

Spiders (Araneae) from square samples and pitfall traps in coastal heathland, western Norway. Habitat preference, phenology and distribution

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Square samples were taken at intervals of 3-4 weeks (early spring 1972 - late summer 1973) in a heterogeneous plant association dominated by *Calluna vulgaris* and several moss species (Loc. I), and in a homogenous, humid *Sphagnum* mat (Loc. II) with very sparse *Calluna*. Probably due to an unusually dry spring/early summer in 1972 the density of spiders decreased drastically towards mid-summer at Loc. I, especially the linyphiids and in particular their juveniles (less so at Loc. II). During late autumn/early winter a maximum of approximately 300 and 200 specimens per square meter was reached at Loc. I and II, respectively. A total of 43 species were found; at Loc. I 42 species and at Loc. II 29 species. The Shannon indices of general diversity were 2.28 and 1.26, respectively. The sharing of 28 species gave a fairly high Soerensen index of similarity (0.79) but a rather low Renkonen index (0.30). At Loc. I the four most dominant species (range 12-21%), *Minyriolus pusillus*, *Erigonella hiemalis*, *Gonglyliellum latebricola* and *G.vivum*, represented 59% of the total. At Loc. II the two most dominant species *Robertus arundineti* (45%) and *Minyriolus pusillus* (10%) represented 55% of the total. Pitfall traps emptied every 3-4 weeks added another 25 species to the list, including some abundant lycosids, and occasional sampling elsewhere in the area added 6 species. Phenological data are presented, and for some abundant species briefly discussed with notes on their habitat preferences and distribution.

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INTRODUCTION

About one hundred years ago the west Norwegian coastal *Calluna* heath area was 30 km at its broadest. Today the largest areas are in the outermost parts of the region. The northern limit of the west European coastal heathland area was approximately at the latitude of Bergen (Gimingham 1972, de Smidt 1995). A narrow strip of west Norwegian coastland north to about Ålesund has been defined as 'The heath area of western Norway' (Anonymous 1984). However, coastal heathland with some *Calluna* is found at least as far north as the Lofoten islands.

Prevailing south-western cyclonic weather systems keep the climate on the west Norwegian coast mild and humid. This open barren coastal area is dominated by heather, bare rocks and mires. This is to a large extent man-made through deforestation and cultivating activities during the last 2000 years (Brekke & Indrelid 1993). Some areas were utilized as pastures and

for production of grass, and most of it still is. In large areas sheep-holding (partly with grazing most of the year) as well as regular burning and cutting of ling for winter fodder maintained the landscape in a patchy state with a mixture of relatively low grown *Calluna* and grasses. These activities are now reduced. Consequently, this outer region is now affected by vegetational succession, due to invasion of birches, rowans (*Sorbus* sp.) and pines (Kvamme 1993); and also by artificial planting of conifers (mainly spruce), an increasing land use the last four or five decades. Documentation of the present day heathland spider fauna is therefore important, because our knowledge about spiders in these types of coastal landscape, other than Hauge et al. (1990, 1991) from the Øygarden archipelago, is sparse. Current knowledge of the spider fauna is based on an internal report with very limited distribution (Hauge 1976 a). A few data have already been published (Hauge 1980).

THE STUDY AREA

The study area is situated north-west of Bergen about 2 km west of Fønnes, approximately on the border of Lindås and Austrheim communities in the northern coastal parts of Hordaland county (Figure 1).

Loc. I. A typical habitat for the region. A relatively humid West Norwegian heathland with a heterogenous plant association. Locally the *Calluna* is fairly dense. Other common plants are *Lycopodium clavatum*, *Blechnum spicant*, *Arctostaphylos uva-ursi*, *Molinia coerulea*, *Erica tetralix*, *Suclisa pratensis*, *Scirpus germanicus*. The moss cover (4-6 cm deep) contained several species, most common were *Hylocomium splendens*, *Pleurozium schreberi*, *Hypnum cupressiforme*, *Dicranum scoparium*, *Polytrichum commune*. Small stands of *Vaccinium vitis-idae*, *Empetrum* sp. and sparse litter were present on the driest flecks, especially close to the bare rocks. The soil is a rather thin raw humus on a sandy base, and highly permeable for water.

Loc. II. A small (approximately 30 x 30 m) local homogenous area, representing areas which are almost completely dominated by a thick, dense and humid (peaty) mat of *Sphagnum* with some *Eriophorum* sp. The *Calluna* was extremely sparse, small and scattered.

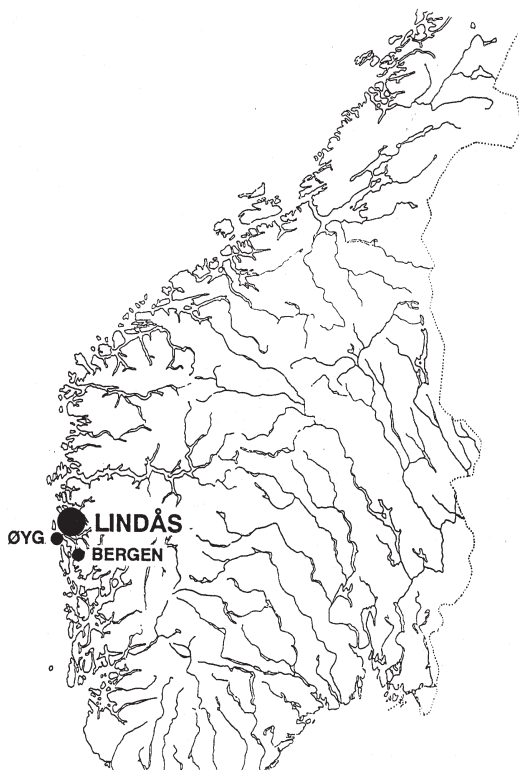


Figure 1
Lindås/Austrheim and the Øygarden archipelago (Øyg.), coastal western Norway.

