Norwegian Journal of Entomology

Volume 47 No. 2 • 2000

Published by the Norwegian Entomological Society
Oslo and Stavanger

NORWEGIAN JOURNAL OF ENTOMOLOGY

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

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Front cover: *Boreophilus henningianus* Sahlberg, 1832 (Coleoptera, Staphylinidae). Artist: Frode Ødegaard.

Printed by: Reprografisk Industri AS, Oslo.

ISSN 1501-8415.

Norw. J. Entomol. 47, 101–112. 2000

Diel fluctuations of invertebrate drift in a Norwegian stream north of the Arctic Circle

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Johansen, M., Elliott, J.M. & Klemetsen, A. 2000. Diel fluctuations of invertebrate drift in a Norwegian stream north of the Arctic Circle. Norw. J. Entomol. 47, 101-112.

Sæterelva is a small, third order, stream situated north of the Arctic Circle (latitude 68° N). Drift samples were collected in 1996 during four periods (22-24 May, 23-25 June, 18-20 August and 6-7 October) to determine whether diel fluctuations in drift changed with the changing light regimes of the Arctic summer. Two of the sampling periods (May and June) had continuous daylight, while August and October had dark nights.

The taxonomic composition of the drift in Sæterelva was similar to that of other northern temperate streams, being dominated by larvae of Ephemeroptera, Plecoptera and Chironomidae. Total 24 h drift density (± SE) was high, ranging from 242 ± 45 individuals per 100 m^3 in May to 772 ± 66 per 100 m^3 in October. Terrestrial invertebrates contributed a high proportion to the total drift (7-39 %), probably as a result of the dense riparian vegetation along the stream. Total drift density of aquatic invertebrates was greater at night than during the day in August and October, while there were no differences between day and night in May and June. Most individual taxa of aquatic invertebrates followed this pattern. The major exception was Hydracarina, which consistently drifted with highest density during the day. It is concluded that simple classifications of drift are difficult to apply to Arctic streams with periods of continuous daylight.

Key words: invertebrate drift, aquatic invertebrates, diel fluctuations, streams.

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INTRODUCTION

Rivers and streams differ from other aquatic environments in having a strong unidirectional flow of water that transports materials from upstream to downstream areas. This transport forms the basis of the River Continuum Concept (Vannote et al. 1980, Minshall et al. 1985). Physical forces associated with the current are perhaps the most important factor affecting organisms in running water and many invertebrates possess morphological adaptations which help them avoid being swept away. Nevertheless, many of these organisms enter the water column (either actively or passively) and are displaced downstream by the current. This phenomenon (termed invertebrate drift) and its causes have been studied extensively (reviews by Waters 1969, 1972, Müller 1974, Statzner et al. 1984, Brittain & Eikeland 1988, Allan 1995).

Elliott (1965a) published the first account of invertebrate drift in Norway. Since then, there have been relatively few publications on this phenomenon in Norwegian streams (Steine 1972, Fjellheim 1980, Bækken et al. 1981, Sandlund 1982, Lillehammer et al. 1995). Invertebrate drift was investigated over several years in Kaltisjokk, a Swedish stream just north of the Arctic Circle (66 °N) (Müller 1966, 1970). The present account is the first on invertebrate drift in a Norwegian stream north of the Arctic Circle.

Since Tanaka (1960) described diel variations in the composition and the intensity of the drift, similar patterns have been observed frequently all over the world (e.g. Waters 1962, Elliott 1965a, b, 1967, McLay 1968, Bishop & Hynes 1969, Clifford 1972, Hynes 1975, Cowell & Carew 1976, Bailey 1981, Allan et al. 1988, Brewin & Ormerod 1994). Several studies have shown that light is the major cue for the diel periodicity of the behavioural drift (e.g. Müller 1965, Elliott 1967, Holt & Waters 1967, Pearson & Franklin 1968, Bishop 1969, Cowell & Carew 1976). North of the Arctic Circle, daylight is continuous in summer, but progressively shortens in autumn to a winter minimum.

The main objectives of this study were to examine how the composition and the diel fluctuations of the invertebrate drift changed with season.

STUDY SITE

Sæterelva is a small third order stream which is the main tributary of the lake Møkkelandsvatn in southern Troms (northern Norway) north of the Arctic Circle (68±49° N, 16±27° E) (Figure 1). The stream flows through mixed deciduous forests, with riparian vegetation dominated by grey alder *(Alnus incana* (L.) Moench), birch (*Betula pubescens* Ehrhart) and willow *(Salix* spp.). The catchment geology is dominated by micaceous gneiss and slate. The flow regime is characterised by wide seasonal fluctuations, with peak flows during snowmelt in May-June and the lowest flows during winter. The mean annual discharge is 0.5 m^3/s. Water temperature falls below 1 °C in early November, and the stream is ice covered from November to May. The area has a coastal climate, with relatively mild winters and cool summers. The stream is oligotrophic (total nitrogen 85-130 µg/l, total phosphorus 2-6 µg/l) and circumneutral (mean pH 7). The stream is mildly polluted, mainly from sewage and agricultural runoff (Muladal & Skotvold 1993).

A 200 m-long stretch of the stream just upstream from Møkkelandsvatn was chosen as the study reach. It has a stony substratum consisting of gravel, cobbles and a few boulders. Aquatic macrophytes and bryophytes are absent. The mean channel width is 4 m and the mean depth is 0.2 m.

Sæterelva is an important spawning site for brown trout *(Salmo trutta* L.), and the fish community consists mainly of juvenile trout with a few three-spined sticklebacks *(Gasterosteus aculeatus* L.).

METHODS

The drift of invertebrates was sampled over two nights and one day during each of three periods: 22-24 May, 23-25 June, 18-20 August 1996. One day and one night was also sampled on 6-7 October 1996. Drift was sampled using four floating drift nets with a mesh size of 430 µm (a detailed description is given in Elliott 1967). The nets were emptied every 3 h. Each net sampled to a depth of 6 cm and the total submerged area was 288 cm^2. An Ott miniature current meter was used to measure water velocity at the middle of the net mouth, at the beginning and end of each 3 h-sample. The volume of water filtered was estimated from the product of the area of the submerged net mouth, current velocity and duration of sampling. All drift samples were preserved in 70 % ethanol, and later sorted in the laboratory using a dissecting microscope at 6x magnification. The invertebrates were handpicked, identified and counted.

Flow through the nets was used to calculate drift density as the number of drifting invertebrates per 100 m^3 sampled (Waters 1969, Elliott 1970, Allan & Russek 1985). Mean drift densities per sampling date (referred to as 24 h drift density) were calculated by pooling all samples from each net and dividing by the total number of hours sampled at that time. Before statistical analyses, all drift densities were log10 transformed to ensure that the components of variance were additive before using analysis of variance (ANOVA) to test for temporal differences in drift (Elliott 1971). A two-way ANOVA using the General Linear Model (GLM) was performed with day versus night as one main effect and sampling date as the other main effect. Night in August and October was defined as the period of darkness between sunset and sunrise. Even though there was no darkness on the sampling occasions in May and June, there was still a large diel difference in light intensity. To test statistically for a diel difference in drift caused by darkness, «night» in May and June was defined as the two 3 h samples taken around midnight (22:00 to 04:00).

RESULTS

Physical measurements

Temperatures ranged from a low of 2.4 °C in May to a high of 13.1 °C in August. Diel variation was highest in August (range 9.9-13.1 °C), lowest in October (range 5.2-5.5 °C) and intermediate in May and June (2.4-3.7 °C and 5.7-6.4 °C, respectively). River discharge was lowest in August (0.1 m^3/s) and highest in May (1.6 m^3/s). Discharge in June and October was 0.7 and 0.8 m^3/s, respectively.

Drift composition

Altogether, 91 taxa (of which 74 were aquatic invertebrates) were collected and identified in the drift samples during the study. The highest number of aquatic taxa was collected in June (64), the least in August (38). Emerging aquatic insects contributed on average 12 % (range 0-31 %) to total drift.

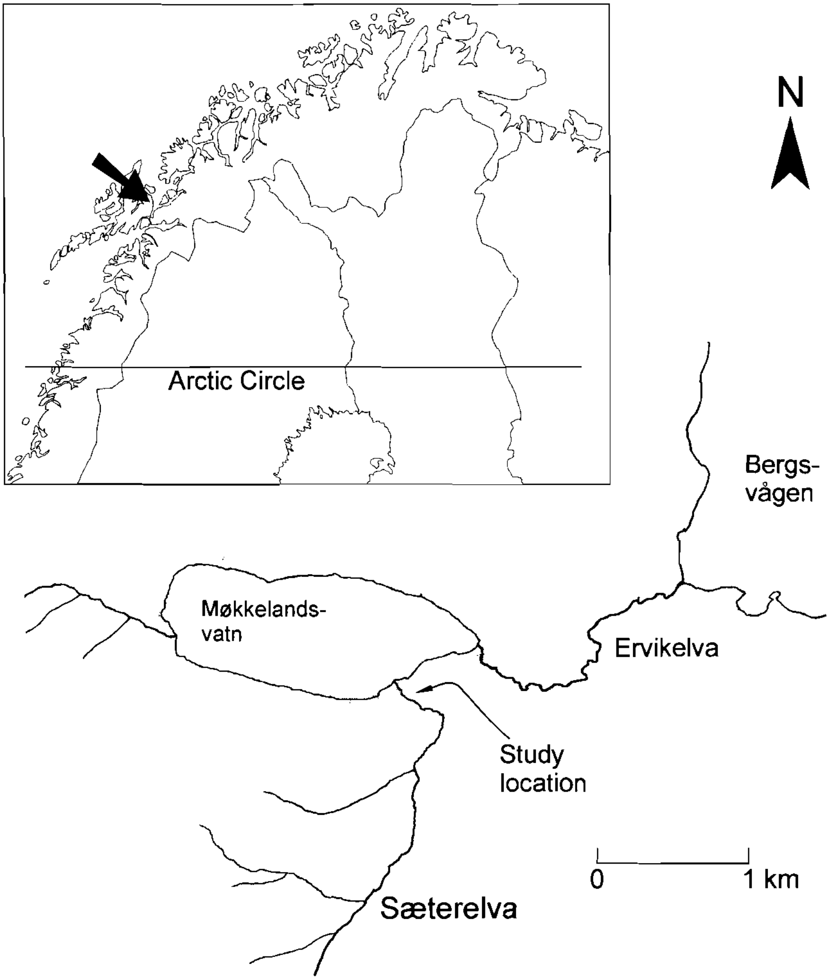

Figure 1. Map of the stream Sæterelva with the study location marked.

The terrestrial component of the drift (invertebrates with a completely non-aquatic life cycle, such as some Hemiptera, Arachnida, Collembola and Coleoptera) contributed an average of 22 % (range 7-39 %).

Density of invertebrate drift

Mean total drift density over 24 h was highest in October (772 ± 66 individuals per 100 m^3) and lowest in May (242 ± 45 per 100 m^3) with June (537 (32 per 100 m^3) and August (405 ± 47 per 100 m^3) being intermediate. Drift densities of the more common taxa showed that aquatic invertebrates comprised most of the drift on all sampling occasions except August, when terrestrial invertebrates were the largest group (Table 1). Both aquatic and terrestrial invertebrates occurred with their highest drift density in October (595 ± 64 per 100 m^3 and 156 ± 16 per 100 m^3 respectively) while emerging aquatic insects drifted with highest density in June (145 ± 21 per 100 m^3). Aquatic invertebrates had their lowest drift density in August (174 ± 25 per 100 m^3). Emerging aquatic insects and terrestrial invertebrates had their lowest densities in May (3 ± 1 per 100 m^3 and 46 ± 15 per 100 m^3 respectively).

Day-night variations in the main components of the drift

On the first sampling occasion in May, there was an increase in discharge (due to snowmelt) late in the afternoon (Figure 2a). This was correlated with an increase in density of drifting terrestrial invertebrates, mainly Diptera, Hemiptera and Collembola, of which only Hemiptera was significant ($F_{(2,37)}=5.09$, $P<0.05$). There were no significant differences in total drift between «night» and day ($F_{(2,37)}=1.55$, $P>0.1$) or between the two «nights» in May ($F_{(1,14)}=2.76$, $P>0.1$) (Table 1).

The water level remained constant through the whole period of drift sampling in June (Figure 2b). There was a significant difference in total drift (all components together) between day and «night» ($F_{(2,37)}=5.58$, $P<0.01$) (Table 1), caused by significantly higher drift of emerging aquatic insects during the day ($F_{(2,37)}=4.06$, $P<0.05$). This peak in the drift of emerging aquatic insects was caused by newly-emerged Chironomidae. Adult Plecoptera (mainly emerging *Brachyptera risi* (Morton)) drifted significantly more at «night» ($F_{(2,37)}=5.08$, $P<0.05$). Water mites drifted significantly more during the day than at «night» ($F_{(2,37)}=14.25$, $P<0.0001$). There were no significant differences between samples for the two «nights».

In August it was dark from about 22:00 h to 04:00 h (Figure 2c). The nocturnal increase in drift occurred chiefly in the first half, but not the second half, of the night. There were no fluctuations in discharge during the sampling period. There were only small differences between the drift samples from the first night and the day samples for all the main components of the drift (Table 1). Drift of most aquatic invertebrates and total drift were significantly higher during the second night than during the first night and the day ($P<0.001$ for most taxa). This difference between the two nights may have been due to the clarity of the night sky; it was clear on the first night and overcast on the second (see Discussion).

In October, darkness lasted nearly as long as the light period of the day (Figure 2d). Slight rainfall in the afternoon produced a small increase in water level during sampling. Total density of drifting invertebrates was significantly higher at night than during the day ($F_{(1,30)}=6.57$, $P<0.05$) (Table 1). The principal component of the drift was aquatic invertebrates, with significantly higher drift at night than during the day ($F_{(1,30)}=7.81$, $P<0.01$). Emerging aquatic insects drifted with highest density during midday/early afternoon, but the difference between day and night was not significant ($F_{(1,30)}=1.38$, $P>0.1$), probably because of the very low numbers compared with June and August. Terrestrial invertebrates peaked both during the day and during the night, without any significant difference between night and day ($F_{(1,30)}=0.53$, $P>0.1$).

Day-night variations for some taxa

There was no difference in drift density between «night» and day for *Baetis* spp. in May and June (Figure 3a, b). In August (Figure 3c), drift was significantly higher during the second night than in the first night and during the day ($F_{(2,37)}=4.22$, $P<0.05$). The diel pattern for Baetis spp. therefore followed that for total aquatic invertebrates with the highest drift densities in the first half of the night (Figure 2c). In October (Figure 3d), mean drift was significantly higher at night than during the day ($F_{(1,30)}=4.35$; $P<0.05$) (Table 1), once again following the same diel pattern as that shown by total aquatic invertebrates.

The pattern of drift for all Plecoptera resembled that of *Baetis* spp. There was a highly significant night-time peak during the second night in August ($F_{(2,37)}=17.59$, $P<0.001$) and in October ($F_{(1,30)}=11.33$; $P<0.01$) (Table 1). These diel patterns in August and October were therefore consistent with those shown by total aquatic invertebrates.

There was no difference in the density of drifting Chironomidae (both larvae and pupae) between day and «night» in May (Table 1). In June the highest density was found during the day, and the difference between «night» and day was significant ($F_{(2,37)}=3.81$, $P<0.05$). In August there was a significant peak in the drift of Chironomidae on the second night ($F_{(2,37)}=24.84$, $P<0.001$). Also in October, most Chironomidae drifted at night ($F_{(1,30)}=10.88$; $P<0.01$). Once again, these diel patterns were consistent with those shown by total aquatic invertebrates.

There was no difference in the density of drifting water mites between day and «night» in May (Figure 4a). In June (Figure 4b), water mites drifted

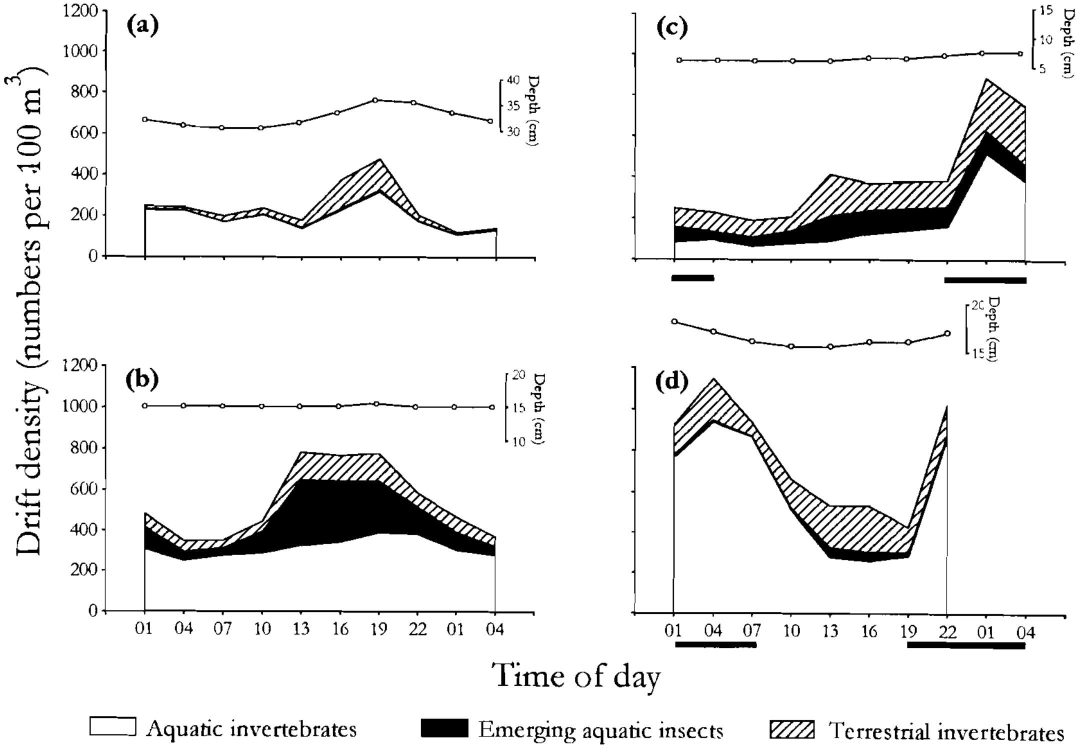

Figure 2. Stacked drift densities (number of individuals per 100 m^3 for the three main drift components in Sæterelva. Changes in the water level during sampling are also given. Samples from (a) 22-24 May, (b) 23-25 June, (c) 18-20 August, and (d) 6-7 October 1996. Shaded bars on the x-axes represent period of darkness between sunset and sunrise.

Table 1. Mean drift densities (number of individuals per 100 m^3 ± 1 SE) of common invertebrates caught on the four sampling occasions in Sæterelva, northern Norway. SE < 0.5 not shown. +, taxa present; -, not found. *, $P<0.05$; **, $P<0.01$; *** $P<0.001$. P-values are from ANOVAs between the 3 periods in May, June and August, and the 2 periods in October. The «night»-period in May and June is the time of day equivalent to the period of darkness in August (termed night).

	May				June			
	«Night»	Day	«Night»		«Night»	Day	«Night»	
Aquatic invertebrates								
Plecoptera	**14 ± 2**	**17 ± 2**	**11 ± 2**		**21 ± 4**	**21 ± 1**	**22 ± 2**	
Brachyptera risi	4 ± 1	3	3 ± 1		9 ± 2	5 ± 1	10 ± 2	
Leuctra spp.	2	3 ± 1	2		1	+	+	
Nemouridae	7 ± 2	11 ± 1	5 ± 1		11 ± 2	14 ± 1	11 ± 1	
Capnidae	+	1	+		+	+	+	
Ephemeroptera	**20 ± 2**	**22 ± 2**	**17 ± 3**		**70 ± 16**	**61 ± 4**	**66 ± 9**	
Baetis spp.	20 ± 2	19 ± 2	17 ± 3		65 ± 16	54 ± 4	60 ± 9	
Ephemerella aurivillii	+	+	+		+	+	+	
Diptera	**173 ± 44**	**152 ± 26**	**79 ± 13**		**147 ± 14**	**193 ± 11**	**158 ± 13**	*
Chironomidae	38 ± 9	34 ± 4	26 ± 3		120 ± 12	159 ± 10	128 ± 12	*
Simuliidae	2 ± 1	3	2 ± 1		23 ± 2	29 ± 2	25 ± 2	
Tipulidae	4 ± 2	1	2 ± 1	*	+	+	+	
Limonidae	1	1	1		+	1	+	
Empididae	3 ± 1	2	2 ± 1		2	2	2	
Psychodidae	123 ± 38	110 ± 23	46 ± 10		1	1	1	
Coleoptera	**1**	**3 ± 1**	**1**		**21 ± 14**	**18 ± 9**	**24 ± 10**	
Trichoptera	**1**	**1**	**1**		**2 ± 1**	**2**	**2**	
Rhyacophila nubila	1	+	+		1	1	1	
Limnephilidae	+	+	+		+	+	+	
Hydracarina	**3 ± 1**	**3 ± 1**	**2 ± 1**		**9 ± 1**	**26 ± 3**	**10 ± 1**	***
Cyclopidae	**+**	**+**	**+**		**6 ± 2**	**8 ± 2**	**7 ± 3**	
Oligochaeta	**13 ± 4**	**5 ± 1**	**9 ± 3**	*	**2**	**2**	**2**	
Total	**227 ± 48**	**205 ± 31**	**121 ± 15**		**278 ± 41**	**332 ± 17**	**291 ± 22**	
Emerged aquatic insects								
Plecoptera	**+**	**2 ± 1**	**+**		**4 ± 1**	**2**	**4 ± 1**	*
Ephemeroptera	**-**	**-**	**-**		**-**	**+**	**-**	
Chironomidae	**+**	**3 ± 1**	**+**	*	**66 ± 20**	**181 ± 29**	**57 ± 14**	*
Trichoptera	**-**	**+**	**-**		**+**	**+**	**+**	
Total	**1**	**5 ± 2**	**+**	*	**77 ± 22**	**193 ± 30**	**67 ± 17**	*
Terrestrial invertebrates								
Diptera	**4 ± 2**	**23 ± 12**	**3 ± 1**		**5 ± 2**	**6 ± 1**	**5 ± 2**	
Hemiptera	**1 ± 1**	**15 ± 6**	**1**	*	**32 ± 3**	**43 ± 4**	**32 ± 5**	
Coleoptera	**+**	**2 ± 1**	**-**		**2**	**3 ± 1**	**1**	
Hymenoptera	**-**	**+**	**-**		**1**	**2**	**1**	
Lepidoptera	**-**	**+**	**+**		**1**	**1**	**1**	
Collembola	**11 ± 3**	**28 ± 9**	**5 ± 2**		**17 ± 3**	**34 ± 6**	**18 ± 3**	
Total	**17 ± 4**	**67 ± 24**	**10 ± 3**		**61 ± 6**	**92 ± 10**	**60 ± 9**	
Total, all groups	**245 ± 52**	**277 ± 54**	**131 ± 17**		**416 ± 42**	**618 ± 43**	**418 ± 29**	**

Table 1. Continued.

	August				October		
	Night	Day	Night		Night	Day	
Aquatic invertebrates							
Plecoptera	**8 ± 3**	**8 ± 1**	**44 ± 6**	***	**159 ± 16**	**52 ± 4**	**
Brachyptera risi	-	-	+		15 ± 2	16 ± 3	
Leuctra spp.	1	3	4 ± 1	***	35 ± 5	8 ± 1	**
Nemouridae	5 ± 1	3 ± 1	30 ± 5	***	66 ± 7	26 ± 3	**
Capnidae	-	-	1	**	31 ± 3	5 ± 1	**
Ephemeroptera	**13 ± 4**	**11 ± 1**	**26 ± 3**	**	**378 ± 54**	**103 ± 17**	*
Baetis spp.	12 ± 3	10 ± 1	20 ± 3	*	371 ± 54	101 ± 17	*
Ephemerella aurivillii	1	+	6 ± 1	***	1	-	
Diptera	**55 ± 12**	**66 ± 8**	**325 ± 40**	***	**277 ± 27**	**141 ± 13**	***
Chironomidae	33 ± 10	55 ± 7	238 ± 31	***	211 ± 24	98 ± 12	**
Simuliidae	19 ± 3	9 ± 1	65 ± 7	***	42 ± 4	19 ± 1	**
Tipulidae	1	1	7 ± 2	***	1	+	*
Limonidae	-	-	+		9 ± 2	5 ± 1	**
Empididae	+	+	1	**	1	+	
Psychodidae	+	+	+		7 ± 1	5 ± 1	
Coleoptera	**3 ± 1**	**2**	**20 ± 2**	***	**7 ± 1**	**7 ± 1**	
Trichoptera	**1**	**4**	**14 ± 2**	***	**18 ± 2**	**10 ± 1**	*
Rhyacophila nubila	1	1	2	***	1	1	
Limnephilidae	+	1	6 ± 1	***	16 ± 2	8 ± 1	*
Hydracarina	**5 ± 1**	**15 ± 2**	**19 ± 2**	***	**11 ± 2**	**13 ± 1**	
Cyclopidae	**2 ± 1**	**1**	**1**		**1**	**+**	
Oligochaeta	**+**	**+**	**1**		**7 ± 1**	**4 ± 1**	
Total	**89 ± 18**	**111 ± 10**	**450 ± 51**	***	**859 ± 82**	**331 ± 33**	**
Emerged aquatic insects							
Plecoptera	**+**	**+**	**1**		**+**	**2**	*
Ephemeroptera	**-**	**3 ± 1**	**+**	*	**+**	**+**	
Chironomidae	**56 ± 28**	**84 ± 13**	**84 ± 12**	*	**8 ± 2**	**25 ± 5**	
Trichoptera	**-**	**+**	**+**		**+**	**-**	
Total	**57 ± 25**	**90 ± 14**	**93 ± 12**	*	**11 ± 2**	**31 ± 6**	
Terrestrial invertebrates							
Diptera	**5 ± 2**	**9 ± 1**	**19 ± 4**	***	**2**	**5 ± 1**	
Hemiptera	**31 ± 9**	**59 ± 10**	**86 ± 13**	**	**49 ± 6**	**88 ± 9**	
Coleoptera	**1**	**4 ± 1**	**-**	***	**2**	**3 ± 1**	
Hymenoptera	**3 ± 1**	**9 ± 2**	**10 ± 1**	*	**3 ± 1**	**3 ± 1**	
Lepidoptera	**+**	**+**	**+**		**7 ± 1**	**3 ± 1**	*
Collembola	**44 ± 22**	**39 ± 9**	**105 ± 26**	*	**71 ± 17**	**69 ± 15**	
Total	**93 ± 35**	**123 ± 21**	**272 ± 50**	**	**137 ± 20**	**175 ± 23**	
Total, all groups	**238 ± 73**	**324 ± 41**	**815 ± 101**	***	**1007 ± 95**	**537 ± 43**	*

significantly more during the day than at «night» ($F_{(2,37)}=14.25$, $P<0.001$). A different pattern was observed in August, with an increase at midday followed by higher densities in the afternoon and early night (Figure 4c). In October, the highest peak in drift density occurred about midday (Figure 4d). In contrast to the other aquatic taxa, diel patterns for water mites in August and October did not follow those shown by total aquatic invertebrates, the chief difference being the higher drift densities of water mites during the day.

