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Faunistic investigations on the soil fauna at the Muellertal (Luxembourg): Chilopoda, Diplopoda, Isopoda, Opiliones

Abstract
The results of a faunistic survey, made in 1998 - 1999 at the Muellertal / Grand Duchy of Luxembourg by Prof. Dr. LUDWIG BECK and his collaborators are presented. The investigated sites showed a rich millipede fauna in relation to the sandy soil there.

Kurzfassung
Faunistische Untersuchungen der Bodenfauna im Müllertal (Luxemburg): Chilopoda, Diplopoda, Isopoda, Opiliones
Im vorliegenden Artikel wird über Ergebnisse einer faunistischen Untersuchung der Bodenfauna berichtet, die in den Jahren 1998 - 1999 von Prof. Dr. LUDWIG BECK und seiner Arbeitsgruppe im Müllertal in Luxemburg durchgeführt wurden. Die Untersuchung ergab eine angesichts des Sandbodens des Gebietes reiche Fauna der genannten Gruppen.

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Key words
Faunistics, Chilopoda, Diplopoda, Isopoda, Opiliones, Muellertal / Luxemburg

1. Introduction

During the last few years the National Museum of Natural History in Luxembourg under the direction of MARC MEYER has carried out an intensive survey of the fauna of the natural reserve "Muellertal" southwest of Echternach. For this reason the soil zoological working group of the National Museum of Natural History in Karlsruhe under the leadership of Prof. Dr. LUDWIG BECK was invited to study several groups of the soil fauna. Three excursions have been made to obtain soil samples. The author of the present paper took part in two of these investigations and used the opportunity to collect additional samples by hand. The faunistic results on centipedes, millipedes, woodlice and harvestmen are presented in this paper.

2. Materials and Methods

The Muellertal is a mountainous area that consists of sandstone rocks of the Lower Jurassic (Lias). Three different sites in the Muellertal were visited during each excursion (tab. 1). At a fourth site (LXMP) only the author of the present paper made a collection and no abiotic parameters were measured. There is a gradient in moisture from LXP (dry) over LXM to LXS (wet). The two excursions, in which the author participated, took place on 21.10.1998 and 20.10.1999. At two sites (LXM, LXP) soil samples and handsorting were both carried out. At each site the author made manual collections lasting approximately one hour. At the site LXM the author sampled as well a spruce forest (Picea abies-monoculture), which was disregarded by the regular sampling.
The numbers of individuals are given in the scheme males/females or males/females/juveniles or males/females/juvenile males/juvenile females. If no dash is given (*Cryptops parisi*) the sex has not been determined (tab. 2).

3. Results

A total of 11 species of centipedes, 12 species of millipedes, 8 species of woodlice and 2 species of harvestmen were caught at the three investigated sites (tab. 4).
The centipede community is typical for mountainous sites. This is shown by the dominance of *Lithobius macilentus* and in comparision the rarity of *L. mutabilis*. The ratio of these two species characterises a chilopod community as either mountainous (*L. macilentus* dominant) or continental (*L. mutabilis* dominant, SPELDA 1999a, 1999b). FRÜND (1991) derives the difference in dominance from differences in precipitation. Another species playing an important role in the centipede community was *Cryptops parisi*. The presence of this species instead of *C. hortensis* shows that there are cooler conditions, although, as well as *L. dentatus,* this species avoids very cold areas (SPELDA 1999a). The geophilids show a characteristic species-spectrum of cooler woodland sites too.
The millipede community consists of members of all four large millipede orders. It is dominated by julids. The species spectrum suggests a richer soil, as demonstrated by the presence of *Polydesmus angustus* instead of *P. denticulatus* and the dominance of *Tachypodoiulus niger* instead of *Julus scandinavius*. As well julids are less important on very poor sites (SPELDA 1999c).
The occurrence of several Western European species (*Cylindroiulus punctatus*, *Melogona gallica*) shows that the sites are influenced by Atlantic conditions.
The occurrence of *Leptoiulus simplex* is remarkable.

Table 1. Description of the four investigated sites.

abbreviation	LXM	LXMP	LXP	LXS
location	Muellertal, Mardelle, 3 km SW Berdorf, 7 km WNW Echternach	Muellertal, Mardelle, 3 km SW Berdorf, 7 km WNW Echternach	Muellertal, Predigtstuhl, 1 km SW Berdorf, 6 km WNW Echternach	Muellertal, „Schluchtwald", 3 km SW Berdorf 7 km WNW Echternach
co-ordinates	06°19' E 49°48' N	06°19' E 49°48' N	06°19' E 49°48' N	06°19' E 49°48' N
exposition	< 5°		NNW / 5-30°	W / 20-40°
floristic associations	Galio-Fagetum	Piceetum	Luzulo-Fagetum	Galio-Fagetum
soil type	sandy, somewhat loamy		sandy	sandy, somewhat loamy
humus type	mull-moder to moder		moder	mull-moder to moder
pH litter ($CaCl_2$)	4,2 (3,6-4,0)		3,6 (2,9-4,7)	5,3 (5,1-5,7)
pH upper soil ($CaCl_2$)	3,6 (3,3-4,0)		2,9 (2,8-3,2)	4,7 (3,8-5,5)

