

## GROUND-LIVING SPIDERS IN BOGS IN NORTHERN EUROPE

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**ABSTRACT.** Spiders were studied in open *Sphagnum* bogs in Sweden, Finland and northern Norway. Material was collected in pitfall traps. Southern sites (hemiboreal zone) differed from coniferous taiga sites (boreal zone, including three subzones), and also the northern sites, north of taiga (palsa and hemiarctic zones) had their own fauna. Typical abundant species for hemiboreal zone was *Pirata uliginosus*, for boreal zone(s) *Pardosa sphagnicola* and *P. hyperborea* and for palsa and hemiarctic zones *Hilaira nubigena* and *Pardosa atrata*. No species was found to be dominant and typical throughout the study area.

**Keywords:** Bogs, abundant spiders, North Europe, Araneae

Peatlands (bogs, fens, mires) are typical habitats in northern Europe, especially in the boreal (taiga) zone (e.g. Euroala et al. 1984). For example, about 30% of the land area of Finland was still classified as peatlands in the 1950's; of this about half has now been changed by human activities; forestry, agriculture and peat harvesting (Wahlström et al. 1996). Although natural peatlands can still be found in northern Europe, in contrast to Central Europe, many organisms living in bogs are now considered endangered. This is true for spiders, e.g., six (or 17.5%) of the 34 spider species included in the Red Data Book of Finland are bog-dwellers (cf. Koponen 2002). The same proportion (17.5%) of the 63 spiders in the Red Data Book of Sweden live in wetlands (bogs or shores of freshwaters) (Gärdenfors 2000).

Although the local spider faunas of bogs in northern Europe have been studied in many countries, only Krogerus (1960), Vilbaste (1980–81) and Koponen et al. (2001) have presented more general analyses of the northern bog fauna. Krogerus (1960) dealt with all arthropods in bogs in Fennoscandia (i.e., Finland, Sweden, Norway and westernmost parts of north Russia); the data on spiders are, due to collecting methods and some taxonomic problems, a little out-of-date when compared with the above-mentioned studies.

In the present paper, I focus on the ground-living spider species in open treeless bogs (*Sphagnum-Eriophorum-Carex* bogs) in different vegetation/bog zones of Finland, Swe-

den and northernmost Norway, east of the Scandian Mountain Range. Main attention is paid to the common (abundant and typical) spider species.

### METHODS

The study sites, 31 bogs, are shown in Table 1. Seven sites are situated in hemiboreal, six in southern boreal, five in middle boreal, five in northern boreal, four in palsa bog (see Euroala et al. 1984) and four in hemiarctic coastal bog zone (see also Fig. 1). All study bogs are situated east of the Scandian Mountain Range (located on the border between Norway and Sweden) at low level, the maximum elevation is 500 m (Varsångssjön site in Sweden). All study sites are situated on the mainland, the Baltic Sea islands being excluded from this paper, due to the special composition of bog spider faunas on islands (e.g., Lehtinen et al. 1979; Almquist 1984; Koponen 2002).

The open peat bogs studied are characterized by *Sphagnum* mosses, cottongrass (*Eriophorum*), sedge (*Carex*) species and cloud-berry (*Rubus chamaemorus*). In addition, low shrubs (*Calluna*, *Ledum*, *Andromeda*, *Betula nana*) and sometimes small pines (*Pinus sylvestris*) are found.

The collecting method was pitfall trapping, 50 traps were used in Karevansuo, 20 traps at other sites. The traps were glass or plastic cups (diameter ca. 6 cm, depth 8 cm) with an aluminium cover to protect traps from rainfall and litter. The preservation liquid was ethylene glycol with some detergent. The distance between traps was 2–3 m, and they were

Table 1.—Study sites in northern Europe; abbreviations for countries and for vegetation zones F = Finland, N = Norway, S = Sweden, I = hemiboreal, II = southern boreal, III = middle boreal, IV = northern boreal, V = palusa bogs, VI = hemiarctic coastal bogs; see Fig. 1.

