Spiders (Araneae) from three human-influenced habitats in the Golsfjellet mountain area, central southern Norway

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Three sites at 900 m a.s.l. in the sub-alpine mountain birch forest region and under different levels of human-influence were investigated. Site 1: An open birch forest with some scattered spruces, a rich bush and field layer and a rich moss cover; very little grazed. Site 2: Tree and bush layer removed, a rich field layer invaded by open area species and some 'culture indicators'; there was a rich moss cover. Site 3: Grazed; tree layer, bush layer and moss cover absent. Pitfall trapping (18 May – 18 Aug. 2000) in site 1-3 resulted in 48, 48 and 22 spider species (in total 64 species). In site 1 and 2 *Pardosa riparia* (C.L.Koch, 1833) and *Alopecosa pulverulenta* (Clerck, 1757) were dominating. *P. sphagnicola* (Dahl, 1908) was also fairly common in site 1, *P. palustris* and *P. hyperborea* (Thorell, 1872) in site 2. Site 3 was almost completely dominated by *Pardosa palustris* (73.2 %) and *Erigone atra* Blackwall,1841 (18.2 %); present (absent elsewhere) were also some specimens of *Oedothorax retusus* (Westring, 1851) (4.6 %).

Key words: Araneae, Southern Norway, sub-alpine, birch forest, pitfalls, grazing.

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INTRODUCTION

Cultivated landscapes are undergoing noticeable changes in Norway today, both as a consequence of regrowth following the abandonment of farms and pastures but also of various human activities. The botanical aspects of these changes have been fairly well documented in our country and much valuable information has become available. In regard to invertebrates, however, knowledge is much more fragmentary and arbitrary. For spiders there are only a few examples (Hauge & Kvamme 1983; Andersen 1990; Hauge et al.1991, 2000). However, several species of spiders in Norway are at present Red Listed, mostly because their habitat is in danger of being destroyed (Aakra & Hauge 2000). In nature conservation in general, most invertebrate groups have been largely neglected (van Helsdingen 2000). The present paper is a small contribution to the knowledge about how ground living spider associations may react to changes in their environment.

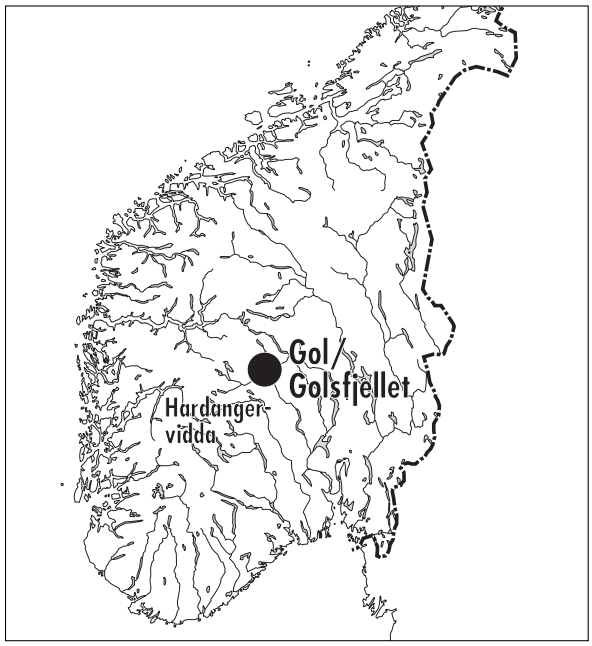

Figure 1
Map of southern Norway showing the location of Gol and the Golsfjellet area. Indicated is also the Hardangervidda high mountain plateaux in the central high mountain areas.

