Norwegian Journal *of* Entomology

NORWEGIAN JOURNAL OF ENTOMOLOGY

The purpose of the Norwegian Journal of Entomology

The main purpose of the Norwegian Journal of Entomology is to serve as a forum for entomological publications, in particular in faunistics, systematics and ecology. National journals like the Norwegian Journal of Entomology cannot compete with international journals, and for many authors there is a dilemma whether to publish their papers in international or in national journals. International journals are usually considered more prestigious, while the national journals have much lower refusal rates.

The importance of the national journals is to print papers of more local studies. In this respect they serve as databases for biodiversity. Detailed knowledge of the presence and distribution of organisms is important to understand the effect of pollution, climate change and other anthropological influences. The Norwegian Journal of Entomology is a journal for the biodiversity of Norwegian insects and related taxonomic groups. In its wider contexts "entomology" includes springtails, mites, spiders and other arachnoids, and sometimes even myriapods.

Although not suitable for international journals, it is important that this kind of information is published. The gradual accumulation of knowledge contributes to a better understanding of our fauna in general. In the future, it is possible that more information will be stored in electronic databases, or that even the journals themselves will be available only on the Internet. New information on distribution and occurrence can be added to the databases without a paper publication. On the other hand, there will still be a demand for paper editions of the journals. They make it easier to be up to date in your field. For the authors, documentation of the originality of their publications is important. Nobody knows how long electronic databases can persist, but paper editions last for hundreds of years.

The activities of The Norwegian Entomological Society are based on voluntary work. So is part of the editorial work and distribution in connection with the Norwegian Journal of Entomology. Although the importance of the journal is generally accepted, it is a dilemma that the expenses must be kept at a low level. For some years the Journal was published by the Norwegian Institute of Nature (NINA) in Trondheim, but in 1998 the institute decided to discontinue the publiction. They claimed that the reason for this was financial. To the Society this was a great disappointment, since we felt that publication of biodiversity would be a central task for an institution like NINA. In particular since insects and related arthropods represent the most diversified groups of the animal kingdom.

Subsequently, the publication of the Journal was continued by the Society itself. By voluntary work and financing through membership fees we were able to give the Journal a new life. Fortunately, the Norwegian Ministry of Environment understands the importance of the Journal as a forum for biodiversity, and has supported the Society with a yearly allowance, partly directly and partly through the SABIMA organization.

To continue publication of the Journal we have to keep our expenses at a low level. The authors can contribute to this by preparing their manuscripts according to our standards. Instructions to authors and the lay-out in general should be followed closely. If at all possible, figures should be submitted electronically on a disk or CD. Better prepared manuscripts will reduce the work of the editor and the editorial secretary. Recently, we have made an agreement with the company 2punkt at Økern in Oslo. They will

produce the settings of the Journal for as low costs as possible. In this connection, well prepared manuscripts from the authors are important and later corrections should be avoided.

In our present times we find that expenses are increasing all around us. Prices of international scientific journals are rising steadily. Regarding the Norwegian Journal of Entomology, the price is actually much lower than it would have been if the journal should have been produced at a commercial rate. To compensate for increasing expenses, however, the Society has decided to increase membership fees from 2005. We hope this will not result in a loss of members, but that we can afford to continue our production of the Journal and the popular Insekt-Nytt as well.

At the 25th Nordic-Baltic Congress of Entomology in 2000, I raised the question: Do we need Nordic national entomological journals? (See Norw. J. Entomol. 48, 35-39.) The answer is of course yes, which is supported by the fact that more than 400 papers were published in the national entomological journals of Denmark, Finland, Norway and Sweden during 1995 - 1999. Among the papers published during this period in the Norwegian Journal of Entomology, 85 were on faunistics, 3 in taxonomy and 14 in ecology.

In conclusion, there is a demand for journals that will publish faunistic data of local interest. Such data form the bases for further reviews. Although not acceptable in international journals, ecological studies may include data of great general interest, and should be published in national journals. Regarding taxonomy, description of a few or single new species will not always be accepted in international journals, but may find their place in national ones. National journals are an important part of the activities of the respective entomological societies and a source of information for members that are spread out all over the country. Without the national journals there would probably be less interest in entomology.

Lauritz Sømme

Altitudinal zonation of ants (Formicidae) in a steep fjord landscape in Sogndal, Western Norway

Sigmund Hågvar

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In a steep fjord landscape in Western Norway, with timber line at about 900 m a.s.l. and scattered trees up to about 925 m, the altitudinal zonation of the ant fauna was studied from sea level to 1030 m a.s.l. Combined with literature data, it was concluded that 18 species lived below 200 m altitude, 12 species at 400 m altitude, 9 species at 600 m altitude, and 7 species at 900 m altitude. Only two species lived above tree line: the world's northernmost ant species *Leptothorax acervorum* which was found up to 1025 m, and the arctic species *Formica gagatoides* which was found at 1000 m elevation. It was a good correlation between the altitudinal and latitudinal distribution of the species within Norway, and temperature is probably an important regulating factor for the ant fauna. Because several species are able to live in the uppermost forest belt, an elevated timber line due to climatic change would imply that also the ant fauna will climb to higher altitudes together with the forest. Since ants are efficient predators, their potential colonisation of higher altitudes may heavily affect today's alpine ground-living fauna.

Key-words: Ants, Formicidae, altitudinal zonation, climatic change.

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INTRODUCTION

In Europe, the highest species number of ants is found in warm, sunny habitats with rather dry soil and a rich availability of microhabitats (Seifert 1996). The thermophilous character of many ant species implies that the species number is reduced towards the north, as shown both on a European scale (Czechowski et al. 2002), and within Scandinavia and Norway (Collingwood 1979, Kvamme 1982). In practice, very few species live north of, or above tree line. The altitudinal zonation of ants has, however, not been studied systematically in Norway. Such data would allow comparison between altitudinal and latitudinal distribution of the species. I therefore found it interesting to study the ant fauna within

a rather steep vertical temperature gradient, from sea level to well above tree line, in a fjord landscape of Western Norway (Figure 1).

During the last decades, altitudinal zonation of organisms has achieved increased attention due to the possibility of global warming. One probable scenario is that the global CO_2 concentration will double during the next 100 years, implying that tree line in South Norway would gradually increase with about 400 m (Holten et al. 1993). Those ant species which are able to live near tree line would be candidates to follow the upper trees in their altitudinal climbing.

In the same locality, the altitudinal zonation of

insects on branches and leaves of birch *(Betula pubescens* Ehrh.*)* was earlier studied by Hågvar (1972, 1976). He found a marked altitudinal zonation, with reduced species numbers of Cicadidae, Heteroptera, Coleoptera and Araneida at higher altitudes. The present study makes it possible to compare the altitudinal zonation of tree-living insects with a ground-living group within the same gradient.

MATERIAL & METHODS

Over a long period, from 1977 to 2004, ants were collected manually in south and west faced hill sides near Barsnes, Sogndal. Various habitats such as bogs, moss turfs, dead wood, warm microhabitats and the underside of stones were inspected along the whole gradient. A similar collection effort at all altitudes was tried to be maintained. Mixed deciduous forest characterized the altitudinal gradient, with patches of *Pinus silvestris* L. forest on dry ridges. At lower levels, heat-demanding trees as *Ulmus glabra* Hudson and *Tilia cordata* Miller occurred. However, above about 600 m altitude, *Betula pubescens* dominated, and the uppermost forest was an almost pure birch stand with crooked stems due to large amounts

of snow (Figure 2). The upper limit for continuous forest (called timber line) varied a little due to local climatic conditions, but was typically 900 m in the sampling area. Scattered birches usually occurred up to about 925 m (called tree line). Even above that, up to about 950 m, single, small birches could be observed in some areas. The highest point in the altitudinal gradient was the peak Solvornnipa at 1031 m.

During the summer of 1991, Johannes Anonby pitfall-trapped ants in a warm, southeast-faced mixed forest a few km apart in Solvorn, at altitudes between 100 and 200 m. These data were included in Figure 3 and shown as crosses at 150 m altitude.

RESULTS

Figure 3 shows the records of 19 ant species at different altitudes. Three species were only taken in the pitfall traps: *Camponotus ligniperda* (Latreille, 1802)*, Myrmica lonae* Finzi,1926, and *M. schencki* Emery, 1894. Above the tree line, two species were recorded: *Formica gagatoides* Ruzsky, 1904 and *Leptothorax acervorum* (Fabricius, 1793). Four species managed well up to tree line: *Formica lugubris* Zetterstedt, 1840,

Figure 1. The fjord landscape where the present study was performed. Ants were collected mainly in the central valley leading up to the highest peak of 1031 m shown in the background, but also in the hillside in the right part of the picture.
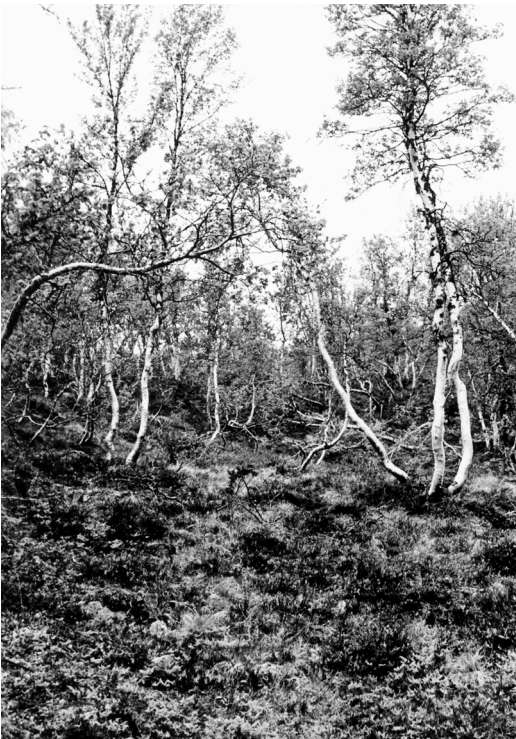
Figure 2. Just below timber line, there is typically a partially open birch forest, where the trees have markedly crooked stems due to large amounts of snow.

F. exsecta Nylander, 1846 (both building mounds of dead plant fragments), *F. lemani* Bondroit, 1917, and *Myrmica ruginodis* Nylander, 1846. *Formica aquilonia* Yarrow, 1955 was recorded twice at 750 m altitude. Two species were not recorded higher than 600 m: *Myrmica scabrinodis* Nylander, 1846 and *Camponotus herculeanus* (L., 1758). The altitude around 400 m seemed to represent the upper level for three species: *Lasius flavus* (Fabricius, 1781), *L. platythorax* Seifert, 1991 and *Formica fusca* L., 1758. The remaining seven species were only recorded at about 150 m altitude, or lower: *Formica rufa* L., 1761, *F. sanguinea* Latreille, 1798, *Lasius niger* (L., 1758), *Camponotus ligniperda, Myrmica lonae, M. schencki,* and *M. sulcinodis* Nylander, 1846. The material indicates a marked reduction of species numbers with altitude, and with a sudden drop in number above tree line (Figure 5).

DISCUSSION

Remarks to each species

If temperature is a major factor for the distribution of ants, there should be a good relationship between their altitudinal and latitudinal distribution. Also, northern species might shift to high altitude habitats in their southernmost geographical area. In the following discussion, these aspects will be treated for each species based on the literature.

The species occurring at the highest altitudes will be mentioned first. However, it is most practical to discuss three pairs of closely related species together: *Formica lemani/F. fusca, Camponotus herculeanus/C. ligniperda,* and *Lasius platythorax/L. niger.*

Formica gagatoides
The species was found once, among *Empetrum hermaphroditum* Hagerup vegetation at 1000 m altitude. This is an exclusively arctic species, ranging from Northeast Siberia to North Norway, but also occurring in alpine and subalpine areas in South Norway (Collingwood 1979, Kvamme 1982). It lacks further South in Europe, as in Germany and Poland, and it is even absent from the mountains of central Europe (Seifert 1996, Czechowski et al. 2002). The species can live in high altitude forest, nesting for instance in treestumps (Kvamme 1982), and a probable extension downward into the uppermost forest is indicated in Figure 3.

Leptothorax acervorum
This species occurred along the whole gradient and had the highest record of all at 1025 m, one hundred meters above tree line. A colony was found in an old piece of wood, that had formerly been used in a trigonometric construction. The next highest record, at 910 m, was under a stone in a south-faced, open and dry place. *L. acervorum* is rather eurytopic and has been recorded all over the country (Kvamme 1982). In a search for the northernmost ant localities in Norway and Europe, Gjelsvik (1998) found the species in several places along the northernmost coast of
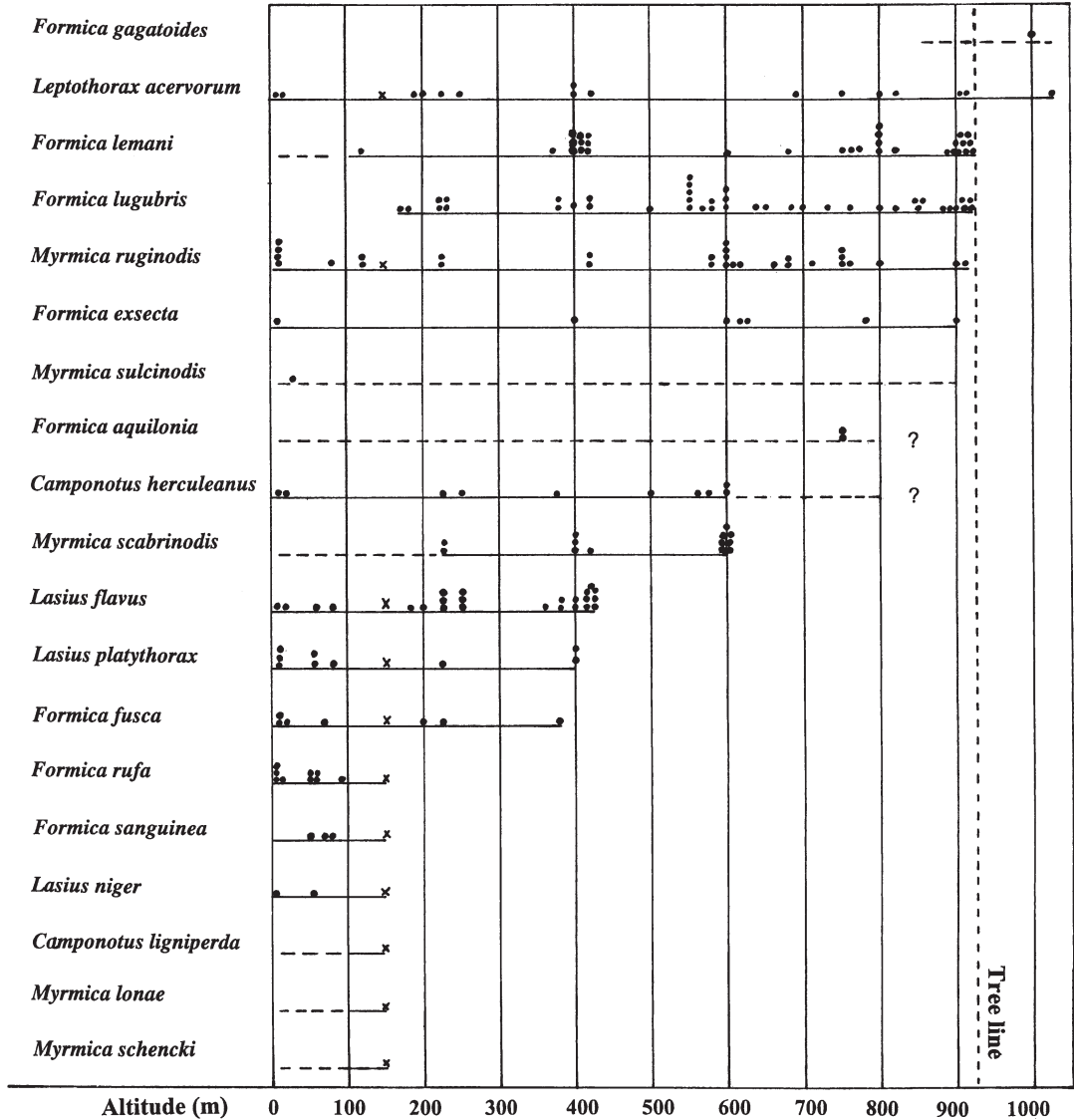
Figure 3. Occurrence of 19 ant species at different elevations. Dots show recordings by manual sampling, and two or more dots placed above each other indicate that several nests were recorded at the same altitude. Crosses at 150 m altitude represent pitfall-samplings at 100-200 m altitude. Unbroken lines show the altitudinal span of each species based on the samplings, while stippled lines indicate extended altitudes supported by the literature. Two question marks show the possibility of still higher occurrence in two species.

Finnmark, even at 71° N, only 6 km from North Cape. All these nests were situated in warm microhabitats, under flat, heat-accumulating stones in dry, south-faced slopes. *L. acervorum* is in fact the world's northernmost ant species, living in the delta of Lena river in Siberia at 73° N (Heinze et al. 1996). Even in Alaska, it is the northernmost species, together with *Leptothorax muscorum* (Nylander, 1846), reaching 69° N (Nielsen 1987).

Formica lemani and *F. fusca*

F. lemani was not found at sea level (below 100 m altitude), but occurred elsewhere up to the tree line. In fact, in the uppermost, half-open forest zone around 900 m, it was the most commonly found species (Figure 3). Nests were typically situated here under stones in south-faced places, sometimes in quite open terrain without trees. Kvamme (1982) reported *F. lemani* from all over Norway. *F. lemani* is a typical boreo-montane species (Czechowski et al. 2002). Its continuous distribution area in Eurasia goes northwards to the border between forest and tundra, and southwards to Fennoscandia, most of England, and the northern part of Russia. Further south in Europe, it occurs only as local populations in mountain areas (Czhechowski et al. 2002). According to Seifert (1996) and Czechowski et al. (2002), *F. lemani* takes over for *F. fusca* in the subalpine mountain areas of middle Europe, being less thermophilous and hygrophilous than *F. fusca*. This altitudinal pattern corresponds with the present data, where *F. fusca* was found only below 400 m altitude. In Norway, *F. fusca* has a southern distribution, occuring northwards to Trøndelag (Kvamme 1982).

Formica lugubris

F. lugubris was the most common mound-building species in the altitudinal gradient. It can sometimes create colonies in groups, with inter-connecting nests (Collingwood 1979, Seifert 1996, Czechowski et al. 2002). Some nests were situated in rather open terrain among the uppermost trees (Figure 4). A large, 80 cm high mound was found at 920 m, in an open, south-faced place with *Vaccinium myrtillus* L*., Betula nana* L. and a few,

2 m high birches nearby. Below 170 m height, however, no mounds of this species were found, although they were actively searched for. A possible explanation is a competition with *F. rufa,* which was confined to the 0-150 m range. A vertical separation of the two species is in accordance with Collinwood (1979). He characterized *F. lugubris* as a robust and active species with similar habits as *F. rufa*, but *F. lugubris* is able to forage at much lower temperatures and replaces *F. rufa* entirely from Central Fennoscandia to the far north Czechowski et al. (2002) give a total distribution of *F. lugubris* similar to *F. lemani*, with a northern main distribution and the occurrence in middle and south Europe only in high altitude coniferous forests. In Norway, it occurs all over the country (Kvamme 1982).

Myrmica ruginodis

Occurring from sea level to tree line, this species is one of the most abundant Norwegian ant species, living in a wide range of habitats over the whole country (Kvamme 1982). In Europe, it is absent from the southern parts, except from some mountain populations. Generally, it replaces the closely related *M. rubra* in cooler habitats, as in mountains, and it is characterized as the least thermophilous *Myrmica* species in Europe (Czechowski et al. 2002).

Formica exsecta

Besides *F. lugubris*, this is the other mound-building species which can be found close to tree line, with the uppermost observation at 900 m altitude. *F. exsecta* was also found at sea level and sporadically throughout the altitudinal gradient. It occurs throughout Norway and may even live above timber line (Kvamme 1982). Czechowski et al. (2002) characterize it as a transpalaearctic species with a northern distribution, lacking in the Mediterranean area.

Myrmica sulcinodis

The single lowland record in the present material (Figure 3) is not representative for this species, but probably only reflects a general low density in the area. *M. sulcinodis* has been recorded even far

north in Finnmark, and lives both in the lowland and higher up (Kvamme 1982). Since it has been recorded just below timber line at 900 m altitude in Rondane mountains (S. Hågvar, unpubl.), and even above timber line in the Femunden area (Kvamme, pers. comm.), its vertical distribution has been stippled up to 900 m in Figure 3. The species prefers open and sun-exposed sites and has a boreo-montane distribution, which implies that it is restricted to mountain areas in middle and South Europe (Seifert 1996, Czechowski et al. 2002).

