

# CHAPTER 7-5

## ARTHROPODS: SPIDERS OF PEATLANDS IN DENMARK AND TUNDRA

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# CHAPTER 7-5

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Figure 1. *Sphagnum* in flush at Cwm Idwal National Nature Reserve, Wales. Flushes at high elevations and in tundra habitats are often carpeted with *Sphagnum*. Photo by Janice Glime.

### Peatlands

*Sphagnum*, while not the only kind of peatland, forms a variety of habitats in wet areas. Among these are flushes (Figure 1), bogs, poor fens, and intermediate fens. Bogs and poor fens are poor in nutrients, whereas intermediate fens are somewhat more nutrient rich. Flushes can likewise be somewhat richer as nutrients are carried into them from higher elevations. These are mostly northern habitats, with similar habitats occurring in the southern hemisphere at similar latitudes, but deprived of the land mass available in the northern hemisphere.

### Two Acidic *Sphagnum* Fens

Below are some examples of quantitatively important mosses and associated spiders in selected minerotrophic fens of low (acidic) and of moderate alkalinity. Only

spiders that are believed to be strongly or fairly strongly dependent on mosses for habitat are listed. Species restricted to bogs are known as **tyrphobionts** and include quite a few spiders; however, the inhabitants of bogs are not necessarily associated with the moss layer but may inhabit the herb, shrub or tree layer. Species characteristic of bogs but not confined to them are called **tyrphophiles**.

*Sphagnum affine* (Figure 2) has become increasingly rare in Denmark, but its presence indicates ombrotrophic conditions and low nutrient availability. Two acidic *Sphagnum* fens near Lake Salten Langsø serve as examples as they have been fairly well investigated in respect to the moss flora and spider fauna. This subchapter largely represents the research of co-author Jørgen Lissner and includes original unpublished research on those spiders associated with bryophytes in bogs and fens in Denmark.





Figure 2. *Sphagnum affine*, a moss of ombrotrophic fens. Photo by Jan-Peter Frahm, with permission.

### Dalhof Mire (observations by Lissner)

The Dalhof Mire is situated south of Lake Salten Langsø and covers just 1.5 hectare (Figure 3). This acidic *Sphagnum*-dominated fen has evolved from a formerly overgrown lake. The depth of the peat layer is unknown. As is typical of small acidic mires, it is rather species poor concerning mosses, but nevertheless contains a rich spider fauna, including several very rare species. This undoubtedly relates to the fen being very old and the fact that it is situated in a protected landscape far from direct human influences.



Figure 3. At a distance the Dalhof Mire seems to be dominated by sedges and grasses, but at closer inspection *Sphagnum* is found to cover almost the entire surface. Photo by Jørgen Lissner, with permission.

The fen consists of a micro-topographic mosaic of hummocks and hollows (Figure 4). The upper surfaces of hummocks are elevated to 20-30 cm above the surrounding hollows. This level of spatial heterogeneity provides a relatively high number of niches for spiders to occupy, particularly on and within the well-developed hummocks.

There are only a few flowering plants in the hollows, the dominant one being *Eriophorum angustifolium*. A higher number of flowering plant species is found on the hummocks: *Empetrum nigrum*, *Calluna vulgaris*, *Vaccinium oxycoccus*, *Eriophorum vaginatum*, *Molinia caerulea*, and *Pinus sylvestris* are among the commonest.



Figure 4. Hummock in acidic *Sphagnum* fen. It is quite obvious that hummocks provide spider habitats that are very different from those of the surrounding hollows. Photo by Jørgen Lissner, with permission.

The hollows of the Dalhof Mire are dominated by *Sphagnum cuspidatum* (Figure 5) and *S. fallax* (Figure 6). *Sphagnum papillosum* (Figure 15) and *S. rubellum* (Figure 7) are also present in the lawn and/or carpet. Moss-associated spiders found here include *Erigonella ignobilis* (Figure 8; Linyphiidae), *Carorita limnaea* (Figure 9; Linyphiidae), and *Robertus unguilatus* (Figure 10-Figure 11; Theridiidae). At least three other *Robertus* species [*R. lividus* (Figure 13), *R. arundineti* (Figure 54), *R. scoticus* (Figure 14)] are also frequently found among mosses in Northern Europe, all three in bogs elsewhere, but also forests (*R. lividus*), heathland (*R. arundineti*), and mountains (*R. scoticus*).



Figure 5. *Sphagnum cuspidatum* in Europe. Photo by Michael Lüth, with permission.



Figure 6. *Sphagnum fallax*. Photo by Michael Lüth, with permission.





Figure 7. *Sphagnum rubellum*. Photo by Michael Lüth, with permission.

*Erigonella ignobilis* (Figure 8) is a common line-weaving spider (**Linyphiidae**) that prefers damp habitats and is found among damp or wet moss, including *Sphagnum* spp. in many different types of bogs and fens across much of Europe. Cherrett (1964) found that this family exhibited habitat specificity in eight vegetation types that strongly correlated with the availability of other arthropods.



Figure 8. *Erigonella ignobilis* (**Linyphiidae**) male (1.4 mm) on *Sphagnum*. Photo by Jørgen Lissner, with permission.

*Carorita limnaea* (Figure 9; **Linyphiidae**) (1.2 mm) is a rare Palaearctic line-weaving spider, apparently only found in acidic *Sphagnum* fens. At the Dalhof Mire it is most common in mosses growing in the transition zone between hummocks and hollows.



Figure 9. *Carorita limnaea* (**Linyphiidae**) male (1.2 mm) on moss. Photo by Jørgen Lissner, with permission.

*Robertus unguatus* (Figure 10-Figure 11; **Theridiidae**) (~2 mm) is another rare species that lives among very wet moss in hollows of acidic *Sphagnum* bogs, but specimens have also been found among wet *Plagiomnium* (Figure 12) mosses in rich fens with plentiful seeping groundwater.



Figure 10. *Robertus unguatus* (**Theridiidae**) male (2.2 mm) on moss. Photo by Jørgen Lissner, with permission.



Figure 11. *Robertus unguatus* (**Theridiidae**) on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 12. *Plagiomnium undulatum*. Photo by Jan-Peter Frahm, with permission.





Figure 13. *Robertus lividus* (Theridiidae) female on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 14. *Robertus scoticus* (Theridiidae) female, a species listed as vulnerable in Slovakia, on *Sphagnum*. Photo by Walter Pfliegler, with permission.