DISCUSSION

The species composition of the drift samples from Sæterelva was relatively diverse, but a few abundant taxa comprised a high proportion of the drift. For example in October, four out of the 69 taxa collected constituted over 60 % of the total catch. A similar observation has been made in other studies (e.g. Cowell & Carew 1976, Schreiber 1995). High diversity may reflect the duration of drift collections, because sampling throughout 24 h (as in the present study) will lead to more diverse catches than sampling for a shorter period (e.g. Cowell & Carew 1976, Benke et al. 1986, Allan et al. 1988). Levels of taxonomic resolution employed by different investigators (especially with regard to Diptera) (e.g. Benke et al. 1986 versus Allan et al. 1988) will profoundly affect records of the diversity of drifting animals and thereby confound interhabitat comparisons. It can be concluded that the overall composition of the drift in Sæterelva was broadly comparable to that of other temperate streams (e.g. Elliott 1967, Ulfstrand 1968, Bishop & Hynes 1969, Armitage 1977).

Drift densities in Sæterelva were well within the

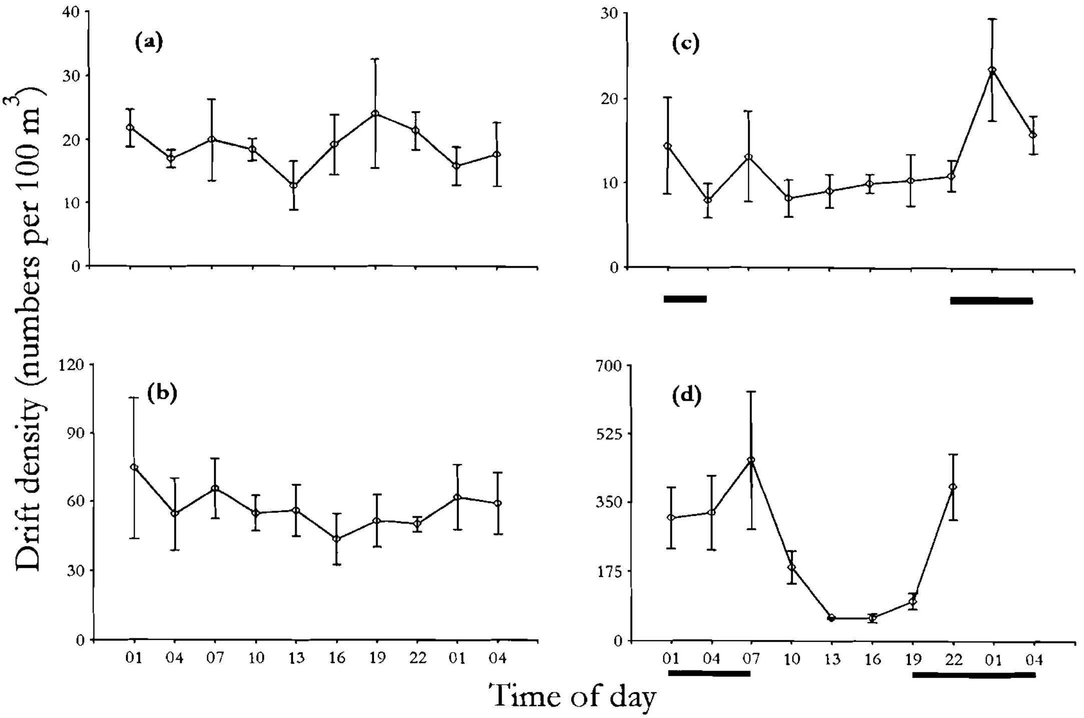

Figure 3. Drift density (number of individuals per 100 m^3) of Baetis spp. in Sæterelva. Notice the difference in scale between each month. Vertical bars represent 1 SE. Samples from (a) 22-24 May, (b) 23-25 June, (c) 18-20 August, and (d) 6-7 October 1996. Shaded bars on the x-axes represent period of darkness between sunset and sunrise.

range of values recorded for temperate and subtropical streams (Waters 1972, Brittain & Eikeland 1988). In a study from Nordfjord, western 0-150 individuals per 100 m^3. From Vindelälven in Sweden, Ulfstrand (1968) found drift densities of 200-500 per 100 m^3, similar to the range of 96-663 per 100 m^3 found in Sæterelva. However, Ulfstrand (1968) used a mesh size of 168 µm, considerably finer than the mesh size of 430 µm used in this study. This indicates that the total drift density in Sæterelva was probably higher.

The present study on invertebrate drift from northern Norway showed contrasting diel drift patterns with differing light regimes: nocturnal maxima when nights were dark and without significant diel fluctuations when light was continuous. A similar pattern has been reported from other Arctic (Hinterleitner-Anderson et al. 1992) and sub-Arctic streams (Müller 1965, 1966). A lack of fluctuations in the drift is also found in fishless streams, e.g. high altitude, tropical Andean (Turcotte & Harper 1982, Flecker 1992) and Himalayan streams (Brewin & Ormerod 1994).

The diel drift pattern in October was a typical bigeminus pattern, with one peak in density just after sunset and one smaller peak just before sunrise. This is the pattern most commonly observed (see references in the Introduction). The diel drift pattern in August was different. No nocturnal maxima (both total drift and individual taxa) were detected on the first night, while the second night had a single peak in drift density. This can perhaps be ascribed to differences in weather conditions, with a clear sky on the first night and dense cloud cover during the second night. Thus the higher light intensity of the first night may have

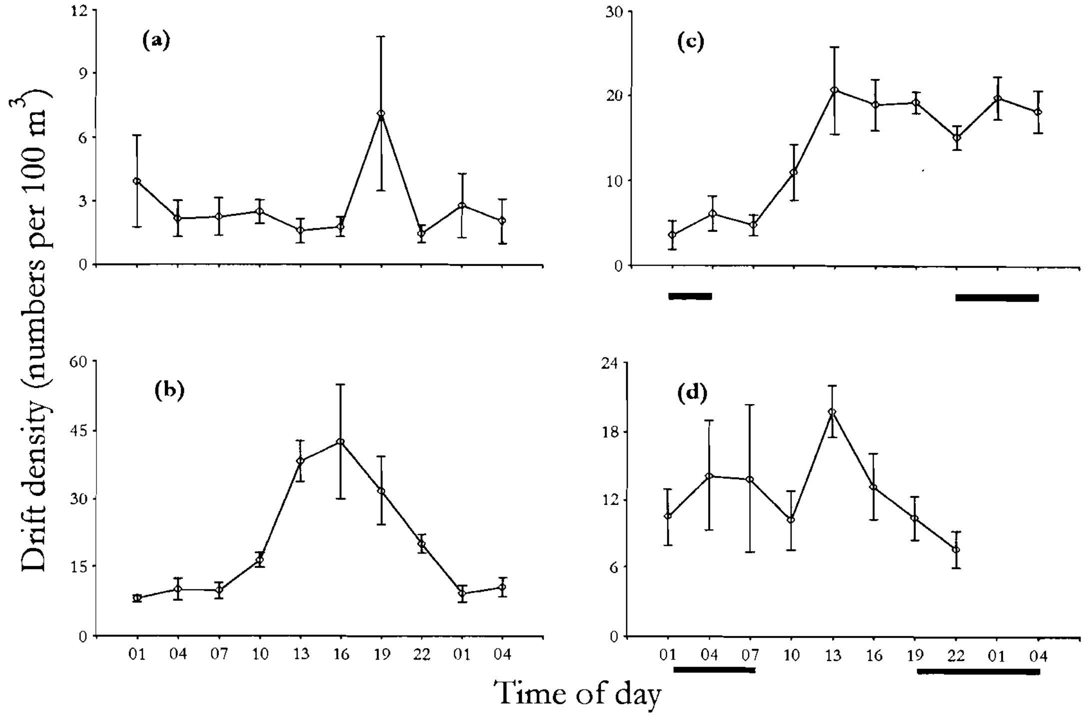

Figure 4. Drift density (number of individuals per 100 m^3) of water mites (Hydracarina) in Sæterelva. Notice the difference in scale between each month. Vertical bars represent 1 SE. Samples from (a) 22-24 May, (b) 23-25 June, (c) 18-20 August, and (d) 6-7 October 1996. Shaded bars on the x-axes represent period of darkness between sunset and sunrise.

depressed the drift. Small changes in light intensity can affect drift, for example moonlight has been shown to have a depressant effect on drift in some rivers (Waters 1962, Anderson 1966, Bishop & Hynes 1969, Hynes 1975). This explanation is however not in accordance with the results of Elliott (1967) who found no evidence for the depressant effect of moonlight on the drift in a small stream in southwest England.

The diel fluctuations in the drift of aquatic invertebrates observed in August and October were eliminated in the continuous light of the polar summer. This was also reported by Müller (Müller 1965, 1966) and Hinterleitner-Anderson et al. (1992). Drift behaviour may be influenced directly by selection, and the minimisation of day drift may be adaptive (Kohler 1985). It has been suggested that the evolution of a periodicity in drift was a predator avoidance mechanism to minimise mortality due to fish predation (Allan 1978, 1984, Flecker 1992) or invertebrate predation (Corkum & Pointing 1979). Studies in fishless streams have found no evidence for consistent diel periodicities (Turcotte & Harper 1982, Flecker 1992, Brewin & Ormerod 1994, Douglas et al. 1994). However, experimental manipulations of fish populations have shown no effects on drift periodicities (Allan 1982, Flecker & Allan 1984), apparently due to the large temporal scales over which adaptive responses develop (Flecker 1992). As the threats from predation would be continuous in the Arctic summer, there are no optimal times for invertebrates to be drifting and therefore no reason to retain a periodicity.

Most taxa followed the general pattern of being night-active in August and October but lacking any diel rhythm in May and June. The major exception to this pattern was water mites (Hydracarina), which were day-active on all sampling occasions. This has also been observed by other workers in streams (Elliott 1967, Elliott & Minshall 1968, Bishop & Hynes 1969, Waringer 1992) and also lakes (Moon 1940, Pieczynski 1964). A predator with a visual foraging behaviour such as water mites may be influenced by the need for light, thus resulting in an increased daytime activity.

Emerging aquatic insects were most abundant in drift samples in June and August, with adult Chironomidae dominant. Most orders of aquatic insects have their most intense emergence periods in these months (Brittain 1982, Pinder 1986, Lillehammer 1988). On all sampling occasions, significantly more adult Chironomidae were taken during the day than at night. Most workers have found highest drift density of emerging aquatic insects after sunset (e.g. Elliott 1967, Elliott & Minshall 1968, Dudgeon 1983).

Terrestrial drift has been shown to increase in sunny weather (Elliott 1967), intense rainfall, and flooding (O'Hop & Wallace 1983), so an increase in density of drifting terrestrial invertebrates could be expected to occur with the afternoon increase in discharge in May. The drift of terrestrial invertebrates was highest during the day on all sampling occasions (although not significant). This agrees with the observations of other workers (Elliott 1967, Turcotte & Harper 1982

Terrestrial invertebrates contributed a significant percentage to the drift in Sæterelva (7-39 %). This is similar to Elliott (1967) (9-38 %) and slightly higher than in other studies (e.g. Bishop & Hynes 1969: 3 %; Hynes 1975: 1 %; Turcotte & Harper 1982: 13-23 %; Waters & Crawford 1973: 8 %). The high percentage of terrestrial invertebrates is probably a result of the dense riparian vegetation along Sæterelva. Mason & McDonald (1982) found input of terrestrial invertebrates to be dependent upon the riparian vegetation, with higher input under alder trees than in the open.

The lack of periodicity in the drift of aquatic invertebrates observed in the present study during the summer exemplifies one of the problems with the drift classification of Waters (1972). As the low-level daytime drift of night-active invertebrates is termed «constant drift» and night-time drift is called «behavioural», it becomes impossible to distinguish these two categories of drift in periods of constant light. This classification is useful in recognising the multifaceted nature of the drift. However, it can also lead to the expectation that the drift of all invertebrates conform to one of these categories. However, the establishment of further categories would not be particularly useful and would only lead to confusion (Brittain & Eikeland 1988).

In conclusion, this study gives support to the theory that predation risk probably is part of the reason behind diel fluctuations in drift of aquatic invertebrates. There was a lack of fluctuations in the midsummer period when light was continuous, and a clear difference between night and day in August and October when nights were dark. This suggests that the invertebrates use the darkness at night as a refugium from drift-feeding fish.

Acknowledgements. We are most grateful for the help of Henning Syvertsen, Torfinn Sørensen and Thomas Olsen in the field. We would also like to thank John O. Solem and an anonymous referee for valuable comments on an earlier version of the manuscript.

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Received 8 January 2000,
accepted 10 May 2000

Norw. J. Entomol. 47, 113–124. 2000

Life cycle, diet and habitat of *Polycentropus flavomaculatus*, *Plectrocnemia conspersa* and *Rhyacophila nubila* (Trichoptera) in Øvre Heimdalen, Jotunheimen Mountains, Norway

Sigve Reiso & John E. Brittain

Reiso, R. & Brittain, J.E. 2000. Life cycle, diet and habitat of *Polycentropus flavomaculatus*, *Plectrocnemia conspersa* and *Rhyacophila nubila* (Trichoptera) in Øvre Heimdalen, Jotunheimen Mountains, Norway. Norw. J. Entomol. 47, 113–124.

Life cycles, diets and habitats of the three trichopterans, *Polycentropus flavomaculatus* (Pictet, 1834), *Plectrocnemia conspersa* (Curtis, 1834) (Polycentropodidae) and *Rhyachopila nubila* (Zetterstedt, 1840) (Rhyachophilidae) were investigated. All three species showed indications of semivoltine life cycles, probably due to low temperatures. *P. flavomaculatus* dominated the outlet of the lake, Øvre Heimdalsvatn, while *R. nubila* was widely distributed, but dominated the faster flowing reaches. *P. conspersa* dominated in the pools in the upper reaches of the stream Brurskardbekken. Both *P. flavomaculatus* and *P. conspersa* were common in the outlet of the small lake Brurskardtjern.

The dietary composition of the three predaceous trichopteran species reflected a combination of prey occurence and foraging/capture techniques. The free-living *R. nubila* had the narrowest niche breadth while the net-spinning, *P. conspersa* and *P. flavomaculatus* had wider niche breadths. However, the species had several similar prey taxa in their diets, indicating that overlap also occurred between predators of very different foraging/capture modes. They all showed monthly variations in feeding habits as a result of seasonal variations in the abundance of prey, indicating that these species are generalists. This coupled with their ability to change to semivoltine life cycles at high altitudes is probably an important factor explaining their wide geographical distribution.

Keywords: Trichoptera, life cycle, habitat, diet.

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INTRODUCTION

Certain trichopteran species demonstrate flexible life cycles throughout their distributional range, shifting from a univoltine life cycle in the lowlands to a semivoltine cycle in montane areas (Solem & Gullefors 1995). Towards their altitudinal limits, semivoltine life cycle strategies are more likely in aquatic insects, mainly due to low water temperatures (Brittain 1978, 1983, 1990, Ward & Stanford 1982, Sweeney 1984).

Polycentropus flavomaculatus, *Plectrocnemia conspersa* and *Rhyacophila nubila* are three widely distributed representatives of two primarily predaceous families, the Polycentropodidae and the Rhyacophilidae, respectively (Dudgeon & Richardson 1988, Wiggins 1996). *P. flavomaculatus* and *P. conspersa* (Polycentropodidae) catch their prey from the drift using elongate, sack-like nets (Wiggins 1996). Both species are found throughout Europe (Malicky 1979, Szczesny 1986, Solem & Gullefors 1995). *R. nubila* (Rhyacophilidae) is free living and actively searches for its prey. It has a northern distribution in Europe and Russia (Fjellheim1976, Solem & Gullefors 1995).

In this present study, life cycle, habitat and diet of these three widely distributed trichopteran species were investigated in a mountainous area. The aim of this study was to obtain knowledge of their ecology at or near their altitudinal limits.

SITE DESCRIPTION

This study was carried out in Øvre Heimdalen, a valley on the eastern slopes of the Jotunheimen Mountains in southern Norway (Latitude 61°25'32" N) (Figure 1). The valley and the lake Øvre Heimdalsvatn ecosystem were thorougly described in Vik (1978). Four stations in the stream, Brurskardbekken, and one station in the outlet of the lake, Øvre Heimdalsvatn, were studied. Brurskardbekken rises at an elevation of 1309 m a.s.l. in a small lake, Brurskardtjern, located at the upper limit of the low alpine zone. Subalpine vegetation and mountain birch (*Betula pubescens*) reach altitudes of about 1200 m a.s.l. along Brurskardbekken. It falls gradually until 1275 m a.s.l., where the stream flows slowly through a series of small pools. After 1250 m a.s.l. the gradient increases substantially until the stream reaches the valley floor at 1100 m a.s.l. The substrate of the streambed in the upper parts of the river is mostly bedrock

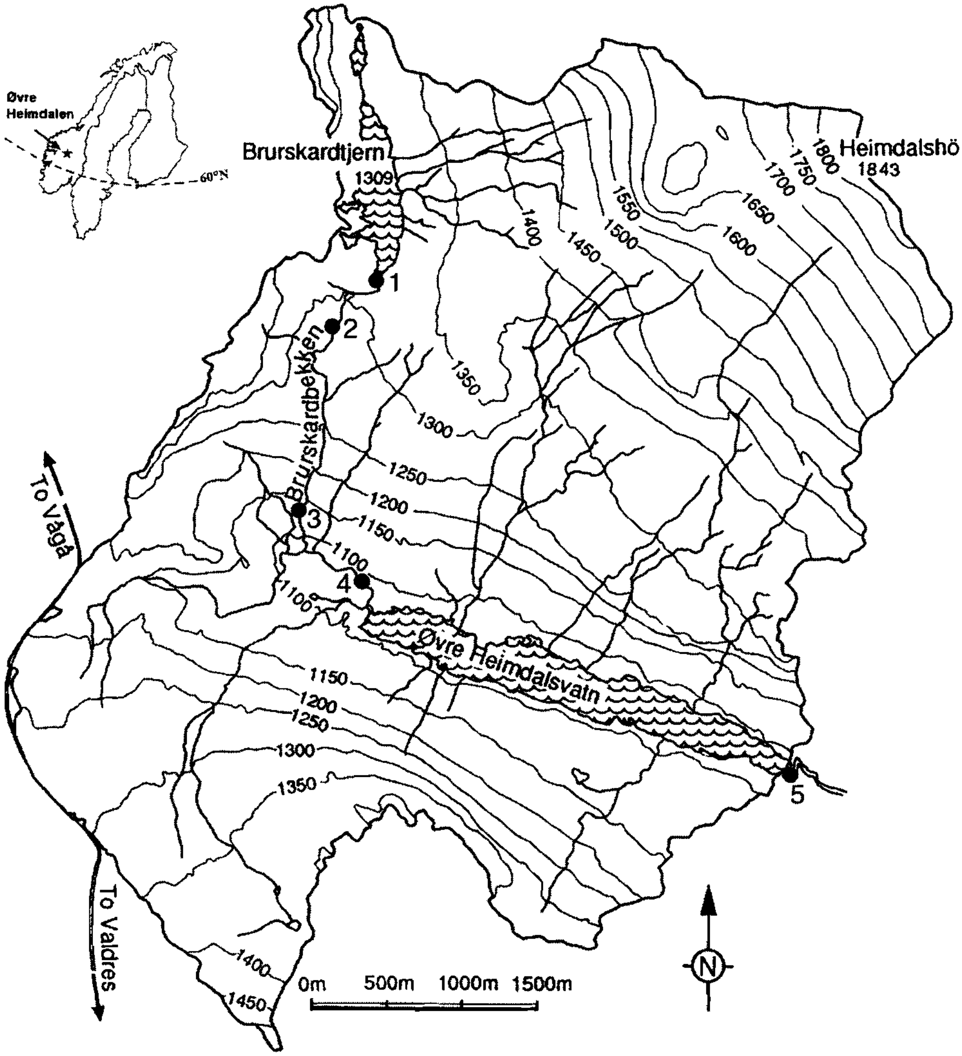

Figure 1. Map of Øvre Heimdalsvatn and the stream Brurskardbekken. Stations 1 to 5 are marked. Altitudes in m a.s.l.

and large stones while smaller stones and sand dominate the slow flowing lower parts. From the Brurskardtjern, the stream flows for 3.2 km before entering the lake, Øvre Heimdalsvatn, at 1090 m a.s.l. The outlet of Øvre Heimdalsvatn is 5-10 m wide and 1.5 m deep. The water is slow flowing with some large pools and the substrate is composed mainly of large stones. The location of the study reaches is given in Figure 1. More details concerning the reaches are given in Reiso (1999).

Water temperatures were recorded by digital loggers in Brurskardbekken (station 4) and the outlet of Øvre Heimdalsvatn (station 5) every hour, and every 3 hours respectively, during the ice-free period (Figure 2). The mean summer temperature (June-September) was 9.6 °C at station 5 and 7.1 °C at station 4.

METHODS

Larvae, prepupae and pupae were collected at all five stations on seven occasions during the ice-free period from June to October 1998. They were collected by a kicking technique (Frost et al. 1971) (30x30 cm net, mesh size 350 µm) and hand picked from stones and other substrates in order to collect all stages. Three, 30 sec. kick samples were taken at each station for density estimates.

Adults were collected by a variety of methods. Three different malaise traps was used, two by Brurskardbekken (station 3 and 4) and one at the outlet of Øvre Heimdalsvatn (station 5). An ultraviolet light trap was used on four occasions at station 5. Adults were also collected in sweep-net samples of riparian vegetation at all stations. Adult collections were used to establish emergence and flight periods.

All samples were preserved in 70 % alcohol in the field, then sorted and identified in the laboratory to species using a dissecting microscope. The larvae were identified to genus using Solem & Gullefors (1995) and to species from Edington & Hildrew (1981). Adults were identified using Malicky (1983). For life history analysis, larval head capsule length and width was measured using an ocular micrometer at 40x magnification.

Where possible the foregut of five, fifth instar larvae from each of the three species was examined on six sampling occasions (Figure 5). The foreguts were removed and mounted on glass slides. After mounting in Hoyers Medium the relative contribution of different food items was estimated using an ocular squared grid. The percentage area occupied by each prey category was calculated. Eleven categories were used: Copepoda, Cladocera, Hydracarina, Chironomidae, Simuliidae, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, adult insects and detritus. Guts with no contents were classified as empty.

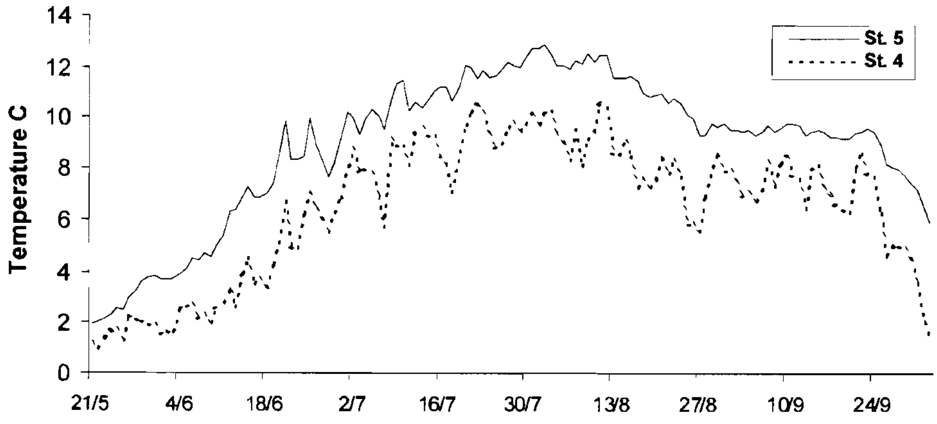

Figure 2. Mean daily water temperatures in Brurskardbekken (station 4) and at the outlet of Øvre Heimdalsvatn (station 5) from 21 May to 3 October 1998.

Niche breadth and niche overlap with respect to diet were calculated for each trichopteran species. Niche breath (B) is given as:

$$B = 1 / \sum_{j=1}^{n} Pj^2$$

where Pj = proportion of the prey group j in the total diet, and B can range from 0 - n (n = number of prey groups) (Dudgeon & Richardson 1988).