Formica aquilonia

This species occurs over the whole country and is generally the most common wood ant, both in Norway and the entire Fennoscandia. (Collingwood 1979, Kvamme 1982). However, in the present locality it was only found at 750 m altitude. This may be due to a preference for coniferous forest (Czechowski et al. 2002), which occurs only as patchy pine stands within the gradient. As indicated in Figure 3, the potential distribution of *F. aquilonia* goes down to the sea level. Within Europe, its main distribution is Fennoscandia, and further south it occurs only scattered in some mountain areas (Collingwood 1979, Czechowski et al. 2002).

Myrmica scabrinodis

M. scabrinodis was recorded in open, often wet pastures and bogs up to 600 m altitude. Although it was common at 600 m, it was searched for in vain in similar habitats at higher altitudes. The absence below 200 m height may be due to a lack of suitable, open, wet habitats, since the terrain here was rather steep and forest-covered. The species has earlier often been misidentified, but recent literature confirms a preference for open, rather wet habitats (Seifert 1996, Czechowski et al. 2002). Its absence from the upper part of the altitudinal gradient is in accordance with an absence from the northernmost Norway, and with only few records north of the polar circle (Kvamme 1982). However, in the Femunden area, the species has been taken above timber line (Kvamme 1982, pers. comm).

Figure 4. A mound of *Formica lugubris* (in the foreground) in a south-faced slope at the timber line.

Camponotus herculeanus and C. ligniperda

C. ligniperda is more thermophilous than *C. herculeanus* and has a more southern distribution in Europe. *C. ligniperda* was recorded only in pitfall traps in the warm slope at about 150 m altitude, and it occurs only in Southern Norway (Kvamme 1982). *C. herculeanus,* however, occurs in forests over the whole country (Kvamme 1982), and in German mountains, it goes up to tree line (Seifert 1996). In central and Southern Europe, *C. herculeanus* is a mountain species (Seifert 1996, Czechowski et al. 2002). *C. herculeanus* colonies were found close to sea level and at 225, 250 and 600 m altitude. Between 375 and 575 m altitude, four stumps were recorded with old *Camponotus* galleries, which were assumed to be *C. herculeanus*. However, it can probably live at still higher altitudes, and its altitudinal distribution has been stippled up to 800 m.

Lasius flavus

L. flavus is a trans-palaearctic species with a southern type of distribution, preferring open and sunny habitats (Czechowski et al. 2002). It lives mostly in the soil and often creates easily visible soil mounds. In Norway, it is mainly a lowland species characteristic for grassland and pastures, occurring northwards only to the Tronheimsfjord area (Kvamme 1982). The avoidance of colder climate corresponds well with its occurrence only in the lower part of the present gradient (up to 400 m). In potentially favourable, open pastures at 600 m it was never

found.

The "twin" species
Lasius platythorax and L. niger

In 1991, the very common *"L. niger"* was split into two species, the real *L. niger* and *L. platythorax*. While *L. niger* is the most common of the two in warm, open cultural landscape, *L. platythorax* is less heat-demanding and more hygrophilous, and takes over for instance in shadowed forests (Seifert 1996). After the revision, Kvamme (1999) recorded *L. platythorax* widespread in the southern half of Norway up to North Trøndelag, while the real *L. niger* is probably restricted to warmer habitats in the southernmost parts of the country. Primary data also indicates a more southern European distribution of *L. niger* compared to *L. platythorax* (Czechowski et al. 2002). The referred data are in accordance with a higher altitudinal distribution of *L. platythorax* (up to 400 m) than *L. niger* (up to about 150 m).

Formica rufa

F. rufa is a wood ant species preferring warm, sunny places, and it is lacking from the northern half of Fennoscandia (Collingwood 1979, Kvamme 1982, Czechowski et al. 2002). Its thermophilous character was confirmed in the present study, as the species was only found in the lowest part of the altitudinal gradient. See also remarks under *F. lugubris*.

Formica sanguinea

This facultative "slave-keeper ant" was found up to 150 m. In Norway, it occurs mainly in the southern part, but there are also records in northern Fennoscandia (Collingwood 1979, Kvamme 1982). It prefers sunny places and robs nests of *F. fusca* and related species for pupae, which are raised as slaves (Seifert 1996, Czechowski et al. 2002). This is a transpalaearctic species with a southern type of distribution (Czechowski et al. 2002).

Myrmica lonae

In Scandinavia, *M. lonae* has earlier been considered a form of *Myrmica sabuleti* Meinert, 1861. While Seifert (1996) claimed that it was not clear whether it is a reproductively isolated species or a morph, he later (Seifert 2000) found a clear habitat segregation and concluded that *M. lonae* is a good species. Most of the earlier Norwegian records of *M sabuleti* belong to *M. lonae,* and the real *M. lonae* is widely distributed in the southernmost Norway (Kvamme 1999). Both species are thermophilous, but *M. lonae* is less thermophilous and less xerophilous, and can inhabit bogs and forests (Seifert 1996, Kvamme 1999, Seifert 2000, Czechowski et al. 2002). In accordance with its rather thermophilous character, *M. lonae* was only recorded in the warm slope at a low level, with pitfall traps.

Myrmica schencki

Like *Camponotus ligniperda* and *Myrmica lonae, M. schencki* was taken only in the pitfall traps in the warm and rather dry slope at 100-200 m altitude. In Norway, *M. schencki* has been recorded mainly along the southernmost coast, preferring warm and sheltered areas (Kvamme 1982). It is a transpalaearctic species with a southern distribution, generally living in dry and warm habitats, and it is characterized as one of the most thermophilous *Myrmica* species in central Europe (Seifert 1996, Czechowski et al. 2002).

Estimated species numbers at different altitudes

Figure 5 shows the estimated number of ant species at different altitudes, based on the whole and stippled lines in Figure 3. Eighteen species (all except *Formica gagatoides*) probably live around 150 m altitude. Because *Formica lugubris* was not found lower down, despite active searching for its mounds, the species number at sea level has been set to seventeen. Twelve species were estimated to occur at 400 m, nine at 600 m and seven at 900 m. Two additional candidates for 900 m (but potentially only in warm, south-faced places) would be *Camponotus herculeanus* and *Formica aquilonia.* In that case, the total species number at 900 m would be nine, the same as at 600 m. At 1000 m elevation, well
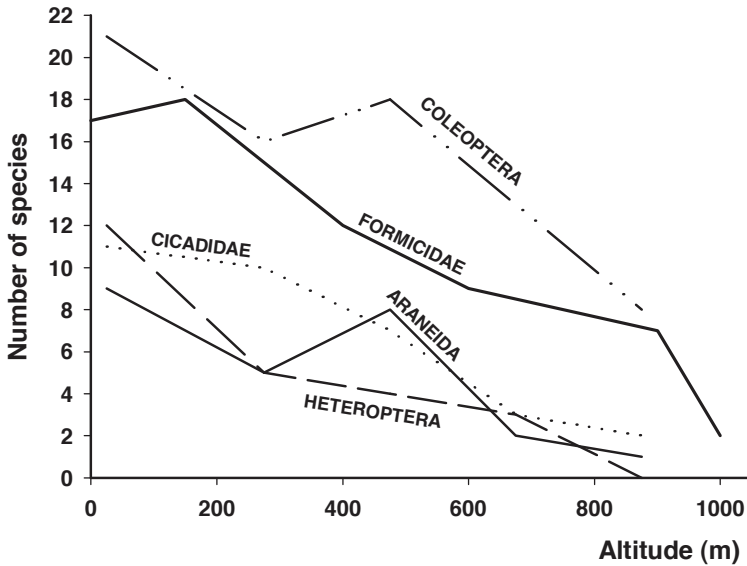
Figure 5. The probable number of ant species at different altitudes (see Discussion). The figure also shows species numbers of four other invertebrate groups at different altitudes on branches of birch in the same locality, according to Hågvar (1976).

above tree line, only two species seem to survive: the world's northernmost ant species *Leptothorax acervorum,* and the arctic species *Formica gagatoides.*

Figure 5 indicates that the number of ant species decreases rather evenly from sea level to tree line, with nearly half of the species still occurring close to tree line. However, above this line, the species number is drastically reduced.

Figure 5 also shows the species number at different altitudes in four other groups, sampled from branches of birch in the same altitudinal gradient (Hågvar 1976). Araneida, Heteroptera and Cicadidae had relatively few species around 675 m and 875 m compared to sea level. Also in Coleoptera, the species loss with increasing altitude was clear, but less drastic. This comparison indicates that the species loss of ants with increasing altitude (within the forested region) is not so great as it may be in certain other invertebrates. Like arboreal Coleoptera, several ant species may live well just below tree line.

However, in treeless, alpine habitats, the ant fauna is very scarce or absent, while quite a high number of ground Coleoptera may live here. In alpine habitats at Finse, Hardangervidda in central South Norway, about 130 Coleoptera species are able to live at 1100 m altitude, decreasing to about 100 species at 1200 m, and 20 species at 1550 m altitude (Ottesen 1995).

Relationships between altitude and latitude

There is a generally good relationship between the upper altitudinal limit of the species in Figure 3 and their northernmost distribution in Norway, according to Kvamme (1982). The following six species which occurred at 900 m or higher have all been recorded in Finnmark, the northernmost county of Norway: *Leptothorax acervorum, Formica gagatoides, F. lemani, F. lugubris, F. exsecta,* and *Myrmica ruginodis.* Also *Formica aquilonia, Camponotus herculeanus, and Myrmica sulcinodis,* which were assumed to reach at least 800 m, occur in Finnmark. One species with maximum altitude

at 600 m, *Myrmica scabrinodis,* has its northernmost distribution in Nordland, the southernmost county in "North Norway". Three species with a maximum altitude around 400 m occur northwards to Trøndelag in mid-Norway: *Lasius flavus, L. platythorax,* and *Formica fusca.* One published record of *L. flavus* in eastern Finnmark has not been verified later.

The remaining six species with an upper altitudinal limit around 150 m are typically South Norwegian species: *Formica rufa, F. sanguinea, Camponotus ligniperda, Lasius niger, Myrmica lonae,* and *M. schenki.* An exception is *F. sanguinea,* which has been recorded in south Trøndelag and even in Eastern Finnmark, but its main distribution is clearly in Southern Norway.

This relationship between altitudinal and latitudinal distribution supports the view that the temperature regime is a limiting factor for many ant species.

Trees as an upper altitudinal limit for some ants

Three common ant species stopped abruptly at the tree line, about 925 m a.s.l. : *Formica lemani, F. lugubris* and *Myrmica ruginodis.* The two first ones were repeatedly recorded just below the tree line, showing that they were doing quite well as long as some trees were present. Their absence at higher altitudes was easy to confirm, as mounds of *F. lugubris* are very obvious, and the two other species are rather easy to find, for instance under stones or as active animals on bare rock. A mound of *Formica exsecta* was found just at timber line at 900 m, but none above. According to Kvamme (1982) the species may occur also above timber line.

A general impression from mountains in South Norway is that ant mounds may be frequent up to timber or tree line, but are generally absent above. There are several possible explanations for this. One is that trees and mound-building ants may respond to the same climatic factors. A second is that wind, snow cover or other factors negative for ants may change abruptly when trees are no longer present. A third possibility

is that trees (usually birch at the tree line) represent an important food source by hosting aphids from which the ants get sugar. High altitude birch forests may harbour good populations of aphids (Hågvar 1976, S. Hågvar unpubl.). A fourth hypothesis is that suitable building material for ant mounds may be scarce for some ant species, when trees are absent. Closer studies on the ant fauna just under and over the forest and tree line could test out some of these hypotheses.

Climatic changes and the altitudinal zonation of ants

Since the tree line is so closely related to the upper limit for several ant species, trees and ants will probably follow each other in their altitudinal climbing. This means that alpine, tree-less communities will be gradually invaded, not only by trees and the accompanying flora, but also by several ant species. Today it is easily observable how abundant and active for instance *Formica lugubris* is on the forest floor, even in the uppermost birch forest of this locality. Since ants are efficient ground predators, the original alpine ground fauna may be rapidly changed as soon as ants invade.

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Additions, corrections and comments to the Carabidae part of: Löbl, I. & Smetana, A. 2003. Catalogue of Palearctic Coleoptera Vol. 1 Archostemata -Myxophaga - Adephaga

Johan Andersen, Stefan Olberg & Oddvar Hanssen

Andersen, J., Olberg, S. & Hanssen, O. 2005. Additions, corrections and comments to the carabidae part of: Löbl, I. & Smetana A. 2003. Catalogue of Palearctic Coleoptera Vol. 1 Archostemata-Myxophaga- Adephaga. Norw. J. Entomol. 52, 13-18.

Additions and corrections are given to the Carabidae part of the catalogue of Löbl & Smetana regarding the Nordic and Baltic countries. Many species were erroneously quoted from Finland, Denmark, Norway, Sweden and especially Estonia and Latvia, whereas other species actually occurring in these countries were missing. Some taxonomical comments are also given.

Key words: Carabidae, corrections, Nordic countries, Baltic countries, Löbl & Smetana.

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INTRODUCTION

The work of Löbl & Smetana (2003) has been reviewed by Hansen & Sagvolden (2003) and Ljungberg (2003). As pointed out by Hansen & Sagvolden (2003), several carabid beetle species that actually occur in Norway (NR in the catalogue) are not reported from that country in the catalogue. A majority of these records are of a more or less recent origin, which reasonably explains why they are missing. It is more serious, however, that many species incorrectly are quoted from countries in Northern Europe in the catalogue. This especially applies to Estonia (EN) and Latvia (LA), but also to Finland (FI), Denmark (DE), Sweden (SV) and Norway). A considerable number of boreal and subalpine/alpine species is quoted from EN and LA in Löbl & Smetana (2003) whereas most of them are absent in these countries according to Silfverberg (2004).

In a work that treats such a tremendous number of species as this one, it may seem pedantic to focus on erroneous records of a minute number of species. However, from a zoogeographical point of view such errors are unfortunate. Thus, they give the impression that the Baltic countries constitute relict areas for an element of northern boreal and subalpine/alpine species. Such an element is hardly represented at all in Estonia and Latvia as is indicated by e. g. the flora (Hultén 1971). The two countries are situated in the boreonemoral zone (Moen 1998) and have a flora and fauna of a southern or eastern origin. Furthermore, that several southern species erroneously are reported from the Nordic countries, may give the impression that they have a greater element of such species than actually is the case.

In the following we give corrections, additions and comments to species concerning Fennoscandia

and Denmark, whereas we only have checked species with a more or less northern distribution regarding the Baltic countries. We have not added species that obviously are introduced. We also treat some taxonomical questions. The page numbers refer to those given in the catalogue. The abbreviations of the countries are the same as used in the catalogue.

LIST OF ADDITIONS AND CORRECTIONS

p. 93. *Nebria salina* Fairmaire & Laboulbène, 1854. Delete FI.

p. 97. *Notiophilus rufipes* Curtis, 1829. Delete NR. The northernmost known records of the species in Northwestern Europe seem to be in central parts of Jutland in Denmark at about 56° N (Lindroth 1985).

p. 109. *Cicindela germanica* Linné, 1758. Delete DE, FI.

p. 118. *Calosoma reticulatum reticulatum* Fabricius, 1787 Delete FI.

p. 136. *Carabus menetriesi menetriesi* Hummel, 1827. Delete FI.

p. 138. *C. intricatus* Linné, 1761. Add SV. The species occurs within a small area in the province Skåne in the southernmost part of Sweden (Lindroth 1985).

p. 171. *C. monilis* Fabricius, 1792. Add NR. The species is rather abundant within a small area in the province Ø in South Norway (Andersen & Hanssen 1992).

p. 206. *Elaphrus lapponicus* Gyllenhal, 1810. Delete LA. The species has a northern distribution and it has not been recorded south of 66° N in East Fennoscandia (Lindroth 1985).

p. 206. *E. angusticollis longicollis* J. R. Sahlberg, 1880. Delete FI.

p. 207. *E. riparius* Linné, 1758 and *E. tuberculatus* Mäklin, 1878 are regarded as separate species in the catalogue and both of them are noted from NR and SV. According to Lindroth (1939, 1961, 1985) there is no sharp limit between the two forms, but a subspecific separation might be possible.

p. 213. *Brachinus crepitans* Linné, 1758. Delete NR. The species has a southeastern distribution in Fennoscandia although it has been recorded as far north as to about 60° N in Sweden (Lindroth 1945b).

p. 226. *Dyschirius laeviusculus* Putzeys, 1846. Add DE, SV. In Sweden the species occurs in the province Skåne in the southernmost part of the country (Lindroth 1985, Lundberg 1995).

p. 226. *D. luticola luticola* Chaudoir, 1850. Delete FI.

p. 245. *Bembidion geniculatum geniculatum* Heer, 1837. Delete DE.

p. 246. *B. tibiale* Duftschmid, 1812. Delete LA, LT. The northernmost records of the species in Europe are from SW Norway (Andersen & Hanssen 1993). This and the preceding species are absent in the European lowland areas because of their ecological requirements (Andersen 1983).

p. 246. *B. hastii* C. R. Sahlberg, 1827. Delete EN, LA. This is a northern, circumpolar species (Lindroth 1963).

p. 246. *B. virens* Gyllenhal, 1827. Delete EN, LA. A boreomontane species othervise occurring in the areas quoted in the catalogue.

p. 247. *B. foveum* Motschulsky, 1844. Delete EN, LA. The species is almost circumpolar, but the westernmost occurrence in Eurasia should be in Petchora in NE European Russia (NT) (Lindroth 1963).

p. 247. *B. lapponicum* Zetterstedt, 1828. Delete DE, EN, LA. The species is also quoted from GB and GE. However, we find no information indicating that this northern species (Lindroth 1963, 1985) should be present in the two countries.

p. 247. *B. velox* Linné, 1761. Delete DE.

p. 248. *B. fumigatum* Duftschmid, 1812. Add NR. A single specimen has recently been collected in SE Norway, but it is uncertain whether the species has established in the country (Ødegaard & Ligaard 2000).

p. 250. *B. tinctum* Zetterstedt, 1828. Delete EN, LA. The species has a northeastern distribution in Europe and has been found south to about 60°N in Finland (Lindroth 1985).

p. 261. *B. dauricum* Motschulsky, 1844. Delete EN, LA. This circumpolar species has a northern distribution in Europe (Lindroth 1985).

p. 262. *B. obscurellum obscurellum* Motschulsky, 1845. Delete EN, LA. According to Lindroth (1985) a small population may exist somewhere at the Baltic Sea, but as far as we know, this has not been documented.

p. 262. *B. petrosum* Gebler, 1833. Delete EN, LA. The species has mainly a northern distribution in Europe (Lindroth 1985).

p. 265. *B. obtusum* Audinet- Serville, 1821. Add NR (Hansen et al. 1998).

p. 265. *B. crenulatum* R. F. Sahlberg, 1844. Delete EN, LA. In Europe only known from eastern part of the Kola Peninsula (NT). It is a tundra species (Lindroth 1985).

p. 265. *B. difficile* Motschulsky, 1844. Delete EN, LA. This is a boreomontane species that seems to be absent in the European lowland areas.

p. 265. *B. fellmanni fellmanni* Mannerheim, 1823. Delete EN, LA. The subspecies is northern and subalpine/alpine (Andersen 1980, Lindroth 1985).

p. 265. *B. hyperboraeorum* Munster, 1923. Delete EN, LA. The species is northern and cicumpolar (Lindroth 1963, 1985).

p. 266. *B. prasinum* Duftschmid, 1812. Delete EN, LA. This is a boreomontane species (Lindroth 1945 a) that is absent in the European lowland areas due to its ecological requirements (Andersen 1983).

p. 266. *B. chaudoirii* Chaudoir, 1850. Delete EN, LA, NR. The species occurs in SE Europe and has been found very isolated at the White Sea (NT) (Lindroth 1985).

p. 268. *B. mckinleyi scandicum* Lindroth, 1943. Delete EN, LA. The species has a very isolated occurrence in the northernmost parts of FI, NR and SV (Andersen & Hanssen 2004).

p. 271. *B. grapii* Gyllenhal, 1827. Delete EN, LA. This circumpolar species has mainly a northern distribution in Europe although its area extends south to about 60° N in Finland (Lindroth 1945).

p. 272. *B. yukonum* Fall, 1926. Delete EN, LA. The species is circumpolar and has a strictly northern distribution in Europe (Lindroth 1985).

p. 272. *Ocys harpaloides* Audinet-Serville, 1821. Delete DE.

p. 274. *Parotachys bisulcatus* Nicolai, 1822.