The hummocks are more species-rich compared to hollows. The following mosses dominate the hummocks in the Dalhof Mire: *Sphagnum papillosum* (Figure 15), *Sphagnum magellanicum* (Figure 16), *Aulacomnium palustre* (Figure 17), and *Polytrichum strictum* (Figure 18), whereas *Sphagnum angustifolium* (Figure 18), *Polytrichum commune* (Figure 20), *Straminergon stramineum* (Figure 21), and *Sphagnum rubellum* (Figure 7) are less abundant. The hummocks also provide habitat for the rare pseudoscorpion, *Microbisium brevifemuratum* (see Chapter 8).



Figure 15. *Sphagnum papillosum* in Europe. Photo by Michael Lüth, with permission.



Figure 16. *Sphagnum magellanicum*. Photo by Michael Lüth, with permission.



Figure 17. *Aulacomnium palustre*. Photo by Janice Glime.



Figure 18. *Polytrichum strictum* from southern Europe. Photo by Michael Lüth, with permission.



Figure 19. *Sphagnum angustifolium* in Europe. Photo by Michael Lüth, with permission.





Figure 20. *Polytrichum commune* showing straight stems and no branching. Photo by George Shepherd, with permission.



Figure 21. *Straminergon stramineum*. Photo by David Holyoak, with permission.

Moss-associated spiders found in the hummocks include *Minicia marginella* (Figure 22-Figure 24; **Linyphiidae**), *Sintula corniger* (Figure 25; **Linyphiidae**), and *Theonoe minutissima* (Figure 26; **Theridiidae**). *Sintula corniger* attaches egg sacks within clumps of *Polytrichum commune* (Figure 20; Harvey *et al.* 2002).



Figure 22. A male of the linyphiid *Minicia marginella* (1.6 mm; **Linyphiidae**) clinging to a *Polytrichum commune* leaf. In Denmark, this species is found only in acidic *Sphagnum* bogs and fens where it appears to prefer the drier (upper) portions of hummocks or drier bogs such as degraded raised bogs. It can be sifted from mosses such as *Polytrichum strictum* and *P. commune*. Photo by Jørgen Lissner, with permission.



Figure 23. *Minicia marginella* (**Linyphiidae**) submale on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 24. *Minicia marginella* (**Linyphiidae**) submale on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 25. *Sintula corniger* (**Linyphiidae**) male (ca. 1.6 mm). A widespread but very local species found among moss and sedges in wet heathland and *Sphagnum* bogs and fens. Photo by Jørgen Lissner, with permission.



Figure 26. *Theonoe minutissima* (**Theridiidae**) on moss. Photo by Jørgen Lissner, with permission.



Other Dalhof Mire spider species, which only sometimes utilize mosses or moss-covered areas as habitat include the **Hahniidae**: *Antistea elegans* (Figure 96); **Linyphiidae**: *Aphileta misera* (Figure 27), *Ceratinella brevis* (Figure 28), *Hypselistes jacksoni* (Figure 29), *Metopobactrus prominulus* (Figure 30), *Tallusia experta* (Figure 31), *Walckenaeria cucullata* (Figure 32), *Walckenaeria nudipalpis* (Figure 33); **Lycosidae**: *Pirata latitans* (Figure 34), *Trochosa spinipalpis* (Figure 35). The latter species is found in damp habitats ranging from acidic *Sphagnum* fens to mineral rich fens. It is frequently found by sifting mosses, which serve as hiding places during the daytime.



Figure 27. *Aphileta misera* on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 28. *Ceratinella brevis* (Linyphiidae) male on moss. Photo by Jørgen Lissner, with permission.



Figure 29. *Hypselistes jacksoni* (Linyphiidae) male on a *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 30. *Metopobactrus prominulus* (Linyphiidae). Photo by Jørgen Lissner, with permission.



Figure 31. *Tallusia experta* (Linyphiidae) male on moss. Photo by Jørgen Lissner, with permission.



Figure 32. *Walckenaeria cucullata* (Linyphiidae) male on moss. Photo by Jørgen Lissner, with permission.



Figure 33. *Walckenaeria nudipalpis* (Linyphiidae) male on *Sphagnum*. Photo by Jørgen Lissner, with permission.





Figure 34. *Pirata latitans* (Lycosidae) female with egg sac on moss. Photo by Jørgen Lissner, with permission.



Figure 35. Female wolf spider *Trochosa spinipalpis* (Lycosidae) (10 mm) photographed with the moss *Paludella squarrosa*. Photo by Jørgen Lissner, with permission.

Some spider species may be found in both hummocks and hollows including the Linyphiidae *Centromerus arcanus* (Figure 36), *Walckenaeria nodosa* (Figure 37- Figure 38), *Walckenaeria acuminata* (Figure 39), and the Lycosidae *Pardosa sphagnicola* (Figure 40).



Figure 36. *Centromerus arcanus* (Linyphiidae) female (2 mm), a common species in a variety of damp habitats, primarily coniferous woodland, wet heathland, and acidic bogs and fens. This tyrphophile species is frequently found among moss, but is not strictly associated with mosses and can be found in wet leaf litter as well. Photo by Jørgen Lissner, with permission.



Figure 37. The male head of *Walckenaeria nodosa* (Linyphiidae) is elevated into a characteristic bulbous lobe. The species measures ca. 2 mm and is associated with *Sphagnum* in poor fens and in depressions of wet heathland. Photo by Jørgen Lissner, with permission.



Figure 38. *Walckenaeria nodosa* (Linyphiidae) female on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 39. The male *Walckenaeria acuminata* (Linyphiidae) (ca. 3 mm) with its peculiar head drawn out into a stalk carrying eight eyes, four midway and four at top. This species is found in a wide array of usually damp habitats. Occasionally it has been sifted from *Sphagnum* lawn carpets of bogs and fens. Photo by Jørgen Lissner, with permission.

The male of *Pardosa sphagnicola* (Figure 40; Lycosidae) has a body length of 5 mm. This species is one of many species of wolf spiders found in moss-dominated bogs and fens. Wolf spiders are capable of running rapidly



about during periods with warm and sunny conditions and hunt their prey on the surface of mosses as well as on water surfaces. When disturbed by trampling they can be observed to run on water surfaces, seeking cover. During cold periods they hide within mosses. Sifting mosses often reveals a high number of wolf spiders of all sizes, mostly belonging to the species-rich genera *Pardosa* and *Pirata*. Many species construct vertical silk tubes within moss clumps. These tubes are used as retreats when the spiders are not running about.



