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A COMPARATIVE STUDY OF THE SPIDER COMMUNITIES OF DIFFERENT WOODLAND HABITATS

Introduction

The Zoniën forest is the largest forest (± 4300 ha.) on silty soils in Belgium. The forest is of special interest because of its history : it has never been under agricultural management. This has resulted in the preservation of the original pedological characteristics which have developed on the Weichelian loess deposits (Langohr & Cuykens, 1985). The forest was however heavily exploited during the wars of the 16 th and 17 th century. During the Austrian period (18 th century) a start was made of a massive reforestation with beech. This resulted in a tradition of beechmonoculture and in the present day some 80% of the forest is made up of beech stands.

Because of water percolation the originally calcareous loess deposit was leached out upto a depth of 2 to 3 m. Probably due to periglacial outdrying, the soil is compacted betweed approximately 30 and 120 cm of depth (Fragipan)(Van Vliet & Langohr, 1981). Under the present-day climatic conditions this layer does not form a barrier for water percolation but, with the exception of a polygonal pattern of fissures existing in it, is impenetrable for root growth. Another problem for the older beech stands is compaction of the surface soil due to their accessibility for horse riding and heavy forest exploitation machines (De Meyer & Langohr, 1984). Both the subsurface and surface compaction are the main causes of important windthrow of older beeches. Liming has been tried out as an attempt to treat the surface compaction.

It is within the context of these problems that we have started an investigation of the soil fauna. We discuss hereafter some preliminary results concerning the variation of the spider communities.

Material and Method

Sampling was done by means of pit falltraps. Six stands (A, B, C, D, E, F) were sampled during a first year cycle (May 1985, May 1986). During the next year A and F were sampled for a second time together with six other stations (G, H, I, J, K, L). In each station 7 glass yars (diameter : 9.5 cm., depth : 10 cm.) half filled with a 4% formaldehyd solution (with some detergent) were used as traps. They were emptied at forthnightly intervals. The vegetation and the litter of each of these stations is briefly characterized in table 1. Table 2 lists the median values of seven measurements for (1) the depth at which periglacial soil compaction (Fragipan) occurs and (2) the depths at which upper soil compaction begins and ends. Also given is the degree of soil compaction for these seven observations.

Table I. : Vegetation characteristics of the different sampled stands

Stands :	A	B	C	D	E	F	G	H	I	J	K	L
* Tree and shrub cover :	70%	40%	80%	100%	50%	100%	50%	100%	50%	100%	50%	50%
* Field cover :	30%	60%	5%	0%	30%	0%	50%	0%	100%	0%	20%	70%
Hyacinthoides sp.	25%											
Sorbus sprouts	5%											
Ferns		60%					20%		5%		15%	20%
Rubus sp.			3%		5%		15%		5%		5%	
Grasses					20%		5%		55%			15%
Juncus, Carex, Luzula									15%			
Urtica dioica									10%			15%
Other herbs					5%		5%		10%			
* Leaf litter composition :												
Beech		30%	30%	100%	100%	5%	100%	100%	100%	15%	100%	100%
Oak	45%	60%	60%			65%				50%		
Hornbeam	10%					20%				30%		
Birch	35%	5%	5%									

Table 2 : Morphology of the soil in the sampled stands :
Depth of surface compaction and Fragipan horizon (in cm.)

Stand	Surface compaction: Median upper limit	Median lower limit	Compaction None	Weak	Strong	Subsurface compaction Fragipan depth
A	-	-	7	0	0	58
B	6	10	0	7	0	48
C	4.5	28	0	0	7	32
D	6.5	29	0	1	6	38
E	0	30.5	0	1	6	33
F	-	-	7	0	0	32
G	6	16	0	0	7	25
H	6	11	1	5	1	50
I	6	19	0	0	7	27
J	-	-	7	0	0	40
K	6	11	0	6	1	25
L	7	17	0	3	4	31