Add DE, NR. The species has quite recently immigrated to Norway, but it is now well established (Ødegaard 1999).

p. 275. *Tachys bistriatus* Duftschmid, 1812. Delete NR. The species has no established populations in Scandinavia (Lindroth 1985).

p. 285. *Patrobus septentrionis* Dejean, 1828. *P. septentrionis* and *P. australis* J. R. Sahlberg, 1875 are regarded as conspecific in the catalogue. The two forms have partly been regarded as subspecies (Lindroth 1961), partly as good species (Lindroth 1985, Lucht & Klausnitzer 1998). We find the latter opinion justifiable. *P. septentrionis* has a boreoalpine, circumpolar distribution (Lindroth 1945a, 1961). It is one of the most abundant and euryoecious carabid beetles above the timber limit in Scandinavia (Lindroth 1985). In Fennoscandia it is present in NR, SV and FI. The total distribution of *P. australis* is imperfectly known (Lucht & Klausnitzer 1998), but it has a much more southern distribution than *P. septentrionis*. In Fennoscandia *P. australis* occurs in SV and FI, but it has not been found in NR. The species occurs at freshwater fringes, usually in shady positions (Lindroth 1985).

p. 347. *Calistus lunatus lunatus* Fabricius, 1775 Delete NR, SV. This southern species has its northernmost occurrences south of Scandinavia.

p. 348. *Chlaenius costulatus* Motschulsky, 1859 Delete NR. The westernmost occurrences of this species in Northern Europe are situated in Northern Sweden (Lundberg 1995).

p. 348. *C. quadrisulcatus* Paykull, 1790. Delete FI

p. 350. *C. nitidulus* Schrank, 1781. Add FI, SV (see also Ljungberg 2003). The species has been found repeatedly on the island Gotland in the Baltic Sea (Lindroth 1986).

p. 351. *C. vestitus* Paykull, 1790. Delete NR. The northernmost reported records of this species in Scandinavia are from South Sweden (Lundberg 1995).

p. 361. *Anisodactylus nemorivagus* Duftschmid, 1812. Delete NR, SV. The species is Westpalearctic and mainly southern, but it has been found as far north as in FI (about 62°N) (Lindroth 1945a,b).

p. 361. *A. signatus* Panzer, 1796. Delete FI, NR,

SV. The species has its northernmost occurrences in DE (Lindroth 1986).

p. 362. *Diachromus germanus* Linné, 1758. DE should formally be added, but the species is now probably extinct in that country (Lindroth 1986).

p. 387. *Microderes brachypus* Steven, 1809. Add FI (Silfverberg 2004).

p. 396. *Trichotichnus laevicollis laevicollis* Duftschmid, 1812. Delete DE, SV.

p.400. *Bradycellus csikii* Loczo, 1912. Add FI (Silfverberg 2004).

p. 401. *B. verbasci* Duftschmid, 1812. Add NR, FI (Hansen et al. 1998, Silfverberg 2004). The species has spread rapidly in Scandinavia (Lindroth 1986).

p. 402. *Dicheirotrichus gustavii* Crotch,1871. Delete FI. The species is halobiontic and is therefore absent in the weakly saline areas on the coast of Finland (Lindroth 1986).

p. 403. *D. rufithorax* C. R. Sahlberg, 1827. Add NR (Sagvolden & Hansen 1993). *D. rufithorax* has expanded rapidly in Scandinavia (Lindroth 1986).

p. 404. *Psychristus discretus* Andrewes, 1930 (*Bradycellus ponderosus* Lindroth, 1939). Add NT. A single specimen has been found in Russia, close to the Finnish border (Lindroth 1986).

p. 417. *Cymindis macularis* Fischer von Waldheim, 1824. Add NR. The species is certainly an old member of the Norwegian fauna.

p. 418. *Demetrias imperialis* Germar, 1824. Add FI. The species has rapidly spread in Fennoscandia (Lindroth 1986, Sagvolden & Hansen 1996).

p. 423. *Microlestes minutulus* Goeze 1777. Add NR. This is an expanding species in Scandinavia (Lindroth 1986) and a single specimen has recently been found in Norway (Olberg & Andersen 2003).

p. 424. *Paradromius linearis linearis* Olivier, 1795. Add NR and SV. The species has quite recently been found in Norway and may be a newcomer in the country (Ødegaard & Ligaard 2000). This, however, is not the case in Sweden (see Lindroth 1945a).

p. 427. *Lebia chlorocephala* J. J. Hoffmann, 1803. Add FI. The species is widely distributed in Finland (Lindroth 1945b).

p. 441. *Badister peltatus peltatus* Panzer, 1796. Add NR (Lundberg 1995).

p. 441. *B. sodalis* Duftschmid, 1812. Add NR. The species has recently been found in SE Norway (Hansen et al. 1998).

p. 442. *Licinus depressus* Paykull, 1790. Add SV. The species is distributed in South and Central Sweden (Lindroth 1945b).

p. 447. *Panagaeus bipustulatus* Fabricius, 1775. Add NR. The species has quite recently been discovered at one isolated locality in SW Norway (Andersen & Hanssen 1992). This does not mean that the species is of recent origin in the country because the district of concern (SFI) has been poorly investigated.

p. 447. *P. crux-major* Linné 1758. Add SV. Although rare, the species is distributed over large parts of the country (Lundberg 1995).

p. 449. *Agonum afrum* Duftschmid, 1812. Add NR. *A. afrum* belongs to a group of very closely related species (the *moestum*-complex) that, as far as we know, not has been revised in Norway. Sweden has three species of the group: *A. afrum*, *A. duftschmidi* J. Schmidt, 1994 and *A. hypocrita* Apfelbeck, 1904 (Ljungberg 1996). Among these species, Silfverberg (1996) reports *A. afrum* from NR, probably because this species is synonymized with *A. moestum* which has been reported from SE Norway. We can verify the existence of *A. afrum* in Norway by eight specimens collected in the provinces AK and Ø.

p. 450. *A. duftschmidi* J. Schmidt, 1994. Delete NR. This is the most southerly of the three species in the *moestum*-complex. Its occurrence in Norway must be deleted since there is no evidence of its existence in the country.

p. 452. *A. consimile* Gyllenhal, 1810. Delete LA. The species was quoted from LA by Barsevskis (Silfverberg 1996), but it has not been quoted from that country by Silfverberg (2004). We also find it unlikely that this subalpine/alpine species (Lindroth 1986) should be a member of the Latvian fauna.

p. 455. *Anchomenus dorsalis* Pontoppidan, 1763. Add NR. The distribution and expansion of this species in Norway has been treated in detail by Andersen (1996).

p. 487. *Pterostichus adstrictus* Eschscholtz, 1823. Delet DE, EN, LA.

p.488. *P. burmeisteri burmeisteri* Heer, 1838. Add SV (Lundberg 1995).

p. 522. *Platyderus depressus* Audinet-Serville, 1812. Add NR. The species has recently been discovered in SE Norway (Skartveit et al. 2000).

p. 527. *Calathus cinctus* Motschulsky, 1850. Add DE, SV (Lundberg 1995).

p. 573. *Zabrus tenebrioides tenebrioides* Goeze, 1777. Delete NR.

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The genus *Anticheta* Haliday, 1838 (Diptera, Sciomyzidae) in Norway

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Greve, L. & Djursvoll, P. 2005. The genus *Anticheta* Haliday, 1838 (Diptera, Sciomyzidae) in Norway. Norw. J. Entomol. 52, 19-20.

The distribution of the genus *Anticheta* in Norway is reviewed. *Anticheta analis* (Meigen, 1830) is reported as new to Norway from RY Tysvær: Muslandstjerna near Muslandsvåg, EIS 14. Two other species, *Anticheta atriseta* (Loew, 1849) and *A. brevipennis* (Zetterstedt, 1846) have been recorded from one or two localities, respectively, in South East Norway.

Key words: *Anticheta*, Diptera, Sciomyzidae, Norway.

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INTRODUCTION

The species in the genus *Anticheta* are among the smaller sciomyzids, and the colour is either all reddish-brown or black with some yellow. The males have a remarkably asymmetrical postabdomen. The periandrium is produced on the right side like a large lobe and the gonostyli are differently shaped on both sides, which make the males easy to recognize.

The larvae are known to feed on the eggs or embryos of snails, and the puparia have been found along the edges of standing water.

Rozkošný (1984) listed five species of the genus *Anticheta* Haliday, 1838, in his review of the Sciomyzidae of Fennoscandia and Denmark. None of them were recorded from Norway. Subsequently, Greve & Økland (1989) and Hansen & Bergsmark (1990) recorded two *Anticheta* species from Norway.

In this paper we present further records of *Anticheta* species from Norway. First records are marked with an asterisk. Regional abbreviations are given in accordance with Økland (1981).

Unless otherwise noted, the material is deposited in Zoological Museum, University of Bergen. The material has been identified by LG.

SPECIES

** Anticheta analis* (Meigen, 1830)
RY Tysvær: Muslandsvåg, Muslandstjerna (EIS 14) 31 May 2004 1 ♂ leg. P. Djursvoll.
The specimen was collected in *Phragmites australis* (Cav.) near the water´s edge.
This is the first record of *A. analis* from Norway. *A. analis* is a yellow to reddish-brown species with two orbital setae and having the first flagellomere entirely black. There are two pairs of dorsocentral and postalar setae. *A. analis* is considered rare in Denmark, uncommon in Sweden and widespread, but uncommon in Finland (Rozkošný 1984).

Anticheta atriseta (Loew, 1849)
VE Tjøme: Torås (EIS 19) 6 July 1984 1 ♂ leg. A. Fjeldså.
Anticheta atriseta was first reported from TEI Kviteseid by Greve & Økland (1989). The next year it was also reported from **BØ** Nedre Eiker

(Hansen & Bergsmark 1990), det. LG.

A. atriseta is a predominantly black species with yellow antennae and legs. The head has only one orbital seta and there are two pairs of dorsocentral and postalar setae on the dorsum.

Anticheta brevipennis (Zetterstedt, 1846)

AK Oslo: Snarøya (EIS 28) 5 July 1931 1 ♂ leg. T. G. Münster (in Zoological Museum, University of Oslo). **Ø** Hvaler: Arekilen 22 July – 15 Aug. 2000 1 ♂ leg. O. Frengen.

Anticheta brevipennis was first reported from **BØ** Hurum by Greve & Økland (1989).

A. brevipennis is a black and yellow species with narrow wings which are shorter than the abdomen. There are only one pair of dorsocentral and one pair of postalar setae. The specimen from Snarøya lacks both wings and one of the hind legs.

DISCUSSION

The genus *Anticheta* in the tribe Tetanocerini is a well defined genus and there are six species in the Palaearctic, restricted mainly to northern and central Europe. The North-Western European species can be determined using the key in Rozkošný (1984).

Noteworthy is the fact that all the five species known from Fennoscandia and Denmark are fairly rare, viz. only recorded from restricted geographical areas. In the field the females may be confused with other genera of Sciomyzidae, while the males are easy to recognize to genus level on account of their special, large postabdomen, and they are not easily overlooked. Two species

(*A. atriseta* and *A. brevipennis)*, are recorded from the south-eastern parts of Norway, an area having more insect species than anywhere else in the country. The occurrence of *A. analis* in RY, is more surprising. Based on what is presently known, all three species of *Anticheta* in Norway must be considered as rare in Norway. The records are few and widely scattered despite considerable collection efforts for several decades.

In Great Britain, *A. analis* is listed in the Red Data Book as "rare", viz. localised within restricted geographical areas or habitats; *A. brevipennis* is listed "vulnerable", meaning that most or all the populations area decreasing because of environmental disturbance (Falk 1991).

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New records of Norwegian Piophilidae (Diptera)

Lita Greve

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Mycetaulus bipunctatus (Fallén, 1823), *Parapiophila lonchaeoides* (Zetterstedt, 1838) and *Pseudoseps signata* (Fallén, 1820) are recorded new to Norway. New records are given for *Actenoptera hilarella* (Zetterstedt, 1847), *Allopiophila luteata* (Haliday, 1833), *Neottiophilum praeustum* (Meigen, 1826) and *Parapiophila* vulgaris (Fallén, 1820).

Keywords: Piophilidae, new records, Norway, geographical distribution.

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INTRODUCTION

Members of the fly family Piophilidae are mostly small, stout and dark flies recorded world-wide, with the highest number of species occurring in the Holarctic. While McAlpine (1977) included the families Neottiophilidae and Thyreophoridae in the family Piophilidae, these families are often considered as separate families. Ozerov (2000) followed McAlpine and included both families in the Piophilidae while Zuska (1984), Soós (1984) and Papp (1984) separated them. The systematics follows Ozerov (2000) who divides Piophilidae into two subfamilies - Neottiophilinae with one tribe and Piophilinae with three tribes. Ozerov recorded 24 genera with more than 70 species from all continents. Around 25 species occur in Europe according to Merz (1996).

The Piophilidae are otherwise rarely mentioned in the literature from Norway with the exception of *Piophila casei,* "The cheese skipper". This species was earlier an important pest on cheese, meat etc. in the households see Greve (2002a,b). For older records of Piophilidae see Zetterstedt (1847), Walker (1847) and Siebke (1877). Duffield (1937) recorded four species collected near carrion of small mammals. Many

Piophilidae species are carrion specialists, some have been reared from bird´s nests, dung, or from rotten wood or fungi.

One species, *Amphipogon flavum* (Zetterstedt, 1838), was first recorded by Ringdahl in 1954. It is actually a common species (Greve & Solem 1983, Greve 2002 a,b).

Piophilinae are black, some with yellow parts, while the Neottiophilinae are colored from yellow to brown. The head is in profile usually higher than long and the face most often concave always with vibrissae present. The antennae are short and the apex usually rounded. The thorax has varying numbers of setae, the scutellum carries four setae. The wings are often hyaline, however, several genera have wings marked with dark. The costa is broken only once near the end of the subcosta which is complete, reaching the costa. The radius is setulose in the subfam. Neottiophilinae. The legs are stout and fairly short, the males in some species with long, dense hairs on femur and tibia. For description of genitalia see Ozerov (2000).

A large collection of Piophilidae has been sorted out from netted insect material, from Malaise

traps, light traps or sometimes from yellow trays. None of this collection has been done specifically to catch Piophilidae. The material is in the collection of Zoological Museum, University of Bergen unless otherwise stated. There are some comments on material in the Zoological Museum, University of Oslo (ZMO). Collection has been done with Malaise traps, light traps, yellow trays water traps and car net. Regional abbreviations are given in accordance with Økland (1981).

FAMILY PIOPHILIDAE

Subfamily Neottiophilinae

The species in this subfamily are shining orange-brown, wing span 13 - 21 mm, markedly larger than the species in the subfamily Piophilinae where most species have a bodylength between 2 and 4 mm. Vein R 1 with spinules/setulose.

Actenoptera hilarella (Zetterstedt, 1847)

Synonym: *Heteromyza hilarella* Zetterstedt, 1847

AK Oslo: Oslo, 1 ♀, (ZMO). **ON** Dovre: Toftemo, 5 Aug. 1873, 1 ♀, (ZMO). **BV** Rollag: Bråtåsen, July 1994, 1 ♀, (ZMO). **HOY** Bergen: Isdalen, 14 June 1970, 1 ♀. **SFY** Naustdal: Naustdal, 8 – 28 July 1986, 1 ♀. **NTI** Verdal: Sulstua (=Suulstua) (Not seen by the author). EIS 28, 35, 39, 58, 71, 99.

A. hilarella is a yellow fly with prescutellar ac. The wings are hyaline.

The first Norwegian record is Zetterstedt´s from NTI Verdal: Sulstua (Suulstua) (EIS 99),12 July 1840 which is also the type locality (Zetterstedt 1847). Later Siebke (1877) recorded one female from Dovre: Toftemo. Zetterstedt (1847) regarded *A. hilarella* as extremely rare, and it is still rarely collected (Merz 1996, Stubbs & Chandler 2001). *A. hilarella* has been recorded from England and Scotland (Cogan & Dear 1975) and from Central Europe (Merz 1996).

Dates of collection are from middle June until beginning of August, and the specimens have either been netted or collected in Malaise traps. The larvae live in birds nests and pupate in the nest material (Merz 1996, Ozerov 2000). The biology is otherwise not known (Stubbs & Chandler 1996).

Neottiophilum praeustum (Meigen, 1826)

Ø Sarpsborg: Tune, Råkil, 20 May 1994, 1 ♂, near Lake Tunevann, 16 June 1991, 1 ♀. **BV** Rollag: Bråtåsen, June 1994, 1 ♀, Veggli, 6 Aug. 1994, 1 ♀. **VAY** Farsund: Sellegrod, 9 – 16 May 1999, 1 ♀. **SFI** Vik: Fresvik, 17 May – 31 June 1997, 1 ♀. EIS 1, 20, 35, 50.

N. praeustum is a fairly large yellow fly without presutural ac and the wings with dark spots. The larvae are ectoparasitic bloodsuckers on nestling birds.

N. praeustum (Meigen, 1826) was first recorded from Norway by Greve & Olsen (1992) from Sarpsborg near Lake Tunevann, see above. Stubbs & Chandler (2001) recorded *N. praeustum* as infrequent, but widespread in England. It has been widely, but rarely recorded in Central- and Northern Europe.

The Norwegian material was collected from early May until early August. Two specimens were netted, one Malaise trapped, and one caught in a car net.

Subfamily Piophilinae

The species in this subfamily are small flies usually measuring from 2 – 4 mm, either entirely dark or with lighter coloured smaller parts of the body. Vein R 1 without spinules.

Allopiophila luteata (Haliday, 1833)

HES Ringsaker: Furnes Sandvold, July 1992, 1♂ 1♀, Helgøya Hovindsholm, 29 June – 27 July 1991, 1♀. **TEI** Kviteseid: Kviteseid, 5–8 July 1988, 1♂. **RY** Finnøy: Sevheim, 27 July – 21 Aug. 1993, 1 ♀. **HOI** Voss: Mjølfjell Solbakken, 680 m a.s.l., 7 – 25 July 1991, 1 ♀. **SFI** Vik: Fresvik, 1–17 July 1997, 1♀. **MRI** Stranda: Lauvvika, 7 – 25 July 1991, 1♀. **STI** Oppdal: Lønset, 17 July – 10 Sept. 1993, 1 ♀. **NTI** Lierne: Limanns-

vikåsen, 6 – 15 July 1986, 1♀. **TRY** Tromsø: Ramfjordnes, Aug. 1991, 3 ♀♀. EIS 14, 17, 41, 45, 50, 77, 79, 108, 162.

Allopiophila luteata has yellowish propleura, and also other yellow parts which distinguish it from most other Piophilidae. *A. luteata* has once earlier been reported from Norway by Duffield (1937). Duffield, however, lists *Piophila luteata* Hal. *var.* which perhaps represents another species. Duffield´s material was taken on carrion (small mammals) at Gæidnovuoppe in Finmark 50 miles NØ of Kautokeino. Merz (1996) gives the distribution as Northern and Central parts of Europe, and *A. luteolata* is also known from the Nearctic, however, it is not common.

The Norwegian records are from all over Norway. All specimens have been collected in Malaise traps. The locality at Mjølfjell at 670 m a.s.l., is the highest situated in the collection. Most specimens have been collected in July, some traps were opened in July and closed in August, and one trap was opened in July and closed in early September.