Figure 40. *Pardosa sphagnicola* (Lycosidae) male (5 mm) on moss. Photo by Jørgen Lissner, with permission.

### Naesgaard Mire (observations by Lissner)

The Naesgaard Mire (Figure 41) is a small (0.75 ha) mire formed in a dead-ice depression near the west end of Lake Salten Langsø. There are hardly any hummocks and the entire mire is very wet, particularly during the winter (Figure 41). The moss vegetation is dominated by *Sphagnum cuspidatum* (Figure 5), much of which is growing submersed, and *Sphagnum fallax* (Figure 6). *Eriophorum vaginatum* dominates among the flowering plants.



Figure 41. The Naesgaard Mire is a very wet *Sphagnum* fen dominated by *Sphagnum cuspidatum* (Figure 42) and *Eriophorum vaginatum*, the latter species forming the tussocks seen on the image. There are only a few, indistinct hummocks. Photo by Jørgen Lissner, with permission.

The spider fauna is not particularly rich, but it does include some rare species, among these *Glyphesis cottonae* (Figure 55; Linyphiidae) found in wet *Sphagnum*. Other

species associated with mosses include *Drepanotylus uncatus* (Figure 56; Linyphiidae), *Maro lepidus* (Figure 57; Linyphiidae), *Pirata piscatorius* (Figure 58; Lycosidae), and *Theonoe minutissima* (Figure 26; Theridiidae).



Figure 42. *Sphagnum cuspidatum*, a species that typically grows submersed, frequently bordering a lake or pool. Photo by Michael Lüth, with permission.

The female of the small comb-footed spider, *Theonoe minutissima* (Figure 26; Theridiidae), measures just 1.2 mm. It may be found in a variety of habitats, but is most commonly found in acidic *Sphagnum* bogs and fens. At the Dalhof Mire this species is found often deep down in hummocks dominated by *Sphagnum magellanicum* (Figure 16). Perhaps it prefers cavities within hummocks just above the water surface.

Other Naesgaard Mire spider species which may not strictly depend on mosses include Hahniidae: *Antistea elegans* (Figure 96); Linyphiidae: *Cnephlocotes obscurus* (Figure 44), *Diplocephalus permixtus* (Figure 43), *Erigonella ignobilis* (Figure 8), *Gnathonarium dentatum* (Figure 45), *Gongyliellum vivum* (Figure 46), *Lophomma punctatum* (Figure 47), *Micrargus herbigradus* (Figure 48), *Oedothorax gibbosus* (Figure 49-Figure 50), *Oryphantes angulatus* (Figure 51), *Palliduphantes ericaeus* (Figure 52-Figure 53), and *Tallusia experta* (Figure 31); Lycosidae: *Pirata latitans* (Figure 34); Theridiidae: *Robertus arundineti* (Figure 54).



Figure 43. *Diplocephalus permixtus* (Linyphiidae) female on *Sphagnum*. Photo by Jørgen Lissner, with permission.





Figure 44. *Cnephalocotes obscurus* (Linyphiidae) on *Sphagnum*. Photo by Morten D. D. Hansen, with permission.



Figure 45. *Gnathonarium dentatum* (Linyphiidae) male on moss. Photos by Jørgen Lissner, with permission.



Figure 46. *Gongylidiellum vivum* (Linyphiidae) male on *Sphagnum*. Photo by Jørgen Lissner, with permission.

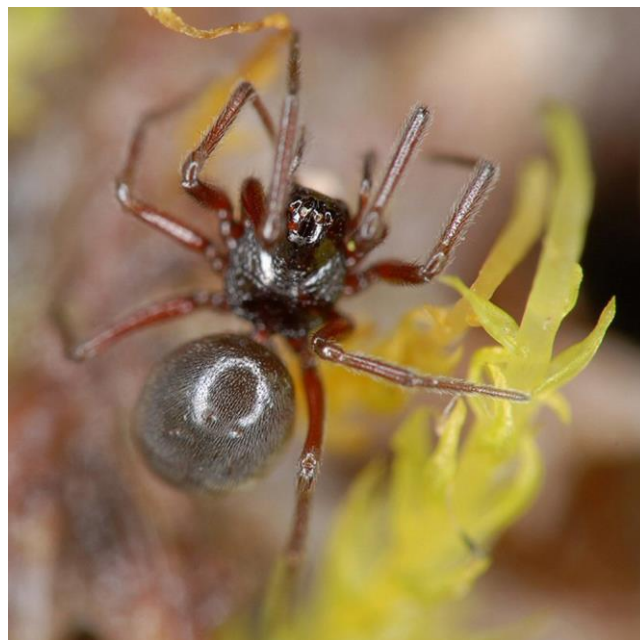


Figure 47. *Lophomma punctatum* (Linyphiidae) female. Photo by Jørgen Lissner, with permission.



Figure 48. *Micrargus herbigradus* (Linyphiidae) female on moss. Photo by Jørgen Lissner, with permission.





Figure 49. *Oedothorax gibbosus* (Linyphiidae) female on *Sphagnum*. Photo by Jørgen Lissner, with permission.



Figure 50. *Oedothorax gibbosus* (Linyphiidae) male on *Sphagnum*. Photo by Jørgen Lissner, with permission.

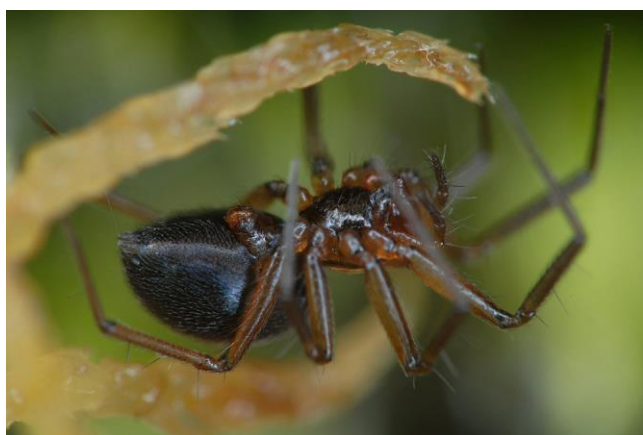


Figure 51. *Oryphantes angulatus* (Linyphiidae) female on *Sphagnum*. Photo by Jørgen Lissner, with permission.