SAMPLING AREA AND METHODS

The Landscape

The Golsfjellet mountain area is situated north-west of the village of Gol, in the western parts of Buskerud county (Fig.1). The

investigated area (900 m a.s.l.) and its surroundings lie in the sub alpine mountain birch region of the north boreal vegetation zone situated east of the south Norwegian central high mountains separating the oceanic western areas ('Vestlandet') and the more continental eastern areas from each other. According to Moen (1998, map 95) the vegetation here should probably be characterised as between weak continental and weak oceanic. From Moen (1998, map 7,8,10 and 11) mean temperatures for January and July may be estimated to approximately –10 ºC and +10 ºC, respectively (the 10 ºC isotherm for the warmest month of the year usually being associated with the tree-line), the yearly precipitation is relatively low (400-500 mm), particularly when comparing with western Norway but to some degree also with the more eastern lowland areas. The numbers of rainy days are 160-170. The summer of the year 2000 was extremely rainy.

This fairly open landscape has for centuries been influenced by various activities like grazing, mowing, cutting of wood, hunting, building of cottages and smaller roads. Three localities, at present undergoing different exploitation by man, were chosen. The terrain is almost flat, sloping very weakly northwards.

The sampling sites

Site 1. Overgrown. An open birch forest (*Betula pubescens*) with some scattered spruces, grazing occurred only sporadically (sheep). The area has remained in this state of overgrowing since at least World War II, at present characterised botanically as a transition zone between a *Vaccinium myrtillus*-forest and a small fern forest, with many forest species present. *Juniperus communis* and *Salix glauca* were dominating in the fairly well developed bush layer. There were also some *Betula nana* and scattered specimens of *Picea abies*. The most common vascular plants in the rich field layer were *Dryopteris linneana*, *Vaccinium myrtillus, V.vitis-idaea, Empetrum* sp. and *Deschampsia flexuosa*. *Maianthenum bifolium, Trientalis europaea, Vaccinium uliginosum and Oxalis acetocella* were also common. Otherwise *Alchemilla alpina, Nardus stricta*, *Polygonum viviparum, Festuca ovina, Agrostis tenuis* and *Luzula frigida* (the last three species indicating cultural influence) were present. *Linnaea borealis* and *Luzula pilosa* were more sporadic in occurrence. There was a rich moss cover (mainly *Pleurozium* sp.).

Site 2. Cleared. Previously a *Vaccinium myrtillus*-forest dominated by *Betula pubescens, Juniperus communis, Salix glauca* and some *Picea abies*. The tree and bush layers were removed in autumn 1999. The site might now be characterised as a transition zone with some forest species left. Most common were *Deschampsia flexuosa* and *Vaccinium myrtillus*. Present were also *V.vitis-idaea, V. uliginosum, Empetrum* sp., *Luzula pilosa, Maianthenum bifolium, Ophrys insectifera*, *Melampyrum* sp., *Trientalis europaea, Aconitum septentrionale, Geranium silvaticum, Polygenum viviparum, Festuca ovina* and *Lycopodium annotinum.* Rarest were *Nardus stricta, Calluna vulgaris* and *Betula nana*. *Luzula frigida* (culture indicator) and *Carex canescens* (culture indicator and pioneer species) were also present, as well as the five pioneer species *Campanula rotundifolia, Anthoxanthum odoratum, Alchemilla alpina*, *Ranunculus acris* and *Agrostis tenuis*. The rich moss cover was dominated by *Pleurozium* sp. and *Dicranum* sp. In addition *Polytrichum* sp. and lichens (*Cladonia* sp. and *Cetraria islandica*) were present.

Site 3. Grazed. Tree- and bush layer as well as mosses were absent. Hard grazing usually occur in the area (cows); however, because of the pitfall trapping grazing was kept to a minimum in the summer of 2000. In the field layer most common plants were *Deschampsia caespitosa, Phleum pratense, Poa alpina, Trifolium repens, Achillea millefolium, Leontodon autumnalis* and *Ranunculum acris.* Present were also *Poa pratense, Alchemilla alpina, Agrostis tenuis, Oxalis acetocella, Anthoxanthum odoratum* and *Stellaria graminea*. *Taraxacum cordatum* and *Festuca rubra* were sporadic in occurrence.

