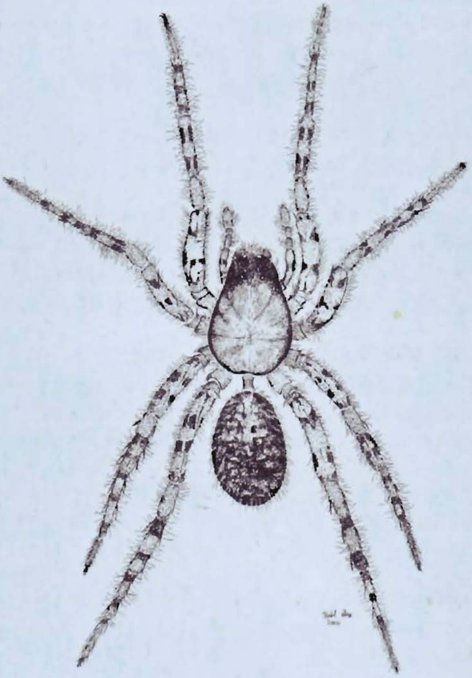
Norwegian Journal of Entomology

Volume 49 No. 2 • 2002



Published by the Norwegian Entomological Society
Oslo and Stavanger

NORWEGIAN JOURNAL OF ENTOMOLOGY

A continuation of *Fauna Norvegica Serie B* (1979-1998), *Norwegian Journal of Entomology* (1975-1978) and *Norsk entomologisk Tidsskrift* (1921-1974). Published by The Norwegian Entomological Society (Norsk entomologisk forening).

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Front cover: *Arctosa stigmosa* (Thorell, 1875) (Araneae, Linyphiidae). Artist: Kjetil Aakra.

Printed by: Reprografisk Industri AS, Oslo

Norw. J. Entomol. 49, 77–80. 2002

Discovery of the rare alate morph of *Acyrthosiphon svalbardicum* Heikinheimo (Homoptera; Aphididae): description and implications for species ecology

Ian D. Hodkinson, Stephen J. Coulson, Jeremy Bird & Nigel R. Webb

Hodkinson, I.D., Coulson, S.J., Bird, J.M. & Webb, N.R. 2002. Discovery of the rare alate morph of *Acyrthosiphon svalbardicum* Heikinheimo (Homoptera; Aphididae): description and implications for species ecology. Norw. J. Entomol. 49, 77-80.

A single alate female of the endemic Svalbard aphid *Acyrthosiphon svalbardicum* is recorded from Storholmen in the Lovén Islands, Kongsfjord, West Spitsbergen. This species has been studied intensively but has hitherto been regarded as entirely apterous. The female is described in detail and the ecological implications of the discovery are discussed in the context of previous work, particularly in relation to the life cycle, dispersal and colonisation.

Key words: *Acyrthosiphon svalbardicum*, *Dryas*, alate, dispersal, colonisation, induction.

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BACKGROUND

Acyrthosiphon svalbardicum Heikinheimo, 1968 is endemic to Spitsbergen, Svalbard. Its general life history and ecology have been studied extensively on Kongsfjord adjacent to Ny-Ålesund where it was known only from apterous forms (Heikinheimo 1968; Strathdee *et al.* 1993c). *A. svalbardicum* feeds on *Dryas octopetala* and its life cycle is highly unusual among high Arctic insects in that it completes up to three generations during the short summer growing season. It overwinters as eggs that hatch to give fundatrices, a proportion of which give rise to apterous males and females, which then mate and lay overwintering eggs (Strathdee *et al.* 1993b; 1995a;). This represents the safe, reliable option that ensures continuity from year to year. However, the remaining fundatrices produce a further generation of viviparae, which then give rise to the males and females that produce additional overwintering eggs. This is the risky option that is only successful in warmer seasons but which allows *A. svalbardicum* sporadically to exploit enhanced growing conditions. It has been argued that the lack of winged forms, which severely limits dispersal, coupled with minimum day degree requirements to complete the life cycle, restricts the spatial distribution of *A. svalbardicum* populations to microclimatically favourable sites adjacent to the fjord margins within the inner fjord. This is despite its host plant being more widely distributed (Strathdee & Bale 1995).

During several years of study *A. svalbardicum* was exposed to many of the stimuli that induce the development of alate forms in other aphids. These include raised temperature, crowding and culturing on detatched sub-optimal host plants within the laboratory (Strathdee 1993a,b; 1995b). Alate forms were never seen, either in the laboratory or field. Decreasing daylength, another possible factor, is also ruled out because of 24 h daylight throughout the effective development period.

In 2000 we discovered the apterous form of *A. svalbardicum* on Midtholmen and Storholmen two of the Lovén Islands in Kongsford, lying about 3 km from the mainland. This immediately raised the question of how a non-robust apterous aphid could cross this marine barrier. The question was potentially answered in summer 2001 when a single alate female was discovered in association with many apterous males and females in a late season Storholmen sample. The description of this unique female is given below. It is interesting to note that we operated 28 yellow sticky traps continually throughout the 2001 season at sites adjacent to areas where *A. svalbardicum* was abundant but did not catch a single dispersing adult aphid.

DESCRIPTION OF THE ALATE ADULT FEMALE OF *A. SVALBARDICUM*

Detailed descriptions of the fundatrix, vivipara ovipara and male morphs, together with species diagnostic features, were given in Strathdee *et al.* (1993c). For comparison the description below follows, as far as possible, the same format. Illustrations were prepared using SYNCROSCOPY *Automontage* and *Montage Explorer* packages to enhance images captured using a JVC3CCD video camera mounted on a Nikon Optiphot 2 microscope from the specimen mounted in canada balsam on a slide.

Morphological features

Whole insect (Figure 1) slightly larger than the other described morphs: note the anomaly in the branching sequence of the M vein of the left forewing. Antenna (Figure 2) with 5 large and 1-3 smaller placoid sensilla on segment 3 and a subapical rhinarium on segments 5 and 6; process terminalis of segment six 1.86 times length of proximal part. Apical segment of rostrum (Figure 3) with 2 oval depressions, bearing 1 subapical seta (0.028 mm) on each lateral margin. Siphunculus (Figure 4) elongate, equal in length to process terminalis. Caudal process (Figure 5) similar to other female morphs, bearing 4 lateral seta along each outer margin.

Measurements (in mm)

Body length 1.74. Forewing length 2.44 , antennal length 1.22. Length of individual segments 3,4,5,6a and 6b are 0.30, 0.20, 0.21, 0.13 and 0.25 respectively. Length of siphunculus 0.26. Length of caudal process 0.18. Length of apical segment of rostrum 0.18. Length of femur - fore 0.43, mid 0.42, hind 0.51. Length of tibia - fore 0.69, mid 0.64, hind 0.89. Length of apical tarsal segment – fore 0.0104, mid 0.098, hind 0.0114.

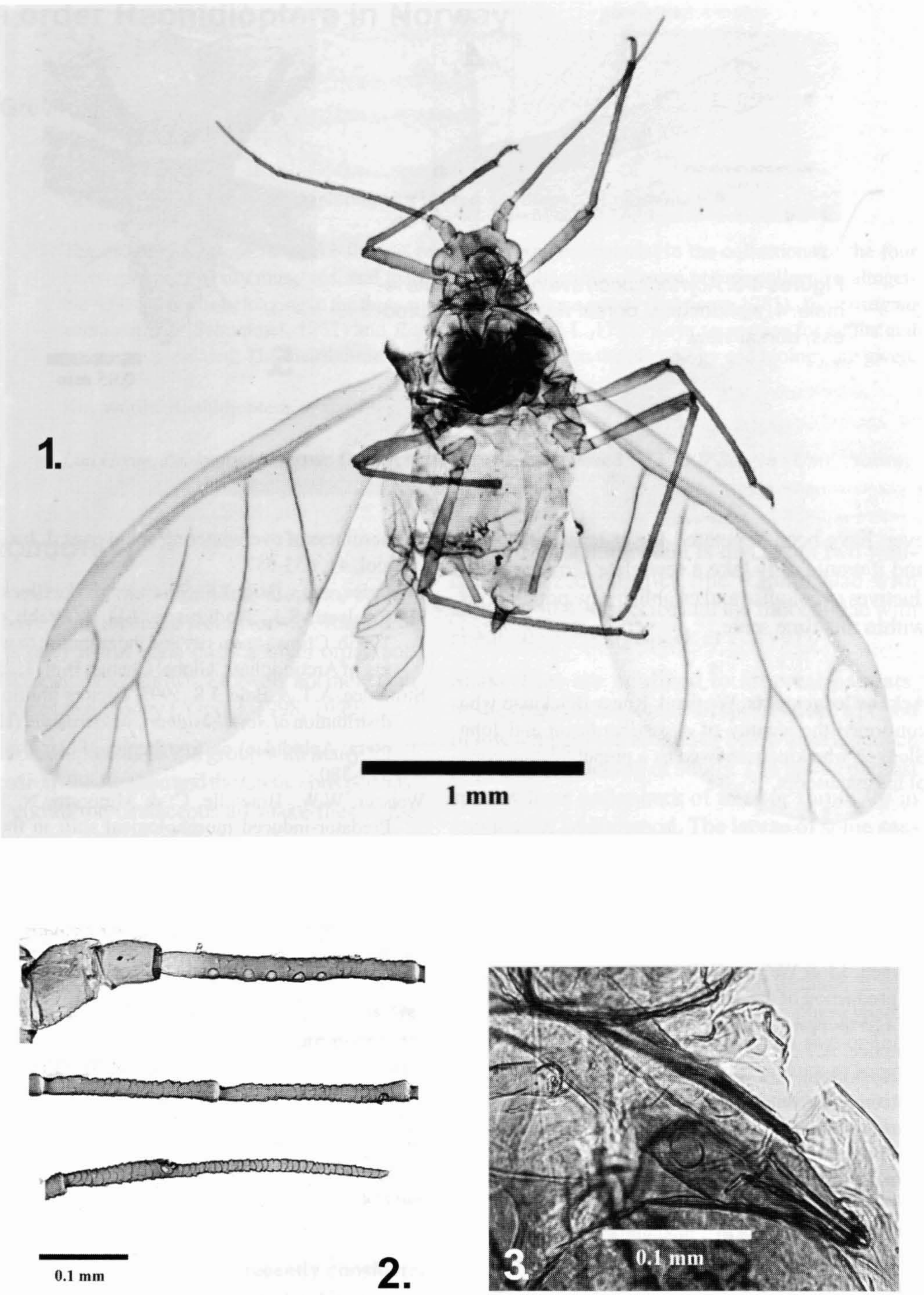
Specimen examined

1♀ collected in water filled pitfall trap (I.D. Hodkinson) Svalbard, Spitsbergen, Storholmen in Kongsfjord 27 July 2001 in association with other apterous morphs. Specimen deposited in The Natural History Museum (London).

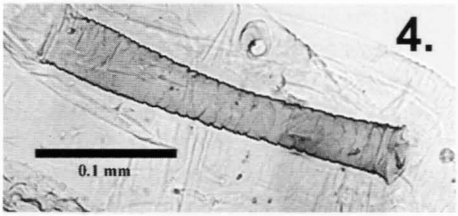
DISCUSSION

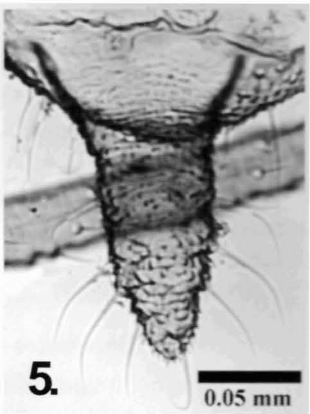
The discovery of an alate *A. svalbardicum* suggests how the aphid might have dispersed to and between isolated islands and it again emphasises the remarkable adaptive flexibility contained within this aphid's genotype. However, it immediately raises the question of the trigger mechanism that induces the expression of wings and the frequency with which alates are produced. Recent work on *Acyrthosiphon pisum* suggests that aphid disturbance by predators and parasitoids can induce wing formation (Weisser et al. 1999, Sloggett & Weisser 2002). Potential aphid parasitoids and syrphid larvae were present among the samples in which the alate aphid was found. This raises the interesting possibility that disturbance may provide the mechanism that stimulates the aphid species to seek out potentially predator-free space.

Whether the production of winged forms is sufficiently regular to provide effective widespread dispersal over appropriate time scales remains unclear. Evidence to date suggests that it is a highly sporadic event. Nevertheless, it does strongly reinforce the conclusions of the mainland distribution studies by suggesting that dispersal may not have been as limited as was assumed and that the restricted distribution pattern observed is maintained even when aerial dispersal to unoccupied habitats is possible. Storholmen and Midtholmen, how-



Figures 1-3. *Acyrthosiphon svalbardicum* alate female. 1. whole insect, dorsal view; 2. antenna, showing configuration of individual segments; 3. apical segment of rostrum.





Figures 4-5. *Acyrthosiphon svalbardicum* alate female. 4. siphunculus, dorsal view; 5. caudal process, dorsal view.

ever, have been vegetated for at least 900 years and it would only take a few alate female reproductives to colonise and establish new populations within this time scale.

Acknowledgements. We thank Roger Blackman who confirmed the identity of *A. svalbardicum* and John Sloggett who kindly showed us a prepublication copy of his manuscript.

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Received 26 June 2002, accepted 9 August 2002.

Norw. J. Entomol. 49, 81–92. 2002

The order Raphidioptera in Norway

Lita Greve

Greve, L. 2002. The order Raphidioptera in Norway. Norw. J. Entomol. 49, 81-92.

The order Raphidioptera, snake-flies, is reviewed based on material in the collections of the four Norwegian university museums, and material in the collections of some private collectors, altogether 454 specimens belonging to the three species *Phaeostigma notata* (Fabricius, 1781), *Xanthostigma xanthostigma* (Schummel, 1832) and *Raphidia ophiopsis* L.,1758. Keys to species for adults and larvae are presented. The distribution is mapped. Remarks on the phenology and biology are given.

Key words: Raphidioptera, snake-flies, distribution, Norway.

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INTRODUCTION

Three species of the order Raphidioptera, snake-flies, have been recorded from Norway. Raphidioptera is on a world scale basis a small order, and only 205 species are known. Probably not more than 250 species exist today (Aspöck 1998, 1999).

The Raphidioptera is an old group with many fossil species from the Jurassic and the Cretaceous periods. In the end of the Cretaceous all snake-flies in the tropical areas died out, and today only species adapted to cold climates survive. The whole order has been described as living fossils as the snake-fly fauna of the Mesozoic was much richer than the present one, and snake-flies occurred in tropical climates and in the southern hemisphere as well (Aspöck 1998). Today few species are distributed south of the 30° N, none in the southern hemisphere.

The known distribution of the majority of species is restricted to the Holarctic with a smaller species group restricted to the Western part of North America and southernmost Canada southwards to Guatemala.

The Raphidioptera was until recently considered one of three suborders in the order Neuroptera. Today the Raphidioptera is considered a separate order in the superorder Neuropterida. The group is considered among the most primitive orders among the Holometabola (Aspöck et al. 1991).

The order Raphidioptera is divided in two well-characterized families, the Raphidiidae with around 180-190 species and the Inocelliidae with about 20 species (Aspöck et al. 1991).

Snake-flies are confined to arboreal habitats, bushes may do for some. All species need a period of low temperature around or below zero to induce pupation or hatching of adults. The larvae of most species lives under bark of trees or shrubs, or in crevices of living wood. The larvae of some species of Raphidiidae lives in the top layer of soil or in the leaf layer around the stem and roots of shrubs (Aspöck et al.1991).

The development from egg to adult takes at least one year in the genus *Raphidia*. For many species of Raphidiidae this period may last two or three years, for most Inocelliidae three years or longer. Pupation takes place shortly after overwintering, and adults appear in late spring or early summer in most species (Aspöck et al. 1991).

The larvae and adults of snake-flies are carnivorous, feeding on a great variety of softskinned arthropods, particularly egg and larvae of insects. In captivity both adults and larvae may eat other types of food (Aspöck et al. 1991). The larvae are probably active and hunt during night-time and the darker hours of the day. The adults are poor flyers and rarely cross open areas. Often they do not leave

Key to Raphidioptera - families

- Head as broad or somewhat broader posteriorly than anteriorly. Compound eyes smaller than in Raphidiidae. Ocelli not present. Antennae filiform, number of segments around sixty-five. Pterostigma without crossveins .. .. Fam. Inocelliidae.

[One species in Fennoscandia and Denmark (*Inocellia crassicornis* (Schummel, 1832)). In Fennoscandia recorded from localities in Middle and Northern Sweden and once from Kuusamo in Finland]

- Head narrower posteriorly than anteriorly. Large compound eyes and three ocelli present. Antennae filiform, number of segments around thirty-five. Three genera, each with one species, in Fennoscandia and Denmark .... Fam. Raphidiidae

Key to adults of Raphidiidae

1. Pterostigma fairly long, pale yellowish brown. Three cellules between pterostigma and the upper branch of M .... *Xanthostigma xanthostigma* (Schummel, 1832)

- Pterostigma very dark blackish 2

2. Pterostigma with two crossveins. Four cellules between pterostigma and the upper branch of M, the second might be three-sided or sometimes poorly developed in one or both wings .... *Phaeostigma notata* (Fabricius, 1781)

- Pterostigma fairly short, nearly always with only one cross-vein. Three cellules between pterostigma and the upper branch of M .... *Raphidia ophiopsis* L. 1758

Key to larvae of the Raphidioptera - families

Note: The number of larval stages in Raphidioptera is around ten. This key can only be used for older larval stages where the pigmentation of the dorsal side of the body segments can be seen clearly. The key is wholly based on the larval keys made Aspöck et al. (1974, 1991). For more detailed figures and photos of larvae see Aspöck et al. (1974).

- Head with four stemmata. The median front end of the mesenotum with a small elevation. ... Family Inocellidae.

[One species *Inocellia crassicornis* (Schummel, 1832)]

- Head with six to seven stemmata. No median frontal elevation on the mesenotum .... Family Raphidiidae.

Key to the Norwegian Raphidioptera larvae of the family Raphidiidae

See the simplified drawing of the median figure (with a superficial likeness to a standing man) - on third dorsal abdominal segment (Figure 1). The shape of the following pigmented areas are important: M = Median figure, LA = Lateral figure. LE = «Legs», F = «Feet» and S = Light, median stripe. Parts of the abdominal segment outside these figures noted here can also be slightly coloured/pigmented.

1. Without a narrow light, median stripe . L and F equally broad and strongly pigmented on reaching the posterior edge (P) of the segment .... *Phaeostigma notata* (Fabricius, 1781)

- Median figure with a narrow light, median stripe 2

2. Median figure lighter pigmented. L and F equally broad reaching the posterior edge of the segment. F lighter pigmented than L. The lateral figures and the median figure are narrowly separated .... *X. xanthostigma* (Schummel, 1832)

- Median figure stronger pigmented. There is a constriction of the pigmented area where L ends and F begins. F is lighter pigmented then L, and widens towards posterior edge of segment. The lateral figures and the median figure are wider separated .... *R. ophiopsis* L. 1758.

the particular three or shrub on which they live (Aspöck 1998). The largest compiled information on this family is found in Aspöck et al. (1991).

The snake-flies are fairly large insects, and very easy to recognize on account of the cylindrical prothorax which is longer and more narrow than the head. The head has large compound eyes, ocelli are present in one recent family, lacking in the other. The antennae are slender, filiform, and fairly short. The legs are normal walking legs with five-jointed tarsi. Meso- and meta-thorax carry two pairs of hyaline wings which are subequal. The pterostigma is prominent and the wing-ribs are blackish. The male genitalia show a great variation and the characters are important in determination. The females have a very long ovipositor.

The first record, from «Søndmøre», of a Norwegian snake-fly was published by Strøm (1783). Strøm's material do not exist any longer, but his figure shows a snake-fly which is either *Phaeostigma notata* or *Raphidia ophiopsis* on account of the dark pterostigma. The oldest Norwegian specimen is one specimen of *P. notata* recorded by Zetterstedt (1838-40) from Verdalen in Northern Trøndelag, still present in Lund University Museum. This specimen was referred to by Wallengren (1871), Schøyen (1887) and Tjeder (1937, 1943a), and the specimen (without abdomen) is present in Wallengren's collection in Lund (R. Danielsson pers. comm.).

Tjeder (1932, 1937, 1943a, b, 1944) made references to Norwegian material of Raphidioptera and Tjeder (1945) presented a catalogue of Norwegian Neuroptera. His catalogue was based on museum material as Tjeder himself did not collect in Norway.

Tjeder (1937, 1940, 1953, 1972) also listed a fourth species from Sweden: *Inocellia crassicornis* (Schummel, 1832). *I. crassicornis* was recor-

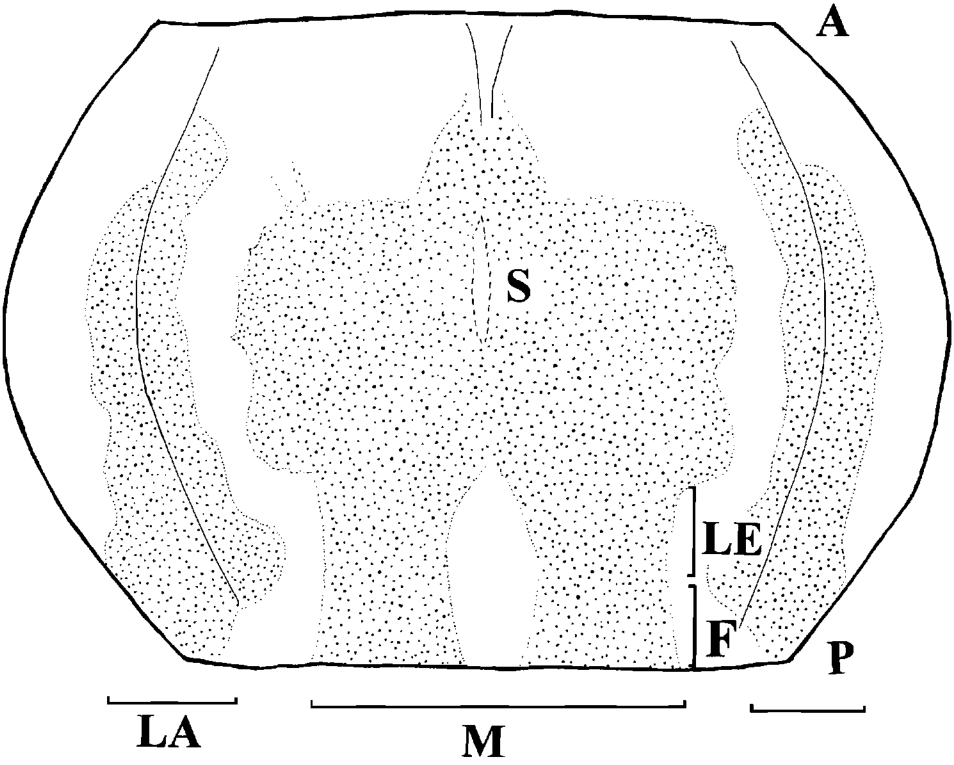


Figure 1. Simplified drawing of the third abdominalsegment, dorsally, of a Raphidiidae larva. A = Anterior part of segment, P = Posterior part of segment. The shape of the following pigmented areas are important: M = Median figure, LA = Lateral figure, LE = «Legs», F = «Feet» and S = Light, median stripe.

ded 1901 from Sweden (Borg 1901) and was for hundred years only recorded from the province Dalarna in Middle Sweden though Tjeder predicted that it must have a wider distributional area in Sweden. *I. crassicornis* has recently been recorded from five other provinces in Middle and Northern Sweden (Bergsten & Pettersson 2000), and thus might perhaps be present in Norway too.

MATERIAL

Material from the Norwegian university museums in Oslo (=ZMO), Trondheim (Vitenskapsmuséet=VT) and Tromsø (=TM), as well as from some private collections are marked with brackets in the material lists. Unless otherwise stated the material is deposited in Zoological Museum, University of Bergen. ZMB is used when material from the same locality is deposited in two different museums.

Regional abbreviations are given according to Økland (1981). The records are referred to the grid zones of the European Invertebrate Survey (EIS). MT = Malaise-trap, LT = Light trap, CL = Collision trap, PT = Pitfall trap, Coll. = Collection.

The material consists of 454 adults, larvae and pupae belonging to three genera and three species. Zetterstedt's specimen from Northern Trøndelag, Verdal, Garnes in The University Museum, Lund, has been checked by B. Tjeder, but not seen by the author.

Most of the older material has been collected by sweep-netting and dry mounted. Adult snake-flies can be dry mounted or kept in alcohol, while larvae and pupae should all be kept in alcohol.

Phaeostigma notata (Fabricius, 1781)

Synonym: *Raphidia notata* Fabricius, 1781

For complete list of synonyms, see Aspöck et al. (1991).

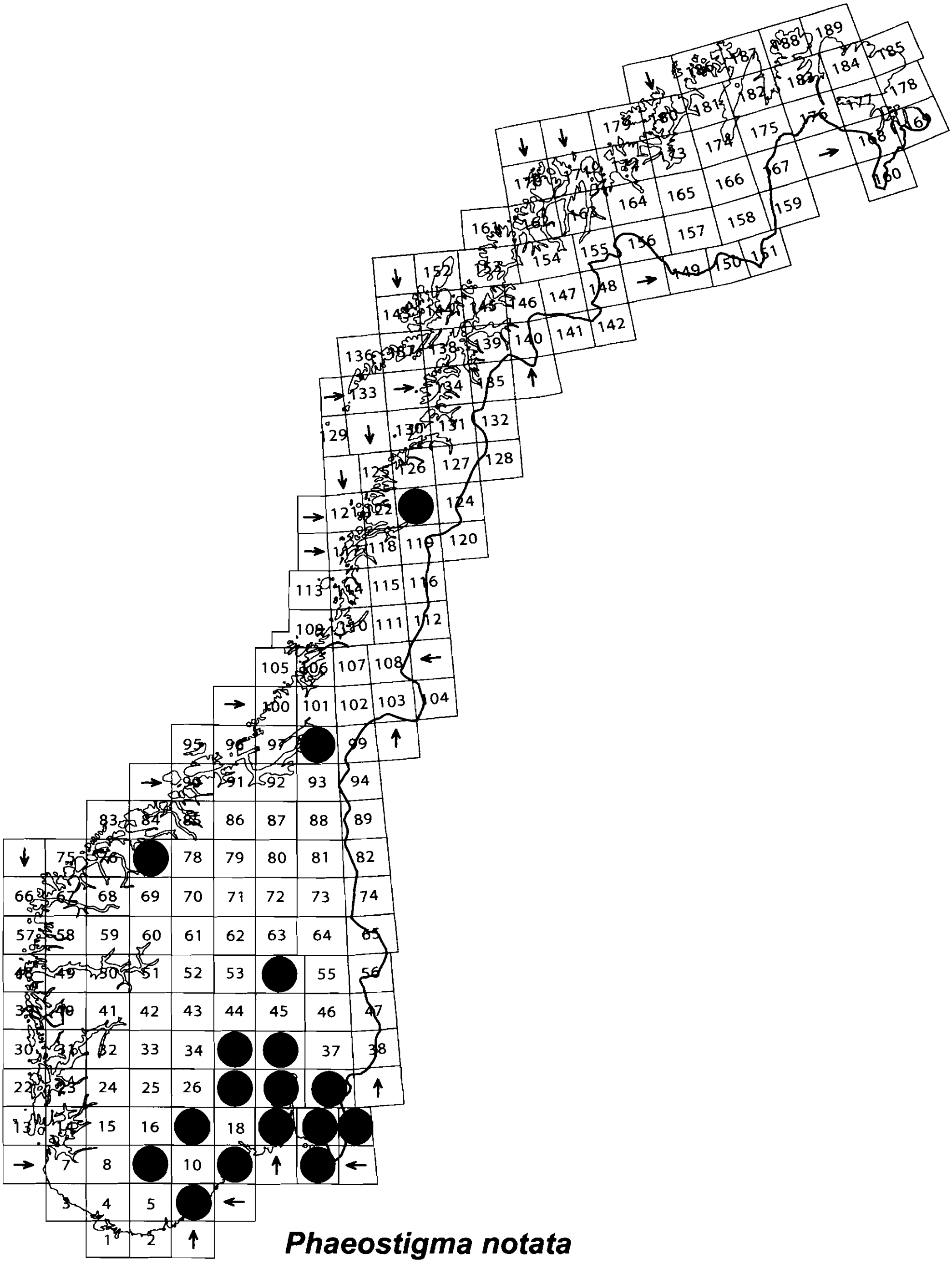
Material: 38 ♂♂ 35 ♀♀ 3 spms., 3 larvae. Figure 2.

Ø (6 ♂♂ 3 ♀♀) Halden: Korsetdalen (ZMO), Remmendalen (ZMO); Sarpsborg: Sandbakken; Hvaler: Huser (ZMO); Aremark: Bøensetra; Tune: Holleby, Råkil, Kil (ZMO), Råkil (T. J. Olsen Coll.). **AK** (18 ♂♂ 14 ♀♀ 1 spm.) Oslo: Bekkelaget, Hoff, Klemetsrud, Oslo, Ris, Rosenberggaten, Tøyen, Østensjøvann (ZMO); Ås: Årungen; Bærum: Borøya (ZMO), Bærum (ZMO), S. Hogstad, Ostøya, Sæterbekken (ZMO); Asker: Bjørkås, Sem; Sørum: Lørenfallet (Egner) (ZMO); Enebakk: Vangen. **OS** (1 ♀) Lillehammer: Lillehammer (ZMO). **BØ** (2 ♂♂ 3 ♀♀) Hole: Røysehalvøya (ZMO); Ringerike: Ringerike (TM), Rishueåsen (ZMO); Nedre Eiker: Mjøndalen (Hagatjern Ryggsetra). **BV** (2 ♂♂ 1 ♀ 3 larvae) Rollag: Bråtåsen, Tråen saga (ZMO); Sigdal: Gudbrandseterfjellet (Heimseteråsen) (larvae, uncertain determination). **VE** (5 ♂♂ 1 ♀) Borre: Adalstjern; Stokke: Robergmyra; Nøtterøy: Hella; Tjøme: Kjære; Brunlanes: Pauler (B. Borgersen Coll.). **TEY** (1 ♂) Drangedal: Skultrevassåsen (ZMO). **TEI** (3 ♂♂ 5 ♀♀) Notodden: Lisleherad; Nissedal: Skogly (ZMO). **AAY** (2 ♀♀) Lillesand: Høvåg, Kvivika (ZMO), Kvåse. **AAI** (1 ♀) Bygland: Heddevika (ZMO). **MRI** (1 ♂) Rauma: Isfjorden (H. Hatlen Coll.). **NTI** (3 ♀♀ 1 spm.) Steinkjer: Egge (Rana Museum), Steinkjer (Heggeliveien 14), Vassaunet (Rana Museum); Verdal: Garnes (University of Lund, Museum), Steinkjer: Egge (Rana Museum). **NSI** (1 ♀ 1 spm.) Rana: Ramnå (ZMO); Svartvasshei (Rana Museum).

EIS 6, 9, 11, 12, 17, 19, 20, 21, 27, 28, 29, 35, 36, 54, 77, 98, 123.

P. notata is new to Ø, BV, TEI, VE, AAY, MRI and NSI. *P. notata* is a fairly rare species in Norway as only 79 specimens have been collected throughout the last 150 years.

P. notata is the largest of the three Norwegian snake-flies with a wing-length of the first pair of wings from 9 mm to 14 mm. The fairly long, dark pterostigma with normally two crossveins and the four cellules between the pterostigma and the upper branch of vein M are two good characters to separate *P. notata* from *X. xanthostigma* and *R. ophiopsis*. Note should be taken that there are some specimens in the material where one wing has only three cellules. Already Tjeder (1937) noted this variation in Swedish material, and Meinander (1962) noted it as well from Finland. Meinander (1962) also remarked on the second of the four cellules which can be threesided, and short. The



Phaeostigma notata

Figure 2. Distribution of *Phaeostigma notata* (Fabricius) in Norway mapped in EIS squares.

teeth of the small rib-forks in the wing margin of *P. notata* are closer together at the wing margin than the teeth of the same rib-forks in the two other species. The male genitalia give good characters (Aspöck et al.1980).

Some published records have not been confirmed: Schøyen (1887) noted *P. notata* from Solør and Odalen, but material from these localties was not found by Tjeder (1943) in his revision. The specimen collected by Fritz Jensen from Ravnå is a slightly uncertain locality, but very probably Ramnå in Rana. The locality «Ringerike» is not marked.

From Figure 2 is it clear that *P. notata* has an eastern distribution in Norway and the northenmost records are slightly north of 66 °N. The northernmost locality, Svartvasshei (Rana), fits well with recent records from Sweden published by Bergsten & Pettersson (2000) where *P. notata* are recorded from Västerbotten somewhat south of the northernmost Norwegian locality.