Bog (parish/area)	Country	Zone	Latitude (N)	Study year
1. Vissmosse (Hörby)	S	I	55°50'	1969
2. Store mosse (Värnamo)	S	I	57°15'	1969
3. Skagershulta (Örebro)	S	I	59°00'	1977
4. Filipstad (Filipstad)	S	I	59°42'	1977
5. Sammalsuo (Halikko)	F	I	60°20'	1970
6. Karevansuo (Masku)	F	I	60°32'	1960's
7. Rehtsuo (Vahto)	F	I	60°35'	1976
8. Stackmora (Orsa)	S	II	61°05'	1977
9. Losemyra (Söderhamm)	S	II	61°25'	1977
10. Kirstula (Renko)	F	II	60°55'	1977
11. Siikaneva (Ruovesi)	F	II	61°52'	1978
12. Haapasuo (Leivonmäki)	F	II	61°54'	1978
13. Lehmo (Kontiolahti)	F	II	62°40'	1970
14. Brana (Östersund)	S	III	63°05'	1977
15. Torsmyra (Umeå)	S	III	63°35'	1977
16. Niemisvesi (Ähtäri)	F	III	62°33'	1969
17. Hirvisuo (Pudasjärvi)	F	III	65°20'	1977
18. Yli-Ii (Ii)	F	III	65°25'	1977
19. Varsängssjön (Östersund)	S	IV	63°06'	1977
20. Vilhelmina (Vilhelmina)	S	IV	64°37'	1977
21. Torankijärvi (Kuusamo)	F	IV	65°58'	1967
22. Hanhimaa (Kolari)	F	IV	67°15'	1978
23. Säytsjärvi (Inari)	F	IV	69°20'	1969
24. Perkosvuoma (Kiruna)	S	V	67°50'	1971
25. Puksalansuo (Utsjoki)	F	V	69°44'	1969
26. Vaisjäggi (Utsjoki)	F	V	69°49'	1977
27. Varangerbotn (Nesseby)	N	V	70°10'	1971
28. Mortensnes (Nesseby)	N	VI	70°10'	1973
29. Kiby (Vadsö)	N	VI	70°05'	1973
30. Vieksajokka (Porsanger)	N	VI	70°22'	1978
31. Simplevatn (Tana)	N	VI	70°25'	1978

placed in lines. Material was collected in the 1960's–1970's (Table 1) by the author. The trapping period was the summer (or growing) season (i.e., 5 months in the south and 2.5 months in the north). The traps were emptied usually once a month. Only one site (Karevansuo in Finland) was studied during three summers, the others were trapped during one summer.

The usefulness of pitfall traps in community studies has been discussed by many authors (e.g., Curtis 1980; Norris 1999). They are suitable for collecting at least common and typical ground-dwelling spider species in a given habitat, especially if trapping is done by the same person. One year of trapping seems to be adequate to find the typical spider species of bogs, despite year to year dif-

ferences (cf. Relys et al. 2002). Dominant and typical species for each zone are listed (Table 3) after average dominance rank, for example if a species was 1<sup>st</sup>, 2<sup>nd</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 3<sup>rd</sup> and 1<sup>st</sup> in abundance in six bogs, its average dominance rank in this zone is  $(12/6) = 2.0$ . The species listed as dominants in a bog zone (Table 3) were found at all bog sites of that zone.

The present material includes 17,360 identified specimens, material is deposited in the Zoological Museum, University of Turku. Nomenclature is according to Platnick (1997) with a few exceptions (*Tricca/Arctosa* and *Agyneta/Meioneta*).

