinctly northern distribution in Europe and has generally been associated with sites where the water table is close to or at the surface of the soil, e.g. the polders (JEEKEL, 1978) and even in submerged sites (ZULKA, 1992). The species is described as eurytopic by several authors; it is however a fairly small polydesmid. There may be further support here for O'NEILL's observation that stressed millipedes wander, and we may be looking at migratory and/or sexual behaviour as well. In territory where there is a mosaic of wooded and non-wooded country, it is a little difficult to separate the resident species

from the wanderers by using Barber traps. This is why there will be some Berlese-Tullgren extractions made in this part of Luxemburg in the near future.

On the whole, julids and glomerids were found throughout the trapping period. There was certainly an early spring peak for the abundant *C. caeruleocinctus.*

In recent years *J. scandinavius* has been taken in a large number of pitfall traps in heathland and grassland; its numbers on the calcareous Keuper Marl are interesting: pitfall traps in calcareous woodland in Belgium have not caught it, yet it is widespread on neutral and acidic soils, both in woodland and open sites. PEDROLI-CHRISTEN (1993) reports its absence from forests on calcareous rocks in Switzerland.

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