METHODS

From spring to November 1972 twelve sample units of 0.25 m² were taken in Loc. I at intervals of 3-4 weeks (Table 1) using the following procedure: The moss cover was removed and the soil surface below sucked with a vacuum cleaner (Kauri et al.1969). A part of the humus layer (1/16 square meter, approximately 3 cm thick) was also taken. As weather conditions became more severe in fall and winter, the vacuum cleaner was abandoned. Instead a varying number (up to 48) of smaller squares (0.16 m² each) including the humus layer (4-5 cm thick) were taken each time (from December 1972).

At Loc. II a varying number (8-16) of *Sphagnum* samples (each 0.16 m²) were taken from late March 1972 to June 1973. All samples were extracted in large Tullgren funnels. An increasing number of pitfall traps were distributed throughout the area: Nineteen traps (31 March - 14 April 1972), 28 traps (March - 18 September 1972), thereafter 38 traps until 3 August 1973. The total pitfall material is presented in Table 2.

The traps were glass jars (diameter of inner opening 5.7 cm) half filled with 4% formaldehyde and some drops of detergent (liquid soap). The traps were provided with a zinc roof for protection against rain and were emptied at intervals of 3-4 weeks (Table 1).

The nomenclature follows Platnick (1998, 2000), Saaristo & Tanasevitch (1996), Tanasevitch (2000) and Wunderlich (1973).

Table 1. Heathland, 1972-1973. Sampling dates (in squares at Loc. I) and sampling periods (in pitfalls). No. 1-20 refer to the abscissa in Figure 4-10.

No.	Loc. I	Pitfalls
1	31.III	31.III-14.IV
2	18.IV	14.IV-3.V
3	5.V	3.-18.V
4	23.V	18.V-7.VI
5	14.VI	7.-28.VI
6	30.VI	28.VI-19.VII
7	25.VII	19.VII-26.VIII
8	28.VIII	26.VIII-18.IX
9	20.IX	18.IX-11.X
10	12.X	11.X-6.XI
11	13.XI	6.XI-8.XII
12	8.XII	8.XII-9.I
13	9.I	9.I-9.II
14	9.II	9.II-12.III
15	12.III	12.III-9.IV
16	9.IV	9.IV-8.V
17	8.V	8.V-4.VI
18	4.VI	4.-25.VI
19	25.VI	25.VI-3.VIII
20	3.VIII	3.-28.VIII

Table 2. Dominances (%) of spider species (adults) in square samples (Loc. I and II) and pitfalls (P), + = < 1%. Phenology: Males (M) and females (F) present in square samples (Q) and pitfall traps (P), I-XII = January- December. V/VII (example) = late May/early June.

SPECIES	LOC. I	LOC. II	P	PHENOLOGY
<i>Ceratinella brevipes</i> (Westring,1851)	2	+	+	Q: M XI-V; F I-XII. P: M IV-VI; F V-VI
<i>Walckenaeria antica</i> (Wider,1834)	2	+	2	Q: M+F I-XII; P: M I-VIII
<i>W. nudipalpis</i> (Westring,1851)	1	3	2	Q: M XI-II; F IX, XI-VI. P: M IX/X-IV/V; F VI/VII, IX/X-XII/I
<i>W. cuspidata</i> (Blackwall,1833)	+		+	Q: M II; F I + III. P: M III/IV-V-VI
<i>Dicymbium nigrum</i> (Blackwall,1834)			+	P: I M III/IV
<i>Gonatum rubens</i> (Blackwall,1833)	2	+	12	Q: M VIII-XI/XII; F I-XII. P: M VIII/I/II; F I-XII
<i>Peponocranium ludicrum</i> (O.P.-Cambridge,1861)	4	+	+	Q: M II/III, F I/II. P: M V-VI; F V-VI/VII
<i>Pocadicnemis pumila</i> (Blackwall,1841)	+		+	Q: F IV-VII
<i>Silometopus elegans</i> (O.P.- Cambridge,1872)	+	1	+	Q: MF I/II-VI/VII. P: M VI
<i>Metopobactrus prominulus</i> (O.P.-Cambridge, 1872)			+	P: M V-VI; F VIII
<i>Tiso vagans</i> (Blackwall,1834)	+	+		Q: M V,VI; F V,XI/XII
<i>Minyriolus pusillus</i> (Wider,1834)	21	10		Q: MF I-XII; P: M VI/VII; F VI,I/II
<i>Tapinocyba pallens</i> (O.P.- Cambridge, 1872)	6	1	+	Q: M IX/X-V; F IX-VI. P: M V-VI
<i>Gongylidielum vivum</i> (O.P.-Cambridge, 1875)	12	5	+	Q: MF I-XII. P: M V-VI
<i>G. latebricola</i> (O.P.-Cambridge, 1871)	13	4	+	Q: M IX-VI; F I-XII. P: M V-VIII
<i>Erigonella hiemalis</i> (Blackwall,1841)	13	3	2	Q: MF I-XII; P: M III/IV, F III/IV-VI/VII
<i>Cnephalocotes obscurus</i> (Blackwall,1834)	2	1	2	Q: M XI/XII-V; F IX/X-VI. P: M IV/V-VIII; F IV-V, IX/X
<i>Jacksonella falconeri</i> (Jackson 1908)	+		+	Q: M VIII-V; F X-V. P: M IV/V-VI
<i>Micrargus herbigradus</i> (Blackwall,1854)	1	1	+	Q: M XI-V; F II-VII,XI. P: M V-VI/VII
<i>Araeoncus crassiceps</i> (Westring,1861)		1	+	Q: F V, X. P: M VIII/VIII
<i>Thyphlocrestus digitatus</i> (O.P.- Cambridge,1872)			+	P: M I/II
<i>Erigone atra</i> (Blackwall,1841)	+			Q: M V
<i>Agyneta cauta</i> (O.P.-Cambridge,1902)	+	1	3	Q: MF V-VI. P: M V-VI/VII; F V-VII
<i>A. decora</i> (O.P.-Cambridge,1870)	+	1	+	Q: M V-VI; F V. P: M VI-VII/VII
<i>A. subtilis</i> (O.P.-Cambridge,1863)	+			Q: F VI,XI
<i>A. conigera</i> (O.P.-Cambridge,1863)	+		+	Q: M,F VI. P: M VI-VII/VIII
<i>A. affinis</i> (Kulczynski,1898)	+	+	+	Q: M V-VI; F V,IX. P: M V-VI/VII; F IV/V- VII, XI/XII
<i>Maro lehtineni</i> Saaristo 1871	+			Q: M V,IV; F III,IV,XII
<i>Centromerus arcanus</i> (O.P.-Cambridge,1873)	1		+	Q: M XI,II-IV; F XI-IV. P: M V-VI
<i>C. sylvaticus</i> (Blackwall,1841)			+	P: M X/XI
<i>C. prudens</i> (O.P.Cambridge,1873)			+	P: M XI/XII
<i>C. concinnus</i> (Thorell,1875)	+	1	11	Q: M VI,X-XII; F XI-V. P: M IX/X-II/III; F IX/X-VI/VII
<i>C. bicolor</i> (Blackwall,1833)			+	P: M IX/X-X/XI, XII/I
<i>Macrargus rufus</i> (Wider,1834)	+		1	Q: M IV,VIII-IX; F VIII-IX,I,V-VI. P: MF X/XI-III/IV
<i>Bolyphantes luteolus</i> (Blackwall, 1833)			+	P: M X/XI, XII/I
<i>Saaristoa abnormis</i> (Blackwall, 1841)			+	P: F IX/X
<i>Bathyphantes gracilis</i> (Blackwall,1841)			+	P: M II/III
<i>B. setiger</i> (F.O.P.-Cambridge,1884)			+	P: M II/III
<i>Poecilonea variegata</i> (Blackwall,1841)			+	P: F III/IV
<i>Tenuiphantes menzei</i> (Kulczynski,1887)	1	+	6	Q: M IX,XI-VI. P: M X-XI, IV/V; F IX-VI
<i>Lepthyphantes ericaeus</i> (Blackwall,1853)	8	+	4	Q: M IX,VI; F IX,XI-VI. P: M X/IX-VI/ VII; F IX/X-VI
<i>Leptothrix hardyi</i> (Blackwall,1850)			+	P: FI X/X
<i>Stemonyphantes lineatus</i> (L.,1758)			+	P: M XII/I-III/IV; F II/III
<i>Microinyphia pusilla</i> (Sundevall,1829)	+			Q: M VI
<i>Robertus lividus</i> (Blackwall,1836)	2	7	+	Q: M I,IV-VI; F IX-VII. P: M VI/VII
<i>R. scoticus</i> Jackson,1914	+			Q: M XII; F XI-I,V,VI
<i>R. arundineti</i> (O.P.-Cambridge, 1871)	+	45	+	Q: M VI-VIII,X-IV; F I-XII. P: M III/IV,VI, VIII/IX.
<i>Euryopis flavomaculata</i> (C.L.Koch,1836)			+	P: M V-VI-VI/VII; F VI-VII/VIII
<i>Pachygnatha degeeri</i> Sundevall,1830	+	2	10	Q: M I,III-IV,XII.P: M III/IV-VI/VII, IX/X- X/XI; F VI/VII, IX/X-XI.
<i>Hahnia pusilla</i> (C.L.Koch,1841)	+	1	+	Q: F I,IV,VI-VIII,XI-XII.P: M III/IV-V/VI; F V-VI