The distributional records of *P. notata* with one exception fits well with the distribution of spontanous spruce (*Picea abies)* in Norway (Moe 1970). One record, however, from inner MRI is outside this area. The total distribution of *P. notata* is shown in Aspöck et al. (1991). All localities are in the lowlands.

The flight period of *P. notata* as recorded from the material is from May until early August. Only few specimens are collected in August and late July. The few specimens from Northern Trøndelag and Nordland province are all collected this late. Further south in Europe the flight period starts somewhat earlier. The developement from egg to adult in middle Europe is estimated to last from two to three years (Aspöck et al.1991).

High population densities have not been recorded in Norway. Even intensive netting has seldom produced more than one specimen each time. Malaise-traps, light traps and other types of traps have only collected few specimens at separate localities even when the traps have been open throughout a summer season.

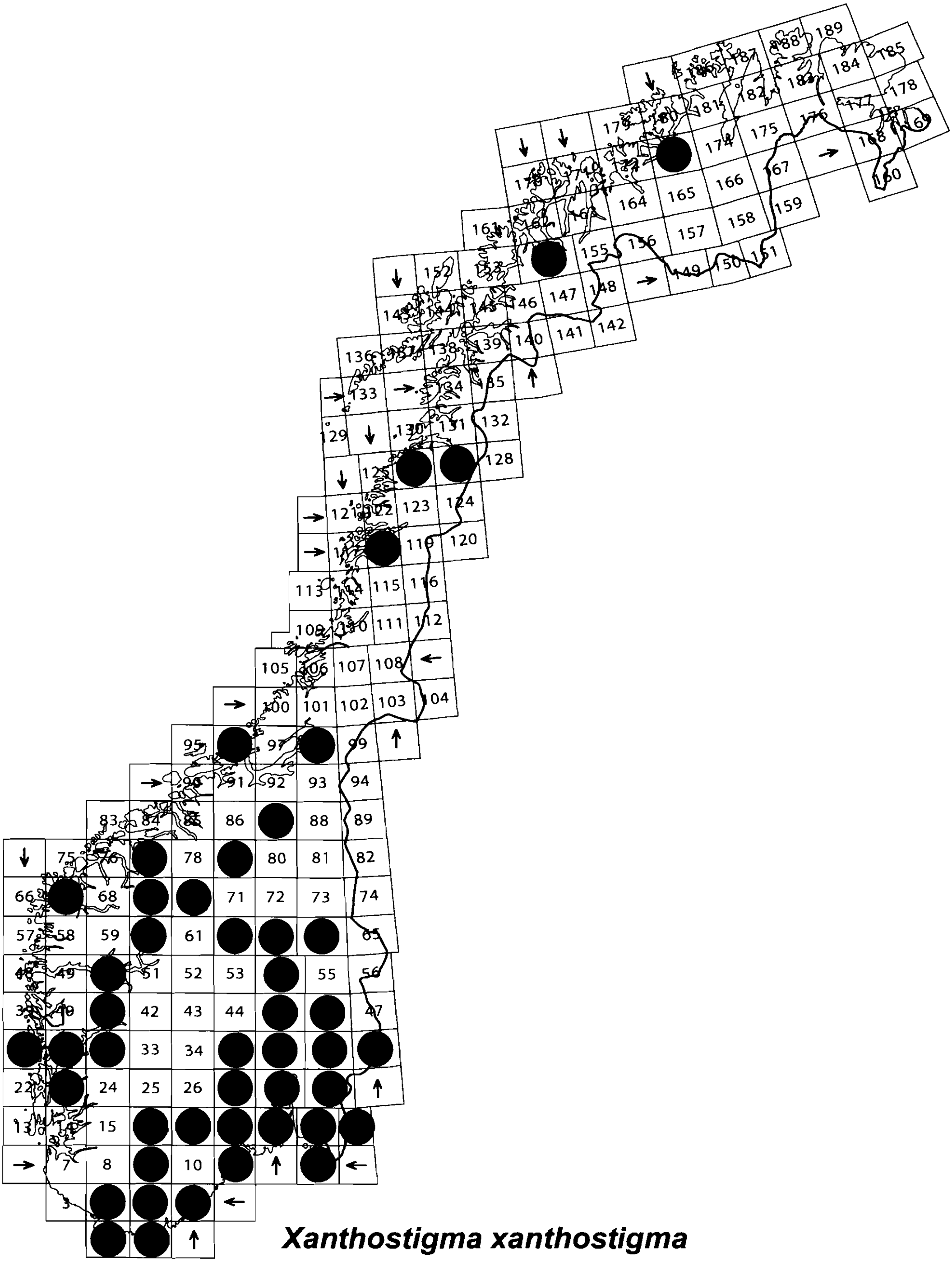
Xanthostigma xanthostigma (Schummel, 1832)

Synonym: *Raphidia xanthostigma* Linnaeus, 1758

For complete list of synonyms see Aspöck et al. (1991).

Material: 106 ♂♂ 178 ♀♀ 8 spm. 2 pupae 5 larvae. Figure 3.

Ø (7 ♂♂ 8 ♀♀) Halden: Strupe; Fredrikstad: Fredrikstad: Fredrikstad (ZMO), Borge Varde; Moss: Jeløy, Hvittingbukta; Hvaler: Hvaler, Huser (ZMO), Rød; Aremark: Bøensetra; Fredrikstad: Fredrikstad (ZMO), Borge Varde; Tune: Råkil (T. J. Olsen Coll./ ZMB), Tunevannet, Rygge: Sildebauen; Våler: Eng (T. R. Nielsen Coll.), Flesjøvannet; county not defined: Vandsjø (ZMO). **AK** (15 ♂♂ 23 ♀♀) Oslo: Oslo, Frøen, Østensjøvann (ZMO), Ås: Ås (Hærumshagen) (Coll. Planteforsk); Frogn: Drøbak, Hulvik, Håøya; Nesodden: Fagerstrand; Bærum: Borøya (ZMO), Haslum gård (Planteforsk Coll.); Asker: Bjørkås, Sem; Sørum: Lørenfallet (Egner) (ZMO); Rælingen: Losby; Enebakk: Vangen; Lørenskog: Losby. **HES** (1 ♂ 5 ♀♀) Kongsvinger: Vinger; Ringsaker: Helgøya (Eiksåsen); Sør-Odal or Nord-Odal: Odalen (ZMO); Eidskog: Holmsjøen, Braserudberget (ZMO); Elverum: Hernes. **HEN** (2 ♂♂ 1♀) Rendal: Storsjøen, Ytre Rendal (ZMO), Solbakken (ZMO). OS (2 ♂♂ 2 ♀♀ 2 spms.) Lillehammer: Lillehammer (ZMO); Sør-Fron: Toverud (B. Borgersen Coll.); Ringebu: Ringebu (ZMO); Lunner: Grindvold (ZMO); Nordre Land: Dokka. **ON** (2 ♂♂ 4 ♀♀) Skjåk: Marlo, Pollfoss; Nord-Fron: Vinstra. **BØ** (7 ♂♂ 29 ♀♀ 1 spm.) Drammen: Underlia (ZMO, ZMB); Ringerike: Væleren (ZMO); Hole: Røysehalvøya (ZMO); Røyken: Hyggen, Kinnartangen; Hurum: Filtvedt, Mølen, Tofteholmen, Verket, Østnestangen (ZMO, ZMB). **BV** (9 ♂♂ 14 ♀♀ 1 larva) Sigdal: Heimseteråsen, Trillemarka (ZMO); Rollag: Bråtåsen, Rollag, Tråen saga, Vårviken (ZMO). **VE** (9 ♂♂ 15 ♀♀ 1 spm. 1 pupa) Holmestrand: Botne; Tønsberg: Frodåsen; Sandefjord: Sandar, Nes; Borre: Adalstjern (ZMO); Larvik: Middagskollen (ZMO), Vemannsås (ZMO); Stavern: Near Minnehallen; Sande: Killingholmen, Kommersøya; Nøtterøy: Herstad; Tjøme: Gon, Kjære, Momarka, Moutmarka. **TEY** (3 ♀♀) Porsgrunn: Porsgrunn (ZMO); Bamble: Langøya; Kragerø: Jomfruland (near lighthouse). **TEI** (20 ♂♂



Xanthostigma xanthostigma

Figure 3. Distribution of *Xanthostigma xanthostigma* (Schummel) in Norway mapped in EIS squares.

26 ♀♀) Notodden: Lisleherad; Bø: Hestetun; Kviteseid: Kviteseid, Morgedal near Brekke; Tokke: Lårdal. **AAY** (1 ♂♂ 9 ♀♀) Arendal: Hasselåsen, Tromøya, Bjelland; Grimstad: Feviktjern; Lillesand: Høvåg (Ørslia), Storemyr (ZMO). **AAI** (5 ♀♀) Evje & Hornes: Stjernebyen; Bygland: Heddevika (ZMO); Bykle: Bykle. **VAY** (4 ♂♂ 5 ♀♀ 1 spm.) Kristiansand: Baneheia (ZMO), Vågsbygd (TM, ZMB); Mandal: Mandal (TM), Rona (Hole) (TM), N. Brinsdal; Søgne: Kvernhusvann (near Søgne Folkehøyskole); Marnardal: Bjelland (Tjelland) (ZMO), Lyngdal: Lyngdal (near Tråvikås), Nebblet (ZMO). **VAI** (1 ♂ 1 ♀) Hægebostad: Naglestad; Kvinesdal: Gjemlestad. **HOY** (2 ♂♂ 2 ♀♀ 1 pupa) Tysnes: Ånuglo; Os: Lepsøy; Vaksdal: Eidslandet, near Midtvannet; Osterøy: Herlandsnesjane. **HOI** (4 ♂♂ 6 ♀♀ 1 spm. 2 larvae) Kvinnherad: Ænesdalen; Ullensvang: Sekse (Planteforsk Coll.), Djønno; Eidfjord: Måbødalen; Granvin: Granvin, Skjervet; Kvam: near Svevatn (Varden). **SFY** (1 ♀) Gloppen: Vereide. **SFI** (2 ♂♂ 1 spm.) Leikanger: Grinde; Aurland: Almenningshytta; Luster: Jostedalen (ZMO). **MRI** (1 ♂) Stranda: Lauvvika. **STY** (1 ♂) Agdenes: Vetaliheia (VT). **STI** (6 ♂♂ 6 ♀♀ 1 larva) Oppdal: Lønset; Midtre Gauldal: Støren (Rognes) (VT). **NTI** (1 ♀) Steinkjer: Steinkjer (ZMO). **NSI** (7 ♀♀) Vefsn: Vefsn (ZMO/TM); Beiarn: Kvål; Saltdal: Storjord. **NNV** (1 larvae - uncertain determination) Sortland: Sortland. **TRI** (3 ♀♀ 1 spm.) Målselv: Målsnes (TM); Øverbygd: Bjerkeng (TM), Råvatn (TM); Malangen: Keianes (TM). **FI** (1♂ 2♀♀) Alta: Vina (TM), Detsika (Buolamalia) (ZMO).

EIS 1, 2, 4, 5, 6, 9, 11, 12, 16, 17, 18, 19, 20, 21, 23, 27, 28, 29, 30, 31, 32, 35, 36, 37, 38, 41, 45, 46, 50, 54, 60, 62, 63, 64, 67, 69, 70, 77, 79, 87, 96, 98, 118, 126, 127, 154, 173.

X. xanthostigma is new to BØ, BV, TEI, AAI, VAI, HOY, SFY, MRI, STY and NNV. The only possible record from NNV, however, is a larva of uncertain determination. The distribution covers nearly all the provinces in Norway, but the records from Northern Norway are few. In other parts of Northern Fennoscandia the distribution is also scattered (Meinander 1962, Bergsten & Pettersson 2000).

The yellow pterostigma is the easiest way to identify *X. xanthostigma* from the two other Norwegian snake-fly species.

Outside Fennoscandia *X. xanthostigma* is distributed south to Bulgaria, and from the British Isles to East Asia. This represents one of the largest distributional areas of any species of snake-fly (Aspöck et al. 1991).

X. xanthostigma has been collected at 600 m a s l in *Pinus silvestris* forest. This is the highest elevated locality in the material. Two Malaise traps in a xerotherm *Pinus* forest at 450 m a s l and 520 m a s l respectively collected a total eleven specimens in two summer seasons (Oddvar Hanssen, coll.).

The larvae develop under the bark of different trees, not only conifers. The development time from egg to adult is at least two years (Aspöck et al. 1991).

The flight period is from early May, a single record from late April. Adults are found until early August. The few records from the Northern provinces are nearly all from July.

Old specimens are mostly netted. Several specimens caught in the later years have been collected in Malaise traps. *X. xanthostigma* has also been collected in light traps, but rarely (Greve & Kobro 1998). A few specimens have been collected in collision traps and one single specimen is from a pitfall trap. A couple of specimens have been collected inside houses. *X. xanthostigma* is the most common of three Norwegian species. The total number of individuals recorded throughout one hundred and fifty years is 299.

Raphidia ophiopsis Linnaeus, 1758

Material: 33 ♂♂ 36 ♀♀ 6 spms. 1 larva. Figure 4.

Ø (3 ♂♂ 2 ♀♀) Sarpsborg: Near Borregård (T. J. Olsen Coll.), Sandbakken; Tune: Råkil (T. J. Olsen Coll./ ZMB); Onsøy: Foter. **AK** (6 ♂♂ 13 ♀♀ 4 spms.) Oslo: Dragonskov, Hovedøya, Rosenberggaten, Ryenberg, Skøyen, Tøyen (ZMO); Nesodden: Fagerstrand; Oppegård: Svartskog; Bærum: Bærum, Borøya (ZMO), Haslum (ZMO), Ostøya; Asker: Bjørkås; Aurskog-Høland: Halsnes; Sørum: Sørliløkka (ZMO); Lørenskog: Losbydalen (ZMO). **HES** (1 ♂ 1 spm.) Stange: Romedal, Tangen. **HEN** (1 ♀) Rendal: Ytre Rendal, Renskåskarven (ZMO). **ON** (1 ♀) Dovre:

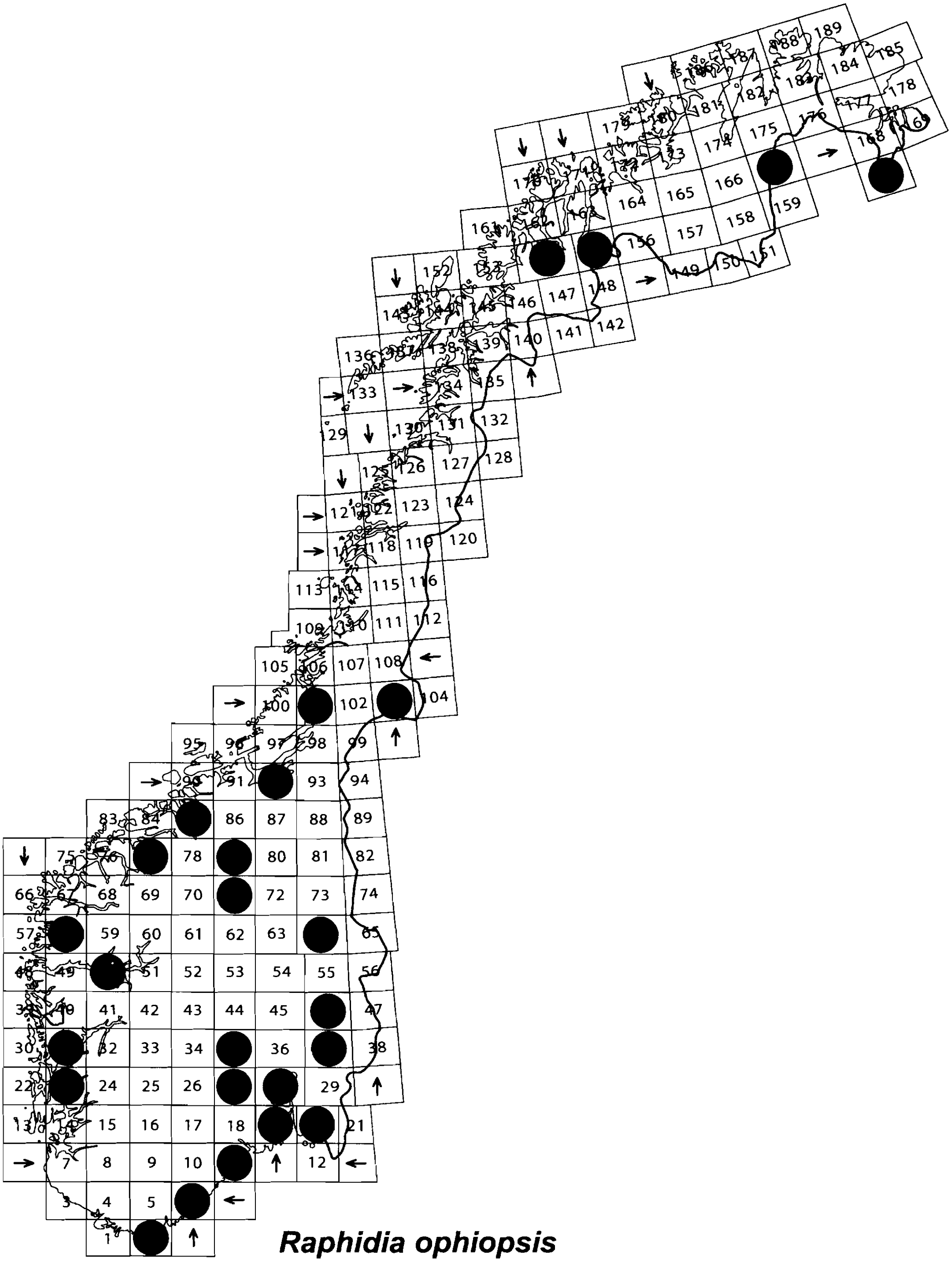


Figure 4. Distribution of *Raphidia ophiopsis* L. in Norway mapped in EIS squares.

Fokstua. **BØ** (2 ♀♀) Hurum: Verket, Verksøya. **BV** (2 ♂♂ 3 ♀♀ 1 larva); Sigdal: Heimseteråsen; Rollag: Bråtåsen, Tråen saga, Veggli. **VE** (4 ♂♂ 3 ♀♀) Tønsberg: Frodåsen; Våle: Langøya; Sem: Eik; Tjøme: Kjære, Tjøme. **TEY** (1 ♂ 1 ♀) Porsgrunn: Porsgrunn; Bamble: Valle. **TEI** (3 ♂♂) Notodden: Lisleherad. **AAY** (2 ♀♀) Risør: South of Granli church; Lillesand: Høvåg, Indre Årsnes. **VAY** (2 ♂♂) Kristiansand: Bråvann (K. Berggren Coll.), Oddernes, Gimlemoen. **HOY** (1 ♂) Stord: Near Tveitavann. **HOI** (1 ♂) Kvam: Ljosnesvåg. **SFY** (1 ♀) Gaular: Viken. **SFI** (1 ♀) Vik: Fresvik. **MRI** (2 ♀♀) Surnadal: Taløyan (ZMO); Rauma: Isfjorden (H. Hatlen Coll.). **STI** (3 ♂♂ 3 ♀♀) Oppdal: Lønset; Klæbu: Målsjøen (VT). **NTI** (1 ♂ 1 ♀) Snåsa: Stod station; Lierne: Storbekken. **TRI** (2 ♂♂ 1 spm.) Bardu: Bardufoss (ZMO); Målselv: Øverbygd, Bjerkeng; Storfjord: Skibotn. **FI** (1 ♂) Karasjok: Karasjok (TM). **FØ** (2 ♂♂) Sør-Varanger: Pasvik, (Near small lake east of Ellenvann) (ZMO).

EIS 2, 6, 11, 19, 20, 23, 27, 28, 31, 35, 37, 46, 50, 58, 64, 71, 77, 79, 85, 92, 101, 103, 154, 155, 160, 167.

R. ophiopsis is new to Ø, HES, BV, VE, TEI, VAY, HOY, HOI, STI, NTI, FØ. The locality ON Dovre: Fokstua (more than 925 m a s l) was mentioned by Tjeder (1937). This is the highest elevation in the material. There is also one specimen without abdomen in ZMO (No.3489) probably labelled «Romsdal June 6 1934 leg. Münster».

Material from the locality Solør was mentioned by Schøyen (1887), but Tjeder (1943a) did not record such material in his revision, and the author has not seen such material in Zoological Museum, University of Oslo.

R. ophiopsis is a complex species where the subspecies *R. ophiopsis ophiopsis* is the only subspecies represented in Fennoscandia. In the southern parts of the distributional area *R. ophiopsis* splits into four subspecies, see Aspöck et al. (1991). The distributional area for *R. ophiopsis ophiopsis* as well as the other subspecies is mapped in Aspöck et al. (1991).

The distribution of *R. ophiopsis* in Northern Sweden has been recorded by Bergsten & Pettersson (2000), and in Northern Finland by Meinander (1962). Based on this information and the Norwegian material it is clear that the species is not common in the northern parts of Fennoscandia. The distribution of *R. ophiopsis ophiopsis* reaches from southern and middle Europe eastwards to Sibiria. The western border in Europe is around 5° E. *R. ophiopsis* must as *P. notata* be considered a fairly rare species in Norway as only 76 specimens have been collected in the last 150 years.

The development time from egg to adult is at least two years (Aspöck et al. 1991).

The flight period is from May to late August/primo September. However, the main part of the material has been collected in May and June. Specimens from northern Norway are all from July.

DISCUSSION

The snake-fly species in Norway are fairly rare insects. Snake-flies are very characteristic insects which are recognised in the field by amateurs as well as experts. They are relatively large and are not difficult to catch since they are rather poor fliers. Snake-flies begin their fly period rather early in the year when relatively few collectors are active. Adults are, however, active in the light of the day, and can be collected in warm and sunny weather. The adults do not spend much time flying and thus perhaps devoid detection.

Only 454 specimens have been collected from Norway throughout, but there is no reason to think they might have been overlooked by entomologists. The author has «hunted» and collected this group along with other Neuropterida for more than three decades.

The larvae is more seldom caught since their are active during the dark hours, and hide during day time.

Two of the species mentioned here, *P. notata* and *R. ophiopsis*, represent 79 and 76 specimens respectively, and these species are decidedly more scarce than *X. xanthostigma* representing 299 specimens of the total material. None of the three species can be said to be common insects.

Collection by Malaise-trap seems to be a good method for catching adults. Light traps are not very efficient as snake-flies are rarely attracted to light (Aspöck et al. 1991). Occasionally a few specimens can be collected where light traps are run throughout several summers (Greve & Kobro 1998). «Fogging» of trees using gas do produce Raphidioptera larvae (J. Skartveit, pers. comm.).

In the northern parts of Scandinavia the distribution is scattered for *X. xanthostigma* and *R. ophiopsis* which are the two species recorded from the two northernmost provinces in Norway. In southern Norway there is a rather remarkable fact that no snake-fly have been caught in the province of Rogaland. This is probably not because of little collection, as the entomologist Fritz Jensen specificly collected Neuropterida in this province, and left a large collection which is in ZMO. Another field entomologist, Tore R. Nielsen, has not observed any snake-flies in this area either (pers. comm.). The records from Hordaland, Sogn og Fjordane and Møre og Romsdal are also few despite much collection done the last decades.

The distribution of *P. notata* in Norway is overlapping the distribution of spontanous spruce *Picea abies* L. Only one locality in inner Møre and Romsdal province lies outside the distributional area. Perhaps this record is due to larvae coming in with planted spruce as the there has been an extensive planting of spruce the last hundred years. *P. notata* could have been a late invader into Fennoscandia after the glaciation periods, and followed the natural immigration of spruce in the area. This has been suggested for other insects as well, like for *Wesmaelius quadrifasciatus* (Greve 1984).

P. notata is not only, however, recorded from spruce. According to Aspöck et al. (1991), *P. notata* has a clear preference for conifers, but the species has also been collected from many different species of trees further south in its distributional area (Aspöck et al. 1991). In a recent survey from Essex (Plant 2001), *P. notata* was collected from oak (*Quercus* sp.) only, so perhaps different populations of *P. notata* thrives on different species of trees.

Acknowledgements. I am very grateful to Dr. Roy Danielsson, Lund, Sweden for information on the collection in the museum of the Lund University. I also want to thank especially Lars Ove Hansen for information on material in the Zoological Museum, University of Oslo. I am also grateful to collectors from which I have borrowed material: Karl J. Grimstad, Branddal, Oddvar Hanssen, Trondheim, Halvard Hatlen, Isfjorden, Tore Randulff Nielsen, Sandnes, Thor Jan Olsen, Sarpsborg, Bjørn A. Sagvolden, Rollag, John Skartveit, Ayr, Scotland and Bjørn Økland, Ås.

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Received 17 April 2002,
accepted 2 September 2002

Norw. J. Entomol. 49, 93–94. 2002

First record of the microcaddisfly *Ithytrichia clavata* Morton from Norway (Trichoptera: Hydroptilidae)

Trond Andersen & Jostein Kjærandsen

Andersen, T. & Kjærandsen, J. 2002. First record of the microcaddisfly *Ithytrichia clavata* Morton from Norway (Trichoptera: Hydroptilidae). Norw. J. Entomol. 49: 93-94.

The microcaddisfly *Ithytrichia clavata* Morton, 1905, has been collected in the River Hakadalselva north of Oslo, SE Norway. The Norwegian specimens were compared with North American specimens, and we conclude that they belong to the same species.

Key words: Trichoptera, Hydroptilidae, *Ithytrichia clavata*, Norway, U.S.A.

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INTRODUCTION

The microcaddisfly *Ithytrichia clavata* Morton, 1905 was described based on material from Ithaca in New York State, U.S.A. The species is widely distributed in the United States and southern Canada (Moulton et al. 1999). The first record from the Palaearctic Region was given by Tjeder (1930), who collected the species in Falun in Dalarna, Sweden. Tjeder borrowed North American material from Morton to compare with the Swedish specimens and stated that «I have not been able to find the slightest difference between them and my specimens from Falun». However, Ross (1944) expressed doubts about the identity of the European specimens. We therefore also studied material from North America, and as Tjeder (1930), we too conclude that the specimens from Norway belong the same species as the North American specimens. *I. clavata* thus appears to be a widespread species found both in the West Palaearctic and the Nearctic zoogeographical Regions.

Ithytrichia clavata occurs in the northwest and western parts of Europe (Botosaneanu & Malicky 1978). In Sweden it has been recorded from Dalarna, Halland and Gästrikland (Forsslund & Tjeder 1942, Gullefors 1988).

The male of *I. clavata* was redescribed and figured by Tjeder (1930) and the male terminalia has also been figured by Malicky (1983) and by Moulton et al. (1999); the latter also gave a detailed description of the female. The larvae and the larval case were described and figured by Wiggins (1996). Houghton & Stewart (1998) reported on the seasonal flight periodicity of *I. clavata* in Texas, U.S.A., and Cload & Stewart (1974) found the larvae to drift, mostly at night.

Ithytrichia Eaton, 1873 is a small genus with, in addition to *I. clavata,* only two nearctic species, four western palaearctic species and one oriental species (Morse 1999). The only other *Ithytrichia* species occurring in Northwest Europe is *I. lamellaris* Eaton, 1873 (Andersen & Wiberg-Larsen 1987). In Norway *I. lamellaris* is frequently found in high numbers in medium to large sized rivers in the southeastern part of the country and it also occurs in western and central parts of Norway (Solem & Andersen 1996). In the Hakadalselva the two species were taken together.

Ithytrichia clavata Morton, 1905

Material examined: Norway, OS Lunner: Hakadalselva at Strekan, (EIS 36), (UTM: 32VNM9669) 1 ♂ sweep-net, 21 July 1987, T. Andersen. **AK** Nittedal: Hakadalselva at Strekan (UTM: 32VNM9669) 4 ♂♂, 3 ♀♀, sweep-net, 9 July 1989, T. Andersen & P. Wiberg-Larsen, (EIS 36).

U.S.A., Minnesota, Pine Co.: Snake River, 2 ♂♂, 29 May 1977, C. L. Daussin.

The River Hakadalselva is about 15 meter wide, shallow, moderate to rapidly flowing with gravel and stones. The locality is situated two kilometers below the Lake Harestuvannet. At the sampling site the River Hakadalselva constitutes the border between Akershus (AK) and South Oppland (OS), and the species was taken in both faunistical regions. Other caddisflies taken at the locality are listed in Andersen et al. (1993).

Acknowledgement. We are indebted to Prof. Ralph Holzenthal, Department of Entomology, University of Minnesota, for the loan of North American specimens of *I. clavata.*

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Received 10 July 2002,
accepted 18 September 2002.

Norw. J. Entomol. 49, 95–96. 2002

Stenelmis canaliculata (Gyllenhal) (Coleoptera, Elmidae) in Norway

Ingvar Spikkeland & Dag Dolmen

Spikkeland, I. & Dolmen, D. 2002. *Stenelmis canaliculata* (Gyllenhal) (Coleoptera, Elmidae) in Norway. Norw. J. Entomol. 49, 95-96.

The river beetle *Stenelmis canaliculata* (Gyllenhal, 1808) was in 1999 recorded in the river Enningdalselva in Østfold county, SE Norway. This is the first record of the species in Norway. Two females were caught in the river 200 m downstream Lake Kirkevannet (37 m a.s.l.). The locality has quite strong current velocity, and the bottom is covered by gravel and stones of variable size. Some hydrographic parameters: pH 6.7, conductivity 6.8 mS/m, Ca^{2+} 3.6 mg/L, Mg^{2+} 1.3 mg/L and total alkalinity 96 mekv/L.

Key words: Freshwater Coleoptera, freshwater biodiversity, *Stenelmis*

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On 23 August 1999 the river beetle *Stenelmis canaliculata* (Gyllenhal, 1808) was recorded in the river Enningdalselva in Østfold county, SE Norway (UTM [ED50] 32V PL453331). Two females were collected (leg. IS, det. DD) during an investigation of the invertebrate fauna of the river. The two specimens of *S. canaliculata* were caught in the river 200 m downstream Lake Kirkevannet, 37 m a.s.l. (Figure 1). The species has not earlier been recorded in Norway (Ødegaard et al. 1996).

The Enningdalselva river system is situated on the southernmost tip of SE Norway. The upper and southern part of the river system is situated in Sweden (Figure 1). The catchment area is dominated by coniferous forests, and the bedrocks are composed of different gneisses and granites, which are poor in lime and plant nutrients. Hence the river system is mainly oligotrophic, but has fairly mesotrophic conditions in the lower parts due to agriculture and marine deposits. The marine limit is about 180 m a.s.l. (Sævre 1984). The upper parts of the river system have suffered from acidification during the past 5-7 decades, and have been limed for many years. The marine deposits and the agriculture around the lower parts of the river, however, have ensured higher pH there. This part of the river has also a high biodiversity of freshwater invertebrates and fishes, many of the species with a southern or south-eastern distribution in Scandinavia (Afzelius & Hardeng 1995, Spikkeland 2000).

The locality had quite strong current velocity, and the bottom covered by gravel and stones of variable size. Some hydrographic parameters: pH 6.7, conductivity 6.8 mS/m, Ca^{2+} 3.6 mg/L, Mg^{2+} 1.3 mg/L and total alkalinity 96 mekv/L.

S. canaliculata has been recorded from approximately 15 localities in southern Sweden, including the Swedish part of the Enningdalselva River system (Engblom et al. 1990, Degerman et al. 1994, Ericsson et al. 1997, Sundberg et al. 2000). The species is not known from Denmark (Nilsson 1996), but has been found in Finland (Hiilivirta et al. 1984). It is also widely distributed in southern and central Europe, mostly in mountainous districts (Hiilivirta et al. 1984) (Figure 1). In Sweden surprisingly many records of the species have been made in limed rivers or in natural calsium-rich waters (Engblom et al. 1990), and the population in River Enningdalselva is probably positively affected by the liming of the upper parts of the river.

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Received 30 May 2002,
accepted 27 August 2002.