Results and discussion

On the whole 140 species of spiders were caught. The faunistics of some of them was briefly discussed in Segers & Maelfait (in press.). In the present study we confine ourselves to a synecological analysis of the most abundant species, i.e. species caught in a number higher than the total number of traps used. (> 98). Based on the procentual abundance of each species over the fourteen sampling units, a detrended correspondance analysis (Hill, 1979) was performed. In table 3 we listed these species and the sampling units according to their scores obtained along the first axis of this analysis. Also mentioned are the procentual abundance of each species per sampling station (/year), the value of Levins' measure for habitat width (Levins, 1968), and the sum of the procentual abundancies per station.

We can discern three groups of species. A first group of species is formed by the species predominantly occuring in A (and B). A second group consists of species with no clear preference for one of some of the sampling units.

Most of these were also observed in large numbers during an investigation of a german beech wood by Dumpert & Platen (1985). The third group comprises species showing a preference for the stations at the other end of the variation axis, G and I.

A is an old stand of oak with a deep soil and without soil compaction. It has a rich spider fauna with a large relative abundance of some small Linyphiid spiders (group 1). For Monocephalus fuscipes it is known that it is bound to forests with fastly decomposing litter (mull humus) (Baert, 1981). The more direct reason for that habitat binding is presumably that these spiders feed on springtails, which only occur in large numbers in good decomposing litter.

Station G and I are old open stands of beech. Due to forest exploitation their soils have a pronounced surface compaction. Station I has been limed some 30 years ago. Although also quite rich the soil spider fauna of both these stands is very differently structured than that of A. The typical spiders (group 3) are well represented in the open stands of beech with a well developed herb vegetation : G, I, L and E. They are almost absent in the catches of station K which only differs from L by the absence of that herb layer. Both K and L are old stands with a heavy compaction of the upper soil due to horse riding. L has been limed some 15 years ago. A spider community (a soil fauna) associated with a better litter breakdown like we find in A has not resulted from that treatment. Poor spider communities are also found in the other monocultures of beech without any herb layer : D and H. The difference between D and C is interesting. Both are young plantations of former old beech stands with severe soil compaction (which is in both still present). In C however we have a richer spider taxocoenosis with a relatively large abundance of the species associated with a good litter breakdown. In spite of the litter composition and the absence of soil compaction we find in J and F poor spider communities and indeed also litter accumulation (mor humus conditions). The reason for this unexpected poverty in not yet clear. Both are however very closed stands with few light and rain penetrating to the litter layer.

Conclusion

As a whole, the above cited results suggest that soil faunas associated with a good litter breakdown are only present under open, mixed stands. Liming does not seem to bring about such a fauna. This is therefore not a good solution to treat the compacted soils of the Zoniën forest. Establishment of mixed and not too dense stands is probably a better treatment. The presence of a larger quantity of dead wood might also help and that by its amelioration of the nitrogen fixation (Pritchett & Fisher, 1987).

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Table 3 : Procentual abundancy of the frequently caught species in the different sampled forest stands with indication of the sampling year (85'-86 : 1, 86-87 : 2)