Mycetaulus bipunctatus (Fallén, 1823)

Ø Sarpsborg: Maugesten Holleby, 27 Sept. 1992, 1 ♂ 1 ♀; Tune: Råkil, 30 June 1993, 1 ♀. **AK** Oslo: Hovedøya, 26 July 1982, 1 ♀; Bærum: Ostøya, 12 Aug. - 1 Sept. 1984, 1 ♀ l specimen. **HES** Ringsaker: Furnes Sandvold, July and Aug. 1997, 1 ♂ 9 ♀♀, Helgøya: Helgøya Hovindsholm, 29 June - 27 July 1991, 2 ♂♂ 4 ♀♀. **BØ** Drammen: Underlia, Aug. 1995, 3 ♀♀; Kongsberg: Hvamsal, 19 July 1995, 1 ♂, Passebekk 19 July 1995, 1 ♀; Nedre Eiker: Mjøndalen Hagatjern Ryggsetra, July 1994, 3 ♀♀; Røyken: Hyggen Kinnartangen, 4 Aug.- 8 Sept. 1991, 1 ♀; Ringerike: Sokna Hovland, 3 Sept. – 11 Oct. 2004, 1 ♀. **BV** Flå: Langtjern, 29 June – 28 July 1986 1 ♂; Gol: Engene, 21 July – 2 Aug. 1982, 4 ♀♀, 2 – 16 Aug. 1982, 1 ♂ 8 ♀♀, 16 – 30 Aug. 1982, 2 ♂♂ 4 ♀♀; Rollag: Tråen saga, Aug. 1994, 6 ♂♂ 5 ♀♀, Veggli, 11 July 1995, 1 ♂, 13 July 1995, 2 ♀♀; Vårviken, Aug. 1994, 14 ♂♂ 24 ♀♀; Sigdal, Trillemarka, 7 July – 18 Aug. 1999, 1 ♀; Ål: Tuftelia, 18 July –

18 Aug. 2000, 1 ♀. **VE** Sande: Kommersøya, 2 Aug. – 26 Oct. 1991, 2 ♀♀; Tjøme: Sandøy, 10 Aug. 1984, 1 ♀. **AAI** Bygland: Heddevika, 27 July – 27 Aug. 1998, 3 ♀♀. **HOI** Voss: Mjølfjell, Solbakken, several dates, different years, July and August, 15 ♂♂ 24 ♀♀. **STI** Oppdal, Lønset, 12 June – 13 Aug. 1992, 4 ♂♂ 6 ♀♀. **NSY** Bodø: Urskar Skuti, 4 Aug.1982, 2 ♀♀, Urskar Storlia, 6 Aug. 1982, 1 ♀. **FV** Alta: Detsika Boulamalia, Aug. – 10 Sept. 1995, 1 ♀, Gargia, 22 June – 6 Aug. 1996, 1 ♀, Kåfjord Møllenes, 21 June – 4 Aug. 1996, 1 ♀. **FØ** Sør-Varanger: Kirkenes Prestøya, 30 July – 8 Aug. 1996, 1 ♂, Svanvik Mellesmo, 20 June – 4 Aug. 1986,1 ♂ 2 ♀♀ Svanvik, Svanhovd, 20 June – 7 Aug. 1986, 2 ♀♀. EIS 9, 19, 20, 27, 28, 35, 36, 41, 43, 44, 45, 79, 126, 165, 169, 173.

M. bipunctatus has head and most parts of thorax orange-colored, the abdomen is black. The large, round, dark spot on the wingtip is a character which separate *M. bipunctatus* from other Norwegian species of Piophilinae. Because of this character it might perhaps have been taken for a species of Sepsidae as the genus *Sepsis* also has dark spots on wing tips.

There are two other *Mycetaulus* species recorded from Central Europe, *M. latipennis* Ozerov & Bartak, 1993 has an oblique apical wing spot, and *M. hispanicus* Duda, 1927 has a clouded posterior cross-vein.

M. bipunctatus has surprisingly not been definitely recorded from Norway earlier according to Zuska (1984). This species was briefly mentioned in Greve (2002a), but no actual records were given. The distribution seems to be in most parts of Norway, both costal and alpine areas. The single locality from western Norway at Voss: Mjølfjell Solbakken at 670 m a.s.l. lies in scattered deciduous, mostly birch (*Betula sp.)* forest with a few pine trees (*Pinus silvestris)*. The flight period seems to be July and August. Collection has been done with net and Malaise traps. The larvae of species of *Mycetaulus* develop in fungi.

Parapiophila lonchaeoides

(Zetterstedt, 1838)

NTI Lierne: Kveskallen, 26 June – 14 July 1986, 1 ♀, Storbekken, 16 July – 20. Aug. 1986 1 ♀. EIS 103, 108.

The specimens from Lierne are both females, and females of some species are difficult to identify in the genus *Parapiophila.* Both, however, are nearly double the size of other dark species in the genus *Parapiophila,* and this fits well with *P. lonchaeoides,* the only European *Parapiophila* species of this size. *P. lonchaeoides* has been recorded from Sweden, and Hedström (1995) mentions *P. lonchaeoides* from the provinces Dalarna, Jämtland and Lule Lappmark. Jämtland borders Lierne in Northern Trøndelag. *P. lonchaeoides* is also recorded from Finland according to Zuska (1984). It is new to Norway. Collection has been done with Malaise traps.

Parapiophila vulgaris (Fallén, 1820)

HEN Folldal: Atna Vollen, 19 – 26 June 1988, 1 ♂ 1 ♀. **BØ** Hurum: Tofteholmen, 1 – 18 May 1991, 2 ♂♂ 2 ♀♀; Kongsberg: Sandsvær, 26 July 1995, 1 ♂; Røyken: Kinnartangen, Hyggen, Primo May 1989, 6 ♂♂ 1 specimen. **BV** Gol: Engene, 5 – 21 July 1982, 1 ♂; Rollag: Rollag, 12 July 1995, 1 ♂. **RY** Finnøy: Sevheim, 16 – 24 Sept. 1992, 1 ♂. **HOI** Kvam: Geitaknottheiane, 28 May – 6 July 1997, 1 ♂ 2 ♀♀; Voss: Mjølfjell Solbakken, 25 May – 5 Aug. 1991, 7- 25 July 1991, 26 June – 7 July 1991, 3 ♂♂ 8 ♀♀. **MRY** Haram: Løvøya Farstad, 21 June – 5 July 1992, 1 ♂. **STI** Oppdal: Kongsvoll near Sprenbekken, 23 – 27 July 1992, 1 ♂, Lønset, 24 June – 17 July 1993, 1 ♂ 1 ♀. **TRY** Tromsø: Ramfjordnes, May – June 1991, 1 ♂. EIS 14, 19, 27, 28, 31, 35, 41, 44, 72, 79, 83, 162.

The male genitalia of this species are very characteristic, however, females of *Parapiophila* species can be difficult to separate. Only new records with males are recorded here. The flight period seems to be from May/June until September, many records are from both June and July, one from September, a few from late May. *P. vulgaris* is clearly widespread and probably a common species in Norway, and is recorded both in alpine and coastal areas. The record from Sprenbekken near Kongsvoll represents the highest latitude at 1250 m a.s.l., an alpine area. Collection has been done by sweepnet, yellow trays, light trap and Malaise traps. *P. vulgaris* is widely spread in Europe and has been recorded from areas such as the Orkney islands (Laurence 1997) and Svalbard (Lohm 1978).

Pseudoseps signata (Fallén, 1820)

AK Frogn: Håøya, 19 May – 3 June 1984, 1 ♀. **HOY** Osterøy: Døsså, 26 June 1982, 3 ♂♂. **HOI** Voss: Mjølfjell Solbakken, 8 – 29 June 1986, 2 ♀♀, 29 June – 6 Aug. 1986, 1 ♀. **STI** Oppdal: Kongsvoll, 30 June 1981, 1 ♂. **FV** Alta: Kåfjord Møllenes, 21 July – 4 Aug 1995, 1 ♀. EIS 28, 40, 41, 79, 173.

P. signata is easily distinguished from other Piophilidae of the same size (2-4 mm) by the darkened areas along the distal parts of veins R 2+3, R 4+5 and M. There is only one pair of dorsocentral bristles. *P. signata* is here recorded for the first time from Norway. *P. signata* is in Scandinavia known from Finland (Hackman 1980) and Sweden (Hedström 1995), but not Denmark (Chandler & Petersen 2001). The records from Sweden are from the southern parts.

The localities here are widely spaced, and located from the south to north of the country. Two localities, at Kongsvoll at around 900 m a.s.l. and at Mjølfjell at 670 m a.s.l., are in subalpine areas while the locality at Håøya is rich lowland with deciduous forest.

One specimen was sweep-netted and the rest collected in Malaise traps. Most specimens from southern Norway were collected in May - June. This could indicate an early period of flight.

P. signata is fairly easy to recognize because of the shaded wingveins, and judged from the few Norwegian records *P. signata* is probably fairly rare. Outside Scandinavia it is known from Scotland (Cogan & Dear 1975) and Russia (Zuska 1984.). The biology is unknown (Stubbs

& Chandler 200l).

DISCUSSION

Check list after Merz (1996).

One can expect more species of Piophilidae to be found in Norway. One species likely to occur is *Parapiophila flavipes* (Zetterstedt, 1847) recorded earlier from Sweden and Finland, and lately from Great Britain (Stubbs & Chandler 2001). Another species is *Protopiophila latipes* (Meigen, 1838) recorded from Sweden (Hedström 1995) and widely distributed in Europe (Merz 1996).

The best keys for the Norwegian material of this family is given by Stubbs & Chandler (2001) and by Merz (1996).

A preliminary check list for the family Piophilidae recorded from Norway. Species marked with an asterisk have been seen by the author. Species new to Norway with*.

Subfamily Neottiophilinae
1. *Actenoptera hilarella* (Zetterstedt, 1847)*
2. *Neottiophilum praeustum* (Meigen, 1826)*
   Subfamily Piophilinae
3. *Allophiophila luteata* (Haliday, 1833)*
4. *Amphipogon flavum* (Zetterstedt, 1838)*
5. *Liophila varipes* (Meigen, 1830) *
6. *Mycetaulus bipunctatus* (Fallén, 1823)* +
7. *Parapiophila coerulescens* (Zetterstedt, 1847) *
8. *Parapiophila lonchaeoides* (Zetterstedt, 1838)* +
9. *Parapiophila vulgaris* (Fallén, 1820)*
10. *Pseudoseps signata* (Fallén, 1820) * +
11. *Piophila casei* (L., 1758) *
12. *Prochyliza nigrimana* (Meigen, 1826) *
13. *Steariibia nigriceps* (Meigen, 1826)*

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The taxonomic status of *Hypnoidus consobrinus* (Mulsant & Guillebeau, 1855) and *H. rivularius* (Gyllenhal, 1827) Coleoptera, Elateridae)

Johan Andersen

Hypnoidus consobrinus and *H. rivularius* have variously been regarded as conspecific and as distinct species. In the present study, the morphology, distribution and ecology of the two forms were studied. The two forms are completely separated in the length ratio of elytra/ pronotum and nearly so in flatness of pronotum and colour, whereas there is more overlap in the other characters studied (overall length, ratio width/length and sinuation of sides of pronotum, slenderness of antennae, surface structure of elytra and form of parameres). *H. consobrinus* seems to be more stenoecious than *rivularius* and has a much more restricted distribution in Fennoscandia. It is concluded that the two forms are distinct, although closely related species. A key to the three West-European species is given.

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INTRODUCTION

Hypnoidus consobrinus (Mulsant & Guillebeau, 1855) and *H. rivularius* (Gyllenhal, 1827) have been regarded as conspecific by e. g. Holdhaus & Lindroth (1939), Stibick (1977) and Silfverberg (2004). On the other hand, Leseigneur (1972) and Freude et al. (1979) regarded *H. consobrinus* and *H. rivularius* as separate species, and according to Lucht & Klausnitzer (1998) there is no reason to synonymize the two forms. Strand (1946 a) also inclined to the opinion that the two forms are separate species. However, Strand (1946) and also Stibick (1977) had very few specimens available in their studies. During investigations in various types of habitats in Norway, I have collected a considerable material of the *Hypnoidus*

consobrinus- *rivularius* complex. This material shows that there is large individual variation in the characters that have been used to separate the two forms. To arrive at a reliable conclusion about the taxonomic status of the two forms, I therefore made morphometric measurements and tried to quantify relative characters. Since closely related species often diverge in habitat selection or chorology (Mayr & Ashlock 1991, May 1996), I have also treated possible differences in ecology and distribution of the two forms.

MATERIAL AND METHODS

The investigated material consisted of 229 specimens from **HES** Kongsvinger (60.3° N) in

Southern Norway to **FN** Vardø (70.5° N) in NE Norway. The material is deposited in the collections of Tromsø University Museum; Zoological Museum, Oslo and NINA, Trondheim. The material from my own collecting is deposited at the Department of Biology, Faculty of Science, University of Tromsø. The specimens have been picked by hand or collected in pitfall traps.

The following morphometric measurements and calculations were made: 1) Overall length; 2) The ratio a/b where a is the length from the end of scutellum to the tip of the elytron and b is the length of the pronotum along the median line (see Münster 1935); 3) The degree of flatness of pronotum given as the index c/d (Figure 1); 4) The width of pronotum given as the index e/b where e is the distance between the posterior angles of pronotum and b is as above (point 2); 5) The length/width ratio of the fourth antennal segment.

The following characters were judged according to subjective scales: I) The degree of sinuation of pronotum based on camera lucida drawings. The sinuation was divided into five categories according to a scale from 0-4 (Figure 2); II) The colour of the pro and meso femora according to the following scale: a) femora light yellow, yellowish brown or light red without notable contrast to the lightly coloured tibia; b) femora
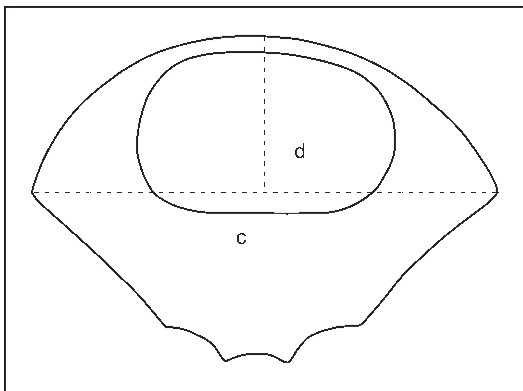
medium brown; c) femora dark brown to black, usually with evident contrast to the more lightly coloured tibia; III) The colour of the posterior angles of pronotum according to the following scale: a) angles reddish or brownish, much paler than rest of pronotum; b) angles somewhat lighter than rest of prontum; c) angles dark. The colour of the elytra and the antennae was also noted, but in spite of a high variation, I have not graded the colour according to a scale. The degree of reticulation of the elytra and the strength of the punctures in the elytral striae were noted in a number of specimens. Camera lucida drawings of the aedeagus of 56 males were also made.

The drawings of the profile of pronotum (Figure 1) were not always performed with individuals in exactly the same positions. However, checks with individual specimens indicated that the discrepancy in the index c/d amounted to no more than 3 % by drawing the pronotum in somewhat different postures from that shown in Figure 1. Measurements of the flatness of pronotum of mounted specimens were usually not performed. The degree of sinuation of the pronotum of each individual was judged independently three times. This showed that neighbouring categories (0-1, 1-2, etc.) could not always be safely distinguished, but this was the case with the more distant ones (0-2, 2-4, etc).

Differences between means were tested using z-tests (> 30 observations in each sample) or two-tailed t-tests (< 30 observations in at least one sample). Differences in the distribution of the various categories of sinuation and of the colour of the femora were tested by means of chi-square tests. The correlations between length, a/b, c/d and e/b for each group (A and B, see results) were tested by means of simple linear regression analyses.

Figure 1. Front view of pronotum of a specimen of Group A *(H. rivularius)* showing the measures used to calculate flatness. In this figure the value of the index c/d is 3.0.

RESULTS

Morphology

The calculated index of a/b gave two distinct groups without overlap (Table 1). Group B had

Table 1. Morphometric measurements of group A *(H. rivularius)* and B *(H. consobrinus)*. Several of the length-measured specimens were not sex determined. a: length from end of scutellum to tip of elytra; b: length of pronotum along median line; e: distance between posterior angles of pronotum; SD: standard deviation; ***: $p < 0.001$; **: $p < 0.01$. For explanation of symbols c and d, see Figure 1.

| | Group A | | | Group B | | | t-test or |
	Mean ± SD	Range	N	Mean ± SD	Range	N	z-test
Length (mm)							
Females	5.4 ±0.43	4.7-6.2	46	6.3 ±0.57	5.5-7.3	21	***
Males	5.1 ±0.41	4.1-5.9	45	5.9 ±0.28	5.1-6.6	17	***
Total	5.4 ±0.42	4.1-6.2	129	6.2 ±0.51	5.1-7.3	44	***
Ratios							
a/b	2.13±0.08	1.90-2.28	165	2.48±0.08	2.35-2.65	44	***
c/d	3.17±0.20	2.70-3.50	54	3.75±0.20	3.43-4.10	35	***
e/b	1.17±0.04	1.07-1.29	58	1.28±0.07	1.24-1.37	26	***
Length/width							
4. ant. segm.	2.0±0.11	1.7-2.1	12	2.2±0.20	1.7-2.4	14	**

much longer elytra relative to the pronotum than group A. These two groups were therefore used as a basis for the further treatment of the material. Flatness of pronotum (c/d) was hardly overlapping between the two groups. Group B had significantly flatter pronotum than group A (Table 1, Figure 3). There was no indication of a correlation between flatness and the index a/b within each of the two groups ($r \le 0.142$, $p > 0.05$). The specimens of group B were significantly longer than those of group A. However, there was a positive correlation between length and c/d within group B ($r = 0.603$, $p < 0.001$) and between length and a/b within group A ($r = 0.384$, $p < 0.05$). Thus, there seems to be some interrelation between total length and the form of pronotum within the two groups. No significant correlations could be found between the other characters of each group ($p > 0.05$). Individuals of group B generally had more slender fourth antennal segment than those of group A, but there was a high degree of overlap between the groups regarding this character.

There was considerable overlap in the sinuation of pronotum between the two groups (Figure 2, 4a). Nevertheless, specimens with almost straight sides of pronotum (categories 0-1) nearly always belonged to group A, whereas few specimens of this group had very sinuated sides. Group B, on the contrary, was dominated by individuals with well developed sinuation (categories 3-4, Figure 2, 4a). However, individuals of group A from Southern Norway generally had more sinuated sides of pronotum than those from Northern Norway ($\chi^2 = 5.28$, $p < 0.05$) although the sinuation of the pronotum of group B was still more prominent than in specimens of group A from Southern Norway ($\chi^2 = 15.1$, $p < 0.001$). Group A and B were well separated by colour. Most individuals of group A had yellow to lightly brown or red femora and more or less pale posterior angles of pronotum, whereas individuals of group B had rather dark brown to black femora and almost or completely dark hind angles of pronotum (Figure 4b). However, specimens of group A from Southern Norway were generally darker than those from Northern Norway and the difference in the colour of the femora of the individuals from the two geographical areas was significant ($\chi^2 = 33.6$, $p < 0.001$). Generally, the colour of the elytra correlated with that of the posterior angles of pronotum; group A had more or less brownish elytra, especially posterior and laterally, whereas group B mainly had individuals
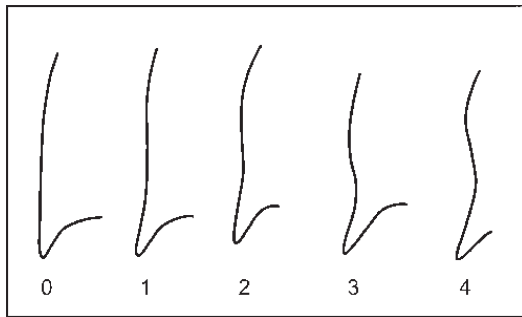
Figure 2. The five different categories into which the degree of sinuation of the sides of pronotum was divided. The drawings show the left side of pronotum. Categories 0-2 are individuals of group A *(H. rivularius),* 3 and 4 specimens of group B *(H. consobrinus).*

Figure 3. The relationship between the index length elytra/pronotum (a/b) and the flatness of pronotum (c/d). Open circles: group A *(H. rivularius),* filled circles: group B *(H. consobrinus).*

with dark elytra.

The lustre of the anterior part of the elytra varied much from very shiny without reticulation to rather dull due to a developed reticulation. This feature, however, varied across groups although strong reticulation was more common in group A and shiny elytra more common in group B. The coarseness of the punctures in the elytral striae varied in individuals of both groups and after having examined a couple of specimens, I found it worthless to study this character further.

Generally, the apex of the parameres of group A was rounded and less widened than in group B. The parameres of group B were more or less angulate and often with a marked tooth on the outer side. The apex of the inner side was also generally more angulate than in group A. However, there was variation in this pattern within both groups (Figure 5), and some individuals could hardly be classified based on the shape of the parameres alone.

Specimens of group A and B occurred sympatrically at four places. The classification of the individuals into groups was not more difficult in these cases than elsewhere. Beside a large difference in the index a/b (1.93- 2.21 for
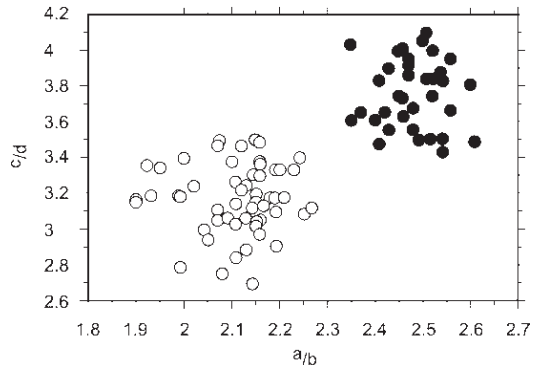
group A and 2.42- 2.61 for group B) individuals of the two groups deviated in at least two other independent characters such as the flatness or sinuation of pronotum and/or by colour.