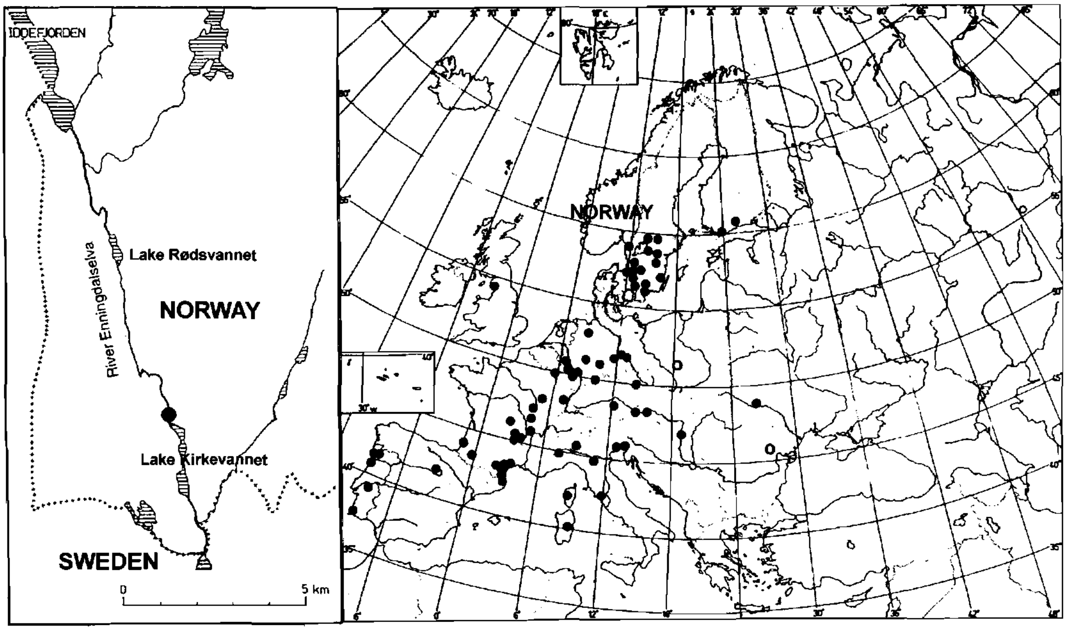

Figure 1. The distribution of *Stenelmis canaliculata* in River Enningdalselva, southeastern Norway (left) and in Europe (right), compiled from data given by Hiilivirta et al. (1984) and Engblom et al. (1990). Open circles: Exact locality not known.

Braconidae (Hymenoptera) of Norway, Part I

Matthias Riedel, Lars Ove Hansen & Øistein Berg

Riedel, M., Hansen, L.O. & Berg, Ø. 2002. Braconidae (Hymenoptera) of Norway, Part I. Norw. J. Entomol. 49, 97-108.

In this faunistic survey we give distributional records in Norway for 105 species of Braconidae belonging to the subfamilies Agathidinae, Blacinae, Cenocoeliinae, Euphorinae, Helconinae, Homolobinae, Ichneutinae, Macrocentrinae, Meteorinae, Neoneurinae, Orgilinae and Rogadinae, mostly from the Southern and Southeastern parts of the country. 81 of the species are not previously recorded in Norway.

Key-words: Braconidae, Norway, distribution.

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INTRODUCTION

With an estimate of 40 000 different species worldwide, the Braconidae represent a major family of parasitoid Hymenoptera (Achterberg 1984). Despite their abundance and economic importance, Braconid wasps have only been studied by a few entomologists leaving their taxonomy and geographical distribution in a fragmentary state, even in better studied areas such as Europe.

Previous publications on Norwegian Braconidae (Strand 1898, 1906, 1919, Achterberg 1974) have reported not more than about hundred different species from Norway. In fact, no comprehensive faunistic survey of Norwegian Braconidae has been made so far. In Britain, the number of described Braconid species is in the range of 1 200, representing almost a fifth of all Hymenoptera known from that country (Shaw & Huddleston 1991). There is no reason to believe that the species number would be substantially smaller in Norway.

To establish a better knowledge of the diversity and distribution of Norwegian Braconidae, we determined material of Braconidae which have been collected in the last few years from different localities. The present publication covers several Braconid subfamilies which could be studied sufficiently due to the availability of recent taxonomic revisions and appropriate identification keys.

MATERIAL

Most of the material reported here have been collected in S- and SE-parts of Norway mainly by the use of malaise-traps and sweep-nets. To avoid misinterpretations, we excluded species from our list which have not been identified with certain accuracy. Reference material of all species is kept in the personal collection of the first author (M. Riedel) and in the collections at the Zoological Museum, University of Oslo.

LIST OF SPECIES

The arrangement of subfamilies, tribes, and genera is still under discussion. We have chosen the suprageneric classification proposed by Shaw & Huddleston (1991). The geographic regions of Norway are given in accordance to Økland (1981), and every species previously not reported from Norway are marked with an asterisk (*). Only the localities are given in the list, but further data on each locality, including UTM-references and EIS-grid numbers, are given in Table 1. The following abbreviations have been used: SN = Sweep-net, MT = Malaise-trap, WT = Window-trap, LT = Light-trap, CN = Car-net.

Agathidinae

**Agathis assimilis* Kokujev, 1895
BØ Mølen, 1♀ 2–4 July 1990.
Distribution: C and E Europe; first Scandinavian record (Simbolotti & Achterberg 1999).

**Agathis griseifrons* Thomson, 1895
ON Hesteskobakken, 9♀♀ July 1992 (MT).
Distribution: Finland, Sweden and C Europe (Simbolotti & Achterberg 1999).

Agathis lugubris (Förster, 1862)
Ø Ystehede, 1♀ 5 July 1994.
Distribution: Widespread in the Palaearctic region, previously recorded from Norway (i.e. **HES** Hamar) (Simbolotti & Achterberg 1992, 1999).

Agathis varipes Thomson, 1895
BØ Underlia, 1♀ July 1994 (MT).
Distribution: Throughout Europe (Simbolotti & Achterberg 1999); previously recorded from Norway (i.e. **BV** Ål) (Strand 1906).

**Bassus calculator* (Fabricius, 1798)
BØ Kinnartangen, 3♀♀ 22 July 1991 and 24 July 1993 (SN).
Distribution: C Europe (Simbolotti & Achterberg 1992); first Scandinavian record.

**Bassus tegularis* (Thomson, 1895)
Ø Råkil, Tune, 1♀ 30 July 1999; **TEY** Ulefoss, 1♀11 June 1994; **VAY** Buene, 1♀ 1♂ April 1981.
Distribution: C Europe and Sweden (Simbolotti & Achterberg 1992).

**Bassus tumidulus* (Nees, 1814)
BØ Miletjern, 1♂ 21 July 1988 (LT); Tofteholmen, 1♀ 7–31 July 1991 (MT); Underlia, 1♀ 20–31 July 1994 (MT).
Distribution: C and S Europe (Simbolotti & Achterberg 1992); first Scandinavian record.

**Earinus elator* (Fabricius, 1804)
Ø Minge, Tune, 1♀ 28 April 1996; **AK** Hval, 2♂♂30 April 1995.
Distribution: Sweden and C Europe (Nixon 1986).

Earinus gloriatorius (Panzer, 1809)
[syn. *Earinus delusor* (Wesmael, 1837)]
Ø Tomb, 1♀ 29 May 1991; Råkil, Tune, 1♀ 28 May 1988, 2♀♀ 20 May 1994, 1♀ 22 May 1994, 1♀ 15 June 1994, 2 ♀♀ 20 June 1994; Sandbakken, 1♂ 1♀ 2–8 June 1996; Gunnarsbybekken, 1♂ 1♀19 May–17 June 1992 (MT); **AK** Skreikampen, 1♀ 25 April 92; Tømte, Hurdal, 1♂ 20 June 1985; Årungen, Ås, 1♀ 28 May 1994; **OS** Bjellum, 1♀ 20 May 1994; **ON** Hesteskobakken, 1♀ 1–25 May 1992 (MT); **NNØ** Elvegård, Skjomen, 1♀ 3 July 1994.
Distribution: N and C Europe (Nixon 1986); previously recorded from Norway as *E. delusor* (i.e. **BV** Ål) (Strand 1906).

Blacinae

Blacus (Blacus) paganus Haliday, 1835
Ø Gunnarsbybekken, 1♀ 24 Aug.–16 Oct. 1992 (MT); **BØ** Underlia, 1♂ June 1988 (MT).
Distribution: Holarctic (Achterberg 1988); previously recorded from Norway (i.e. **STY** Agdenes) (Haeselbarth 1973).

Blacus (Ganychorus) nitidus Haeselbarth, 1973
Ø Borge Varde, 1♀ 26 Aug. 1994.
Distribution: Widespread in the Palaearctic region; previously recorded from Norway (i.e. «Norway») (Achterberg 1988).

**Blacus (G.) pallipes* (Haliday, 1835)
BØ Kinnartangen, 1♂ 11 July 1991.
Distribution: Widespread in Europe (Achterberg 1988).

Blacus (G.) ruficornis (Nees, 1812)
Ø Gunnarsbybekken, 1♀ 24 Aug.–16 Oct. 1992 (MT); Telemarkslunden, 1♀ 19 May–17 June 1992 (MT).
Distribution: Holarctic, previously recorded from Norway (Achterberg 1988).

Cenocoeliinae

**Lestricus secalis* (Linnaeus, 1758)
BØ Underlia, 2♀♀ 20–31 May 1992, 3♀♀ 1–30 June 1992, 2♀♀ July 1993 (MT); **VE** Langøya, Våle, 1♀ 28 May–1 July 1991; **HEN** Åsta, 1♀ 7 July 1996.
Distribution: Europe (Achterberg 1994).

Euphorinae

**Centistes (Ancylocentrus) edentatus* (Haliday, 1835)
VE Kommersøya, 1♀ 17 May 1990; **BV** Veggli, 1♂ 23 June 1995 (CN).
Distribution: Sweden, Germany and England (Hellén 1958).

**Dinocampus coccinellae* (Schrank, 1802)
VE Langøya, Våle, 1♀ 11 Aug. 1990.
Distribution: An almost cosmopolitean species (Tobias 1986).

**Leiophron basalis* Curtis, 1833
Ø Telemarkslunden, 1♀ 19 May–17 June 1992 (MT); **BØ** Ryghsetra, 1♀ July 1994 (MT).
Distribution: England (Tobias 1986).

**Microctonus aethiopoides* Loan, 1975 [syn. *M. aethiops* auct. nec Nees]
ON Hesteskobakken, 2♀♀ July 1992 (MT); **VE** Langøya, Våle, 1♀ 2 Aug.–11 Sept. 1991 (MT).
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Myiocephalus boops* (Wesmael, 1835)
Ø Sandbakken, 1♂ 8 June 1996.
Distribution: Holarctic (Tobias 1986).

**Perilitus kokujevi* Tobias, 1986
TEI Lisleherad, 1♂ 2♀♀ 6 Aug.–19 Oct. 1993 (MT).
Distribution: Only known from Russia (Tobias 1986).

**Peristenus grandiceps (*Thomson, 1891)
Ø Råkil, Tune, 1♂ 7 July 1993; **BØ** Mølen, 5♂♂ 2–4 July 1990 (SN); Tofteholmen, 1♀ 7–31 July 1991 (MT); Kinnartangen, 1♀ June 1993 (MT).
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Peristenus nitidus* (Curtis, 1833)
AK Sognsvann, 2♂♂ 18 May 1989; Bleiker, 1♀ 7 May 1989.
Distribution: W Europe (Tobias 1986).

**Peristenus orchesiae* (Curtis, 1833)
TEY Langøya, Bamble, 1♀ 5–6 July 1995 (SN).
Distribution: W Europe (Tobias 1986).

**Peristenus pallipes* (Curtis, 1833)
Ø Øra, Gansrødbukta, 1♀ 27 June 1995; Råkil, Tune, 1♀ 20 July 1995; Holleby, Tune 1♀ 20 June 1993; Grimsøy, 1♀ 22 May 1994; Hvittingbukta, Jeløy, 1♀ 3–30 June 1995 (WT); Telemarkslunden, 1♀ 19 May–17 June 1992 (MT); **BØ** Tofteholmen, 1♂ 28 May–7 July 1991 (MT); Underlia, 2♀♀ June 1992 (MT); Kinnartangen, 5♀♀ 2–28 May 1991 (MT)**; BV** Veggli, 1♂ 1♀ 23 June 1995, **VE** Langøya, Våle, 1♀ 8 July–2 Aug. 1991 (MT); **ON** Hesteskobakken, 1♀ 1–25 May 1992 (MT).
Distribution: Holarctic (Tobias 1986).

**Peristenus picipes* (Curtis, 1833)
Ø Telemarkslunden, 1♂ 1♀ 19 May–17 June 1992 (MT); Tomb, 1♂ 18 May 1995.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Pygostolus falcatus* (Nees, 1834)
Ø Råkil, Tune, 1♀ 22 July 1994.
Distribution: Europe (Tobias 1986).

**Pygostylus multiarticulatus* (Ratzeburg, 1852)
Ø Råkil, Tune, 1♀ 8 June 1996.
Distribution: C Europe and Italy (Achterberg 1992); first Scandinavian record.

**Pygostolus otiorhynchi* (Boudier, 1834)
Ø Nes, Torsnes, 1♂ 15 April 1992; Øra, Gansrødbukta, 1♀ 21 July 1995; Bloksberg, Hankø 1♂ 3–29 June 1995 (WT); **BØ** Mølen, 1♀ 2–4 July 1990.
Distribution: Sweden and C Europe (Achterberg 1992).

Pygostolus sticticus (Fabricius, 1798)
Ø Telemarkslunden, 1♀ 17 June–21 July 1992 (MT); Råkil, Tune, 3♀♀ 5 June–2 July 1995; Vister, Tune, 1♀ 15 June 1999; **BØ** Kinnartangen, 1♀ June 1993 (MT); **TEY** Langøya, Bamble, 1♀ 13 July–27 Aug. 1995 (WT); **VAY** Storenes, 1♀ May 1986.

Table 1. EIS- and UTM-references of Braconidae included in this study. Collector is given for each locality. LOH = Lars Ove Hansen, ØBe = Øistein Berg, TJO = Thor Jan Olsen.

Locality	Municipality	EIS	UTM [WGS84]	Leg.:
ØSTFOLD (Ø)				
Akerøya	Hvaler	12	32V PL 08.46	TJO
Bloksberg, Hankø	Fredrikstad	20	32V PL 014.648	J.I. Båtvik, O. Hanssen
Borge Varde, Borge	Fredrikstad	20	32V PL 152.741	TJO
Fredrikstad	Fredrikstad	20	32V PL 121.650	O. Sørlibråten
Grimsøy	Sarpsborg	20	32V PL 25.57	TJO
Gunnarsbybekken, Ekeby	Rygge	19	32V NL 946.842	LOH, G.Walberg
Holleby, Tune	Sarpsborg	20	32V PL 201.801	TJO
Jelsnes, Tune	Sarpsborg	20	32V PL 225.823	TJO
Kirkebøen, Enningdalen	Halden	12	32V PL 452.322	TJO
Minge, Tune	Sarpsborg	20	32V PL 205.850	TJO
Molteberg	Fredrikstad	20	32V PL 204.693	TJO
Nes, Torsnes	Sarpsborg	20	32V PL 157.619	TJO
Øra, Gansrødbukta	Fredrikstad	20	32V PL 135.628	TJO
Råkil, Tune	Sarpsborg	20	32V PL 194.755	TJO
Rauer, Onsøy	Fredrikstad	19	32V NL 96.66	LOH
Roppestad, Nes	Fredrikstad	20	32V PL 155.602	TJO
Sandbakken	Sarpsborg	20	32V PL 241.699	TJO
Sildebauen	Rygge	19	32V NL 976.777	ØBe
Skjeberg[dalen]	Sarpsborg	20	32V PL 30.73	TJO
Skjebergdalen	Sarpsborg	20	32V PL 30.73	TJO
Telemarkslunden, Ekeby	Rygge	19	32V NL 948.844	LOH, G.Walberg
Tomb	Råde	20	32V PL 032.788	TJO, J.I.I.Båtvik
Tunevannet E, Tune	Sarpsborg	20	32V PL 197.764	TJO
Vestfjella, Aremark	Aremark	21	32V PL 56.13	TJO
Vestgårdtangen, Isesjø	Sarpsborg	20	32V PL 278.744	TJO
Vister	Sarpsborg	20	32V PL 152.741	TJO
Ystehede	Halden	12	32V PL 383.498	LOH
AKERSHUS (AK)				
Årungen	Ås	28	32V NM 98.17	ØBe
Bærum	Bærum	28	32V NM [unknown]	ØBe
Bleiker	Asker	28	32V NM 813.331	ØBe
Egner, Lørenfallet	Sørum	37	32V PM 25.61	O. Sørlibråten, LOH
Haslum	Bærum	28	32V NM 87.42	O.J. Lønnve
Hval	Asker	28	32V NM 833.350	ØBe
Kirkejordet, Ås	Ås	28	32V NM 996.162	T. Hofsvang
Kjaglidalen	Bærum	28	32V NM 792.470	M. Falck
Kolsås	Bærum	28	32V NM 85.43	ØBe
Kværner	Oslo	28	32V PM 004.423	M. Falck
Skreikampen	Eidsvoll	36	32V PN 18.16	TJO
Sognsvann	Oslo	28	32V NM 966.496	ØBe
Tømte, Hurdal	Nannestad	37	32V PM 14.86	LOH
HEDEMARK Northern (HEN)				
Solbakken, Ytre Rendal	Rendalen	64	32V PP 18.38	Leif R. Natvig
Åsta	Åmot	55	32V PN 26.71	ØBe
OPPLAND Southern (OS)				
Bjellum	Jevnaker	36	32V NM 781.826	ØBe
Grindvoll	Lunner	36	32V NM 82.85	O.J. Lønnve
OPPLAND Northern (ON)				
Vålåsjø, Dovrefjell	Dovre	71	32V NP 217.930	TJO
Hesteskobakken, Vinstra	Nord-Fron	64	32V NP 431.286	K. Myhr, LOH

Table 1. Cont.

Locality	Municipality	EIS	UTM [WGS84]	Leg.:
BUSKERUD Eastern (BØ)				
Ble Fjellstue	Kongsberg	27	32V NM 206.238	ØBe
Drammen, 15 km N of	[?Lier]	28	32V NM [unknown]	T. Munk
Kinnartangen	Røyken	28	32V NM 750.201	ØBe, LOH
Labro, Kongsberg	Kongsberg	27	32V NM 37.09	B.A. Sagvolden
Miletjern, Mjøndalen	Nedre-Eiker	28	32V NM 582.237	LOH
Mølen	Hurum	19	32V NL 848.950	ØBe, LOH
Østnestangen	Hurum	19	32V NL 85.99	LOH
Ramvikholmen	Hurum	19	32V NL 868.988	LOH
Ryghsetra, Hagatjern	Nedre-Eiker	28	32V NM 588.221	Y. Berg, D. Ruud, LOH
Tofteholmen	Hurum	19	32V NL 882.985	LOH
Underlia	Drammen	28	32V NM 661.247	LOH
Verksøya, Verket	Hurum	28	32V NM 797.090	LOH, ØBe
BUSKERUD Western (BV)				
Bråtåsen	Rollag	35	32V NM 137.538	LOH, B.A. Sagvolden
Rollag	Rollag	35	32V NM 165.500	LOH, B.A. Sagvolden
Vårviken	Rollag	35	32V NM 148.533	LOH, B.A. Sagvolden
Veggli [-Rollag]	Rollag	35	32V NM [unknown]	B.A. Sagvolden
VESTFOLD (VE)				
Bjørkøya	Sande	19	32V NL 759.987	ØBe
Heggedal, Tjølling	Larvik	19	32V NL 618.474*	J.A. Stenløkk [*ED50]
Kloppsand	Larvik	19	32V NL 51.37	ØBe
Kommersøya	Sande	19	32V NL 746.987	LOH
Langøya, Våle	Re	19	32V NL 774.965	LOH
Løvøya	Borre	19	32V NL 820.911	LOH
TELEMARK Coastal (TEY)				
Bamble	Bamble	11	32V [unknown]	J.A. Stenløkk.
Langesundtangen	Bamble	11	32V NL 431.390	LOH, O. Hanssen
Langøya, Bamble	Bamble	11	32V NL 433.414	LOH, R. Mehl
Ulefoss	Nome	18	32V NL 71.16	J.A. Stenløkk
TELEMARK Interior (TEI)				
Lisleherad	Notodden	27	32V NM 15.07	A. Bakke
AUST-AGDER Coastal (AAY)				
Laget, Tvedestrand	Tvedestrand	11	32V NL 03.04	J.A. Stenløkk
AUST-AGDER Interior (AAI)				
Støylen	Åmli	10	32V ML 66.19	ØBe
VEST-AGDER Coastal (AAY)				
Buene	Kristiansand	2	32V MK 495.413	K. Berggren
Nebbdal	Lyngdal	4	32V LK 935.526	K. Berggren
Storenes	Kristiansand	2	32V MK 390.425	K. Berggren
SØR-TRØNDELAG Interior (STI)				
Ramstad	Midtre Gauldal	87	32V NQ 68.81	ØBe
NORDLAND North-Eastern (NNØ)				
Elvegård, Skjomen	Narvik	140	33V [unknown]	ØBe

Distribution: C Europe, Sweden, and Norway (**HOY** Bergen) (Achterberg 1992).

**Townesilitus bicolor* (Wesmael, 1835)
Ø Telemarkslunden, 1♀ 19 May–17 June 1992 (MT); Øra, Gansrødbukta, 1♀ 15 June 1995; **BØ** Underlia, 1♀ June 1988, 1♀ July 1992 (MT); **VE** Langøya, Våle, 1♀ 8 July–11 Aug. 1991 (MT).
Distribution: Widespread in Europe, including Sweden (Haeselbarth 1988).

Helconinae

Helconini

**Helcon nunciator* (Fabricius, 1793)
Ø Råkil, Tune, 1♂ 15 June 1988; Fredrikstad, 1♀ 1 Aug. 1991; **AK** Bærum, 1♀ (no date) 2001 ex firewood; **OS** Grindvold, 1♀ 7 July 1991; **BØ** Underlia, 2♀♀ June 1994 (MT); **STI** Ramstad, 5♀♀ 21 July 1999.
Distribution: Sweden, C Europe (Achterberg 1987).

**Helcon tardator* Nees, 1812
AAY Låget, 2♀♀ 18 June 1988.
Distribution: Sweden, C Europe (Achterberg 1987).

Helconidea dentator (Fabricius, 1804)
Ø Råkil, Tune, 1♀ 1 Aug. 1995.
Distribution: Widespread in the Palaearctic region; including Norway («Norway») (Achterberg 1987).

**Helconidea ruspator* (Linnaeus, 1758)
Ø Øra, Gansrødbukta, 1♀ 21 July 1995; **BØ** Kinnartangen, 1♀ 22 July 1991, 1♀ 24 July 1993.
Distribution: C Europe and E Palaearctic region (Achterberg 1987).

**Wroughtonia spinator* (Lepeletier, 1825)
TEY Bamle, 1♀ 17 June 1988.
Distribution: Sweden, C and S Europe (Achterberg 1987).

Diospilini

Diospilus capito (Nees, 1834)
Ø Gunnarsbybekken, 1♀ 24 Aug.– 16 Oct. 1992 (MT); **BØ** Ramvikholmen, 1♀ 12 Aug. 1990; Ryghsetra, 1 F July 1994 (MT); **BV** Vårviken, 1♀ Aug. 1992 (MT); **ON** Hesteskobakken, 1♀ 6 Aug.–19 Sept. 1992 (MT).
Distribution: Widespread in Europe; also Norway (i.e. **ON** Dovre) (Hellén 1958).

**Diospilus fusciventris* Hellén, 1958
Ø Telemarkslunden, 1♂ 19 May–17 June 1992 (MT); **ON** Hesteskobakken, 1♀ July 1992 (MT).
Distribution: Finland (Hellén 1958).

**Diospilus rufipes* Reinhard, 1862
Ø Holleby, Tune 1♀ 20 June 1993.
Distribution: Finland, Germany and France (Hellén 1958).

**Taphaeus hiator* (Thunberg, 1822)
BØ Mølen, 1♀ 2 July 1990; Østnestangen, 1♀ 26 May–8 July 1995 (MT).
Distribution: Finland, Sweden, and C Europe (Hellén 1958).

Brachistini

**Eubazus longicaudis* (Ratzeburg, 1844)
BØ Kinnartangen 1♀ June 1993 (MT).
Distribution: Sweden, Finland, Russia, and Germany (Hellén 1958).

**Eubazus minutus* (Ratzeburg, 1848)
BØ Underlia, 1♀ May 1994 (MT).
Distribution: Germany and Finland (Hellén 1958)

**Eubazus tibialis* (Haliday, 1835)
Ø Telemarkslunden, 1♀ 19 May–17 June 1992, 2♀♀ 17 June–21 July 1992 (MT).
Distribution: Europe (Hellén 1958).

**Eubazus lepidus* (Haliday, 1835)
BØ Kinnartangen, 1♀ 6 July–4 Aug.1991 (MT).
Distribution: N and C Europe (Hellén 1958).

**Eubazus semiruguosus* (Nees, 1813)
Ø Telemarkslunden, 2♀♀ 19 May–17 June 1992 (MT); **ON** Hesteskobakken, 2♀♀ 1–25 May 1992 (MT).
Distribution: Widespread in Europe (Hellén 1958).

**Foersteria laeviuscula* Szepligeti, 1896
Ø Kirkebøen, Enningdalen, 1♀ 8 July 1993; **BØ** Kinnartangen 1♀ July 1991.
Distribution: Belgium, Hungary, The Netherlands, Mongolia (Achterberg 1990); first Scandinavian record.

**Foersteria puber* (Haliday, 1835)
Ø Bloksberg, Hankø, 1♂ 3–29 June 1995 (WT).
Distribution: Widespread in the Palaearctic region; Sweden (Achterberg 1990).

**Schizoprymnus crassiceps* (Thomson, 1891)
BV Bråtåsen, 1♀ July 1994 (MT); **ON** Hesteskobakken, 2♀♀ July 1992 (MT).
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Schizophrymnus obscurus* (Nees, 1813)
Ø Rauer, Onsøy, 1♀ 20–30 July 1989.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Triaspis pallipes* (Nees, 1813)
Ø Telemarkslunden, 7♀♀ 19 May–16 Oct. 1992 (MT).
Distribution: Palaearctic (Tobias 1986).

Homolobinae

Charmontini

Charmon cruentatus Haliday, 1833
There are two forms which differ in the length of the ovipositor sheath. The forma *brevicaudus* Hellén 1958 (ovipositor sheath 0.60-0,74 times fore wing) has been found in Norway previously (i.e. **AK** Oslo; Achterberg 1979). The specimen reported here belong to the nominate form and have ovipositor sheaths with a length 1.0-1.1 times the fore wing.

Ø Råkil, Tune 1♀ 6 Oct. 1995; Gunnarsbybekken, 1♀ 19 May–17 June 1992 (MT); Telemarkslunden, 1♀ 21 July–24 Aug. 1992 (MT); **ON** Hesteskobakken, 1♀ 6 Aug.–19 Sept. 1992 (MT); **BØ** Mølen, 1♂ 4–6 May 1990.
Distribution: Holarctic, including Norway (Achterberg 1979).

Homolobini

**Homolobus (Phylacter) testaceator* (Curtis, 1831) [Syn. *H. annulicornis* (Nees)]
Ø Sandbakken, 1♂ 12 June 1998; Alby, Jeløy, 1♂ 24 Aug. 2001; Gunnarsbybekken 1♀ 10 May–17 June 1992 (MT); Telemarkslunden, 1♀ 19 May–17 June 1992, 2♂♂ 2♀♀ 21 July–24 Aug. 1992, 2♀♀ 24 Aug.–16 Oct. 1992 (MT); Sildebauen, 1♀ 26 Aug. 1995; **VE** Langøya, Våle, 1♀ Sept.–Oct. 1987, 1 F 8 July–2 Aug. 1991 (MT).
Distribution: N and C Europe (Achterberg 1979).

**Homolobus (Chart.) infumator* (Lyle, 1914)
Ø Råkil, Tune, 1♀ 22 Aug. 1988, 1♀ 10 Sept. 1992, 1♀ 28 Aug. 1995, 1♀ 8 Sept. 1995; Sandbakken, 1♀ 18 Sept. 1995, 1♀ 27 July 1996, Skjeberg, 1♂ 22 July 1995, 1♀ 12 July 1996; Isesjø, 1♀ 1 Oct. 2001; Telemarkslunden 1♀ 24 Aug.–16 Oct. 1992 (MT); Sildebauen, 3♂♂ 3♀♀ 26 Aug. 1995; **AK** Haslum, 1♀ 14 Oct. 1990; **BØ** Underlia, 1♂ 1 Oct. 1985.
Distribution: Holarctic, Oriental and Neotropical region (Achterberg 1979).

**Homolobus (H.) discolor* (Wesmael, 1835)
Ø Gunnarsbybekken, 1♀ 19 May–17 June 1992 (MT); **BØ** Kinnartangen, 4♀♀ 5 Oct. 1990.
Distribution: N and C Europe (Achterberg 1979).

**Homolobus (Oulophus) bohemani* (Bengtsson, 1918)
BØ Kinnartangen, 3♂♂ 6 July 1989 and 11 July 1991.
Distribution: Sweden, Finland, Germany, Kurile Islands and the Himalayas (Achterberg 1979).

**Homolobus (Apatia) truncator* (Say, 1829)
Ø Fredrikstad, 1♀ 1 Aug. 1991.
Distribution: Holarctic and Oriental region (Achterberg 1979).

Ichneutinae

**Ichneutes facialis* Thomson, 1895
Probably a colour-form of *I. reunitor* Nees
AK Kværner (EIS 26), 1 F 12–26 June 1990.
Distribution: Sweden and Finland (Hellén 1958).

Ichneutes reunitor Nees, 1816
Ø Råkil, Tune 1♂ 15 May 1994; Telemarkslunden, 1♀ 19 May–17 June 1992 (MT); **BØ** Underlia, 1♀ May 1994 (MT); **BV** Rollag, 1♀ 5 June 1995.
Distribution: Widespread in Europe (Hellén 1958), including Norway (i.e. **NSI** Hattfjelldal; **AK** Skedsmo) (Strand 1906, 1919).

**Proterops nigripennis* Wesmael, 1835
TEI Lisleherad, 1♀ 6 Aug.–19 Oct. 1993 (MT).
Distribution: Europe (Hellén 1958).

Macrocentrinae

**Macrocentrus bicolor* Curtis, 1833
Ø Råkil, Tune, 1 F 28 Aug. 1995; Rauer, Onsøy 3♂♂ 1♀ 29 July 1989; Roppestad, Nes, 1♀ 27 Aug. 1999; Telemarkslunden, 2♂♂ 17 June–21 July 1992, 2♂♂ 21 July–24 Aug. 1992, 1♀ 24 Aug.–16 Oct. 1992 (MT).
Distribution: Europe, including Sweden (Achterberg 1993).

**Macrocentrus blandus* Eady & Clark, 1964
Ø Telemarkslunden, 1♀ 19 May–17 June 1992 (MT); **AK** Egner, Lørenfallet, 1 F Oct. 1994 (MT); **VE** Løvøya, 1♂ Sept. 1994 (MT).
Distribution: Europe, including Sweden (Achterberg 1993).

**Macrocentrus collaris* (Spinola, 1808)
Ø Råkil, Tune, 1♀ 10 June 1994; **BØ** Ryghsetra, Hagatjern, 1♀ 18 Sept. 1992; Underlia, 1♀ May 1999; 1♂ 5♀♀ June 1992; 1♂ July 1992 (MT).
Distribution: Widespread in Europe, including Sweden (Eady & Clark 1964, Achterberg 1993).

**Macrocentrus gibber* Eady & Clark, 1964
VE Heggedal, Tjølling, 1♀ 13 Aug. 1980; Jelsnes, Tune, 1♀ 2 Aug. 1993; **BØ** Ryghsetra, Hagatjern 3♀♀ July 1994 (LT).
Distribution: Mainly boreo-montainous in Europe, known from Sweden and Finland (Achterberg 1993).

**Macrocentrus infirmus* (Nees, 1834)
Ø Råkil, Tune 1♀ 16 July 1993, 2♀♀ 10 Aug. 1994, 1♀ 10 Sept. 1994; Telemarkslunden, 1♀ 21 July–24 Aug. 1992 (MT); **ON** Hesteskobakken, 2♀♀ July 1992, 3♀♀ 6 Aug.–19 Sept. 1992 (MT); **BV** Vårviken, 3♀♀ July 1992 (MT); **TEI** Lisleherad, 1♀ 6 Aug.–19 Oct. 1993 (MT).
Distribution: Widespread in Europe (Eady & Clark 1964, Achterberg 1993).

**Macrocentrus linearis* (Nees, 1811)
Ø Gunnarsbybekken 1 F 24 Aug.–16 Oct. 1992 (MT).
Distribution: Holarctic, known from Sweden (Achterberg 1993).

Macrocentrus marginator (Nees, 1812)
Ø Råkil, Tune, 1♀ 14 July 1993; **BØ** Underlia, 1♀ July 1993 (MT); **BØ** Kinnartangen, 1♀ 5 July 1991 (MT); **BV** Veggli, 1♀ 29 June 1995; **VE** Langøya, Våle, 1♀ June 1990, 1♀ 8 July–2 Aug. 1991; **TEY** Langesundtangen, 1♂ 13 July–27 Aug. 1995.
Distribution: Holarctic (Eady & Clark 1964); Norway (i.e. **BV** Ål) (Strand 1906).