## RESULTS

**A case study.**—The most abundant species, and some rare interesting ones, found in the

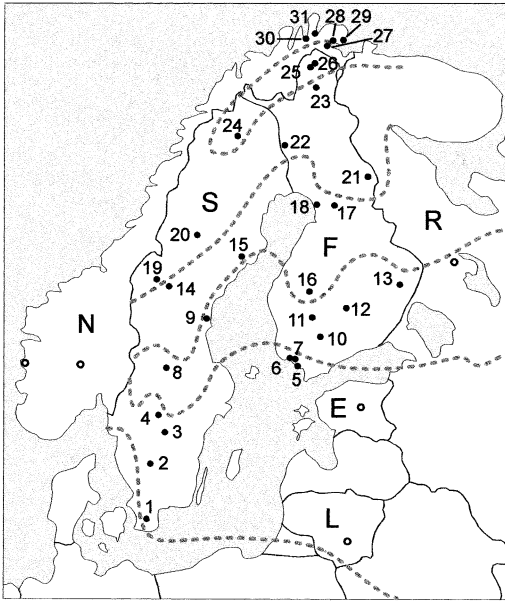


Figure 1.—Study bogs (1–31) and vegetation zones, indicated by dotted lines (modified from Ahti et al. 1968) in northern Europe. Sites 1–7 in hemiboreal, 8–13 in southern boreal, 14–18 in middle boreal, 19–23 in northern boreal, 24–27 in palsa bog and 28–31 in hemiarctic coastal zone, see Table 1. Open circles = comparative data from literature, see the text. Abbreviations for countries: E = Estonia, F = Finland, L = Lithuania, N = Norway, R = Russia, S = Sweden.

most thoroughly studied bog, Karevansuo in Finland, are shown in Table 2. Spiders in this bog, situated near the northern limit of the hemiboreal zone, were collected during three summers. Two species (*Pirata uliginosus* (Thorell 1856) and *Pardosa hyperborea* (Thorell 1872)) clearly dominated, and the ten most abundant species comprised 69% of all material. Among the 20 most abundant species were nine Lycosidae, nine Linyphiidae, one Hahniidae and one Philodromidae species.

**Dominant species.**—The dominant species in each vegetation zone are shown in Table 3. Three boreal zones (southern, middle and northern boreal) had the same two top-scorer species *Pardosa sphagnicola* (Dahl 1908) and *P. hyperborea*, also *Tricca alpigena* (Dobson 1852) was typical in boreal zones. In the southernmost, hemiboreal zone, *Pirata uliginosus* and also *Pardosa pullata* (Clerck 1757) were characteristic species. In two northern-

most zones, palsa and coastal hemiarctic bogs, *Hilaira nubigena* (Hull 1911) and *Pardosa atrata* (Thorell 1873) were typical species. There were no species dominant in all studied six zones, or even in three zones (if boreal ones are combined). The total number of top-scorers (Table 3) was 20, of which nine were lycosids and eight were linyphiids. A general trend was the dominance of lycosid species in hemiboreal and boreal zones (I–IV), and of linyphiids in palsa and especially in coastal hemiarctic bogs (V–VI).

## DISCUSSION

Although the material was collected 20–35 years ago, the spider assemblages are very probably still living in these bogs; bogs are known to be stable habitats under natural conditions (e.g., Karofeld 1995).

When comparing the present data with material from adjacent areas, great faunal similarity (the same abundant species) was found with closely situated bogs in Russian Karelia (near Lake Onega) where the typical boreal bog fauna was reported by Uzenbaev (1987). In the Baltic states, Estonia and Lithuania, fauna generally resembling that in hemiboreal and southern boreal sites of Finland and Sweden was found; however, with some marked differences (Koponen et al. 2001). The present data were more similar with that from Estonia (Vilbaste 1980–81) than with Lithuanian data. For example, the dominant species in Lithuanian peatbogs (Koponen et al. 2001), the lycosid *Aulonia albimana* (Walckenaer 1805), was absent in all present study areas. West of the Scandian Mountain Range, in southern Norway, bog fauna found in continental mountain areas (Hauge & Wiger 1980) partly resembled that of the present study; however, some typical species were missing (e.g., *Pirata uliginosus* and *Gnaphosa lapponum* (L. Koch 1866)). The spider fauna in coastal bogs in southwestern Norway (Pommeresche 1999), differed more from the present one, especially the lycosid fauna (*Pardosa hyperborea* and *P. sphagnicola* missing, and *Pirata hygrophilus* Thorell 1872 dominating).

In general, different vegetation zones had characteristic spider communities. The most southern (hemiboreal) and northern zones (hemiarctic and also palsa zone in lesser degree) differed from the three boreal zones. The border between boreal and palsa zones is

Table 2.—The most abundant species (>10 individuals), and some other interesting bog species, found in Karevansuo bog, Finland;  $n$  = total number of individuals,  $s$  = total number of species.