Niche overlap (Oxy) was calculated according to the formula:

$$Oxy = (\sum_{j=1}^{n} Px,j \; Py,j)/(\sqrt{\sum_{j=1}^{n} Px,j^2 \; Py,j^2})$$

where Px,j and Py,j are the percentage use by species x and y of the same prey group. Values > 0.75 are indicative of high overlap between species (Dudgeon & Richardson 1988).

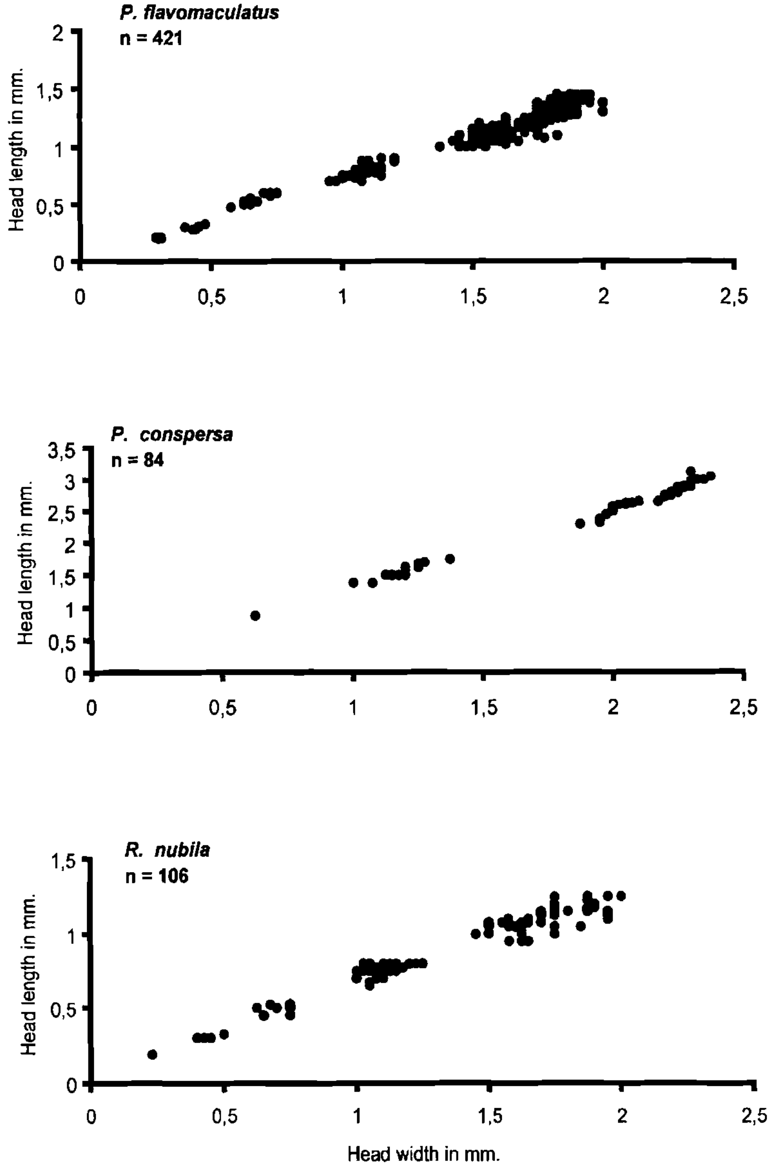

Figure 3. Head width and head length measured for the different instars of *P. flavomaculatus*, *P. conspersa* and *R. nubila* from Øvre Heimdalen during 1998.

RESULTS

Polycentropus flavomaculatus

In Øvre Heimdalen, *P. flavomaculatus* was found at stations 1 and 5. The species constituted a large part of the trichopteran fauna in these outlet areas (Table 1). The *P. flavomaculatus* population in the outlet of Øvre Heimdalsvatn had the highest density of Trichoptera at all stations, with an average of 19.9 larvae per kick sample during the ice free period. At station 1 the average was 0.9 *P. flavomaculatus* larvae per 30 sec. kick sample.

Head capsule measurements of larval *P. flavomaculatus* fell into discrete groups, representing the five larval instars (Figure 3). The size distribution of fifth instar larvae was bimodal, representing male and female larvae. First instar larvae were found at the beginning of June and in August, but only in low numbers (Figure 4). Second instar larvae were found in June and August, while third instar larvae occurred in June and July. Fourth and fifth instar larvae were found throughout the ice-free period. Pupae were recorded throughout July, and adults were taken from late July to mid-August.

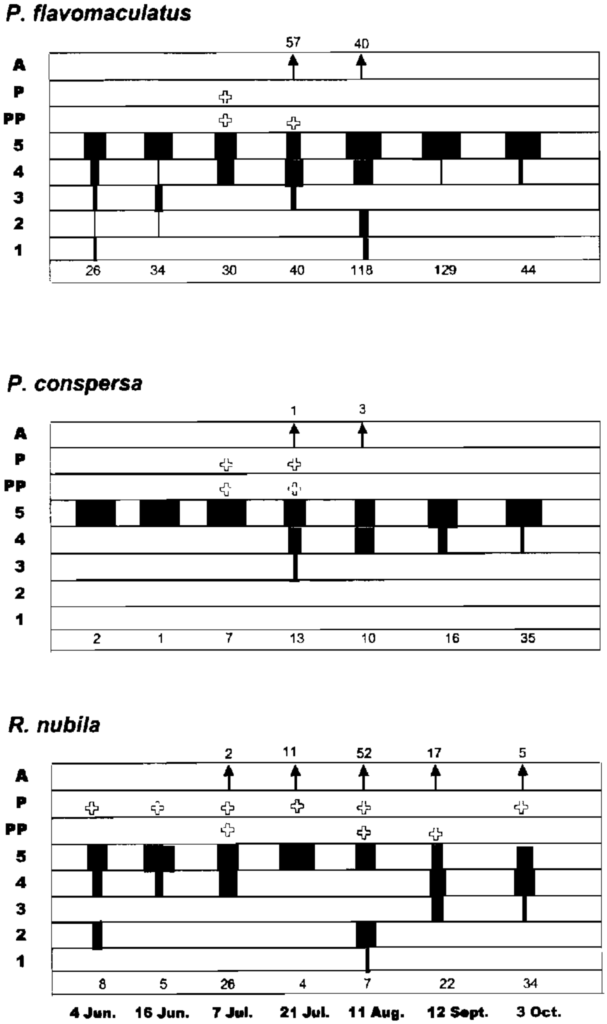

Figure 4. Instar frequency distribution on each sampling date during 1998 for *P. flavomaculatus*, *P. conspersa* and *R. nubila* from Øvre Heimdalen. Numbers above dates are number of larvae used in the analysis. The width of each bar is proportional to the frequency of that instar on that date. Numbers above arrows are total number of adults collected.

Table 1. The total number and the frequency composition (%) of the total trichopteran larval fauna for *P. flavomaculatus*, *P. conspersa* and *R. nubila* at each station in Øvre Heimdalen.

Station	**1**	**2**	**3**	**4**	**5**
P. flavomaculatus	18 (39.1)	*	*	*	418 (92.7)
P. conspersa	19 (41.3)	36 (85.7)	2 (6.7)	*	*
R. nubila	8 (17.4)	6 (14.3)	36 (72)	7 (53.8)	32 (7.1)

The diet of *P. flavomaculatus* was characterised by seasonal variation in the type of food consumed (Figure 5), having a niche breadth value of 6.65 with respect to diet. Most groups of prey were fragmented when found in the foregut, although small Chironomidae were sometimes found whole. *P. flavomaculatus* had dietary overlap of 82 % and 50 % with *P. conspersa* and *R. nubila*, respectively.

Plectrocnemia conspersa

Plectrocnemia conspersa was found at stations 1, 2 and 3. At stations 1 and 2, it was the dominant species comprising 41.3% and 85.7% of the trichopteran fauna collected in kick samples (Table 1). At station 3 only two larvae were recorded during the ice-free period. Head capsule measurements of the larval *P. conspersa* fell into three groups representing larval instars (Figure 3). No first or second instar larvae were recorded. One, third instar larvae was found in late July. Fourth instar larvae were found from late July to October. Fifth instar larvae were found on all sampling occasions and showed a clear separation in size between male and female larvae. Pupae were recorded in July and adults in late July and August (Figure 4).

The diet of *P. conspersa* was also characterised by seasonal variations in the type of food consumed (Figure 5). *P. conspersa* had a niche breadth of 3.28 with respect to diet. The prey found in the foreguts were less fragmented than in *P. flavomaculatus* and *R. nubila*. *P. conspersa* had dietary overlap of 82 % and 47 % with *P. flavomaculatus* and *R. nubila*, respectively.

Rhyacophila nubila

Rhyacophila nubila was found at all five stations. It dominated the trichopteran fauna in the faster flowing inlet area at stations 3 (72 %) and 4 (53.8 %). At station 5, relatively high numbers of *R. nubila* occurred, although only comprising 7.1 % of the total trichopteran fauna (Table 1).

Head capsule measurement of larval *R. nubila* collected fell into five groups, representing discrete larval instars (Figure 3). In contrast to the other two species there was no evidence of sexual dimorphism in the fifth instar. Fifth instar larvae and pupae occurred on all sampling occasions throughout the ice-free period. Only one first instar larva was recorded, collected in August. Adults were taken from beginning of July to October, with a peak during August (Figure 4).

The foregut of *R.nubila* larvae contained six different prey categories (Figure 5). All prey groups were highly fragmented. *R. nubila* had a niche breadth value of 2.37 and dietary overlap of 50 % and 47 % with *P. flavomaculatus* and *P. conspersa*, respectively.

DISCUSSION

Life cycle

Trichopteran species may have multivoltine, univoltine or semivoltine life history strategies. However, most species in Northwest Europe are either univoltine or semivoltine, while some are able to alternate between the two strategies depending on the environmental conditions (Solem & Gullefors 1995). At high altitudes or towards their northern limits, many widely distributed trichopteran species require more than one year to complete their

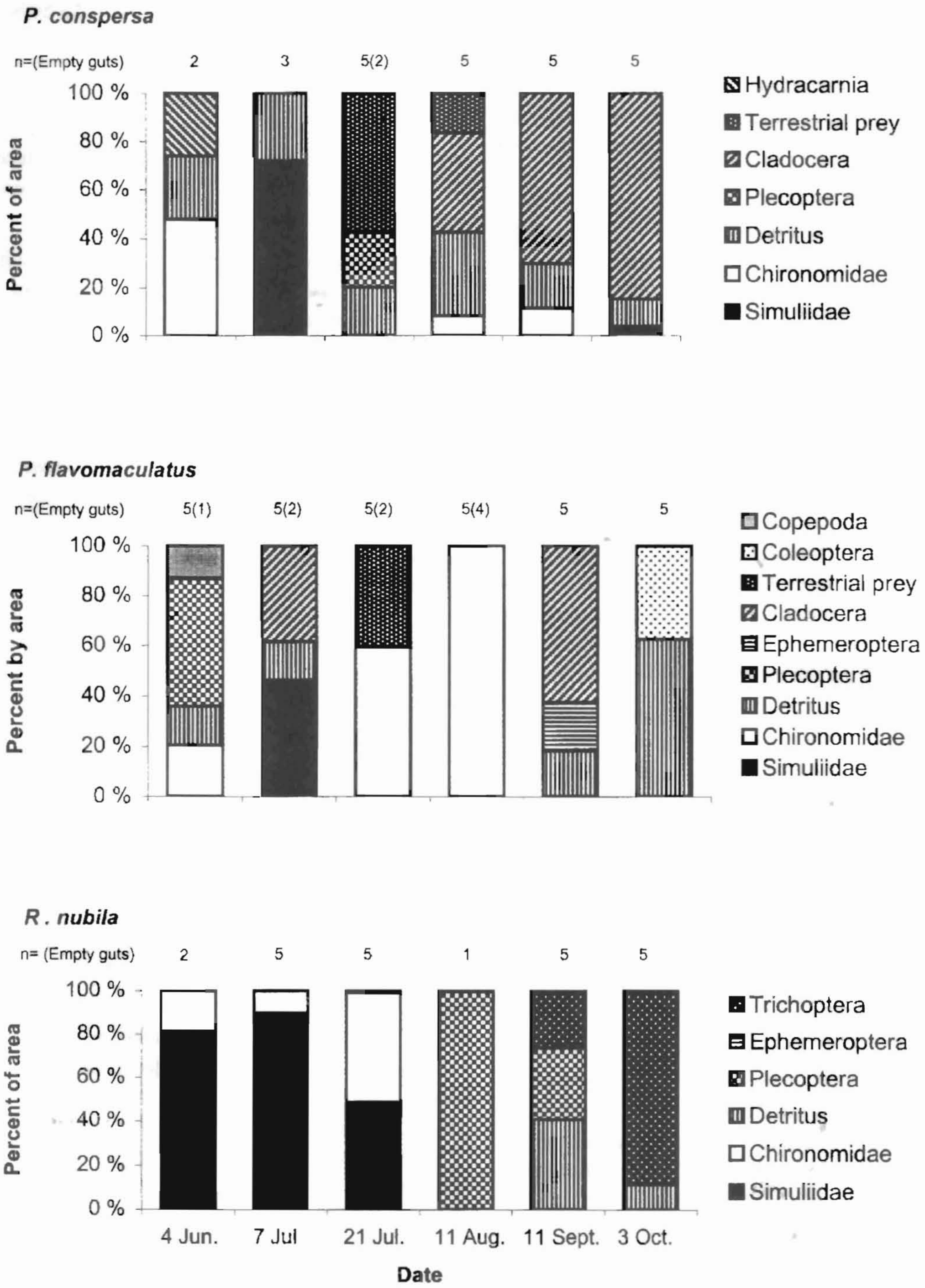

Figure 5. Monthly variations in dietary compositions of *P. flavomaculatus*, *P. conspersa* and *R. nubila* in Øvre Heimdalen during 1998. The percentage area occupied by each prey category in fore-guts mounted on glass slides, is displayed. Numbers above bars are total guts analysed on that date.

life cycle (Andersen & Tysse 1984). This seems to be the situation for *P. flavomaculatus*, *P. conspersa*, and *R. nubila* in Øvre Heimdalen.

All instars of *P. flavomaculatus* were present at the beginning of June, indicating that the larvae of this species overwinter in all stages (Figure 4). This fact, together with the presence of fifth instar larvae in all samples during the ice-free period and a restricted emergence period, suggests a semivoltine life cycle. In an earlier study, Eikeland (1982) found that *P. flavomaculatus* population in Øvre Heimdalen varied between a two and a three year life cycle. He mainly explained this semivoltine life cycle by the low temperatures. In another low temperature location in northern Sweden, Ulfstrand (1968) also considered the species to have a two year life cycle. In contrast, Recasens & Puig (1987) found *P. flavomaculatus* to have three generations per year in northern Spain, while Elliott (1968) found *P. flavomaculatus* to be univoltine in southern England. In close association with the influence of water temperature, the length of the ice-free season and the abundance of prey also influence the variation in life cycle length.

P. flavomaculatus emerged during late July and early August. The presence of first and second instar larvae in August suggested that egg incubation had a duration of about one month. During this period water temperatures were around 12 °C in the outlet of Øvre Heimdalsvatn. This fits in well with the laboratory results of Eikeland (1982) in which a mean incubation time of 34 days for *P. flavomaculatus* eggs at 12 °C was found.

The life history of *P. conspersa* is not readily apparent because too few larvae were collected. However, the available data also suggest a semivoltine life cycle for this species, due to the presence of fifth instar larvae on all sampling occasions and a restricted emergence period thus resembling the life cycle of *P. flavomaculatus* (Figure 4). Szczesny (1986) and Lancaster et al. (1995) assumed *P. conspersa* to be univoltine in Poland and England, respectively.

Studies of egg and pupal development have shown how temperature affected the life cycle length of *P. conspersa*. The egg development period varied between 93 days at 6 °C and 20 days at 18 °C (Hildrew & Wagner 1992), while in another study pupae metamorphosis varied between 12 days at 16-17 °C to 23 days at 10-11 °C (Tachet 1967). At station 2, where *P. conspersa* was found in highest densities, Sand (1997) recorded the mean temperature to be 8.9 °C during the ice-free period. Considering the low summer temperatures in Brurskardbekken, a semivoltine life cycle seems most likely.

The life cycle of *R. nubila* is more complex, with fifth instar larvae present during summer and a long emergence period (Figure 4). The presence of first and second instar in August indicates hatching of a new generation. Fjellheim (1976) found the egg incubation time for *R. nubila* to be 16 days at 18 °C. However, Brurskardbekken temperatures were around 10 °C at the beginning of August and the incubation period would be longer. The presence of adults in September indicated oviposition at even lower temperatures leading to overwintering in early instars or even as eggs. These overwintering early instar larvae or eggs probably needed an additional winter before emergence, leading to a semivoltine life cycle. In Swedish Lappland, Ulfstrand (1968) considered *R. nubila* to have a semivoltine life cycle, while in western Norway, Fjellheim (1976) found *R. nubila* to be univoltine. Both studies found life cycles difficult to interpret due to poor synchronisation.

The presence of *R. nubila* pupae early in the season indicated that some larvae overwinter as pupae. This phenomenon has also been found in the related species *Rhyacophila dorsalis* (Edington & Hildrew 1981). The pupae would have continued to develop when water temperatures rose, emerging in early summer. This might be one of the reasons why *R. nubila* had such a long flight period, lasting from early July until October with a peak in early August. A long flight period has also been shown for *R. nubila* in the Dovrefjell Mountains (Solem 1985) and in western Norway (Fjellheim 1976).

Water temperatures and food quality have been considered the most important factors prolonging life cycle in aquatic insects (Brittain 1978, 1990, Ward & Stanford 1982, Sweeney 1984). Reviewing the benthic insects in the lake Øvre Heimdalsvatn, Larsson et al. (1978) found only one example of a multivoltine life cycle. In contrast, semivoltine life cycles were fairly common in this high altitude area. Andersen & Tysse (1984) found that the limnephilid, *Chaeopteryx villosa,* had a univoltine life cycle in a lowland stream (90 m a.s.l.) and a semivoltine life cycle in a mountain stream (1220m a.s.l.) in western Norway. Brittain (1978) described a similar pattern for the stonefly *Nemurella pictetii.* Such adaptations enable the species to colonise a wider range of habitats than species with fixed life cycles. Species with a flexible life cycle will also be able to alternate life cycles and survive in unstable and harsh environments such as mountain areas. The semivoltine life cycle strategies of *P. flavomaculatus*, *P. conspersa* and *R. nubila* are therefore an adaptation to the relatively low summer temperatures and the eight months of ice and snow cover in Øvre Heimdalen.

Few first instar larvae were found during this study. This might be due to short duration and rapid development in the early instars during the summer or different habitat use between instars. In western Norway, Fjellheim (1976) found that *R. nubila* developed rapidly from egg to second instar in the autumn, before ice cover. The same rapid development from egg to second instar was also found in the *P. flavomaculatus* population in Øvre Heimdalen (Eikeland 1982).

Habitats

P. flavomaculatus, *P. conspersa* and *R. nubila* occupied different habitats in the streams of Øvre Heimdalen (Table 1). *P. flavomaculatus* and *P. conspersa* were typical pool species, inhabiting areas of low current velocity (Edington 1968). *P. flavomaculatus* was common in the two lake outlets (stations 1, 5), while *P. conspersa* was common in the lake outlet and pools in the upper reaches of Brurskardbekken (stations 1, 2). Earlier studies have shown that *P. conspersa* usually inhabits tributaries while *P. flavomaculatus* occurs in the main stream (Otto 1985). Otto (1985) suggested that *P. conspersa* dominates over *P. flavomaculatus* when their distributions overlap because of its larger size. This might be the reason why *P. conspersa* dominates the upper reaches of streams. The upper reaches of a stream may be more favourable for a larger species like *P. conspersa* because in these areas there are more larger potential prey items compared to the lake outlets. Otto (1984) found the dominant size group of drifting potential prey animals to be three times larger in a stream than in a lake outlet, suggesting a mechanism whereby prey size might be a factor affecting their distribution.

Temperature may be a factor influencing distribution patterns of polycentropodid larvae. *P. flavomaculatus* was only found in high numbers in lake outlets, areas having a relatively higher mean temperature than streams (Richardson and Mackay 1991). However, at station 1 both species occurred together, showing that *P. flavomaculatus* can live under the same temperature regime as *P. conspersa* and that temperature might not be the most important factor governing the distribution of the two species in Øvre Heimdalen.

The habitat of *R. nubila* was different than for the two polycentropodid species. It occurred at all the sampling stations in Øvre Heimdalen, but was most numerous at stations 3 and 5, station 3 being a typical fast flowing area while station 5 was slow flowing. This indicates little preference for water velocity in *R. nubila* as found in the two polycentropodid species. However, Bækken et al. (1984) demonstrated that *R. nubila* disappeared from a former riffle after the construction of a weir dam, suggesting the species has a water velocity threshold. In high velocity areas like stations 3 and 4, *R. nubila* was the dominant Trichoptera species. Its ability to exploit such habitats reduces competition with other predaceous trichopterans like *P. flavomaculatus* and *P. conspersa* in Øvre Heimdalen.

Diet

The diet of the three predaceous trichopteran species (Figure 5) reflected a combination of the prey found in the habitat and the foraging/capture techniques used. *P. flavomaculatus* and *P. conspersa* are typical filter feeders, passively catching prey drifting/crawling into their nets. By contrast *R. nubila* actively searches for its prey, lacking constructions to aid prey capture. However, the overall similarity of the diets of the study species was notable. All three species consumed Simuliidae, Chironomidae and Plecoptera although there was interspecific variation in the importance of these items. The diets of the two closely related *P. flavomaculatus* and *P. conspersa* were most similar (overlap 82 %). However, *R. nubila* exhibited considerable overlap in diet with the two polycentropodid species indicating their overlap also occurred between predators of very different foraging/capture mode. Townsend & Hildrew (1979) found considerable overlap between *P. conspersa* and the more mobile alderfly *Sialis fuliginosa*, indicating the same pattern. On the basis of high dietary overlap in the polycentropodid species, it is possible that competition for food and /or suitable net spinning sites could be a factor influencing their local distribution.

The monthly variations in feeding habits of the larvae (Figure 5) reflected the seasonal variations in prey abundance. For example, in early July, all three trichopteran species showed a dominance of simuliid prey in their diet, indicating a simuliid peak in the benthos at that time. This fits with observations of dense simuliid aggregation on rocks in all parts of the stream during July. Bildeng (1982) found the same pattern in his study of the filter feeding trichopteran, *Arctopsyche ladogensis*, in the River Glomma. In June 50 % of the benthic fauna by numbers consisted of simuliid larvae, leading to a dominance of simuliid in the species gut.

R. nubila had the narrowest niche breadth with respect to diet, consuming six prey categories. The lack of zooplankton in the diet reflects its foraging/capture techniques. It detects its prey by vision or sound, while it explores the substrate using side to side motions (Malmqvist & Sackmann 1996). During June and July, the diet was dominated by Chironomidae and Simuliidae, both numerous in Brurskardbekken (Lillehammer & Brittain 1978). After July other prey categories become important. This can be explained by the emergence of Simuliidae and Chironomidae in mid summer, forcing *R. nubila* to change to other prey groups. In late summer early instars of Plecoptera and Trichoptera hatched from eggs laid earlier in the summer and early instars of these two groups seem to be of major importance in the *R. nubila* diet. The presence of detritus in late summer could also be a sign of lower prey densities and reduced activity of both *R. nubila* and its prey due to lower water temperatures.

P. flavomaculatus and *P. conspersa* consumed similar types of prey including both aquatic and terrestrial items. The large difference in niche breath between the two species was probably associated with a lack of dietary dominance by a single prey group in the diet of *P. flavomaculatus*. In the diet of *P. conspersa*, Cladocera were clearly the most important prey item during August, September and October. The dominance of Plecoptera in the guts of *P. flavomaculatus* in June could be due to the life cycle of this species. Many plecopteran species emerge during June (Lillehammer 1978) and therefore have their maximum activity in this month. The presence of Copepoda in the June sample can be explained by the flushing of the plankton population in the lake during the spring snowmelt spate (Larsson 1978).

Chironomids occurred in guts of both *P. flavomaculatus* and *P. conspersa* in June, August and September. This fitted emergence pattern of chironomids along the shores of Øvre Heimdalsvatn, where they showed peak emergence in June and August (Brittain & Lillehammer 1978). The presence of Cladocera in the gut of *P. flavomaculatus* in July was due to the life cycle of *Holopedium gibberum*. This species hatched from resting eggs at the beginning of July and reached maximum densities during July in Øvre Heimdalsvatn (Larsson 1978).

Wind and rain can explain the occurrence of adult insects in the diet in late July. Such weather conditions may cause flying and emerging insects to fall down into the water where they can be captured in *P. flavomaculatus* and *P. conspersa* nets. Townsend & Hildrew (1979) found terrestrial prey in *P. conspersa* guts in significantly greater numbers after a period of high winds and rain. In late July and in August, adult insects were more important for *P. conspersa* than for *P. flavomaculatus*. This could be due to greater wind exposure in the area around stations 1 and 2 compared to the main valley where the outlet is situated.

In late summer *Bosmina longispina*, reached its maximum densities in Øvre Heimdalsvatn (Larsson 1978) and Cladocera were found in the diet of both polycentropodid species. The relative high amount of empty guts found in *P. flavomaculatus* in July and August could be due to fifth instar larvae preparing for pupation. A similar pattern was found in *P. conspersa.*

In conclusion all three species showed monthly variations in feeding habits as a result of seasonal variations in the abundance of the prey, indicating the species to be generalists.

Their flexible life cycle and the fact that they are generalists with regard to diet are probably important factors explaining their wide geographical distribution.

