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Notes on the spatial distribution of some spider species (Araneae) in a north Norwegian birch forest

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In June-August 1968 quantitative samples were taken on the ground in the relatively dark Loc.I and the more open Loc.II, in the moss cover from the upper green third (level A) and from the lower two thirds (level B), at Loc.I also in pure leaf litter. For some spider species spatial segregation (vertically and horizontally) is discussed. The A-layer at Loc.I was dominated by the fairly large Hilaira herniosa (33.1 %) and the medium sized Centromerus arcanus (10.3 %), the small sized Tapinocyba pallens was scarce (3.7 %). In total differences were less clear (17.3-22.1 %). T.pallens dominated (43.6 %) in the litter samples, the other two were more scarce. T.pallens was scarce at Loc.II (in total 1.1 %). Here the light coloured Diplocentria rectangulata dominated at the B-level (34.4 %), and the dark pigmented Minyriolus pusillus dominated at the A-level (21.5 %). The former was not found at Loc. I, the latter was scarce (totally absent from the litter samples). A small sweep net material from the two field layers indicates some faunal differences compared to the moss and litter.

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INTRODUCTION

Vertical and horizontal distribution of spiders have been demonstrated and discussed by several workers (Christophe & Blandin 1977, Toft 1979, Rapp 1980, Irmler & Heydemann 1988, Maelfait et al.1990, Leclerc & Blandin 1990). Segregation of spider species in sub-habitats may increase the species diversity in a given area and prevent competition (Duffey 1966; Schaefer 1972, 1974, 1980; Scheidler 1989, 1990).

The vertical distribution of spiders within the ground layer in some Finnish forests was discussed by Huhta (1971) who showed clear differences in the microdistribution for some linyphiid species. He also demonstrated a clumped horizontal distribution pattern for one of the abundants linyphiids, *Tapinocyba pallens*, related to the microclimatic conditions close to the ground. Based on material from a north Norwegian birch forest, these aspects will be further accounted for here.

In a previous study (Hauge 1977), a report on ground-living spiders collected during the summers of 1967 and 1968 in two localities in northern Norway was given. The sampling procedure during the second summer differed from that of the preseeding year, allowing some insight into the microdistribution of some of the species. This spatial aspect was not discussed in Hauge (1977), and the results are presented below.

THE SAMPLING AREA

A brief characterization of the sampling areas is given here. For more detailed information, see Hauge (1977).

The two north faced birch forest localities are situated at approximately 200-230 m a.s.l. close to the Skjomen fjord in NE Nordland, northern Norway (68°17'N, 6°35'E). Both localities are facing to the north. Loc.I is

situated in gently sloping terrain with tall trees and a dense canopy. So, in the vegetation period (from about mid-summer) the ground is well protected against insolation, largely also due to a dense blanket of small ferns (*Dryopteris phaegopteris* and *D. linneana*). Underneath is a moss cover richly littered with dead leaves. Locally there are moss-free accumulations of leaf litter (especially close to the tree stems), that became densely packed during heavy rain periods, perhaps offering rather small space for small species. The more flat Loc. II is light and open, the trees are smaller and scattered, the ground rich in mosses and with a more variable field layer dominated by *Vaccinium* spp. and *Empetrum* sp. Leaf litter is scarce.

METHODS

Whilst collecting was more at random in 1967, the 1968 samples were chosen more subjectively, but lumped together in Hauge (1977, Table X). In fact, on each locality square samples were taken in the moss cover (June-August 1968) as follows: The upper green third was removed with a pair of scissors and held apart from the lower, less green two thirds. Both parts were hand-sorted. At Loc.I additional samples were taken in pure leaf litter. A small sweep net material from the two field layers, collected at mid-summer/early autumn 1967, is also available.

RESULTS AND DISCUSSION

Spiders in moss and litter

Fourty-three species are listed (Table 1). The material in Hauge (1977) denoted as *Agyneta cauta* (O.P.-Cambridge, 1902) has been reidentified according to Hippa & Oksala 1985), and here transferred to *A. olivacea* (Emerton, 1882).