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Table 2. Continued.

SPECIES	LOC.		P	PHENOLOGY
	I	II		
<i>Antistea elegans</i> (Blackwall,1841)			+	P: M VII-VIII
<i>Ero furcata</i> (Villers,1789)	+		+	Q: F IV. P: M VII/VIII; F IV/V
<i>Xysticus cristatus</i> (Clerck, 1757)	+	+	+	Q: M IV; F I-II,IV. P: M V/VI, IX/X
<i>Ozyptila atomaria</i> (Panzer,1810)	+		+	P: F III/IV, VII/VIII
<i>Neon reticulatus</i> (Blackwall,1853)	+			Q: M V-VI,F V
<i>Euophrys petrensis</i> C.L.Koch,1841			+	P: M VI
<i>Clubiona trivialis</i> L.Koch,1841	2	3	+	Q: M II,V-VI,VIII,XI-XII. Å: M VI-VII; F VII/VIII
<i>Scotina gracilipes</i> (Blackwall, 1859)			+	P: M VI,VIII
<i>Agroeca proxima</i> (O.P.-Cambridge,1871)			+	P: M VIVII,IX/X; F VIII/IX-X/XI
<i>Micaria silesiaca</i> L.Koch, 1875			+	P: M VI
<i>Gnaphosa leporina</i> L.Koch,1866			+	P: M VI
<i>Zelotes latreillei</i> (Simon,1878)	+		2	Q: M I; F III. P: MF IV/V-VIII/IX
<i>Haplodrassus signifer</i> (C.L.Koch,1839)	+	+	+	Q: F XII, F III. P: MF IV/V,VIII/IX
<i>Trochosa terricola</i> Thorell,1856	+	3	17	Q: M II-V,VIII;X; F III-IV,VI,VIII,XI-I. P: M II/III; F III/IV,IX,X.
<i>Alopecosa pulverulenta</i> (Clerck,1757)			2	P: M V-VI; F V-VII/VIII
<i>Pardosa pullata</i> (Clerck,1757)			11	P: M IV/V-VII/VIII; F IV/V-VIII
<i>P. nigriceps</i> (Thorell,1856)			6	P: M V-VII/VIII; F V-VIII/IX.
<i>P. palustris</i> (L.,1758)			+	P: M V-VII/VIII
Numbers of specimens	2572	340	3650	
Numbers of species	43	29	61	

RESULTS

The quantitative samples

In western Norway precipitation is fairly high and rather evenly distributed throughout the year, being statistically lowest in spring (May). From early spring to mid-summer 1972 precipitation was extraordinary low and the number of sunny days high. At Loc. I the soil became very dry and dusty, obviously deleterious to the ground living spider fauna which was reduced to a low level at mid-summer (Figure 2A), especially the linyphiids and in particular their juveniles (Figure 3). During 'normal' weather conditions from late summer the spider fauna recovered, reaching a peak of approximately 300 specimens per square meter in December. A fairly high density was maintained during a practically snow-free mild winter and more 'normal' spring, obviously resulting in a more 'normal' summer minimum in 1973 (Figure 2).