The rare and very small *Sphagnum* mire inhabitant, *Glyphesis cottonae* (Figure 55; Linyphiidae) (0.9-1.0 mm), has a very scattered occurrence throughout its range, apparently being absent from most *Sphagnum* bogs and mires. At the Naesgaard Mire it is found in *Sphagnum fallax* (Figure 6) and *S. cuspidatum* (Figure 5) in wet parts of the mire. It is unlikely that the species is widely overlooked as it is often abundant where it occurs. Perhaps the dispersal capacity of this species is low since there are

plenty of mires having suitable micro-habitats without the presence of this species. Both *Sphagnum fallax* and *S. cuspidatum* are very common members of the moss flora in northern European acidic fens, so we should expect a more common occurrence of *Glyphesis cottonae*.



Figure 52. *Palliduphantes ericaeus* (Linyphiidae) female on moss. Photo by Jørgen Lissner, with permission.



Figure 53. *Palliduphantes ericaeus* (Linyphiidae) male on moss. Photo by Jørgen Lissner, with permission.



Figure 54. *Robertus arundineti* (Theridiidae) male. Photo by Jørgen Lissner, with permission.





Figure 55. *Glyphesis cottonae* (Linyphiidae) (0.9-1.0 mm) on *Sphagnum* in a mire. Photo by Jørgen Lissner, with permission.

Another widespread Palearctic moss inhabitant, *Drepanotylus uncatus* (Figure 56; Linyphiidae), reaches a body length of 3 mm. The male is easily recognized by the curved palpal tibial apophysis just visible on the image. This species is found among mosses in acidic bogs and fens. More rarely, records relate to mosses of neutral or alkaline mesotrophic fens.



Figure 56. Male *Drepanotylus uncatus* (Linyphiidae) (3 mm) on *Sphagnum*. Note the curved palpal tibial apophysis just visible on the image. Photo by Jørgen Lissner, with permission.

The small male of *Maro lepidus* (Figure 57; Linyphiidae) measures just 1.2 mm in body length and belongs to the line-weaving spider family. This is a rather uncommon species most often found in wet *Sphagnum* of acidic bogs and fens, such as raised bogs and *Sphagnum* depressions of wet heathland. In Denmark, this species has been found among *Sphagnum fallax* (Figure 6) on several occasions.



Figure 57. *Maro lepidus* (Linyphiidae) male (1.2 mm) on moss. Photo by Jørgen Lissner, with permission.

As one of the largest members of *Pirata*, *P. piscatorius* (Lycosidae) (8 mm) bears resemblance to fishing spiders (*Dolomedes* spp.). The species is confined to very wet habitats and constructs a vertical silken tube (retreat) in *Sphagnum* mats which extends down below the water surface. If disturbed the spider will escape down below the water surface (Bristowe 1923 in Harvey *et al.* 2002). It is found in a wide array of wetlands such as carr, mires, bogs and fens, but is more frequent in acidic bogs and fens than in rich fens.



Figure 58. *Pirata piscatorius* (Lycosidae) (8 mm) bears resemblance to fishing spiders (*Dolomedes* spp.). Photo by Jørgen Lissner, with permission.

## Raised Bogs

In their treatise on spiders of raised peat bogs in Poland, Kupryjanowicz *et al.* (1998) considered the spiders of raised peat bogs to form three groups: 1) inhabiting sunlit peat bog [*Sphagnetum magellanici* (Figure 16)], 2) occupying moderately illuminated *Ledo-Sphagnetum*, 3) preferring shaded peat bogs (*Vaccinio uliginosi-Pinetum*). These three habitats are separated by the relative contributions of peat bog and forest species. Forest shading decreases the number of peat bog species. They found that there are a number of **hygrophilous** (water-loving) and **heliophilous** (sun-loving) species that were common to all the study areas.

As discussed earlier, Kupryjanowicz *et al.* (1998) found 203 species of spiders in the six raised bogs of their



Polish study areas. Komposch (2000) found no relationship between percentage of endangered arachnids and diversity or evenness of wetland communities or with percentage of endangered plant species. Some species are not known outside raised bogs. These include **Gnaphosidae**: *Gnaphosa microps* (Figure 59); **Lycosidae**: *Arctosa alpigena lamperti* (Figure 60); **Linyphiidae**: *Glyphesis cottonae* (Figure 55), *Meioneta mossica* (see Figure 61); **Liocranidae**: *Scotina palliardi*; **Salticidae**: *Heliophanus dampfi* (Figure 62); and **Theridiidae**: *Theonoe minutissima* (Figure 26). Most of the raised bog species are more general peat bog species, including **Linyphiidae**: *Agyneta cauta*, *Aphileta misera* (Figure 27), **Gnaphosidae**: *Gnaphosa nigerrima* (Figure 63), **Lycosidae**: *Pardosa hyperborea* (Figure 64), *P. maisa*, and *P. sphagnicola* (Figure 65); or hygrophilous species such as **Linyphiidae**: *Drepanotylus uncatus* (Figure 56), and *Notioscopus sarcinatus* (Figure 98); and **Lycosidae**: *Pirata uliginosus* (Figure 66).



Figure 61. *Meioneta affinis* (Linyphiidae) female on moss. This species lives on moss, grass, and dry stones (Nentwig *et al.* 2012). Photo by Jørgen Lissner, with permission.



Figure 59. *Gnaphosa microps* (Linyphiidae). Photo by Glenn Halvor Morka, with permission.



Figure 62. *Heliophanus dampfi* on leaf. Photo by Jørgen Lissner, with permission.



Figure 60. *Arctosa alpigena lamperti* on *Sphagnum*. Photo by Rudolf Macek, with permission, with permission.



Figure 63. *Gnaphosa nigerrima* male on moss. Photo by Jørgen Lissner, with permission.





Figure 64. *Pardosa hyperborea*. Photo by Walter Pfliegler, with permission.



Figure 65. *Pardosa sphagnicola*, carrying spiderlings, on *Sphagnum* and the lichen *Cladina*. Photo by Walter Pfliegler, with permission.



Figure 66. *Pirata uliginosus* (Lycosidae), a bog dweller. Photo by Jørgen Lissner, with permission.