Acknowledgements. We wish to thank Gunnar Halvorsen for valuable comments on the manuscript, and John Solem for important information on some of the species. Research facilities in Øvre Heimdalen were provided by the Zoological Museum, University of Oslo. The Norwegian Water Resources & Energy Directorate (NVE) kindly supplied temperature data from the outflow of Øvre Heimdalsvatn.

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Received 16 June 2000,
accepted 31 October 2000

Individual variation in behavioural attraction and corresponding olfactory receptor capability to enantiomers of the pheromone ipsdienol in the pine engraver *Ips pini*

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Tømmerås, B.Å. 2000. Individual variation in behavioural attraction and corresponding olfactory receptor capability to enantiomers of the pheromone ipsdienol in the pine engraver *Ips pini*. Norw. J. Entomol. 47, 125–130.

Individual variation in pheromone production and behavioural responses elicited by pheromone compounds are shown in bark beetles as well as species of other insect groups. The aim of the present study was to elucidate whether the individual variations are reflected at the level of olfactory receptor neurons. In the bark beetle *Ips pini* (Col., Curculionidae, Scolytinae) the relationship between individual variation in behavioural attraction and olfactory receptor capability to the enantiomers of ipsdienol are compared. The method applied was recording electroantennograms, EAG. Responses were recorded to 0-25% and 90-100% (-)ipsdienol and no differences in the elicited EAG-responses were discovered between the individuals of the two potentially most extreme behavioural groups. Consequently, the different behavioural responses of individuals seem not to be based on variations of the olfactory receptor neurons. The behavioural variation seems to be connected to integration on higher level in the central nervous system.

Key words: *Ips pini*, EAG, pheromones, individual variation, olfactory receptor neurons

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INTRODUCTION

Intraspecific communication by chemical signals, defined as pheromones (Karlson & Lüscher 1959), is well studied in species of several insect families. In solitary species, simple pheromone mixtures are used for partner attraction, whereas in social insects complex mixtures from numerous glands serve various intraspecific functions. Although not social, numerous individuals of the bark beetles of the subfamily Scolytinae live together on the same host tree. Several species show mass attack and are considered pest insects. Their chemical ecology is rather well studied. Individual variation is shown both intra- and interpopulationally. This variation relates to pheromone production and release of pheromones, as well as to the behavioural response to pheromones (cf. Byers 1989). Schlyter & Birgersson (1989) reported that the coefficient of variation of the production of pheromone in bark beetles often turned out to be close to 100%. The ratio of variation using enantiomers of compounds was lower, approximately 25%. Variation in behavioural responses occurred in all tests, but was not easily quantified. It is not well documented whether the olfactory receptor level or higher levels in the nervous system are responsible for the observed individual variation in behavioural responses to pheromones.

In the pine engraver, *Ips pini* (Say) interpopulational variation in production and behavioural response to pheromones is well documented. This is due to the utilisation of different enantiomers of the pheromone ipsdienol (Birch et al. 1980, Lanier et al 1980). Electrophysiology, electro-antennograms (EAG) and single cell recordings, has been applied in order to detect differences between populations in the ability of the olfactory receptor neurons to perceive the pheromones. By means of EAG, Angst & Lanier (1979) was not able to find such differences, but the use of single cell recordings indicated differences in the number of identified receptor neurons detecting the two enantiomers of ipsdienol (Mustaparta et al. 1985).

The aim of the present study was to test if individually observed behavioural responses of the bark beetle, *Ips pini* (western population) to the pheromone (-)ipsdienol (Birch et al. 1980) corresponded to differences in the olfactory receptor neurons of the individual beetles. The method used to study the olfactory abilities of the antenna to perceive the pheromone compounds was recording electro-antennograms (EAG). This is the only possible method when studying relationships between behavioural responses and the olfactory receptor abilities in the same individual.

MATERIALS AND METHODS

Insects and pheromone substances

The insect material, adult beetles of *I. pini*, originated from California, USA. They consisted of five groups which had been collected from traps baited with mixtures with different ratios of (+) and (-)ipsdienol, 0%, 25%, 50%, 90%, 100% of the (-)enantiomer. The beetles were transported to Norway by air immediately after trapping. The insects were kept in the laboratory at 4-5°C for maximum 20 days. The synthetic enatiomers of ipsdienol were kindly provided by Firmenich Company, Switzerland, and were synthesised according to Ohloff & Giersch (1977).

Preparation and electrophysiological recordings

The preparation of living insects of *I. pini* for electrophysiological recordings followed standard preparation technique on plexiglas holders described previously (Angst & Lanier 1979, Tømmerås et al. 1993). Beetles were immobilised in a plexiglas holder, and antennal movement was prevented by placing the antenna onto wax. The recording glass capillary electrode filled with insect ringer solution was inserted into the distal part of antenna. The indifferent glass electrode was placed in the mouth of the insects.

Experimental procedure

Synthetic compounds from a «syringe olfactometer» (Kafka 1970) were tested by the stimulation procedure described by Mustaparta et al. (1980). A syringe containing 0.01, 0.1,...,100µg of the compound inserted onto a filter paper was the odour source for stimulation. The synthetic compounds were tested in double series, independently made syringe set A and B, at five concentration steps, from the lowest to the highest. Before and after a test program a syringe without compounds was used as pure air stimulation for control as well as a syringe with a small piece of bark to check stable recording conditions. Baseline and EAG

Table 1. The successful EAG recordings grouped after sex and previous behavioural response to (+) and (-)ipsdienol of the individual beetles of *I. pini*.

% of (-)ipsdienol in the traps	behavioural responses ♀♀	♂♂	Sum
0	1	3	4
25	2	3	5
50	3	3	6
90	0	2	2
100	5	7	12
Log	6	-	6
Random	6	4	10

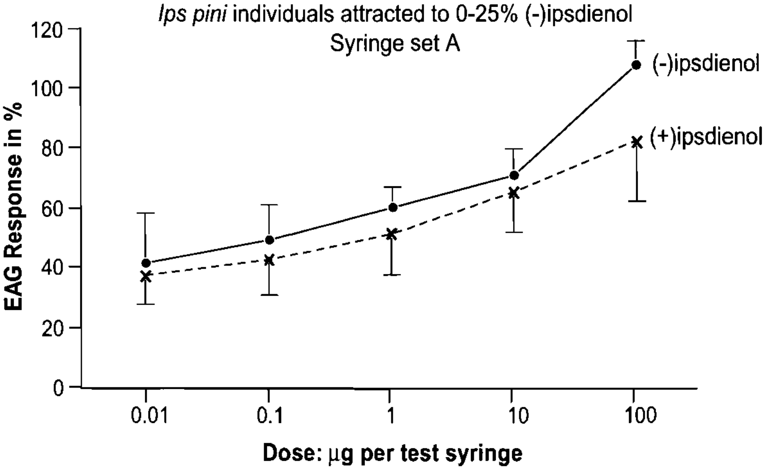
amplitudes were continuously visualised on an oscilloscope and stored on tape.

Evaluation of data

The amplitude of EAG responses was determined as the maximum of negative deflection of the DC potential between the electrodes during stimulation. In order to allow comparison of the EAG responses obtained in different individuals, the EAG amplitudes (varying from 0,75mV to 2,3mV) were normalised and expressed as a percentage of the mean response of the two syringes containing 100(g (-)ipsdienol.

RESULTS AND DISCUSSION

Successful EAG recordings were obtained from 45 individuals as shown in Table 1. There were no differences between females and males as reported



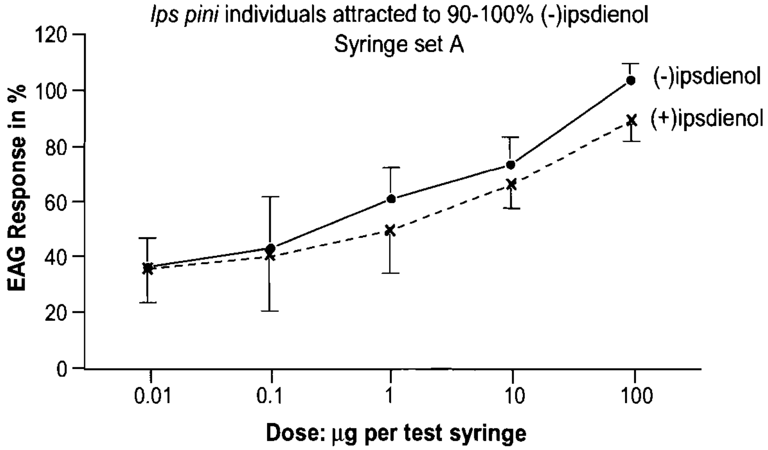


Figure 1. Dose-response relationships for electroantennogram (EAG) responses elicited of the two enantiomers of ipsdienol from syringe set A. Top: Individuals of Ips pini which previously showed behavioural attraction to 0 or 25% (-) ipsdienol (N=9). Below: Individuals which showed behavioural attraction to 90 or 100% (-) ipsdienol (N=14). Bars refer to standard deviation (SD).

previously on bark beetles (Angst & Lanier 1979, Mustaparta et al. 1979, 1980, Tømmerås 1985, Tømmerås & Mustaparta 1989).

To allow statistical analysis, the data from the EAG recordings were grouped. The 9 individuals which in behavioural tests responded to either 0 or 25% (-)ipsdienol are compared to the 14 individuals which responded to either 90 or 100% of the (-)enantiomer of the pheromone ipsdienol (Figure 1 and 2). To secure a more reliable dose-response relationship the two independently made stimulation series were kept separately (syringe set A and B). Figure 1 shows the results obtained by syringe stimulation of serie A while Figure 2 shows corresponding data obtained by using serie B as stimulation source. No differences in the elicited EAG-responses were seen from the recordings when

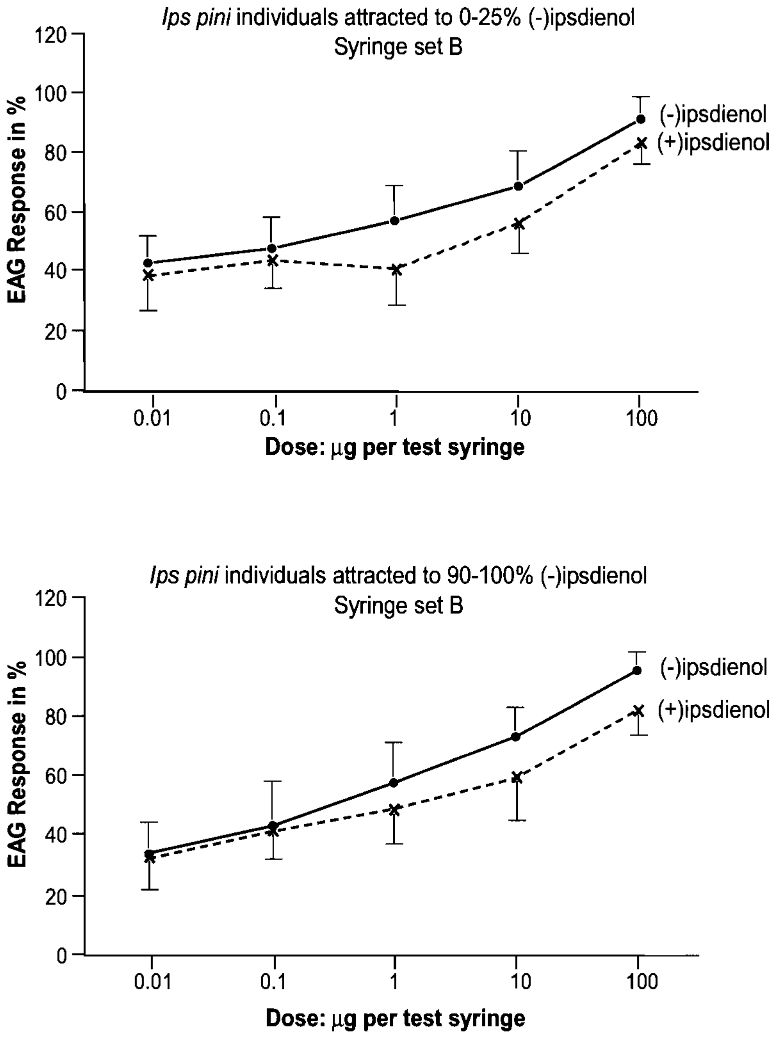


Figure 2. Dose-response relationships for electroantennogram (EAG) responses elicited of the two enantiomers of ipsdienol from syringe set B. Top: Individuals of *Ips pini* which previously showed behavioural attraction to 0 or 25% (-) ipsdienol (N=9). Below: Individuals which showed behavioural attraction to 90 or 100% (-) ipsdienol (N=14). Bars refer to standard deviation (SD).

comparing the individuals from the two potentially most extreme groups according to the behavioural responses to mixtures of (+) and (-)ipsdienol.

In the present study variation on the olfactory receptor level between individuals with different behavioural responses was not found. This means that the property of the olfactory receptor neurons of *I. pini* seems not to be the basis for the variation in observed behaviour of individuals aroused by the two enantiomers of ipsdienol. The basis for the behavioural variation of individuals seems to be different integration on a higher level in the central nervous system.

It could be argued that the bark beetle species might possess an intermediate type of olfactory receptor cell for receiving e.g. blends of the two ipsdienol enantiomers, and this would hide variations that could be discovered by the use of the EAG technique. However, it has previously been shown that the receptor cells are types responding to either (+) or (-) ipsdienol, and that there are no intermediate receptor types present in bark beetles (Mustaparta et al. 1985).

Evaluation of individual differences on the level of olfactory receptor neurons is in general difficult due to differences in recording conditions and the physiological status of the insect from one recording to another. In addition the EAG technique is considered quite coarse as a basis for evaluation of the importance of chemical agents for the insects. These factors are probably not so important uncertainties in the present study when only testing the relative differences between EAG responses elicited of two enantiomers of the main pheromone compound ipsdienol. In addition the recording conditions and the physiological status have been monitored using control stimulations during each test of the insects.

Acknowledgements. I especially acknowledge Steven Seybold and David Wood, University of California, Berkeley, for performing the behavioural selection tests of the bark beetle *Ips pini* and organise the supply of living beetles to the laboratory in Norway. I also thank Prof. Hanna Mustaparta at Department of Zoology, NTNU, head of the laboratory where the experiments were carried out.

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Received 29 September 1999,
accepted 17 April 2000

Norw. J. Entomol. 47, 131–136. 2000

A new species of *Physoneura* Ferrington et Sæther, 1995, from Ecuador (Chironomidae, Orthocladiinae)

Elisabeth Stur & Trond Andersen

Stur, E. & Andersen, T. 2000. A new species of *Physoneura* Ferrington et Sæther, 1995, from Ecuador (Chironomidae, Orthocladiinae). Norw. J. Entomol. 47, 131–136.

Physoneura paulseni sp. n. is described and figured as male imago based on specimens collected in the Chimborazo Province in Ecuador. The genus *Physoneura* Ferrington et Sæther, 1995, originally described based on two species from Chile and Argentina, now includes three species from South America. A key to the male imagines is given.

Key words: Chironomidae, Orthocladiinae, *Physoneura*, new species, Ecuador

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INTRODUCTION

The genus *Physoneura* was erected by Ferrington & Sæther (1995) for two Orthocladiinae species, *P. nigroflava* (Edwards, 1931) and *P. minuscula* (Edwards, 1931) from Patagonia and Southern Chile. Edwards (1931) placed the two species in the genus *Spaniotoma* Philippi, subgenus *Smittia* Holmgren. The two species show similarities to several semi-terrestrial genera like *Pseudosmittia* Goethgebuer and *Colosmittia* Sæther et Andersen. Brundin (1956) discussed the systematic position of the two species and doubted they belonged in *Pseudosmittia.* When erecting the genus Ferrington & Sæther (1995) placed *Physoneura* in the *Corynoneura* group of genera together with *Corynoneura* Winnertz, *Thienemaniella* Kieffer and *Tempesquitoneura* Epler et de la Rosa, mainly based on the subapical inflation of R_1 and the apical inflation of R_{4+5}. The genus also has a small, but distinct keel on the front trochanter and an oblique tibial comb, which are characters shared with *Corynoneura.* But *Physoneura* differs from the other three genera, particularly in the shape of the phallapodeme, which has a blunt, rounded aedeagal lobe, in contrast to the pointed and strongly recurved aedeagal lobe usually found in the *Corynoneura* group of genera. Thus, as pointed out by Ferrington & Sæther (1995), knowledge of the females and the immatures is necessary to place the genus with certainty.

Of the two previously described species, *P. nigroflava* (Edwards) is known from Bariloche in Territory Rio Negro in Argentina, while *P. minuscula* (Edwards) was collected in Castro, on the Island of Chiloé in southern Chile. Both localities are in Patagonia south of 30° south latitude. The newly described species was collected in the Chimborazo Province in Ecuador, where it was taken close to permanent snow beds at an altitude of about 4.800 meter. The species thus extends the known range of the genus north to the central Andes, an area which also has a predominately austral fauna (see e.g. Humphries & Parenti 1999).

METHODS

The material examined was mounted on slides following the procedure outlined by Sæther (1969). The general terminology and abbreviations follow Sæther (1980). The measurements are given as a range followed by the mean.

The holotype and 9 paratypes of *Physoneura paulseni* sp. n. are deposited in the Museum of Zoology, Bergen, Norway (ZMBN); 2 paratypes are deposited in the Zoologische Staatssammlung, Munich, Germany (ZSM); 2 paratypes in Coleçao Entomológica, Instituto Oswaldo Cruz, Rio de Janeiro, Brazil (FIOCRUZ); and 2 paratypes in Museo Ecuatoriano de Ciencias Naturales, Quito, Ecuador (MECN).

SYSTEMATICS

Physoneura Ferrington et Sæther, 1995, emended

Generic description as in Ferrington & Sæther (1995), except sternapodeme without or with distinct oral projections.

Key to male imagines of *Physoneura* Ferrington et Sæther, 1995

1. Small species, wing length about 0.75 mm; R_{4+5} ending above apex of Cu_1; abdominal segments 1-3 yellowish. Chile. (Ferrington & Sæther 1995: Figures 6-10). .. *P. minuscula* (Edwards)

— Larger species, wing length > 1.0 mm; R_{4+5} ending proximal to apex of Cu_1; colouration uniformly dark brown to black. 2

2. Wing length about 1.04 mm; transverse sternapodeme without oral projections; inferior volsella weak. Argentina. (Ferrington & Sæther 1995: Figures 1-5). .... *P. nigroflava* (Edwards)

— Wing length about 1.30 mm; transverse sternapodeme with strong, triangular oral projections; inferior volsella relatively well developed, broadly rounded to subtriangular. Ecuador. (Figures 1-10). . *P. paulseni* sp. n.

Physoneura paulseni new species

(Figures 1 - 10)

Holotype: male, **Ecuador:** Chimborazo Province: Refugio Hermanos Carrel, 4.800 m a. s. l., 9. February 1997, picked from in between hairs on composite flower, J. Skartveit leg. (ZMBN No.: 279).

Paratypes: 15 males, as holotype.

Diagnostic characters: See key.

Etymology: Named after Frederik A. Paulsen, for giving chironomid material from exotic places to Bergen Museum.

Description

Male imago (n = 10, if not otherwise stated). — Total length 1.62-1.90, 1.74 mm. Wing length 1.25-1.35, 1.30 mm. Total length / wing length 1.27-1.40, 1.32. Wing length / length of profemur 3.83-4.16, 3.99. Colouration dark brown.

Head (Figure 1). Antenna as in Figure 3; AR 0.24-0.29, 0.27; ultimate flagellomere 124-152, 135 μm long. Postorbitals 0-2, 2. Clypeus with 4-6, 6 setae. Cibarial pump, tentorium and stipes as in Figure 2. Tentorium 106-117, 111 (5) μm long; 10-13, 12 (5) μm wide at sieve pore, 10-14, 13 (5) μm wide at posterior tentorial pit; stipes 88-98, 96 (6) μm long; 23-32, 26 (6) μm wide. Palp segments lengths in μm: 12-16, 15; 18-27, 24; 37-41, 39; 41-49, 44; 51-74, 59. Third palp segment with 1 sensilla clavata subapically, 10-12, 12 μm long.

Thorax (Figure 5). Antepronotum with 1 seta. Dorsocentrals 2-4, 3; prealars 2. Scutellum with 2 setae.

Wing (Figure 4). VR 1.36-1.47, 1.40. False vein 412-488, 449 μm long. Brachiolum with 1 seta, other veins bare. Squama bare.

Legs. Dorsal keel of front trochanter as in Figure 7. Spur of front tibia 29-36, 33 μm long; spurs of middle tibia 14-18, 16 μm and 11-15, 13 μm long; of hind tibia 30-37, 33 μm and 17-25, 21 μm. Width at apex of front tibia 22-28, 24 μm; of middle tibia 21-23, 22 μm; of hind tibia 26-30, 28 μm. Hind tibial comb (Figure 6) with 9-12, 10 setae; shortest setae 15-21, 18 μm long; longest setae 25-30, 28 μm long. Lengths and proportion of legs are given in Table 1 and 2.

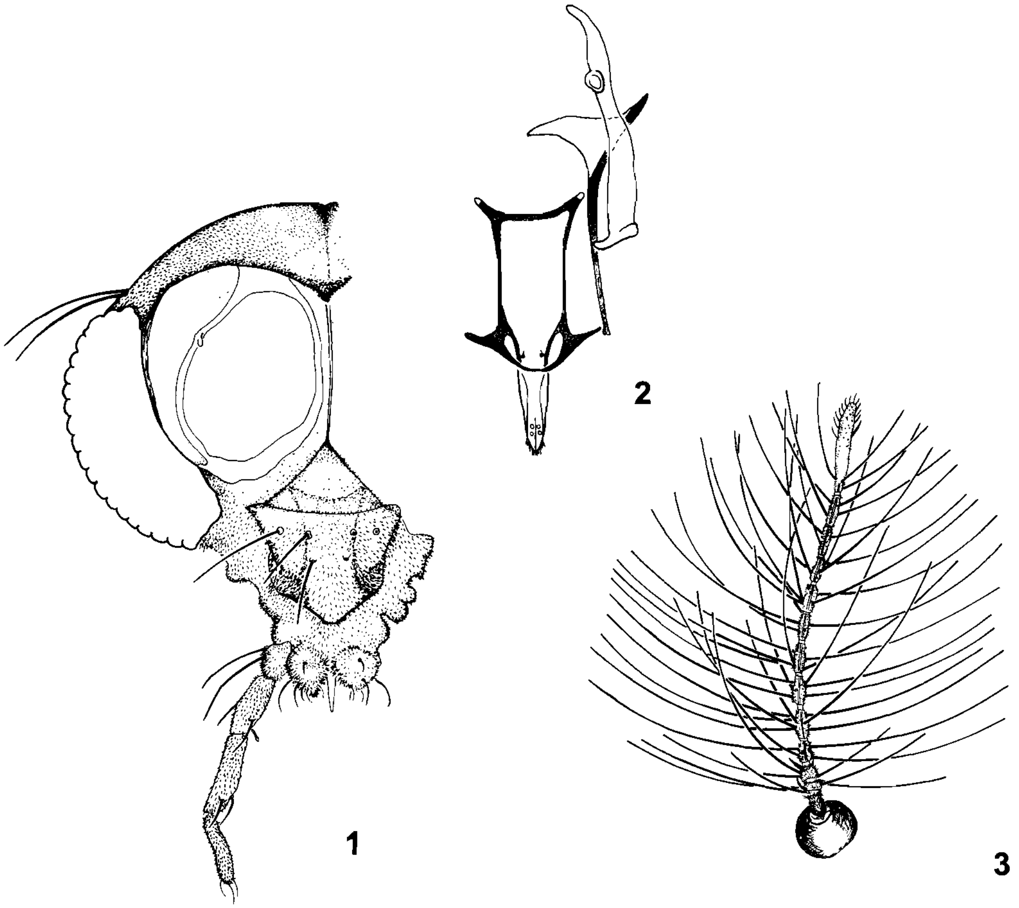
Hypopygium (Figures 8-10). Anal point not distinctly set off, with 1-4, 3 weak setae; laterosternite IX with 1-3, 2 setae. Phallapodeme 37-43, 41 μm long. Transverse sternapodeme arcuate, with distinct, triangular oral projections; 51-59, 57 μm long. Gonocoxite 102-113, 106 μm long; inferior volsella relatively well developed, broadly rounded to subtriangular, 33-41, 38 μm long, 11-17,

Table 1. Lengths (in µm) of legs for males of *Physoneura paulseni* sp. n.

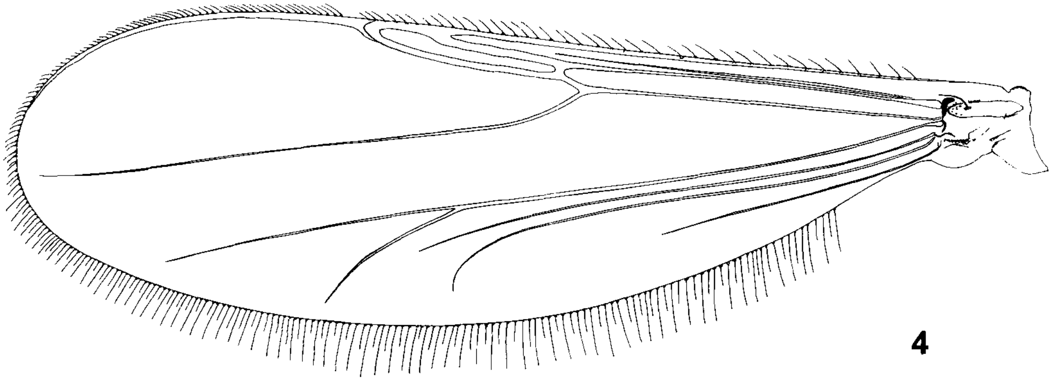
	fe	ti	ta$_1$	ta$_2$	ta$_3$	ta$_4$	ta$_5$
p$_1$	304-344, 320	388-444, 404	172-192, 180	96-116, 104	68-80, 72	32-40, 36	24-28, 26
p$_2$	384-412, 399	332-352, 344	140-160, 148	84-116, 99	56-76, 70	32-36, 33	24-32, 28
p$_3$	364-408, 391	380-424, 396	192-224, 205	92-116, 105	100-112, 105	36-44, 38	28-36, 29

Table 2. Proportions of legs for males of *Physoneura paulseni* sp. n.