The *Sphagnum* mat (Loc. II) never became completely dry and losses seem to have been less severe (Fig.2 B). A maximum slightly below 200 specimens per square meter was reached in November. Most of the time the density of spiders was lower than at Loc. I. But the proportion of juveniles (Linyphiidae and *Robertus* spp.only) was higher.

Altogether 43 spider species were found in the square samples (Table 2), 42 on Loc. I and 29 on Loc. II, giving a relatively high Soerensen index of similarity (0.79). However, the density dependent Renkonen number (see Wallwork 1970) was rather low (0.30), indicating large differences in abundance for some of the spider species.

In the floristically and structurally rather heterogenous Loc. I the four most abundant species together represented 59% of the total. These were all small linyphiids (*Minyriolus pusillus*, *Erigonella hiemalis*, *Gongyliidiellum vivum* and *G.latebricola*) with dominance values within a rather narrow range (12-21%). Within the more homogenous vegetation of Loc. II the two most abundant species alone constituted a similar proportion of the total (55%). Similar results were also reported by Almquist (1982). The last two species were the small and very dominant *Robertus arundineti* (45%) and the much less dominant *Minyriolus pusillus* (10%). The former is commonly referred to as psychrophilous, and was extremely scarce at Loc. I (Table 2). *M. pusillus*, on the other hand, was the most common species (21%) at Loc. I. By some workers it has been considered as psychrophilous. Also the Shannon index of general diversity from the two localities (2.28 and 1.26, respectively) as well as the higher number of species present (33 and 19, respectively) give evidence for a more hete-

rogenous spider fauna at Loc. I. Rare species are here defined as those being represented with less than 1%.

The pitfall material

The pitfall material (61 species) added another 25 species to the total (68 species), including 10 (partly abundant) cursorial species, scarce or absent from the square samples.

Additional species

Six species were found during occasional sampling elsewhere in the area: *Agyneta saxatilis* (Blackwall, 1844), 1 female in pitfalls 3-6 June 1971 (in *Sphagnum*); *Tenuiphantes zimmermanni* (Bertkau, 1890), 1 male and 1 female in sieving samples 2 Oct. 1972; *Salticus cingulatus* (Panzer, 1797) 1 male and 2 juvenile specimens in sieving samples 2 Oct. 1972; *Heliophanus flavipes* (Hahn, 1823), 1 female in sieving samples 2 Oct. 1972; *Drassodes cupreus* (Blackwall, 1834), 1 male and 1 female in pitfalls 3-6 June 1971; *Pirata piraticus* (Clerck, 1757), 1 female in pitfalls 3-6 June 1971 (*Sphagnum*).

DISCUSSION

For epigeic spiders, the peak activity period of adult males may indicate the main breeding season of the species (Aitchison 1980, Schultz & Finch 1996). If so, most erigonids and practically all lycosids in our material (Table 2) are stenochrone spring/early summer breeders, as defined by Schaefer (1976) and obviously the most common pattern among epigeic spiders (Schaefer 1976, Puntser 1980). However, different methods may give different results (Merrett 1983, Merrett & Snazel 1983), exemplified by the lack of several cursorial species (mostly lycosids) in the square samples (Table 1).

Some small netbuilders

The four clearly most abundant (adult) species in the square samples at Loc. I mentioned above plus *Tapinocyba pallens* (6%) represent 65% of the total. They all (plus several other erigonids) had a very short period of active males in spring (Table 2). And, except for *Erigonella hiemalis* (Figure 5A), they were all very scarce in the pitfall material (the females extremely scarce). However, the square samples show their

Figure 2
Loc. I (A) and II (B). Densities (numbers of specimens/m²) of epigeic spiders, April 1972 - late June/August 1973.

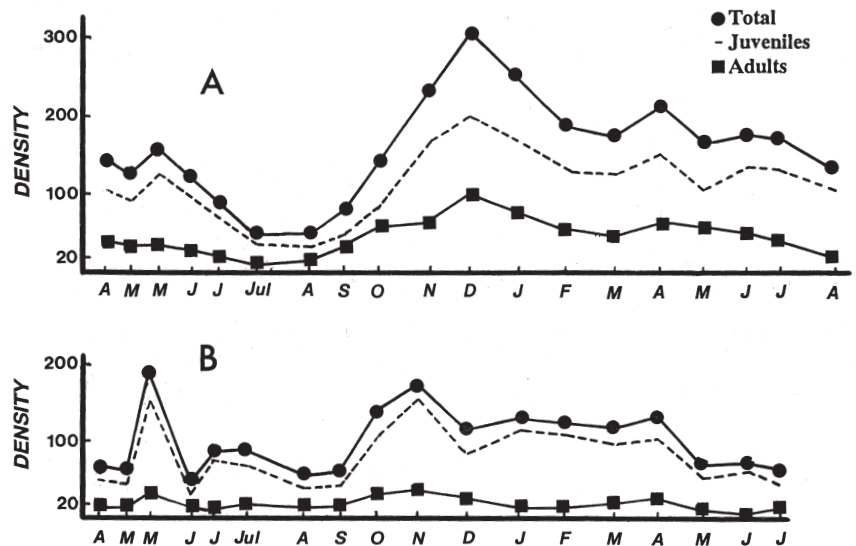
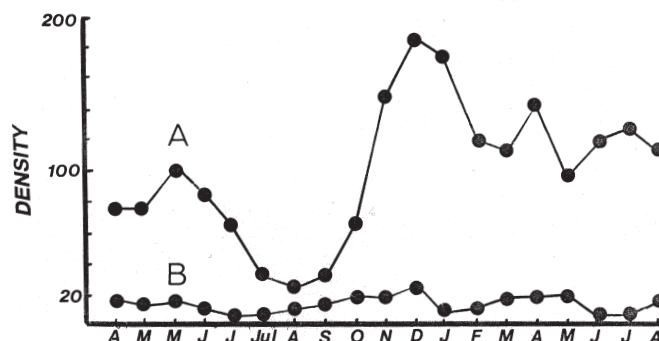


Figure 3
Loc. I. Densities (numbers of specimens/m²) of juvenile spiders, April 1972 - August 1973. A: Linyphiidae + *Robertus* spp.), B: The other families.



presence as adults (both sexes) in most parts of the year (Figure 4A-D, Figure 5 B). The males' active periods were immediately followed by a summer minimum in the populations (especially the males), for some species adult specimens were totally absent, see also Huhta (1965) and Hauge (1977). The adults clearly die around mid-summer (males first). Consequently, the total density of the adult spiders dropped to a minimum at mid-summer (Figure 2). Several species in of this group of spiders living close to the ground are known to prefer relatively high and stable humidity. The recovery of these spider populations in the autumn may indicate that the new generation may have spent the mid-summer at the egg stage, perhaps the most resistant stage against drought.

