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The diplopod taxocoenosis (Diplopoda, Myriapoda) of the forest of Ename (eastern Flanders, Belgium): species diversity and activity distribution

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Samenvatting

Het bos t' Ename in Oost-Vlaanderen (België) werd gedurende één jaar (1994-1995) intensief met bodemvallen onderzocht. De Diplopoda-taxocoenose bestaat uit in totaal 16 soorten (36 % van de Belgische fauna). Vooral de vangsten van de zeldzame soorten *Polydesmus gallicus* en *Archiboreoiulus pallidus* zijn vermeldenswaard. Voor de talrijkste soorten worden details verstrekt betreffende de activiteitsdistributies.

Abstract

The forest of Ename in eastern Flanders (Belgium) was intensively sampled for one year (1994-1995) by means of pitfall traps. In total, 16 species of Diplopoda were encountered (36 % of the Belgian fauna). Especially the captures of the rare species *Polydesmus gallicus* and *Archiboreoiulus pallidus* are worth mentioning. For the most abundant species, phenological data are added.

Résumé

La forêt d'Ename, située en Flandre orientale (Belgique), a été échantillonée intensivement pendant une année (1994-1995) à l'aide de pièges. Au total, 16 espèces de Diplopoda ont été récoltées (36 % de la faune belge). Entre eux *Polydesmus gallicus* et *Archiboreoiulus pallidus* qui sont rares en Belgique. Pour les espèces les plus abondantes, des détails phénologique sont fournis.

Key words: Diplopoda, forest, diversity, activity distribution

Introduction

The total forested area in Flanders is about 115.000 ha or approximately 8.5 % of the total area. In the province of eastern Flanders the area covered with forest decreased constantly to reach a minimum around 1929 of 9.768 ha (LUST, 1989). Afterwards a slight increase was noted to reach now about 13.000 ha which is 4.5% of the total area of this province.

The forest of Ename is situated in the south of the province of eastern Flanders, between Gent and Oudenaarde. The forested area is actually divided into two separate areas, one of 46 and one of 15 ha. It forms a characteristic forest on a relatively steep slope being the eastern edge of the valley of the river Scheldt. Around the forested areas pastures and cultivated fields are situated, interconnected with quite some important hedges and rows of trees.

The forest is situated within the sandy loam area of Flanders with quite some variety in soil types from loamy sand to clay. The history of the forest is very well studied and I refer for all details here to TACK et al. (1993).

Material and methods

The area was sampled by pitfall trapping. Pitfalls measured 9.5 cm in height with an identical diameter. They were filled with a 4% formaldehyde solution. Some detergent was added to reduce surface tension. 39 traps were active for one year and emptied at fortnightly intervals. For a detailed description of the stations sampled we refer completely to DE BAKKER (1995).

The sampling period was from 15 April 1994 till 15 April 1995. Myriapoda were manually sorted. However due to bad conservation, some samples were lost. The usable time periods are listed in Table 1.

Diplopods were mainly identified by using BLOWER (1985), DEMANGE (1981) and SCHUBART (1934). Nomenclature follows BLOWER (1985).

Results

Table 2 summarises all results. 16 diplopod species were present in the traps, out of the 45 known to occur in Belgium. This is 36 % of the Belgian fauna.
The majority of diplopod millipedes live at the interface of the soil and the litter layer on which many of them feed

Table 1. Sampling periods.

1	= 13-30.IV.1994
2	= 30.IV-14.V.1994
3	= 14-28.V.1994
4	= 28.V-12.VI.1994
5	= 26.VI- 10.VII.1994
6	= 30.X-13.XI.1994
7	= 13-27.XI.1994
8	= 27.XI-13.XII.1994
9	= 13-25.XII.1994
10	= 25.XII.1994-10.I.1995
11	= 10-21.I.1995
12	= 21.I-4.II.1995
13	= 4-18.II.1995
14	= 18.II-4.III.1995
15	= 4-18.III.1995
16	= 18.III-1.IV.1995
17	= 1-14.IV.1995

(BLOWER, 1985). Activity on soil surface level is considerable for a significant proportion of the species which are therefore easily captured by pitfall trapping. Many species however make excursions deeper into the soil when the need arises, e.g. for moulting or egg laying, or to avoid low temperatures or dryness. Soil sampling is then necessary to assess abundances (e.g. FRANKE et al., 1988).