In the three rather large localities 48 pitfall traps were arranged in rows, in each row eight traps were placed 2 to 3 m from each other. The traps were 0.33 l glasses (diameter of opening 5.8 cm) half filled with 4% formaldehyde and provided with a zinc roof for protection against rain. The traps were operating from 19 May to 18 August (emptied also 18 June and 18 July).

Adult spiders have been identified to species and are deposited at Bergen Museum. The nomenclature follows Platnick (2000) and (the Linyphiidae) Tanasevitch (2000).

RESULTS AND DISCUSSIONS

General

The total number (64) of species (Table 1) almost equals the number (66) known from the low alpine Hardangervidda/Finse area in the central high mountains (Hauge & al. 1998, Hauge & Ottesen in prep.). However, despite having several species in common with these low alpine areas, our species list is somewhat different. Typical high mountain species are fewer, the number of Nordic lowland (open land and forest) species higher.

Table 1 indicates that a rich ground flora is beneficial to the ground living spider fauna, especially when combined with a well developed moss cover. The latter is in particular very important for small net building species of the Linyphiidae (Palmgren 1972) which, for several reasons, may segregate vertically in the moss cover (Hauge 1998) and therefore contribute to the increase of species diversity in the area. Hence, site 1 and 2 both housed more than twice the number of species (48) com-

Tabl1 1. Spiders at Golsfjell 2000, males/females in 3 sites and 3 sampling periods (seasonal).

SPECIES	1. Overgrown	2. Cleared	3.Grazed	Seasonal
Lycosidae				
Alopecosa pinetorum (Thorell, 1856)	4/2	9/1	1/0	13/2 - 2/0 - 0/1
A. pulverulenta (Clerck, 1757)	89/28	91/20	19/1	183/27-11/7-5/15
Pardosa amentata (Clerck, 1757)	1/0	1/1		1/1-0/1-0/0
P. fulvipes (Collett, 1875)			2/0	0/0-0/0-2/0
P. hyperborea (Thorell,1872)	10/17	42/12	1/0	38/7-13/5-1/7
P. lugubris (Walckenaer, 1802) (s.stricto)	3/12	9/7		3/12-9/7-0/0
P. palustris (Linnaeus, 1758)	13/2	79/14	773/367	392/61-295/88-176/234
P. riparia (C.L.Koch, 1833)	134/74	158/59	5/0	241/63-51/21-5/49
P. sphagnicola (Dahl, 1908)	65/38	1/1		33/15-30/14-3/9
Pirata piraticus (Clerck, 1757)	8/10			0/0-8/8-0/2
Gnaphosidae				
Gnaphosa lapponum (L. Koch, 1866)	16/9	6/2	1/0	2/1-7/0-14/10
G. leporina (L. Koch, 1866)	13/3	12/5	4/0	6/2-17/5-6/1
Haplodrassus signifer (C.L.Koch, 1839)	7/4	6/0	3/1	15/5-1/0-0/0
Micaria alpina L.Koch, 1872	2/0	2/0		0/0-0/0-4/0
Zelotes subterraneus (C.L.Koch, 1833)	1/0			0/0-1/0-0/0
Clubionidae				
Clubiona reclusa (O.P.-Cambridge, 1863)		1/0		1/0
Thomisidae				
Ozyptila trux (Blackwall, 1846)	1/1			1/0-0/0-0/1
Xysticus cristatus (Clerck, 1757)	1/1	1/0	4/0	5/1-1/0-0/0
X. luctuosus (Blackwall, 1836)	2/2	2/2		3/1-1/0-0/3
X. obscurus Collett, 1877	10/0	2/1		
Linyphiidae				
Agyneta subtilis (O.P.-Cambridge, 1863)	1/0	1/0		2/0-0/0-0/7
Allomengea scopigera (Grube, 1859)			0/1	0/0-0/0-0/1
Asthenargus paganus (Simon, 1884)	3/0	1/4		3/2-1/0-0/2
Bathyphantes gracilis (Blackwall, 1841)	1/1			0/1-1/0-0/0
Bolephthyphantes index (Thorell, 1856)		0/1		01-0/0-0/0
Centromerus arcanus (O.P.-Cambridge, 1873)	11/1	1/2		10/3-2/0-0/0
C. bicolor (Blackwall, 1833)			0/1	0/1-0/0-0/0
Ceratinella brevipes (Westring, 1851)	1/1			1/1-0/0-0/0
Cnephalocotes obscurus (Blackwall, 1834)	4/1	4/1	0/1	7/1-0/1-0/2
Dicymbium tibiale (Blackwall, 1836)	13/5	10/5	2/0	25/7-0/2-0/1
Diplocentria bidentata (Emerton, 1882)	22/6	18/5	1/1	35/10-5/1-0/0
Diplocephalus latifrons (O.P.-Cambridge, 1836)	2/2	14/5	0/1	14/3-2/4-0/1
Erigone atra Blackwall, 1841		3/1	250/34	133/14-102/10-18/11
E. dentipalpis (Wider, 1834)		1/0		1/0-0/0-0/0
Gonatium rubellum (Blackwall, 1841)		1/2		0/0-0/1-1/1
G. rubens (Blackwall, 1833)	1/4	0/5		0/8-0/1-1/0
Hilaira frigida (Thorell, 1872)	1/0			1/0-0/0-0/0
H. pervicax Hull, 1909		1/0		1/0-0/0-0/0
Lepthyphantes antroniensis Schenkel, 1933	7/3	4/1		11/0-0/3-0/1
L. obscurus (Blackwall, 1841)	1/0			0/0-0/0-0/1
Leptorhoptrum robustum (Westring, 1851)	4/1	1/0	1/0	0/0/-0/0-4/1
Macrargus carpenteri (O.P.-Cambridge, 1894)		0/1		0/0-0/1-0/0
M. rufus (Wider,1834)	0/1	0/1		0/0-0/2-0/1
Maro sublestus Falconer, 1915	1/0			1/0-0/0-0/0
Maso sundevalli (Westring, 1851)	0/1	5/6		0/5-0/2-5/0