	LR	BV	SV	BR
p$_1$	0.42-0.46, 0.45	3.71-4.04, 3.88	3.94-4.23, 4.04	2.14-2.78, 2.35
p$_2$	0.41-0.47, 0.43	3.54-4.28, 3.93	4.65-5.26, 5.02	2.27-3.03, 2.54
p$_3$	0.45-0.55, 0.52	3.41-3.69, 3.57	3.61-4.39, 3.86	2.90-3.75, 3.28



Figures 1-3. *Physoneura paulseni* sp. n., male imago. 1, head; 2, cibarial pump, tentorium and stipes; 3, antenna.



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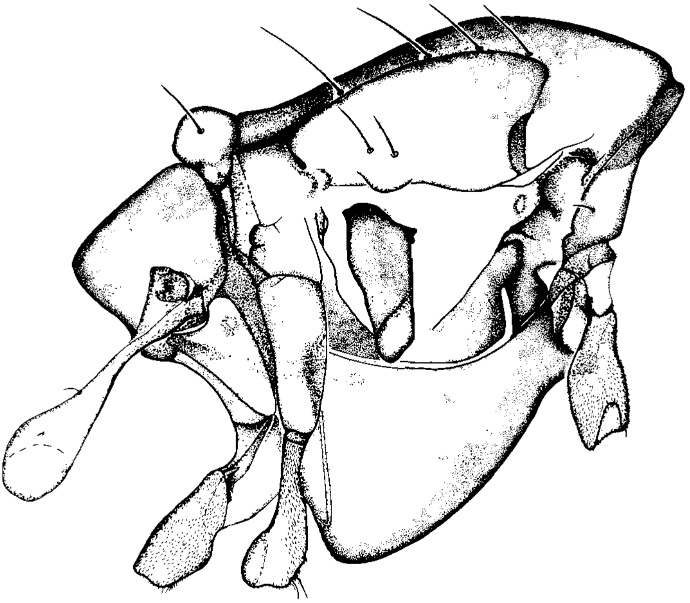

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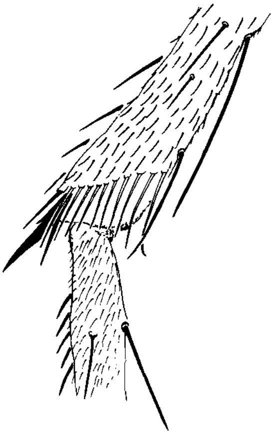

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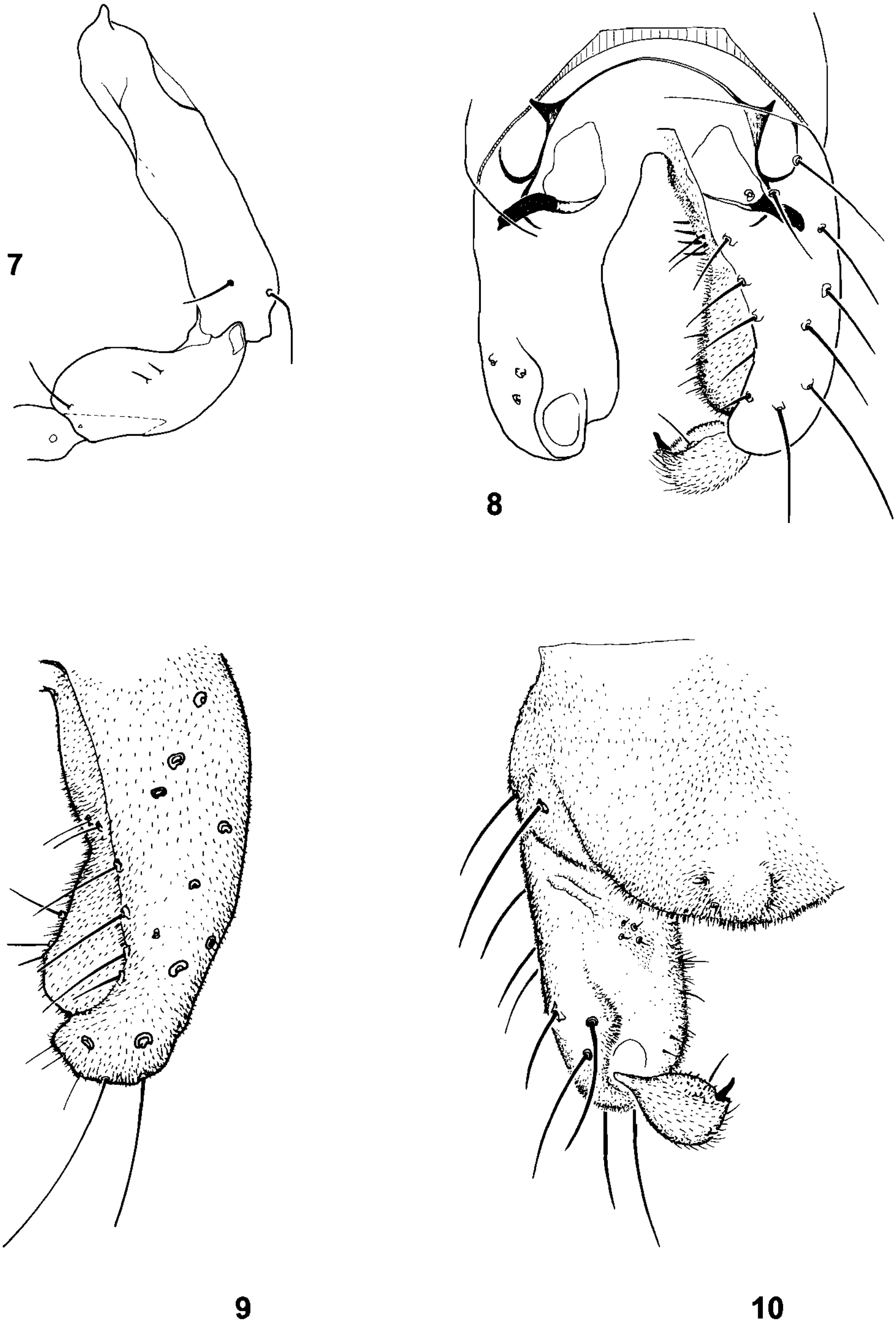
Figures 4-6. *Physoneura paulseni* sp. n., male imago. 4, wing; 5, thorax; 6, tibial comb.



Figures 7-10. *Physoneura paulseni* sp. n., male imago. 7, trochanter of front leg; 8, hypopygium with tergite IX removed, left dorsal aspect, right ventral aspect; 9, gonocoxite and inferior volsella, ventral aspect; 10, tergite IX and dorsal aspect of left gonocoxite and gonostylus.

13 µm wide, widest at 0.67-0.81, 0.72 of length, ending at 0.83-0.89, 0.86 of gonocoxite length. Gonostylus 43-48, 45 µm long; megaseta 6-9, 8 µm long. HR 2.06-2.65, 2.32; HV 3.71-4.18, 3.90.

Biology: The species was collected close to a small, slow flowing, shallow stream with substrate of stones, pebbles and gravel. The locality was situated approximately 100 meters below permanent snow beds at 4.800 m altitude in an area with sparse vegetation. The midges were found sitting in between the hairs on the stem and leaves of the Asteracea *Culcitium nivalis* Kunth.

Acknowledgements. We are indebted to Dr. John Skartveit, Museum of Zoology, University of Bergen, for providing us with the Orthocladiinae material he collected in Ecuador. Thanks are also due to professor Göran Högstedt, Department of Zoology, University of Bergen, for all help and support, to Paul Ramsay, University of Plymouth and other members of TAXACOM, for identifying *Culcitium nivalis* Kunth, and to Gladys Ramirez, Museum of Zoology, University of Bergen, for making the slide preparations. Permission to collect in Ecuador was given by INEFAN, Quito. The study of South American Orthocladiinae is funded through the Norwegian Research Board (NF) project no.: 121975/720.

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Received 31 July 2000,
accepted 22 September2000

Norw. J. Entomol. 47, 137–147. 2000

Description of females of three species of *Ectrepesthoneura* Enderlein (Diptera, Mycetophilidae)

Lene Martinsen & Geir E. E. Söli

Martinsen, L. & Söli, G. E. E. 2000. Description of females of three species of *Ectrepesthoneura* Enderlein (Diptera, Mycetophilidae). Norw. J. Entomol. 47, 137–147.

Descriptions of the females of *Ectrepesthoneura hirta*, *E. colyeri* and *E. pubescens* are given, based on material from two Norwegian localities. The studied specimens were hatched from deacying wood and collected by use of Malaise traps. The three species can only be separated on differences in the outline of the terminalia, especially in the shape of the gonapophysis 9. A preliminary key for females of the studied species is given, together with detailed figures of the terminalia.

Key words: Mycetophilidae, fungus gnats, *Ectrepesthoneura*, female, description.

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INTRODUCTION

The genus *Ectrepesthoneura* Enderlein, 1911 belongs to the family Mycetophilidae in the superfamily Sciaroidea. The genus is commonly ascribed the tribe Leiini (e.g. Edwards 1925, Söli 1997), but in several respects it takes an intermediate position between the two tribes Leiini and Gnoristini. Tuomikoski (1966) and Väisänen (1986) have both argued for its inclusion in the latter.

Ectrepesthoneura is known from the Holarctic region only, with 12 species from the Palaearctic and 3 from the Nearctic subregions (Table 1); two more species have been described from Baltic/German amber (Eocene/Oligocene), *E. magnifica* (Meunier, 1904) and *E. rottensis* Statz, 1944 (Evenhuis 1994). A revision of the European and eastern Nearctic species of *Ectrepesthoneura*, including an identification key for males, are given by Chandler (1980).

As for the majority of species of Mycetophilidae, most females of *Ectrepesthoneura* have never been described, or the descriptions are inadequate, without detailed illustrations of the terminalia (e.g. Caspers 1991; Chandler 1980; Zaitzev 1984). Chandler (1980) assumed that most females in the British material studied by him, belonged to *E. hirta*, and included a very brief description, without figures, of these females and a second female tentatively ascribed *E. pubescens*. The female of *E. hirta* has been figured, but not thoroughly described by Söli (1997: Fig. 42A, B).

Chandler (1980) discussed the relationship between *Ectrepesthoneura* and *Tetragoneura* Winnertz, 1846, by American authors usually regarded as synonyms (e.g. Vockeroth 1981), and suggested that some of the ten Nearctic species described as *Tetragoneura* should be transferred to *Ectrepesthoneura*. These two genera have commonly been regarded as sistergroups (e.g. Söli 1997), but in a recent paper, Chandler (1999) suggests that *Ectrepesthoneura* is paraphyletic and that new genera will be recognized.

Hopefully, more thorough studies of female *Ectrepesthoneura* will not only prove valuable in the identification of species, but may also reveal new characters that can be valuable in future studies to solve the phylogenetic relationship of *Ectrepesthoneura* and other enigmatic genera within Mycetophilidae.

Table 1. Extant species of *Ectrepesthoneura* Enderlein, 1911.

PALAEARCTIC:
- *E. bucera* Plassmann, 1980
- *E. chandleri* Caspers, 1991
- *E. colyeri* Chandler, 1980
- *E. gracilis* Edwards, 1928
- *E. hirta* (Winnertz, 1846)
- *E. ledenikiensis* Bechev, 1988
- *E. montana* Zaitzev, 1984
- *E. nigra* Zaitzev, 1984
- *E. ovata* Ostroverkhova, 1977
- *E. pubescens* (Zetterstedt, 1860)
- *E. referta* Plassmann, 1976
- *E. tori* Zaitzev & Økland, 1994

NEARCTIC:
- *E. bicolor* (Coquillett, 1901)
- *E. laffooni* Chandler, 1980
- *E. canadensis* Zaitzev, 1993

MATERIAL AND METHODS

Material

The material originates from two different localities: Frogn, Akershus, SE Norway, and Alta, Finnmark, N Norway. The material from Frogn was collected by use of hatching-traps attached to logs of decaying wood, and the emerging insects were collected in test tubes. These samples held three species of *Ectrepesthoneura*, *E. colyeri*, *E. hirta* and one female that could not be identified. The sample from Alta held two species, *E. hirta* and *E. pubescens*, and were collected by use of Malaise traps. The specimens were stored in 70 % alcohol, and later several of them were dissected and slide mounted according to the method described by Söli (1997). The material is kept in the collection of Zoological Museum, University of Oslo, Norway.

Measurements and terminology

The arrangement of the ocelli is described by two ocellar ratios defining the position of the lateral ocellus in relation to the median ocelli and the compound eye. Due to the strong reduction of the second segment of palpus, the palpomere ratios are given as the length of the first segment to the length of third, fourth and fifth segment, respectively. The length of scutum was measured as a straight line from its anterior to its posterior border; and the length of thorax as a straight line from the anterior border of scutum to the posterior border of scutellum. The wing length was measured from the distal median plate to the apex of wing. Two leg ratios are used in the descriptions, given for fore, mid and hind leg, respectively: SV, the combined length of femur and tibia to the length of the first tarsomere; and BV, combined length of femur, tibia and first tarsomere to the combined length of tarsomere 2-5 (see Söli 1997). In addition, the lengths of the tibial spurs are given in relation to the diameter of the tibiae, measured apically. The arrangement of the tibial setae and bristles is indicated by use of the following abbreviations: a, anterior; p, posterior; d, dorsal; v, ventral; ad, anterodorsal; av, anteroventral; pd, posterodorsal; pv, posteroventral (McAlpine 1981).

Total length is calculated as the combined length of head, thorax and abdomen. When five or more specimens were measured the mean value is given in brackets after the range.

The morphological terminology follows Söli (1997).

Association of females

As all but one of the samples obtained by hatching held just one species, the presence of males and females in the same sample was considered a reliable evidence for the association of the sexes. The sample with two species contained *E. colyeri* and an unidentified female. Females of *E. colyeri* were primarily associated on the basis of another sample containing just one species. In the material from Frogn, *E. colyeri* and *E. hirta* were found in two different habitats, giving further support to the association. On the basis of the association of females from Frogn and by use of species keys (Chandler 1980; Hutson *et al.* 1980), males and females of *E. hirta*, and males of *E. pubescens,* were identified in the material from Alta. Consequently the remaining female specimens in the sample from Alta were considered to be *E. pubescens.*

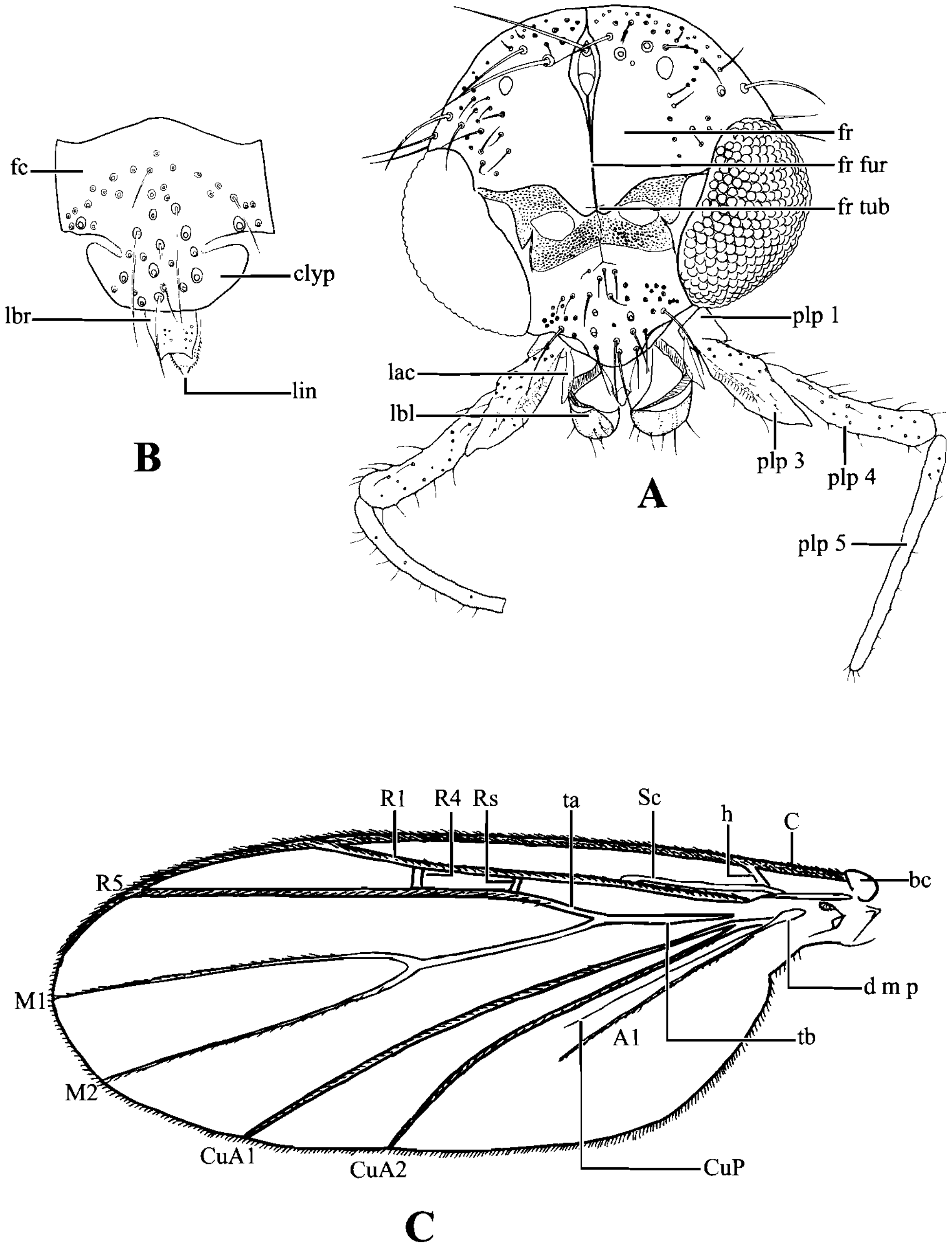

Figure 1. - A. Head of *Ectrepesthoneura colyeri* Chandler. - B. Face and clypeus of *E. hirta* (Winnertz). - C. Wing of *E. colyeri*. Abbreviations: A = anal vein; bc = basicosta; C = costa; clyp = clypeus; CuA1 and CuA2 = anterior branches of cubitus; CuP = posterior branch of cubitus; d m p = distal median plate; fc = face; fr = frons; fr fur = frontal furrow; fr tub = frontal tubercle; h = humeral; lac = lacinia; lin = lingua; lbl = labellum; lbr = labrum; M1 and M2 = branches of media; plp = palpomere; R1 = anterior branch of radius; R4 and R5 = posterior banches of radius; Rs = radial sector; Sc = subcosta; ta = anterior transversal; tb = basal transversal.

STUDIED FEMALES OF *ECTREPESTHONEURA*

General morphology

Coloration. Head dark brown. Palpi and mouthparts yellow. Thorax dark brown. Halters yellow to whitish. Wings clear without markings; costa and radius dark, remaining veins yellowish. Legs mainly yellowish, trochanters and sometimes also the basalmost part of coxae brown. Coxa, trochanter and femur with pale setae. Tibial spurs yellowish. Abdominal tergites brown or with yellow markings.

Head (Figure 1A, B). Three ocelli in linear arrangement on top of head. Vertex and lateral portions of frons evenly covered with setae of variable size. Height of compound eye about 0.5 times height of head. Eyes with shallow invaginations above antennal socket; 3-4 small interommatidial setae. Frontal furrow usually distinct and complete. Scape with setae on apical half; pedicel with row of apical setae, one bristle. Flagellum with 14 flagellomeres. Surface of each flagellomere with trichia and rounded depressions, probably representing campaniform sensilla. Fused face and clypeus with numerous setae of variable size. Labrum apically broad. Lingua pointed, with several apical fringes. Palpus with 5 segments: first segment short; second strongly recuced, hardly traceable; third segment thickened at middle, with specialised sensilla along inner surface; fourth attached to third about $^1/_3$ from it's distal end; fifth segment long and slender. Segment 3-5 of palpus with some setae. Lacinia oblong.

Thorax. Scutum with pale setae arranged in indistinct, broad rows. Most setae small, but posteriorly some long and pronounced bristles. Scutellum with two pairs of bristles, and additional small intermittent setae. Antepronotum and proepisternum evenly covered with setae, some long and pronounced. Remaining pleural sclerites bare. Anapleural suture complete, declining posteriorly.

Wings (Figure 1C). Costa produced beyond tip of R5. Sc reaching 0.5 to 0.6 distance to base of Rs. R4 present, forming small, oblong radial cell. Length of crossvein ta subequal to or longer than radial cell. R1 short, 0.8 to 1.6 times as long as crossvein ta. Median and posterior fork complete; stem of posterior fork very short. All veins with setae except h, Sc, tb, R4, Rs, stem of M, basal portion of M1, M2 and crossvein ta.

Legs. Hind coxa with one row of long and several smaller setae posteriorly, and additional group of setae anteriorly, near apex. Tibia and tarsi densely clothed with short, unevenly arranged, dark trichia. Fore tibia only with setae apically.

Terminalia (Figures 2-5). Pair of broad gonocoxites 8 intimately fused with posterior border of sternite 8, evenly clothed with small setae and several bristles posteriorly. Pair of weakly sclerotized, subtriangular gonapophyses 8 located dorsally of gonocoxites 8. Median, membranous labia located between gonocoxites 8 and gonapophyses 8. Tergite 8 narrow. Tergite 9 longer than tergite 8, setose. Pair of gonocoxites 9 located laterally of tergite 9, densely covered with trichia. Gonapophyses 9 plate-like and membraneous, usually with longitudinal sclerotized keel. Spermathecal eminense usually distinct, ending in membraneous area probably representing vestiges of sternite 9. Spermathecal ducts weakly sclerotized. Tergite 10 narrow, with transverse row of long setae posteriorly, median portion of basal border prolonged cephalad. Sternite 10 narrow, bare. Cerci two-segmented; second, ovate segment much smaller than first segment.

Key to females of *E. colyeri*, *E. hirta* and *E. pubescens*

1. First segment of cercus produced apically beyond the attachment of second segment (Figure 2C, D). Wing length equal to or less than 3 times as long as profemur .... *colyeri*

– Second segment of cercus attached at the extreme apex of first segment. Wing length more than 3 times as long as profemur 2

2. Viewed laterally, dorsal border of gonocoxites 8 distinctly invaginated (concave) towards apex (Figure 4C). Gonocoxites 8 with a collection of strong apical setae. First segment of cercus about 3 times as long as second .... *pubescens*

– Viewed laterally, dorsal border of gonocoxites

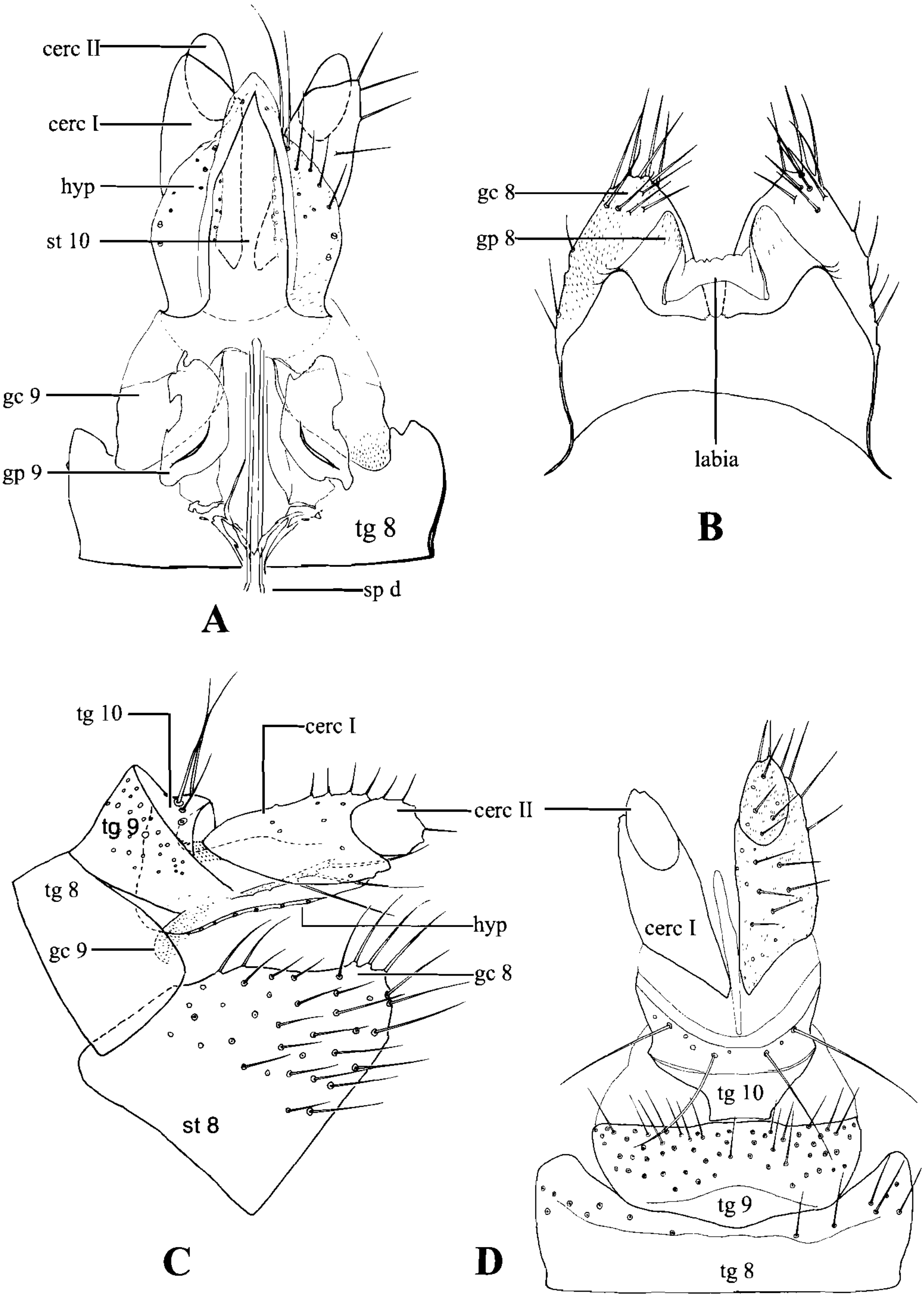

Figure 2. Female terminalia of *Ectrepesthoneura colyeri* Chandler. - A. Ventral view, sternal parts removed. - B. Dorsal view, tergal parts removed. - C. Lateral view. - D. Dorsal view. Abbreviations: cerc = cercus; gc = gonocoxite; gp = gonapophysis; hyp = hypoproct; sp d = spermathecal duct; st = sternite; tg = tergite.