Except for the short mid-summer period, a relatively large number of adult specimens from several equally sized spider species (approximately 1.5 millimeter long) seem to live together in the same habitat almost all year. What activities are going on outside the very short active period is hard to tell. Perhaps they sit passive on their nets (if they have one). According to Miller & Obrtel (1975) several species of this 'subfamily' (Erigoninae) are adapted to small space, dwelling inactively close to the soil surface most of the time. Theoretically, they may utilize the same resources, resulting in competition and reduction of population size below their saturation level. Spatial segregation in microhabitats, vertically in the moss cover or horizontally within the total area (Hauge 1998), seems possible. *Erigonella hiemalis* and (especially) *Minyriolus pusillus* are very dark coloured species, *T. pallens* and the *Gongyliidiellum* spp. paler.

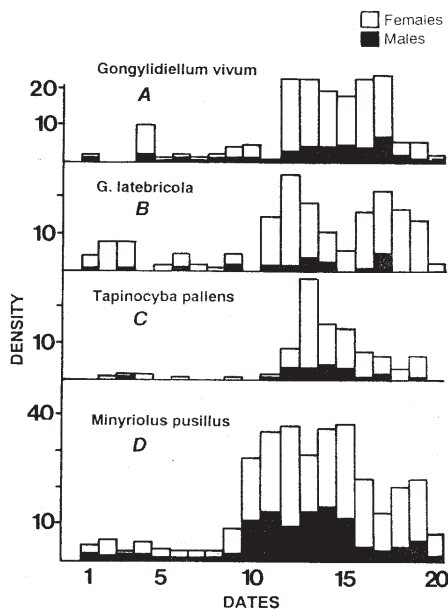


Figure 4
Loc. I. Densities (numbers of specimens/m²) of four dominating Erigoninae (A-D), April 1972 - August 1973 (sampling dates in Table 1).

So, vertical segregation directly correlated with a combination of exposure to light and degree of pigmentation seems possible, probably also vertical segregation (as well as in microspace) in relation to larger species. Important ecological factors such as humidity and temperature preference have frequently been discussed in the literature, and to some degree have been related to the geographical distribution of the species.

***Minyriolus pusillus* (Wider, 1834) and *Tapinocyba pallens* (O.P.-Cambridge, 1872)**

Both species are common and widespread, in Fennoscandia (Huhta 1965, Lehtinen et al.1979), elsewhere in Central Europe (Maurer & Hänggi 1986, 1990; Flatz 1988; Hänggi et al.1995) and on the British Isles (Locket et al. 1974); and they have both very often been reckoned as typical forest species. However, in eastern (Huhta 1971) and in western (coastal) Fennoscandia (Hauge et al.1991, Hauge et al. in prep.) they are reported as fairly common also in open and semi-open habitats, frequently occurring together in the same habitat. This also applies to north Norwegian birch forests (Hauge 1977, Hauge 1998) in which their spatial segregation (vertically and horizontally) seems to have some relation to light conditions on the site (due to great differences in pigmentation of the two species) and to the conditions on the ground (the presence of a moss cover vs accumulations of leaf litter).

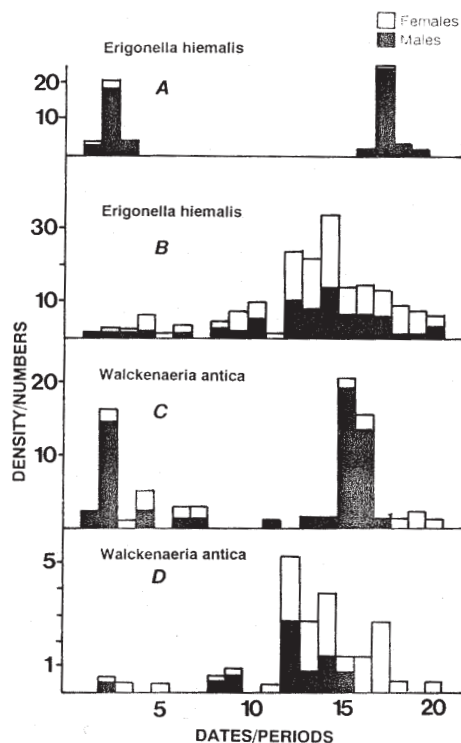


Figure 5
Loc. I. Numbers of specimens in pitfalls (A, C) and densities (numbers of specimens/m²) (B, D) of two erigonid species, April 1972 - August 1973 (sampling dates and periods in Table 1).

Gongyliidiellum spp.

G. vivum and *G. latebricola* were frequently found together in the same sub-samples, see also Casemir (1976) and Reinke & Irmeler (1994). They have been reported from both humid habitats (Palmgren 1976, Ruzicka 1987, Heimer & Nentwig 1991) and from dry places (Maurer & Hänggi 1990, Platen et al. 1991). *G. latebricola* clearly has a fairly wide ecological amplitude (Palmgren 1972, Kronestedt 1983, Hänggi et al. 1995), but seems to prefer forests (Locket & Millidge 1953, Dumpert & Platen 1985, Thaler 1985, Flatz 1988). In eastern Fennoscandia (Finland) it follows the pine forest to its northern limit (Palmgren 1976), in Sweden it ranges north to Pite (Almquist 1983) and Lule Lappmark (Lars Jonsson pers. comm.), presumably as far north as the northernmost Norwegian record (Hauge 1976 b).