Distribution and ecology

The specimens of group B were collected in the following localities: **STI** Midtre Gauldal: Kotsøy; Melhus: South of Baggøya and Volløya; **NSI** Saltdal: Bleiknes, Borkenes and Brenne; **TRI** Balsfjord: Fjellfrøsvatn; Målselv: Rundhaug, Nymoen, Lilleng, Øverbygd and Holt; Storfjord: Lullesletta; Nordreisa: Sappen; **TRY** Tromsø: Breivikeidet, two localites; **FV** Alta: Elvestrand and Bossekop. All these finds were made by the author except those from Sappen (leg. A Strand) and Bossekop (leg. T. Münster). The material of group A originated from most of the provinces in Northern Norway: **NSY**, **NSI**, **NNV**, **TRY**, **TRI**, **FV**, **FN**, **FØ** and from the following provinces in Southern Norway: **HES**, **BØ**, **BV**, **OS**, **ON, STI**. The material was collected by several persons, including myself.

All my finds of the individuals of group B are from the lowland in the southern and middle boreal zone. Most of the localities are situated in large valleys, only two of them in smaller ones. In 7 of 15 cases the finds were made on
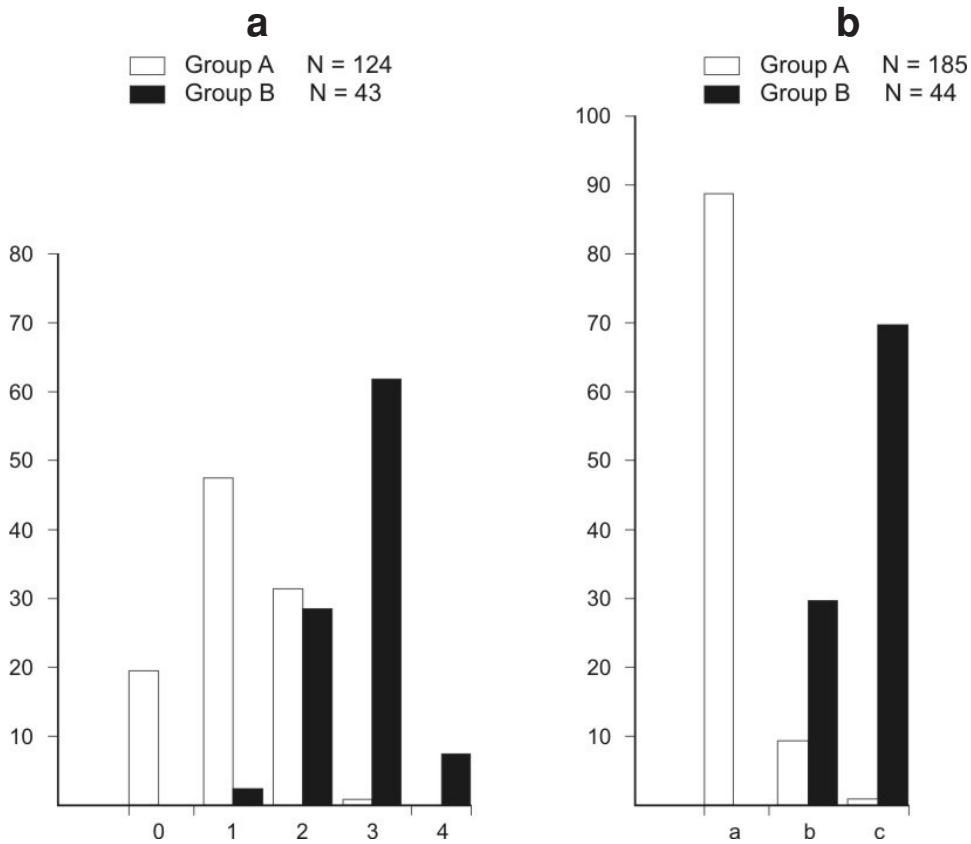
Figure 4. a. Percentage distribution of group A *(H. rivularius)* and B *(H. consobrinus)* regarding the degree of sinuation of the sides of pronotum (see Figure 2). b. Percentage distribution of group A *(H. rivularius)* and B *(H. consobrinus)* regarding the colour of the front and mid femora. Category a: femora light; b: femora somewhat infuscated; c: femora dark brown or black.

river banks, the other ones in anthropogenic habitats (fallow land, arable land), but rather close to rivers (< 150 m); only in one case the distance was more than 150 m. On river banks most of the specimens were collected in the driest and most elevated parts which had a sparse vegetation consisting of e. g. *Rumex acetosella*, *Lychnis alpina*, *Astragalus alpinus*, *Lotus corniculatus*, *Campanula rotundifolia,* *Achillea millefolium* and *Festuca ovina*. At some of the localities the staphylinid beetle *Aleochara suffusa* (Casey, 1906) was present. The finds in anthropogenic habitats were made in open, more or less dry sites with a sparse vegetation of e. g. *Rumex acetosella*, *Achillea millefolium*, *Solidago*

virgaurea, *Festuca ovina, Agrostis capillaris* and *Deschampsia flexuosa*. The xerophilous carabid beetle *Amara quenseli* (Schönherr, 1806) occurred in most of these anthropogenic habitats. At two localities the individuals were collected in mesic sites with a vegetation consisting of *Equisetum arvense*, *Trifolium repens*, *Potentilla anserina*, *Leontodon autumnalis* and *Achillea millefolium*. The group B- specimens were always found in open habitats. The sites had soils with a very low organic content. The texture of the soil varied from pure sand, heterogeneous, gravel-mixed sand to silt or pure clay.
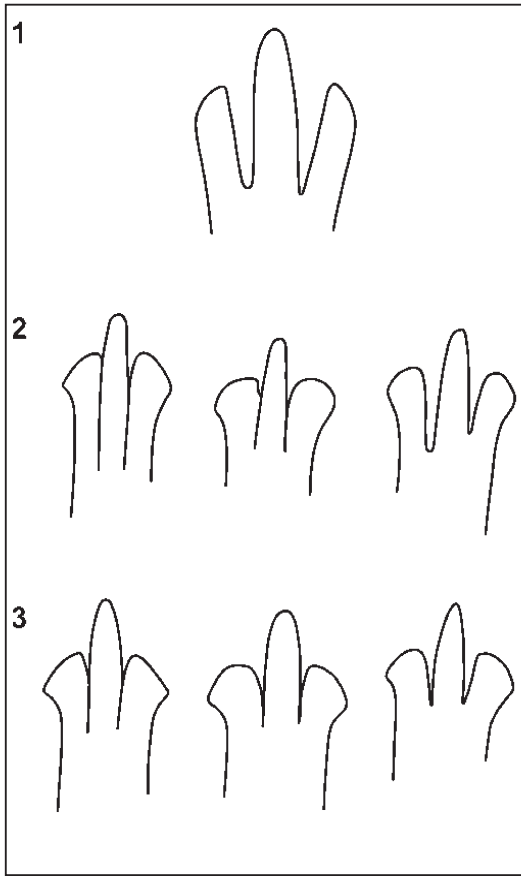
Figure 5. Aedeagus of: 1: *H. riparius;* 2: group A *(H. rivularius);* 3: group B *(H. consobrinus).*

Five of the 38 localities where individuals of group A were found are situated on river banks. A majority of the localities are situated outside valleys and several of them on islands off the coast of Troms and Finnmark. Five of the localities are located in the alpine zone. The specimens of group B occurred in nearly all types of open habitats e. g. on river banks, fallow land, arable land, sand pits, meadows, but also in rather dry birch forest. The soil type varied much; soil with a low organic content and little vegetation and a varying texture, grassland soil with dense vegetation and podsol soil with a dense litter layer. The individuals occurred on wet as well as on rather dry soil.

DISCUSSION AND CONCLUSION

From the descriptions of Münster (1935) and Freude et al. (1979) it is obvious that the specimens of group A belong to *H. rivularius*. Münster (1935) gave values for the index a/b where a and b were measured in the same way as in the present study. Münster (1935) got mean values of 2.13 for males and 2.15 for females (range 1.89 to 2.28) of *H. rivularius*. These values are nearly identical with those of group A (Table 1). The morphometric indices given in Freude et al. (1979) indicate that the specimens of group B belong to *H. consobrinus*. Likewise, five specimens that A. Strand had determined to *H. consobrinus*, belong to group B. However, *H. consobrinus* and *H. rivularius* are more variable than what appears from the descriptions of Strand (1946 a) and Freude et al. (1979). The question is whether the two forms really are different species or only represent one very variable species. This is discussed in the following.

Based on the study of six claimed specimens of *H. consobrinus,* Stibick (1977) regarded this form as conspecific with *H. rivularius*. However, in a table including both these forms, he gave no values for length, colour and the a/b index and other characters were treated as all or none like the flatness of pronotum which he grouped in flat or convex. In fact, the present study reveals that the two taxa are completely separated by the index a/b. Furthermore, the % overlap regarding flatness of pronotum is small. The indices a/b and probably also c/d do not seem to vary much within the geographical range of the two forms. Thus, in his study of *H. rivularius*, Münster (1935) also included individuals from Siberia and Mongolia besides specimens from Norway. Münster (1935) also studied some specimens of *H. frigidus* Kiesenwetter, 1863 from the mountains of Central Europe. Although he got low a/b values for this form, the range (1.87-2.08) is situated within that of *rivularius* and he and Stibick (1977) regarded *H. rivularius* and *H. frigidus* as conspecific, which certainly is correct. The colour, on the other hand, seems to vary within the geographical range of *H. rivularius*.
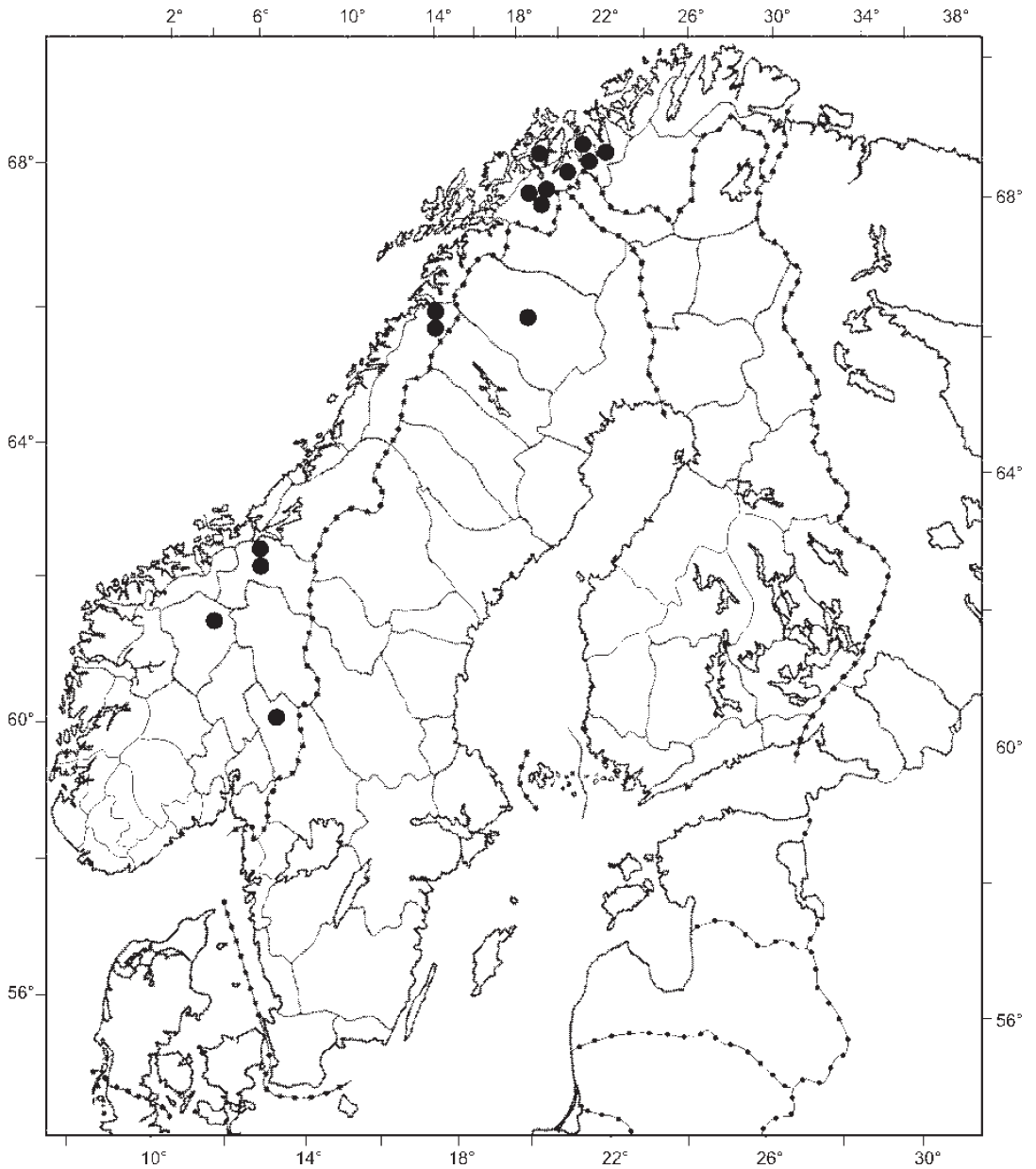
Figure 6. Distribution of *Hypnoidus consobrinus* in Fennoscandia. Specific localities are localities are given for Northern Norway, whereas only provinces are given for the rest of Scandinavia. The map is based on Strand (1946b), Lindroth (1960), Fjellberg (1972), Gustafsson (2004) and my own records.

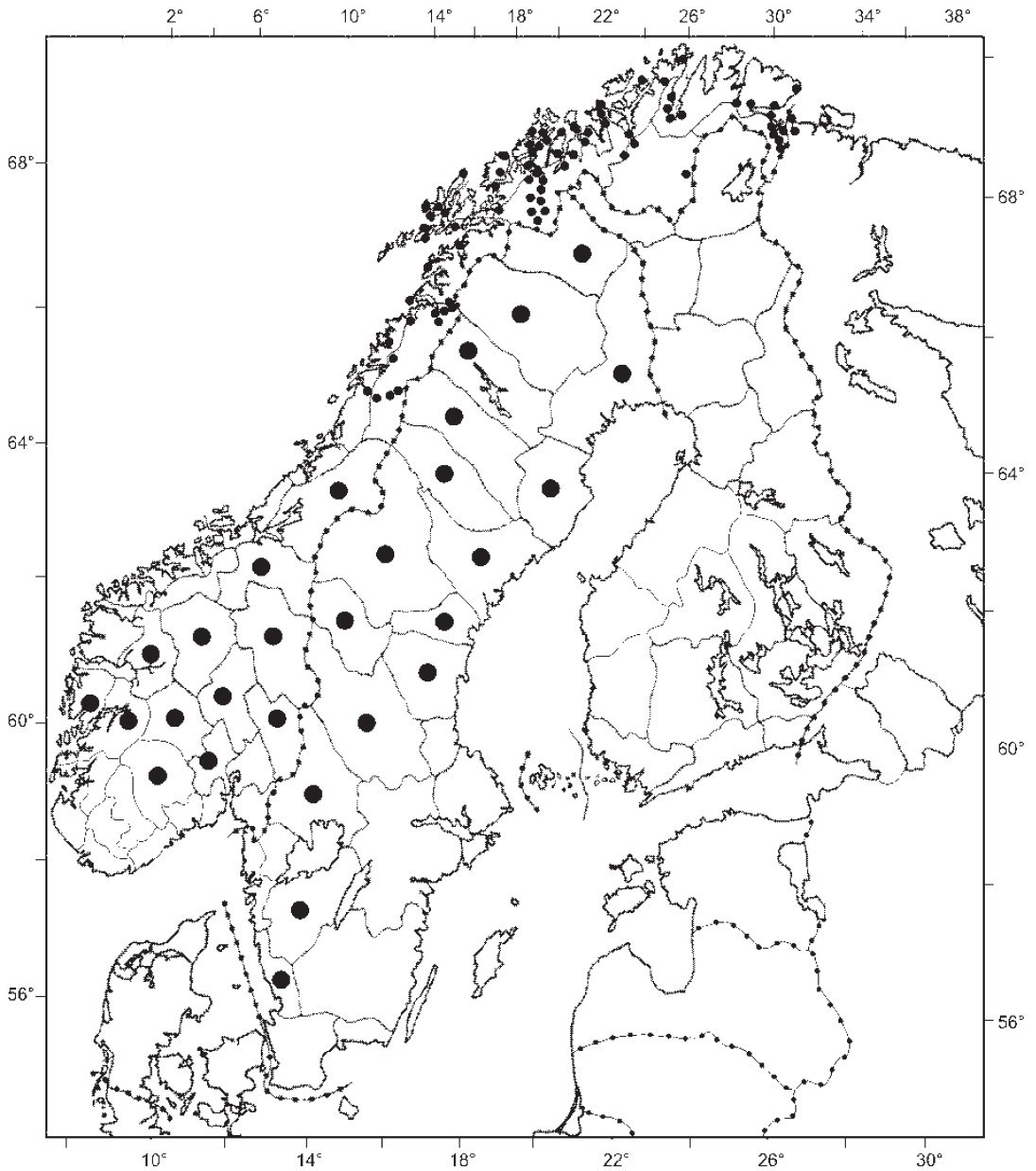**Figure 7.** The distribution of Hypnoidus rivularius in Scandinavia. Specific localities are given for Northern Norway, whereas only provinces are given for the rest of Scandinavia. The map is based om Strand (1946b), Lindroth (1960), Fjellberg (1972), Fustafsson (2004) and my own records.

Münster (1935) mentioned that specimens from Siberia and Mongolia have the same colour as those from Norway, but the form *frigidus* is darker. The present investigation indicates that there also is colour variation of *H. rivularius* in Norway; individuals from the southern part of the country are generally darker than those from the northern part. *H. rivularius* is nearly always paler than *H. consobrinus* in Northern Norway.

There is considerable variation in size and in the sinuation of pronotum of *H. rivularius* and *H. consobrinus*. Nevertheless, they constitute two rather well separated groups also in these characters (Table 1, Figure 4a). Size is, however, partly correlated with form within each group. Regarding size, it may be relevant to focus on intraspecific variation. Andersen & Nilssen (1983) found that the intraspecific size variation (index largest/smallest individuals) of free-living species (not living within plants) was below 1.4 except for some groups with a very special mode of life. Based on data in Freude et al. (1979), I have calculated that the mean intraspecific size variation of free-living species of Elateridae is 1.3. If the individuals of *consobrinus* and *rivularius* are pooled, the size variation amounts to 1.8, i.e. a much higher size variation than what is usual among other free-living beetle species. If they are treated separately, however, the two groups get values that are fairly in concordance with what is common among free-living species (1.5 for group A, 1.4 for group B).

The shape of the parameres of *consobrinus* and *rivularius* varies much and there are transitional forms that hardly are separable on this character alone (Figure 5). Differences in the structure or shape of the aedeagus of insects have often been used as conclusive evidence of species specificity (Claridge et al. 1997). However, among sibling species of certain taxa of beetles including Elateridae, such differences may be small or absent (Lindroth 1963, Freude et al.1979, Johnson & Lundberg 1977, Nilsson 1990). Thus, I find that the obscure difference between the two forms of *Hypnoidus* regarding the shape of the parameres hardly is of decisive importance for

their taxonomic status. At the localities where the two forms occurred sympatrically, they seemed to be equally well separated as elsewhere. Thus, there is no indication of hybridization.

Both *H. consobrinus* and *H. rivularius* have boreoalpine distributions (Freude et al. 1979), but their distributions in Fennoscandia are quite different. *H. rivularius* has a wide distribution in Fennoscandia. It mainly occurs in the mountains in Southern Norway (Münster 1935, Fjellberg 1972), whereas the form is found almost everywhere in Northern Norway, from sea level to above or north of the timber line and from the outermost islands to the most continental parts (Figure 7). Contrary to this, *H. consobrinus* seems to have a distribution restricted to the fjord districts (N Norway) and the valleys of the inland (Figure 6), and it has exclusively been encountered in the lowland. In Sweden, *H. consobrinus* is known from a single province in the northernmost part (Lule lappmark) (Gustafsson 2004), but it has not been discovered in the other countries adjacent to Norway and Sweden.

H. rivularius occurs in open habitats as well as in forests and in sites with very different soil and moisture conditions. *H. consobrius,* on the other hand, occurs in open xeric or mesic sites on river banks and in anthropogenic habitats with mineral soil, mostly close to rivers. The species has been collected in pitfall traps in fluvial forests (Bergan et al. 2001), but it is possible that this occurrence was associated with a habitat shift in connection with hibernation (O. Hanssen, pers. comm.). The description of the habitat of *H. consobrinus* given here, deviates from that in Central Europe, where the species occurs in alpine meadows (Freude et al. 1979). *H. consobrinus* is probably primarily riparian in Scandinavia (Andersen & Hanssen 1994). The species is rather rare and it is red-listed in Norway (Direktoratet for naturforvaltning 1999).