Macrocentrus nidulator (Nees, 1834)
AK Kolsås, 1♀ 17 Aug. 2001; **BØ** Miletjern, Mjøndalen, 1♂ 21 July 1988 (LT)**;** **VE** Langøya, Våle, 1♀ 11 Aug. 1990.
Distribution: Widespread in Europe; Norway (i.e. **ON** Lom) (Achterberg 1993).

Macrocentrus nitidus (Wesmael, 1835)
Ø Kirkebøen, Enningdalen, 1♀ 16 July 1997; Holleby, Tune, 1♂ 12 June 93; Råkil, Tune, 1♀ 22 June 1994; Telemarkslunden, 1♂ 4♀♀ 19 May–17 June 1992, 3♂♂ 1♀ 21 July–24 Aug. 1992 (MT).
Distribution: N and C Europe; Norway (i.e. «Norway») (Eady & Clark 1964).

Meteorinae

Meteorus abdominator (Nees, 1811)
Ø Borge Varde, Borge, 2♂♂ 21 Aug. 1993; Råkil, Tune, 1♀ 10 June 1999; Sildebauen, 1♂ 26 Aug. 1995; **BØ** Kinnartangen, 1♀ 22 July 1990; Drammen, 15 km N of, 1♀ 13 July 1996; **VE** Langøya, Våle, 1♂ 11 Aug. 1990; **TEI** Lisleherad, 1♀ 6 Aug.–19 Oct. 1993 (MT).
Distribution: Europe, Sweden (Huddleston 1980); Norway (i.e. **BV** Ål) (Strand 1906).

Meteorus abscissus Thomson, 1895

Ø Gunnarsbybekken, 1♀ 21 July–24 Aug. 1992 (MT).
Distribution: Sweden, Austria, Hungary, Ireland and Italy (Huddleston 1980).

Meteorus cinctellus (Spinola, 1808) [syn. *M. tenellus* Marshall, 1887]

HEN Solbakken, Y. Rendal, 1♂ 11 July 1943; **VE** Langøya, Våle, 1♀ 11 Aug. 1990.
Distribution: Europe (Huddleston 1980); Norway (i.e. **BV** Ål) (Strand 1906), and as *M. tenellus* (i.e. **NTI** Overhalla) (Strand 1919).

**Meteorus colon* (Haliday, 1835)

AK Kjaglidalen, 1♀ 11–26 July 1990 (MT).
Distribution: C Europe, Sweden (Huddleston 1980).

Meteorus filator (Haliday, 1835)

Ø Gunnarsbybekken, 1♂ 24 Aug.–16 Oct. 1992 (MT).
Distribution: N and C Europe, reported from Norway (i.e. «Norway») (Huddleston 1980).

**Meteorus gyrator* (Thunberg, 1822)

Ø Skjebergdalen, 1♀ 25 Sept. 1992; Råkil, Tune, 1♀ 12 Aug. 1988; Sandbakken, 1♀ 18 Sept. 1995; Telemarkslunden, 3♂♂ 1♀ 17 June–21 July 1992, 1♂ 21 July–24 Aug. 1992 (MT); **BØ** Kinnartangen, 1♂ 8 July 1989.
Distribution: N and C Europe (Huddleston 1980).

**Meteorus hirsutipes* Huddleston, 1980

BØ Kinnartangen, 1♀ Aug. 1993 (MT).
Distribution: Finland, Germany and Ireland (Huddleston 1980).

Meteorus ictericus (Nees, 1811)

Ø Øra, Gansrødbukta, 1♀ 11 Aug. 1995; Molteberg, 1♀ 18 June 1997; **AK** Kirkejordet, 1♀ 3–10 July 1986 (MT).
Distribution: Europe (Huddleston 1980); Norway (i.e. **HOY** Bergen) (Strand 1919).

**Meteorus jaculator* (Haliday, 1835)

Ø Telemarkslunden, 1♀ 24 Aug.–16 Oct. 1992 (MT); **VE** Langøya, Våle, 1♀ 8 July–2 Aug. 1991 (MT).
Distribution: C Europe and Sweden (Huddleston 1980).

**Meteorus oculatus* Ruthe, 1862

Ø Sandbakken, 1♀ 12 June 1998, .
Distribution: C Europe and Sweden (Huddleston 1980).

**Meteorus pulchricornis* Wesmael, 1835

BØ Kinnartangen, 1♀ 8 Sept.–4 Oct. 1991 (MT).
Distribution: Widespread in Europe, also Sweden (Huddleston 1980).

**Meteorus rubens* (Nees, 1811)

Ø Skjebergdalen, 1♀ 25 Sept. 1992.
Distribution: Holarctic, reported from Denmark, Sweden and Iceland (Huddleston 1980).

**Meteorus versicolor* (Wesmael, 1835)

Ø Akerøya, 1♀ 6 June 1992.
Distribution: Widespread in the Palaearctic region, also Sweden (Huddleston 1980).

Zele albiditarsus Curtis, 1832

Ø Råkil, Tune, 1♀ 26 June 1988; **BØ** Kinnartangen, 10♀♀ 25 June 1989, 15 July 1989 and 11 July 1991; **AAI** Støylen, 1♀ 5 July 1980.
Distribution: Widespread in the Holarctic region (Achterberg 1984).

**Zele caligatus* (Haliday, 1835)

Ø Sandbakken, 1♀ 1 Sept. 1998.
Distribution: Holarctic, known from Finland, Denmark and C Europe (Achterberg 1979).

**Zele chlorophthalmus* (Spinola, 1808)

Ø Råkil, Tune, 1♀ 12 Sept. 1992, 1♂ 1 Aug. 1995; Gunnarsbybekken, 1♀ 21 July–24 Aug. 1992 (MT).
Distribution: Europe (Achterberg 1979).

Zele deceptor f. deceptor (Wesmael, 1835)

Ø Tunevannet, 1♀ 3 July 2000; **BØ** Verksøya, 1♀ 18 June 1989; **VE** Langøya, Våle, 2♀♀ Sept.–Oct. 1987 (MT); **HEN** Solbakken, Y. Rendal, 1♀ 13 July 1943.
Distribution: Europe (Achterberg 1984); also Norway (i.e. **NTI** Ovrhalla; **NSI** Rana) (Strand 1919).

Neoneurinae

Neoneurus auctus (Thomson, 1895)

Ø Gunnarsbybekken, 1♀ 21 July–24 Aug. 1992, 3♂♂ 24 Aug.- 16 Oct.1992 (MT); Telemarks-

lunden, 4♂♂ 1♀ 21 July–24 Aug. 1992 (MT).
Distribution: Widespread in the Palaearctic region, also Norway (i.e. **NSI** Hattfjelldal) (Shaw 1992).

Orgilinae

**Orgilus parvipennis* Thomson, 1895
Ø Råkil, Tune, 1♀ 25 Aug. 1993.
Distribution: C Europe, Finland and Sweden (Taeger 1988).

**Orgilus pimpinellae* Niezabitowski, 1910
Ø Råkil, Tune, 1♂ 10 June 1994, 1♀ 22 June 1994.
Distribution: Widespread in the Palaearctic region (Taeger 1988).

ROGADINAE

Exothecini

**Colastes braconius* (Haliday, 1833)
Ø Gunnarsbybekken, 1♀ 24 Aug.–16 Oct. 1992 (MT).
Distribution: Widespread in Europe, known from Sweden and Finland (Papp 1975).

**Colastes incertus* (Wesmael, 1838)
Ø Borge Varde, Borge, 1♀ 28 May 1992.
Distribution: Belgium, England, Austria and Finland (Papp 1975).

Rogadini

**Aleiodes (Neorhogas) cruentus* (Nees, 1834)
BØ Labro, Kongsberg, 1♀ 26 June 1992.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

Aleiodes (N.) dimidiatus (Spinola, 1808)
AK Egner, Lørenfallet, 1♂ May 1994 (MT); **ON** Vålåsjø, 1♂ 26 May 1992; **VE** Kloppsand, 1♂ 13 June 1993.
Distribution: Widespread in the Palaearctic region (Tobias 1986); including Norway (i.e. **BV** Ål) (Strand 1906).

Aleiodes (Neorhogas) dissector (Nees, 1834)
VE Bjørkøya, 1♂ 27 May 1989.
Distribution: Widespread in the Palaearctic region (Tobias 1986); Norway (i.e. Kr[istians amt] = Oppland) (Strand 1898).

**Aleiodes (Neorhogas) grandis* Giraud, 1857
Ø Vestfjella, 1♂ 29 Aug. 1992; Rauer, Onsøy, 1♀ 28–30 July 1989.
Distribution: Europe (Tobias 1986).

**Aleiodes (N.) praetor* (Reinhard, 1863)
Ø Sildebauen, 1♀ 26 Aug. 1995.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Aleiodes (N.) rufipes* (Thomson, 1891)
BØ Ryghsætra, Hagatjern 1♀ 27 June–3 July 1994 (LT); **BV** Vårviken, 1♀ July 1992 (MT).
Distribution: Widespread in Europe, including Finland and Sweden (Tobias 1986).

**Aleiodes (N.) rugulosus* (Nees, 1812)
TEI Lisleherad, 1♀ 27 May–22 June 1993 (MT); **BØ** Ble Fjellstue, 600 m, 1♀ 6 Aug. 1997.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Aleiodes (N.) unipunctator* (Thunberg, 1822)
Ø Øra, Gansrødbukta, 1♀ 6 Aug. 1996; **BØ** Kinnartangen, 1♀ 6 July 1989, 1♀ 11 July 1991; Miletjern, Mjøndalen, 3♂♂ 4♀♀ June–July 1988 (LT).
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Aleiodes (s.str.) bicolor* (Spinola, 1808)
Ø Råkil, Tune, 1♂ 10 July 1995; **BØ** Tofteholmen, 1♀ 7–31 July 1991 (MT); Mølen, 1♀ 12 July 1989.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

Aleiodes (s.str.) circumscriptus (Nees, 1834)
Ø Øra, Gansrødbukta, 1♀ 13 May 1992; Råkil, Tune 1♂ 22 July 1994, 1♀ 23 May 1995; Sildebauen, 1♂ 26 Aug. 1995; **AK** Kværner, 1♀ 12–26 June 1990 (MT); **ON** Hesteskobakken, 3♀♀ 1–25 May 1992 (MT); **BØ** Tofteholmen, 2♀♀ 7–31 July 1991 (MT); Kinnartangen, 7♀♀ 6–8 July 1989, 11 July 1991, 8 Sept.–24 Oct. 1991, June 1993; Miletjern, Mjøndalen, 1♂ July 1988; Mølen, 2♂♂ 2–4 July 1990; **VE** Langøya, Våle, 1♀ May 1991; **TEI** Lisleherad, 1♀ 22 June–6 Aug. 1993 (MT); **VAY**

Nebbdal, 2♀♀ 18 April 1981.
Distribution: Widespread in the Palaearctic region (Tobias 1986); also Norway (i.e. **TEY** Bamble; **NTI** Overhalla) (Strand 1919).

**Aleiodes (s.str.) compressor* (Herrich-Schäffer, 1838) [syn. *Petalodes unicolor* Wesmael]
AK Sognsvann, 1♀ 18 May 1989.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Aleiodes (s.str.) esenbecki* Hartig, 1838
Ø Rauer, Onsøy, 1♂ 28–30 July 1989.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Aleiodes (s.str.) modestus* Reinhard, 1863
BØ Mølen, 1♂ 13 July 1989.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Aleiodes (s.str.) pallidator* (Thunberg, 1822)
VE Langøya, Våle, 1♀ June 1990.
Distribution: Widespread in the Palaearctic region (Tobias 1986).

**Clinocentrus umbratilis* Haliday, 1836
Ø Råkil, Tune, 1 F 22 June 1994.
Distribution: Europe (Tobias 1986).

Hormiini

Hormius moniliatus (Nees, 1812)
Ø Råkil, Tune, 1♀ 5 May 1995; Telemarkslunden, 4♀♀ 21 July–24 Aug. 1992 (MT); **BØ** Underlia, 10♀♀ May–June 1992, 1♂ June 1992 (MT); Ramvikholmen, 1♀ 12 Aug. 1990; Kinnartangen, 1♀ July 1993 (MT).
Distribution: Widespread in the Palaearctic region (Tobias 1986), known from Norway (i.e. **AK** Skedsmo) (Strand 1919).

DISCUSSION

In this faunistic survey we include distributional records of 105 species of the subfamilies Agathidinae, Blacinae, Cenocoeliinae, Euphorinae, Helconinae, Homolobinae, Ichneutinae, Macrocentrinae, Meteorinae, Neoneurinae, Orgilinae and Rogadinae of Braconid wasps found in Norway. Most of them are common and widespread in Europe or in the entire Palaearctic region.

Although about 80 % of the species which were reported in this paper are new records for Norway, our knowledge of the Norwegian Braconid fauna remains imcomplete. Since almost 300 species of the above mentioned subfamilies are reported from Britain (Shaw & Huddleston 1991), we estimate that only about 1/3 to 1/2 of the species occurring in Norway have been found so far. This opens a wide field for future faunistic research of these economically important parasitoids in Norway.

Acknowledgements. For the generous donation of braconid material we would like to thank Thor Jan Olsen, Jan I.I. Båtvik, Alf Bakke, Kai Berggren, Kai Myhr, Gaute Walberg, Jan A. Stenløkk, Ove Sørlibråten, Bjørn Sagvolden, Morten Falck, Trond Hofsvang and Devegg Ruud.

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Received 27 March 2002,
accepted 21 October 2002.

Norw. J. Entomol. 49, 109–113. 2002

A new species of *Platycheirus* from the Central Caucasus (Diptera, Syrphidae)

Jens-Hermann Stuke & Tore R. Nielsen

Stuke, J.-H. & Nielsen, T.R. 2002. A new species of *Platycheirus* from the Central Caucasus (Diptera, Syrphidae). Norw. J. Entomol. 49, 109–113.

Male and female *Platycheirus migriaulii* sp. n., a species of the *manicatus* group, is described on the basis of material from the Central Caucasus (Georgia, Kazbegi). A key is given to separate it from resembling species within the group.

Key words: *Platycheirus*, Syrphidae, new species, Caucasus, Georgia, Kazbegi, key.

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INTRODUCTION

More than sixty Palaearctic species belong to the genus *Platycheirus* Le Peletier & Serville, 1828. When visiting the Georgian part of the Caucasus, the first author caught an unknown *Platycheirus* species which is described below.

Platycheirus migriaulii was found in alpine habitats, in altitudes from 2200 to 3000 m. The areas were mainly dry and the vegetation poor: the plants did not cover the ground completely anywhere (less then 10 % at the highest altitudes) and there were no bushes or trees.

The specimens were caught when sitting on rocks, hovering, flying between the vegetation and sitting on undeterminated flowers. Some specimens were swept from the vegetation with a net. The collecting was done between 12 and 16 hours.

MATERIAL AND METHODS

Platycheirus migriaulii sp. n.

Figures 1-7.

Type material: Holotype 1♂ (02.VIII.2001, slopes W Kazbegi up to 2500 m, Georgia, Kazbegi, 42°39.55' N, 044°38.20' E, leg. Stuke, coll. Zoological Museum of the University Amsterdam [ZMAN]), Paratypes: 1♂, 7♀♀ (same labels as holotype, coll. Stuke & Nielsen); 13♂♂, 14♀♀ (31.VII.2001, scree slope 3km SSE Kobi, Georgien, Kazbegi, 42°31.21' N, 044°30.92' E, leg. & coll. Stuke & Nielsen [4♂♂, 4♀♀ in alcohol collection]); 6♂♂, 1♀ (02.VIII.2001, area at the base of a glacier 6km W Kazbegi, 2800-3000m, Georgien, 42°39.61' N, 044°33.39' E, leg. & coll. Stuke).

Etymology: The species is named after Dr. Roin Migriauli, Tiflis. Without his great help the excursion to the Caucasus would not have been possible.

SYSTEMATICS

Description

Male holotype. Head (Figures 1 and 2): Antennae completely black, 3rd joint rather large. Arista thickened on the basal half. Face rather much produced and «nosy», grey dusted with the exception of the facial tubercle, the mouth-edge and a posteroventral triangular area of the cheek. Face at the sides with long white hairs. Lunula shining black. Frons grey dusted, black haired. Eye angle about 105°. The eyes touching for a short distance, equal to the distance between front and hind ocelli. Ocellar triangle without obvious dusting, with black and a few white hairs. Occiput dusted with light yellow hairs and additional long black dorsolateral hairs. Genae lightly dusted with a mixture of light yellow and a few black hairs.

Thorax (Figures 4-6): Mesoscutum und scutellum shiny, coarsely punctate, with a mixture of black and light yellow hairs. Humeri and postpronotum slightly dusted. Pleura dusted. Long white hairs that are twisted apically can be found on anepisternum, anepimeron and dorsally on katepisternum. There are some shorter hairs that are not twisted apically on ventral part of katepisternum.

Wings completely covered with microtrichia. Squamulae dirty white. Halteres yellow-brown with darker base.

Legs black except for the knees, the three basal tarsomeres and tibial apex of fore legs. Fore legs: Femur dorsally with no hairs; posteriorly with long black and white hairs; ventrally on apical half with a row of short, black bristles. Tibia laterally with several black and a few white hairs and bristles; ventrally with a few smaller black bristles near base. Tarsus with only white hairs. Shape of tarsus is shown in figures 4 and 5. Middle legs: femur anteriorly and posteriorly with long yellowish white hairs. On ventral apical part are several black hairs, and on ventral side are additional several black bristles. Tibia ventrally and posteriorly with white and black hairs and black bristles. Coxae and trochanter with a tuft of short, dense black bristles and some white hairs. Tarsomeres with only small white hairs. Hind legs: femur anteriorly and posteriorly with pale hairs. On the anterior side of femur 3 the hairs are as long as the width of femur, on the posterior side the hairs are shorter. Tibia with short white hairs with the exception of the shiny dorsal side. Coxa and trochanter with several long white hairs and a few black bristles. Tarsus with only small white hairs; basal tarsomere slightly thickened.

Abdomen (Figure 7) black. Tergit 2-4 each with a pair of steel-grey dust spots. Tergite 1. the sides of tergite 2-4, the posterior margin of tergit 4, the top of the abdomen, and the sternites 2-3 with a metallic, grey lustre. The abdomen is completely covered with whitish hairs; the longest hairs are anterolaterally on tergit 2 and posterolaterally on sternit 2.

Variation of males

Some males have purely white hairs on the genae and the scutellum. Fore tibia can be completely pale on the dorsal side.

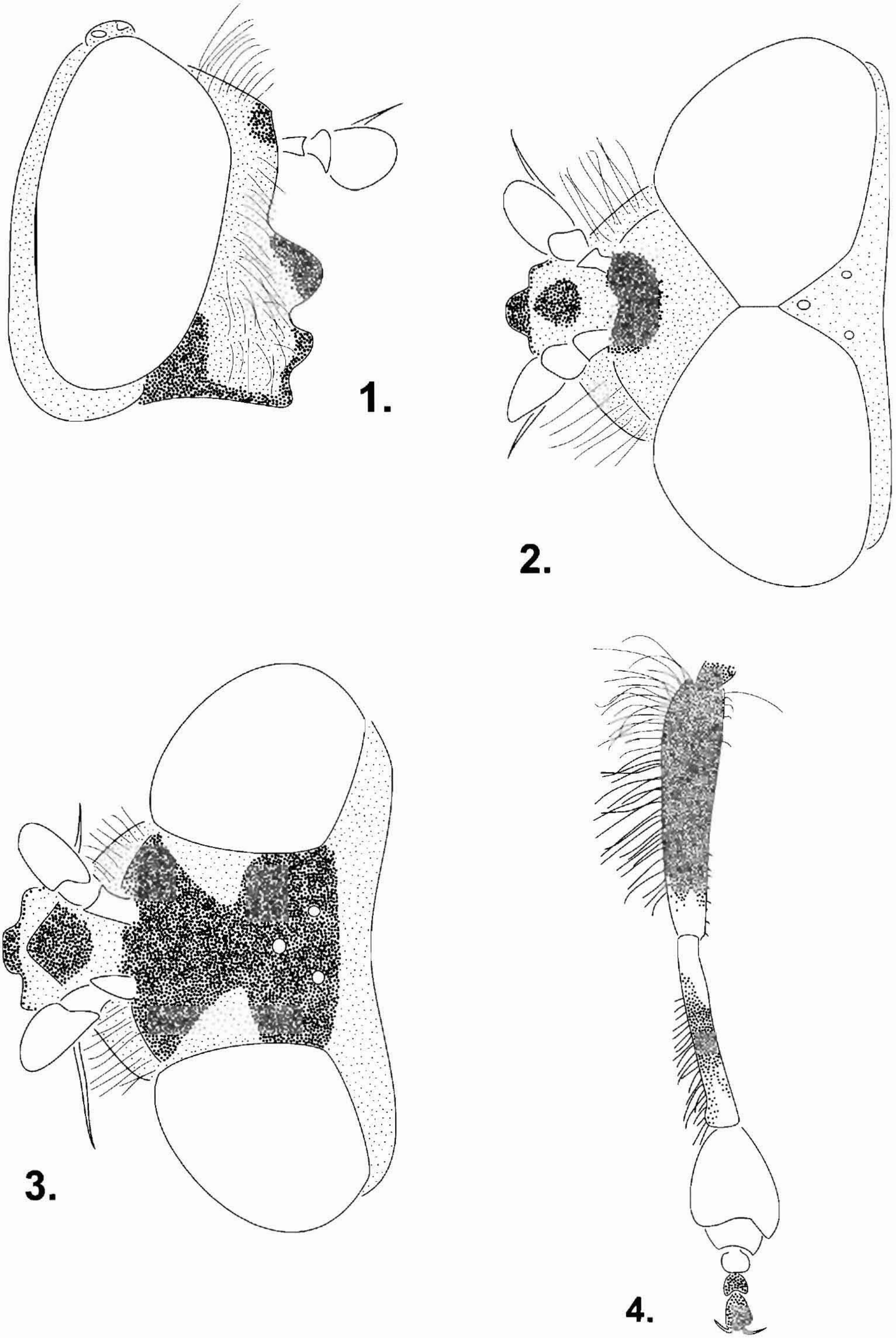
Key to separate the female of *Platycheirus migriaulii* sp. n. from the females of *Platycheirus discimanus* and *Platycheirus groenlandicus.*

1. Face much produced and «nosy», heavily greyish dusted (except facial tubercle shiny black). The white facial hairs long, as long as the depth of 3rd antennal joint. Frons with two lateral, triangular greyish dust spots which contrast well with the black ground colour (Figure 3). Scutum long haired, the longest hairs 2x longer than depth of 3rd antennal joint. Tergite 2-4 each with a pair of subquadrate, ill-defined spots. Tergite 5 all black, lightly brownish dusted. .... ***migriaulii*** sp. n.

– Face less produced, hairs on face and scutum shorter, frons without distinct triangular dust spots. Tergite 2-4 with well-defined dust spots. **2**

2. Frons with a transverse, more or less diffuse band of grey and/or brownish dusting. The hairs on anterior part of scutum as long as depth of 3rd antennal joint. The spots on tergite 3-4 longish rectangular, they are occupying at most half the length of the tergites. .... ***groenlandicus*** Curran

– Frons shining black, only very lightly dusted. The hairs on anterior part of scutum shorter, obviously shorter than depth of 3rd antennal joint. The spots on tergite 3-4 squarish, hind margin sloping backwards towards the lateral margin of tergite. The spots are occupying about 2/3 of the length of the tergites . ... ***discimanus*** (Loew)



Figures 1–4. *Platycheirus migriaulii* sp. n. - 1: head, lateral (♂, paratype). - 2: head, dorsal (♂, holotype). - 3: head, dorsal (♀, paratype). 4: femur 1, tibia 1, and tarsus 1, dorsal (♂, holotype).

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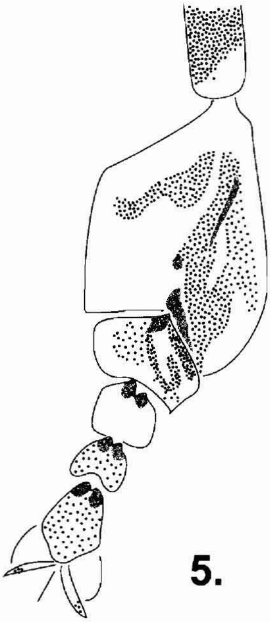

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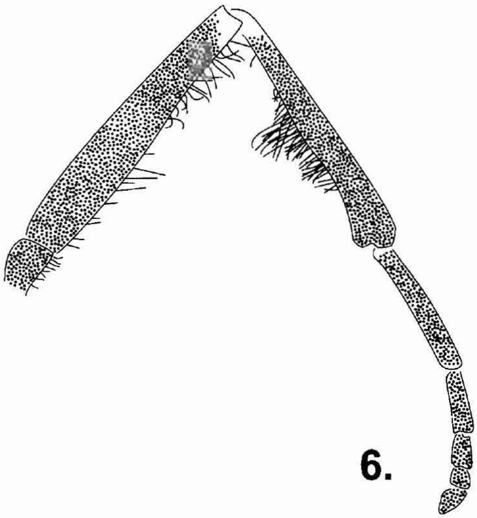

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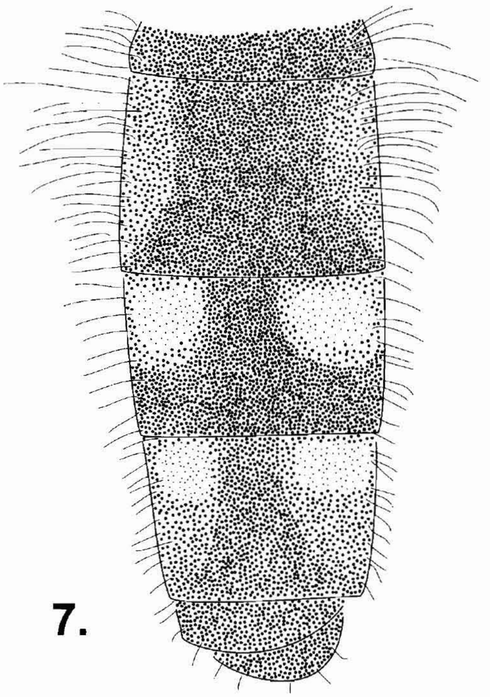

7.

Figures 5-7. *Platycheirus migriaulii* sp. n. - 5: tarsus 1, ventral (♂, paratype). - 6: tibia 2, anterior (♂, paratype). - 7: abdomen (♂, paratype).

Female

Similar to male, except for the normal sexual dimorphism and the following: Frons shiny with two lateral, triangular dust spots (Figure 3); the hairs are white and black. Genae white haired. Mesoscutum and scutellum white haired, sometimes with a few black hairs. Knees more broadly yellow than in the male. Legs usually without black hairs or bristles. Tibiae without long hairs. Femora anteriorly with only a few rather short white hairs. Hind femur usually without longer hairs posteriorly. The grey abdominal dust spots are less obvious, sometimes they can be seen only at a suitable angle. Abdomen more shining than in the male, sternites 1-5 completely shiny on posterior and lateral edge and only sligtly dusted in the middle. The longest abdominal hairs are anterolaterally on tergite 2.

Body length: male 5.5 – 7.5 mm, female 5.5 – 7.7 mm. Wing length: male 5,0 – 6,6 mm, female 5.3 – 6.7 mm.

Diagnosis

Platycheirus migriaulii has a produced face, black antennae, non dilated fore tibia, the two basal tarsomeres of tarsus 1 broadened (males only) and no compact tuft of several long wavy white hairs at base of femur 1. With these features it belongs to the *manicatus*-group sensu Dušek & Láska (1982) and the *manicatus*-subgroup sensu Vockeroth (1990). There are four additional species of this group that have a black abdomen with grey dust spots on the tergites: *Platycheirus discimanus* Loew, 1871 (holarctic), *Platycheirus groenlandicus* Curran, 1927 (holarctic), *Platycheirus oreadis* Vockeroth, 1990 (nearctic), and *Platycheirus thylax* Hull, 1944 (nearctic). The male *Platycheirus migriaulii* is characterized by the form and unique pattern of the tarsus 1 dilation (Figure 4 and 5), the lack of black bristles on tibia 2 and the distribution of hairs on tibia 2 (Figure 6). The shape of tarsus 1 is rather similar to that of *Platycheirus cintoensis* van der Goot, 1961, but *migriaulii* is easily distinguished from *cintoensis* by e.g. the shorter and stouter abdomen, the grey tergite spots and the less protruding lower part of face. The female of *Platycheirus migriaulii* can be separated from the holarctic species by means of the key presented below.

Acknowledgements. The tour to the Caucasus would have been impossible without the help of some friends: Roijn Migriauli (Tiflis) organised the tour. Micheil Ivaniashvili (Tiflis), Karen Jahn (Bremen) and Heiko Knitter (Bremen) were patient company and helped in planning and in practical operations. Martin Hauser (Champaign) and J. Richard Vockeroth (Ottawa) sent us nearctic *Platycheirus* material. Ben Brugge (Zoölogisch Museum, Amsterdam) kindly gave us the opportunity to study the *Platycheirus cintoensis* holotype.

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Received 27 August 2002,
accepted 14 October 2002

Bokanmeldelse • book review

Nilsson, Anders N. 2001. World Catalogue of Insects. Volum 3. Dytiscidae (Coleoptera). 395 s. Apollo Books, Kirkeby Sand 19, DK-5771 Stenstrup, Denmark. ISBN 87-88757-62-5. DKK 690,- + porto. Ved abonnement på serien gis 10% rabatt.

Med verdenskatalogen på vannkalver (Dytiscidae) er den siste av de tre store gruppene innen biller i ferskvann dekket i denne viktige bokserien fra Apollo Books. Forfatteren er Anders Nilsson som jo er i særklasse på dette feltet. Med sine studier av vannkalver de siste tiår har Nilsson løftet kunnskapen om denne billefamilien atskillige hakk, slik at den nå er en av de store billefamiliene vi kjenner best, både taksonomisk og økologisk.

Vannkalvene er ikke katalogisert siden Zimmermanns bind i Coleopterorum Cataloges som kom i 1920. Den gang inneholdt gruppen 1887 arter i 44 slekter. Med Nilssons katalog er artsantallet mer enn doblet, til 3792 arter i mer enn 160 slekter, hvilket demonstrerer både behovet for katalogen og hvor mye som har skjedd på dette feltet de siste 80 år.

Boken starter med en innholdsfortegnelse hvor antall arter i alle taxa er angitt. Videre følger en kort innledning som forklarer hvordan selve katalogen er bygget opp og hvordan den skal brukes. Katalogen reflekterer taksonomisk håndverk i publisert litteratur fram til 30. september 2001. Det har vært nødvendig å gjøre enkelte nomenklaturiske endringer som en følge av arbeidet, og disse er gjengitt i innledningen. Oppbygning av den innledende teksten kunne vært gjort litt mer leservennlig gjennom f eks et sammendrag eller en litt mer «myk» start der gruppa settes i perspektiv både økologisk og historisk taksonomisk. Katalogen er i grove trekk bygd opp på samme måte som de to foregående bind i serien med de unntakene som er nevnt i innledningen. De viktigste forskjellene er at alle taxa på samme nivå er listet alfabetisk slik at slektskapet mellom grupper ikke kommer fram. Fordelen med dette er at boken er lett å finne fram i, noe som kan være hensiktsmessig i en så omfattende katalog. Slektskapet mellom ulike taxa på samme nivå er dessuten ofte ufullstendig kjent, slik at den systematiske rekkefølgen som blir valgt ut fra dagens kunnskap fort vil kunne bli foreldet etter hvert som nye fylogenetiske analyser blir publisert. Videre er artenes utbredelse kun angitt etter biogeografiske regioner. Mange vil nok savne nasjonale utbredelsesangivelser, selv om dette er et bevist valg fra forfatteren som mener at nasjonal utbredelse bør reflekteres i kataloger innen hver biogeografiske region. For den palearktiske region vil dette være et kortvarig problem siden den nye serien Catalogue of Palearctic Coleoptera er nært forestående. Det første bindet i denne serien kommer i 2003 og omhandler bl a vannkalvene.

Hoveddelen av boken består av selve katalogen som er en liste over alle gyldige navn og synonymer på høyere taxa og arter innen familien. For alle taxa refereres til originalbeskrivelsen, og til hvilke biogeografiske regioner de ulike taxa forekommer. En viktig forbedring i forhold til tidligere kataloger er at det refereres til moderne litteratur hvor taxonet er beskrevet. For høyere taxa refereres dessuten hvor mange arter som finnes, typearten og hvordan den ble angitt, kjønnet, samt publikasjoner der taxonet er synonymisert, erstattet eller gitt ny rangering. Under artsnavnet refereres bl a hva slags typemateriale som finnes og typelokaliteten. Et lite minus, men en vanskelig oppgave, er at det ikke sies noe om hvor typematerialet befinner seg. Det refereres også til hvilke navn som er gitt som erstatningsnavn (replacement names), og publikasjoner som har gitt navnene ny status, nye kombinasjoner eller synonymisert navnet første gang. Mye av informasjonen knyttet til taxa er forkortet, noe kunne med fordel ha vært listet opp i en tabell for å bedre lesbarheten.