Stewart (2001) found *Heliophanus dampfi* (Figure 62; Salticidae) in Britain for the first time on a raised bog at Flanders Moss. In all, he found 118 species of spiders at Flanders Moss. Lycosids comprised 41% of the trapped specimens, with *Pirata uliginosus* (Figure 66; Lycosidae) (177 individuals) overshadowing the usually more common *Pirata piraticus* (Figure 67) (2 individuals). But the most common species in traps was the tetragnathid *Pachygnatha degeeri* (Figure 68) (440 individuals), most of which were trapped in the drier area at the edge of the moss, in heather and tufts of grass, perhaps not really using the moss habitat.



Figure 67. *Pirata piraticus* in bog. Photo by Trevor and Dilys Pendleton at <<http://www.eakingbirds.com/>>, with permission.



Figure 68. *Pachygnatha degeeri* (Tetragnathidae) male on moss. Photo by Jørgen Lissner, with permission.

Other species from mosses in Flanders Moss include *Agroeca proxima* (Figure 69; Liocranidae) (nocturnal hunter), *Neon reticulatus* (Figure 70; Salticidae), *Ozyptila* (Figure 71; slow walkers; Thomisidae), *Pirata piraticus* (Figure 67; Lycosidae), *Scotina gracilipes* (Figure 72; Liocranidae) (nocturnal hunter), *Xysticus* (Figure 73; Thomisidae) (slow walkers), *Zora spinimana* (Figure 74; Zoridae) (daytime hunter) (Stewart 2001).





Figure 69. *Agroeca proxima* (Liocranidae) male on moss. Photo by Jørgen Lissner, with permission.



Figure 72. *Scotina gracilipes* (Liocranidae) female on moss. Photo by Jørgen Lissner, with permission.



Figure 70. *Neon reticulatus* (Salticidae). Photo by Trevor and Dilys Pendleton <[www.eakringbirds.com](http://www.eakringbirds.com)>, with permission.



Figure 73. *Xysticus ferrugineus* (Thomisidae) female on moss. Photo ©Pierre Oger, with permission.



Figure 71. *Ozyptila trux* on moss. Photo by Jørgen Lissner, with permission.



Figure 74. *Zora spinimana* (Zoridae) female on sand. Photo ©Pierre Oger, with permission.

*Robertus lividus* (Figure 13; Theridiidae) is a common spider of a number of grassy and mossy habitats. It appeared in only one of the two bogs in this Danish study. *Pholcomma gibbum* (Figure 75; Theridiidae) is a 1.5 mm spider common in grass, moss, and detritus at Flanders Moss, but absent in the Danish studies.





Figure 75. *Pholcomma gibbum* (Theridiidae) female on moss. Photo by Jørgen Lissner, with permission.

Of interest is the presence of *Pachygnatha clercki* (Figure 76-Figure 77; Tetragnathidae) at Flanders Moss. We did not find this spider listed in any of the other studies included in this chapter, but it is a very common species in many habitats where it is found among low vegetation in places such as bogs or marshes and the edges of ponds, rivers, and streams (Harvey *et al.* 2002). This spider makes no web and hunts at ground level among mosses and low plants in damp places (Stewart 2001).



Figure 76. *Pachygnatha clercki* (Tetragnathidae) male on leaf. Photo by Ed Nieuwenhuys, with permission.



Figure 77. *Pachygnatha clercki* (Tetragnathidae) female on leaf. Photo by Ed Nieuwenhuys, with permission.

### Raised Bogs in Denmark (observations by Lissner)

The spider fauna of raised bogs is relatively rich, at least when compared to the vegetation, which is rather species poor. A significant fraction of the spider species is associated with higher strata of the vegetation or is mainly confined to leaf litter in the lagg-zone. Three raised bogs situated in Denmark serve as examples here.

**Lille Vildmose** is the largest raised bog found in northwestern Europe, covering more than 20 sq. km. An additional 2.5 sq. km of degraded raised bog is found in the area. The Kongens Mose raised bog and the Storelung raised bog are much smaller, covering 1.6 sq. km and 0.3 sq. km, respectively, both with degraded parts. Projects aimed at restoring degraded parts of these bogs have been initiated.

The **Lille Vildmose** raised bog in Denmark contains relatively large, undisturbed areas dominated by *Sphagnum cuspidatum* (Figure 5) in the hollows and *S. magellanicum* (Figure 16) and *S. rubellum* (Figure 7) on the hummocks. Unique, raised bog structures have evolved, such as well-developed secondary lakes created over time by relatively higher decomposition rates of *S. cuspidatum* dominating the hollows compared to decomposition rates of other *Sphagnum* species growing on the hummocks. Plants occurring with some abundance, but otherwise rare in the region include *Scheuchzeria palustris*, *Rubus chamaemorus*, *Drosera anglica*, and *Sphagnum affine* (Figure 78). The latter has become increasingly rare in Denmark; its presence indicates ombrotrophic conditions and low nutrient availability. *Calluna vulgaris* is one of the commonest flowering plant species on the bog surface. A range of biotopes adjoin the bog area, including various forest types and open areas with acidic and calcareous grassland as well as dry and wet heathland. As a consequence of the variety of habitats the entire area is



very species rich. About 300 spider species have been recorded at the Lille Vildmose, more than half the number of species known from the entire country of Denmark.



Figure 78. *Sphagnum affine*. Photo by Jan-Peter Frahm, with permission.

The **Kongens Mose** raised bog contains remnants of undisturbed raised bog but also areas that have been degraded by peat cutting and drainage. The bog is bordered to the east by Draved Forest, one of the best natural forests of Denmark. The combined spider fauna of these two areas is very rich.

The **Storelung** raised bog consists mostly of forested wetland, but about 10 ha is raised bog with degraded parts or recently restored areas.

Spider species found among mosses in these three raised bogs include *Clubiona norvegica* (Figure 79; **Clubionidae**), *Gnaphosa nigerrima* (Figure 63; **Gnaphosidae**), and *Centromerus levitarsis* (Figure 81; **Linyphiidae**).

The female *Clubiona norvegica* measures 6.5 mm. It belongs to the family **Clubionidae** (sac spiders), so-named because they make silken sacs (Figure 80) as retreats on plants and rocks. In much of its range it is a rare inhabitant of *Sphagnum* bogs, including raised bogs. Here, it can be sifted from moss and *Sphagnum*, but it may also sometimes be swept from higher vegetation, such as *Salix*.



Figure 79. This female *Clubiona norvegica* (**Clubionidae**) measures 6.5 mm. This specimen was found among *Sphagnum* with sparse *Molinia* in an wet area of the bog with much open water. Photo by Jørgen Lissner, with permission.