The genus *Hypnoidus* is in need of a revision. This is because of a great variation of some of

the species, e.g. *H. rivularius* and *H. consobrinus* and that the description of some of the species is based on single specimens (Stibick 1977). Mitochondrial DNA analysis is playing an increasing role in taxonomical studies (Winston 1999) and the method ought to be used in future studies of the genus.

To summarize, the two forms differ in several features such as morphology (especially in the index a/b), colour, distribution and ecology, and there is no evidence of hybridization in sympatric populations. In accordance with Strand (1946a), Leseigneur (1972) and Freude et al. (1979) I therefore conclude that *H. consobrinus* and *H. rivularius* are distinct, although very closely related, species.

Key to the Fennoscandian species of Hypnoidus

A key to the three Fennoscandian species of *Hypnoidus* is presented below. The characters used to separate *H. riparius* (Fabricius, 1792) from the two other species are based on Münster (1935), Freude et al. (1979) and my own studies of 70 specimens of the species. Morphometric measurements of 39 of these specimens were made and the aedeagus of 14 males was drawn.

1. Pronotum with a strong, longitudinal microsculpture often giving a dull, fatty shine, very rarely with faint microsculpture, punctuation scattered. Elytral striae without punctures. Body stout; index width/length of pronotum: 1.28-1.40. Elytra moderately long; ratio of length of elytra/pronotum: 2.23-2.50. Length 5.7-7.3 mm. Apex of outer side of parameres completely rounded, inner side of apex angulate (Figure 5a). ………*H. riparius*

- Pronotum without or with obsolete microsculpture, punctuation denser. Punctures in elytral striae usually evident, but sometimes almost absent. Body more slender. Outer side of parameres widened towards apex, more or less angulate (Figure 5b,c)…..………..… 2

2. Elytra short; ratio of length of elytra/pronotum: 1.9- 2.28. Pronotum longer and more convex;

index width/length: 1.07- 1.29; index width/ height (see Figure 1): 2.70- 3.50. Sides of pronotum often less sinuate (Figure 2). Femora and/or angles of pronotum usually yellow, light brown or reddish. Elytra usually brownish, at least posteriorly and laterally. Specimens from S Norway often darker. Smaller (males 4.1- 5.9 mm; females : 4.7- 6.2 mm). Aedeagus (Figure 5b). ....*H. rivularius*

- Elytra always appreciably longer; ratio of length of elytra/pronotum: 2.35-2.65. Pronotum broader and flatter; index width/length: 1.24- 1.37; index width/ height: 3.43-4.10. Sides of pronotum more or less sinuate (Figure 2). Femora nearly always dark brown or black, angles of pronotum usually equally dark as the rest of forebody. Elytra dark or somewhat lighter posteriorly and laterally. Larger (males: 5.1- 6.6 mm; females: 5.5- 7.3 mm). Aedeagus (Figure 5c)….*H. consobrinus*

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Gamasina and Microgyniina (Acari, Gamasida) from soil and tree hollows at two traditional farms in Sogn og Fjordane, Norway.

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Slomian S., Gulvik M.E., Madej G. & Austad, I. 2005. Gamasina and Microgyniina (Acari, Gamasida) from soil and tree hollows at two traditional farms in Sogn og Fjordane, Norway. Norw. J. Entomol. 52, 39-48.

Gamasina and Microgyniina (Gamasida) from wooded meadows and wooded pastures in Sogn og Fjordane, Western Norway were investigated. Samples were taken from two different microhabitats: tree hollows in *Fraxinus excelsior* and *Ulmus glabra*, and from soil close to the trees. The mean density of Gamasida adults in soil was 9 106 ind. m⁻² at Grinde and 2 489 ind. m⁻² at Kusslid. The mean density in material from tree hollows was 641.7 ind. kg⁻¹ at Grinde and 67.8 ind. kg⁻¹ at Kusslid. Thirty-four species were recorded from the soil samples collected under the trees (26 species at Grinde and 13 at Kusslid), and 42 species from rotten wood in tree hollows (38 species at Grinde and 12 at Kusslid). Twenty species were found in both microhabitats, 22 species occurred only in tree hollows and 14 species only in the soil. The relatively small number of samples in this preliminary survey revealed high species diversity of gamasid mites. The presence of pollarded trees appears to enrich the gamasid fauna of old cultural landscapes. In all, 57 species (54 Gamasina and 2 Microgyniina) from 13 families were identified. Of these, 36 species were recorded from Norway for the first time.

Key words: Gamasina, Microgyniina, wooded meadows, pastures, tree hollows, soil

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INTRODUCTION

During the last 10-20 years, intensive studies of soil biota have been carried out in a number of countries to survey the bioindicative value of the fauna and to develop a system of soil quality classification based on biological criteria (Paoletti & Bressan 1996, Paoletti et al. 1991, Ruf et al. 2003). For example, the Dutch government has established a multidisciplinary research programme to develop a biological indicator for soil quality (BISQ) (Brussaard et al. 1988) as part of its efforts to follow up the Convention on Biological Diversity. Worldwide, most of this research focuses on soil ecology in agro-ecosystems. Intensive agriculture has negative effects on soil through chemical and mechanical disturbance, which influences both biotic and abiotic components (Stinner & House 1990, Werner & Dindal 1990, Crossley et al. 1992). In contrast to conventional cultivation, 'alternative' agricultural systems (such as manure-based organic, legume-based organic, no-tillage farming and ecological farming) promote the formation of organic matter, and maintain soil conditions and biodiversity (Paoletti 1988, Favretto et al. 1992, Fernandez et al. 1997, Koehler 1997).

Gamasina may be used as bioindicators of changes in soil properties and of the impact of

human activities on the environment. The less environmentally disturbed a soil is, the higher its 'Maturity Index' (Ruf 1998). The 'Maturity Index' is calculated by ranking mesostigmatid mite taxa according to their life-history traits on an *r/K*-scale, which expresses the ratio of species in a community with predominantly *K* attributes (persisters) to those with more *r* attributes (colonizers). Most Gamasina are mobile, predatory mites. The larger, surface-dwelling gamasid mites attack other arthropods. Smaller deep-litter and soil forms are predominantly nematophagous and are the most important predators of nematodes in many habitats. Phytoseiidae and Macrochelidae play an important role in both natural and applied biological control of nematodes and micro-arthropods (Mori & Chant 1966, Krantz 1998.). In open landscapes, such as undisturbed meadows, they can reach a density of 10 000 m^{-2} (Koehler 1997).

The earliest information on Norwegian gamasid mites was published by Andersen (1863) and Berlese (1904, 1906, 1920). Since then, relatively few papers have been published (Oudemans 1927, Edler & Mehl 1972, Haagvar 1978). In a checklist of Norwegian Acari based on the literature data, Mehl (1979) listed 90 species of Gamasina (with Phytoseiidae). Microgyniina were not mentioned in any of the papers. Phytoseiids are best known for their role in biological control. During the last twenty years, there has been a great increase in the number of described species of the Phytoseiidae in Norway (Edland 1987, 1994, Karg & Edland 1987, Edland & Evans 1998, Evans & Edland 1998, Denmark & Edland 2002). Lundqvist et al. (2000) presented three species of Gamasina that were found in Norwegian caves. According to Mehl (1998) three species have been recorded from Norwegian agricultural environments: *Androlaelaps casalis, Haemogamasus pontiger* and *Dermanyssus gallinae*.

The present paper contains the results of preliminary studies of Gamasina and Microgyniina mites inhabiting soil and tree hollows on traditional farms that have been continuously managed for many generations. The tree hollows represent specific microhabitat and create specific condition for mites.

SITE DESCRIPTION

The investigations were carried out at two traditional farms. The Grinde farm is situated at Leikanger municipality (EIS 50) and the Kusslid farm at Førde municipality (EIS 49), both in Sogn og Fjordane. Traditional farms like these are rare in Norway today (Austad 1988, Nordrehaug et al. 1999). The study sites were situated in an abandoned meadow with a tree canopy and in a wooded pasture, both of which had been used as hay meadows for several hundred years earlier in their history. There are scattered old pollards at both sites. Traditional management was restricted to grazing in spring and autumn, annual scything, and pollarding in a four to six-year cycle. The trees forming the tree canopy are some old *Fraxinus excelsior* Linnaeus that have been dated to the early 1800s, and *Ulmus glabra* Hudson, dated to the 1700s. The study site at Grinde was classified as intermediate, nutrient-rich 'old' meadow and the study site at Kusslid as tufted hair-grass grassland (*Deschampsia caespitosa* grassland) (the classification of vegetation types follows Fremstad (1998)). The farms have been investigated by Austad (1988), Austad & Losvik (1998), Norderhaug et al. (1999) and Austad et al. (2003), and these publications provide more information on the flora, management and history of the sites.

METHODS AND MATERIAL

Material for extraction was collected on 16–19 October 2001 from the following microhabitats: a) hollows in pollarded trees, and b) soil and the corresponding surface layer (combined vegetation/litter/soil strata). The material was collected by M. E. Gulvik.

A total of 19 qualitative samples of rotten wood at different stages of decay, together with

accumulated plant material, were taken in tree hollows. Four samples were taken from *U. glabra* at Kusslid, and 15 from *U. glabra* and *F. excelsior* at Grinde. Some of the trees at Grinde were in a restored traditional hay meadow and some at the edge of an old wooded hay meadow where traditional use was discontinued in 1975-1980. This meadow has gradually become overgrown. The trees at Kusslid were situated in a wooded pasture (previously a hay meadow, but mowing and pollarding have been discontinued). Most of the hollows in the pollarded trees were small and round (13-35 cm in diameter). Six samples were taken from hollows at the base of trees, and 13 samples from hollows about 1 - 1.5 m above ground. It was impossible to take samples of a specific area inside tree hollows, and density was therefore determined as the mean abundance per 1000 g dry weight of decaying wood (following the extraction of microarthropods, the samples were oven-dried at 45 ^{o}C for 48 h). The mean dry weight of the samples was 91.2g (min 27.38 g, max 163.19 g).

At the same time, 11 quantitative soil samples (cores 22 cm^2, depth 5 cm) were collected near the trees (0.5–4 m from the trunk), eight cores at Grinde and three cores at Kusslid. For soil samples, mean density m^{-2} was calculated. Gamasida of the families Microgyniidae, Zerconidae, Parasitidae, Macrochelidae, Eviphididae, Ascidae, Laelapidae, Veigaiaidae, Rhodacaridae, Pachylaelapidae, Digamasellidae and Ameroseiidae were determined to species level. The list of species follows the taxonomy of Blaszak & Madej (1997). Uropodina were excluded from the analysis.

The soil mesofauna was extracted from the samples with a modified Tullgren funnel for six days, at a temperature of up to 40-45 ^{o}C (measured above the samples) and 10-15 ^{o}C lower in the collecting vessels. The specimens were collected in beakers of 75 % ethanol, and then fixed on permanent slides in Faure – Berlese liquid. Adult Gamasida were identified to species level.

In total, 1 124 specimens (942 adults, 748 from rotten wood and 194 from soil) and 182 juveniles were collected.

RESULTS

The mean density of Gamasida in soil was was 9 106 ind. m^{-2} at Grinde and 2 489 ind. m^{-2} at Kusslid. A total 54 species of Gamasina and 2 species of Microgyniina were identified. Thirty-four species were recorded from the soil samples collected under the trees (26 species at Grinde and 13 at Kusslid), and 42 species from rotten wood in tree hollows (38 species at Grinde and 12 at Kusslid). Twenty species were found in both microhabitats, 22 species occurred only in tree hollows, and 14 species only in soil. Table 1 contains a list of the mite species collected at the Grinde and Kusslid farms in Sogn og Fjordane. Species new to the fauna of Norway (37 species) are marked with an asterisk (*).

Some of the species recorded seemed to be associated with a particular microhabitat. The dominant species in soil, *Leptogamasus suecicus* (1 527 ind. m^{-2}, 16.8 % of all soil Gamasida at Grinde), *Paragamasus (Anidogamasus) cambriensis* (1 244 ind. m^{-2}, 13.7 % of all soil Gamasida at Grinde), *P. (Anidogamasus) lapponicus* (1 414 ind. m^{-2}, 15.5 % of all soil Gamasida at Grinde) and *Pachylaelaps humeralis* (961 ind. m^{-2}, 10.6% of all soil Gamasida at Grinde), all showed low dominance in tree hollows. The dominant species in rotten wood, *Microgynium rectangulatum, Proctolaelaps pygmaeus*, *Dendrolaelaps (Cornodendrolaelaps) cornutulus* and *Ameroseius furcatus* (14.9 %, 27.3 %, 11.8 %, 28.2 % of all specimens in rotten wood at Grinde, respectively) were not found in soil. These species are closely connected with dead wood. All representatives of the Microgyniina, Digamasellidae, *Hirstionyssus*, *Gamasellus*, *Ameroseius* and *Amblyseius* were found in tree hollows only. Species belonging to the genus *Hypoaspis* occurred mostly in rotten wood. The Parasitidae were the least selective taxon, and almost all species were found both in soil and in tree hollows. Four species found in the

Table 1. Occurrence and densities of Gamasida species (adults) found in microhabitats at the farms investigated. Species new to Norway are marked with an asterisk*. TH: Tree hollows, mean no. of adults per 1000 g dry weight, S: Soil, mean no. of adults m^{-2}, G: Grinde farm, K: Kusslid farm.

Species	TH [kg^{-1}]		S [m^{-2}]	
MICROGYNIINA	G	K	G	K
Microgyniidae				
Microgynium rectangulatum Trägardh, 1942	95.6	0	0	0
Microsejus truncicola Trägardh, 1942	2.7	0	0	0
GAMASINA				
Zerconidae				
Prozercon kochi Sellnick, 1943	0	0	56.6	0
P. traegardhi (Halbert, 1923)	4.6	0	0	0
Zercon baloghi Sellnick, 1958	0	0	56.6	0
Z. curiosus Trägardh, 1910	8.2	6.3	0	0
Z. triangularis C. L. Koch, 1836	0	1.6	0	0
Parasitidae				
Parasitinae				
Vulgarogamasus kraepelini (Berlese, 1904)	3.6	0	113.1	75.4
V. oudemansi (Berlese, 1904)	2.7	0	0	0
Pergamasinae				
Amblygamasus dentipes (C. L. Koch, 1835)	0	0	452.5	0
A. hamatus (C. L. Koch, 1839)	0	0	56.6	0
Holoparasitus calcaratus (C. L. Koch, 1839) S. Hyatt, 1987	2.7	4.7	113.1	0
Leptogamasus suecicus Trägardh, 1936	0.9	3.2	1527.1	0
Paragamasus (Aclerogamasus) alpestris Berlese, 1904)	3.6	0	226.2	0
P. (Anidogamasus) cambriensis Bhattacharyya, 1963	0.9	0	1244.3	0
P. (Anidogamasus) celticus Bhattacharyya, 1963	0.9	3.2	0	452.5
P. (Aclerogamasus) insertus (Micherdziński, 1969)	10.9	6.3	56.6	0
P. (Anidogamasus) lapponicus (Trägardh, 1910)	0.9	6.3	1414	150.8
P. (Anidogamasus) runcatellus (Berlese, 1904)	0.9	0	509	150.8
P. (Anidogamasus) vagabundus (Karg, 1968) s. Karg, 1971	0	12.6	0	603.3
Pergamasus (Pergamasus) crassipes (Linne, 1758) s. Micherdzinski, 1969	1.8	0	56.6	0
P. (Thenargamasus) septentrionalis (Oudemans, 1902)	0.9	0	509	0
Macrochelidae				
Geholaspis (Geholaspis) longispinosus (Kramer, 1876)	0.9	0	0	75.4
G. (Longicheles) mandibularis (Berlese, 1904)	0	0	395.9	75.4
Eviphididae				
Eviphis ostrinus (C. L. Koch, 1836)	0	0	395.9	75.4
Ascidae				
Gamasellodes bicolor (Berlese, 1918)	0	0	56.6	0

Tabel 1. (continued)

Species	TH [kg⁻¹]		S [m⁻²]	
Lasioseius ometes (Oudemans, 1903)	0.9	0	0	0
Lasioseius muricatus (C. L.Koch, 1839)	2.7	0	0	75.4
Proctolaelaps pygmaeus (Müller, 1860) s. Karg, 1971	175.7	0	0	0
Arctoseius semiscissus (Berlese, 1892)	0.9	0	0	0
Cheiroseius (Cheiroseius) borealis (Berlese, 1904)	0	0	56.6	0
Laelapidae				
Hirstionyssinae				
Hirstionyssus soricis (Turk, 1945) s. Evans et Till, 1966	0.9	0	0	0
Laelapinae				
Androlaelaps casalis (Berlese, 1887) s. Till, 1963	5.5	0	0	0
Hypoaspis (Geolaelaps) aculeifer (Canestrini, 1883)	0	7.9	0	75.4
H. (Geolaelaps) brevipilis Hirschmann, 1969	21.8	11.0	0	0
H. (Geolaelaps) helianthi Samšinak, 1958	2.7	0	0	0
Hypoaspis (Alloparasitus) oblonga (Halbert, 1915) s. Karg, 1971	0.9	1.6	0	0
H. (Alloparasitus) sardoa (Berlese, 1911)	4.6	0	0	0
Hypoaspis sp.	10.0	0	226.2	0
Veigaiaidae				
Veigaia cervus (Kramer, 1876)	0	0	56.6	0
V. decurtata Athias-Henriot,1961	0.9	0	169.7	0
V. exigua (Berlese, 1916)	0	0	0	150.8
V. kochi (Trägardh, 1901)	0.9	0	56.6	0
V. nemorensis (C. L. Koch, 1839)	0	0	0	75.4
Rhodacaridae				
Ologamasinae				
Gamasellus montanus (Wilmann, 1936)	0	3.2	0	0
Rhodacarellinae				
Rhodacarellus epigynalis Sheals, 1956	0	0	56.6	0
R. kreuzi Karg, 1965	0.9	0	0	226.2
Pachylaelapidae				
Pachylaelaps (Pachylaelaps) furcifer Oudemans, 1903	0	0	113.1	0
P. (Pachyseius) humeralis Berlese, 1910	1.8	0	961.5	0
P. (Pachylaelaps) karawaiewi Berlese, 1920	0.9	0	0	0
P. (Pachylaelaps) laeuchlii Schweizer, 1922	0	0	452.5	0
Digamasellidae				
Dendrolaelaps (Cornodendrolaelaps) cornutulus Hirschmann, 1960	75.5	0	0	0
D. (Dendrolaelaps) nostricornutus Hirschmann et Wiśniewski, 1982	0.9	0	0	0
D. (Punctodendrolaelaps) punctatus Hirschmann, 1960	1.8	0	0	0
Ameroseiidae				
Ameroseius furcatus Karg, 1971	181.1	0	0	0
Phytoseiidae				
Amblyseius sp.	7.3	0	0	0

samples from tree hollows were extremely contagiously dispersed: *P. pygmaeus* (192 of 193 specimens were in one sample, dry weight 57.18 g), *Ameroseius furcatus* (194 of 199 specimens were in the same sample as *P. pygmaeus*), *M. rectangulatum* (103 of 105 specimens were in one sample, dry weight 49.54 g), *Dendrolaelaps cornutulus* (70 of 83 specimens were in the same sample as *M. rectangulatum*).

DISCUSSION

If elements of the soil fauna are to be used as bioindicators of habitat change and for effective management and conservation of terrestrial ecosystems, it is essential to have basic information on the density, diversity, and distribution of the fauna (Paoletti & Bressan 1996, Behan-Pelletier 1999). Policy goals can be formulated on the basis of deviation from a chosen reference habitats. Arable land converted to 'alternative' agro-ecosystems, ungrazed grassland, secondary succession following cultivation and forests have all been investigated and used as reference sites for comparison with conventional farmland (Paoletti1988, Perdue & Crossley Jr. 1990, Werner & Dindal 1990, Vreeken-buijs et al. 1994, 1998, Scheu & Schulz 1996).

The mite community at a particular site can be characterised using the 'Maturity Index' (Ruf 1998). The expected faunal community is predicted using known preferences or threshold values for each taxon. Comparative norms for the taxa used as bioindicators in different ecosystems can be by analysing published species lists from unperturbed sites that are suitable reference areas. Knowledge of the soil microarthropods fauna of old, traditionally run farms, which can be used as reference areas, will be useful in the conservation and restoration of valuable cultural landscapes. In Sogn og Fjordane in Western Norway we still can find a small-scale agricultural landscape that has been managed traditionally for many generations. Such areas offer important opportunities for research on soil

biota. The results of the present investigation may be of general interest for sustainable agriculture and conservation of terrestrial ecosystems.