stand : species:	A1	A2	B1	C1	E1	F1	F2	J2	D1	K2	H2	L2	G2	I2	habitat width (Levins) (* : Values under median)
Monocephalus fuscipes	42.6	36.4	10.0	2.5	3.8	1.3			0.8	1.3			0.4	0.8	*0.173
Tapinocyba insecta	30.2	27.8	22.7	0.8	12.7	0.8	0.4						3.2	1.2	*0.209
Lepthyphantes flavipes	24.8	18.6	14.6	26.5	3.5	3.7	2.5	1.0	3.5	0.2		0.2	0.5	0.2	*0.329
Walckenaeria cucullata	14.2	12.9	12.3	2.6	21.4	24.6	7.1		0.6	0.6		1.3	1.3	0.6	*0.370
Diplocephalus picinus	19.4	29.0	7.1	2.8	1.7	4.2	5.3	7.8	0.7	0.3	2.7	2.9	7.7	8.3	0.541
Pirata hygrophilus	0.9	1.9			61.6	13.0	21.0		1.9						*0.126
Coelotes inermis	10.9	11.0	8.9	4.3	12.2	12.7	15.9	6.6	3.2		4.7		6.8	2.5	0.674
Diplocephalus latifrons	28.4	26.9	3.2	1.5	8.0			0.2	1.2	0.5	0.2	2.0	12.4	15.2	*0.347
Saaristoa abnormis	7.2	8.0	16.8	10.4	0.8	11.2	6.4	12.0	4.8		7.2	1.6	8.0	5.6	0.690
Walckenaeria acuminata	12.7	7.8	12.7	1.8	5.0	15.0	9.6	3.2	1.4	0.5	6.4	1.8	13.6	8.2	0.637
Macrargus rufus	2.7	6.8	5.6	0.8	8.9	8.3	16.9	10.0	3.6	8.2	11.2	6.2	4.9	5.7	0.869
Coelotes terrestris	5.7	3.8	4.5	3.4	11.3	8.9	9.4	5.7	4.0	17.0	4.6	13.4	4.5	3.7	0.742
Centromerus aequalis		5.0	7.9	4.5	11.8	9.9	9.9	5.0	11.8	2.0	11.8	2.0	13.3	5.0	0.720
Lepthyphantes zimmermani	11.2	2.9	6.5	6.0	2.4	5.9	5.2	3.5	10.4	12.7	4.5	10.8	10.1	7.5	0.850
Walckenaeria corniculans	10.1	3.4	2.5	2.7	11.2	6.7	4.3	5.4	3.4	1.6	27.1	2.9	10.1	8.5	0.567
Histopona torpida	1.7	0.5	4.0	7.0	6.3	12.3	8.0	2.5	4.9	8.1	16.8	10.8	14.5	2.3	0.718
Micrargus herbigradus	2.3	0.5	15.9	6.9	4.1	11.4	5.6	5.3	0.3	1.0	3.6		17.7	25.3	0.505
Centromerus sylvaticus	3.6	10.3	6.7	1.5	2.9	2.0	3.1	3.1	2.6	2.9	11.4	14.3	8.9	26.4	0.515
Microneta viaria	1.5	1.4	4.1	3.2	7.8	6.9	7.4	6.2	3.2	9.0	8.0	2.9	18.8	19.5	0.644
Walckenaeria atrotibialis	2.7	1.8	0.9	1.8	9.8	3.6	0.9		1.8		7.1	0.9	45.5	23.2	*0.251
Linyphia clathrata		3.6	0.6	0.6	5.4	1.8	5.4	0.6		4.2	7.2	16.8	29.5	24.0	*0.376
Trochosa terricola	0.7	1.4	2.2	1.4	9.4	1.4	2.2	1.4	3.6	5.0	5.0	11.5	9.4	45.3	*0.317
Pardosa lugubris		3.8	1.8	0.9	4.7		1.8	0.4	2.5	1.6	1.6	3.4	14.0	63.3	*0.174
Diplostyla concolor	0.7	1.1	1.1	1.8	0.4	0.7				0.7	1.8	0.7	47.8	43.3	*0.196
Pachygnatha listeri				2.3	0.8			0.8		0.8	0.8	2.3	12.7	79.6	*0.128
Total :	234	226	172	98	228	166	148	90	70	78	144	108	316	425	

<u>Jocqué:</u> Can you explain why Pirata hygrophilus is very common in a few stands whereas it was virtually absent in most others. Could the presence of open spaces in some of these stands provide an explanation?
<u>Segers:</u> So far, we cannot explain this phenomenon with certainty. We suppose that the presence of flacks of water could be the explanation, but these also occur where P. hygrophilus is rare. The stands where it is commen indeed have open spaces, but other stands with open spaces are poor in P. hygrophilus.