Etter katalogdelen følger tre appendix som omhandler fossile taxa, ikke tilgjengelige navn, og arter som er ekskludert fra vannkalvene. Ikke tilgjengelige navn er arter som er beskrevet som «ab»,«var», «form» samt såkalte *nomina nuda* som er navn som ikke er knyttet til en beskrivelse. Referanselista til slutt er svært omfattende (52 s.) og verdifull i seg selv. Den vil nærmest være en komplett bibliografi på systematikk hos vannkalver.

Katalogisering er ofte preget av stor usikkerhet pga at systematikken er fundamentert på for dårlige analyser. Som følge av nye og mer inngående analyser av slektskap, hender det derfor ofte at taxa må bytte navn, f eks ved flytting, splitting og synonymisering av taxa. Studier av gammel litteratur er også ofte en årsak til navnebytter f eks ved homonymi eller at man gjenoppdager gamle artsbeskrivelser som er gjort før gjeldende navn. Den nye katalogen innebærer at 7 norske arter må skifte navn i forhold til Nilsson & Holmen (Fauna Ent. Scand. Vol 32, 1995): *Hydroporus picicornis* J. Sahlberg, 1875 skal nå hete *Hydrocolus sahlbergi* Nilsson, 2001; *Laccophilus ponticus* (Sharp, 1882) skal nå hete *L. poecilus* Klug, 1834; *Hydroglyphus pusillus* (Fabricius, 1781) skal nå hete *H. geminus* (Fabricius, 1792).

Agabus-artene i *chalconatus*-gr., *erichsoni*-gr. og *opacus*-gr. skal flyttes til slekten *Ilybius*. Dette får konsekvenser for 4 norske *Agabus*-arter som nå skal hete *Ilybius erichsoni* (Gemminger & Harold, 1868), *I. subtilis* (Erichson, 1837), *I. opacus* (Aubé, 1837) og *I. wasastjernae* (C.R. Sahlberg, 1824).

I sum er dette et meget viktig arbeid som vil stå som en svært sentral referanse på vannkalver gjennom mange tiår. Katalogen vil være fundamentalt viktig for personer ved museer og vitenskaplige institusjoner over hele verden som ønsker inngående taksonomisk oversikt over vannkalvene på verdensbasis, og et utmerket utgangspunkt og en inspirasjonskilde for den som vil revidere grupper. Prisen er kanskje i overkant av hva den generelt interesserte entomolog vil betale for denne type litteratur som tross alt er rettet mot spesialister. Jeg må bare gratulere forfatteren og forlaget med nok et kjempearbeid som etter mitt skjønn er av den høyeste faglige kvalitet.

Frode Ødegaard

Gärdenfors, U., Aagaard, K., Biström, O. (red.) & Holmer, M. (ill.). 2002. Hundraelva nordiska evertebrater. Handledning för övervakning av rödlistade småkryp. 288 s. Nord 2002:3. Nordiska Ministerrådet och ArtDatabanken. Pris DKK 225 / SEK 290. ISBN 92-893-0755-2.

Virvelløse dyr blir i økende grad trukket inn i vernearbeidet, både i Norge og internasjonalt. På «rødlistene» over truete og sjeldne arter i de nordiske landene utgjør virvelløse dyr omtrent halvparten av artene, og blant dem igjen dominerer insektene. Med fagbiologiske øyne er dette ikke overraskende, siden hovedtyngden av klodens artsmangfold ligger her. Men det er en formidabel pedagogisk oppgave å få gjennomslag for bevaring av sjeldne inseker, snegler eller muslinger, på linje med sjeldne fugl, pattedyr eller orkideer. Denne boka representerer imidlertid et glimrende forsøk nettopp i denne retning. For fagbiologer inneholder den mye nyttig informasjon, og for andre (inkludert byråkrater og politikere) bør den kunne være til stor inspirasjon gjennom sine vakre illustrasjoner og pedagogiske oppsett.

Boka er på svensk og presenterer 111 nordiske evertebrater som er av spesiell interesse å bevare i et nordisk perspekiv. Disse håndplukkede artene fyller følgende kriterier: 1) De skal kunne identifiseres i felt, 2) de skal kunne inventeres med ikke-destruktiv metodikk, 3) de er biotopspesialister, slik at man samtidig fokuserer på særegne og sjeldne naturmiljøer, og 4) de skal være rødlistet i flere nordiske land, men likevel være såpass tallrike at de lar seg overvåke. De aller fleste artene i boka er insekter, men man har inkludert en igle (blodiglen), tre snegler (blant annet tårnformet damsnegl) og tre muslinger (elvemusling, tykkskallet malermusling og flat dammusling). Blant insektene i boka dominerer biller og sommerfugler, men det er blant annet med fem libeller, en vannymfe, en døgnflue, to gresshopper, fire teger og en sikade (sangsikaden). Den enkelte art har ofte ulik rødlistestatus i de forskjellige nordiske landene, og dette er oppgitt. Selve systemet for rødlisting, med definisjoner av internasjonale og nasjonale truethetskategorier, er ryddig forklart foran i boka.

Hver art er presentert over to sider, og inkluderer en nydelig fargeillustrasjon av Martin Holmer og et utbredelseskart som viser kjente lokaliteter før og etter 1975. Teksten er standardmessig delt opp i følgende asnitt: Utseende, økologi, trusler, bevaringstiltak, overvåkningsmetoder, status og litteratur. Her er mye interessant stoff både for leg og lærd, og fremstillingen er grei og oversiktelig. Bak i boka finnes også en lang og verdifull litteraturliste.

Hovedformålet med boka er at man skal få til en overvåking av disse artene og deres levesteder i Norden. Vi finner et informativet kapittel over ulike ikke-destruktive innsamlingsmetoder som kan brukes i den forbindelse, og for hver enkelt art angis forslag til overvåkingsteknikk. Men hvem skal utføre overvåkingen? Her spriker bokas intensjoner og virkeligheten. Med et så godt faglig opplegg, burde Nordisk Råd ha sørget for midler til løpende overvåkingsprogrammer i de nordiske landene. Derfor må boka nøye seg med å si: «Vårt håp er at boka skal anvendes både innen offisielle inventerings- og overvåkingsprosjekter, og av interesserte privatpersoner som vil følge enkeltarter på hjemstedet».

Foreløpig avhenger oppfølgingen av spredte ildsjeler, som lar seg inspirere av bokas konkrete budskap. Men dette monner trolig lite. Her har vi et verktøy og et opplegg som egner seg for nasjonal satsing i hvert enkelt land. Det er miljøvernmyndighetene som burde følge opp dette med konkrete, langsiktige prosjekter.

Jeg savner en innholdsfortegnelse, slik at man raskt kan få et overblikk over de utvalgte artene, og hvilke dyregrupper de tilhører. Riktignok finnes et register bak, men det gir ingen oversikt over bokas oppbygning. Det ville også ha vært nyttig med en samlet oversikt over de aktuelle biotopene som artene er knyttet til. Som kjent er det livsmiljøene til de truete artene som må reddes, dersom man vil redde artene.

Til slutt: Layoutmessig er boka lekker, og den er egnet til å inspirere både entomologer og byråkrater. Her blir man sittende å bla, og glede seg over de vakre fargeillustrasjonene. Det er et veldig godt grep å alliere seg med kunstnere i kampen for å bevare vårt myldrende mangfold. For mangfoldet er vakkert. Og det appellerer til alle.

Sigmund Hågvar

Norw. J. Entomol. 49, 117–138. 2002

Spiders (Araneae) in low alpine areas at Finse, Southern Norway

Erling Hauge & Preben S. Ottesen

Hauge, E. & Ottesen, P. S. 2002. Spiders (Araneae) in low alpine areas at Finse, Southern Norway. Norw. J. Entomol. 49, 117-138.

Pitfall trapping in 47 south exposed sites during the snow free season resulted in 47327 specimens and 55 species of spiders from 5 families, Linyphiidae and Lycosidae dominating. Field characteristics (estimated microclimatic temperature, soil humidity, soil organic content and plant sociological classification) have been tabulated, the sites being ranked based on their soil humidity, nutrient content and temperature; and the spider species based on their humidity preferences. Direct gradient analyses and reciprocal averaging (RA) ordinations of sites and species correspond fairly well. These results also correspond well with our present knowledge of the ecological preferences of species and their zoogeographical distribution in northern Europe (including the North Atlantic Islands. In the climatically most favourable sites, i.e. at «Nordnuten» (a steep eutrophic warm area with dry and humid meadows) lowland spiders, including a handful of so-called «widespread spider species» (species present in more than 2/3 of the 47 sites), all Nordic lowland species, were dominating; and more or less taking a central position in the species' ordination diagram, while at the climatic extreme ends of axis 1 (the dry/cold and the wet/cold parts) most typical high mountain species are situated. This is most clearly observed for the cold mires, in which a few high mountain «hygric» species almost completely seem to outnumber the «Nordnuten» lowland species, in the coldest mires even so for the «widespread» species. Similarly, in both species and site ordination diagrams, where axis 2 indicates a poor/cold - rich/warm gradient, the trend was a domination of lowland species/ «warm» eutrophic sites in the upper half of the diagram. A Trellis diagram based on Soerensen indices of similarity shows that the «coldest» mires (especially the largest ones), as well as the two river sides, had few species in common with most other sites, the humid and dry meadows. Higher similarity indices were found within and between the dry and humid meadows. In some «Nordnuten» sites, having relatively dense growths of high perennials and *Salix* sp., some lowland forest spider species (very scarce/absent elsewhere in the area) reached relatively high densities. Seasonal variations of most species (phenology and numbers of specimens) are shown and briefly discussed.

Key words: Spiders, Araneae, southern Norway, alpine areas.

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INTRODUCTION

The Finse area with the Hardangervidda high mountain plateau south of it comprises the southernmost high mountain areas in Fennoscandia. From here and other adjacent areas on relatively high ground a brief survey on other studies with various aspects on spiders have been summarised (Hauge et al.1998). For larger lists of (partly the same) species in similar areas in the north Fennoscandian mountains (Holm 1950, 1951, Palmgren 1965); from Central Europe (Puntscher 1980, Maurer & Hänggi 1990) and the many works of Dr. K. Thaler and his collaborates, from southern Europe perhaps to some extent Bosmans et al. (1988), should primarily be recommended.

The field work that this study is based on was carried out (Ottesen) in the summer of 1985 in selected low alpine habitats in the Finse area (Figure 1), primarily in order to study habitat preferences, spatial distribution and segregation of high mountain species of beetles (Coleoptera) in relation to environmental factors (such as soil humidity and organic content, altitude and temperature) and the species' seasonal activity patterns. The results were presented in Ottesen (1996). Based on the same environmental data set as for the beetles, the rather large spider material from the traps (identified by EH) is presented below. Hopefully, it will contribute to the knowledge of the species' ecology and their roles in species communities from different parts of their distribution range, according to the intentions of van Helsdingen (2000).

STUDY AREA

The Finse/Hardangervidda area is situated in a transition zone between western and eastern south

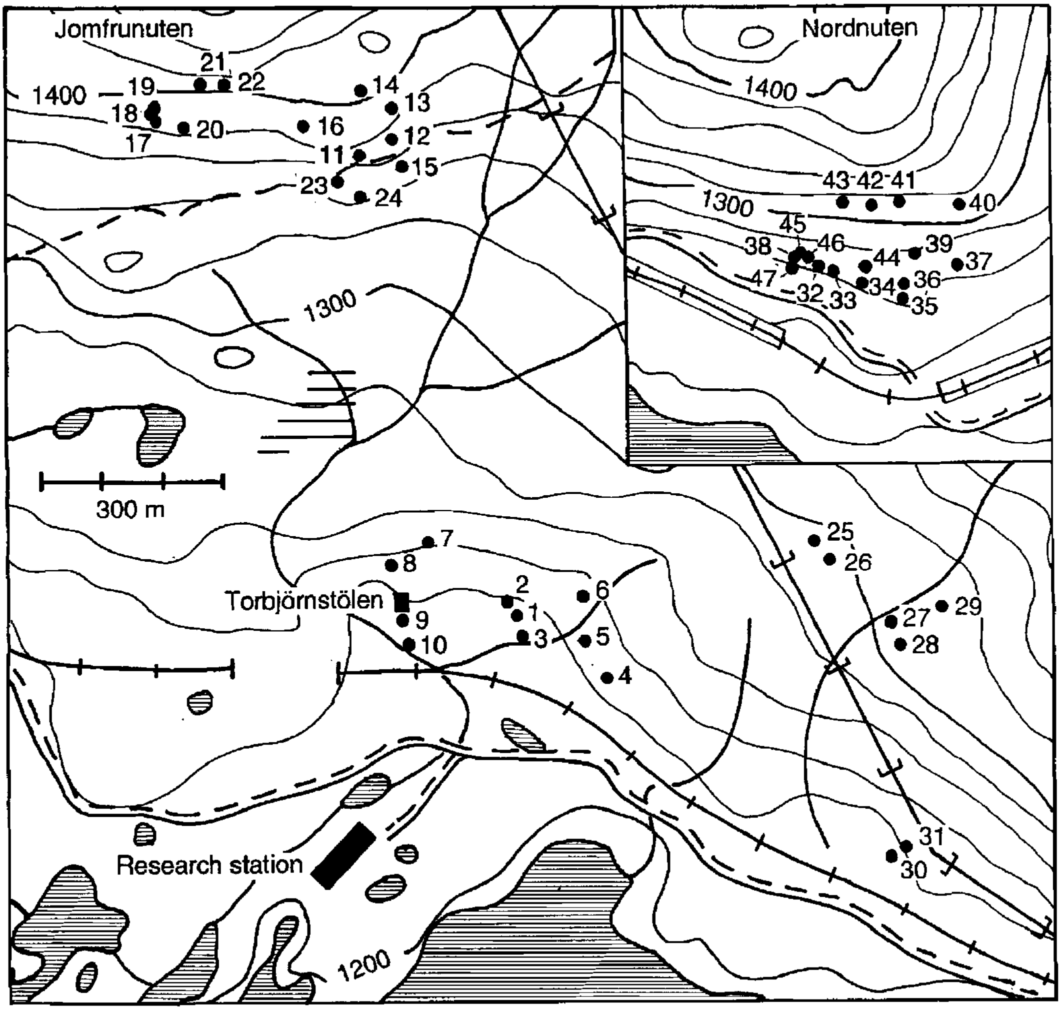

Figure 1. Map of the Finse area north of the Research Station, located 1.5 km SE of Finse railway station. Black dots: Trapping sites, numbered 1 to 47 following the numbers in Table 1. The Torbjørnstølen sub field include the TT-plots, Jomfrunuten the JN-plots and plots 24-31 the Kvannjolnuten plots. At upper right, at the same scale, is the Nordnuten sub field with the NN-plots, located 2.3 km W of the research station.

Norway, the climate being weakly oceanic influenced (Moen 1998), at least in its western areas. All sites were chosen exclusively on south faced slopes within the low alpine region, which at this latitude is located approximately between 1000 and 1400 m above sea level. The middle alpine region reaches about 1650 m a.s.l., beyond that is the high alpine region. The highest point (1870 m a.s.l.) in the area is the peak of the Hardangerjøkelen glacier. Immediately below the low alpine heaths is, as usual in the Nordic areas, a relatively open zone with scattered mountain birches, called *regio subalpina* by Holm (1950) and Palmgren (1965); below that the coniferous forest zone (*regio sylvatica*).

Summers are short and cold, the snow-free season lasting for about four months on sites with moderate snow cover during winter; locally the snow cover is permanent. Minimum night-time air temperatures (June - September) may exceed 0 °C, reaching a maximum of 4.7 °C in August; daily mean maximum temperatures 8.0 °C. Strong winds are normal, monthly mean velocity during the snow free season vary between 4.6 and 5.6 m per second. Precipitation is frequent, increasing from about 50 mm per month in May (the driest part of the season also in the *lowland* western areas) to about 120 mm in July, afterwards remaining fairly constant at the July level until winter, all according to unpublished 30 year mean values from the Norwegian Institute of Meteorology. Normally vegetation is low. Rich growths of bushes (*Salix* spp.) and areas with high perennials occur in the Finse area only in some steep and warm south-facing slopes, particularly on the Nordnuten and Kvannjolnuten mountains (Figure 1). For more detailed descriptions of the whole area, Wielgolaski (1975) can be recommended.

METHODS AND SAMPLING PROCEDURES

In the upper half of the low alpine region (i.e. between 1210 and 1410 m a. s. l.) 47 sites were selected (Figure 1). The intention was to maximise variation in soil humidity between the habitats and to minimise the variation in exposure and time of snowmelting. Sites appearing homogenous and large enough to take the traps were preferred. The sampling sites were chosen within four areas in the vicinity of the Finse High Mountain Research Station (Figure 1), their names originally being shortened to JN (Jomfrunuten), KV (Kvanndalsnuten), NN (Nordnuten) and TT (Torbjørnsstølen) as seen in Table 1 and 2.

Pitfall traps were used. A pilot study testing their contents of Coleoptera showed that six traps in each locality were sufficient (Ottesen 1996). In the current investigation the first traps were set 6 May and emptied at intervals, splitting the material in five sub-periods (Table 3). In order to secure equal lengths of the sampling periods on the sites, the traps were emptied each time in the same order during the two days work taking to visit all traps. The traps were plastic cups with an upper diameter of 6.5 cm and 9.5 cm deep, half filled with formaldehyde (4 %) added a small amount of detergent (for breaking the surface tension). Approximately 3-4 cm above each trap was placed a 15 x 15 cm (0.2 cm thick) roof made of plexi glass.

The angle sun/surface (Table 1) indicates the heat exposed from the sun and was expected to be correlated with the average microclimatic temperature. The *exposure* of each site was measured and expressed as the angle at which the sun beams reached the ground at noon on midsummer's day (21 June) and was calculated from standard equations (Holter et al. 1979).

Soil humidity samples were taken twice: On 2 July 1985 (a sunny day after a «normal» period with frequent rain) and on 29 June 1986 after a hot and dry period with no rain for 2 weeks (very unusual in the area). In each site five soil samples (each 10 cm^2) were taken randomly with a soil corer and cut into three sections: 1) the litter layer, 2) upper two cm of the mineral soil layer (often rich in organic contents) and 3) a further 3 cm (i.e. 2-5 cm below the soil surface) of the soil layer (which usually was dominated by mineral particles), stones larger than 2 mm were sifted out. The sub samples were weighed to the nearest 10 mg and pre-dried at 40-50 °C, then at 105 °C to constant weight. Soil humidity used in this paper is identical to the weight of water in percent of total soil fresh weight.

Table 1. Field characteristics, listed in the same order as Table 2. No: the field serial number, as used in Table 2. Name: Field name used during the sampling program. F. ser no (Finse serial nnumber): Permanent number found in field on a metal disc attached to a white topped iron pole. m a.s.l.: meters above sea level. Dec (Declination): the slope of the ground in degrees. Expos (Exposure): Direction of slope, in degrees deviation from south, positive towards east. Angle sun/surface: see text. % soil humidity ± SD: Percent soil water content ± SD, after a dry period and a normal, i.e. humid period. % Soil organic content ± SD: Percent weight loss during combustion.

No	Name	F. ser no	m asl.	Dec	Expos	Angel sun/ surf.	% soil humidity ± SD Dry	% soil humidity ± SD Normal	% Soil org. cont. ± SD	Plant sociological classification Dahl (1984)
OLIGOTROPHIC - MESOTROPHIC AREAS										
Lichen heaths and blueberry slopes										
29	KV5	84	1340	3.0	-153.0	39.9	37.8 ± 17.5	34.4 ± 5.2	14.1 ± 5.3	Cetrarietum nivalis
15	JN5	70	1385	1.5	-117.0	37.9	26.4 ± 5.7	33.5 ± 5.8	15.7 ± 4.6	Cetrarietum nivails
13	JN3	68	1395	3.5	-70.2	36.1	44.9 ± 10.4	37.1 ± 9.8	18.5 ± 8.7	Deschampsio-Anthoxanthion
24	JN14	79	1363	33.0	1.8	4.3	26.0 ± 4.4	28.7 ± 2.5	15.1 ± 2.7	Phyllodico-Vaccinion
14	JN4	79	1405	9.0	-18.0	28.7	27.0 ± 5.7	30.6 ± 4.7	14.9 ± 4.9	Cetrarietum nivalis
5	TT5	60	1222	15.5	-88.2	39.4	23.1 ± 2.5	28.2 ± 3.3	11.7 ± 2.5	Deschampsio-Anthoxanthion
6	TT6	61	1228	7.0	-27.0	31.1	31.1 ± 13.0	32.1 ± 4.6	20.9 ± 5.4	Phyllodico-Vaccinion
4	TT4	59	1226	5.0	-99.0	38.2	24.0 ± 2.0	26.4 ± 2.4	10.7 ± 3.1	Cetrarietum nivalis
40	NN9	95	1310	20.0	-3.6	17.2	38.7 ± 4.2	48.1 ± 9.7	33.1 ± 5.6	Phyllodico-Vaccinion
Dry meadows										
8	TT8	63	1228	8.5	18.0	29.2	31.6 ± 2.9	35.6 ± 2.8	19.2 ± 3.3	Deschampsio-Anthoxanthion
1	TT1	56	1216	12.0	-63.0	33.2	40.0 ± 3.7	42.9 ± 8.7	26.6 ± 5.9	Deschampsio-Anthoxanthion
9	TT9	64	1212	13.0	-14.4	24.8	22.1 ± 1.4	26.5 ± 3.7	12.1 ± 2.8	Summer farm meadow
22	JN12	77	1410	29.5	0.0	7.7	22.2 ± 2.4	30.6 ± 3.4	14.8 ± 3.2	Ranunculeto-Oxyrion
7	TT7	62	1240	29.0	-14.4	11.3	21.9 ± 5.3	32.9 ± 5.8	20.3 ± 4.7	Phyllodico-Vaccinion
28	KV4	83	1330	10.0	-95.4	39.2	32.2 ± 3.7	36.2 ± 5.3	13.3 ± 6.5	Deschampsio-Anthoxanthion
27	KV3	82	1330	9.0	-104.4	40.2	30.0 ± 5.7	45.5 ± 11.5	20.3 ± 10.7	Deschampsio-Anthoxanthion
Humid meadows										
23	JN13	78	1367	23.0	0.0	14.2	56.2 ± 7.5	55.5 ± 5.1	39.7 ± 4.5	Deschampsio-Anthoxanthion
21	JN11	76	1410	23.0	6.3	14.5	61.6 ± 5.7	68.3 ± 7.1	53.9 ± 6.2	Deschampsio-Anthoxanthion
17	JN7	72	1385	8.0	36.0	31.0	74.6 ± 4.0	65.0 ± 4.7	46.7 ± 3.2	Dryadetum
18	JN8	73	1390	8.0	57.6	33.5	59.9 ± 2.2	67.4 ± 2.4	58.3 ± 2.9	Dryadetum
16	JN6	71	1390	11.5	-2.7	25.7	51.5 ± 5.5	33.3 ± 8.6	14.2 ± 7.8	Deschampsio-Anthoxanthion
19	JN9	74	1390	4.5	99.0	38.1	72.4 ± 3.2	73.0 ± 3.9	55.7 ± 5.8	Deschampsio-Anthoxanthion
30	KV6	85	1220	12.0	-57.6	32.1	58.7 ± 3.5	50.3 ± 10.3	22.7 ± 7.1	Rumiceto-Salicetum lapponae
11	JN1	66	1385	6.5	-54.0	33.7	67.1 ± 7.8	70.4 ± 4.0	51.8 ± 5.5	Deschampsio-Anthoxanthion

Table 1. Continued.

No	Name	F. ser no	m asl.	Dec	Expos	Angel sun/ surf.	% soil humidity ± SD Dry	% soil humidity ± SD Normal	% Soil org. cont. ± SD	Plant sociological classification Dahl (1984)
EUTROPHIC, "WARM" AREAS										
Dry meadows										
39	NN8	94	1275	12.0	-32.4	27.7	29.2 ± 3.1	42.1 ± 7.9	25.1 ± 8.2	Deschampsio-Anthoxanthion
35	NN4	90	1260	11.0	-32.4	28.4	28.5 ± 4.9	31.6 ± 4.2	13.2 ± 4.7	Deschampsio-Anthoxanthion
36	NN5	91	1264	7.0	-72.0	35.5	26.5 ± 1.2	29.9 ± 4.4	11.9 ± 3.2	Deschampsio-Anthoxanthion
47	NN16	102	1255	4.0	-68.4	35.9	43.2 ± 7.2	47.8 ± 6.1	28.2 ± 5.3	Geranietum silvatici alpicolum
33	NN2	88	1261	9.0	-45.0	31.4	25.1 ± 2.3	28.4 ± 3.2	9.9 ± 1.6	Deschampsio-Anthoxanthion
37	NN6	92	1270	3.0	77.4	36.6	42.6 ± 6.5	44.0 ± 13.0	24.8 ± 5.6	Hygro-Festucetum ovinae
32	NN1	87	1260	12.0	-18.0	26.0	33.8 ± 3.7	35.3 ± 4.3	14.8 ± 4.5	Geranietum silvatici alpicolum
46	NN15	101	1260	17.0	-14.4	21.1	31.9 ± 3.0	42.9 ± 9.1	22.8 ± 6.4	Geranietum silvatici alpicolum
45	NN14	100	1262	15.0	-7.2	22.3	35.4 ± 6.1	49.8 ± 3.4	32.0 ± 4.1	Geranietum silvatici alpicolum
Humid meadows										
44	NN13	99	1265	11.0	-36.0	28.9	49.0 ± 9.9	47.0 ± 7.7	26.0 ± 8.9	Geranietum silvatici alpicolum
38	NN7	93	1255	7.0	-21.6	30.7	46.5 ± 4.3	48.2 ± 9.7	27.9 ± 4.1	Geranietum silvatici alpicolum
41	NN10	96	1310	32.0	-7.2	6.6	44.0 ± 14.7	56.8 ± 12.1	37.2 ± 11.6	Geranietum silvatici alpicolum
43	NN12	98	1310	29.0	-9.0	9.5	54.8 ± 15.1	54.2 ± 16.5	36.4 ± 12.8	Geranietum silvatici alpicolum
42	NN11	97	1310	35.0	-5.4	3.8	51.1 ± 11.4	54.6 ± 8.0	34.2 ± 9.4	Geranietum silvatici alpicolum
RIVERSIDES										
10	TT10	65	1210	0.0	0.0	37.2	53.4 ± 3.2	44.0 ± 4.1	10.4 ± 4.7	Rumiceto-Salicetum lapponae
31	KV7	86	1220	10.0	-70.2	34.9	83.3 ± 1.8	83.3 ± 2.1	69.5 ± 1.9	Rumiceto-Salicetum lapponae
MIRES										
Small										
34	NN3	89	1261	3.0	-45.0	35.1	75.9 ± 16.1	63.8 ± 21.1	56.8 ± 14.1	Chamaemoreto-Sphagnetum acutifol.
20	JN10	75	1383	6.0	30.6	32.1	84.0 ± 15.3	92.1 ± 1.3	91.7 ± 9.4	Caricion bicoloris-atrofuscae
12	JN2	67	1386	2.0	-81.0	36.9	86.5 ± 0.9	90.2 ± 1.0	86.6 ± 1.5	Calliergonetum sarmentosi
Large										
2	TT2	57	1217	11.0	-72.0	35.1	88.6 ± 3.8	89.8 ± 2.7	87.3 ± 4.9	Caricion canescentis-fuscae
3	TT3	58	1211	6.5	-63.0	34.6	78.0 ± 5.1	85.6 ± 1.9	80.5 ± 2.1	Caricion canescentis-fuscae
25	KV1	80	1330	5.0	-49.5	34.1	85.7 ± 0.4	91.6 ± 2.5	88.5 ± 2.3	Caricion canescentis-fuscae
26	KV2	81	1330	6.5	-82.8	36.8	89.5 ± 1.4	86.9 ± 3.3	88.6 ± 3.5	Caricion canescentis-fuscae

Table 2. Classification of the spiders in the lower alpine region of Finse. The abundance data are octave transformed, but N shows number of individuals of each species. + = 1 individual, not included in the calculations, - = no record. Within each species group, the species are sorted vertically according to their soil humidity preference (SHP). The fields are grouped horizontally according to their soil humidity and within each group according to the weight of the species.

	OLIGOTROPHIC - MESOTROPHIC AREAS																								EUTROPHIC, "WARM" AREAS														RIVER-SIDES		MIRES								
SOIL WATER CONTENT:	< 44 %																44 - 75 %								< 44 %									44 - 75 %							> 75 %								
	Lichen heaths & Blueberry slopes									Dry meadows							Humid meadows								Dry meadows									Humid meadows							Small			Large				SOIL HUMIDITY PREFERENCE	
FIELD No.:	29	15	13	24	14	5	6	4	40	8	1	9	22	7	28	27	23	21	17	18	16	19	30	11	39	35	36	47	33	37	32	46	45	44	38	41	43	42	10	31	34	20	12	2	3	25	26	N	(SHP)
SPECIES TOLERATING POOR, COLD AREAS																																																	
Xeric - mesic species (SHP < 44 %)																																																	
Scotinotylus evansi	-	-	-	1	-	+	2	-	-	+	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	30.4
Gnaphosa lapponum	2	1	2	3	3	3	-	2	2	-	-	-	-	+	2	1	-	-	+	-	-	-	-	-	1	1	+	1	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	159	33.8
Improphantes complicatus	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	34.2
Mecynargus borealis	2	3	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	46	34.6
Haplodrassus signifer	-	-	-	2	+	+	1	+	1	+	3	+	-	1	-	+	1	-	-	-	-	-	-	-	1	+	+	1	2	+	-	-	-	1	-	-	1	-	-	-	+	-	-	-	-	-	-	73	34.8
Erigone atra	-	-	+	+	-	1	-	-	-	-	-	7	-	-	-	3	1	1	+	1	3	4	+	1	-	-	+	1	+	+	1	+	-	-	4	-	-	-	3	-	1	-	-	-	1	-	-	482	35.9
Micaria alpina	-	1	2	1	-	1	+	+	-	1	1	-	1	+	-	-	1	1	-	-	-	-	-	-	+	+	1	1	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	52	37.1
Xysticus cristatus	-	-	-	1	+	2	1	-	1	1	2	-	-	1	-	1	-	+	-	-	-	-	-	-	1	1	1	2	1	+	1	+	1	1	1	1	+	+	-	-	1	-	-	-	-	-	-	98	37.1
Metopobactrus prominulus	1	1	1	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	+	-	-	-	-	36	38.5
Hahnia ononidum	-	-	+	-	+	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	131	38.6
Bolyphantes luteolus	+	-	+	-	-	1	+	1	1	1	+	-	-	1	+	-	-	-	-	-	-	-	+	-	1	3	2	1	1	1	+	-	1	1	1	1	1	1	-	-	1	-	-	-	-	-	-	114	38.8
Tiso aestivus	+	+	4	4	4	5	3	1	2	3	+	+	4	1	-	1	5	4	3	2	3	-	+	-	2	+	+	4	-	-	-	-	-	1	+	-	-	-	-	-	-	-	1	-	-	-	-	569	40.1
Mecynargus morulus	-	-	-	-	-	+	1	-	1	2	1	-	-	-	+	3	+	1	-	-	2	-	1	-	1	1	1	1	1	-	1	+	1	3	2	-	-	-	-	1	-	-	-	-	-	-	-	131	40.6
Tenuiphantes mengei	-	-	+	1	-	1	1	-	1	3	1	-	-	1	1	2	-	-	-	-	-	-	-	-	1	2	3	1	1	-	1	3	3	1	1	4	5	4	+	-	+	-	+	-	-	-	-	402	42.6
Walckenaeria cuspidata	-	-	-	-	-	-	-	-	-	2	2	1	1	2	-	1	+	2	-	+	3	+	4	-	1	1	1	2	4	-	5	3	2	4	4	3	3	4	-	1	1	-	2	1	+	-	-	507	43.8
Mesic - hygric species (SHP 44 - 75 %)																																																	
Ceratinella brevipes	+	+	1	-	-	+	-	-	-	+	1	1	-	-	1	1	-	1	-	-	-	1	1	-	2	1	3	1	1	4	2	-	-	1	3	-	1	2	2	+	3	+	1	-	1	-	+	223	45
Ozyptila rauda	1	-	-	-	+	-	-	1	1	-	-	-	-	-	1	-	-	+	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	49.6
Hilaira frigida	1	1	3	2	-	-	-	1	-	-	-	-	-	-	1	4	-	-	-	2	2	2	-	-	-	+	+	-	1	4	-	-	-	1	-	-	+	-	+	-	4	+	1	-	+	-	-	223	49.6
Collinsia holmgreni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	3	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	+	135	56.7
Leptorhoptrum robustum	-	-	-	-	-	+	-	1	-	-	1	2	-	-	-	1	-	+	-	-	3	4	1	1	-	-	-	+	-	-	1	1	1	-	1	1	5	4	6	2	-	-	1	2	5	1	-	602	58.7
Pardosa amentata	-	-	-	-	-	-	-	-	-	-	-	4	4	-	-	-	1	1	-	-	3	-	6	5	-	-	-	1	1	-	4	4	3	1	4	6	6	6	5	6	+	1	4	5	5	3	4	1656	58.7
Semljicola faustus	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	5	-	-	-	+	-	-	-	+	-	-	-	1	2	2	-	-	-	+	2	-	-	-	-	158	61.5
Erigone arctica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	+	-	-	-	+	1	-	-	20	62.7
Mecynargus monticola	4	3	-	-	-	-	-	1	-	-	-	-	1	-	3	1	-	-	3	1	-	3	-	1	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	2	-	1	1	-	-	+	6	432	63
Wabasso questio	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	+	4	-	-	114	64.6

Table 2. Continued.