	Family	Inds.	%
<i>Pirata uliginosus</i> (Thorell 1856)	Lycosidae	885	24.1
<i>Pardosa hyperborea</i> (Thorell 1872)	Lycosidae	802	21.9
<i>Tricca alpigena</i> (Doleschall 1852)	Lycosidae	159	4.3
<i>Trochosa spinipalpis</i> (F.O.P.—Cambridge 1895)	Lycosidae	116	3.2
<i>Agyneta cauta</i> (O.P.—Cambridge 1902)	Linyphiidae	112	3.1
<i>Walckenaeria antica</i> (Wider 1834)	Linyphiidae	110	3.0
<i>Pardosa sphagnicola</i> (Dahl 1908)	Lycosidae	99	2.7
<i>Alopecosa pulverulenta</i> (Clerck 1757)	Lycosidae	93	2.5
<i>Macrargus carpenteri</i> (O.P.—Cambridge 1894)	Linyphiidae	85	2.3
<i>Lepthyphante angulatus</i> (O.P.—Cambridge 1881)	Linyphiidae	80	2.2
<i>Antistea elegans</i> (Balckwall 1841)	Hahniidae	55	1.5
<i>Maro lepidus</i> Casemir 1961	Linyphiidae	55	1.5
<i>Drepanotylus uncatu</i> (O.P.—Cambridge 1873)	Linyphiidae	49	1.3
<i>Pirata piscatorius</i> (Clerck 1757)	Lycosidae	47	1.3
<i>Centromerita concinna</i> (Thorell 1875)	Linyphiidae	46	1.3
<i>Pardosa pullata</i> (Clerck 1757)	Lycosidae	42	1.1
<i>Pirata insularis</i> Emerton 1885	Lycosidae	38	1.0
<i>Thanatus formicinus</i> (Clerck 1757)	Philodromidae	34	0.9
<i>Agyneta affinis</i> (Kulczynski 1898)	Linyphiidae	34	0.9
<i>Bathyphantes gracilis</i> (Blackwall 1841)	Linyphiidae	33	0.9
<i>Stemonyphantes lineatus</i> (Linnaeus 1758)	Linyphiidae	33	0.9
<i>Gnaphosa lapponum</i> (L. Koch 1866)	Gnaphosidae	30	0.8
<i>Drassodes pubescens</i> (Thorell 1856)	Gnaphosidae	26	0.7
<i>Robertus arundineti</i> (O.P.—Cambridge 1871)	Theridiidae	21	0.6
<i>Tallusia experta</i> (O.P.—Cambridge 1871)	Linyphiidae	20	0.5
<i>Bolyphantes luteolus</i> (Blackwall 1833)	Linyphiidae	20	0.5
<i>Agroeca proxima</i> (O.P.—Cambridge 1871)	Liocranidae	19	0.5
<i>Lepthyphantes mengei</i> Kulczynski 1887	Linyphiidae	18	0.5
<i>Haplodrassus signifer</i> (C.L. Koch 1839)	Gnaphosidae	17	0.5
<i>Scotina palliardi</i> (L. Koch 1881)	Liocranidae	15	0.4
<i>Zelotes latreillei</i> (Simon 1878)	Gnaphosidae	15	0.4
<i>Agroeca brunnea</i> (Blackwall 1833)	Liocranidae	13	0.4
<i>Walckenaeria nudipalpis</i> (Westring 1851)	Linyphiidae	13	0.4
<i>Dipoena prona</i> (Menge 1868)	Theridiidae	12	0.3
<i>Bathyphantes parvulus</i> (Westring 1851)	Linyphiidae	11	0.3
<i>Centromerus arcanus</i> (O.P.—Cambridge 1873)	Linyphiidae	11	0.3
<i>Xysticus lineatus</i> (Westring 1851)	Thomisidae	7	
<i>Neon valentulus</i> Falconer 1912	Salticidae	6	
<i>Minicia marginella</i> (Wider 1834)	Linyphiidae	6	
<i>Zora parallela</i> Simon 1878	Zoridae	5	
<i>Haplodrassus moderatus</i> (Kulczynski 1897)	Gnaphosidae	5	
<i>Drassyllus pusillus</i> (C.L. Koch 1833)	Gnaphosidae	4	
<i>Pelecopsis parallela</i> (Wider 1834)	Linyphiidae	3	
<i>Taranucnus setosus</i> (O.P.—Cambridge 1863)	Linyphiidae	3	
<i>Pirata piraticus</i> (Clerck 1757)	Lycosidae	2	
<i>Theonoe minutissima</i> (O.P.—Cambridge 1879)	Theridiidae	2	
<i>Gnaphosa microps</i> Holm 1939	Gnaphosidae	1	
<i>Maro sublestus</i> Falconer 1915	Linyphiidae	1	
<i>Maro minutus</i> O.P.—Cambridge 1906	Linyphiidae	1	
<i>Centromerus levitarsis</i> (Simon 1884)	Linyphiidae	1	
<i>Agyneta mossica</i> (Schikora 1993)	Linyphiidae	1	
<i>Walckenaeria capito</i> (Westring 1861)	Linyphiidae	1	
Total $n$ = 3670, $s$ = 98			