Figure 80. **Clubionidae** retreat sac. Photo by Aniruddha Dhamorikar through Creative Commons.



Figure 81. Ventral view of the female *Centromerus levitarsis* (**Linyphiidae**) showing the characteristic long, slender scape of the epigyne. This specimen was sifted from *Sphagnum palustre* at the Storelung raised bog and measures ca. 1.8 mm. Photo by Jørgen Lissner, with permission.

## Two Spring-Fed Mires

Lake Bredsgård (12 ha) and Lake Rosborg (75 ha, Figure 100) serve as examples of **mesotrophic fens** with a high number of moss species and a diversity of microhabitats. Both fens are the results of failed land reclamation projects which were aimed at draining the lakes for agriculture and pasture. However, the areas remained too wet after drainage due to the presence numerous springs along the former bottoms and lake sides supplying a large and constant amount of cold groundwater. At the fens, seep areas are found with rare, but characteristic, bryophytes, e.g. *Cratoneuron filicinum* (Figure 82), *Paludella squarrosa* (Figure 83), and *Hamatocaulis vernicosus* (Figure 84). The two fens are also microrefugia for the yellow marsh saxifrage (*Saxifraga hirculus*), a threatened and declining plant in most of Europe.



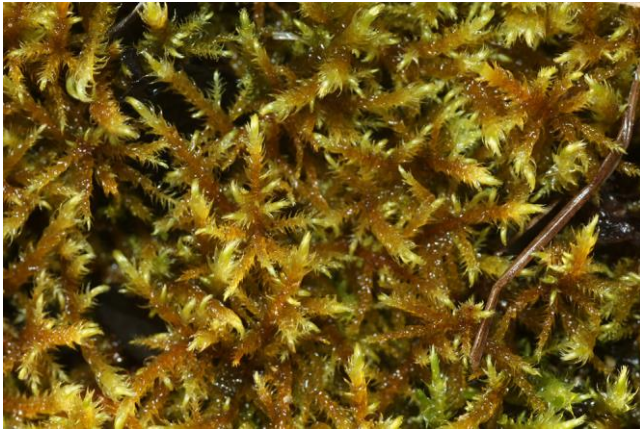


Figure 82. *Cratoneuron filicinum*. Photo by Barry Stewart, with permission.



Figure 83. *Paludella squarrosa* in Europe. Photo by Michael Lüth, with permission.



Figure 84. *Hamatocaulis vernicosus* in Europe. Photo by Michael Lüth, with permission.

The combined moss flora of both fens counts to about 65 species, indicating that these fens are of regional importance. A number of liverworts are known from the fens, but only *Marchantia polymorpha* (Figure 85) occurs with some abundance. At least twelve *Sphagnum* species occur in the fens. *Sphagnum palustre* (Figure 86), *Sphagnum teres* (Figure 87), *Sphagnum fimbriatum* (Figure 88), and *Sphagnum warnstorffii* (Figure 89) are quantitatively important and form mats of some sizes

locally. *Aulacomnium palustre* (Figure 17), *Calliergonella cuspidata* (Figure 90), *Climacium dendroides* (Figure 91), *Dicranum bonjeanii* (Figure 92), and *Polytrichum commune* (Figure 20) dominate among the other bryophyte species. In addition, *Helodium blandowii* (Figure 93) and *Tomentypnum nitens* (Figure 94) may locally dominate seep areas.



Figure 85. *Marchantia polymorpha*. Photo by James K. Lindsey, with permission.



Figure 86. *Sphagnum palustre* in Europe. Photo by Michael Lüth, with permission.



Figure 87. *Sphagnum teres* in Europe. Photo by Michael Lüth, with permission.





Figure 88. *Sphagnum fimbriatum* in Europe. Photo by Michael Lüth, with permission.



Figure 89. *Sphagnum warnstorffii* in Europe. Photo by Michael Lüth, with permission.



Figure 90. *Calliergonella cuspidata* in Bretagne. Photo by Michael Lüth, with permission.



Figure 91. *Climacium dendroides*. Photo by Janice Glime.



Figure 92. *Dicranum bonjeanii* in Europe. Photo by Michael Lüth, with permission.



Figure 93. *Helodium blandowii* in Europe. Photo by Michael Lüth, with permission.



Figure 94. *Tomentypnum nitens*. Photo by J. C. Schou, with permission.

#### Lake Bredsgård (observations by Lissner)

The spider fauna of Lake Bredsgård is not thoroughly investigated. Moss-associated spider species include **Hahniidae**: *Antistea elegans* (Figure 96); **Linyphiidae**: *Ceratinella brevis* (Figure 95), *Erigonella ignobilis* (Figure 8), *Maso sundevalli* (Figure 97), *Notioscopus sarcinatus* (Figure 98), *Oedothorax gibbosus* (Figure 49-Figure 50), *Walckenaeria cuspidata* (Figure 103); **Salticidae**: *Sitticus caricis* (Figure 102); **Theridiidae**: *Robertus arundineti* (Figure 54).





Figure 95. *Ceratinella brevis* (Linyphiidae) on moss. Photo by Jørgen Lissner, with permission.

*Antistea elegans* (Figure 96; Hahniidae) belongs to the lesser cobweb spiders, characterized by having the spinners arranged in a transverse row. The male has a body length of about 3 mm. The species builds a small sheet over depressions at ground level (Cattin *et al.* 2003). It has been recorded from a variety of damp habitats, including bogs with wet *Sphagnum*.



Figure 96. *Antistea elegans* (Hahniidae) on *Sphagnum*. The male shown here has a body length of 3 mm. Photo by Jørgen Lissner, with permission.



Figure 97. *Maso sundevalli* (Linyphiidae) female on moss. Photo by Jørgen Lissner, with permission.



Figure 98. *Notioscopus sarcinatus* (Linyphiidae) male (2 mm) positioned on *Cinclidium stygium* (Figure 99), a rare moss of minerotrophic fens. The spider is found in a variety of mosses, perhaps most numerous in *Sphagnum warnstorffii* (Figure 89), a common species of minerotrophic fens. Note the peculiar conical process on the carapace separated from the head by a narrow slit. Photo by Jørgen Lissner, with permission.



Figure 99. *Cinclidium stygium*. Photo by Kristian Peters through Wikimedia Commons.