FIELD No.:	29	15	13	24	14	5	6	4	40	8	1	9	22	7	28	27	23	21	17	18	16	19	30	11	39	35	36	47	33	37	32	46	45	44	38	41	43	42	10	31	34	20	12	2	3	25	26	N	
SPECIES MOSTLY PREFERING RICH, WARM SOILS (NORDNUTEN SPECIES)																																																	
Xeric - mesic species (SHP < 44 %)																																																	
Oryphantes angulatus	-	-	-	+	-	-	-	-	1	-	-	-	-	1	1	+	+	-	-	-	-	-	1	-	2	4	5	3	4	2	1	1	1	2	1	2	3	1	-	1	4	-	1	-	-	-	-	322	39.9
Hypomma bituberculatum	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3	3	3	4	2	2	2	1	3	2	2	2	1	-	1	3	-	1	+	-	-	-	264	41.6
Agyneta decora	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	4	1	2	4	1	+	-	4	-	-	-	+	-	1	-	-	-	-	-	-	157	42.4
Dismodicus bifrons	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	+	-	1	2	3	1	2	3	2	3	-	-	-	-	1	-	-	-	-	167	43.1
Mesic - hygric species (SHP 44 - 75 %)																																																	
Lepthyphantes pallidus	-	-	-	-	-	-	1	-	-	+	1	+	-	1	-	1	-	-	-	-	-	-	1	-	+	-	1	+	-	+	-	1	2	1	1	3	4	4	-	-	-	-	-	-	+	-	-	174	47.2
Centromerus sylvaticus	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	1	1	+	1	+	+	1	2	1	1	5	6	6	-	1	-	-	-	-	-	-	-	615	50.2
Cnephalocotes obscurus	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	1	+	-	-	-	4	-	-	-	-	-	-	90	52.8
Hypselistes jacksoni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	1	+	1	-	2	-	-	+	-	-	-	+	-	-	-	4	-	-	-	-	-	-	67	64.5
Hygric species (SHP > 75 %)																																																	
Mecynargus sphagnicola	-	-	-	+	-	-	-	-	-	-	-	+	+	+	1	1	-	-	+	-	+	3	-	5	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4	2	-	5	4	2	5	1	5	572	77.3
Arctosa alpigena	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-	1	3	100	81.3
Hilaira nubigena	-	+	-	-	-	-	-	-	-	-	-	-	+	-	+	-	1	-	-	-	-	-	1	5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	5	-	5	7	-	-	5	4	749	82.7
Erigone psychrophila	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	+	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	4	1	4	6	2	332	83.3
Drepanotylus uncatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	3	1	1	1	41	84.2
WIDESPREAD SPECIES (REPRESENTED IN > 2/3 OF HABITATS)																																																	
Xeric - mesic species (SHP < 44 %)																																																	
Gonatium rubens	7	7	4	5	7	2	3	5	6	3	+	2	3	5	5	5	4	2	5	3	2	2	+	+	3	1	2	1	1	2	-	+	+	3	+	1	+	+	+	-	2	2	-	-	-	-	-	2120	34.4
Oedothorax retusus	2	3	9	8	8	8	7	7	4	8	8	5	7	5	6	3	8	8	1	1	5	1	5	1	8	8	9	7	6	7	5	5	2	5	6	4	2	2	2	1	6	1	2	5	3	-	-	13674	36.6
Gnaphosa leporina	3	2	4	5	5	5	5	2	3	4	5	2	5	4	3	1	5	5	1	1	4	-	4	-	4	4	2	4	4	1	3	3	2	3	2	+	-	-	-	1	1	1	2	1	+	-	-	1471	37.9
Pardosa palustris	6	5	7	7	6	7	6	6	7	6	7	7	7	7	6	7	7	8	5	5	6	5	2	4	6	7	6	6	6	7	6	6	5	6	6	5	3	1	3	1	6	4	4	3	1	-	2	8708	39.1
Walckenaeria karpinskii	4	4	2	2	2	2	-	3	2	-	-	-	-	+	4	3	3	1	3	+	-	+	+	1	2	1	2	3	2	4	+	1	-	3	1	-	1	+	-	-	3	-	+	-	-	-	-	461	39.5
Oreonetides vaginatus	+	+	2	1	1	+	+	+	1	1	-	+	1	1	1	3	1	-	+	1	1	1	-	-	1	1	+	1	1	1	1	1	1	3	1	3	1	1	1	-	1	-	1	-	-	-	-	193	42.7
Mesic - hygric species (SHP 44 - 75 %)																																																	
Pelecopsis mengei	-	+	-	-	-	3	4	2	3	2	+	1	1	4	2	4	5	2	-	1	6	4	-	5	4	3	4	3	3	6	1	4	6	5	3	5	4	4	5	-	3	+	3	-	-	-	+	1620	45.4
RARE SPECIES (<=10 IND.), NOT INCLUDED IN CALCULATIONS																																																	
Micrargus herbigradus	-	-	-	-	-	-	-	-	+	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	26.1
Poeciloneta variegata	-	-	-	-	-	-	-	-	+	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	27.7
Pardosa hyperborea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	1	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	8	41.6
Lepthyphantes antroniensis	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	3	44.1
Diplocentria bidentata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	7	50.2
Pardosa riparia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	1	53.3
Tenuiphantes alacris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	1	-	-	-	-	-	+	-	-	-	-	4	57.9
Agyneta nigripes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	59.9
Agyneta olivacea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	+	-	-	-	-	3	61.8
Bathyphantes gracilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	71.6
																																															Sum	**4732**	

Table 3. Spiders (adults) at Finse. Numbers of specimens trapped in five periods (I-V) and in total.

SPECIES/PERIOD	**I** **6 May** **29 June**	**II** **29 June** **18 July**	**III** **18 July** **10 Aug.**	**IV** **10 Aug.** **29 Aug.**	**V** **29 Aug.** **16 Sept.**	**TOTAL**
LINYPHIIDAE						
Agyneta decora (O.P.-Cambridge, 1870)	109	37	10		1	157
A.nigriceps (Simon,1884)	1	1				
A.olivacea (Emerton,1882)	2	1	3			
Bathyphantes gracilis (Blackwall,1841)	2	1	3			
Bolyphantes luteolus (Blackwall,1833)	3	13	24	74	114	
Centromerus sylvaticus (Blackwall,1841)	2	5	27	88	493	615
Ceratinella brevipes (Westring,1851)	153	32	11	16	11	223
Cnephalocotes obscurus (Blackwall,1834)	53	18	13	4	2	90
Collinsia holmgreni (Thorell,1871)	84	32	9	5	5	135
Diplocentria bidentata (Emerton,1882)	5	1	1	7		
Dismodicus bifrons (Blackwall, 1841)	114	45	6	2	167	
Drepanotylus uncatus (O.P.-Cambridge,1873)	32	2	1	3	3	41
Erigone atra (Blackwall, 1833)	184	167	84	33	14	482
E.arctica (White, 1852)	9	3	7	1	20	
E.psychrophila Thorell,1872)	267	30	19	12	4	332
Gonatium rubens (Blackwall,1833)	295	184	919	543	179	2120
Hilaira frigida (Thorell,1872)	152	9	17	26	19	223
H.nubigena Hull,1911	43	9	129	213	355	749
Hypomma bituberculatum (Wider,1834)	185	60	10	7	2	264
Hypselistes jacksoni (O.P.-Cambridge,1902)	42	2	5	11	7	67
Improphantes complicatus (Emerton,1882)	15	2	2	19		
Lepthyphantes antroniensis Schenkel,1933	2	1	3			
L.pallidus (O.P.-Cambridge,1871)	3	25	72	41	33	174
Leptorhoptrum rubustum (Westring,1851)	27	152	214	144	65	602
Mecynargus borealis (Jackson.1930)	13	4	6	7	16	46
M.monticola (Holm,1943)	322	37	19	29	25	432
M.morulus (O.P.-Cambridge,1873)	86	13	4	10	18	131
M.sphagnicola (Holm,1939)	469	48	10	27	18	572
Metopobactrus prominulus (O.P.-Cambridge,1872)	14	4	4	12	2	36
Micrargus herbigradus (Blackwall,1854)	4	4				
Oedothorax retusus (Westring,1851)	4178	1021	3610	3220	1645	13674
Oreonetides vaginatus (Thorell,1872)	136	8	18	16	15	193
Oryphantes angulatus (O.P.-Cambridge,1881)	226	47	17	12	20	322
Pelecopsis mengei (Simon,1884)	564	330	231	251	244	1620
Poeciloneta variegata (Blackwall,1841)	1	1	1	3		
Scotinotylus evansi (O.P.-Cambridge,1894)	8	5	1	8	23	
Semljicola faustus (O.P.Cambridge,1900)	114	12	8	13	11	158
Tenuiphantes alacris (Blackwall,1853)	2	1	1	4		
T.mengei (Kulczynski,1887)	15	37	57	63	230	402
Tiso aestivus (L.Koch,1872)	193	100	139	87	50	569
Wabasso questio (Chamberlin,1848)	86	13	13	1	1	114

Table 3. Continued.

SPECIES/PERIOD	I 6 May 29 June	II 29 June 18 July	III 18 July 10 Aug.	IV 10 Aug. 29 Aug.	V 29 Aug. 16 Sept.	TOTAL
Walckenaeria cuspidata (Blackwall,1833)	342	92	24	17	32	507
W. karpinskii (O.P.-Cambridge,1873)	355	35	24	25	22	461
HAHNIIDAE						
Hahnia ononidum (Simon,1875)	38	53	37	2	1	131
GNAPHOSIDAE						
Gnaphosa lapponum (L.Koch,1866)	17	22	76	25	19	159
G. leporina (L.Koch,1866)	433	397	512	91	38	1471
Haplodrassus signifer (C.L.Koch,1839)	65	7	1	73		
Micaria alpina L.Koch,1872	21	9	19	3	52	
LYCOSIDAE						
Arctosa alpigena (Doleschal,1852)	68	7	20	4	1	100
Pardosa amentata (Clerck,1757)	1115	358	147	21	15	1656
P.hyperborea (Thorell,1872)	6	1	1	8		
P. palustris (L.,1758)	5326	1999	1120	176	87	8708
P. riparia (C.L.Koch,1833)	1	1				
THOMISIDAE						
Ozyptila rauda Simon,1875	15	3	3	4	7	32
Xysticus cristatus (Clerck,1757)	32	12	25	24	5	98

The species' soil humidity preferences (SHP) (Table 2) were calculated as the weighted mean soil humidity (H_i) with the number of specimens (N_i) in the current habitats n_i (i = 1- 47):

$$SHP = \sum_{i=1}^{n} H_i * N_i / \sum_{i=1}^{n} N_i$$

The species/sites matrix (Table 2) was subjected to Reciprocal averaging (RA), also called correspondence analysis (Gauch 1982), using the shareware program MVSP (Multivariate Statistical Package Ver. 2 by Warren L. Kovach, Univ. College, Wales, U.K.). As recommended by Gauch (1982), the abundance data were octave transformed, and rare species (<10 individuals in the total material) and accidental species with one individual in a plot (marked with «+» in Table 2) were deleted from the analysis.

Only adult specimens have been identified to species level. The nomenclature follows Platnick (2000), except for the Linyphiidae which follows Tanasevitch (2000). The plant sociological terms follow Dahl (1984). A more detailed description of the methods and interpretation of abiotic factors is found in Ottesen (1996)

RESULTS

Field characteristics are presented (Table 1) and a total yield of 55 spider species from five families is listed (Table 2 and 3). The number of species is comparable to results from low alpine areas (at 700 - 900 m a.s.l.) in Finnish (60 species) and Swedish (55 species) Lapland (Holm 1950, Palmgren 1965) and at about 1700 m a.s.l. in Central Europe (Maurer & Hänggi 1990). At present, altogether 66 species of spiders are known from the low alpine areas in the Finse/Hardangervidda region (Hauge et al.1998).

The small ground living web builders, the linyphiids + *Hahnia ononidum*, dominated (80.0 % of total); the larger «raptorial» spiders were represented by 11 species only. Several Linyphiidae, two species of Lycosidae and one Gnaphosidae species were quite abundant (Table 3) in numbers of individuals. The lowest numbers of species were found in the large mires (mean 11.8 species); much higher in the smaller mires (mean 21.3 species), which were close to the eutrophic Nordnuten humid (23.8 species) and dry meadows (23.3 species). In between were the riversides (mean 17.5), the oligotrophic/mesotrophic humid meadows (mean 15.1), the dry meadows (mean 18) and the lichen heaths/blueberry slopes (mean 17 species).

The beetles were richer in species (Ottesen 1996, Table 3): Eighty-seven species from 16 families, Carabidae (13 species) and Staphylinidae (47 species) dominating. This may partly be explained by the variation in trophic levels within the order of Coleoptera, several species being herbivorous (partly *strong* food specialists) and saprophagous/coprophagous (Ottesen 1996, Table 5). Spiders are exclusively carnivores.

The sampling sites are grouped according to their humidity contents measured during the dry period (Table 1), and in the direct gradient analysis of the spiders (Table 2) the species are grouped according to their calculated soil humidity preference (SHP). In both cases there is a continuum of values. So, in order to decide the limits between the groups in a meaningful manner, subjective observations during the field work have also been taken

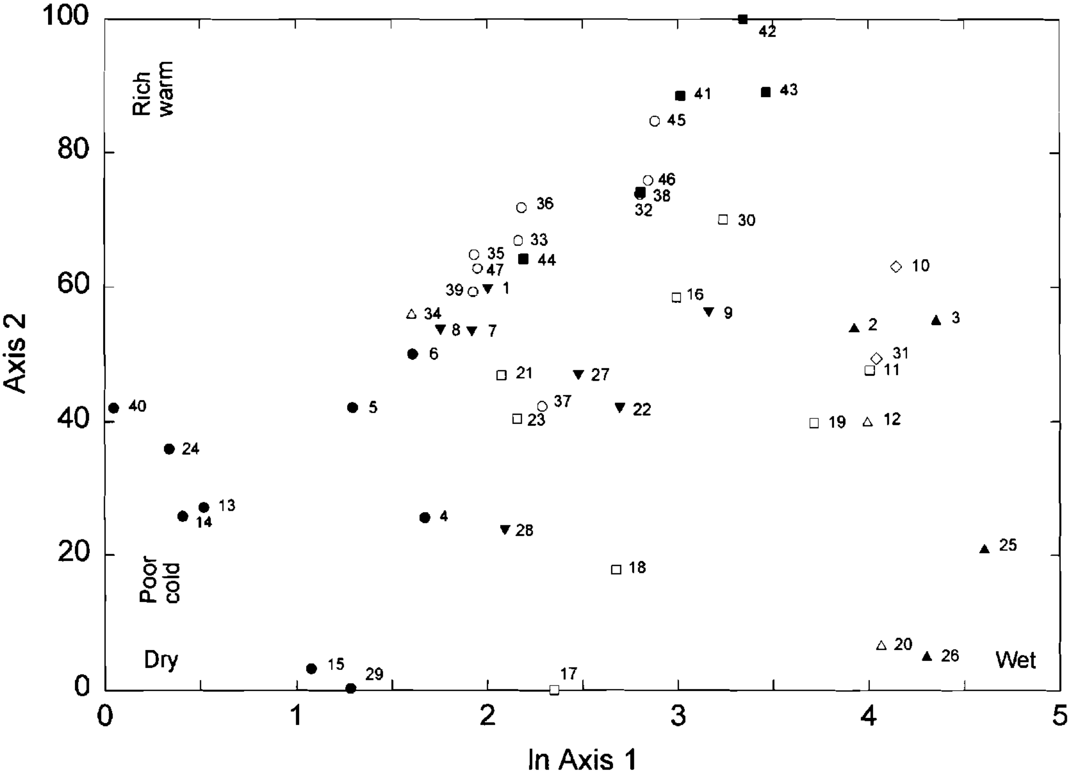

Figure 2. The sampling sites, plotted on axis 1 and 2 scores from a reciprocal averaging (RA) on the species x sites matrix. Axis 1 reflects a dry - wet gradient, while axis 2 reflects nutritional and thermal status from cold oligotrophic sites to warm, eutrophic areas. The site symbols reflect group affinities as shown in Table 1 and 2. **1) Oligotrophic - mesotrophic areas.** ●: Lichen heaths and blueberry slopes, ▼: Dry meadows, ❏: Humid meadows. **2) Eutrophic, warm areas.** O: Dry meadows, ■: Humid meadows. **3) Riversides**: ◊. **4) Mires.** Small mires: Δ, Large mires: ▲.

into consideration, the limit between dry and humid meadows then set at 44 % humidity, between humid meadows and mires at 75 % (Table 1). So also for the species (Table 2). Species found in more than 2/3 of the sites are here grouped separately as «the widespread species». Based on Table 1 and 2, sites and species have been ordinated (Figure 2 and 3). For practical reasons, natural logarithms (ln) are here used for axis 1. Figure 3 fairly well reflects our present knowledge about several of the species' ecological preferences and geographical distribution (see Discussion). The phenology of most species is shown in Figure 4. A Trellis diagram (Figure 5) based on the Soerensen (1948) absent/present index shows the similarities of the species contents between the different sites (and groups of sites), further visualised by the shading of certain areas (see Discussion).

DISCUSSION

Ordination of sites

Mires and river sides

Figure 2 largely reflects Table 1. All «mires» (except for site 34) and the two riversides are situated in the right, «humid» part of the diagram, together with two humid Jomfrunuten oligotrophic-mesotrophic meadows (site 11 and 19). Like most mires, site 11 (a humid meadow) shared rather

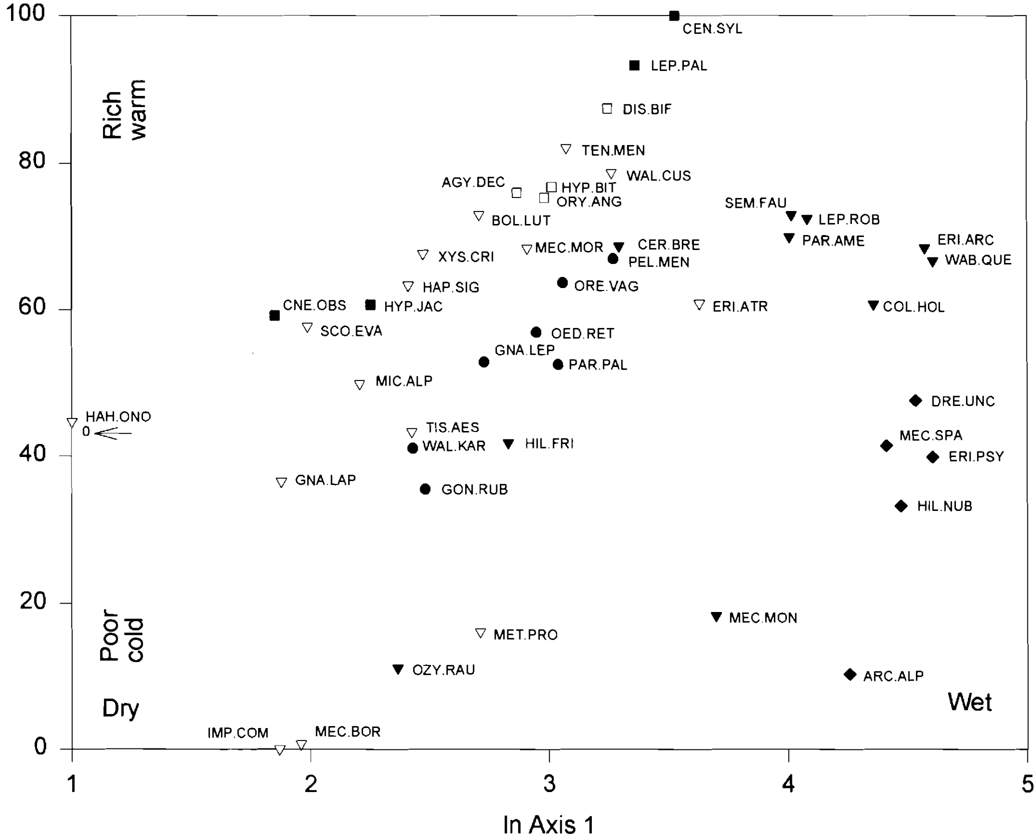

Figure 3. Spider species, plotted by axis 1 and 2 scores from a reciprocal averaging (RA) of the site x species matrix. Axis 1 reflects a dry - wet gradient, while axis 2 reflects nutritional and thermal status from cold oligotrophic sites to warm, eutrophic areas. The species names are abbreviated to first three letters in their genus and species names. The symbols reflect group affinity as shown in Table 1 and 2. **1) Widespread species**: **●**. **2) Species tolerating poor, cold areas.** Δ: Xeric - mesic species, ▼: Mesic - hygric species. **3) Species mostly preferring rich, warm soils (Nordnuten species).** ❑: Xeric - mesic species, ■: Mesic - hygric species. **4)** ◆: **Hygric species**.

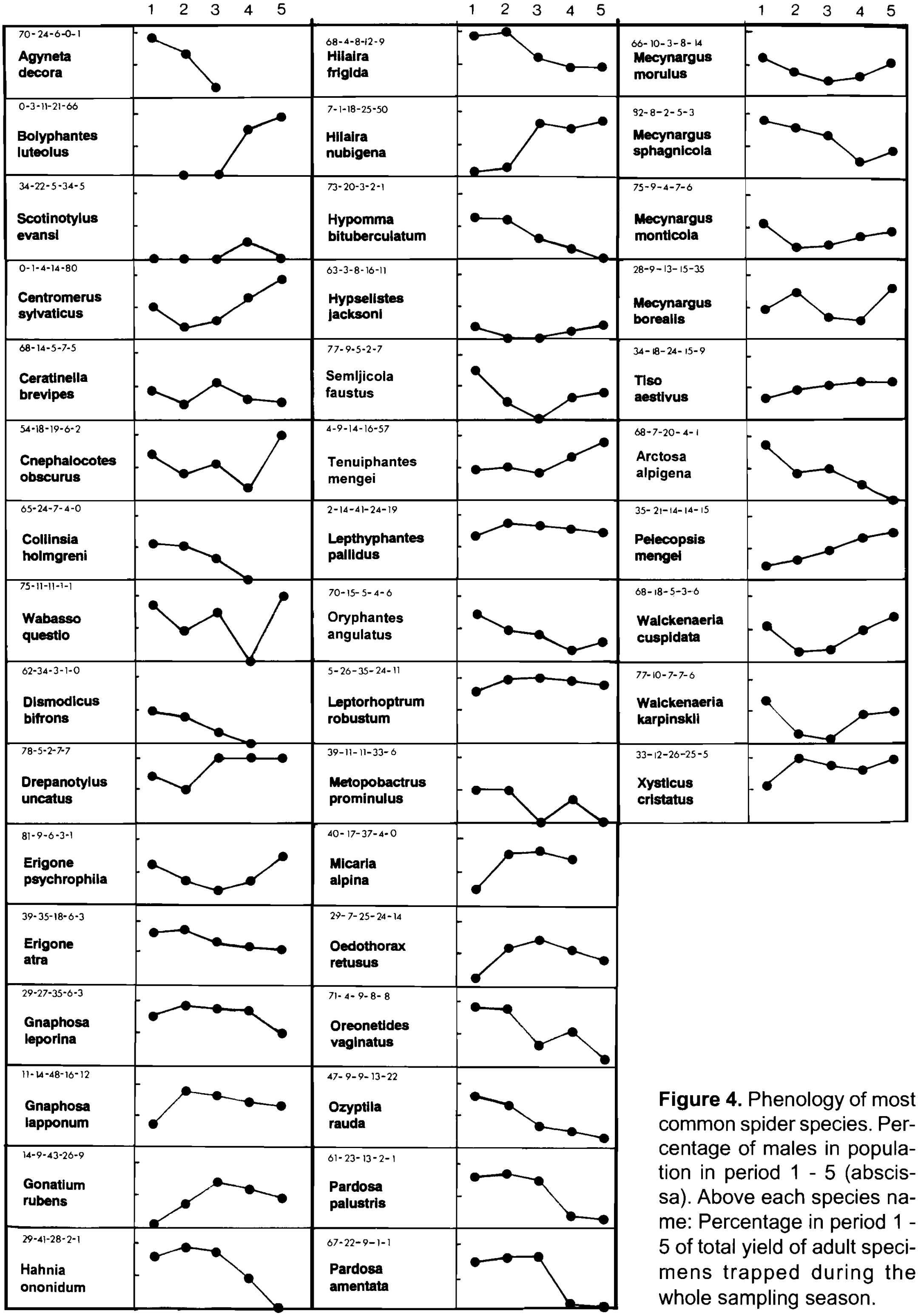

Figure 4. Phenology of most common spider species. Percentage of males in population in period 1 - 5 (abscissa). Above each species name: Percentage in period 1 - 5 of total yield of adult specimens trapped during the whole sampling season.

4	14	15	29	5	13	6	24	40	7	9	22	1	8	27	28	11	16	19	21	23	30	17	18	33	35	36	39	37	32	45	46	47	38	41	42	43	44	12	20	34	2	3	25	26	10	31			
-	86	45	48	66	61	70	79	51	61	38	66	68	66	38	81	14	44	32	61	72	22	46	41	47	68	62	65	65	39	26	45	64	47	26	4	6	48	11	21	53	40	6	0	4	7	6	4	Cet.niv.	Lichen heaths
	-	45	28	95	82	85	92	36	56	36	73	88	89	26	61	12	50	24	67	73	29	31	34	48	83	77	84	57	30	27	43	74	42	24	2	9	45	10	20	51	41	6	0	3	12	5	14	Cet.niv.	
		-	87	35	32	27	34	41	38	34	28	77	27	30	53	12	27	37	35	38	10	61	36	35	24	19	24	26	25	34	35	25	23	20	2	4	28	11	21	20	7	4	0	6	5	9	15	Cet.niv.	
			-	23	19	27	39	47	42	29	32	28	25	33	51	12	30	34	29	29	7	33	42	29	24	16	21	31	29	24	29	24	27	17	1	3	29	9	20	18	1	1	0	20	4	7	29	Cet.niv.	
				-	80	83	78	8	51	34	69	87	76	22	55	13	48	22	66	84	29	26	30	48	83	78	87	57	39	25	41	68	42	25	3	5	40	11	17	50	41	6	0	3	6	5	5	Des.ant.	Dry meadow
					-	73	69	27	44	27	60	80	87	19	51	12	38	18	56	73	24	21	22	38	80	82	83	52	32	30	36	60	37	22	2	1	37	10	16	50	40	6	0	3	5	5	13	Des.ant.	Dry meadow
						-	83	39	60	40	77	83	80	33	63	17	59	32	73	93	32	31	37	57	78	72	78	66	45	33	54	74	50	30	7	1	54	14	19	55	41	6	0	3	10	5	6	Phy.vac.	Blueb. slopes
							-	48	68	44	79	80	76	38	72	12	54	33	74	83	28	42	46	55	72	64	71	64	48	69	51	68	50	24	2	1	53	10	20	51	41	6	1	3	5	5	24	Phy.vac.	
								-	48	40	42	26	24	48	31	16	33	40	40	31	5	55	53	43	25	19	23	29	41	22	38	25	40	20	4	6	41	12	20	27	3	6	0	3	9	2	40	Phy.vac.	
									-	49	72	56	53	48	68	12	27	38	67	52	34	49	50	63	49	40	46	57	55	12	61	54	67	28	5	7	61	12	20	42	29	6	0	3	3	7	7	Phy.vac.	
										-	57	40	36	44	42	14	47	49	54	40	21	40	43	29	37	29	34	39	52	26	48	36	50	27	4	4	49	10	18	29	18	10	0	3	10	7	9	Sum.farm	Dry meadows
											-	70	67	42	64	12	59	38	86	76	33	46	49	65	63	55	61	63	61	32	60	67	62	28	6	8	55	14	22	50	45	10	4	3	5	25	22	Ran.oxy.	
												-	97	27	60	12	49	26	69	83	29	27	30	54	87	79	85	62	45	28	48	69	45	24	2	4	47	15	26	48	41	22	0	3	5	5	1	Des.ant.	
													-	25	57	12	46	23	63	80	27	26	29	46	86	83	88	57	30	30	46	68	43	27	5	7	45	11	18	50	42	6	0	3	5	6	8	Des.ant.	
														-	40	18	38	49	50	33	7	47	70	45	27	23	21	35	41	29	39	25	42	26	7	9	43	12	20	26	2	5	0	0	11	5	27	Des.ant.	
															-	14	50	36	61	63	25	56	42	52	58	50	55	65	44	29	50	58	50	26	4	6	49	13	21	53	6	6	0	7	7	9	28	Des.ant.	
																-	38	35	12	19	20	12	15	17	14	16	15	25	22	33	32	14	22	43	26	29	24	46	53	17	26	34	26	41	36	42	11	Des.ant.	Hum. meadows
																	-	50	52	61	38	33	41	57	53	37	43	57	53	59	62	52	54	42	21	22	64	22	21	41	29	13	0	3	23	11	16	Des.ant.	
																		-	35	34	34	45	54	40	25	21	23	48	35	36	43	24	39	30	18	19	51	18	23	26	9	15	0	8	37	11	19	Des.ant.	
																			-	71	31	42	56	67	61	53	59	63	57	28	56	68	57	24	2	4	55	10	17	48	41	6	0	3	5	5	21	Des.ant.	
																				-	29	35	40	57	78	82	78	68	44	38	54	71	50	31	9	11	50	14	19	55	41	6	0	3	12	5	23	Des.ant.	
																					-	6	9	35	24	22	26	22	46	19	44	30	36	35	36	26	33	50	5	23	8	24	0	20	7	53	30	Rum.sal.	
																						-	59	39	25	17	21	27	39	23	35	28	38	18	2	4	23	10	30	18	5	2	0	10	5	8	17	Dryadetum	
																							-	47	27	20	16	36	42	30	41	33	41	33	5	7	46	14	26	29	3	2	0	11	11	7	18	Dryadetum	
																								-	53	47	47	71	66	39	69	57	71	37	13	15	71	17	17	54	25	6	0	3	10	8	33	Des.ant.	Dry meadows
																									-	61	86	61	41	31	48	70	48	31	5	10	47	13	17	57	41	6	0	3	7	5	35	Des.ant.	
																										-	85	58	34	26	42	63	44	32	8	11	41	3	15	58	40	7	0	3	10	5	36	Des.ant.	
																											-	58	41	31	65	66	46	29	7	10	45	13	18	53	41	6	0	3	8	5	39	Des.ant.	
																												-	45	33	45	62	55	34	11	9	57	13	18	60	40	7	0	9	17	11	37	Des.ant.	
																													-	38	71	49	75	39	19	17	62	21	19	36	30	17	6	13	16	17	32	Ger.silv.	
																														-	55	36	40	55	30	32	46	22	19	26	13	9	5	8	21	15	45	Ger.silv.	
																															-	52	73	55	33	34	72	21	19	39	35	17	6	14	25	18	46	Ger.silv.	
																																-	55	34	7	12	79	15	17	57	42	6	0	3	7	6	47	Ger.silv.	
																																	-	41	21	20	15	23	19	46	32	13	6	3	16	5	38	Ger.silv.	Hum. meadows
																																		-	62	65	41	25	16	31	32	25	6	20	29	29	41	Ger.silv.	
																																			-	80	15	20	2	9	35	26	6	27	33	39	42	Ger.silv.	
																																				-	15	24	5	13	29	29	6	19	34	30	43	Ger.silv.	
																																					-	17	20	47	23	7	0	3	17	7	44	Ger.silv.	
																																						-	45	14	30	26	43	34	28	25	12	Call.sac.	Small mires
																																							-	15	11	19	32	34	38	37	20	Car.bic.	
																																								-	4	7	0	3	11	5	34	Chae.sph.	
																																									-	36	11	24	29	48	2	Car.can	Large mires
																																										-	18	25	62	30	3	Car.can	
																																											-	27	41	36	25	Car.can	
																																												-	8	46	26	Car.can	
																																													-	25	10	Rum.sal.	River
																																														-	31	Rum.sal.	sides

Figure 5. A Trellis diagram based on Sørensen index of similarity (x 100) (Sørensen 1948). The 47 sampling sites have been grouped as in Table 1 and 2. However, within each of these main groups the sites are rearranged somewhat in order to bring more closely together the sites with similar plant associations. The intention of framing some areas in the diagram is to visualise better some important aspects discussed in the text.

few species with the drier sites in the area (Figure 5), but relatively few species in common with most humid meadows as well. Several of its abundant inhabitants were the hygric *Mecynargus sphagnicola* and *Hilaira nubigena* and the mesic-hygric *Pardosa amentata* (see discussion below). Perhaps the site should be reckoned as a mire. Perhaps so also site 19, which was inhabited by some hygric species, including *Arctosa alpigena*. However, all these sites were situated fairly close to each other in the field (Figure 1), probably resulting in some «species leakage» between these sites.