Table 3.—Dominant species in peatbogs in different zones (average dominance rank, see Methods).

I. Hemiboreal zone (7 bogs):	
<i>Pirata uliginosus</i>	4.6
<i>Antistea elegans</i>	6.9
<i>Alopecosa pulverulenta</i>	7.0
<i>Pardosa pullata</i>	8.3
<i>Trochosa spinipalpis</i>	10.1
<i>Walckenaeria antica</i>	10.4
II. Southern boreal zone (6 bogs)	
<i>Pardosa sphagnicola</i>	2.0
<i>P. hyperborea</i>	6.5
<i>Antistea elegans</i>	6.8
<i>Pirata uliginosus</i>	7.0
<i>Tricca alpigena</i>	8.5
<i>Alopecosa pulverulenta</i>	10.5
<i>Trochosa spinipalpis</i>	10.8
III. Middle boreal zone (5 bogs)	
<i>Pardosa sphagnicola</i>	1.4
<i>P. hyperborea</i>	2.2
<i>Tricca alpigena</i>	5.0
<i>Antistea elegans</i>	7.2
<i>Alopecosa pulverulenta</i>	7.6
<i>Walckenaeria antica</i>	9.6
<i>Gnaphosa lapponum</i>	11.0
IV. Northern boreal zone (5 bogs)	
<i>Pardosa hyperborea</i>	4.0
<i>P. sphagnicola</i>	8.0
<i>Centromerus arcanus</i>	10.6
<i>Tricca alpigena</i>	11.2
<i>Walckenaeria nudipalpis</i>	14.0
<i>Lepthyphantes angulatus</i>	14.2
<i>Pardosa atrata</i>	16.2
V. Palsa zone (4 bogs)	
<i>Hilaira nubigena</i>	3.8
<i>Pardosa atrata</i>	4.0
<i>P. hyperborea</i>	4.8
<i>Lepthyphantes angulatus</i>	6.3
<i>Tricca alpigena</i>	12.2
<i>Hahnina ononidum</i> Simon 1875	13.0
VI. Hemiarctic coastal zone (4 bogs)	
<i>Hilaira nubigena</i>	3.3
<i>Bathyphantes gracilis</i>	5.0
<i>Pardosa atrata</i>	9.0
<i>Lepthyphantes angulatus</i>	9.0
<i>Agyreta mossica</i>	9.7
<i>Pelecopsis mengei</i> (Simon 1884)	11.0
<i>Pardosa palustris</i> (Linnaeus 1758)	12.5

clear, and it is especially characterized by the high dominance of the linyphiid *Hilaira nubigena* Hull 1911, while in all more southern zones, two or three lycosids were the most abundant species. The great number of species and abundance of linyphiids in the north (and at high elevations) is a known phenomenon (e.g., Koponen 1993). The generalized division, widely used by geobotanists (cf. Ahti et al. 1968), into hemiboreal, boreal and northern (north of taiga forest zone) zones is supported by data on spider faunas. The general correspondence of spider faunas in bogs with vegetation zones has been earlier shown by the author (Koponen 1994) in Quebec, and also in smaller scale in bogs of southwestern Finland (Koponen 2002).

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