#### Lake Rosborg (observations by Lissner)

Moss-associated spiders of Lake Rosborg (Figure 100) include **Linyphiidae**: *Aphileta misera* (Figure 27), *Gnathonarium dentatum* (Figure 45), *Lophomma punctatum* (Figure 47); **Gnaphosidae**: *Gnaphosa nigerrima* (Figure 63); and **Salticidae**: *Sitticus caricis* (Figure 102).



Figure 100. Lake Rosborg, a spring-fed mire with a rich moss flora. Photo by Jørgen Lissner, with permission.



*Aphileta misera* (Figure 27; **Linyphiidae**) is a small and indistinct species of the line-weaving spiders. The female shown measures ca. 2 mm. The species is fairly common in various types of acidic bogs. Some records from rich fens could relate to mineral poor areas of heterogeneous rich fens. Egg sacks have been found affixed within clumps of *Polytrichum commune* (Figure 20) (Harvey *et al.* 2002).

Another ground spider, *Gnaphosa nigerrima* (Figure 101) is found in among mosses in both acidic bogs and rich fens. The male measures ca. 7 mm. The species can be found in wet *Sphagnum*-dominated hollows of raised bogs as well as within dense clumps of ribbed bog moss [*Aulacomnium palustre* (Figure 17)] in rich fens, mosses of quite different bryological life forms. This nocturnal spider emerges at night to hunt actively, but hides during the day in a silken retreat within the moss carpet. The spider is rather rare in much of its range, which is peculiar considering it is frequently found among common moss species. One of its favorites, *Aulacomnium palustre*, is very common in a wide array of mire habitats. Nevertheless, this spider species (at least in Denmark) is only found in the very best bogs and mires with high species diversity.



Figure 101. *Gnaphosa nigerrima* (Gnaphosidae) on mosses. Photo by Jørgen Lissner, with permission.



Figure 102. The jumping spider *Sitticus caricis* (4 mm, **Salticidae**) inhabits bogs and fens and hunts among low vegetation and on the surface of *Sphagnum* mats. Photo by Jørgen Lissner, with permission.



Figure 103. *Walckenaeria cuspidata* (Linyphiidae) male on *Sphagnum*. Photo by Jørgen Lissner, with permission.

## Tundra Peatlands

Tundra peatlands are extensive and the influence of *Sphagnum* on the water regime and nutrient cycling is extensive. The *Sphagnum* acts like a sponge, holding water until its capacity is reached, then releasing it suddenly, causing rushes because the permafrost beneath it is impenetrable. In the summer, this vast peat carpet becomes a safe site for spiders, providing moisture and a refuge from the high UV light of the tundra sunshine.

In the Arctic tundra, the tundra influence may be greater than the influence of bogs and *Sphagnum*. The Arctic bogs of the Yukon have more **Linyphiidae** than do the forests there (Dondale *et al.* 1997). Dondale *et al.* found *Ceratinopsis stativa* in moss and litter (and also in mosses in forests), *Erigone blaesae* in bog litter, *Hybauchenidium gibbosum* (Figure 104) in moss and plant litter, *Kaestneria rufula* (Figure 105) in moss and plant litter, *Oreonetides vaginatus* (Figure 106) in plant litter, *Procerocymbium sibiricum* in moss and litter in spruce bogs, *Scotiotylus sacer* in bog litter, and *Walckenaeria clavicornis* (Figure 107) in moss in bogs and heaths.



Figure 104. *Hybauchenidium gibbosum*. Photo by John Sloan, with permission.



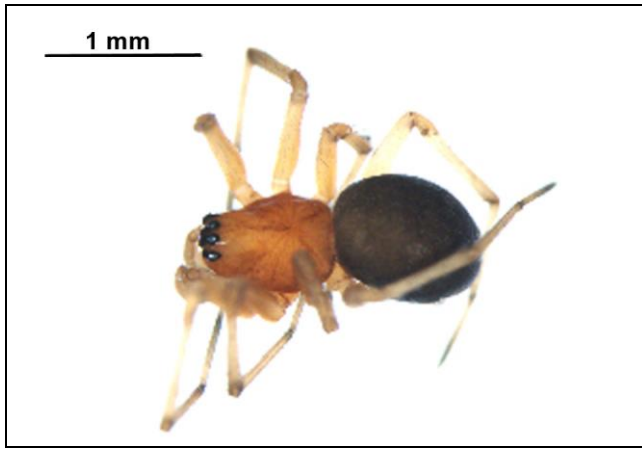


Figure 105. *Kaestneria rufula*. Photo by Gergin Blagoev through Bold Systems Creative Commons.



Figure 106. *Oreonetides vaginatus* on leaf. Photo by Rudolf Macek, with permission.



Figure 107. *Walckenaeria clavicornis* with closeup of cephalothorax in lower image. Photos by Jørgen Lissner, with permission.

Not surprisingly, due to the open nature of the habitat, the Yukon **Lycosidae** are represented by a number of species (Dondale *et al.* 1997). *Arctosa raptor*, *Pardosa sodalis* in moss in larch or spruce bogs, *Pirata piraticus* (Figure 67) in moss and herbs in bogs, and *Pirata zelotes* in bogs and swamps. These are probably only surface relationships, but the mosses undoubtedly play a role in creating a suitable habitat. Likewise, in the **Salticidae** *Cobanus cambridgei* (as *Sitticus finschii*) occurs in litter in spruce bogs. The **Gnaphosidae** are represented by *Micaria pulicaria* and *M. tripunctata* among bog mosses, the latter in spruce bogs.