On the other hand: Site 34, the only Nordnuten «mire» chosen, is situated close to most other sites here (Figure 1) and, as to its species content, it seems to function more like a medium dry meadow (Table 2 and Figure 4), with **all** «hygric» species totally lacking and *Pardosa amentata* scarce. The temperature at Nordnuten is obviously too high for the more typical arctic hygric species to thrive and compete with other (lowland) species (discussed below). We also think that small mires, like other small sites, are more vulnerable to species leakage from their surroundings compared to the larger mires; at least as concerns the volatile linyphiids. So, sometimes the distinguishing of very wet «meadows» and mires may not be an easy task (Hauge et al.1998).

Site 20, 25 and 26, situated in the lower/right corner of the diagram (Figure 2), obviously deserve the label «cold» mires; the other ones (site 2, 3 and 12), all situated half way up axis 2, can be characterised as «warmer» mires. As to their species contents, the «large mires», especially site 25 and 26, clearly have very little in common with most other sites in the area (Figure 5).

The river sides (site 10 and 31) are situated fairly close to the «warmer» mires (Figure 2), mostly due to some common (partly abundant) «hygric» species (Table 2). Like *most* mires, the river sites otherwise deviated rather much from most other sites as concerns their species contents (Figure 5), including site 34. Site 10, however, is also very different from one of the «coldest» large mire (site 26). These irregularities may be explained by the fairly dense growths of *Salix* sp. on the river sides, making them more similar to some Nordnuten meadows, especially the densest ones (site 41 - 43), discussed below. Mutually, the two river sides house somewhat different spider faunas, the similarity index (25) being relatively low (Figure 5); partly due to the presence of different hygric and mesic-hygric species (Table 2), partly also due to the different density of the willow thickets here (Ottesen 1996).

The «meadows»

The eutrophic «warm» humid and dry meadows (Table 1), all located at Nordnuten (NN), are situated in the upper half of the diagram (Figure 2); the other ones mostly in its lower half, the «lichen heaths/blueberry slopes» more scattered to the left, most other oligotrophic-mesotrophic dry and humid «meadows» scattered in the central areas, the *Dryas*-associations (site 17 and 18) lowest.

Site 17 and 18 shared the high mountain species *Arctosa alpigena* with most mires (and site 19!), otherwise they had rather few species in common with some groups of sites: The large mires, the two humid river sides (with *Salix*) and the two Nordnuten sites 42 and 43. The two last mentioned sites (to some extent also site 41) had the richest and densest vegetation (*Salix* and high perennials) in the area. The three sites (especially no. 42 and 43) had relatively few species in common with most other meadows (Figure 5), and were instead inhabited by several lowland forest species absent/scarce elsewhere in the area (discussed below). However, mutually as well as with the river sides, they all show fairly high similarity indices (Figure 5), archieve an upper (somewhat isolated) top/right position above all other Nordnuten sites (Figure 2).

Site 40, the only blueberry slope at Nordnuten is, apart from three other lichen heaths/blueberry slopes (Figure 2), isolated from most other sites (including the other Nordnuten sites). It housed many xeric-mesic species (including the four Nordnuten xeric-mesic species), a rather high number of the mesic-hygric *Hahnia ononidum* and the mesic-hygric lowland species *Cnephalocotes obscurus*. The latter was abundant also in the small «mire» (site 34) and very scarce elsewhere.

Ordination of species

Figure 3 fairly well reflects our present knowledge about the species' ecological preferences and geographical distribution in northern Europe, used in discussions below. Some other aspects should also be kept in mind. Wind-born transport of spiders is common. Fairly strong persistent winds (mainly south-western) in the open Finse mountain area, may be responsible for several of the + signs in Table 2. Large fall-outs of ballooning spiders have been reported in the mountains, even after long-distance transport from the lowlands (Crawford et al.1995). Strong wind make steep vertical moisture gradients at ground level, an extra challenge for spiders resting on top of the ground vegetation. Linyphiidae (especially their juveniles) seem to be very vulnerable to drought (Hauge 2000). Vertical segregation of web-building species in the ground cover is partly related to microspace and body size (Duffey 1966), probably also web size, increase species diversity. The *structure* in ground vegetation is important for web construction (Huhta 1971, Scheidler 1990). Body size of spiders and their potential prey are significantly positive correlated (Nentwig 1982). Co-occurrence and competition for space was discussed in Leclerc & Blandin (1980). Vertical distribution of spiders in the ground cover may partly depend on degree of pigmentation (Hauge et al.1998; Hauge 2000). Excessive ultraviolet light, especially in the thin high mountain air, is deleterious to pale specimens, while heat absorption from sun light in these cold areas is beneficial for dark pigmented species. Suitable micro-climatic conditions beneath stones, e.g. relative high and stable thermal conditions, are beneficial for the survival of specimens and for the brooding of their eggs; increasing diversity of invertebrates in the mountains (Østby et al.1975), allowing some lowland species to exist in the area.

The «widespread» species

All these seven species are per definition «widespread» in the area (Table 2), five ranging as the most abundant ones. Consequently they overlap greatly spatially, with each other and with several other species. In the species ordination diagram (Figure 3) they occupy a central position, an inherent characteristic of the RA method itself (Ottesen 1996). Very centrally placed here, and fairly close to each other, are the two xeric-mesic «hunters», the diurnal *Pardosa palustris* and the nocturnal *Gnaphosa leporina*. Otherwise the two species' SHP values (Table 2) and male seasonal activity patterns are fairly equal (Figure 4). The hunting species are discussed at the end of this chapter.

The four xeric-mesic Linyphiidae start (Figure 3) a sequence from a low/left position with the *Gonatium rubens*, having the lowest SHP value (34.4) of them all, and ends in an upper/right position with the only mesic-hygric member of the group, *Pelecopsis mengei* (SPH = 45.4). For the latter, a preference for humid habitats is indicated (Holm 1950, Palmgren 1965, Hauge et al. 1978, 1998, Maurer & Hänggi 1990); however, scarce/absent in the large (cold) mires and the coldest small mire (site 20). The combination too cold/too moist conditions seems to be unfavourable. Perhaps competition from the «true» high mountain species here is too strong (see discussion below). Otherwise *P. mengei* is widespread in northern and eastern Fennoscandia (Hauge 1971, 1977, Palmgren 1976, Hauge & Wiger 1980), by Flatz (1988) denoted as an Atlantic species. However, its northwestern limit in Europe is in the Scottish highlands (Locket et al. 1974). It is unknown on the North Atlantic islands (Ashmole 1979, Agnarsson 1996) and in coastal western Norway.

Walckenaeria karpinskii (SHP = 39.5) is a nordic species preferring forests (Koponen 1976). In southern Norway it is known only from low alpine heaths and south-eastern inland forests. Its xeric-mesic con-generic, *W. cuspidata* (SHP = 43.8) has a wider distribution, which also includes open areas and forests on the west Norwegian coastal islands (Hauge et al. in prep); reflecting its much higher position among the other widespread lowland species (Figure 3). Spatially (Table 2) and phenologically (Figure 4) the two species overlapped much. However, *W. karpinskii* was fairly abundant in the lichen heaths/blueberry slopes, *W. cuspidata* totally absent; the latter better represented in the Nordnuten more humid meadows (Table 2), especially the densest ones. *W. cuspidata* seems to prefer moist habitats (Palmgren 1965, 1976, Huhta 1971, Puntscher 1980, Ruzicka

1987). So, we suggest that, when spatially overlapping, the two species may be separated vertically, with *W. cuspidata* resting closer to the ground.

In the North Fennoscandian mountains *Oreonetides vaginatus* «had it highest frequencies» above the timber line up to 1000 m a.s.l. (Holm 1950, Palmgren 1965); and very frequent under stones, see also Palmgren (1975) and Hauge et al. 1978). At Finse it was frequent but scarce, ordinated rather close to *Pelecopsis mengei* (Table 2) and, like the latter, absent from the coldest mires. It is light coloured, and should be reckoned as a typical nordic lowland forest species surviving under stones above the tree line. In Finland it is common and distributed in coniferous forests all over the country (Palmgren 1975); common also in southeast Norwegian inland coniferous forests (Hauge & Wiger 1980, Hauge unpublished), but recorded only once in (inland) western Norway (Hauge unpublished).

The clearly most «common» linyphiid in our samples is *Oedothorax retusus* (Table 3), followed by *Gonatium rubens*. Both species have, in contrast to *Pelecopsis mengei*, been found even on the uttermost west Norwegian coast (Hauge et al. in prep.); however, *O. retusus* extremely scarce (*O. fuscus* locally abundant!), and *G. rubens* fairly common. Common also on relatively high altitudes (6-700 m) in Iceland (Agnarsson 1996), neither *O. retusus* nor *O. fuscus* have been recorded from Iceland; both *Oedothorax* spp. (and *G. rubens*) are reported as fairly common on Shetland (Ashmole 1979). Compared to *O. retusus* (SHP = 36.6), *G.rubens* (SHP = 34.4) was at Finse totally absent from the large mires and more scarce in the small mires, river sides and in the Nordnuten sites. For *O.retusus* medium humid meadows seem to be preferred (Maurer & Hänggi 1990). This is fairly well supported by Hauge et al. (1998) who in the mountain found *O. retusus* restricted to the medium dry site; here relatively scarce in the square samples compared to the pitfall catches, indicating an active species. In north Fennoscandian low alpine areas (Holm 1950,1951, Palmgren 1965) *O. retusus* was rather common (and abundant under stones). From the Alps (Manderbach & Framenau 2001) it is reported as preferring open, intermediate to moist habitats, being very common on river banks, by Koponen (1968) given the label hygrophilous. *Gonatium rubens* prefers open medium humid habitats (Huhta 1971, Palmgren 1976), denoted as photophilous (Reincke & Irmler 1994) and even xerophilous (Heimer & Nentwig 1991, Platen et al. 1991, Schikora 1994); in western Norway it is being replaced by *G. rubellum* in the densest forests (Hauge & Halvorsen in prep.). *G. rubens* has been associated with the field layer (Hauge 1998), perhaps explaining its «success» in the windy Finse mountain area and the variable ecological and habitat data reported in literature. The species is relatively large and dark (reddish on the prosoma), *O. retusus* smaller and lighter (yellowish on the prosoma). So, the coexistence of these two common species at Finse may, at least partly, be explained by vertical segregation. Their seasonal patterns were rather equal (Figure 4).

Forest species

Typical forest species were few, and all in a top right position in Figure 3: *Centromerus sylvaticus*, *Lepthyphantes pallidus* and *Dismodicus bifrons*. These and several other lowland species clearly have their highest densities in the eutrophic «warm» areas (Table 2), especially in the steep south-facing Nordnuten sites with the richest growths of high perennials and *Salix* sp., site 41-43. *D. bifrons* is in the lowland often found in the higher vegetation strata, the tree and bush layer (Maurer & Hänggi 1990), while *L. pallidus* in the alpine heaths has frequently been collected under stones. So, *shade* as an ecological factor in this mountain area should not be completely ruled out, as asserted for the beetles (Ottesen 1996).

Below these three species (Figure 3) are situated, centrally in the upper half of the diagram, several lowland species («xeric-mesic» and «mesic-hygric»); all in literature more or less associated with both forests and open areas. The remaining species (including the «hygric» species) are scattered around, some of them in small groups closer to the margins of the diagram; the majority more or less typical high mountain/arctic species.

Notes on some xeric-mesic cold tolerating species

Improphantes complicatus and *Mecynargus borealis* are situated closely together near the lower left corner and isolated from most other species (Figure 3); both with rather low and equal SHP values, very local in occurrence and frequently overlapping with each other (Table 2). The former is a light coloured holarctic/alpine species (Thaler 1981, Eskov 1994), in most parts of its distribution area found on high ground and very often under stones or in stony habitats (Holm 1950, 1951, 1958, 1967, 1980, Palmgren 1965, 1976, Tambs-Lyche 1967, Hauge et al.1978, Maurer & Hänggi 1990, Koponen 1992, Agnarsson 1996). It is also reported from pine forest in Lapland (Koponen 1972) and at sea level in Iceland (Agnarsson 1996).

The small size and light colour of *M. borealis* have lead to speculations about a protected life in small space in the ground. This is supported by Hauge et al. (1998), who found, in contrast to *Oedothorax retusus* (discussed above), *M. borealis* dominating in square samples from the lichen heath and rather inactive (i.e. scarce in the pitfalls). It clearly prefers dry habitats and was frequently found under stones (Holm 1937, 1958, Koponen 1980, 1992). At Finse it was most abundant in site 15 and 29 (Table 2), e.g. the two coldest/driest habitats (Figure 3).

Also *Tiso aestivus* is a small and light coloured species. Like *M. borealis*, it was at Hardangervidda scarce in the pitfalls, but the dominating species in the *square* samples (Hauge et al. 1998). However, unlike *M. borealis* this was in the *medium dry* meadow; in other words spatially clearly segregated from each other. This is supported by our material: The two species are here ordinated far from each other, *T. aestivus* in a central position (Figure 3), more abundant (Table 2 and 3) and present even in the warm Nordnuten sites (*M. borealis* here totally absent. Spatial overlap between the two is very small (Table 2) and both are scarce/absent from the mires and riversides. Also *T. aestivus* prefers alpine heaths (Koponen 1976) and is frequently found under stones or in stony terrain (Holm 1950, Palmgren 1965, Hauge et al. 1978, Puntscher 1980, Maurer & Hänggi 1990). Symptomatically, the few specimens of *M. borealis* reported from Iceland are from high altitudes in inner central areas only (Agnarsson 1996), while *Tiso aestivus* also has been collected at sea level, reaches in the North Atlantic south to the Faeroes (Ashmole 1979) and is, unlike *M. borealis*, known also in Britain (Locket et al.1974, Merrett and Murphy 2000).

Metopobactrus prominulus, low positioned midways on axis 1 (Figure 3), is reported from a variety of situations (Holm 1950, 1967, Wiehle 1960, Palmgren 1965, 1976, Heimer & Nentwig 1991, Hauge et al. 1978, 1998, Hauge & Refseth 1979, Andersen & al.1980), with statements like «prefers dry habitats», «xerophilous», «no marked preference for humidity», «thermophilous». At Finse most specimens were found in dry areas, but also in two small mires (Table 2). In western Europe it reaches northernmost Scotland (Locket et al.1974); unknown in the North Atlantic islands and on the west Norwegian coast. Eastwards there are a few (unpublished) records from lowland areas mid-ways into western and north Norwegian fjords. Otherwise it is widely distributed all over eastern Fennoscandia (Palmgren 1976, Jonsson pers. comm.); in the north up to 700 m a.s.l. (Holm 1950, Palmgren 1965).

On the other hand, *Scotinotylus evansi* has a rather limited distribution southwards in eastern Fennoscandia, in Sweden reaching Dalarne county (Jonsson pers. comm). In the North Atlantic its *southern* limit is on the Faeroes (Ashmole 1979) and, like *Tiso aestivus*, it occurs also at sea level in Iceland (Agnarsson 1996). It is also recorded from the Reinøy island in northernmost Norway (Holm 1973), but to our knowledge not found in the lowland of southern Norway. At Finse the few specimens were restricted to dry sites (Table 2), occupying a left position on the diagram (Figure 3), the SHP value is very low (Table 2). For an Arctic species, its fairly high position along axis 2 indicates a preference for *relatively* high temperatures, perhaps explaining why it so often has been found under stones (Holm 1950, Palmgren 1965, Agnarsson 1996) and in stony terrain (Hauge et al. 1978, Maurer & Hänggi 1990, Heimer & Nentwig 1991).

Hahnia ononidum (SHP = 38.6) was very local in occurrence, almost all specimens were in (the Nordnuten) site 40; both site (Figure 2) and the species (Figure 3) isolated in an extreme left position mid-ways up axis 2. It is a forest species occasionally found also in alpine grass meadows and heaths as well as in humid birch forests on high altitudes in central and north European high mountains (Holm 1950, Palmgren 1965, Hauge 1977, Maurer & Hänggi 1990, Puntscher 1980, Heimer & Nentwig 1991, Thaler 1997). Elsewere it is widely distributed in forests all over eastern Fennoscandia (Palmgren 1977, Jonsson pers. comm.), including south-eastern Norway (Hauge 1989); but not yet recorded from Britain, the west Norwegian coast or the North Atlantic Islands.

Notes on some mesic-hygric cold tolerating species and hygric species

Semljicola faustus (SHP = 61.5), *Leptorhoptrum robustum* (SHP = 58.7) and *Pardosa amentata* (the latter discussed later), are situated closely together on the upper/right half of the diagram (Figure 3), i.e. the warm/wet part of it.

S. faustus was absent from all large mires and the coldest small mire (site 20), *L. robustum* from two of the coldest mires (site 20 and 26). For both species, affinity to moist habitats has repeatedly been reported in literature. Both are widely distributed in the *eastern* Fennoscandian lowland (Sweden and Finland), reaching the southernmost coasts (Palmgren 1975, Jonsson pers. comm.). In the North Atlantic *L. robustum* is common on all islands. For *S. faustus* the Faeroes represent its southern limit in the region (Ashmole 1979). Neither of the two species are at present known in western Norway. In south-eastern Norway there are a few records from below the tree line, but only on high ground close to the central mountains (Hauge & Refseth 1979, Hauge & Wiger 1980); below the tree line in northern Fennoscandia collected in humid sub-alpine birch forests (Holm 1950, Hauge 1977), here clearly preferring the upper layer of the moss cover (Hauge 1998). To our knowledge, this fairly dark coloured spider has never been collected under stones. On the other hand, the light coloured *L. robustum* has frequently been found under stones (Holm 1950, 1965, Wiehle 1956, Palmgren 1975, Ashmole 1979, Maurer & Hänggi 1990) or under debris on sea shores in Iceland (Agnarsson 1996). In the north Fennoscandian alpine heaths (up to 1000 m a.s.l.) it was almost without exceptions found under stones (Palmgren 1965). The fairly high densities at site 42 and 43 and on a one of the river sides (Table 2) indicate some need for shelter. Also *S. faustus* was present in site 42 and 43. Otherwise it was, in contrast to *Mecynargus morulus* (discussed below), extremely scarce in the Nordnuten area.

Unlike *L. robustum* and *S. faustus*, *Collinsia holmgreni* (SHP = 56.7), *Erigone arctica* (SHP = 62.7) and *Wabasso questio* (SHP = 64.6) were totally absent from the Nordnuten sites (Table 2) and situated closer to the wet end the diagram (Figure 3); all species preferring moist habitats (Agnarsson 1996), but were scarce/absent in the coldest mires.

The light coloured *C. holmgreni* has frequently been found under stones (Holm 1937, 1950; Palmgren 1965, Thambs-Lyche 1967, Hauge & Sømme 1997). Together with *W. questio*, it should be reckoned as a typical high mountain species in southern Fennoscandia. Elsewhere in Fennoscandia both species have a rather limited distribution southwards (Palmgren 1976, Jonsson pers. comm). In the North Atlantic *W. questio* is restricted to Iceland, while *C. holmgreni* is reaching south to the Faeroes (Agnarsson 1996).

The three *Erigone* spp. seem to be fairly well segregated ecologically (Figure 3). The mesic-hygric *Erigone arctica* (SHP = 62.7) was scarce and restricted to the river sides and two small mires (Table 2); otherwise widespread all over Sweden and Finland, no records from south-eastern Norway. In coastal western Norway it is distributed far north to northern Nordland (Hauge 1989), on Iceland from the high mountains down to sea level (Agnarsson 1996) and common elsewhere on the other North Atlantic islands (Ashmole 1979). The xeric mesic *E. atra* (SHP = 35.9), a widespread and common aeronautic/pioneer species, is situated relatively close to the centre of the diagram (Figure 3), together with most other lowland species, while the typical high mountain species *E. psychrophila* (SHP = 83.3) is grouped with the few other hygric species in the wetter/colder part of the diagram. On Hardangervidda it was very abundant but restricted to the wet meadow (Hauge et al.1998), *E. atra* abundant also in the dry meadow; both species absent from the driest locality (a lichen heath), in which *E. tirolensis* was found.

Our data and other sources (Holm 1950, Palmgren 1965, Hauge et al. 1998) clearly show that the mesic-hygric *H. frigida* (SHP = 49.6) and the hygric *H. nubigena* (SHP = 82.7) are ecologically well segregated. The latter is grouped together with the other few hygric high mountain species in the cool/wet part, *H. frigida* in a central position on the diagram (Figure 3) below most other northern lowland species and, in contrast to *H. nubigena*, very sparse in the coldest mires *and* site 11 and 19 (Table 2). The two species were found together in 5 sites only and have rather different seasonal patterns (Figure 5, Hauge et al. 1978). All this fairly well reflects their distribution elsewhere in northern Europe. Both species were in the north Fennoscandian mountains found sublapidicolous and primarily in areas above the tree line (Holm 1950, Palmgren 1965). *H. frigida*, however, has been found on the coast far north in Norway (Holm 1970,1973), down to sea level in Iceland (Agnarsson 1996) and elsewhere in the North Atlantic reaching south to Shetland (common and mostly collected under stones) and Scotland (Ashmole 1979), *H. nubigena* restricted to the Faeroes. Southwards in Fennoscandia both species are reaching some inland areas (in Härjedalen county) (Jonsson pers. comm.), while more east (in Finland) *H. nubigena* seems not to be distributed south of the Polar Circle. *H. frigida* is here reaching the middle boreal zone in Bottenviken (Palmgren 1975), with somewhat higher summer temperatures (Moen 1998, Map 53).

Apart from *Hilaira nubigena* and *Erigone psychrophila* (discussed above) a small group of «hygric» Erigonidae contains *Mecynargus sphagnicola* (SHP = 77.3). Here (Figure 3) it is placed far from its three congeners, the two xeric-mesic species *M. borealis* (SHP = 34.6) and *M. morulus* (SHP = 40.6), and the mesic-hygric *M. monticola* (SHP = 63.0). Hence, the four species of the genus seem well segregated, ecologically (Figure 3); phenologically less so (Figure 4). *M. borealis* is light-coloured and obviously rather inactive (discussed above), the other ones are dark. Otherwise, there is very little spatial overlap between the two xeric-mesic species, the small *M. borealis* and the larger *M. morulus* (Table 2).

M. morulus, common in the Finnish lowland (Palmgren 1976) and frequent in the Nordnuten area is consequently situated in the upper half of the diagram together with the other lowland species, the typical high mountain species (*M. borealis*) in a very low position (Figure 3); all this fairly well supported by literature (Holm 1950, Palmgren 1965, 1976, Ashmole 1979, Hauge 1989, Heimer & Nentwig 1991, Agnarsson 1996, Merrett & Murphy 2000, Jonsson pers. comm.).

Unlike *M. morulus*, the mesic-hygric *M. monticola* and the hygric *M. sphagnicola* were absent from most Nordnuten sites, a general trend for the «hygric» species in our material. One exception is site 43, having the densest vegetation of all sites. Here, lower insolation may lead to lower temperatures on the ground and consequently lower evaporation, a combination obviously beneficial to hygric mountain species. Elsewhere in the warm Nordnuten sites, these species probably cannot compete with the lowland species. On the other hand: Most mountain mires do not seem to be very hospitable to the «Nordnuten species» and several other lowland species.

Notes on the «hunting» species

Three families and 12 species were found (Table 3). Among the Lycosidae, the «widespread» xeric-mesic open area species *Pardosa palustris* (SHP = 39.1) dominated (Table 2 and 3), absent only in one cold mire, and abundant in most sites. It was by Koponen (1968) characterised as hygrophilous. The less frequent species (in 26 sites), the mesic-hygric *Pardosa amentata* (SHP = 58.7), seems to prefer warmer and more humid habitats. The hygric mountain species, *Arctosa alpigena* (SHP = 81.3), was less frequent (8 sites), fewer in number and clearly prefers the cold/wet habitats.

For *P. amentata* several authors indicate moist habitats (Itämies & Ruotsalainen 1985). The presence of relatively high numbers of *P. amentata* in the denser Nordnuten sites indicate some need for shelter. Here it seems to compete better with *P. palustris*. Both species are widespread on the Fennoscandian lowland; *P. palustris* also (common) in the North Atlantic, while *P. amentata* reaches only north to the Orkney (Ashmole 1979). The absence of the latter on the other islands, including the coastal islands of western Norway (Hauge et al. in prep.), may be explained by the presence of large populations of the coastal species *Pardosa pullata* and *P. nigriceps*, both totally absent from the south Norwegian high mountains.

Also the Gnaphosidae were dominated by a lowland species, the «widespread» xeric-mesic, *Gnaphosa leporina* (SHP = 37.9) in a very central position in the diagram (Figure 3), close to *Pardosa palustris*. It was scarce/absent in the mires, river sides and the densest Nordnuten humid sites. The xeric-mesic *G. lapponum* (SHP = 33.8) is a more typical high-mountain species and is situated more towards the low/left corner, while the widespread lowland species *Haplodrassus signifer* (SHP = 34.8) is situated in the upper half of the diagram.

Like many other gnaphosids, these three gnaphosids are relatively light coloured and nocturnal. *G. leporina* was reported as frequent under stones in the north Fennoscandian mountains (Palmgren 1965). In general, the Gnaphosidae were mostly scarce in numbers (Table 2), especially in the humid meadows (particularly in those with the vegetation) and in the large cold mires. In the mountains (Hauge et al.1998) as well as in the lowland (Hauge et al. in prep.), relatively high temperature and not too high humidity seem to be the best combination for active running spiders. Many gnaphosids are nocturnal, probably not the dark coloured *Micaria alpina*. To be nocturnal in cold high mountain areas may be an extra challenge for these animals, especially in combination with high humidity. Unlike the Lycosidae, clearly having their highest activity in spring, activity of Gnaphosides seems to be highest more towards mid-summer (Figure 4), like on the extreme oceanic coastal islands of western Norway (Hauge et al. in prep.).

The two Thomisidae species found are fairly well segregated (Figure 3). The xeric-mesic widespread lowland species *Xysticus cristatus* is positioned in the upper half of the diagram (Figure 3), while *Ozyptila rauda*, a high mountain species in southern Norway (Hauge 1989) and in Northern Sweden distributed down into the sub alpine region, has got a rather low position close to its dry/cold corner.

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Received 13 February 2002,
accepted 15 October 2002.

Norw. J. Entomol. 49, 139–142. 2002

Structural infestations of ants (Hymenoptera, Formicidae) in southern Norway

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Birkemoe, T. 2002. Structural infestations of ants (Hymenoptera, Formicidae) in southern Norway. Norw. J. Entomol. 49, 139-142.

An investigation of structure-infesting ants was carried out in southern Norway during the summer of 2002. A questionnaire including information about nesting locations and building characteristics was distributed to pest control operators. Together with ants collected at the sites, the questionnaire answers provide the basis of the present study. The attacked buildings were mainly located along the southern coast from Kragerø to Stavanger (31 cases). Four additional cases were reported from Oppland County. *Camponotus ligniperda* was the most common carpenter ant species (26 attacks) while *Camponotus herculeanus* was only found in five buildings. In addition to the carpenter ants, two smaller ant species, *Lasius platythorax* (three attacks) and *Formica fusca* or *F. lemani* (one attack), were reported. Carpenter ant's nests were located in 71 % of the attacked buildings. Similar to previous findings from USA and Sweden, outer walls were the most commonly attacked structure followed by the floor and roof. However, almost all buildings with unknown nesting locations had heated floors with polystyrene insulation. Only a few buildings where the nests have been located had a similar construction and this difference was statistically significant. Thus, in cases were the nests could not be located carpenter ant attacks are most likely associated with heated floors and polystyrene. This complicates sanitation, as ant nest location is usually a prerequisite for a successful extermination of carpenter ants.

Keywords: Carpenter ants, *Camponotus* spp, building structure, polystyrene.

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INTRODUCTION

Structure-infesting ants are a problem in large areas of Norway as they excavate wood or other soft material for nest construction. Most structural damage is caused by carpenter ants, *Camponotus herculeanus* (Linnaeus, 1758) and *Camponotus ligniperda* (Latreille, 1802), which have the potential to weaken even load-bearing building structures.

C. herculeanus is distributed throughout Norway, reaching the northernmost tree frontier (Collingwood 1979). It is a typical inhabitant of shaded coniferous forests. *C. ligniperda* is distributed in southern Norway north to latitude 63° (Collingwood 1979). It inhabits stony banks and sun exposed borders of woodland and is a more xerothermic species than *C. herculeanus*.

Successful sanitation of carpenter ants is usually dependent on nest location. To achieve this goal, pest control operators follow ant trails, listen for sounds inside structures and identify excavated nesting material. When possible, drilling through structures could provide a final verification of nest location. While searching for ant's nests, knowledge of preferred nesting sites is also important. In a previous study of carpenter ants from Washington State, USA (Hansen & Akre 1985), outer walls were the most frequent site of attack, but floor, attic and roof were also favourite nesting sites. A correlation between attack and rot was also revealed. In another study carried out in Sweden (Butovitsch 1976), 52 % of all attacks were found in outer walls, with floors (32 %) and roofs (16 %) as other important sites. This investigation also found that 28 % of the attacks were connected with damage caused by rot. This rose to 40 % looking at floors only.

Building style varies with country and time period. Neither of the previous investigations have considered heated floors with polystyrene insulation as an important nesting location. At present, several pest control operators claim that this has become a preferred habitat for carpenter ants.

To investigate the nature of ant attacks on buildings, a study was carried out in southern Norway during the summer of 2002. All species of structure-infesting ants were included.

MATERIALS AND METHODS

Pest control operators were asked to fill out a questionnaire when inspecting houses attacked by ants during the summer of 2002. The questionnaire should be followed by a sample of 2-3 specimens of ants collected at the location and returned to the Norwegian Institute of Public Health. The ants were identified in the laboratory according to Collingwood (1979) and Seifert (1996).

RESULTS AND DISCUSSION

Carpenter ants

C. ligniperda accounted for 26 attacks. Several samples of this species were collected within each municipality during the summer of 2002. List of records: **TEY** Kragerø (EIS 11) 14 June 3☿☿, 26 June 3☿☿, 26 June 3☿☿. **AAY** Arendal (EIS 6) 25 June 1♂ 2☿☿, 25 June 3☿☿, 22 July 1♀ 2☿☿; Birkenes 10 June 3☿☿; Hisøy (EIS 6) 13 June 2♀♀ 3☿☿; Tromøy (EIS 6) 17 June 1♀ 2☿☿, 19 June 1♀ 1☿, 24 June 4☿☿, 24 June 2♀♀, 24 June 2☿☿, 25 June 3☿☿, 26 July 2☿☿, 10 July 7☿☿; Tvedestrand (EIS 6) 11 June 3☿☿, 28 July 2☿☿; Øyestad (EIS 6) 20 June 3☿☿, 24 July 1♀1☿, 26 July 6☿☿. **VAY** Kristiansand (EIS 2) 3 May 2♀♀ 1☿, 4 June 2☿☿, 4 June 2☿☿, 5 June 3☿☿; Søgne (EIS 2) 3 June 2☿☿.

Table 1. Occurrence of rot/leakage or heating source close to nest locations. One building included two nests.

	Yes	No	Not known
Rot/leakage	7	12	4
Heating source	12	11	-

C. herculeanus accounted for 5 attacks during the summer of 2002. List of records: **OS** Nordre Land 6 August 2♀♀ 1☿; Søndre Land (EIS 45) 30 July 1☿; Østre Toten (EIS 45) 6 August 2♀♀ 11☿☿. **ON** Østre Slidre 31 July 1♀. **AAY** Tromøy (EIS 6) 25 June 4 ☿☿.