G. vivum, on the other hand, has in Fennoscandia and elsewhere in Europe a more southern and coastal distribution, being unknown in Finland (Palmgren 1977) and Sweden (Jonsson pers. comm.). While *G. latebricola* previously is reported from the inner south-eastern areas of Norway (Hauge & Wiger 1980), the few Norwegian records of *G. vivum* are restricted to areas situated not too far from the coasts, and only in western areas from Kristiansand to Bergen (Andersen et al. 1980, Hauge unpublished). In the Øygarden archipelago (western Norway) *G. vivum* was among the most abundant and eurytopic species, even in the wooded areas (Hauge et al. 1991, Hauge et al. in prep.) while, *G. latebricola* was completely absent. *G. vivum* is also common in open coastal habitats elsewhere in western Europe (Hänggi et al. 1995, Schultz & Finch 1996). In contrast to *G. latebricola* it is also recorded from northernmost Scotland (Locket et al. 1974) and the Faroes, but not yet from Shetland (Ashmole 1979).

Erigonella hiemalis (Blackwall, 1841)

Most authors consider the species to be hygrophilous, but it has also been reported from dry meadows (Palmgren 1976) and described as 'predominantly xerophilous' (Dumpert & Platen 1985). Also other reports on habitat preferences vary: woods (Locket & Millidge 1953, Engelhardt 1958, Dumpert & Platen 1985, Heimer & Nentwig 1991), semi-open areas and forest ecotons (Blick 1989), open places (Flatz 1988), woodland and open areas (Hauge et al. 1991, Hauge et al. in prep.). It also has been described as indifferent towards light (Huhta 1971), euryoecious and thermophilous (Casemir 1975) and as a common aeronaut (Zeltner 1989, Reinke & Irmeler 1994). In contrast to the species discussed so far, *E. hiemalis* is recorded from Shetland (Ashmole 1979).

Other common net-builders**Lepthyphantes ericaeus** (Blackwall, 1853)

This small Linyphiinae species (adults 1.5 mm long) is perhaps able to utilize the same resources (for instance microspace and prey), and thereby is a potential competitor to the erigonids discussed above. In habitat preferences (Hänggi et al.

1995) and general distribution in western Europe it resembles *Gongyliidiellum vivum*, but extends to more eastern and northern areas. It is known from the Russian Plain (Mikhailov 1997), south-western areas of Finland (Palmgren 1975, Lehtinen et al. 1979), in Sweden north to Uppland (Holm 1968, Kronestedt 1983) and in Norway as far north as the Lofoten islands (Ashmole & Planterose 1979). The south Norwegian records are from coastal areas only: from the outer Oslofjord area (Andersen & Hauge 1995) all around to Hordaland, here rather eurytopic (and abundant) in the Øygarden archipelago (Hauge et al. 1991, Hauge et al. in prep.). Its north-western limit at present seems to be on the Faroes (Ashmole 1979, Bengtson & Hauge 1979).

Like the common erigonids discussed above, adults were present in the area most of the year (females dominating), with a mid-summer minimum (Figure 6D). However, unlike the erigonids, there was a long winter active period (Figure 6C). There was a large peak at mid-winter and a smaller one in spring overlapping with the active period of the erigonids indicating diplochrony.

Tenuipalpis mingei (Kulczynski, 1887)

Compared to *Lepthyphantes ericaeus*, *T. mingei* is a larger species (approximately 2.5 milli-meter) and slightly darker in

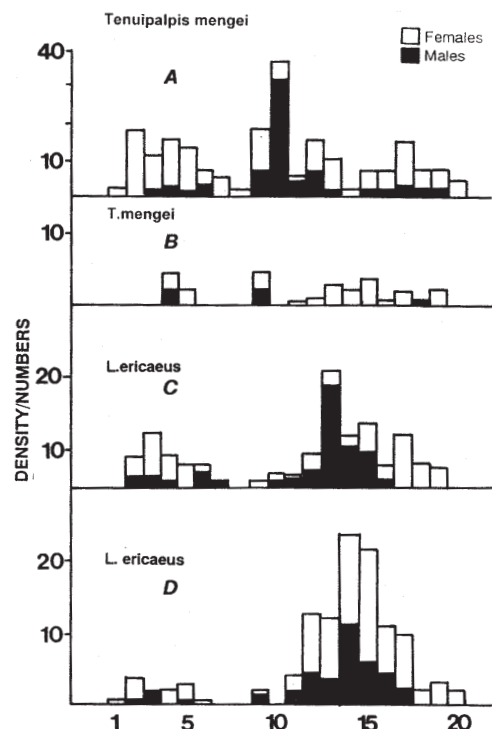


Figure 6

Loc. I. *Tenuipalpis mingei* and *Lepthyphantes ericaeus*. Numbers of specimens in pitfalls (A, C) and densities (B, D), April 1972-August 1973 (sampling dates and periods in Table 1).

colour. Spatial segregation is therefore possible. However, *T. mengei* was scarce in the quantitative samples (Figure 6B). Like *L. ericaeus*, both sampling methods show diplochrony (Figure 6A, B), their small spring peaks overlapping, more so than their main peaks. *T. mengei* was active earlier in the autumn, reaching an earlier maximum in winter. Thus (as concerns their male activity) their phenology showed little overlap with each other and with the most abundant small erigonids.

Compared to *Lepthyphantes ericaeus*, *Tenuiphantes mengei* clearly has the widest ecological amplitude, see Hänggi et al. (1995, p. 208/211). It is more widespread in Fennoscandia, in inland areas up to the lower alpine heaths in Lapland (Holm 1950) as well as in Norway (Hauge et al. 1978, Hauge & Refseth 1979, Hauge & Ottesen in prep.). It is well established in Iceland (Agnarsson 1996) and elsewhere in the North Atlantic (Ashmole 1979), including the west Norwegian coast (Hauge et al. 1991, Hauge et al. in prep.).