continued next page

Tabl1 1. Continued

SPECIES	1. Overgrown	2. Cleared	3.Grazed	Seasonal
Mecynargus morulus (O.P.-Cambridge, 1873)			1/0	0/0-1/0-0/0
Minyriolus pusillus (Wider, 1834)	3/0	1/0		4/0-0/0-0/0
Oedothorax retusus (Westring, 1851)			34/40	19/8-9/25-6/7
Oreonetides vaginatus (Thorell, 1872)	1/0	1/0		1/0-0/1-0/0
Oryphantes angulatus (O.P.-Cambridge, 1881)	18/5	6/5		24/6-0/2-0/1
Porrhomma pallidum Jackson, 1913	6/2	1/1		5/1-0/1-2/1
Savignia frontata (Blackwall, 1833)			4/2	1/1-3/10/0
Semljicola faustus (O.P.-Cambridge, 1900)	4/2			4/1-0/1-0/0
Sintula corniger (Blackwall, 1856)		7/0		7/0-0/0-0/0
Tapinocyba pallens (O.P-.Cambridge, 1872)	14/4	16/1		29/5-1/0-0/0
Tenuiphantes alacris (Blackwall, 1853)	2/0	1/6		3/4-0/2-0/0
T. mengei (Kulczynski, 1887)	1/4	0/2		1/0-0/0-0/6
T. tenebricola (Wider, 1834)	11/5	1/2		0/0-2/2-10/5
Thyreosthenius parasiticus (Westring, 1851)			0/1	0/0-0/1-0/0
Walckenaeria cuspidata (Blackwall, 1833)	0/4	2/1		2/4-0/1-0/0
W. nudipalpis (Westring, 1851)	0/2	0/2		0/3-0/1-0/0
Araneidae				
Cercidia prominens (Westring, 1851)	0/1	3/1		1/2-1/0-1/0
Hahniidae				
Cryphoeca silvicola (C.L.Koch, 1834)	1/0	0/3		0/4-0/0-0/0
Hahnia ononidum Simon, 1875		2/0		0/0-2/0-0/0
Sum specimens	771	718	1557	
Sum species	48	48	22	

pared to the 22 species captured in the heavily grazed moss free site 3, mainly due to the high proportion of the net building species. Site 1 and 2 were rather equal as to their spider species content (Sørensen index of similarity = 0.81), while clearly more different from site 3 (in both cases Sørensen index = 0.40).