This mountainous Pleistocene relict reaches its northwestern border in Belgium (Ardennes) and Luxembourg. It has already been recorded for Luxembourg by Remy & Hoffmann (1959) and Kime (1994).
Orthochordeumella pallida is sometimes said to be an Atlantic species too. More recent faunistic investigations have shown that this species occurs as well, in a very localised way, in Central Europe (Fründ & Ruszowski 1989, Spelda 1999a). The explanation for this strange distribution might be the competition with *Mycogona germanica*, which is very common in Central Europe but mostly missing from areas where *Orthochordeumella* species occur. It might be possible that *O. pallida* was widely distributed in Central Europe once in the past but has been replaced in most areas. Only on very few sites have relict populations survived until present time. In this respect the absence of *M. germanica* in the samples is remarkable, although the species has been recorded from Luxembourg, even near Echternach (Remy & Hoffmann 1959).
The woodlice show a species spectrum characteristic of regular woodlands. The dominance of *Oniscus asellus* at the Predigtstuhl suggests somewhat disturbed conditions. With *Porcellio monticola* an Atlantic element is present in the woodlouse community.
The fauna of harvestmen was surprisingly poor. Only the species *Lophopilio palpinalis* and *Oligolophus tridens* have been found, each as a single specimen each in 1998 at the site LXM. Although these two species are among the most common litter-dwelling opilionids, *Nemastoma lugubre* and *Paranemastoma quadripunctatum* might have been expected too. At the other sites and in the captures of 1999 no harvestmen were found.
The site LXM was distinctly richer in both chilopod and diplopod species (tab. 4). The sites LXP and LXS showed similar species numbers and composition. This is not too surprising, as both are neighbouring slopes. In contrast LXM contains more different level parts (tab. 1).
Both excursions have been made during the second half of October at nearly the same date. As well the climatic conditions were more or less comparable. This gives the opportunity to check if a single sample is representative for the composition of the community. Differences in the captures might result from either community changes or stochastic effects. Differences in low numbers might be mostly the result of the latter. If the sampling is insufficient there will be a species change between two collections.
If all the data of one year is pooled (except for LXMP, wich has only been collected in one year) the species numbers of both years deviate only slightly from each other (tab. 4). In the diplopods even the total number of specimens seems to be nearly the same. Both *Glomeris* species and *Tachypodoiulus niger* occurred in both years on all sites. *Allaiulus nitidus* was only missing at LXMP. In 1998 the julids *T. niger* and *A. nitidus*, in 1999 the chordeumatids *Craspedosoma rawlinsii* and *Chordeuma sylvestre* have been collected in distinctly higher numbers (tab. 3). This change in abundance might be interpreted as the result of cooler conditions in 1999.
The centipede numbers of the different years cannot be compared which each other in the same way, because many specimen in the samples of the year 1998 had unfortunately been broken, making the lithobiids undeterminable. Nevertheless its is obvious that *C. parisi* was more common in 1998.
Beside these changes in abundance there is a high correspondence between the collections of both years. If a species occurred in one year at numbers higher than seven (a critical number in statistics, see Spelda 1996) it has normally been found in the other year too. The only exception might be *Oniscus asellus* at the site LXM. But as *O. asellus* tends to aggregate, this should not be rated too high. In both years *O. asellus* was a dominant woodlouse at the site LXP.

Table 2. Number of centipedes, millipedes, woodlice and harvestmen found at the Muellertal at the different sites in two different years.

Site	LXM	LXMP	LXM	LXP	LXP	LXS	LXS
Date	1998	1998	1999	1998	1999	1998	1999
Chilopoda							
Lithobiidae							
Lithobius aeruginosus	.	0/0/0/1	1/0	0/1	0/1	.	.
Lithobius crassipes	.	1/1	.	.	.	.	0/2
Lithobius dentatus	.	0/1	0/5	0/1	2/5	.	2/0
Lithobius macilentus	0/1	.	2/3/2/0	.	1/0/1/0	.	.
Lithobius mutabilis	.	.	1/0	.	.	.	.
Lithobius piceus	.	.	.	.	.	.	0/1
Lithobius tricuspis	2/0	.	1/1	0/3	2/0	.	1/0
Cryptopidae							
Cryptops parisi	5	.	2	3	6	3	.
Geophilidae							
Geophilus alpinus	0/0/0/1	.	.	.	1/2	.	.
Strigamia acuminata	0/1		0/1				
Strigamia crassipes	.	1/0	.	.	.	.	
Diplopoda							
Glomeridae							
Glomeris intermedia	4/12	1/1	2/7	2/1	0/1	0/2	1/4
Glomeris marginata	1/6/0/1	0/1	2/4 2/2/1	3/5	2/3/2/0	1/8	.
Julidae							
Julus scandinavius	0/2	.	1/1	.	.	.	.
Leptoiulus simplex	0/1		0/1	1/0	1/2	0/4	2/1
Allajulus nitidus	4/8/0/4	4/4	10/6/0/1	0/3/1/0	1/6/0/3	3/1	.
Cylindroiulus punctatus	.	0/1	1/0	.	1/2/1/0	.	0/2/1/0
Tachypodoiulus niger	1/4/3/0	4/8/2/0	3/4/1/2	3/13/9/1	2/5/1/0	1/3 0/2	.
Craspedosomatidae							
Craspedosoma rawlinsii alemannicum	1/1	2/1	7/2	.	1/4/1	1/0	.
Chordeumatidae							
Chordeuma sylvestre	1/1	.	4/8/2	1/3	0/2/1	0/1	.
Melogona gallica	1/0/0/1	.	.	.	.	.	.
Orthochordeumella pallida	0/1	.	.	.	.	.	.
Polydesmidae							
Polydesmus angustus	0/1	0/1	2/0	.	1/1	0/1	1/1
Isopoda							
Ligiidae							
Ligidium hypnorum	.	.	.	.	0/2	0/1	.
Trichoniscidae							
Trichoniscus pusillus	0/1	.	.	.	0/2	.	.
Oniscidae							
Oniscus asellus	.	1/2	4/7	3/3/1/0	3/3 1/1	1/0	.
Philoscia sp.	.	.	0/1	.	.	.	.
Porcellionidae							
Porcellio monticola	.	1/0	.	.	.	.	.
Porcellium conspersum	0/1	.	.	.	.	.	.