8 even or slightly convex towards apex (Figure 3C). Gonocoxites 8 with setae evenly dispersed. First segment of cercus distinctly less than 3 times as long as second .... *hirta*

The difference in the ratio used in the first couplet to separate *E. colyeri* from the remaining two species is small, and the character should be used with care.

Ectrepesthoneura colyeri Chandler

Figures 1A, C and 2.

Ectrepesthoneura colyeri Chandler, 1980: 32.

Studied material. **AK** Frogn: Danemark (EIS 18), 9 ♀♀ 5 ♂♂ 13 May - 8 July 1997, 2 ♀♀ 1♂ 8 July - 26 August 1997 (hatching-traps), B. Økland & L. Martinsen.

Description (female)

Total length 3.52-4.07 (3.69) mm (n=8).

Coloration. Antennae with scape dark brown, pedicel and first flagellomere yellow; remaining flagellomeres brown, not as dark as scape. Trochanters dark. Femora slightly darkened basely, very weakly on fore leg. Hind femur darkened at apical fourth to apical third. Abdominal tergites brown with yellow markings: 1 and 2 with yellow areas laterally; 3 and 4 with yellow areas posterolaterally making the brown area triangular-shaped; 5 with a slim yellow area on hind margin; 6 and 7 completely brown. Abdominal sternites: 1-4 yellow, 5-7 brownish. Terminalia brown, except for yellow cerci.

Head. 0.8-0.9 (0.9) times as long as wide. Lateral ocellus separated from eye border and median ocellus by 3.2-4.3 (3.6) and 3.2-3.8 (3.5) times its own width, respectively. Frontal furrow distinct and complete. Length of flagellum 1.0-1.1 mm, or about 1.2-1.4 (1.3) times as long as scutum. Flagellomeres 1-13 and 14, 1.4-2.0 and 2.5-3.6 times as long as wide, respectively. Fused face and clypeus with about 40 setae. Palpomere ratios 1:3.1-5.0:3.7-5.3:4.7-8.9.

Thorax. Total length 0.90-0.98 (0.93) mm. Lenght of scutum 0.77-0.84 (0.81) mm.

Wings. Wing length 2.57-2.78 (2.67) mm. Wing length to length of R1 6.67-8.19 (7.40). Wing length to length of profemur 2.81-3.00 (2.91). Costa covering about 0.7 distance between R5 to M1. Crossvein ta subequal in length to radial cell, with 2-4 setae apically. R1 somewhat longer than ta and fused with costa for short distance. Median fork starting at, or slightly before, level of R4. Veins M1 and M2 without setae on basal 1/5 and 1/7, respectively; crossvein ta without setae on basal half.

Legs. Mid tibial setae: 4-5 small p apically, 6 pv, 4 pd, 3 ad, and several additional setae on apical border. Hind tibial setae: 7-10 small p, 15-19 pd, 13 ad, and a group of small setae posterior apically. Leg ratios: femur to tibia 1.06-1.08 (1.07), 1.19-1.23 (1.21), 0.86-0.90 (0.89); SV 2.81-3.03 (3.93), 3.00-3.30 (3.16), 3.75-3.96 (3.87); BV 2.91-3.18 (3.05), 3.23-3.48 (3.38), 3.94-4.31 (4.12); spurs 2.2-2.7; 2.6-3.0, 3.11-4.2; 2.5-3.1, 3.4-4.0.

Terminalia. Viewed laterally, gonocoxites 8 evenly rounded. Tergite 8 with one row of setae posteriorly and few additional setae laterally. Gonocoxites 9 plate-like, weakly sclerotized. Gonapophyses 9 plate-like with uneven border, weakly sclerotized, with keel about $^{1}/_{4}$ from basal border. Sternite 10 subtriangular. Hypoproct with setae laterally, a few long basally. First segment of cerci produced apically beyond attachment of second, and about 2.5 times as long as this.

Biology. Specimens of *E. colyeri* were hatched from a rotten trunk of oak (*Quercus robur*).

Ectrepesthoneura hirta (Winnertz)

Figures 1B and 3.

Tetragoneura hirta Winnertz, 1846: 19. Fig. 8.

Ectrepesthoneura hirta (Winnertz, 1846), Enderlein 1911: 155

Studied material. **AK** Frogn: Smihagen (EIS 28), 4 ♀♀ 4 ♂♂ 8 July - 26 August 1997, 3 ♂♂ 13 May - 8 July 1997 (hatching-traps), B. Økland & L. Martinsen; **FV** Alta: Detsika, Buolamalia (EIS 173), 3 ♀♀ 44 ♂♂ 11 June - 3 July 1995 (Malaise trap, sandy slope), L. O. Hansen & H. Rinden.

Description (female)

Total length 3.57-4.05 mm (n=4).

Coloration. Antennae with scape dark brown, pedicel and base of first flagellomere yellow, remaining flagellomeres brown. Trochanters, base of

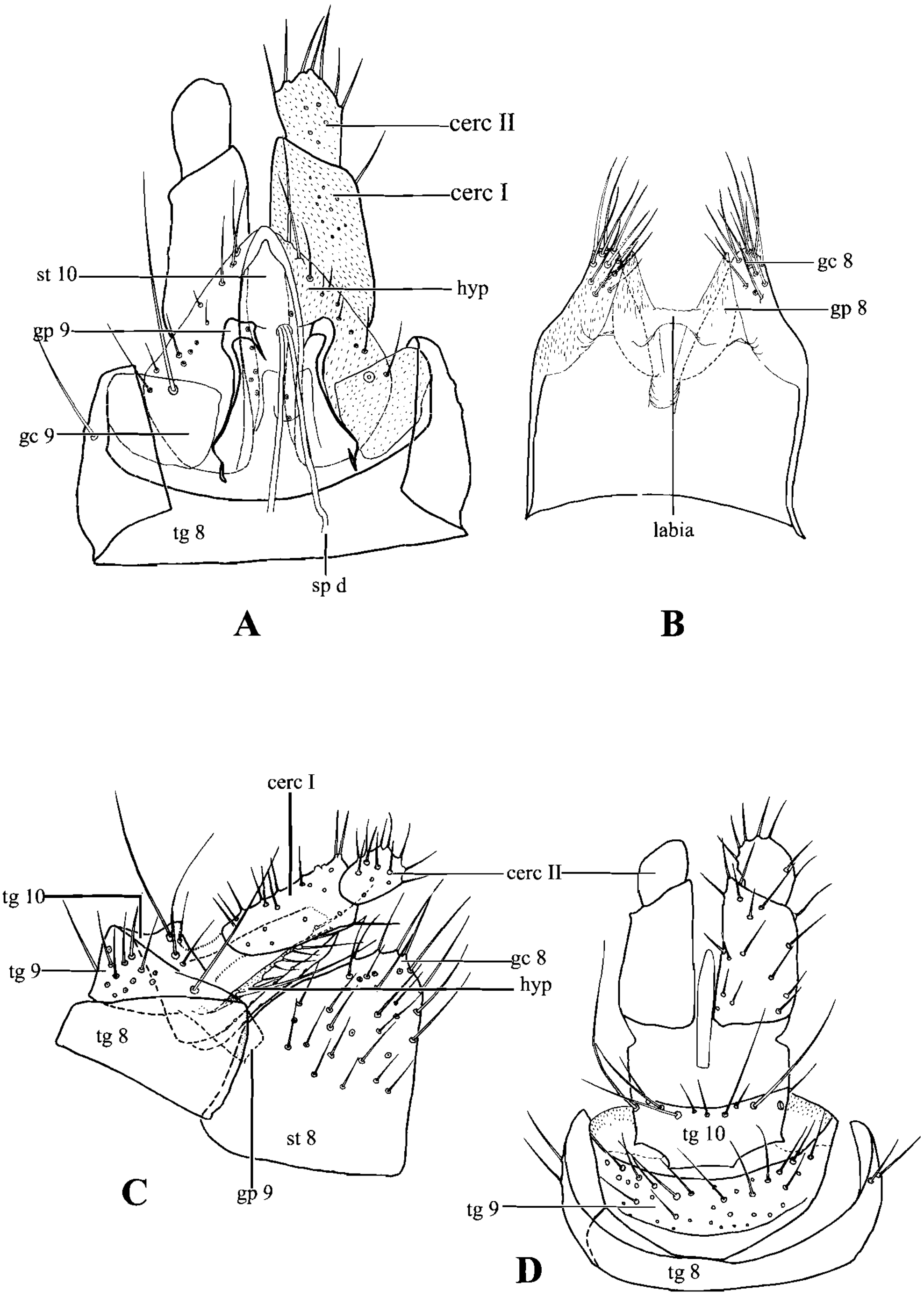

Figure 3. Female terminalia of *Ectrepesthoneura hirta* (Winnertz). - A. Ventral view, sternal parts removed. - B. Dorsal view, tergal parts removed. - C. Lateral view. - D. Dorsal view. Abbreviations: see Figure 2.

femora, extreme apex of mid femur, apical fourth of hind femur and the basalmost part of hind coxa dark brown. Abdomen uniform dark brown, or tergite 1-5 with yellow bands apically. Terminalia yellow, except for brown cerci.

Head. 0.7-1.0 times as long as wide. Lateral ocellus separated from eye border and median ocellus by 2.2-2.5 and 2.6-3.1 its own width, respectively. Frontal furrow distinct, with rupture near frontal tubercle. Several long, pronounced setae posteriorly on vertex, reaching down to level of antennal attachment. Length of flagellum 1.04-1.08 mm, or about 1.1-1.4 times as long as scutum. Flagellomeres 1-13 and 14, 1.6-1.9 and 2.1-3.3 times as long as wide, respectively. Fused face and clypeus with about 50 setae. Palpomere ratios 1:2.5-2.7:2.7-4.0:4.2-6.0.

Thorax. Total length 0.90-1.08 mm. Length of scutum 0.78-0.93 mm.

Wings. Wing length 2.62-3.36 mm. Wing length to length of R1 6.08-6.60. Wing length to length of profemur 3.19-3.38. Costa covering about 0.7 distance between R5 and M1. Crossvein ta longer than radial cell, with 8 setae. R1 short, but longer than ta. Median fork starting at level of R4. Basal 1/6 of M1, extreme bases of M2 and crossvein ta without setae.

Legs. Mid tibial setae: 4 p, 6 small pv, 3 pd, 4 ad, and several additional setae on apical border. Hind tibial setae: 6-8 small p, 12 pd, 1 d basally, 14 ad, and a group of small setae posterior apically. Leg ratios: femur to tibia 0.92-1.11, 0.93-1.08, 0.79-0.83; SV 2.60-2.73, 2.87-3.07, 3.44-3.82; BV 2.35-2.83, 2.98-3.35, 4.12-4.46; spurs 2.1-2.9; 3.1-3.3, 3.3-4.3; 2.9-3.1, 3.0-3.9.

Terminalia. Viewed laterally, gonocoxites 8 evenly rounded. Tergite 8 with some lateral setae. Gonocoxite 9 plate-like. Gonapophyses 9 with well sclerotized, curved lateral border; otherwise weakly sclerotized. Vestiges of sternite 9 as very weakly sclerotized rectangular plate. Sternite 10 oblong. Hypoproct with several lateral setae, basalmost very long. First segment of cercus cylindrical, 2.1-2.4 times as long as second; second segment ovate, situated at extreme apex of first.

Biology. Specimens of *E. hirta* were hatched from deacaying trunks of ash (*Fraxinus excelsior*). The species has previously been hatched from rotten wood of beach, pine and *Coryolus versicolor*, and from fungus encrusted bark (Chandler 1980).

Ectrepesthoneura pubescens **(Zetterstedt)**

Figure 4.

Sciophila pubescens Zetterstedt, 1860: 6559

Ectrepesthoneura messaurensis Plassmann, 1975: 10.

Studied material. **FV** Alta: Detsika, Buolamalia (EIS 173), 14 ♀♀ 14 ♂♂ 11 June - 3 July 1995 (Malaise trap, sandy slope), L. O. Hansen & H. Rinden.

Description (female)

Total length 3.43-3.67 (3.61) mm (n=6).

Coloration. Scape dark brown, pedicel and basal half or entire first flagellomere yellow. Remaining flagellomeres brown. Fore and mid coxae slightly darkened at extreme base. Trochanters and extreme base of femora dark. Mid femur darkened at extreme apex. Hind femur darkened at apical third. Tibial spurs yellowish. Abdominal tergites brown. Terminalia light brown.

Head. 0.7-0.9 (0.8) times as long as wide. Median ocellus slightly smaller than laterals. Lateral ocellus separated from eye border and median ocellus by 2.5-3.3 (2.8) and 2.5-3.7 (3.0) times its own width, respectively. Frontal furrow nearly distinct, with rupture near frontal tubercle. Length of flagellum 0.80 mm (n=1), or 1.3 times as long as scutum. Fused face and clypeus with 30-35 setae. Palpomere ratios 1 : 2.5-2.7 : 2.8-3.6 : 4.4-6.3.

Thorax. Total length 0.73-0.80 (0.74) mm. Length of scutum 0.58-0.68 (0.63) mm.

Wings. Wing length 2.16-2.45 (2.31) mm. Wing length to length of R1 7.06-9.07 (8.09). Wing length to length of profemur 3.35-3.50 (3.43). Costa covering about half or somewhat more of distance from R5 to M1. Crossvein ta subequal in length to radial cell, with 5-6 setae. R1 somewhat longer than ta. Median fork starting at, or slightly before level of R4. Basal fourth of ta, extreme base of M1 and basal third of M2 without setae.

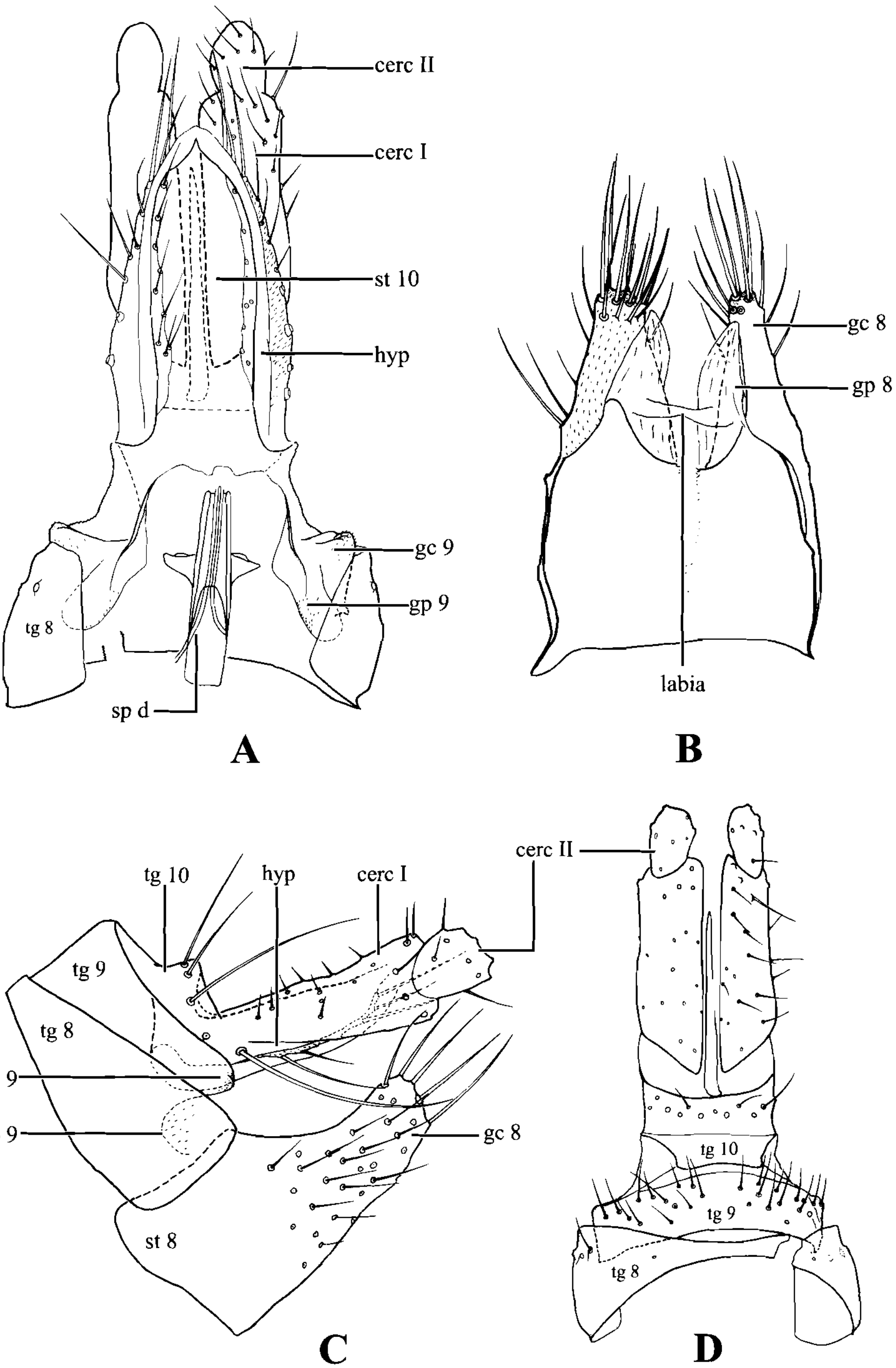

Figure 4. Female terminalia of *Ectrepesthoneura pubescens* (Zetterstedt). - A. Ventral view, sternal parts removed. - B. Dorsal view, tergal parts removed. - C. Lateral view. - D. Dorsal view. Abbreviations: see Figure 2.

Legs. Mid tibial setae: 2 small p, 4 small pv, 2 pd, 4 ad , and several additional setae on apical border. Hind tibial setae: 10 minute p, 12 pd, 8 ad, and a group of small setae posterior apically. Leg ratios: femur to tibia 1.03-1.08 (1.05), 1.12-1.22 (1.15), 0.83-0.86 (0.84); SV 2.93-3.33 (3.14), 3.24-3.42 (3.33), 3.58-4.05 (3.77); BV 3.07-3.35 (3.26), 3.48-4.16 (3.72), 4.10-4.50 (4.30); spurs 2.2-2.3; 2.8-3.0, 3.6-3.7; 2.4-2.6, 3.1-3.4.

Terminalia. Viewed laterally, gonocoxites 8 tapered towards apex, with numerous apical setae giving brushy appearance. Tergite 8 with 2 small, median setae; additional setae laterally. Gonocoxites 9 rounded, small. Gonapophysis 9 curved, plate-like, with trichia. Sternite 10 rectangular with pointed apex. Hypoproct with setae laterally, basalmost very long. First segment of cercus long, cylindrical, 2.8-3.3 times as long as second; second segment ovate, situated at extreme apex of first.

CONCLUSIVE REMARKS

In the keys given by Chandler (1980) and Hutson *et al.* (1980) several non-genital characters are used in the identification of *E. colyeri, E. hirta* and *E. pubescens*. Due to intraspecific variation these characters were found to be unreliable in the present study; in females such variation was found to be even larger than in males. Hence, only characters dealing with the terminalia have so far, proved to separate satisfactorily between females of the studied species.

In addition to characters used in the key, the characters that most clearly distinguish between females applies to the chaetotaxy and/or outline of gonocoxites 8, labia, gonocoxites 9, gonapophysis 9 and the area surrounding the spermathecal eminence. Except for the outline of gonocoxites 8, these characters can only be studied in cleared, preferably slide mounted specimens.

In *E. pubescens* the most prominent setae on gonocoxites 8 are located distally, seemingly forming a thin brush; in *E. hirta*, and most clearly in *E. colyeri*, these setae are more evenly dispersed. Moreover, in *E. pubescens* the two gonocoxites 8 are more slender than in any of the other species. Despite being difficult to observe, the shape and position of labia seems to be a good character to separate between the species. In *E. colyeri,* labia is clearly attached laterally to gonapophysis 8, but not so in any of the other observed species. *E. colyeri* also has the broadest labia, while in *E. pubescens* labia can only be observed as a transverse, narrow bridge. The gonocoxites 9 vary slightly in shape and attachment to tergite 9 in the studied species, but *E. pubescens* is the only species with trichia basally on gonapophysis 9.

Females of *E. pubescens* are in general smaller than females of both *E. colyeri* and *E. hirta*. Body size, however, is known to vary considerably within species of Mycetophilidae (e.g. Väisänen 1984, Söli 1997), and can usually not be used as a diagnostic character. Colouration and colour pattern represent another type of character that should be used with great care. In some genera, however, such characters seem rather constant and apparently separate well between species. This may also be true for *E. colyeri* and *E. hirta*, of which the former has brown terminalia with yellowish cerci, while *E. hirta* has yellowish terminalia and brown cerci.

The single female that could not be identified was hatched from decaying oak wood, together with *E. colyeri*. The species differed most pronounced in the large, rounded gonocoxites 9, and in the position of the two gonapophyses 9, bordering the spermathecal ducts medially. Most probably the female belongs to one of the species already recorded from SE Norway, viz. *E. tori*, *E. bucera*, *E. referta* or *E. nigra* (see e.g. Økland & Zaitzev 1997).

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Received 26 October 2000,
accepted 7 November 2000

Euides speciosa (Boheman, 1845) (Homoptera, Delphacidae) in Norway

Lars Ove Hansen

Hansen, L. O. 2000. *Euides speciosa* (Boheman, 1845) (Homoptera, Delphacidae) in Norway. Norw. J. Entomol. 47, 148.

The plant hopper *Euides speciosa* (Homoptera, Delphacidae) is recorded for the first time in Norway. Four males were captured at the northern shore of Lake Østensjøvannet, Oslo, July 1996. Notes on distribution and biology are briefly given.

Key words: *Euides speciosa,* Homoptera, Delphacidae, Lake Østensjøvannet, new to Norway.

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Introduction

The Lake Østensjøvannnet is situated only 5 km from the city centre of Oslo. It is a well known resource and picnic area, used for many years as a study site for the University of Oslo. In 1995 an investigation was initiated to get a more total survey of the insect fauna in this area, in particular the terrestric groups. Until present a total of 1800 insect species are recorded from this Lake area (Hansen & Falck 2000), including the first record in Norway of the planthopper *Euides speciosa.*

The subfamily Delphacinae includes only three genera in N Europe, i.e. *Delphax*, *Conomelus* and *Euides* (Ossiannilsson 1978). *Euides speciosa,* the only species occuring in N Europe of this genus, resembles *Delphax* as imago, but they may easily be distinguished by their antennae. *Delphax* has the first antennal segment considerably longer than the second, while the first segment in *Euides* is shorter than the second (Jensen-Haarup 1920).

The record

Four males of the planthopper *E. speciosa* were captured in a malaise-trap situated at **AK** Oslo: Østensjøvannet (Northern shore) (EIS 28) 1 - 31 July 1996, leg. Lars Ove Hansen & Morten Falck. The locality is a typical eutrophic freshwater shore dominated by *Phragmites communis* together with other limnic shore plants (e.g. *Iris*, *Typhae*, *Juncus*), and some alder forest (*Alnus incana*) as well.

Biology and distribution

E. speciosa is widespread in both limnic and marine shores, most abundant on *P. communis* (Jensen-Haarup 1920). The biology seems quite similar to that of the two northern European species of *Delphax.*

E. speciosa is found widespread in Europe, eastwards to Kazakhstan (Ossiannilsson 1978). In Sweden it is not rare in the SE parts of the country, where it is recorded north to Uppland (Up) and Närke (Nä). It seems scarce but widespread in Denmark, and very rare in Finland.

Acknowledgements. I am indebted to Morten Falck for help during the field work, and to Østensjøvannets Venner (i.e. Friends of Østensjøvannet), represented by Finn Gulbrandsen, who financed this insect study at Lake Østensjøvannet. Also thanks to Anne Mette Austmyr for kindly correcting the English.

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Received 18 October 2000,
accepted 10 November 2000

Norw. J. Entomol. 47, 149–152. 2000

Spiders (Araneae) new to Norway

Kjetil Aakra, Arne Bretten & Otto Frengen

Aakra, K., Bretten, A. & Frengen, O. 2000. Spiders (Araneae) new to Norway. Norw. J. Entomol. 47, 149–152.

Haplodrassus umbratilis (L. Koch, 1866), *Drassyllus pumilus* (C. L. Koch, 1839) *Zelotes puritanus* Chamberlin, 1922 (Gnaphosidae), *Lepthyphantes abiskoensis* (Holm, 1945) (Linyphiidae) and *Achaearanea riparia* (Blackwall, 1834) (Theridiidae) are reported for the first time from Norway. Data on distribution and ecology are provided for each species.