Gonatium rubens (Blackwall, 1833)

Like *Tenuiphantes ericaeus*, both sampling methods indicate almost identical seasonal patterns (Figure 7A,B), but with only one peak and with male activity occurring much earlier in the season, in fact overlapping with the largest peak of *Tenuiphantes mengei* (Figure 6A). *G. rubens* is larger (females 3-3.5 mm) than *L. ericaeus* and *T. mengei*. In addition activity (Figure 7A) there was no seasonal overlap with the smaller erigonids discussed above, while the quantitative samples show greater seasonal overlap (Figure 4, Figure 5B, Figure 7B). And (similar to *T. mengei*) *G. rubens* was very scarce in the quantitative

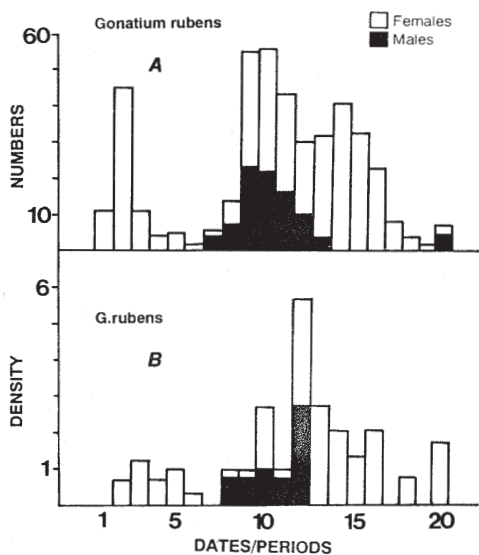


Figure 7
Loc. I. *Gonatium rubens*. Number of specimens in pitfalls (A) and density (B), April 1972-August 1973 (sampling dates and periods in Table 1).

samples, so there is probably no spatial overlap. Both *G. rubens* and *T. mengei* have frequently been reported from vegetation strata above the moss cover (Maurer & Hänggi 1990, Heimer & Nentwig 1991, Hauge 1998). And (similar to *L. ericaeus*, but unlike the smaller erigonids) they both show a fairly high level of female activity most of the year (Fig. 6A, 7B).

In middle Europe *G. rubens* obviously prefers forests (Platen et al. 1991, Hänggi & al. 1995), although several authors also report the species from open areas. In contrast to *Lepthyphantes ericaeus* it resembles *Tenuiphantes mengei* in being common and widely distributed in Fennoscandia, to northern Nordland (Hauge 1977) and Swedish and Finnish Lapland, here ascending into the alpine areas at 1000 m a.s.l. (Holm 1950, Palmgren 1965). In south Norwegian low alpine areas it was among the most common species (Hauge et al. 1978, Hauge & Ottesen in prep.).

Centromerus concinnus (Thorell, 1875)

Like *Tenuiphantes mengei* and *Gonatium rubens*, this species was very scarce in the quantitative samples (Figure 8B), both sexes having a single large peak of activity in late autumn/mid-winter (Figure 8A), the males somewhat later than the males of *G. rubens* and neatly timed **between** the main peaks of *Lepthyphantes ericaeus* and *Tenuiphantes mengei*. Its body size (2-2.5 millimeter) is most similar to *T. mengei* and lies between *L. ericaeus* and *G. rubens*.

Numerous authors (Merrett 1969; Walker 1969; Palmgren 1972, 1975; Sudd 1972; Schaefer 1971; Almquist 1972, 1973; Lockett et al. 1974; Ashmole 1979; Holm 1980; Kronstedt 1983; Tveit & Hauge 1984; Andersen & Hauge 1995; Hänggi et al. 1995; Platen 1996) indicate habitat preferences and distribution in western Europe resembling those of *L. ericaeus*. It is known from high altitudes in central (Maurer & Hänggi 1990) and southern Europe (Bosmans et al. 1986), eastwards reaching the Caucasus (Eskov 1994, Mikhailov 1997). But despite Bauchhens (1990) describing it as a Nordic species, there is (to my knowledge) only one record (Huhta & Viramo 1979) from northern Fennoscandia. Most Finnish records are restricted to the southern and south-western coastal areas (Palmgren 1972, 1975), the few Swedish records report the species north to Östergötland and Öland (Almquist 1973, 1982, Kronstedt 1983) and Uppland (Jonsson pers. comm.), in Norway known only from the southern coastal areas, i.e. from the outer Oslofjord (Andersen & Hauge 1995) to Hordaland, but here frequent and eurytopic (Hauge et al. 1991, Hauge et al. in prep.). It is rare in the North Atlantic (Ashmole 1979, Holm 1980).

Robertus spp.

Robertus arundineti (O.P.-Cambridge, 1871) clearly dominates in the square samples at Loc. II (Table 2) and is a stenoeicous, psychrophilous species. The larger, darker and hygrophilous *R. lividus* (Blackwall, 1836) was less abundant at Loc. II, being present in both locality types (Table 2), while all specimens of

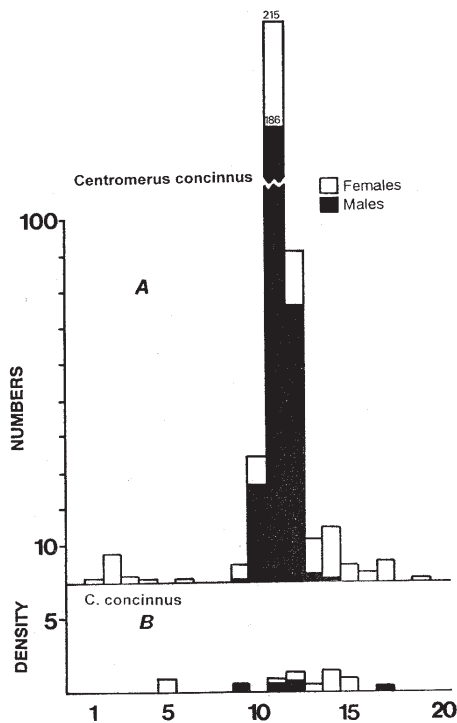


Figure 8
Loc. I. *Centromerus concinnus*. Number in pitfalls (A) and density in square samples (B), April 1972-August 1973 (sampling dates and periods in Table 1).