Table 3. Sum of centipedes, millipedes and woodlice found at the Muellertal in the different years (sites LXM, LXP, LXS pooled) and the different sites (both years pooled). Only species with at least seven collected specimens are treated.

date / site	1998	1999	LXM	LXMP	LXP	LXS
Chilopoda						
Lithobius dentatus	2	14	5	1	8	2
Lithobius macilentus	1	9	8	0	2	0
Lithobius tricuspis	5	5	4	0	5	1
Cryptops parisi	11	7	7	0	9	3
Diplopoda						
Glomeris intermedia	21	15	25	2	4	7
Glomeris marginata	20	23	14	1	13	16
Leptoiulus simplex	6	7	2	0	4	7
Allajulus nitidus	43	12	24	0	21	14
Cylindroiulus punctatus	0	8	1	1	4	3
Tachypodoiulus niger	38	20	18	14	34	6
Craspedosoma rawlinsii alemannicum	3	15	11	3	6	1
Chordeuma sylvestre	7	17	16	0	7	1
Polydesmus angustus	3	6	3	1	2	3
Isopoda						
Oniscus asellus	9	18	11	3	13	3

4. Discussion

REMY & HOFFMAN (1959) recorded 28 species of centipedes from Luxembourg, some of them remarkable thermophile or Atlantic faunistic elements not known in Germany (*Himantarium gabrielis*, *Dignathodon microcephalum*, *Gnathomerium inopinatum*). It was remarkable that nevertheless two species (*Lithobius aeruginosus*, *L. mutabilis*) have been recorded additionally. *L. aeruginosus* occurs in Germany and the southern part of the Netherlands (BERG 1995). For that reason its occurrence is not surprising. *L. mutabilis* is a continental species that does not occur in western Europe (compare BRÖLEMANN 1930, EASON 1964, BERG 1995). It probably reaches its western border at Luxembourg. *Geophilus alpinus*, formerly known as *G. insculptus* (SPELDA 1999a) has been confused with *G. proximus* in earlier times. It is very probable that most of the numerous records given for *G. proximus* (REMY & HOFFMANN 1959) belong in fact to *G. alpinus*.

The Grand-Duchy of Luxembourg is famous for the occurrence of several thermophilous millipedes (*Ommatoiulus rutilans*, *Stosatea italica*) too, but these are confined to limestone areas (REMY & HOFFMANN 1959, KIME 1994, KIME 1996). REMY & HOFFMAN (1959) listed 36 species of millipedes for Luxembourg. One of them (*Craspedosoma alemannicum*) is now regarded as a subspecies of *C. rawlinsii* (SPELDA 1991). As KIME (1996) discovered *Orthochordeumella pallida* in Luxembourg, the list still stands at 36.

As the Muellertal is a mountainous woodland with sandy soil, a poorer fauna than in limestone areas is to be expected. For such an area the millipede fauna is quite rich. The reason might be that the Lias-sandstone contains a higher amount of calcium, thus having a higher pH and therefore supporting a richer soil fauna. Although the number of collected animals was low, compared with the investigations of KIME (1994, 1996) it can be assumed that the species composition has been recorded quite completely.

For the woodlice and harvestmen the lack of comparable data does not allow a more detailed analysis of the species community. Generally it is in correspondence with other investigations in western Central Europe.

Table 4. Number of species in centipedes, millipedes, woodlice and harvestmen found at the Muellertal in the different years (sites LXM, LXP, LXS pooled) and the different sites (both years pooled).

date / site	1998	1999	LXM	LXMP	LXP	LXS	total
Chilopoda	8	8	8	4	6	5	11
Diplopoda	11	10	12	6	9	9	12
Isopoda	5	4	4	3	4	3	8
Opiliones	1	0	1	1	0	0	2

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