Key words: Aranea, new to Norway.

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INTRODUCTION

The species reported here were all discovered in SE Norway. Four of the species were first collected by the second author (AB) and the fifth by the third author (OF). Additional specimens of two of these species were discovered by the first author in material originating from a survey of rare insect habitats in the Oslofjord region (see Hanssen & Hansen 1998 for description of these localities). The locality at Furuberget, Hedmark is a pine forest on calcareous ground with a dense cover of needles. Bjørgedalen is a deciduous forest with little or no ground vegetation.

Abbreviations of faunal provinces follow Økland (1981). Nomenclature is according to Platnick (1998). The material is deposited in the collections of the Museum of Natural History and Archaeology, Department of Natural History, NTNU. All specimens were captured by pitfall traps except where noted.

RESULTS AND DISCUSSION

GNAPHOSIDAE

Haplodrassus umbratilis (L. Koch, 1866)

Material: **HES** Hamar: Furuberget (EIS 46), 1-29 May 1993, 2♂♂ (leg. AB). **Ø** Fredrikstad: Hankø, Bloksberg (EIS 20), 3-29 June 1995, 3♂♂, 1♀ (leg. O. Hanssen & J. I. I. Båtvik). Moss: Jeløy, Hvittingbukta (EIS 19) 3-30 June 1995, 1♂ (leg. O. Hanssen & G. Hardeng).

This is a widespread and common species occurring north to Uppland in Sweden (Jonsson pers comm.), in southern parts of Finland (Palmgren 1943), southern Great Britain (Roberts 1995), most parts of continental Europe (Grimm 1985) and as far east as South Siberia (Mikhailov 1997). For this reason the present discovery is not suprising and *H. umbratilis* is presumably also widespread in SE Norway. It is mainly found in dry, stony habitats, including heaths (Roberts 1995) and coniferous forests (Grimm 1985).

Drassyllus pumilus (C. L. Koch, 1839)

Material: **AK** Asker: Bjørkås (EIS 28), 4 June-2 July 1995, 1♂ (leg. L. O. Hansen & O. Hanssen). **HES** Hamar, Furuberget (EIS 46), 1-29 May 1993, 4♂♂ (leg. AB).

D. pumilus is known from Östergötland and Gotland in Sweden (Jonsson pers comm.), southwestern parts of Finland (Palmgren 1943, Lethinen et al. 1979), but has not been recorded from Great Britain or Ireland (Locket et al. 1974, van Helsdingen 1996). It is also found in central and eastern parts of continental Europe (Grimm 1985). The species is probably more widespread than current records suggest, but apparently has a scattered distribution in Fennoscandia. *D. pumilus* is a thermophilous spider occurring in various sun-exposed habitats (Thaler 1981, Grimm 1985).

Zelotes puritanus Chamberlin, 1922

Material: **HES** Hamar: Furuberget (EIS 46), 1-29 May 1993, 2♂♂, 3♀♀ (leg. AB).

Z. puritanus is only known from Södermanland in Sweden (Sandström et al. 1994) and has neither been reported from Finland (Palmgren 1977), nor Great Britain or Ireland (Locket et al. 1974, van Helsdingen 1996). There are otherwise only a few scattered records from continental Europe: Switzerland and Austria (Thaler 1981, 1997, Muster 1997), southern Germany (two records each in Saxony and Bavaria and one in Thuringia - Grimm 1985, Uhlenhaut 1990, Stumpf & Blick pers. comm.), former Czechoslovakia (Miller & Buchar 1977) and Poland (Starega 1972). The record reported here is the northermost in Europe. Outside Europe, *Z. puritanus* is known from Russia, northeastern Siberia (Mikhailov 1997), Mongolia (Marusik & Logunov 1998), Tuva (Marusik et al.

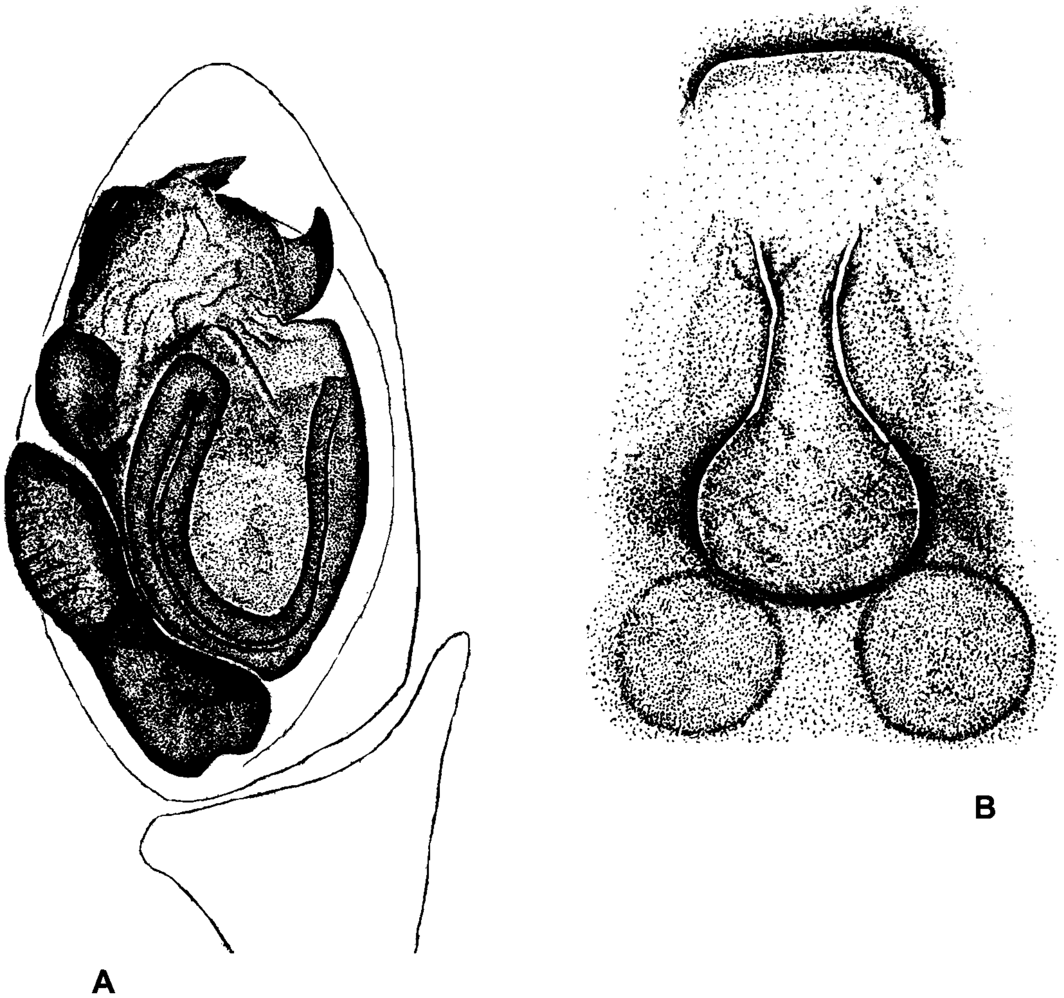

Figure 1. *Zelotes puritanus*. Male palpal organ, ventral view (A) and epigyne (B).

2000) and western parts of North-America (Grimm 1985). The distribution of the species is disjunctive (Marusik et al. 2000).

Like the preceeding species, *Z. puritanus* is thermophilous. In summarising the known occurences in Europe, Grimm (1985) mentioned records from heathlands and forest habitats. A more recent finding (H. Stumpf pers. comm.) from a steep southwards facing limestone slope (45°) in Würzburg, Northern Bavaria, highlights the thermophilous requirement of this species. European records of *Z. puritanus* are from the most continental parts of the region, suggesting that the distribution in Norway is rather limited. The species is generally found at high elevations in continental Europe; at 700-1200 m in Switzerland and Austria (Thaler 1981), and Asia; at 1700-1800 m in Tuva, Russia (Marusik & Logunov 1994) and at 1700 m in Mongolia (Marusik & Logunov 1998). At northern latitudes in Europe the species is found at lower elevations. Furuberget is very close to the railway and main roads passing through Hamar city and an anthropogenic mode of dispersal into Norway cannot be ruled out. The male palpal organ (Figure 1A) and the epigyne (Figure 1B) are very distinctive.

LINYPHIIDAE

Lepthyphantes abiskoensis (Holm, 1945)

Material: **HES** Ringsaker: Bjørgedalen (EIS 46), 1-29 May 1993, 1♀ (leg. AB).

Predominantly a northern species reported from Lule and Torne Lappmark in Sweden (Jonsson pers. comm.) and the southern half of Finland (Palmgren 1976) which has not been found in Great Britain or Ireland (Locket et al. 1974, van Helsdingen 1996) or continental Europe (Heimer & Nentwig 1991). According to Mikhailov (1997) it has been recorded from the Russian plain and as far east as Shakalin. The species is presumably widespread in Fennoscandia. The current record is the westernmost according to Marusik et al. (2000). *L. abiskoensis* has been found in various types of vegetation and appears to prefer the lower field layers (Palmgren 1976).

THERIDIIDAE

Achaearanea riparia (Blackwall, 1834)

Material: **Ø** Hvaler: Kirkøy, Stakhalden, 4 July 2000, 1♂, sweep netting (leg. OF).

The discovery of this species in Norway was expected as it occurs north to Helsingland in Sweden (L. J. Jonsson pers. comm.) and north to 62°N in Finland (Palmgren 1974). It is thermo- and photophilous, having been found in overhanging banks, on stony ground, below flat stones and on stonewalls (Roberts 1995, Palmgren 1974). It is common and widespread in Europe (Heimer & Nentwig 1991).

Acknowledgements. Many thanks to Helmut Stumpf and Theo Blick for information on the habitat and distribution of *Z. puritanus*, to Lars J. Jonsson for distributional data from Sweden and to Lars Ove Hansen and Oddvar Hanssen who kindly allowed the first author access to the Oslofjord material.

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Received 28 August 2000,
accepted 28 September 2000

Norw. J. Entomol. 47, 153–162. 2000

Noteworthy records of spiders (Araneae) from central regions of Norway

Kjetil Aakra

Aakra, K. 2000. Noteworthy records of spiders (Araneae) from central regions of Norway. Norw. J.Entomol. 47, 153–162.

New records are presented for a number of species recently discovered in Central Norway. *Caviphantes saxetorum* (Hull, 1916) (Linyphiidae) and *Arctosa stigmosa* (Thorell, 1875) (Lycosidae) are new to Fennoscandia while *Singa nitidula* C. L. Koch, 1844 (Araneidae) and *Myrmarachne formicaria* (De Geer, 1778) (Salticidae) are new to Norway. Three rare araneids, *Araneus nordmanni* (Thorell, 1870), *Araneus saevus* L. Koch, 1872 and *Gibbaranea omoeda* (Thorell, 1870), have not been recorded from Norway for almost 100 years. The northernmost records in Europe of *Anyphaena accentuata* (Walckenaer, 1802) (Anyphaenidae), *Micaria subopaca* Westring, 1861 (Gnaphosidae), *Troxochrus nasutus* Schenkel, 1925 (Linyphiidae), *Tegenaria atrica* C. L. Koch, 1843 (Agelenidae) and *Dipoena torva* (Thorell, 1875) are also given as well as new distributional data on *Arctosa cinerea* (Fabricius, 1777) (Lycosidae).

Key words: Araneae, distribution in Norway.

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INTRODUCTION

Relatively few papers have included data on the spider fauna of central Norway, i.e. the counties of Sør- and Nord-Trøndelag (Collett 1876, 1877, Storm 1898, Strand 1904a,b, Tambs-Lyche 1940, 1941, Hauge 1972, 1989, Solem & Hauge 1973, Hauge & Furunes 1976, Dolmen 1977). In previously undetermined collections of spiders from the region, the author discovered several species which are either new to Fennoscandia and/or Norway, have not been found for almost 100 years or which have a new northern limit in Europe.

The new records presented here originate from four sources: (1) the depository of the Museum of Natural History and Archaeology (MNHA), (2) the forest fragementation experiment carried out by NINA in the coastal spruce forest at Mosvik north of Trondheim (Tømmerås & Breistein 1995 Tømmerås et al. 2000), (3) the investigation of the riparian evertebrate fauna of Gaula south of Trondheim supervised by NINA (Andersen & Hanssen 1994) and (4) collections made by the author (KA) and Otto Frengen (OF) in spring and summer 2000. The spider material collected by NINA has only been partly incorporated into the reports mentioned above.

Abbreviations of faunal provinces are according to Økland (1981), the nomenclature follows Platnick (1998, 2000). The material is deposited in the collections of the Museum of Natural History and Archaeology, Department of Natural History, NTNU, except where otherwise noted. Other abbreviations used are: PT (pitfall traps), MT (malaise traps), WT (window traps), ZMO (Zoological Museum, Oslo).

RESULTS AND DISCUSSION

AGELENIDAE

Tegenaria atrica C. L. Koch, 1843

Material: **STI** Trondheim: Lade, 7 April 2000, 1♀, inside building (leg. U. Mostervik).

This is the northernmost record from Europe. Previously the species has only been reported from various cities in South Norway: Oslo, Larvik, Arendal, Kristiansand, Stavanger, Bergen (Hauge 1989). It is known north to Uppland in Sweden (Jonsson pers. comm.) and from Helsinki in Finland (Palmgren 1977).

ANYPHAENIDAE

Anyphaena accentuata (Walckenaer, 1802)

Material: **STI** Melhus: Gravråk (EIS 92), 18 April 2000, 3 subadults, handpicked from under bark on *Alnus incanus* and *Salix triandra* by the river Gaula (KA).

The northernmost record of this species from Europe. *A. accentuata* is previously known north to Hordaland (Hauge 1989). In Sweden it occurs north to Dalarne (Jonsson pers. comm.) while in Finland it has been found in southern parts of the country (Palmgren 1943).

ARANEIDAE

Araneus nordmanni (Thorell, 1870)

Material: **NTI** Mosvik: Meltingen (EIS 97), 27 August 1996, 2♀♀, MT, 13 September 1997, 1♂, WT, coastal spruce forest (Tømmerås et al. 2000).

A. nordmanni has not been recorded from Norway since Collett (1877) who found it in eastern parts of South Norway and Strand (1900) who collected it from southern Nordland (juveniles only, specimens from ZMO examined by the author). *A. nordmanni* occurs south to Uppland in Sweden (Jonsson pers. comm.), in scattered localities throughout Finland (Palmgren 1974), central and northern Europe (Heimer & Nentwig 1991). It ranges east to the Far East and west to North-America (Esyunin & Efimik 1996, Mikhailov 1997).

A. nordmanni belongs to the canopy fauna (Maurer & Hänggi 1990, Heimer & Nentwig 1991), probably being characteristic of old-growth coniferous forests. It is of special conservation concern due to its rarity and apparent sensitivity to modern forestry practices (Ehnström & Walden 1986).

Araneus saevus L. Koch, 1872

Material: **NTI** Mosvik: Meltingen (EIS 97), 7 September 1996, 1♀, MT, coastal spruce forest (Tømmerås et al. 2000).

This species was previously known from a few old records; «Drammen-Ullensaker» and «Åmot - Elverum» (Collett 1877). *A. saevus* is generally a rare species taken as far north as Åsele Lappmark in Sweden (Jonsson pers. comm.) and found almost north to the Polar Circle in Finland (Palmgren 1974, 1977). It is not known from Great Britain or Ireland (Locket et al. 1974, van Helsdingen 1996), but is present in central parts of continental Europe, northern Asia and North-Amerika (Esyunin & Efimik 1996, Mikhailov 1997).

This species is another of our canopy spiders (Heimer & Nentwig 1991), although the specimens reported by Tullgren (1952) and Palmgren (1974) where found near or on buildings.

Gibbaranea omoeda (Thorell, 1870)

Material: **NTI** Mosvik: Meltingen (EIS 97), 25 July 1994, 1♂, MT, 25 July 1994, 1♂, WT, 2 August 1996, 1♂, WT, 16 July 1996, 2♂♂, MT, 2 August 1996, 1♂, MT. All from coastal spruce forest (Tømmerås et al. 2000).

This is the first record from Norway for almost a century. The species has previously been recorded from Oslo, Drammen, Valdres, Sande and Botne (Collett 1877, Strand 1900, Hauge 1989). Storm (1898) reported it from Trondheim but this was referred to *G. bituberculata* Walckenaer by Tambs-Lyche (1941). It ranges north to Uppland in Sweden (Jonsson pers. comm.), north to about 63° in Finland (Palmgren 1974) but is apparently absent from Great Britain and Ireland (Locket et al. 1974, van Helsdingen 1996). *G. omoeda* is otherwise known from continental Europe, west and central Siberia, Shakalin and as far east as Japan (Esyunin & Efimik 1996, Mikhailov 1997).

The habitat preferences are probably similar to *A. nordmanni* and *A. saevus*, i.e. the higher layers and canopy of coniferous trees (Roberts 1995). Palmgren (1974) indicated that it is very stenotope, only occuring on conifers. Even if the species appear to be rather widespread in Norway, most records are very old and the documented sensitivity to modern forestry practices (Petterson 1996) indicate that it is vulnerable to human influence.

Singa nitidula C. L. Koch, 1844

Material: **STI** Midtre Gauldal: Mo (EIS 87), 13 – 24 May 1994, 1♂, PT, open sand banks (Andersen & Hanssen 1994).

New to Norway. Apparently a rather rare species in both Sweden where it is known from Uppland and Dalarne (Jonsson and Kronestedt pers. comm.) and Finland where it has been found in a few places in the southeast and along the coast of the Botnian Bay (Palmgren 1974).

S. nitidula is a riparian species occurring in low vegetation and litter along streaming water (Palmgren 1974, Roberts 1995).

GNAPHOSIDAE

Micaria subopaca Westring, 1861

Material: **STI** Trondheim: Trondheim City (EIS 92), 28 November 1951, 1♀, taken inside the Museum of Natural History and Archaeology (MNHA, leg. R. Dahlby).

Previous Norwegian records are restricted to southeastern and southern Norway (Hauge 1989), and the present record is the northernmost from Europe. In Sweden only known as far north as Uppland (Jonsson pers. comm., Tullgren 1946), while there are only scattered records from southern Finland (Palmgren 1943). *M. subopaca* is considered rare in Great Britain (Leighton 1971) where records are concentrated around London (Locket et al. 1974), but is relatively common in continental Europe (Heimer & Nentwig 1991).

The species is synanhtropic in the northern end of its range and distribution data suggest a transition in habitat preference at the margins of its range both in regard to altitude and latitude. Roberts (1995) mentions it being abundant in a Liverpool factory, all Finnish records are from inside houses (Palmgren 1943) and according to Thaler (1997) it is «an der Waldgrenze synantrop». Its natural habitat is tree trunks, epecially in sunny places (Miller 1967, Wunderlich 1979a, Roberts 1995, Thaler 1997).

LINYPHIIDAE

Caviphantes saxetorum (Hull, 1916)

Material: **STI** Midtre Gauldal: Mo (EIS 87), 13-24 May 1994, 1♀, PT, sand banks (Andersen & Hanssen 1994).

New to Fennoscandia. *C. saxetorum* is a rare species known from scattered localities north to Scotland in Great Britain (Cooke & Merrett 1967, Locket et al. 1974), central continental Europe (Georgescu 1973, Wunderlich 1975, 1979b, Maurer & Hänggi 1989, Steinberger 1996, Thaler 1993), Poland (Starega 1972), Russia (Mikhailov 1997) and North America (Crawford 1990). This is in other words the northernmost record in Europe and a rather surprising discovery.

Locket et al. (1974) and Steinberger (1996) indicated that the species is restricted to open sand banks along rivers although Wunderlich (1975) and Maurer & Hänggi (1989) reported *C. saxetorum* from dry, ruderal sites. Cooke & Merrett (1967) found the species beneath stones and boulders on sand or shingle-covered river banks during the fall and under smaller stones during the summer. The spider occupies the small spaces between the rocks and sand (Wunderlich 1979b).

The spider itself is very small (1.5 – 1.7 mm total length, Cooke & Merrett 1967) and pale in colour. The vulval structures (Figure 1) of the present specimen correspond to the photograph provided

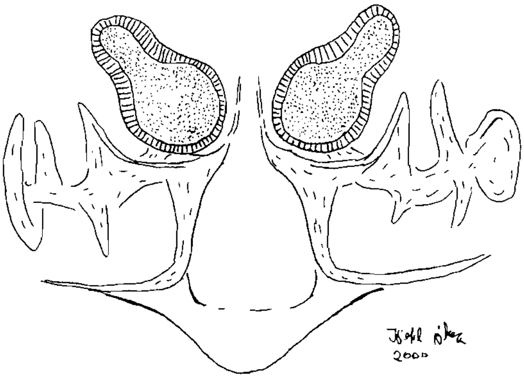


Figure 1. *Caviphantes saxetorum.* Vulvae.

by Cooke & Merrett (1967). The coiled tubules seen to the side and below the spermatheca are very characteristic in this genus (Wunderlich 1979b). A membrane appears to cover the space between the tubules rendering the latter difficult to see in my specimen, but their course has been adequately illustrated by Millidge (1984; Figure 32). The small epigynal scape is also highly characteristic.

Troxochrus nasutus Schenkel, 1925

Material: **NTI** Mosvik: Meltingen (EIS 97), 23 June-1 July 1994, 1♂, PT, coastal spruce forest (Tømmerås et al. 2000).

This is the second record from Norway (Hauge 1989) and the northernmost record from Europe. In Sweden *T. nasutus* is distributed north to Uppland (Jonsson pers. comm.) while in Finland it is confined to southern counties (Palmgren 1976). Palmgren (1976) commented upon the scattered distribution of the species. The species is absent from the British isles (Locket et al. 1974) and mainly confined to central parts of continental Europe (Maurer & Hänggi 1990) and the Russian plain (Mikhailov 1997).

It appears to be restricted to closed canopy coniferous forests with little or no ground-cover where it may be locally abundant (Gudik-Sørensen 1997).

LYCOSIDAE

Arctosa cinerea (Fabricius, 1777)

Material: **STI** Melhus: Gravråk (EIS 92), 1 May 1991, 1♂, 2♀♀, hand picking (Andersen & Hanssen 1994). Søndre Jaktøya (EIS 92), 27 May 2000, hand picking, 1♂ (leg. K. Aakra). Midtre Gauldal: Mo (EIS 87), 13 May-20 June 1994, 4♂♂, PT, (Andersen & Hanssen 1994). **NTI** Stjørdal: Langøra (EIS 92), 27 April 1990, 1♀, hand picking (leg. A. Bretten). Levanger: Rinnleiret (EIS 98), 26 August 1999, 1♀, manual collecting (leg. F. Ødegaard). These records are all from sand/gravel banks along rivers or estuaries with little or no vegetation cover, except the last two specimens which came from coastal sand dunes.

Additional material examined (ZMO): **MRI** Romsdal (1♂, 6♀♀, 3 juv., 1864, leg. J. H. S. Siebke, Tube No. 505. 2♂♂, 5♀♀, 1864, leg. J. H. S. Siebke, Tube No. 506. 2♀♀, 1 juv., June 1875, leg. R. Collett, found in Tube No. 708 labeled «*Epeira pyramidata*» along with a juvenile Araneidae sp.) and Surnadalen (3 juv., no date, Tube No. 504).

This impressive spider (Figure 2) was first reported from Norway by Collett (1876) and later by Storm (1898) and Strand (1898). Strand found the species in **AAY** Tvedestrand: Akerøya, while those of Storm, according to Tams-Lyche (1941), originated from **MRI** Surnadalen. Collett (1876) reported the species (obviously based on the ZMO material noted above) from «Surendal–Romsdalen» which in all probabillity refers to the rivers Rauma and Surna, respectively (Collett's and Strand's records and the correct locality of Storm's record were not included in the Norwegian checklist). Andersen & Hanssen (1994) provided additional records: **STI** Melhus: Gaula, Orkdal: Orkla, Selbu: Selbusjøen and **NTI** Stjørdal: Stjørdalselva, partly based on the above material.

The species thus seems to be present in all major river system in the region and Trøndelag no doubt is the centre of distribution of *A. cinerea* in Norway today. It ranges north to Norrbotten in Sweden but is local, ocurring on sandy lakes and seashores (Holm 1947) and appears to be restricted to coastal parts of southern and central Finland and sandy inland habitats of northern Finland (Krogerus 1932, Palmgren 1939). In Great Britain it is known from central and northern parts (Locket et al. 1974) and from southern parts of Ireland (van Helsdingen 1996). The species is widely distributed in continental Europe and North-Africa and east to the Far east, including Japan (Buchar & Thaler 1995, Esyunin & Efimik 1996).

A. cinerea is a strongly psammophilous species occurring in vegetation-free sand and shingle-covered riverbeds, lake- and seahores (Krogerus 1932, Framenau 1995), biotopes which are rare in Norway (DN 1999). Although it was not reported from coastal dunes in western Norway by Folvik (1992), nor from south Norway by Andersen & Hauge (1995), Almquist (1973) and Krogerus (1932) collected it from this type of habitat in southern parts of Sweden and Finland, respectively. *A. cinerea* is nocturnal and spends the day in a chraracteristic tubular retreat contructed in the sand.

Some doubt remains as to whether the species is present today along all rivers mentioned above. For instance, regulation of rivers prevents deposition of silt and sand and causes the habitat of *A. cinerea* to be covered by vegetation. It shows considerable sensitivity to habitat changes (Framenau 1995) and has disappeared from at least one Norwegian locality; **STI** Melhus: Kuøra, where the habitat of the species no longer exists (J. Andersen pers. comm.).