As to the *numbers of specimens* captured at site 1 and 2, the Lycosidae were dominating, *Pardosa riparia* (C.L.Koch,1833) and *Alopecosa pulverulenta* (Clerck,1757) in both sites, *P. sphagnicola* (Dahl,1908) (scarce/absent elsewhere) in site 1, while the two (more or less) open land species *P. palustris* (L.,1758) and *P. hyperborea* Thorell,1872) seem to increase their abundance somewhat in site 2.

In contrast to sites 1 and 2, the total number of specimens (1557) trapped within the poorer plant association of site 3 was more than twice as high as the fairly equal numbers (771 and 718, respectively) trapped in sites 1 and 2 (Table 1). The very dominant *Pardosa palustris* and the subdominant *Erigone atra* Blackwall, 1841 (partly also *Oedothorax retusus* (Westring, 1851)), are responsible for that. Altogether they comprise 96.0 % of the total number of adult specimens trapped in site 3. They are all common (frequent) and partly very abundant in Fennoscandian low alpine areas, in southern Norway (Hauge et al.1978, Hauge et al.1998, Hauge & Ottesen in prep.) as well as in northern Fennoscandia (Holm 1950, Palmgren 1965). Like in Hauge (2000, table 2), the dominance values of the spider species associations in the two more diverse plant societies (site 1 and 2) are more even.

Notes on some species

P. palustris is known to prefer open, not too humid habitats, and reported as very common above the tree line (Holm 1950). At Finse it was the most common *Pardosa* species (Hauge & Ottesen in prep.) and was given the label 'xeric-mesic', obviously competing with the 'mesic-hygric' *P. amentata* (Clerck, 1757); the latter probably preferring some shelter as well. At Golsfjellet *P. amentata* was absent from the grazed area and scarce elsewhere (Table 1), in site 1 and 2 there was perhaps competition from other hygric species like the fairly abundant *P. sphagnicola*.

The latter was characterised as 'exclusive sphagnicolous' (Holm & Kronestedt 1970). Like *Pirata piraticus* (Clerck, 1757), it was at Golsfjellet (Table 1) virtually restricted (almost) to the woodland area (site 1), here occurring together with the abundant *P. riparia*. The latter is reported as common in relatively open habitats on high ground in both northern and central Europe (Holm

& Kronestedt 1970). At site 2 it was still present in large numbers (together with a fairly high population of *P. palustris*). At site 3, however, it seems to suffer from hard competition from *P. palustris*. *P. hyperborea*, in northern Fennoscandia preferring relatively open sub alpine birch forest (Holm 1950), seems (like *P. riparia*) to be slightly more abundant in the cleared area (site 2) and scarcer in the grazed area (site 3). It was present but scarce in the low alpine areas at Finse (Hauge & Ottesen in prep.).

Pardosa lugubris (Walckenaer,1802) (s.stricto) is widely distributed in Europe and known from a variety of forest types, in woodland clearings and along hedges (Töpfer-Hofmann et al. 2000). At Golsfjellet it was present but relatively scarce in sites 1 and 2, and totally absent from the grazed area (site 3).

Also *Alopecosa pulverulenta* is to our knowledge unknown from areas above the tree line in Fennoscandia. It was, however, relatively abundant in sites 1 and 2, and present in site 3 as well. On the west Norwegian coast (Hauge et al. in prep.) it was fairly common in some relatively open forests, while *Pardosa lugubris* was totally absent from the area.