The moss samples from the two localities shared only 19 species. Only two species from the leaf litter were absent from the moss samples. The *numbers* of species found at level A and B, and in litter, were rather equal (range 23-29). Most probably due to the hand-collecting procedure, the cursorial species are few. The handling of the moss cover may also be responsible for specimens escaping downwards, leading to underrepresentation in the upper layer and overrepresentation in the deeper layer.

In 1967 (May-Sept.) three well known woodland linyphiid species in Fennoscandia (Koponen 1995) dominated at Loc.I: *Tapinocyba pallens* (35.8 %), *Centromerus arcanus* (16.7 %) and *Hilaira herniosa* (8.3 %). All species were most abundant (at least the males) at both ends of the season, and the percentage of males in the populations were clearly lowest in late June/early July (Hauge 1977, Table IX). In other words: Between these three species there was (at least locally) great overlap, spatially as well as seasonally. However, as to body lengths (and to some degree also pigmentation) the three species are different: The pale *T.pallens* is small (1.5 mm), *C.arcanus* is a larger species (females 2.0 mm, males 2-2.5) and perhaps slightly more pigmented, while *H.herniosa* is largest (3.5 mm) and clearly darker. So, spatial segregation, vertically within the moss cover or in microhabitats, seemed likely, leading to another sampling procedure in 1968. Duffey (1966) compared *Lepthyphantes ericaeus, L. mengei* and *L. zimmermanni*, quoting:'.....there is an increase in body size and intensity of color pattern from *ericaeus* to *zimmermanni* which parallels the change from a dark zone with small space to a light zone with large space'. At Loc.II some other small Erigoninae were obviously replacing *T.pallens* (extremely scarce here) in 1967, indicating a large scale of horizontal segregation within the forest (Hauge 1977, Table III). Also the dominance values of *C.arcanus* and *H.herniosa* were lower at Loc.II.

Like in 1967, the same three species dominated in the moss cover at Loc.I in 1968 (Table 1). At least in the lower (and denser) part (B) and totally (A+B) their dominances were relatively equal (range 17.5-24.5 and 17.3-22.1, respectively). However, in the rather loose upper part (level A) differences were large (range 3.7-33.1 %), with dominances of the species corresponding fairly well with their body lengths and pigmentation: *H.herniosa* was most common, *T.pallens* considerably less so, with *C.arcanus* in between. In pure leaf litter, *T.pallens* was very dominating (43.6 %), while *C.arcanus* and *H.herniosa* were clearly more sparse. Here two other small species (*Diplocentria bidentata* and *Robertus scoticus*) increased their dominance values somew-

Table 1. Skjomen 1968. Dominances (%) of adult species in upper (A) and lower part (B) of moss cover (Loc. I and II), and from pure leaf litter in Loc. I (+=Dominances <2.0 %)