A total of 31 carpenter ant attacks were reported. The majority was located along the coast of southeastern Norway between Kragerø and Kristiansand. *C. herculeanus* and *C. ligniperda* are recorded previously from all counties included in the present study. However, it is clear that along the southeast coast, *C. ligniperda* dominated completely with 25 out of 26 attacks. In Oppland County, however, all 4 attacks were caused by *C. herculanus*.

The carpenter ants attacked 24 houses, six cottages and one undescribed building. Building age varied considerably, the oldest being built in the 1700-century, the newest in 2001. Carpenter ant nests were located in 71 % of the buildings (22 out of 31). Of these buildings, rot or leakage was detected in relation to 30 % of the nests (Table 1). As many as half of the nests were located close to a heating source. In three out of four cases, this source was sun exposure. Other sources of heat were heated floors and various electrical installations. The nests were constructed in various materials, domi-

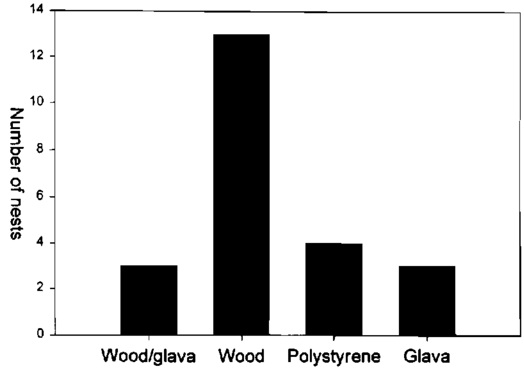

Figure 1. Nesting material of carpenter ants in buildings. One building contained two nests.

nated by wood (56 %) (Figure 1). In addition, 12% of the nests were found in a combination of wood and glava insulation. The remaining nests were constructed in glava insulation or polystyrene.

The most frequent attacked building structure were outer walls (60 %), including window frames and wall sills, followed by floors (31 %) and roofs (18 %) (Figure 2). The orientation of the outer walls varied; six faced east, six faced west or southwest and one faced north.

Butovitsch (1976) concluded from Sweden that *C. herculeanus* and *C. ligniperda* are equally important pests in areas with overlapping distribution. This investigation, however, showed a different result as *C. ligniperda* dominated totally along the southeast coast of Norway. In the present study outer walls were most frequently attacked and rot or leakage occurred in relation to 30 % of the nests. These figures were almost identical to the Swedish investigation (Butovitsch 1976). Outer walls were also demonstrated as the most attacked site in USA, Washington State (Hansen & Akre 1985).

Only four out of the six nests located in floors were constructed in polystyrene insulation and only at one site was the nest constructed in a heated floor with polystyrene. However, almost every building where the pest control operators had failed to locate the nest had heated floors with polystyrene. Furthermore, such floors were unequally represented in buildings with and without located nests (Table 2, Fisher exact test, p=0.01). Most likely carpenter ants nests were located in heated floors when the pest control operators failed finding the nests. Sanitation is generally more successful when nests are located. Thus, heated floors may not only provide a good habitat for the carpenter ants, but also complicate and increase the cost of sanitation. Crawl space where equally represented in buildings with and without located nests (Table 2, Fisher exact test, p=1.0).

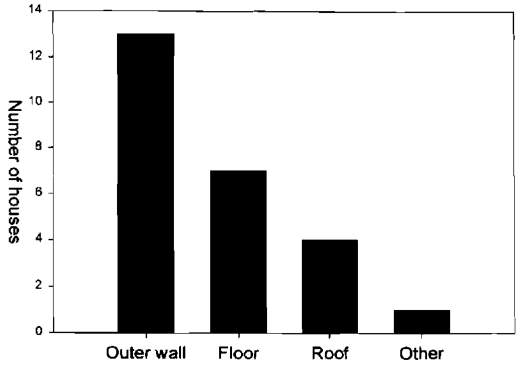

Figure 2. Number of houses infested by carpenter ants in different structures. One house had two nests, and three houses had nests covering more than one structure.

Other ants

Lasius platythorax (Seifert, 1991) was responsible for three infestations in buildings. List of locations: **VAY** Kristiansand (EIS 2) 5 June 3☿☿. **RY** Stavanger (EIS 7) 18 April 4☿☿, 18 April 2☿☿. *Formica fusca* (Linnaeus, 1758) or *F. lemani* (Bondroit, 1917) was responsible for one infestation. List of location: **RY** Stavanger (EIS 7) 19 April 3☿☿. Only one of the attacked buildings was a house, the others included a school, a retirement home, and one concrete building. Similar to carpenter ants, most ant's nests were located in the outer walls (in three out of four buildings). However, due to the low number of infestations reported, it is impossible to draw any general conclusions for these species. Two nests were constructed in wood and one in polystyrene. One nest was of unknown material. Three out of four nests were located close to a heating source, whereas only one was connected with rot or leakage.

Table 2. Structural features of buildings attacked by carpenter ants.

Heated floor with polystyrene

	Yes	No	Unknown
Nest located	6	15	1
Nest not located	7	1	1

Crawl space

	Yes	No	Unknown
Nest located	7	13	2
Nest not located	2	6	1

Acknowledgements. This study was carried out in cooperation with Anticimex, Norway. No data would have been available without the work of Frank Bjerke, Vidar Eriksen, Kay Gundersen, Gisle Høie, Kjell H. Nilsen, Stian Nilsen, Stein Norstein, Frank Nygård and Jon Magne Nygård. Karen Riddervold and Arnulf Soleng gave valuable comments on the manuscript.

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Received 16 October 2002,
accepted 11 November 2002.

Norw. J. Entomol. 49, 143–144. 2002

Hoplothrips carpathicus Pelikán, 1961 (Thysanoptera, Phlaeothripidae) in Norway

Sverre Kobro & Halvor Solheim

Kobro, S. & Solheim, H. 2002. *Hoplothrips carpathicus* Pelikán, 1961 (Thysanoptera, Phlaeothripidae) in Norway. Norw. J. Entomol. 49, 143-144.

Hoplothrips carpathicus Pelikán, 1961 is recorded for the first time in Norway. The thrips were found in standing dead birches with coarse and cracked bark, where it probably forage on an ascomycete *Pseudospiropes longipilus.* A large number of specimens are developed from one single birch.

Key words: *Hoplothrips carpathicus,* thrips, dead wood, fungivorous, *Pseudospiropes longipilus.*

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INTRODUCTION

Hoplothrips carpathicus Pelikán, 1961, has been regarded as an almost unknown species, collected only a few times from dead beech, *Fagus sylvatica,* in Central and Southern Europe (Pelikán 1961, zur Strassen 1994). It was later collected from birch, *Betula*, in Sweden and in numbers indicating that the species is not so rare (Kobro & Nittérus 1999). Recently *H. carpathicus* was studied in Norway and the results are presented here.

MATERIALS AND METHODS

Pieces of about 0.1 m^2 of bark has been removed from dead birch with an axe, kept in a Berlese funnel for one to two weeks and thrips were collected in 70 % ethanol. *H. carpathicus* adults can be distinguished from the other *Hoplothrips* species by the long 8th antennal segment, and having two sense cones on both 3rd and 4th antennal segment (zur Strassen 1994).

A one-way ANOVA test has been used for statistical analyses.

RESULTS AND DISCUSSION

When the habitat of *H. carpathicus* was known, the species was easier to find. In Norway and Sweden the habitat is standing dead birches with coarse and cracked bark. The first record from Norway was **AK** Frogn: Håøya (EIS 28), 29 December 1998. Additionally it was collected several times through the years 1999 and 2000; **AK** Nesodden: Fagerstrand (EIS 28). **HEN** Stor-Elvdal: Messelt (EIS 64). **VE** Stokke: Melsomvik (EIS 19). **TEI** Notodden: Tinnfoss (EIS 27). **BØ** Kongsberg: Kongsberg (EIS 27). **AAY** Grimstad: Grimstad (EIS 6). **AAI** Valle: Besteland (EIS 9). The specimens are kept in the thrips reference collection of the Norwegian Crop Research Institute.

Studying bark under a stereomicroscope both eggs, larvae and adults were observed. The eggs were found in the deepest crevices and cavities in the bark and in clusters of a few up to 20. The larva is pale (photo in Kobro & Nittérus 1999) in contrast to that of the other *Hoplothrips* species known to us.

Distribution on a single birch

Bark was removed from the four points of the compass from one birch, and from several heights above the ground (0.5-5.5 m), and thrips were collected and counted. The number of thrips in each sample varied from zero to almost 300 larvae and adults. There was no significant difference in number of thrips between the north, east, south and west side of the birch. The density of thrips was highest at the levels of 1.5 and 2.5 m above the ground, but the differences were not significant due to the great variation between the samples. The variations (SD) were greater than the means, which also indicated an aggregated appearance of *H. carpathicus*.

The density of thrips decreased at higher levels probably due to change in the structure of the bark. Higher up on the trunk the bark was less cracked, providing less habitat for the thrips.

Fungus

Fungal spores were observed on many specimens of the thrips. One spore-type was dominating (photo in Kobro & Nittérus 1999), but also three other spore-types were found in small amounts. The dominating spore-type resembled the conidia of the anamorph state of *Melanomma subdispersum* (Karst.) Berl. & Vogl., named *Pseudospiropes longipilus* (Corda) Hol. (Dothideales). Dark mats of this fungus, which is an ascomycete, and not a wood-rotting fungus, could also be observed on bark samples taken from the tree. The mats were most common in the cracks. As the fungus was the only one found in the studied bark samples, we assume that the thrips forage on it. The fungal spores were found most commonly on the larva, but also on winged adults, and we suggest that *H. carpathicus* may contribute to the dispersing of *P. longipilus* both within and between the dead birch trees.

A common species?

Assuming that *H. carpathicus* is univoltine, the total number of thrips larvae produced in one year from the investigated birch can be estimated to at least 2700 specimens. On the other hand, dead birches of the right size and stage of decay, and containing *H. carpathicus* are quite dispersed. Thus it is not clear whether the species is rare or common.

We have also collected bark samples from more than 300 dead trees of several species to look for fungivorous thrips. *H. carpathicus* was recorded only sporadically from other trees than birch. It was found once on Norway spruce, *Picea abies* and once on pine, *Pinus sylvestris*.

The birches with *H. carpathicus* can be found in crowded biotopes dominated by other tree species. As the birches have died recently, we suggest that they represent the end of the latest serale stage before the climax society, which is spruce in the investigated areas.

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Received 25 October 2002,
accepted 11 November 2002.

Norw. J. Entomol. 49, 145–146. 2002

Autumn migration of a colony of *Hypogastrura socialis* (Uzel) (Collembola, Hypogastruridae)

Sigmund Hågvar & Arne Fjellberg

Hågvar, S. & Fjellberg, A. 2002. Autumn migration of a colony of *Hypogastrura socialis* (Uzel) (Collembola, Hypogastruridae). Norw. J. Entomol. 49, 145-146.

A compact colony of the collembolan *Hypogastrura socialis* (Uzel), covering about 0.5 m^2, was observed to migrate 9 meters during one and a half day in a garden near Oslo during late August. Dense summer colonies of this species within litter of needles below spruce trees is well known from Norway, but these colonies have been considered to be stationary in the snow-free season. However, similar surface migrations of whole colonies in this species have been observed in Germany during the summer, and of a related species in Switzerland during winter. The purpose of this spectacular behaviour is probably a search for food.

Key words: Collembola, *Hypogastrura socialis,* colony, migration.

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INTRODUCTION

The colony-living forest collembolan *Hypogastrura socialis* (Uzel) is famous for long distance migrations on the snow surface during winter (Hågvar 1995, 2000). This migration occurs on an individual basis, and animals from a given colony is probably spread over a large area. Winter migration starts by vertical upwards migration through the snow layers in mild weather (Leinaas 1981b). During summer, the species has an extremely aggregated distribution on the forest floor, living in dense colonies in thick mats of needles below certain spruce trees (Leinaas 1983). Since the species lives in patchy and temporary habitats, the colonies must sooner or later move (MacArthur & Wilson 1967, Leinaas 1983). One has anticipated that migration only occurs during winter on snow, and migration of these summer colonies has never been observed in Norway.

OBSERVATIONS

During the last days of August 1998, a colony of *H. socialis,* perhaps counting millions of animals, was observed migrating in a garden at Kolbotn in Oppegård municipality near Oslo. The garden was situated close to a mixed forest. The migration was easily observed, especially since a part of the route was over flat stones, forming a garden pavement. According to the garden owner (H. Helmen, pers. comm.), the colony moved as a dense mass, covering the ground over approximately a half square meter (about 60-70 cm broad and a little longer). This aggregated population moved slowly and evenly as one group in a fixed direction, altogether 9 meters during one and a half day. It means that the speed was approximately 25 cm per hour. At least some of the animals migrated by jumping, since an empty match-box placed in front of the animals was immediately colonized. The relevant route was easy to migrate and probably contained little food (flat garden stones), so this may partly explain the rather rapid migration. When the first author next day visited the garden at 30 August, the colony had stopped migration and became stationary, and most of the individuals had withdrawn into the sand between pavement stones. However, active animals were still observed over several square decimeters. They were easily sampled by placing a piece of paper on the ground, onto which they jumped.

H. socialis is a cyclomorphic species with distinct summer and winter forms, and the change to winter form takes place in September/October (Leinaas 1981a). Our migrating animals were of the summer form.

DISCUSSION

Summer migration of compact, large colonies of this species has been observed in Germany by Zernecke (1999). He regularly observed several migration fronts during the entire snow-free season at particular places in the forest, usually one or two days after rainfall. Periodically, the colonies returned into the soil and remained stationary due to moulting. A typical migration rate of the front in his colonies was 10-20 cm per hour, but could be more than one meter per hour. This corresponds well with the present observation. The German study indicates that colonies of this species may show regular summer migrations. The question remains whether migration of summer colonies regularly takes place in Norway as well, but the present observation shows that it may occur.

Movements of large Collembola colonies is a spectacular phenomenon. In Switzerland, large colonies of a related species, *Ceratophysella sigillata* (Uzel), shows regular winter migrations, both on bare and snow-covered ground. When humidity allows, the colonies move towards trees, climbing to feed on algae growing on the bark (Zettel et al. 2002). It is reasonable to assume that the summer migrations in *H. socialis* are also due to food search, since food resources may become depleted within a short time by such dense colonies.

Acknowledgement: We want to thank Hans A. Helmen and his wife for their interesting observations of the colony in their garden.

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Received 11 November 2002,
accepted 15 November 2002

Nekrologer • Orbituaries

Jac. Fjelddalen (1918-2002) in memoriam

Jac. Fjelddalen passed away on 4 May 2002 at the age of 83, and we have lost one of the most prominent persons within plant protection and plant health in Norway. Jac. Fjelddalen was also a very dedicated entomologist. Insects and insect collection were not only the main focus in his professional life, but also an important and dear hobby to him.

Jac. Fjelddalen was born in Solum, Telemark county, in 1918. After completing his master study in horticulture at Agricultural University of Norway in 1946, he immediately obtained a position at Norwegian Plant Protection Institute in Oslo as a research assistant. He became an assistant professor in 1950, and five years later he was appointed State Entomologist. In 1968, Fjelddalen was employed as director at Norwegian Plant Protection Institute, a position he held until 1987, when he retired. His time as director was a period of considerable increase in staff and activities of the Plant Protection Institute.

As the State Entomologist, he gave lectures in applied entomology in horticulture and agriculture at Agricultural University of Norway. Fjelddalen had several sabbatical studies abroad, i.e. he spent one year in USA in 1949 to study entomology and insecticides at several universities and research institutions.

During the years after the Second World War, many new synthetic pesticides were launched on the market. Fjelddalen become early aware of the negative side effects of the pesticides during the 1950's and 60's, problems like chemical resistance and residues in the environment. He was the first person to write about integrated pest management (IPM) in Norwegian journals as a new option in pest control as opposed to chemicals. Norwegian Plant Protection Institute has always focused on plant health to prevent crop losses due to pests, and Fjelddalen was in this context a very active representative both on the national and Nordic scene as well as on the international level. When Norway became a member of European and Mediterranean Plant Protection Organization (EPPO) in 1955, Fjelddalen was appointed as the Norwegian representative. He was council delegate to EPPO for 30 years (1956-1986). As a credit for his keen interest and effort within international plant health to prevent spreading of quarantine pests on plants, Fjelddalen was the fifth person who received the EPPO Gold Medal (1981). In 1987, he was awarded His Majesty The King's Medal of Merit in Gold.

Up to 1958, Norwegian Plant Protection Institute was situated at the Natural History Museums at Tøyen in Oslo in small and inconvenient localities. A new building was planned at the campus of Agricultural University of Norway at Ås, and Fjelddalen played an important role during the planning process. The building itself became an excellent and modern place for laboratories, offices and teaching facilities for many years to come.

In addition to all his administrative duties at Norwegian Plant Protection Institute, Fjelddalen was a member of many boards and committees. After his retirement, he was still a frequent guest at his former institute, and presently had more time available to systematize and publish material and data collected during earlier years. Two such recent publications are his overviews of Norwegian gall mites (Eriophyoidea) and Coccinae, which was published in 1995 and 1996, respectively.

Fjelddalen was a prominent and active member of The Norwegian Entomological Society for a long time. He also had several duties within the board. He was the treasurer during 1950 to 1954, but his major task was the position as distributor of the Society's publications, a job he managed continuously for about 35 years, from 1962 until 1997.

Every summer Fjelddalen traveled to different parts of Norway in order to collect a wide variety of insects, which each year were added to the collection at Norwegian Plant Protection Institute. He was interested in all kind of insects which represented pest species on crops and ornamentals. In addition to collect the insect specimens themselves, Fjelddalen showed great interest in symptoms on plants made by phytophagous insects, especially gall forming and leaf mining species. The collection at Norwegian Plant Protection Institute contains many such specimens from a large variety of Norwegian plants collected by Fjelddalen.

Jac. Fjelddalen was always an excellent supporter for his colleagues with an enormous knowledge of his profession, and he was a person from whom one could always seek advise. His great enthusiasm was an inspiration for all of his co-workers. A long-lasting effort within Norwegian entomology for more than five decades has come to an end.

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Trond Hofsvang

Lixus iridis (Olivier) (Coleoptera, Curculionidae) in Norway

Tone Birkemoe

Birkemoe, T. 2002. *Lixus iridis* (Olivier) (Coleoptera, Curculionidae) in Norway. Norw. J. Entomol. 49, 153.

Two specimens of the large curculionid *Lixus iridis* were found on *Anthriscus sylvestris* at Darbu (**BØ** Øvre Eiker). The species have never been collected in Norway previously.

Key words: *Lixus iridis*, Curculionidae, Norway, *Anthriscus sylvestris*.

Tone Birkemoe, Norwegian Institute of Public Health. P.O.Box 4404 Nydalen, NO-0403 Oslo, Norway.

The large (11-17 mm) green and yellow Curculionidae *Lixus iridis* (Olivier, 1807) is known from most of Europe including Denmark (West 1941), Finland and Sweden (Lundberg 1995). The larva lives and feeds on stems of plant species in genera of Umbelliferae: *Sium, Oenanthe, Chaerophyllum, Conium, Cicuta, Heracleum, Apium, Levisticum, Angelica, Archangelica, Anthriscus, Cnidium* and *Pastinaca* (West 1941, Diekmann 1983, Koch 1992). It may occur as a pest species on *Levisticum officinale* (Diekmann 1983).

Two specimens of *L. iridis* were found on *Anthriscus sylvestris* at **BØ** Øvre Eiker: Darbu by the road E134 (EIS 27), 6 June 2002. The specimens are deposited in the private collection of Frode Ødegaard and in the Zoological museum of Oslo. According to Diekmann (1983), overwintering adults start feeding on host plants in May, and start egglaying in June. The larvae pupa in July-August and imagines hatch after 8-12 days.

The last decades, *A. sylvestris* has increased its distribution in Sweden with a corresponding increase in the distribution of *L. iridis* (Cederberg 1998).

Aknowledgements. Thanks to Eline Hågvar, Jan Henrik Simonsen and Solveig Aasen for taking part in the identification of the beetle and host plant. Thanks to Preben Ottesen and Frode Ødegaard for verifying our identification and help with literature references.

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Received 13 November 2002,
accepted 22 November 2002

XXVI NORDIC - BALTIC CONGRESS OF ENTOMOLOGY

Skalupes, Latvia, July 7 to 13, 2003

By the decision of the General Assembly of XXV Nordic-Baltic Congress of Entomology in Melsomvik, Norway on July 2000, the congress now will be held in Latvia.

All Nordic and Baltic scientists and students, also our colleagues from other countries doing research in entomology are hearty welcomed to the Congress. Besides insects, the congress covers also all other terrestrial arthropods. Plenary session, sections, poster presentation and excursions will be organised.

Congress is organised by:

Entomological Society of Latvia / Institute of Biology / Faculty of Biology

Location:

The congress will be held in Ligatne Rehabilitation Centre what is located at the banks of Gauja river inside the Gauja National Park (Cesis district, Central Latvia). National Park provides excellent possibilities for collecting and observing arthropods in different types of biotopes, like typical for Latvia and also rare forests, meadows, bogs, steams and other habitats.

Preliminary Programme:

The scientific program will include plenary sessions, workshops and poster sessions. Themes of the scientific sessions will include:

- applied entomology (agriculture, forest, medical, veterinary);
- taxonomy and faunistics (terrestrial and aquatic arthropods);
- arthropods ecology.

Abstracts and Proceedings:

Congress abstracts will be published before, proceeding - after the Congress.

Language:

English will be Congress official language.

Expression of Interest:

To receive the next announcements and to assist us to plan ahead for the Congress, please contact us.

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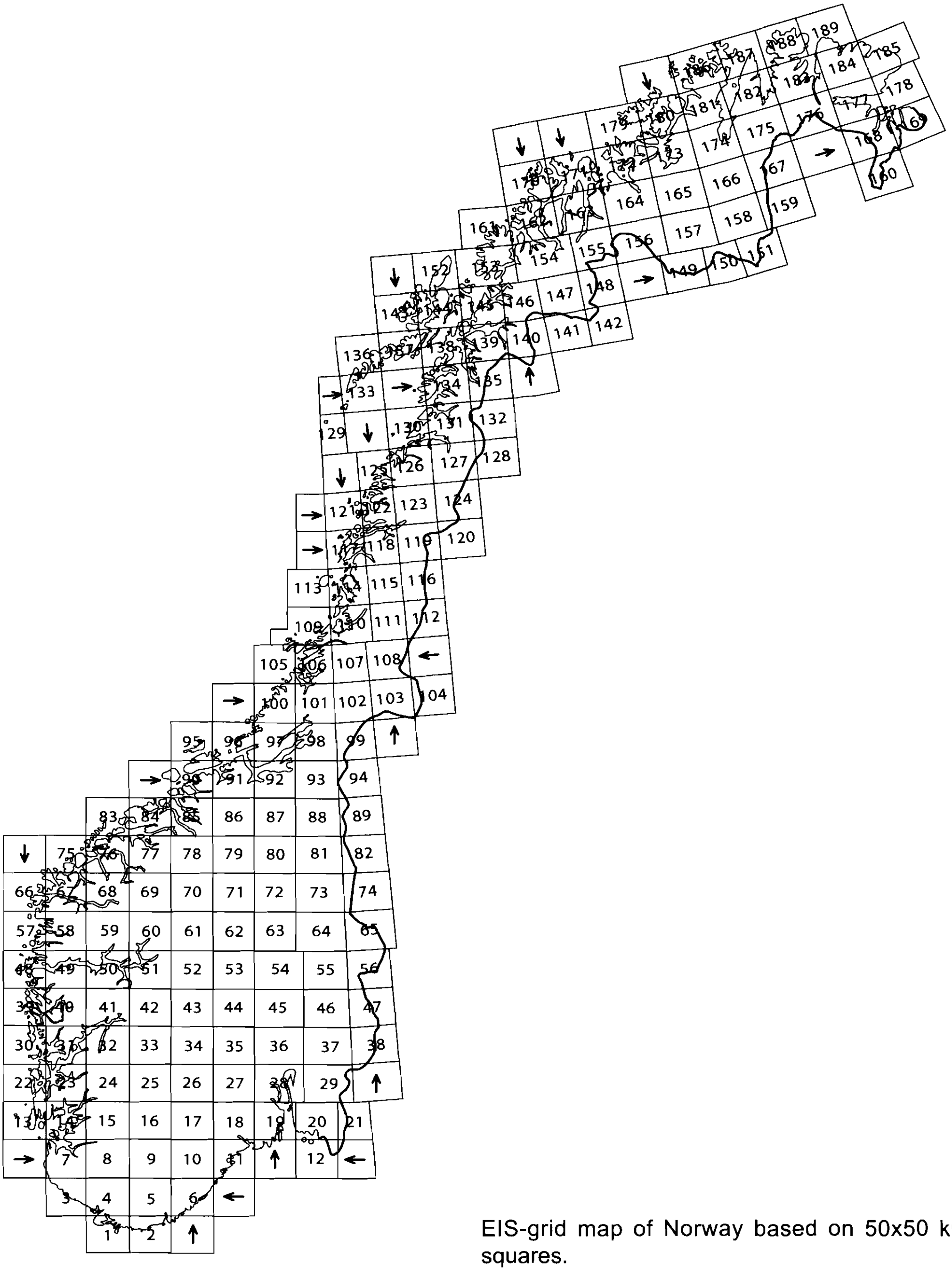
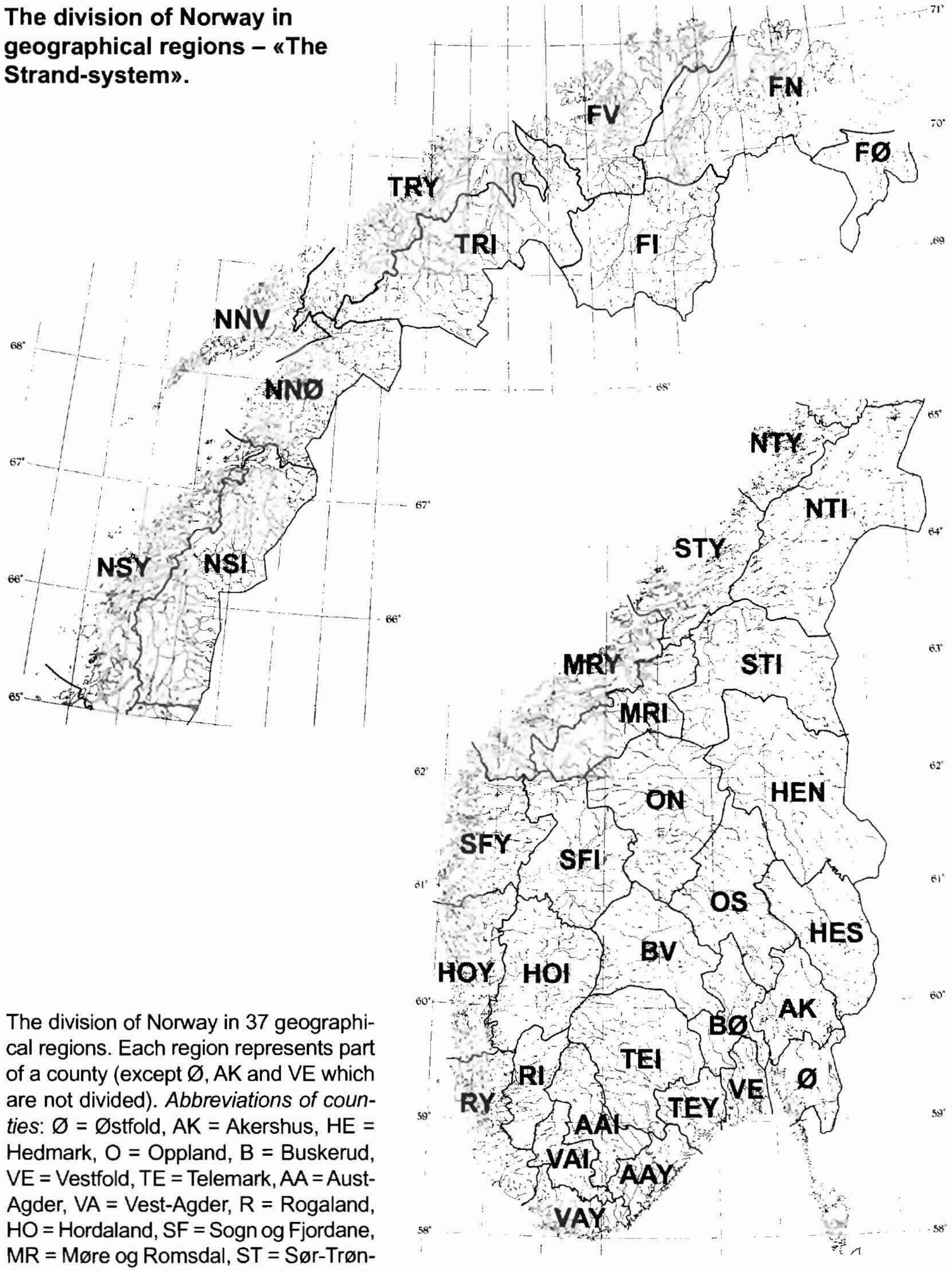
The EIS-grid system of Norway



EIS-grid map of Norway based on 50x50 km squares.

The division of Norway in geographical regions – «The Strand-system».



The division of Norway in 37 geographical regions. Each region represents part of a county (except Ø, AK and VE which are not divided). *Abbreviations of counties*: Ø = Østfold, AK = Akershus, HE = Hedmark, O = Oppland, B = Buskerud, VE = Vestfold, TE = Telemark, AA = Aust-Agder, VA = Vest-Agder, R = Rogaland, HO = Hordaland, SF = Sogn og Fjordane, MR = Møre og Romsdal, ST = Sør-Trøndelag, NT = Nord-Trøndelag, N = Nordland, TR = Troms, F = Finnmark. *Abbreviations of subdivisions*: I = interior, Y = coastal, S = southern, N= northern, V= Western, Ø = eastern.

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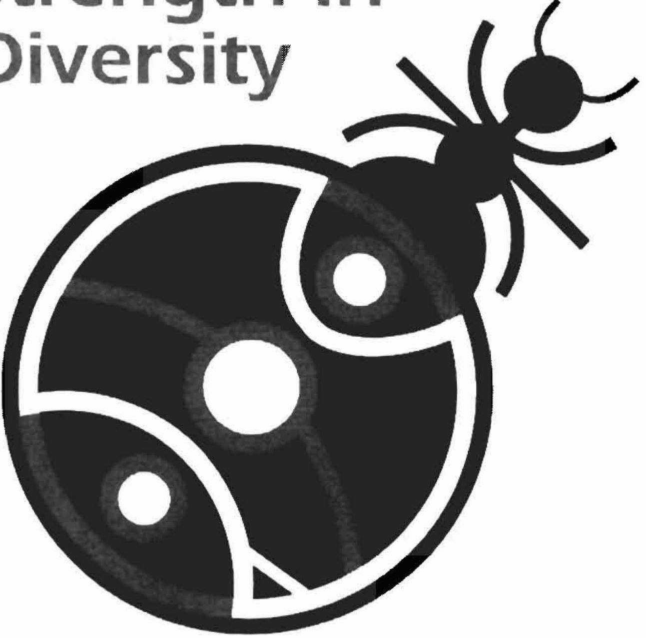

XXII International Congress
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Norwegian Journal of Entomology

Volume 49 • 2001

Articles

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Nomenclature. Scientific names of genera and species should be written in italics. The name of the author and year of description (if appropriate), separated by a comma, should be included the first time the name of an insect or another terrestrial arthropod is mentioned in the text, e.g. *Rhyacophila nubila* (Zetterstedt, 1840). Names of authors should be written in full, except L. for Linnaeus.

Localities. In faunistic papers the names of Norwegian localities should be according to K.A. Økland (1981), Fauna (Oslo) 34, 167-178, and preferably the EIS number should be added.

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Borror, D.J., Tripleton, C.A. & Johnson, N.F. 1989. An introduction to the study of insects. Sixth edition. 875 pp. Saunders College Publ., Philadelphia.

Chapter in book

Dennis, R.L.H. & Williams, W.R. 1995. Implications of biogeographical structures for the conservation of European butterflies. Pp. 213-230 in Pullin, A.S. (ed.), Ecology and conservation of butterflies. Chapman & Hall, London.

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ISSN 1501-8415.

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Information

The present journal is a continuation of **Fauna norvegica Series B** (Norwegian Journal of Entomology). With Volume 45 (1998) the publication of this journal by the Foundation for Nature Research and Cultural Heritage Research (NINA-NIKU) has been discontinued. Starting with Volume 46, the journal is published as **Norwegian Journal of Entomology** by the Norwegian Entomological Society. Editor is Professor Lauritz Sømme, University of Oslo.