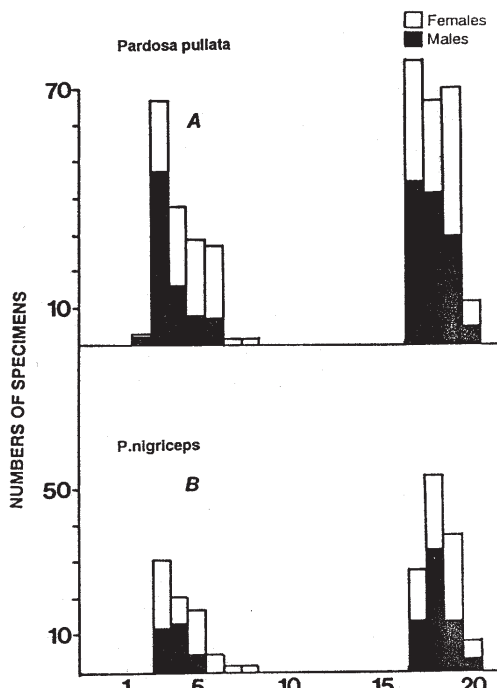


Figure 9
Loc. I. *Pardosa pullata* and *P. nigriceps*. Numbers of specimens in pitfalls, April 1972-August 1973 (sampling periods in Table 1).

the less humidity dependent forest species, the small *Robertus scoticus* Jackson, 1914 were confined to Loc. I. Neither of the species were abundant in the pitfall catches; their spatial activity seems to be rather low (Miller & Obrtel 1975), but for all species adults were present more or less throughout the year (Table 2).

Cursorial species

Most species from this group, except for *Clubiona trivialis* and perhaps also the Thomisidae, were best represented in the pitfall catches. *Pardosa pullata* and *P. nigriceps* were abundant and completely overlapping seasonally with each other (Figure 9) and also with *Trochosa terricola* (Figure 10B). The latter, however, was active earlier in the season, reached an earlier maximum, and exhibits (in contrast to the *Pardosa* spp.) a small secondary peak in the autumn, subsequently followed by a mid-winter pause (Figure 10B), which indicates diplochrony. A few inactive adult specimens of *T. terricola* (both sexes) were

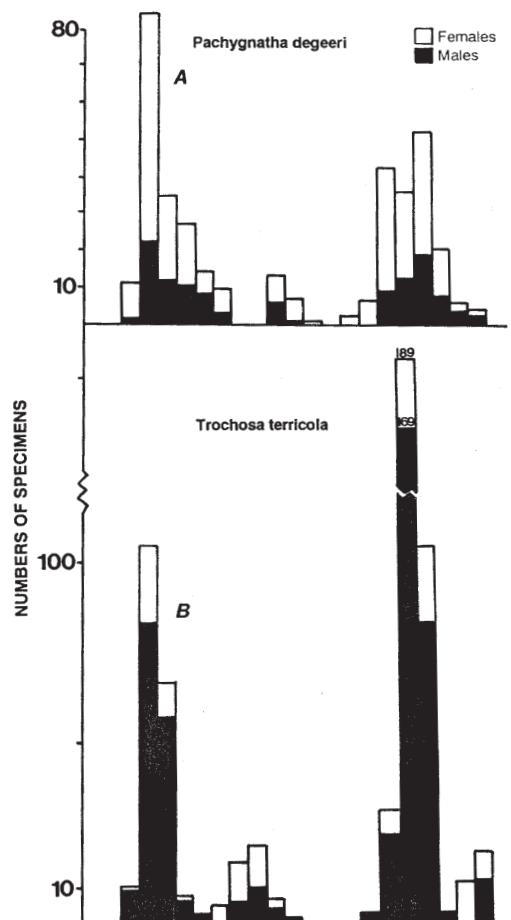


Figure 10
Loc. I. *Pachygnatha degeeri* and *Trochosa terricola*. Numbers of specimens in pitfalls, April 1972-August 1973 (sampling periods in Table 1).

found in square samples (frozen *Sphagnum*) at mid-winter when no activity of the species was registered. *T. terricola* is nocturnal (Schaefer 1972; Flatz 1987, 1988), the *Pardosa* spp. diurnal (Itämiés & Ruotsalainen 1984).

Pachygnatha degeeri is known to be cursorial in the adult stage (Heimer & Nentwig 1991) and shows an activity pattern (Fig.10 A) similar to that of *T. terricola*.

SAMMENDRAG

Edderkopper fra kvadratprøver og fallfeller i kysthei på Vestlandet. Habitatpreferanse, fenologi og fordeling

Et edderkoppmateriale (totalt 74 arter) fra et tilsynelatende karrig og klimatisk hardt utsatt kysthei-landskap i Lindås/Austrheim-området i det vestlige Norge presenteres. Gjennom et drygt år (vår 1972 - sensommer 1973) er det i et utvalgt område tatt kvadrat-prøver og samlet med fallfeller. Materialet viser en forholdsvis rikholdig edderkoppfauna (artsmessig og individmessig) i de vegetasjonsmessig mer varierte delene rik på røsslyng, og med et rikt spekter av andre høyere planter og moser, mens faunaen er noe fattigere i de plantemessige mer homogene (bl.a. lyngfattige) og mer konstant fuktige arealene ensidig dominert av *Sphagnum*. I det klimamessig normalt nokså stabilt fuktige området ser det ut til at lengre tørkeperioder kan ha negativ effekt på den totale tettheten av den bakkelevende edderkoppfaunaen, særlig innen de arealene som er mest utsatt for uttørring, mens den ser ut til å klare seg noe bedre i fuktig *Sphagnum*. Særlig går dette ut over familien Linyphiidae, og spesielt ungdomsstadierne deres. Forskjeller i tetthet og dominans, så vel som ulike data om artenes fenologi skyldes delvis også valg av samplingsteknikk (kvantitative prøver versus barberfellefangster). Fenologiske data basert på begge typer metodikk er gitt for samtlige arter. Noen av de mest dominante artene er kort diskutert m.h.t. økologi og habitat preferanse, segregering i tid og rom, og utbredelse generelt.

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