SPECIES	LOC. I			LOC. II			LITTER
	A	B	A + B	A	B	A + B	
Ceratinella brevipes (Westring, 1851)	2.9	+	+				+
C. brevis (Wider, 1834)					+	+	+
Walckenaeria cuspidata (Blackwall, 1833)	+	+	+	+	+	+	+
W. karpinskii (O.P.-Cambridge, 1873)	7.4	2.3	3.2	4.5	4.5	+	2.3
W. nudipalpis (Westring, 1853)		+	+	+	+	+	+
Gonatium rubellum (Blackwall, 1841)	2.9		+	+	+	+	+
Pocadicnemis pumila (Blackwall, 1841)		+	+	5.0	3.2	3.6	
Pelecopsis mengei (Simon, 1884)		+	+				+
Minyriolus pusillus (Wider, 1834)	3.7	+	2.1	21.5	7.5	10.9	
Tapinocyba pallens (O.P.-Cambr.,1872)	3.7	20.5	17.3	+	+	+	43.6
Centromerus arcanus (O.P.-Cambr.,1873)	10.3	24.8	22.1	7.9	8.8	8.6	2.4
Hilaira herniosa (Thorell, 1875)	33.1	17.5	20.5	7.4	5.0	5.6	5.9
Micrargus herbigradus(Blackwall, 1856)		+	+	+	5.9	4.7	+
Panamomops mengei Simon, 1926							+
Diplocentria bidentata (Emerton, 1882)	+	4.0	3.4	+	2.9	2.4	7.6
D. rectangulata (Emerton, 1915)				16.0	34.4	30.0	
Semljicola faustus (O.P.-Cambr., 1900)	2.2	+	+	4.5	+	+	2.5
S. latus (Holm, 1939)	4.5	4.5	4.5	3.0	+	+	4.7
Porrhomma pallidum Jackson, 1913)	+		+		+	+	
Sintula corniger (Blackwall, 1856)				3.0	+	+	
Agyneta olivacea (Emerton, 1882)	4.4	2.1	2.5				2.1
A. conigera (O.P.-Cambr., 1863)	+	+	+				
Microneta viaria (Blackwall,1841)							+
Maro sublestus Falconer, 1915	+	+	+				+
Centromerus sylvaticus (Blackwall, 1841)		+	+				
Macrargus multesimus(O.P.-Cambr.,1875)					+	+	
M. rufus (Wider, 1834)		+	+		+	+	
Oreonetides vaginatus (Thorell, 1882)		+	+				+
Bolyphantes index (Thorell, 1856)				+	+	+	
B. luteolus (Blackwall, 1833)				+	+	+	
Lepthyphantes alacris(Blackwall, 1853)		+	+				+
L. angulatus (O.P.-Cambridge, 1881)	+	+	+				4.2
L. antroniensis (Schenkel, 1933)	2.2	+	2.0	+	+	+	+
L. mengei Kulczynski, 1887				+	+	+	+
L. tenebricola (Wider, 1834)	3.7	+	+				2.1
Robertus lividus (Blackwall, 1836)	+	+	+				2.1
R. lyrifer Holm, 1939				3.5	2.9	3.0	
R. scoticus Jackson, 1914	3.7	6.3	5.8	3.0	13.5	10.9	8.5
Hahnia ononidum Simon, 1875	2.2	+	+	11.0	3.8	5.5	
Cryphoeca silvicola (C.L.Koch, 1834)	3.7	+	+				3.8
Ozyptila trux (Blackwall, 1846)	2.9	+	+	2.5	+	+	
Haplodrassus soerenseni (Strand, 1900)					+	+	
Zora spinimana (Sundevall, 1833)					+	+	
N	136	576	712	200	624	824	236
Numbers of species	23	29	31	23	29	29	26

Table 2. Skjomen 1968. Loc. I and II. Dominances (%) of species from the field layers (sweep net) in late summer/early autumn 1967 (+=<1.0 %).-

ADULT SPIDERS	LOC. I	LOC. II
Gonatium rubellum (Blackwall, 1841)	27.6	22.2
G. rubens (Blackwall, 1833)	+	1.6
Lepthyphantes alacris (Blackwall, 1853)	6.5	
L. angulatus (O.P.-Cambridge, 1881)	1.6	
L. expunctus (O.P.-Cambridge, 1875)	1.6	1.6
L. mengei Kulczynski, 1887	10.6	
L. tenebricola (Wider, 1834)	9.8	1.6
Bolyphantes alticeps (Sundevall, 1832)	14.6	
B. index (Thorell, 1856)	7.3	23.8
B. luteolus (Blackwall, 1833)	3.3	11.1
Neriene montana (Clerck, 1757)		3.2
Helophora insignis (Blackwall 1841)		1.6
Pocadicnemis pumila (Blackwall, 1841)	+	3.2
Cnephalocotes obscurus (Blackwall, 1834)		3.2
Minyriolus pusillus (Wider, 1834)		1.6
Tapinocyba pallens (O.P.-Cambr., 1872)	2.4	
Diplocentria bidentata (Emerton, 1882)	1.6	
Hilaira herniosa (Thorell 1875)	4.1	3.2
Hahnia ononidum Simon, 1875	+	
Cryphoeca silvicola (C.L.Koch, 1834)	4.1	
Ozyptila trux (Blackwall, 1846)		7.9
Xysticus obscurus Collett, 1877		3.2
Cercidia prominens (Westring, 1851)		1.6
Evarcha falcata (Clerck, 1757)	2.4	9.5
N	123	63