Also the Gnaphosidae and Thomisidae seem to be somewhat less frequent in site 3. Except for *Zelotes subterraneus* (C.L. Koch,1833), all gnaphosids (and the thomisid species *Xysticus cristatus* (Clerch,1757)) in our list are common species in the south Norwegian low alpine areas. *Gnaphosa lapponum* (L.Koch,1866) and *Micaria alpina* L.Koch,1872 should in southern Norway be considered a typical high mountain species; while *Gnaphosa leporina* (L.Koch, 1866) and *Haplodrassus signifer* (C.L.Koch,1839) are common in lowland areas as well. *G. leporina* is present even on the west Norwegian coastal islands.

Erigone atra is in southern Norway found in open areas, from the western coastal areas to the high mountains (Hauge et al. in prep.). It was absent in the catches from site 1 and very scarce in site 2. However, in site 3 it was the dominating linyphiid species. This is perhaps no surprise, as it is a well known aeronaut and pioneer species. From pitfall trapping in the Finse area it was given the ecological label 'xeric-mesic' (Hauge & Ottesen in prep.), mostly due to its aeronautic habits. When based on *square samples* from the low alpine areas of Hardangervidda high mountain plateaux (Hauge et al.1998), it seems to prefer rather wet habitats and to shun the driest ones. This is in some contrast to the second dominant linyphiid species at site 3 (*Oedothorax retusus*), which at Hardangervidda obviously preferred drier habitats (Hauge et al.1998, Table 1 and 2), more in accordance with the label 'xeric mesic' formally put on it by Hauge and Ottesen (in prep.). Although very sparse, *O. retusus* is known from coastal western Norway (Hauge et al. in prep.). Here the hygrophilous *O. fuscus* (Blackwall, 1834) was locally abundant. In the North Atlantic both species are known north to Shetland (Ashmole 1979). Both were collected at sea level far into a west Norwegian fjord as well; *O. retusus* locally abundant, *O. fuscus* very scarce (Hauge et al. 2000).

SAMMENDRAG

Edderkopper (Araneae) i menneskepåvirkede habitater.

Våre data fra dette subalpine bjørkeskogsområdet på Golsfjellet (900 m.o.h.) viser at fjerning av tre- og/eller buskskiktet har en viss effekt på noen arter i den bakkelevende edderkopp-faunaen. Dette går ut over fuktighetsavhengige arter, mest tydelig for lycosidene *Pardosa sphagnicola* og *Pirata piraticus*. Lyset som økologisk faktor antydes best ved den utpregede åpenmarksarten *Pardosa palustris*, den mest vanlige fjellarten av samtlige jaktedderkopper på listen. Den foretrekker også i større grad halvtørre marker, og konkurrerer ut sine øvrige slektsfrender i område 3. Selv med et trefritt område (lok. 2), men med feltskikt og moselag intakt og uten altfor sterke beitepåkjenninger, beholdes en relativ lang artsliste (dvs. høy diversitet) hos disse marklevende edderkoppene. Similaritetsindeksen (0.81) mellom område 1 og 2 viser da at disse er temmelig like artsmessig sett. Men man ser også at de noe mindre utpregede skogsartene øker sin tetthet noe fra område 1 til 2 (Tabell 1). I forhold til område 1 og 2 er forandringene i artslisten mer tydelig på område 3, hvor beitetrykket tydelig har forarmet vegetasjonen. Antall arter minker betraktelig (til under det halve), og kun et fåtall arter (3 stykker) dominerer antallsmessig. Disse er, i tillegg til *Pardosa palustris*, de to pionerartene *Oedothorax retusus* og *Erigone atra* (en velkjent aeronaut). Begge hører til blant de små nettbyggende artene i familien Linyphiidae som beitingen ellers går mest utover. For svært mange av disse artene lever godt beskyttet i moseskiktet, hvor plass (mosedekkets tykkelse for den vertikale artssegregeringen) og vegetasjonens struktur (for nettbyggingen) betyr mye.

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