Little work has been done on the mite fauna in Norway, and some older publications are not very reliable because of uncertain species identity, problems with synonyms (particularly among Phytoseiidae) and unknown habitats. Our study of gamasid mites revealed high species diversity. In a relatively small number of samples taken for a preliminary survey, we found 42 species in tree hollows and 34 species in soil. In this study, we found great species richness at Grinde. The presence of pollarded trees appears to enrich the Gamasid fauna of old cultural landscapes. It is difficult to make a direct comparison of our results with data from the literature, as the natural conditions in Western Norway (such as climate, topography, landscape use, biogeography, soil) are very different from those in countries where more research on soil ecology has been carried out. Comparable data for Norway do not exist. All the Gamasida species recorded in this study were already known to be present in Europe (Karg 1993). A total 119 species of Gamasina (excluding Phytoseiidae) and 2 species of Microgyniina are known from Norway, including those recorded for the first time here.

A comparison with data from the literature (Table 2) showed high species richness in differ habitats. For example, 67 Gamasina species were collected in *Melico-Fagetum hordelymetosum* (Schaefer & Schauermann 1990), 52 species in *Fagetum sudeticum* (Dziuba et al. 1979) and 52 species in old grassland (Curry 1969). On the other hand, habitats changed by human activity can be rich in mite species as well (Table 2). Madej and Skubala (1996) recorded 30 Gamasina species in strongly degraded acid beech wood in the industrial region of Upper Silesia, Southern Poland. Forty-five species were found in eight urban green areas in Warsaw (Niedbala et al. 1990). In Italy, Paoletti (1988) found 20 species in soil and litter in four lowland residual woodlands. Our species list was compared with species lists from four European studies mentioned in Table 2 (Niedbala et al. 1990

Table 2. Number of Gamasida species recorded from natural and anthropogenically modified habitats.

Biotope	No. of species	Country	Reference
Traditional meadow and pasture	56	Norway	Present paper
Tree hollows	42		
Soil	34		
Four cultivated fields	19	Poland	Dziuba (1962)
Old grassland	52	Ireland	Curry (1969)
Four lowland residual woodlands	20	Italy	Paoletti (1988)
Tilio-Carpinetum natural forest	23	Poland	Niedbala et al. (1990)
Tilio-Carpinetum suburban forest	14		
Arrhenatheretum meadow	21		
Two urban parks in Warsaw	19		
Eight urban green areas in Warsaw	45		
Melico-Fageum hordelymetosum	67	Germany	Schaefer & Schauermann (1990)
Luzula-Fagetum	13		
Meadow	26-34	Germany	Buryn & Hartmann (1992)
Strongly degraded acid beech wood in Galman	30	Poland	Madej & Skubala (1996)
Fagetum sudeticum, Katowice	52	Poland	Dziuba et al. (1997)
Salici-Populetum typical deciduous inundated forest	37	Slovakia	Kovac et al. (1999)
Arable soils	11-26		

in natural and suburban forest, meadow, parks and urban green areas; Kaluz 1997 in forest, Dziuba 1962 in crops and Madej & Skubala 1996 in forest). *Rhodacarellus silesiacus* was the most numerous species in typical deciduous inundated forest (*Salici-Populatum*) in Slovakia (Kaluz 1997), but was not recorded in our study. *Zercon triangularis*, *Pergamasus crassipes*, *Hypoaspis aculeifer*, *Veigaia exigua* and *V. nemorensis* seem to be the most common species in both natural and anthropogenically-modified habitats, whereas *Eviphis ostrinus* seems to be characteristic in soils in natural habitats.

In our samples, representatives of the family Ascidae accounted for 1.2 % of all Gamasida recorded in soil at Grinde, and 4.6 % in tree hollows at Grinde, with the exception of *Proctolaelaps pygmaeus* in tree hollows (27.3 % of all Gamasida in tree hollows at Grinde). According to Niedbala et al. (1990), *Asca bicornis* dominates in urban green areas, but it was not recorded in our samples. The dominant species in moist meadows in Poland (Niedbala et al. 1990) were *Paragamasus misellus* (not recorded from Norway) and *Veigaia nemorensis*. In strongly degraded acid beech woodland in Poland (Madej & Skubala 1996), *Veigaia nemorensis* was one of the most dominant species (eudominant, 355 ind. m^{-2}), whereas we found this species only in soil at Kusslid (75 ind. m^{-2}, representing only 3 % of

all Gamasida in the area).

Knowledge of Gamasina diversity and of the occurrence of species in differ habitats can be used in studies to develop a system to apply a soil-monitoring network. However, the relationship between soil biodiversity and ecosystem health has not been well quantified. More extensive studies of different habitats at various temporal and spatial scales (from soil quality to landscape) are needed to establish a database that can be used to predict and understand density, species composition and species diversity in relation to e.g. cultivation techniques and land use. In Western Norway, where the landscape and climate vary widely, it is particularly important to compile local reference data on species composition and population density for soil-living mites. This paper will be treated as the starting point for further research.

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Dispersal abilities and breeding periods of ground beetles (Coleoptera, Carabidae) in coastal Central Norway

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Species composition of ground beetles was investigated in coastal Central Norway 2002, with emphasis on time of breeding and dispersal power. The 34 sites included open habitats as well as forest habitats. Sampling was carried out by pitfall traps. Altogether, 2091 specimens were collected representing 35 carabid species. Species supposed to have high dispersal abilities had highest species richness and abundance. Species with poor dispersal abilities were however most abundant in forests. More macropterous species were found, but brachypterous species were more abundant. Autumn breeders dominated both in species numbers and abundance, with the exception of the meadow sites. These trends may be modeled by the Atlantic climate with mild winters and high precipitation, which seems to facilitate the use of open habitats for species normally occurring in forests.

Keywords: Carabidae, Atlantic climate, coastal Central Norway

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INTRODUCTION

The importance of dispersal for presence and survival for ground beetles in fragmented habitats is well documented, since periods of isolation may result in extinction of populations with low abilities of dispersal (den Boer 1990). This supports the founding hypothesis, under which founding of new populations is considered to be the main effect of dispersal (de Vries et al. 1996).

There are two different approaches to divide species into species with good and poor dispersal abilities, i.e. based on hind wing morph type or based on studies of population turnover.

The former approach is most frequently used, looking at the proportion of (1) macropterous species with full-winged specimens during parts of or during the whole season, (2) brachypterous species with reduced wings or incidentally full-winged (below 1%) and (3) dimorphic species having both full-winged specimens and specimens with reduced wings (Fournier & Loreau 2001, Halme & Niemelä 1993). This approach is preferable if the habitats are physically isolated in some way (e.g. by road systems, rivers, lakes). Most macropterous species are small with fairly good ability to recolonize areas of extinction, as population densities fluctuate between years (den Boer 1970, 1981, 1990). Brachypterous species are more often large species, being able to disperse by walking only; meaning that ground obstacles like road systems become great barriers.

The other approach is to distinguish between "fast-spreading species" and "slow-spreading species" based on local population turnover (den Boer 1990). The fast-spreading species group includes some large brachypterous species, like *Carabus problematicus* Herbst, while some macropterous species, like *Amara lunicollis* Schiødte, are considered to be slow-spreading species (den Boer 1990).

The present work is part of a larger study, which has been published elsewhere (Hatteland 2004, Hatteland et al. 2004, Hatteland et al. 2005). The aim of the present study was to study species composition in relation to dispersal abilities and breeding periods. Due to the fluctuating Atlantic climate, species with good dispersal abilities were expected to be more species rich and abundant than species having poor dispersal abilities. Furthermore, an even clearer difference in species richness and abundance was expected in the open areas than in tree covered areas, as the climate will be even more fluctuating. In addition, we predicted a higher species richness and abundance of spring breeding species in open habitats and a dominance of autumn breeders in shaded habitats. This was based on the hypothesis that winter larvae from autumn breeders survive better in more stable habitats, like forests, while summer larvae have a much shorter larval development and therefore survive better in more fluctuating environments (Luff 1993). Furthermore, we predicted spring breeding species to be generally more abundant and species rich, due to the severe Atlantic climate with strong winds and high precipitation.

MATERIALS AND METHODS

Study areas and sampling procedures

The present study was carried out in the Nærøy municipal, North Trøndelag County, Central Norway (65.75°N, 11.5°E). In the main study area in Kjeksvika (0-63 m above sea level) close to Abelvær, altogether 26 sampling sites were chosen. Botanical surveys and vegetation descriptions of Kjeksvika are according to Nilsen (1998) and Fremstad (1997). Heathland is the dominant vegetation type in Kjeksvika, and has a diverse flora, mostly due to the richness of shell-derived sand in the area.

Eight additional sites were chosen outside the Kjeksvika area. These were located along the road from Abelvær to Skaga, and consisted of different types of forest.

Altogether, 13 vegetation types and seven transition zones (transitions between vegetation types) were sampled (Table 1). Ten vegetation types were situated in Kjeksvika, of which three were heathland. The seven transition zones were all in the Kjeksvika area. The sites outside Kjeksvika contained five vegetation types; scrubland, open coniferous forest (bilberry woodland), dense spruce forest, birch forest and other deciduous forest (tall fern-downy birch stand). Pitfall trapping was continuous from 6 May to 11 September 2002, divided into two periods: from 6 May to 15 June and from 16 June to 11 September. A trapping line was established in each site, consisting of eight pitfall traps, at 1-2 m intervals. The traps consisted of plastic cups with an upper diameter of 6.5 cm and 9.5 cm deep, half filled with formaldehyde (4%). A metal roof (11x11 cm) was placed approximately 3-4 cm above each trap.

The mean temperature during our trapping period was 14.7 °C, i.e. 2.6 °C warmer than the last five year's mean. Furthermore, the summer of 2002 was much drier than normal for the region. The precipitation values in May, June, July and August were 33.1%, 33.6%, 40.7% and 68% lower than the last five year mean, respectively.

Species identifications were made according to Lindroth (1961, 1985, 1986) and compared with specimens from the Andreas Strand beetle collection at Bergen Museum. The material is deposited at Bergen Museum.

Den Boer´s (1990) grouping of species determined as "fast-spreading" and "slow-spreading" has been used, which included twelve of our species (Table 2).

Statistical methods

A two-way unbalanced ANOVA test was used in the testing of differences between fast-spreading and slow-spreading species, time of breeding and hind wing morph type, on species richness, as well as between the sites and between the two trapping periods. An significance level of alpha = 0.05 was used. Tests were performed in SAS/STAT software, version 8.02.

The abundance of the species was investigated by applying the Hill´s N2 diversity index, which is the inverse of the Simpson´s index. The index computes effective number of occurrences; i.e. species abundance not influenced by sample size (Hill 1973):

$N2 = [\sum (Y_i k_i / Y+k)^2]^{-1}$, Y_i = abundance of a species in sample i, k_i = abundance of all species in sample i, Y = abundance of a species in all samples, k = abundance of all species in all samples

This was computed by using the CANOCO package, version 4.0 (ter Braak and Smilauer 1998).

RESULTS

A total of 2091 specimens belonging to 35 carabid beetle species were found in the 34 sites (Table 2). Of these, five (14 %) were singletons and two (6 %) were doubletons, while 18 species (51 %) were represented by ten or more specimens.

Dispersal abilities

A significantly (p<0.001) higher richness and abundance of fast-spreading species was evident (Table 1), along with a difference between the two trapping periods, spring and autumn (p=0.046). There was also some difference between the sites, but not significant (p=0.056). Slow-spreading species were most common in birch forests, as well as in other deciduous and open coniferous forests (Table 1). Furthermore, five slow-spreading species were found, while seven fast-spreading species were identified (Table 2). In addition, fast-spreading species were twice as common scoring 44.2 in Hill´s N2 diversity index as opposed to 20.5 for the slow spreading species.

In total, 14 (40 %) brachypterous, 19 (54 %) macropterous, and two (6 %) dimorphic species (Table 2) were found. The distribution of brachypterous, macropterous and dimorphic species was significantly different (p<0.0001). Macropterous species were absent from the dense spruce forest and most common in deciduous forests, bogs, and meadows (Table 1). The dense spruce forest was only inhabited by brachypterous species. Furthermore, brachypterous species were most abundant overall, although less abundant in meadows, the dike, and birch forests. The dimorphic species were most abundant in open coniferous forests. The transition zones deviated from the vegetation types having higher proportions of macropterous species (Table 1). Total relative abundance of brachypterous, macropterous and dimorphic species were 80.3 % (1678 specimens), 19.3 % (404 specimens) and 0.4 % (9 specimens), respectively.

Autumn and spring breeders

In total, 17 (49 %) autumn breeding species and 14 (40 %) spring breeders (Table 2) were found. In addition, four (11%) species regarded as both spring and autumn breeders were found. The relation between these two species groups was significantly different (p<0.0001). Spring breeders were absent from the dense spruce forest, wet heathlands and the planted spruce stand, while being most abundant in meadows, bogs, open coniferous, birch and other deciduous forests (Table 1). Overall, autumn breeders were most abundant, especially in the heathlands and the bird fertilized coastal vegetation. The autumn breeders were most common in the transition zones (Table 1). Spring breeders were completely absent from the transition zone between dry grass-herb heathland and birch forest. Total relative abundances of autumn and spring breeding species were 81% (1728 specimens) and 17% (349 specimens), respectively.

Table 1: List of vegetation types and transition zones and their respective number of sites, mean number of fast-spreading, slow-spreading, macropterous, brachypterous, dimorphic, spring breeding and autumn breeding species.

Habitat type	Sites	Fast spread.	Slow spread.	Macropt.	Brachypt.	Dimorp.	Spring breeder	Autumn breeder
Dike	1	1	0	1	1	0	1	1
Meadow	3	3	0.3	4	2	0	4	2.3
Wet heathland	3	0.7	0	1.3	5.6	0	0	6.7
Dry heathland	1	3	0	2	4	0	1	5
Dry grass/herb rich heathland	2	1.5	0.5	2.5	4.5	0	1	6
Bird fertilized coastal vegetation	2	2	0.5	2.5	5	0.5	1	7
Scrubland	3	1	0	1.3	4.3	0	1	4.3
Bog	2	3	0.5	3.5	5	0	3	6
Birch forest	3	1	0.7	2	3.7	0	2.3	3.3
Open coniferous forest	3	1	1	2.7	7	0.3	3	4.7
Other deciduous forest	2	1	1	3.5	5.5	0.5	3	5.5
Dense spruce forest	1	0	0	0	5	0	0	4
Planted spruce stand	1	0	0	1	2	0	0	3
Dike-meadow	1	2	1	5	3	0	3	4
Dry heath-wet heath	1	3	1	2	6	0	3	5
Dry heath-birch forest	1	2	1	4	5	1	4	6
Meadow-birch forest	1	2	2	4	6	1	3	8
Meadow-herb rich heath	1	3	2	5	4	0	3	5
Herb rich heath-birch forest	1	0	0	1	1	0	0	2
Bog-birch forest	1	3	1	5	6	0	3	7

Table 2: List of species captured in 272 pitfall traps, Central Norway in 2002. A = autumn breeder, S = spring breeder. B = brachypterous, D = dimorphic, M = macropterous. F = fast-spreading species, S = slow-spreading species, (D) = dimorphic species in literature.

Species	Time of breeding	Wing morphology	Fast-spread. /slow spread.	No. of specimens	Hill's index
Carabus hortensis L., 1758	A	B	-	591	-
C. violaceus L., 1758	A	B	-	81	-
C. problematicus Herbst, 1786	A	B	F	41	5.9
C. coriaceus L., 1758	A	B	-	37	-
Cychrus caraboides (L., 1758)	A	B	-	120	-
Pterostichus niger (Schaller, 1783)	A	M	F	95	13.6
P. nigrita (Paykull, 1790)	S	M (D)	F	37	6.9
P. strenuus (Panzer, 1797)	S	B (D)	-	5	-
P. diligens (Sturm, 1824)	S	B (D)	S	23	5.1
P. oblongopunctatus (Fabricius, 1787)	S	M	S	11	2.9
Patrobus atrorufus (Ström, 1768)	A	B	-	244	-
P. assimilis Chaudoir, 1844	A	B	-	17	-
Calathus micropterus (Duftschmid, 1812)	A	B	-	359	-
C. melanocephalus (L., 1758)	A	B (D)	S	20	4.8
Leistus terminatus (Hellwig, 1793)	A	M	-	62	-
Loricera pilicornis (Fabricius, 1775)	S	M	F	131	10.9
Elaphrus riparius (L., 1758)	S	M	-	2	-
Notiophilus biguttatus (Fabricius, 1779)	A	D (D)	S	3	3.0
N. germinyi Fauvel, 1863	A	M	-	8	-
N. palustris (Duftschmid, 1812)	S	D (D)	-	6	-
Trechus obtusus Erichson, 1837	S/A	B	-	40	-
Bembidion lunatum (Duftschmid, 1812)	A	M	-	1	-
Agonum piceum (L., 1758)	S	M	-	3	-
A. fuliginosum (Panzer, 1809)	S	B (D)	-	99	-
Amara aenea (Degeer, 1774)	S	M	-	12	-
A. communis (Panzer, 1797)	S	M	F	9	4.9
A. lunicollis Schiødte, 1837	S	M	S	8	4.7
A. plebeja (Gyllenhal, 1810)	S	M	F	2	1.0
A. aulica (Panzer, 1797)	A	M	-	7	-
A. familiaris (Duftschmid, 1812)	S	M	-	1	-
A. apricaria (Paykull, 1790)	A	M	-	1	-
Harpalus latus (L., 1758)	S/A	M	F	9	1.0
H. quadripunctatus Dejean, 1829	S/A	M	-	4	-
Trichocellus placidus (Gyllenhal, 1827)	A	M	-	1	-
Cymindis vaporariorum (L., 1758)	S/A	B (D)	-	1	-

DISCUSSION

Most carabid population densities fluctuate between years (den Boer 1990), most probably making results hard to extrapolate. Seasonal variations in climate may alter the activity of the animals. Besides, activity peaks are often correlated with reproductive behavior (Mortensen 1985), and rather specific to different periods of the year (Adis 1979, Thiele 1977). In addition, the reproduction period it self may to some degree be influenced by climatic factors in general (Thiele 1977). The extreme values for the last two months may have altered the activity of the species, especially the late-summer and autumn breeding species. Previous studies have revealed drastically reduction of carabid abundance during dry and hot weather conditions (Kuu, A. pers. comm.).

Dispersal abilities
As predicted, there was a clear significant dominance in species numbers and abundance of fast-spreading species (Table 1 and 2). This is in accordance with reports from West Norwegian coastal areas (Bruvoll 1985, Mortensen 1985, Pedersen 1986, Waage 1984). Studies from inland areas show an opposite pattern, showing slow-spreading species being either dominating or showing no significant differences at all (Solevåg 2004).

The macropterous species group contained the highest number of species, while brachypterous species were generally more abundant (Tables 1 and 2). It is therefore possible that the species-pool for the investigated area contains a higher number of macropterous species, which in fact supports the prediction that species with high dispersal abilities are more common in coastal areas than dimorphic and brachypterous species. This is in accordance with the high abundance of fast-spreading species, and is probably due to the ability to migrate by air. Migration contributes perhaps to increase the species numbers by emigration, as well as decrease the abundance by immigration. Some macropterous species observed in this study are most likely "travelers"

and/or outside their distribution area (Hatteland et al. 2004). However, few macropterous species have actually been observed flying (den Boer 1970). In fact, most macropterous species have only occasionally fully developed hind wings and wing muscles (Nelemans 1983, van Huizen 1977).

Macropterous species are perhaps underestimated by pitfall trapping, since they in most cases are small to medium in size (Mommertz et al. 1996, Spence & Niemelä 1994), and may partly explain why abundance of macropterous species was generally lower than for brachypterous species.

Spring and autumn breeders
In the present study autumn breeders were far more abundant and species rich then might be expected (Table 1), which is in accordance with results from West Norwegian coastal areas (Waage 1984). In the present study the spring breeders were more abundant and more species rich in meadows, compared to the other vegetation types. In the other open habitats, and also in the transition zones autumn breeding species were either equally or more abundant and species rich than the spring breeding species. This do not support our prediction that fluctuating habitats should inhabit more spring breeding species with short-lived summer larvae, and autumn breeding species with long-lived winter larvae should inhabit closed and stable habitats. Perhaps the mild winters typical for the Atlantic climate explain these observations, meaning that stability in temperature compared to the inland climate is a far more important factor than the stressing elements in the Atlantic climate (e.g. wind and precipitation). Autumn breeders are often more or less hygrophilous species avoiding the drying sun by being forest dwellers. In addition, the forest species normally lack the highly metallic elytra, something which is very common for a typical open habitat species (Thiele 1977). It is possible that the metallic elytra serve to protect open habitat species from bird predation due to the reflections of the sun (Lindroth 1974, Pedersen 1986). The typically overcast weather of the Atlantic climate perhaps facilitates open areas as habitats for species that normally occur in forests.