In soil and pitfall samples, millipedes often make up a conspicious proportion of the macrofauna present. Quadrat sampling and Tullgren extraction effected in Belgium shows that diplopods alone can reach considerable densities of up to 750 individuals per square meter (KIME, 1992). Even higher densities, up to 850 ind./m^2 are recorded from other countries (e.g. BLOWER, 1985; DAVID & COURET, 1985).

It is known that several abiotic parameters influence the occurrence and distribution of millipedes in Belgium. Ecological analyses demonstrate that in general soil texture and temperature, as well as pH and hydrology (depth of water table) are determining factors (e.g. BLOWER, 1985; DAVID, 1988; KIME, 1992; KIME & WAUTHY, 1984; KIME et al., 1992). Moreover, population densities as well as species diversity are in general highest on basic soils: mesotrophic mulls and mull moders have more millipedes than calcic mulls (KIME, 1992). This is in agreement with the high species diversity (16 species) found in Ename forest. To compare: detailed sampling of 27 sites in Belgium resulted in millipede species diversity ranging from 2 to 14 (KIME, 1992). In the forest of Houthulst (western Flanders, some 65 kilometers to the west, 12 species were found after an intensive pitfall and soil sampling campaign, the former lasting several years (ALDERWEIRELDT & KIME, in press).

Considering the known distribution data (R.D. KIME, unpublished results), several species found at Ename can be considered as very common in Belgium. These

Table 2. Diplopoda (males/females) collected at Ename forest during 1994-1995. Numbers above columns refer to time periods listed in Table 1.

SPECIES	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Family Craspedosomatidae																		
Craspedosoma rawlinsii	4/5			1/0					1/1			1/1		0/1	0/1	1/0	0/1	
Family Chordeumatidae																		
Chordeuma sylvestre	30/10		1/0	1/1	1/0		6/2	2/1	5/4	3/2		1/0	1/0	3/0		3/0	2/0	1/0
Melogona gallica	43/46	3/1	5/1	4/0	1/1			0/1		2/2		1/4	2/7	4/10	6/7	6/3	6/5	3/4
Family Blaniulidae																		
Archiboreoiulus pallidus	9/3			5/1	2/0					1/0		1/1	0/1					
Family Julidae																		
Tachypodoiulus niger	226/42	11/1	68/7	7/7	16/2	9/3	9/3	4/1					3/0	38/2	3/3	17/4	30/7	11/2
Cylindroiulus caeruleocinctus	24/10	1/0	2/1	2/2	3/0	4/1			1/1				2/0	2/0	1/0	2/0	3/4	1/1
Cylindroiulus punctatus	34/18	1/1	7/1	3/4	9/1	6/1	1/0						1/0			1/1	3/6	2/3
Julus scandinavicus	87/61	12/6	6/5	11/1	11/6	4/4	1/0	1/3	6/1	1/0		4/1	2/2	10/3	2/1	1/5	10/12	5/15
Leptoiulus belgicus	19/2						8/0	2/0	5/0	1/2		1/0		2/0				
Leptoiulus kervillei	17/6	1/1	1/0	3/0	3/2	6/3									1/0	1/0	1/0	
Brachyiulus pusillus	2/8				0/2	1/3										1/2	0/1	
Family Polydesmidae																		
Polydesmus angustus	35/24	4/8	2/0		2/0	2/0	2/0	2/1		2/0		2/1	2/0	3/1	2/4	2/5	5/3	3/1
Polydesmus denticulatus	3/0		1/0		1/0	1/0												
Polydesmus inconstans	12/3			2/0	4/1	4/1	1/1			1/0								
Polydesmus gallicus	90/46	6/4	7/1	9/2	12/2	1/3	0/1	1/3	2/4	0/1		4/2	2/3	12/4	9/4	5/4	6/1	14/7
Brachydesmus superus	29/22	2/0	8/4	8/3	6/6	0/7		0/1						1/0		1/0	3/1	

species are *Craspedosoma rawlinsii, Melogona gallica, Tachypodoiulus niger, Cylindroiulus punctatus* and *Brachydesmus superus*. Most of these species are more or less eurytopic (BLOWER, 1985; HAACKER, 1968; HAUPT, 1990; KIME, 1994; PEDROLI-CHRISTEN, 1993; THIELE, 1968).