In the Faroe Islands, many of the species are found in bogs or with *Sphagnum*, but most are also in other habitats. These multi-habitat species associated with *Sphagnum* or bogs included **Hahniidae**: *Hahnia montana* (Figure 108) (Harvey *et al.* 2002; Lissner 2010, 2011), **Linyphiidae**: *Centromerita bicolor* (Figure 109) (Lissner 2011), *Centromerus arcanus* (Figure 36) [bogs (Harvey *et al.* 2002)], *Erigone psychrophila* (Figure 110) [*Sphagnum* at the edge of bog pools (Harvey *et al.* 2002), *Hilaira nubigena* (Figure 111) [*Sphagnum* bog; also in Britain (Holm 1980; Lissner 2011)], *Improphantes complicatus* (Figure 112) [*Sphagnum* bogs (Lissner 2011)], *Saaristoa abnormis* (Figure 113) [among *Sphagnum* (Holm 1980)], *Semljicola faustus* (Figure 114) [among *Sphagnum* in bog of pine forest (Bengtson & Hauge 1979; Holm 1980)], *Walckenaeria clavicornis* (Figure 107) [in bogs of Greenland (Holm 1967) and in *Sphagnum* in Britain (Harvey *et al.* 2002)]. *Walckenaeria nodosa* (Figure 37-Figure 38) [a moss dweller in the Faroes (Lissner 2011), occurs in lowland bogs in Britain (Harvey *et al.* 2002)] and *Walckenaeria nudipalpis* (Figure 33) in bogs (Holm 1980). The **Lycosidae**, as in lower latitude bogs and tundra in general, are relatively common, including *Arctosa alpigena* (Figure 115) [in *Racomitrium* (Figure 116-Figure 117) of the Faroes (Harvey *et al.* 2002) and *Sphagnum* bogs of Sweden (Almqvist 2005)], and *Pardosa palustris* (Figure 118) [*Sphagnum* bogs (Schenkel 1925; Holm 1980; Bengtson & Hauge 1979)].



Figure 108. *Hahnia montana* (Hahniidae). Photo by Jørgen Lissner, with permission.





Figure 109. *Centromerita bicolor* female on moss. Photo by Jørgen Lissner, with permission.



Figure 110. *Erigone psychrophila* (Linyphiidae) male on moss. Photo by Jørgen Lissner, with permission.



Figure 111. *Hilaira nubigena* (Linyphiidae). Photo by Glenn Halvor Morka, with permission.



Figure 112. *Hylyphantes nigrinus* (Linyphiidae). Photo ©Pierre Oger, with permission.



Figure 113. *Saaristoa abnormis* (Linyphiidae). Photo ©Pierre Oger, with permission.



Figure 114. *Semljicola faustus*. Photo by Jørgen Lissner, with permission.





Figure 115. *Arctosa alpigena* (Lycosidae) from *Sphagnum*. Photo by Barbara Thaler-Knoflach, with permission.



Figure 118. *Pardosa palustris* female with spiderlings. Photo by Walter Pfliegler, with permission.



Figure 116. *Racomitrium* hummocks in Iceland. Photo by Janice Glime.



Figure 119. *Micaria constricta* (Gnaphosidae). Photo by Biodiversity Institute of Ontario through Creative Commons.

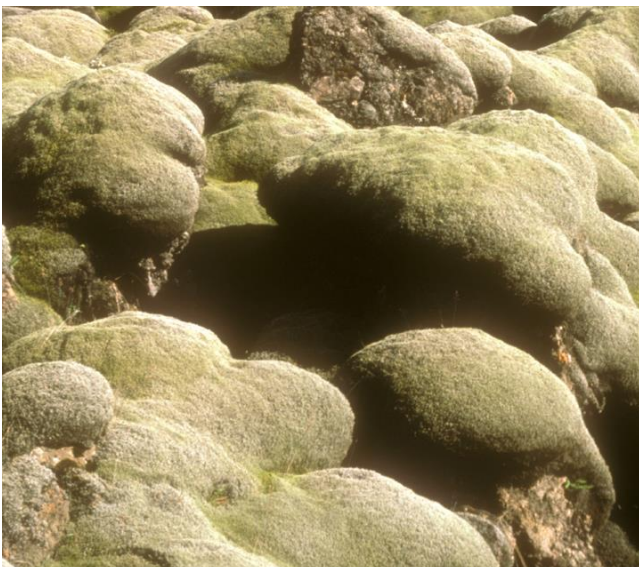


Figure 117. *Racomitrium canescens* hummocks in Iceland. Photo by Janice Glime.



Figure 120. *Xysticus* sp. (Thomisidae) preying on an insect. Photo by Hectonicus through Wikimedia Commons.



The US Fish and Wildlife Service (Global Species 2013) constructed a food web for the fauna of *Sphagnum fuscum* (Figure 121) in the Alaskan tundra. Among the organisms featured in this web was the spider *Pirata piraticus* (Figure 67; **Lycosidae**). He indicated that the springtail (**Collembola**) *Bourletiella hortensis* served as a primary food source for this spider in the *S. fuscum* hummocks. On the other hand, birds were the main predators of the spiders, including the Lapland Longspur (*Calcarius lapponicus*), Common Redpoll (*Carduelis flammea*), and Boreal Chickadee (*Poecile hudsonica*). While this food web serves only to provide examples, it does emphasize the importance of tundra *Sphagnum* habitats as a source of food for spiders, in this case emphasizing springtails.

This tundra moss species synonymium was described by Popp in 1962. He found *Limnozetes ciliatus* and *L. rugosus* in association with it.



Figure 121. *Sphagnum fuscum* hummock. Photo by Michael Lüth, with permission.

## Summary

Peatlands include flushes, bogs, poor fens, and intermediate fens, as well as moors and mires. They are extensive in the Arctic, where they are important in controlling the hydrology and temperature.

The Danish mires are represented by spider families that are typical in mires elsewhere, including the **Linyphiidae**, **Theridiidae**, **Hahniidae**, and **Lycosidae**. Many of these are small spiders that live among the stems of the *Sphagnum*. Some Lycosidae make tubes that permit them to move quickly from the surface of the moss mat to below the water surface, providing a quick escape route.

Raised bogs represent true bogs where water input is entirely from precipitation. Their communities of spiders depend on the amount of sunlight reaching the moss canopy, with shading causing a decrease in bog species. In addition to the families common in the Danish mires, they also house the **Gnaphosidae** and **Salticidae**, and even the **Tetragnathidae**. Others may be **Liocranidae**, **Thomisidae**, and **Zoridae**. In Denmark, **Clubionidae** join the fauna.

Springfed mires are fens with more nutrients than bogs but still have at least twelve species of *Sphagnum*. The spider families are similar, despite the differences in plant species. *Gnaphosa nigerrima* hides in a silken

retreat in the moss carpet, especially *Aulacomnium palustre*, but is rare despite its widespread preferred moss species.

The tundra peatlands often have unique flora, perhaps due to their geographic isolation. Their species sometimes coincide with those of lowland bogs. Due to the open nature and available sunshine, **Lycosidae** are common. *Racomitrium* hummocks are common and can be inhabited by *Arctosa alpigena*. Other arthropods, especially **Collembola**, are important as food for the spiders.

Of the 112 families of spiders, the number of families typical of peatlands are only a small representation.

## Acknowledgments

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