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Harpiphorus lepidus (Klug, 1814) (Hymenoptera, Symphyta, Tenthredinidae) in Norway

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Lönnve, O. J. 2005. *Harpiphorus lepidus* (Klug, 1814) (Hymenoptera, Symphyta, Tenthredinidae) in Norway. Norw. J. Entomol. 52, 57-58.

The tenthredinid wasp *Harpiphorus lepidus* (Klug, 1814) is recorded from Norway for the first time. A single ♀ was captured at Nesodden municipality (AK), June 2003. Comments on its food plant and distribution are given.

Key words: *Harpiphorus lepidus*, Hymenoptera, Symphyta, Tenthredinidae, *Quercus*, Norway

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Harpiphorus lepidus (Klug, 1814) is a small tenthredinid wasp, the only species of this genus in Europe, about 4-5 mm long and characterized by yellowish green ground colour and black markings. This species is recorded for the first time from Norway.

A single ♀ was captured in a Malaise-trap at Skoklefall, Nesodden municipality (AK), (UTM 32V WGS 84 NM 935359; EIS 28) on 5 – 10 June 2003 (leg. O. J. L.). The specimen is kept in the entomological collection at the Natural History Museum, University of Oslo.

The larva of *H. lepidus* is known to feed on oak (*Quercus* sp.), where they utilize the upper surface of the leaves (Benson 1952). Taeger *et al.* (1998) mention particularly *Q. robur*, and it is probably also the main food plant in Norway. Anyway, *Quercus* is abundant at the locality.

The species is reported from Germany (Blank et al. 1998), Denmark (Nielsen & Henriksen 1915) and Britain (Fitton et al. 1978), but not from Finland (Viitasaari & Vikberg 1985). According to Benson (1952), *H. lepidus* is very rarely found in Britain, and Nielsen & Henriksen (1915) claims it very rare in Denmark. *H. lepidus* is probably a rare species also in Norway. After examinations of Symphyta material from different localities where oak is a natural part of the flora, only this specimen where identified as *H. lepidus*. It is distributed in N, C and E Europe, and also Turkey (Lacourt 1999). The distribution of the species in Norway probably follows the distribution of *Qurcus* along the coast-line.

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Book reviews

M.P. van Veen. 2004. Hoverflies of Northwest Europe. Identification keys to the Syrphidae. 254 s. 18 fargeillustrasjoner og flere hundre svarthvit tegninger. Innbundet. KNNV Publishing, Utrecht, Nederland. ISBN 90 5011 199 8. Euro 34,95 pluss eksp.avg. og porto. Kan betales med VISAkort og bestilles over e-post: info@knnvuitgeverij.nl

Godt illustrerte fagbøker og enkle nøkler er ofte en naturlig innfallsport når en vil bli kjent med en plante- eller dyregruppe. Folk som har ønsket å gjøre seg kjent med de fargerike og tallrike blomsterfluene (fam. Syrphidae), har i en senere periode fått tilgang på flere slike. Eksempler er Stubbs og Falks "British Hoverflies" (1983 og senere) og Torp's bok "Danmarks svirrefluer" (1994).

I løpet av de siste 25 år har det imidlertid skjedd en betydelig økning i kunnskapen om den europeiske faunaen, særlig gjennom en rekke nye artsbeskrivelser og reviderte nøkler. For nybegynnere har det selvsagt ikke vært enkelt å få en oversikt i dette, enn si skaffe all nødvendig litteratur for en trygg seilas….!

Mark P. van Veens nye bok gir nå en samlet oversikt over blomsterfluefaunaen i det nordvestlige Europa, fra Tyskland og det nordligste Frankrike i sør og nordover, inklusive det vestligste Russland, Finland, Skandinavia og Island. 505 arter er nå kjent i dette området.

Boka begynner med en fargerik bilderevy over vanlige blomsterfluer og noen av de "modellene" de etterligner (mimer), men forklarer også forskjeller fra en del andre fluefamilier. Nyttig er også en detaljert gjennomgang av hvor i skog og mark en kan finne ulike slekter og arter, og årsaker til at de er så stedbundne. Flygetid på året, og på dagen, er også viktig for den som ønsker å kartlegge faunaen best mulig.
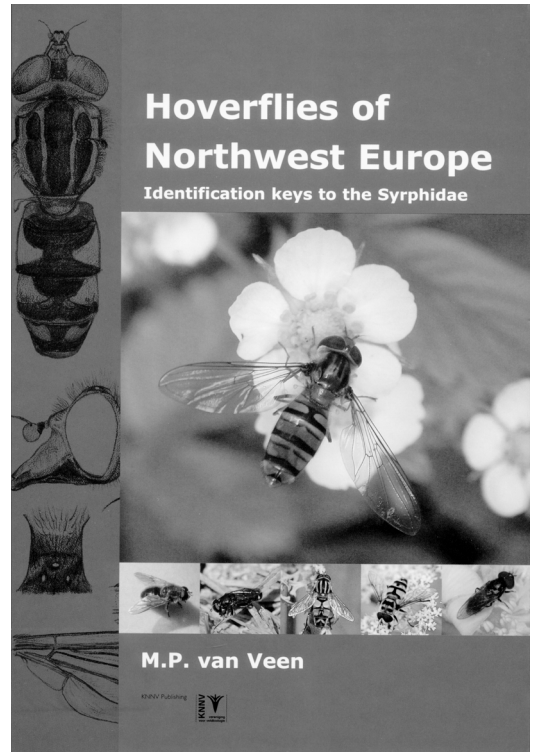
Senere tar boka for seg hvordan en teknisk best kan samle inn og ta vare på fluene, og for den ivrigste samleren er det gode tips om oppdrett av larver og klekking av blomsterfluer i fangenskap – et arbeid som i de siste år har gitt en mengde nyttige informasjoner om artenes levevis og økologi.

Før forfatteren tar fatt på bestemmelsesnøklene, har han en presentasjon av de ulike kroppsdelene som nevnes senere. Navnene (termene) er koblet til gode tegninger, og for enhver bruker av boka burde det ikke ta lang tid å bli kjent med – og repetere - anatomiske uttrykk som her og der dukker opp i tabellene.

Bokas store styrke er de mange oppdaterte nøklene, og de tallrike, gode tegningene. På mange av figurene er det dessuten piler som peker på kritiske karakterer. Dette gjør bestemmelsene enklere og sikrere enn i flere av de tidligere bøkene.

Boka er lett å finne fram i. Slektene er ordnet alfabetisk i boka, hver med sin nøkkel, og med en

kort omtale av hver art. Bakerst i boka har forfatteren en indeks, en slags sjekkliste, som viser hvor i Nordvest-Europa artene er funnet, og hvor i boka de er omtalt.

Dessverre er det en del mindre ting som trekker ned. Litt forvirrende er det at noen av figurene opererer med foreldete artsnavn. Eksempler er fig. 25 *Eristalis nemorum* som nå heter *E. interrupta*, fig. 328 *Eristalis horticola* som i nøkkelen ovenfor korrekt heter *E. lineata,* og fig. 298 *Epistrophe similis* som i dag skal hete *E. obscuripes*. Figurene 615 og 646 skal begge forestille *Platycheirus parmatus*, men figurene er så ulike at det skaper usikkerhet. I nøkkel over slekten *Spilomyia* vises det til et nøkkelledd 3. Dette mangler i tabellen og har trolig ved et uhell blitt til ledd 4.

Det er trolig bl.a. stort tidspress under utgivelsen som er skyld i disse småfeilene, og jeg føler det nesten unfair å nevne dem. For boka ”Hoverflies of Northwest Europe” er et flott bokverk som forfatteren har lagt mye arbeid i, og som for oss er et nytt og etterlengtet redskap. Jeg anbefaler boka varmt til alle som i større eller mindre grad kommer til å arbeide med denne fargerike og spennende fluefamilien.

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Tore R. Nielsen

Brown, John W. 2005. World Catalogue of Insects, Volume 5. Tortricidae (Lepidoptera). 24 x 17 cm, 741 sider. Innbundet. Apollo Books, Kirkeby Sand 19, DK-5771 Stenstrup, Danmark. ISBN 87-88757-41-2. DKK 960,00 + porto. Ved abonnement på serien gis 10 % rabatt.

Med litt over 9000 beskrevne arter utgjør viklerne – overfamilien Tortricoidea med den ene familien Tortricidae – en betydelig del av verdens diversitet av småsommerfugler (Microlepidoptera). De overgås kun av overfamilien Gelechioidea. På grunn av dette høye artstallet er boka blitt en skikkelig murstein. Det er klart at det ligger et enormt arbeid gjennom flere år bak et slikt kjempeverk.

Alle vitenskapelige navn på viklere publisert før 31. desember 2004 er med i boka der de er behandlet i samsvar med den fjerde utgaven av *International Code of Zoological Nomenclature*, men det er et viktig unntak: Alle artsnavn har beholdt den opprinnelige stavemåte, uavhengig av slektsnavnets kjønn. Dette fordi den endelige plassering i slekter i mange tilfeller ennå ikke er avklart. Originalbeskrivelsen til så å si samtlige navn er blitt sjekket med hensyn til gyldighet, homonymi, autor, publikasjonsår, sidetall, opprinnelig taksonomisk kategori og opprinnelig kombinasjon. Infrasubspesifikke navn og feilstavinger er også tatt med, selv om mange av dem er ”ugyldige under koden”.

Alle arter er listet alfabetisk under hver slekt, og slektene er igjen listet alfabetisk uavhengig av høyere kategori, dvs. underfamilie og tribus. Imidlertid er det anført i hvilken underfamilie og tribus hver slekt hører hjemme. For hvert navn er det referanse til beskrivelsen, til typemateriale (om det dreier seg om holotype, lectotype, neotype, syntyper etc.), til samlingen / museet der typen(e) oppbevares, og geografisk informasjon om hvor typen(e) er innsamlet. Til forskjell fra fjærmøll-katalogen (Gielis 2003), blir ikke informasjon om geografisk utbredelse (bortsett fra typemateriale) og informasjon om næringsplanter gitt.

Det er særdeles nyttig at det gis en liste over alle katalogens referanser og deres forkortelser. Det er likeledes en liste over forkortelser på museer og samlinger. Vi merker oss at i denne listen står det ZMO som forkortelse på Zoological Museum, Oslo, Norway. Men dessverre er dette blitt til "ZMUO" flere steder inne i katalogen der det refereres til typemateriale (ZMUO står for Zoological Museum, University of Oulu).

I et så stort arbeid er det ikke til å unngå at det finnes noen feil. Jeg har oppdaget noen få som jeg nevner her:

Acleris obtusana (Eversmann, 1844) oppføres som et synonym til *A. lacordairana* (Duponchel, 1836). Kyrki (1982) viste at det er en god art. *A. fuscana* (Barnes & Busck, 1920) er den nordamerikanske underarten til *obtusana*, ikke en selvstendig art slik den står oppført som.

Under slekten *Cosmorrhyncha* oppføres type-arten *Tortrix ocellata* Mabille, 1900 som junior synonym til *Carpocapsa ocelliferana* Walker, 1863. Lenger nede listes den opp som en god art.

Katalogen fører ikke til mange navne-endringer på norske viklere. Jeg har funnet to: Den sjeldne arten *Rhyacionia piniana* (Herrich-Schäffer, 1851) er overført til en annen slekt og tribus, der den plasseres sammen med tre nordamerikanske arter i slekten *Corticivora* Clarke, 1951. En titt på avbildninger av genitaliene til disse artene viser at denne forandringen nok er korrekt.

Den vanlige arten på rose som vi har kalt *Notocelia roborana* (Denis & Schiffermüller, 1775), må vi venne oss til å kalle *N. aquana* (Hübner, 1799), da *roborana* er et nomen nudum, (dvs. et "nakent" navn, uten beskrivelse).
Denne katalogen er uunnværlig for alle som vil jobbe systematisk med viklere, og er også et viktig hjelpemiddel for naturhistoriske museer som har insektsamlinger.

World Catalogue of Insects

Volume 5

JOHN W. BROWN

Tortricidae (Lepidoptera)
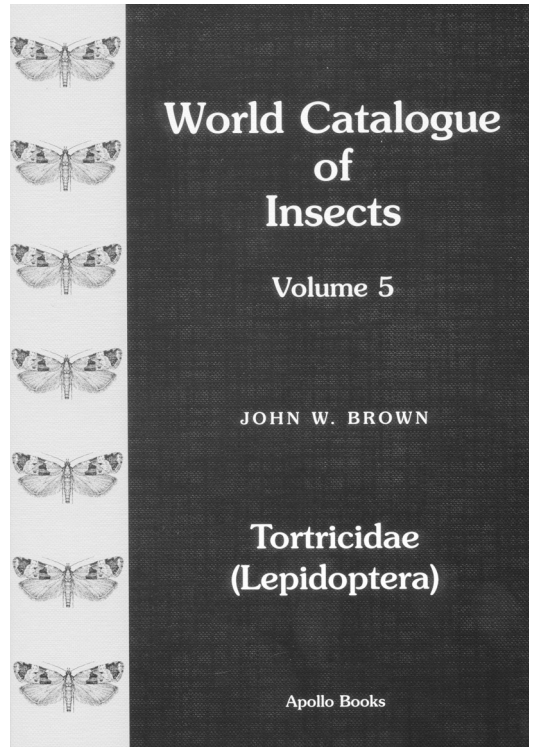
Apollo Books

LITTERATUR

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Kyrki, J. 1982. Acleris obtusana, a good species (Lepidoptera, Tortricidae). Notulae Ent. 62, 37-42.

Leif Aarvik

Gullan, P.J. & Cranston, P.S. 2005. The insects. An outline of entomology. Third editon. 502 pp. ISBN 1-4051-1113-5. Blackwell Publ. (for further information see www.blackwellpublishing.com) Price GBP 30.-.

This book is probably the most well-written textbook in entomology in our present time. It was first published in 1994, and presently appears in its third edition.

Although there is a chapter on phylogeny and classifications, as well as guides to the insect orders, taxonomy and systematics are not the main topics of this book. The book covers entomology in general, and other aspects are extensively treated. This includes chapters on anatomy and physiology, followed by reviews on reproduction, development and life histories.

Ecological aspects of entomology are particularly well described, e.g. the role of insects in soil, litter and other decaying matters. The relation between insects and plants is presented in a special chapter, as is predation and parasitism as well. Aquatic insects and social insects are given separate chapters. The more applied aspects of entomology are discussed under pest management and under medical and veterinary entomology. As pointed out by the authors, insect control is important, but entomology includes more positive than negative aspects of insects because their benefits to the environment outweight their harm.

The illustrations are clear and instructive line drawings in a uniform style. Some photographic examples of the diversity of insects are given in colour plates. A number of special topics are enlightened in boxes separated from the general text. Examples are boxes on "molecular insight into insect development" and "the language of bees". The unusual discovery and description a few years ago of a new order of insects – the heel walkers (Mantophasmatodea) is presented in a special box.
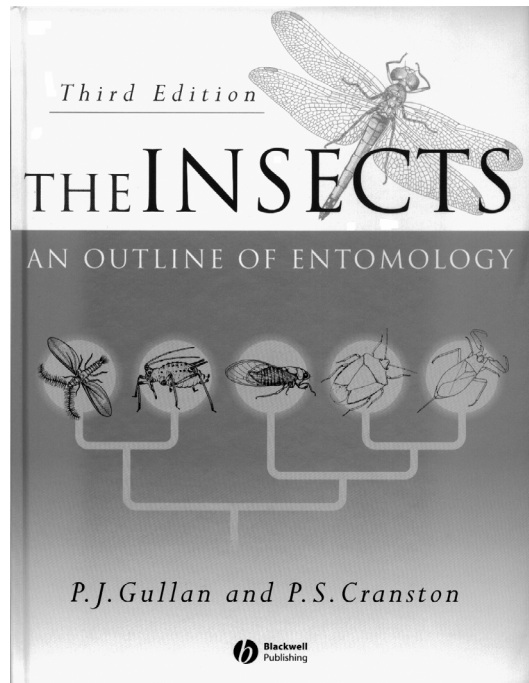
It is not the purpose of a review like this to look for mistakes or printing errors. A review of a book of 500 pages has to be more general. As an introduction to the broad field of entomology, this textbook is highly recommended. For anybody interested in entomology, this is a book you should have in your bookshelf as a source of information. The book is most suitable for teaching courses in entomology, and is presently used at universities throughout the world. In Norway it has been used for courses in entomology at The University of Oslo and at the Norwegian University of Life Sciences, and is recommended for other universities as well.

Lauritz Sømme

Argentine ants *Linepithema humile* (Mayr, 1868b) infesting Norwegian flats

Crisanto Gómez, Núria Roura-Pascual & Tone Birkemoe

Gómez, C., Roura-Pascual, N. & Birkemoe, T. 2005. Argentine ants infesting Norwegian flats. Norw. J. Entomol. 52, 63-64.

This is the first record of Argentine ants (*Linepithema humile*) from Norway. Several hundred workers were found infesting two flats at Sandnes, Rogaland.

Key words: *Linepithema humile*, Argentine ants, urban pests, Norway

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

The Argentine ant, *Linepithema humile* (Mayr, 1868b), was found in two flats above a stable at RY: Sandnes (58.85ºN; 5.73ºE). The ants were first seen in November 2004, but not identified to species before February 2005 when a pest control company was engaged to eradicate the pest. According to the pest controller, several hundred workers were present. However, no brood, queens or males were found. The owners of the flats had recently been visiting Italy and Spain with their horses and the ants had also been observed in the trailer transporting the horses on return to Norway.

The Argentine ant is one of the world's worst invasive alien species (www.issg.org/database). Its native distribution is limited to the Paraná River drainage in South America (Tsutsui et al. 2001, Wild 2004), but is now established in many Mediterranean and subtropical parts of the world thanks to human-mediated transport (Suarez et al. 2001; Roura-Pascual et al. 2004). Although associated with human-modified habitats (agricultural and urban zones) throughout its non-native range, the Argentine ant can also colonize natural areas with low anthropogenic disturbance causing severe ecological and economic effects (i.e. Vega & Rust 2001; Holway et al. 2002; Gómez & Oliveras 2003, Ness & Bronstein 2004).

This is the first report of Argentine ants from Norway, and at present the most northern infestation recorded. The previous northern occurrence was in Edinburgh (55.93ºN; 3.25ºE) (Wild 2004). Although there is no indication that the Argentine ants may have spread to outdoor habitats, the import and long duration of the infestation in this costal area is worrying. Roura-Pascual et al. (2004) recently predicted the geographical potential of Argentine ants in the face of future global climate change, and indicated that higher latitude areas are becoming more vulnerable to invasion. Specifically, some isolated areas along the Norwegian coast (Bodø being the northernmost site) were predicted to

present more suitable conditions for the Argentine ant in the future.

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Wild, A.L. 2004. Taxonomy and distribution of the Argentine Ant, *Linepithema humile* (Hymenoptera: Formicidae). Annals Entomol. Soc. Am. 97, 1205-1215.

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Manuscripts should be written in English or occasionally in Norwegian with an English summary. The authors are advised to consult previous issues for lay-out and fonts. The manuscripts should be submitted in duplicate as «one and a half» spaced lines on one side of the paper. Separate sheets should be used for (1) title page with authors names, (2) abstract followed by a list of up to six Key words and the name(s) and postal address(es) of the author(s), (3) Tables, (4) numbered Figures and (5) legends to Figures. *Acknowledgements* should be gathered under a single heading at the end of the text. All manuscripts will be considered by referees before acceptance.

Abstract should not exceed 300 words and should cover the main results and conclusions of the paper Authors, year, title of paper and Norw. J. Entomol. Vol. No. should be inserted above the abstract.

Tables are typed on separate sheets and numbered consecutively. Each Table must have a heading. Write «Table» in full both in the text and Table heading. Avoid vertical lines in the Tables.

Figures should (if at all possible) be submitted electronically as separate files, e.g. in JPEG, TIFF or EPS formats, with resolution not less than 600 dpi. The Figures must be numbered consecutively and all Figures must be referred to in the text. Write «Figure» in full. On paper copies the names(s) of the author(s) should be written in the margin of each figure. The size of the figure must not exceed 210 x 290 mm (standard A4). The author should take into consideration that most figures have to be reduced. In *line drawings* the line thickness should not be less than 0.25 mm after reduction, and capital letters should not be smaller than 2.0 mm. Choose contrasting patterns and avoid fine tone rasters. Photographs must be of high quality with good contrasts. Maps and morphological illustrations, e.g. pictures of insects, should include a scale bar.

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. ***Rhyaco-phila 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 or UTM should be added. Dates are written e.g. as 17 May 2005, see previous issues.

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Examples:

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Book

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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