JUVENILE SPIDERS	LOC. I	LOC. II
Gonatium spp.	36.0	34.0
Bolyphantes spp.	29.3	40.0
Lepthyphantes spp.	22.4	9.7
Linyphiidae indet.	3.9	1.4
Theridiidae indet.		+
Hahniidae indet.	+	
Cryphoeca sp.	+	
Thomisidae indet.	5.1	12.3
Dictynidae indet.	+	
Araneidae indet.	2.1	+
Lycosidae indet.		1.4
Salticidae indet.	+	
N	331	147

hat compared to the moss samples in which both were most common in the B-level (in both localities). *Semljicola faustus* and *S.latus* (both dark coloured species) show relatively high dominances in the A level. The latter, however, dominated also in level B (Loc.II), and both were present in the leaf litter (Table 1). As to humidity, *S.latus* is probably the most eurytopic of the two congeners (Palmgren 1976). The dark coloured *Hahnia ononidum* obviously avoids the leaf litter. It was clearly most common in the open Loc.II, and especially in the A level (in both localities).

In the open Loc.II exposure to light is obviously higher (at least in the upper part of the moss carpet), and probably to a large degree responsible for the faunal differences between the localities (Table 1), see also Hauge (1977, Table III-VIII). Here the heavily pigmented but very small *Minyriolus pusillus* dominated in the A layer (21.5%), and was among the most common ones in the B-layer as well (7.5%). This is in sharp contrast to Loc.I, where it (despite its small size) seems to be outnumbered, perhaps primarily by the equally sized *Tapinocyba pallens*, being very scarce in the moss samples and completely absent from the leaf litter samples (Table 1). Both of the last mentioned species are well known, widespread and eurytopic forest species in the Nordic countries, often very abundant (Koponen 1995); and also occurring together (abundantly) in western open areas as well (Hauge in prep., Hauge & al. in prep.). However, the presence of a moss cover is obviously essential for *M.pusillus* (Palmgren 1972), and so also for *C.arcanus* (Palmgren 1975). The latter and *H.herniosa* showed (compared to the moss samples at Loc.I) only slightly lower dominances at Loc. II.

The most dominant species at Loc. II was the small and much lighter *Diplocentria rectangulata*. However, compared to *M.pusillus* it was relatively more common in the B-layer (Table 1). According to Heimer & Nentwig (1991) its biology is 'very little known', but obviously fairly well known in (mostly northern) Fennoscandia (Huhta 1971; Palmgren 1976; Biström & Väisänen 1988; Koponen 1995).

Spiders in the field layer

The field layer (Table 2), based on 664 specimens only, differs clearly from the lower stratum. The relatively high dominance (in both localities) of the (fairly large) woodland Erigoninae species *Gonatium rubellum,* together with some other linyphiidae genera and species (*Lepthyphantes, Bolyphantes, Neriene montana* and *Helophora insignis*)constituting more than 80% of total, adults as well as juvenils, is noteworthy. Most other adult Linyphiidae, common in the lower strata, were more scarce and/or absent in the field layer, for instance *T. pallens* (2.4% at Loc.I) and *C.arcanus* (totally absent), while the larger *H. herniosa* was well represented in both localities. Relatively many thomisids were found in Loc.II. Some species were present only in the field layer materials (and partly abundant): *Bolyphantes alticeps, Lepthyphantes expunctus, Helophora insignis, Neriene montana, Xysticus obscurus, Cercidia prominens* and *Evarcha falcata.*

SAMMENDRAG.

Romlig fordeling av noen edderkopparter i en nord-norsk bjørkeskog

I to nordnorske bjørkeskogs-lokaliteter (Lok. I og II) er det i Juni-August samlet kvantitativt i skogbunnens mosedekke (begge lokalitetene) og i fallførna (Lok. I). Moseprøvene ble delt i en øvre, grønn del (ca.1/3 av mosens totale tykkelse) og den underliggende 2/3-delen. Sampling er også gjort i de to ulike feltskiktene. En kort diskusjon av noen av de vanligste artene antyder segregering vertikalt (i mosen og i forhold til feltskiktet) og horisontalt (Loc.I og II imellom, og på Loc.I mellom moseprøvene og fallførnaprøvene). Faktorer som lys, plantesamfunn, samt artenes størrelse og pigmentering er tillagt en viss betydning.

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