Chordeuma sylvestre is common in Belgium. Ename forest is however at the north-western edge of its distribution area. It seems to be a species of predominantly moist decidious forests with sometimes preference for calcic soils (SCHUBART, 1934).

Cylindroiulus caeruleocinctus is widespread and quite common in Belgium. The species is often very abundant in grassland areas and is also known to occur in hedges and agricultural fields where it can be responsable for economic damage (BLOWER, 1985; HAACKER, 1968; KIME, 1994; PEDROLI-CHRISTEN, 1993; SCHUBART, 1934).

Another common and widespread species in Belgium is *Julus scandinavicus*. This species is moreover very common in north-west and central Europe (KIME, 1994). It has mainly been found in forests, to a lesser extent in grasslands, heaths, sand dunes and marshes (BLOWER, 1985; KIME, 1994; PEDROLI-CHRISTEN, 1993; SCHUBART, 1934).

Leptoiulus kervillei is quite common in Belgium and an atlantic species. However, this species is absent to rare in neighbouring countries. It has never been found in The Netherlands nor Luxemburg. According to KIME (personal communication), it is strongly associated with silty soils. *Leptoiulus belgicus* is another, quite common, atlantic species occurring only in low-lying areas of Belgium (KIME, 1992).

Brachyiulus pusillus is widespread but not very common in Belgium. According to SCHUBART (1934) it is partly synantropic and associated with high humidity. In Great-Britain it is also found in grassland and arable land (BLOWER, 1985).

Of the four *Polydesmus*-species encountered at Ename forest, *P. angustus* is by far the commonest in Belgium. It prefers moist humus on well-drained substrates in forests (KIME, 1994; PEDROLI-CHRISTEN, 1993; SCHUBART, 1934), situations widely available at Ename forest. Exceptionally, it has been reported as a pest species in agricultural fields (SCHUBART, 1934). BLOWER (1985) calls it quite eurytopic because it also enters more acid situations such as pine forests and heathland areas.

Polydesmus denticulatus is widespread throughout Belgium but less common than *P. angustus*. The former species seems less dependent on moisture than the latter. It is tolerant, occurring in a wide range of habitats (KIME, 1994; PEDROLI-CHRISTEN, 1993). In Great-Britain it is mainly found in woods (BLOWER, 1985) whereas in Germany it is more confined to farmland, gardens, etc. (SCHUBART, 1934).

Also widespread but not very common in Belgium is *Polydesmus inconstans*. It seems to occur often in association with cultivation (BLOWER, 1985).

At Ename, high numbers of *Polydesmus gallicus* were encountered. This species is however uncommon in Belgium. It is known from only 11 other UTM-10x10 km squares. It has a mainly atlantic distribution and occurs in woodland as well as open country often in very damp situations, swamps, ditches, etc. (BLOWER, 1985; SCHUBART, 1934).

Faunistically interesting is also the capture of the obviously uncommon *Archiboreoiulus pallidus.* Known from only 11 other UTM-10x10 km squares it seems widespread but rare in Belgium as well as in other parts of its distribution area. It has been considered as being mainly synantropic, occurring for instance on cultivated fields and causing on occasions economic damage (BLOWER, 1985; KIME et al., 1992; SCHUBART, 1934).

Phenology patterns of diplopods are not very well known and are moreover not always easy to interpret (e.g. DONDALE et al., 1972; TISCHLER, 1958; VICKERMAN & SUNDERLAND, 1975). It is for instance not so clear what proportion of soil surface activity is caused by sexual or reproductive stimulae. Deducing life cycle patterns from pitfall data is therefore far less evident for diplopods than for several other soil surface active arthropods (e.g. spiders, carabid beetles). Anyway, analysing diplopod activity on soil level can provide useful additional information.

The activity patterns can be deduced from Table 2. Captures of the following species were in excess of eigthy individuals: *Melogona gallica, Tachypodoiulus niger, Julus scandinavicus* and *Polydesmus gallicus*. For all these species, adults of both sexes were found in almost all the studied sampling periods. In general, activity on the soil surface level tends to be very low to absent during December and January.

T. niger seems to show higher activity from late Winter till late Spring (peaks in February and first half of May). Eggs of this species are laid in Spring. The activity pattern registrated here is thus compatible with what is known of the life cycle history of this species (BLOWER & FAIRHURST, 1968; FAIRHURST, 1970, 1974).

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