Arctosa stigmosa (Thorell, 1875)

Material: **STI** Midtre Gauldal: Follstad (EIS 87), 13 May-20 June 1994, 23♂♂, 8♀♀, PT. Frøsetøya (EIS 87), 20 June-24 July 1994, 1♂, 1♀, PT. Mo (EIS 87), 13 May-24 July 1994, 6♂♂, 1 subad., 3♀♀, PT (all Andersen & Hanssen 1994). Melhus: Melhus (EIS 92), 4 May 1994, 1♂, 1♀ (both donated to the Swedish Museum of Natural History), manual col-

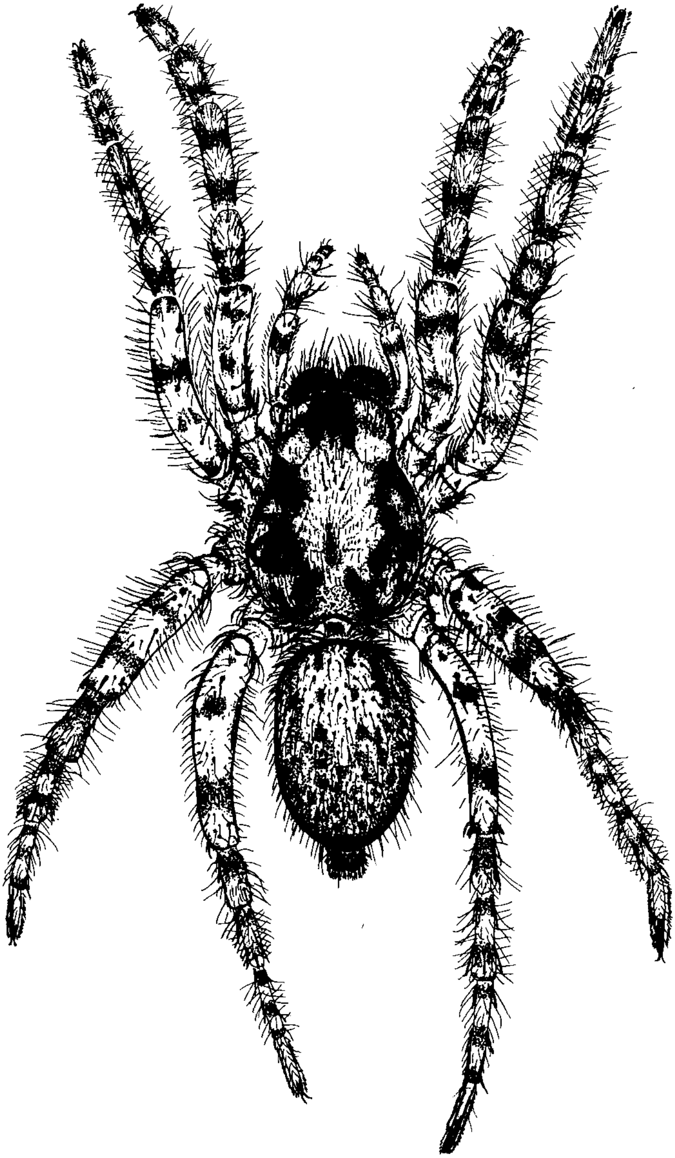


Figure 2. *Arctosa cinerea*. Habitus, adult female.

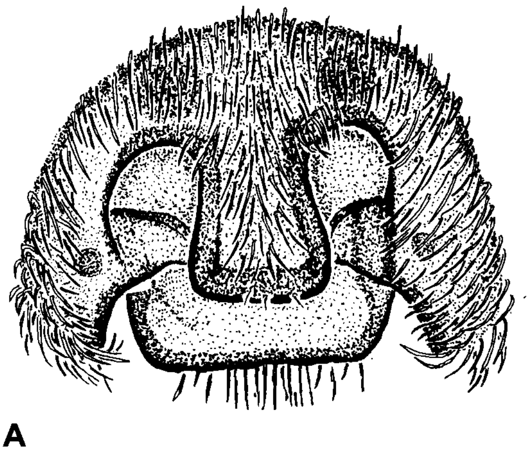
lecting. Gravråk, Søberg, 22 May 2000, 1♀, hand collecting from litter (KA). Orkdal: Elnvang (EIS 91), 26 May 2000, 1♀, manual collecting, (OF).

New to Fennoscandia. This is the northernmost record from Europe and a very surprising discovery because it is a fairly large spider being abundant in the appropriate habitat. Similar patterns of isolated occurences have been reported in riparian beetles, however (Andersen 1983, 1984, Andersen & Hanssen 1992).

The closest known occurences are from Baltikum (Relys 1994, Mikhailov 1997) and Poland (Kupryjanowicz pers. comm.). It is also known from central parts of continental Europe, including France, Romania, Bulgaria, Hungary, Slovakia, southern Germany, Switzerland and ranges as far east as southern Siberia, China, Japan and Korea (Denis 1937, Buchar 1968, Blick & Scheidler 1991, Paik 1994, Framenau 1995, Steinberger 1996, Esyunin & Efimik 1996, Marusik et al. 1996, Mikhailov 1997, Yin et al. 1997, Song et al. 1999). In continental parts of Europe it is very rare and local (Buchar & Thaler 1995, Steinberger 1996).

The Norwegian populations reported here are thus isolated ones, probably of relictual character. Presumably *A. stigmosa* colonized the region some time after the retreat of the ice cover when sandy river and glacial deposits were commonplace. As developing vegetation cover and other factors reduced the number of available habitats populations were increasingly isolated until only those inhabiting sandy riverbanks remained. The species may eventually be found in appropriate habitats in Sweden (Klarälven) and Finland. Krogerus (1932) failed to collect it from sandy coastal dunes in Finland however, and *A. stigmosa* has never been found in this type of habitat. The other large rivers in central Norway probably harbour *A. stigmosa* as well, at least those where *A. cinerea* has been found (see above).

Ecological requirements of *A. stigmosa* are very similar to those of *A. cinerea*, all specimens were collected in vegetation-free or barely vegetated sand and gravel banks alongside the rivers Gaula and Orkla which is in accordance with the habitat



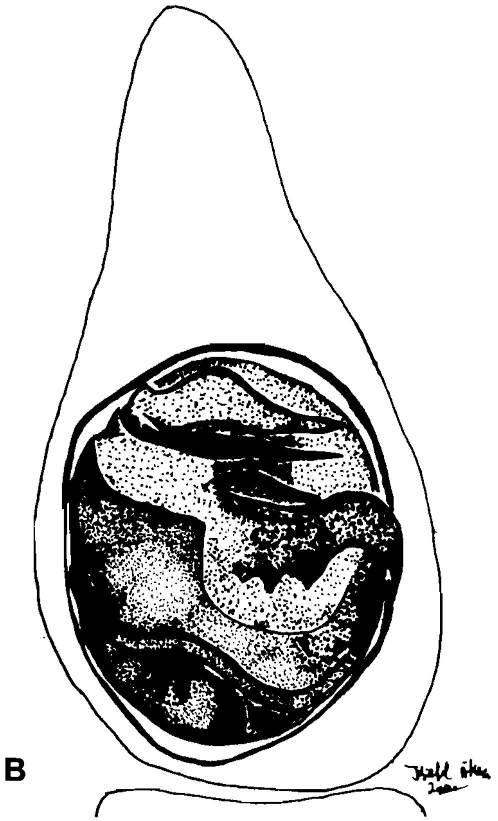


Figure 3. *Arctosa stigmosa*. Epigyne (A) and male palpal organ (B).

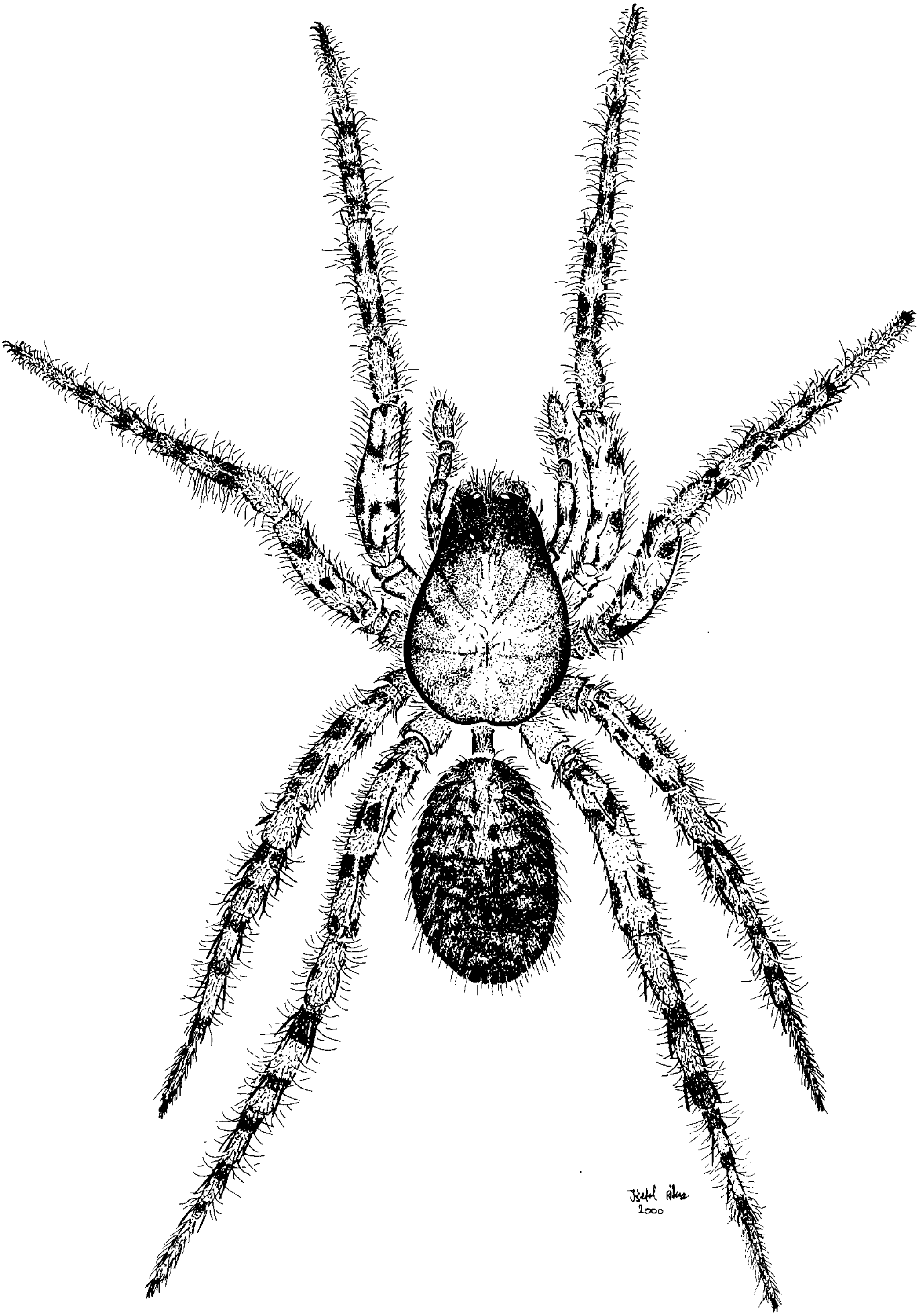


Figure 4. *Arctosa stigmosa.* Habitus, adult male.

description of Heimer & Nentwig (1991) and Buchar & Thaler (1995). Marusik et al. (1996) collected the species in «stony shore in forest steppe». Available literature does not reveal much about the life history of this species. It not known if the mode of life is similar to *A. cinerea* (see Framenau 1995). The large number of specimens caught compared to *A. cinerea* may suggest a cursorial hunting style, but could also be explained by the smaller size of *A. stigmosa*. Main activity in central Norway (based on the pitfall material) appears to take place in early summer (May-June), but specimens of both sexes were found until late July. This corresponds to the activity period given by Heimer & Nentwig (1991), although they indicate that adults may also be found in October. No specimens have been seen running in daylight, indicating that the species is nocturnal. A single female has been collected from litter in the forest bordering the sandbanks while another was found beneath stones. It is therefore likely that the species spends the day in such places and not in burrows.

The epigyne (Figure 3A) is distinctive and in good agreement with depictions given by Denis (1937), Miller (1971) and Heimer & Nentwig (1991). The male palal organ is distinguished from other members of the genus by the shape of the tegular apophysis which is distinctly curved and bears a small knob and pointy projections on the posteriolateral side (Figure 3B). The habitus of the male is shown in Figure 4, the female is very similar. The black ocular region of the carapace contrasting with the lighter, brownish areas behind is characteristic as is the light yellow-greenish cardiac mark clearly visible against the dark brown surrounding areas on the abdomen. All legs are annulated in dark brown.

SALTICIDAE

Myrmarachne formicaria (De Geer, 1778)

Material: **STI** Midtre Gauldal: Mo (EIS 87), 13-24 May 1994, 1♂, PT, sandy ground in *Salix Triandra* forest (Andersen & Hanssen 1994).

New to Norway.This is the northernmost record in Europe. The species has been taken north to Värmland in Sweden (Jonsson pers. comm.), is known from the southern coast of Finland (Palmgren 1943) and is otherwise widely distributed in Europe and throughout Asia as far east as the Kurile islands (Mikhailov 1997).

The habitat descriptions of this species vary somewhat, Heimer & Nentwig (1991) suggest that *M. formicaria* may be found in a wide variety of habitats. The current record is more in accordance with Tullgren (1944) who indicated a preference for spaces beneath flat rocks on warm beaches.

THERIDIIDAE

Dipoena torva (Thorell, 1875)

Material: **NTI** Mosvik: Meltingen (EIS 97), 2 August 1996, 1♂, MT, coastal spruce forest (Tømmerås et al. 2000).

Northernmost record in Europe. The species was recently reported from Norway for the first time (Aakra 2000), details regarding distribution, habitat preferences and conservation status were given therein. The specimen reported here is the first male collected in Norway.

Acknowledgements. Thanks to Johan Andersen, Oddvar Hanssen and Frode Ødegaard for help with the material from Gaula, to the staff at ZMO for their kind assistance during my visit, to Bjørn Åge Tømmmerås from NINA for permission to publish their material from Gaula, Mosvik and Hjerkinn, to Arne Bretten for access to his collection, to Erling Hauge and Lars Ove Hansen for comments on the manuscript, to Theo Blick for information on various species and to Torbjørn Kronestedt for verifying the determination of *Arctosa stigmosa*. Also thanks to Oddvar Hanssen for preparing Euparal mounts of the epigynes of *Caviphantes saxetorum* and *A. stigmosa* and Otto Frengen for his excellent company and help on my collection trips.

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Received 30 August 2000,
accepted 3 October 2000

Norw. J. Entomol. 47, 163–176. 2000

Ichneumonidae (Hymenoptera) new for the fauna of Norway

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Riedel, M., Hansen, L. O. & Berg, Ø. 2000. Ichneumonidae (Hymenoptera) new for the fauna of Norway. Norw. J. Entomol. 47, 163–176.

In this faunistic survey we give distributional records for 169 species of parasitoid wasps of the family Ichneumonidae (Hymenoptera) which are new for the fauna of Norway. Fifteen of them have not been reported from Scandinavia before.

Key words: Ichneumonidae, Hymenoptera, fauna of Norway.

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INTRODUCTION

With more than 21,000 valid extant species worldwide the Ichneumonidae represent one of the largest families of the Hymenoptera (Yu 1999). About 4,000-4,500 species have been found in Europe so far (Gauld & Bolton 1988). Despite their abundance and important role in biological pest control, the taxonomy, ecology, and geographical distribution of many groups of Ichneumonidae remain incompletely known, even in better studied areas such as Europe.

To establish a better knowledge of the diversity and distribution of Norwegian Ichneumonidae, we studied collections of ichneumon wasps which have been brought together from several localities during the last years. From this material more than 700 different ichneumonid species have been identified yet. The present publication is the second one covering these findings with the aim to compile a catalogue of all Ichneumonidae found in Norway. The first was presented by Riedel & Berg (1997).

MATERIAL

The Ichneumonidae recorded in this paper were mostly collected in the Southern and Southeastern parts of the country by the use of hand nets and Malaise traps. To avoid severe misinterpretations, we excluded the species which have not been identified with certain accuracy.

The subfamilies, tribes, genera, and species are listed in alphabetic order using the recent Interactive Catalogue of World Ichneumonidae (Yu 1999). From this catalogue we also took the distributional records, but mention only the Scandinavian countries in more detail here. The biogeographic regions within Norway are defined in accordance to Økland (1981). The reference material for our publication is kept in the personal collection of the first author (M. Riedel), and at the Zoological museum, Oslo.

The following abbreviations has been used in the text: ABa = Alf Bakke, BAS = Bjørn A. Sagvolden, GWa = Gaute Walberg, KMy = Kai Myhr, LOH = Lars Ove Hansen, MFa = Morten Falck, PAT = Per A. Tangen, TJO = Thor Jan Olsen, YBe = Yngvar Berg, ØBe = Øistein Berg, MT = Malaise-trap, ZMO = Zoological museum, Oslo.

LIST OF SPECIES

ACAENITINAE

Coleocentrus excitator (Poda, 1761)

AK Bærum: Kjaglidalen (EIS 28), 1♀ 22 June - 5 July 1990, MT, leg. MFa. Distribution: Palaearctic, known from Denmark, Sweden, and Finland. The report from Norway in Yu (1999) seems to be a mistake.

Phaenolobus terebrator (Scopoli, 1763)

Ø Fredrikstad: Gansrød (EIS 20), 1♀ 9 August 1995, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

ADELOGNATHINAE

Adelognathus pilosus Thomson, 1888

BØ Drammen: Underlia (EIS 28), 1♀ May 1994, MT, leg. LOH. Distribution: Europe, known from Finland and Sweden.

Adelognathus punctatulus Thomson, 1883 [syn. *chrysopygus* auct. nec Gravenhorst]

BØ Hurum: Ramvikholmen (EIS 19), 1♀ 12 August 1991, leg. LOH; Røyken: Kinnartangen (EIS 28), 1♀ July 1991, MT, leg. LOH. Distribution: Holarctic, known from Finland and Sweden.

ANOMALONINAE

Barylypa delictor (Thunberg, 1822)

Ø Rakkestad (EIS 20), 1♂ 5 July 1989, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Erigorgus latro (Schrank, 1781)

ON Nord-Fron: Hesteskobakken (EIS 62), 12♀♀ and 1♂ 1-25 May 1992, MT, leg. KMy & LOH. Distribution: Palaearctic, known from Sweden.

Erigorgus procerus (Gravenhorst, 1829)

AK Oslo: Bygdøy (EIS 28), 1♂ 4 May 1986, leg. MFa; **BØ** Drammen: Underlia (EIS 28), 13♀♀ May 1994, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

BANCHINAE

Teleutaea striata (Gravenhorst, 1829)

TEI Notodden: Lisleherad (EIS 27), 1♀ 6 August - 19 October 1993, MT, leg. ABa; **BØ** Hurum: Mølen (EIS 19), 1♂ 2 - 4 July 1990, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Lissonota digestor (Thunberg, 1822)

Ø, Sarpsborg, Råkil (EIS 20), 1♀ 24 July 1996, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Lissonota versicolor Holmgren, 1860

AK Frogn: Håøya, Dragesund (EIS 28), 2♀♀ 23 July 1995, leg. ØBe. Distribution: Palaearctic, known from Sweden.

CAMPOPLEGINAE

Charops cantator (De Geer, 1778)

VE Larvik: Nevlunghavn (EIS 19) 1♀ 3 July 1993, bred from *Zygaena filipendulae* (Lepidoptera), leg. H. Elven. Distribution: Palaearctic and Ethiopean, known from Finland and Sweden.

Cymodusa declinator (Gravenhorst, 1829)

Ø Sarpsborg: Råkil (EIS 20), 2♀♀ 1 September and 10 October 1993, leg. TJO. Distribution: Palaearctic, known from Denmark and Sweden.

Dusona adriaansei (Teunissen, 1947)

Ø Rygge: Sildebauen (EIS 19), 1♀ 26 August 1995, leg. ØBe. Distribution: Known from the Netherlands and Finland.

Dusona alticola (Gravenhorst, 1829)

Ø Sarpsborg: Blåkollen (EIS 20), 1♀ 4 September 1992, leg. TJO. Distribution: Palaearctic, known from Sweden.

Dusona americana (Ashmead, 1890) [syn. *mariae* Dalla Torre]

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♂ 21 July - 24 August 1992, MT, leg. LOH & GWa.

Distribution: Holarctic, known from Finland and Sweden.

Dusona debilis (Förster, 1868)

VE Våle: Langøya (EIS 19), 1♀ 8 July - 2 August 1991, MT, leg. LOH. Distribution: Known from Germany and Finland.

Dusona disclusa (Förster, 1868)

ON Nord-Fron: Hesteskobakken (EIS 62), 4♀♀ 6 August - 19 September 1992, MT, leg. KMy & LOH. Distribution: Palaearctic, known from Finland.

Dusona falcator (Fabricius, 1775)

Ø Rygge: Sildebauen (EIS 19), 1♀ 26 August 1995, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Dusona vidua (Gravenhorst, 1829)

Ø Halden, Enningdalen, Kirkebøen (EIS 12), 1♀ 10 August 1997, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Eriborus obscuripes Horstmann, 1987

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 1 August 1994, leg. TJO. Distribution: Central Europe, Finland.

Leptocampoplex punctulatus (Ratzeburg, 1848) [syn. *cremastoides* Holmgren]

Ø Sarpsborg: Tune, Råkil (EIS 20), 2♀♀ 20 July 1995 and 26 August 1994, leg. TJO. Distribution: Holarctic, known from Sweden.

Phobocampe crassiuscula (Gravenhorst, 1829)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 10 May 1993, leg. TJO; **Ø** Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♀ 17 June - 21 July 1992, MT, leg. LOH and GWa. Distribution: Palaearctic, introduced into Canada, known from Sweden.

Rhimphoctona melanura (Holmgren, 1860)

Ø Halden, Enningdalen, Kirkebøen (EIS 12), 1♀ 10 August 1997, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Rhimphoctona obscuripes (Holmgren, 1860)

TEI Notodden: Lisleherad (EIS 27), 2♀♀ 22 June - 6 August 1992, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

COLLYRIINAE

Collyria trichophthalma Thomson, 1877

Our report of *Collyria coxator* (Villers) from Norway (Riedel & Berg 1997) is a misdetermination of this species, *Collyria coxator* has not been found in Norway so far. **BØ** Røyken: Kinnartangen (EIS 28), 1♀ June 1993, MT, leg. LOH; Nedre Eiker: Ryghsetra (EIS 28), 1♀ June 1994, MT, leg. YBe & LOH. Distribution: Palaearctic, known from Sweden.

CRYPTINAE

Cryptini

Agrothereutes leucorhaeus (Donovan, 1810)

BV Rollag: Djupdal (EIS 27), 1♀ 28 July 1993, leg. BAS; **VE** Våle: Langøya (EIS 19), 2♂♂ June 1990, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Hoplocryptus rufonigra (Desvignes, 1856)

VE Våle: Langøya (EIS 19), 1♀ 28 May - 8 July 1991 and 6♀♀ and 1♂ 8 July - 2 August 1991, MT, leg. LOH, **BØ** Røyken: Kinnartangen (EIS 28), 1♀ 24 July 1993, leg. ØBe; **TEI** Notodden: Lisleherad (EIS 27), 1♀ 6 August - 9 October 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

Hoplocryptus quadriguttata (Gravenhorst, 1829)

TEI Notodden: Lisleherad (EIS 27), 1♀ 22 June - 6 August 1993, MT, leg. ABa. Distribution: Palaearctic, known from Sweden.

Cryptus minator (Gravenhorst, 1829)

The identity of this species is questionable (van Rossem 1969). The specimen mentioned below has a body length of 6.5 mm and length of forewing of 5.5 mm. The propodeal spiracles are ovoid, about

2.0 times as long as wide, the gastral tergites are coriaceous. Areola with strongly convergent cubital cross veins, 2rm almost twice as long as 3rm. **TEI** Notodden: Lisleherad (EIS 27), 1♀ 27 May - 22 June 1993, MT, leg. ABa. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Enclisis macilenta (Gravenhorst, 1829)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 5 August 1994, leg. TJO; **Ø** Rygge: Ekeby, Gunnarsbybekken (EIS 19), 2♀♀ 19 May- 17 June 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Enclisis vindex (Tschek, 1871)

TEI Notodden: Lisleherad (EIS 27), 1♀ 27 May - 22 June 1993, MT, leg. ABa. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Hidryta fusiventris (Thomson, 1873)

BØ Røyken: Kinnartangen (EIS 28), 1♀ 6 July - 4 August 1991, leg. LOH; **Ø** Sarpsborg: Tune, Råkil (EIS 20), 1♂ 25 July 1993, leg. TJO; **VE** Våle: Langøya (EIS 19), 2♀♀ and 1♂ 8 July - 2 August 1991, MT, leg. LOH. Distribution: Palaearctic, known from Sweden.

Idiolispa subalpina (Schmiedeknecht, 1904)

FV Måsøy: Rolvsøy, Gunnarnes (EIS 186), 1♀ MT, August 1992, leg. PAT. Distribution: Palaearctic, known from Finland and Sweden.

Listrognathus compressicornis (Gravenhorst, 1829)

BV Rollag: Vårviken (EIS 35), 1♀ July 1992, MT, leg. BAS. Distribution: Palaearctic, known from Finland and Sweden.

Meringopus nigerrimus murorum (Tschek, 1872)

TEI Notodden: Lisleherad (EIS 27), 1♀ 27 May - 22 June 1993, MT, leg. ABa; **Ø** Fredrikstad: Onsøy, Hankø, Bloksberg (EIS 20), 1♂ 3-29 June 1995, leg. LOH & J.I.I. Båtvik. Distribution: Holarctic, known from Finland and Sweden.

Mesostenus dentifer Thomson, 1896

BØ Drammen: Underlia (EIS 28), 1♂ May 1994, MT, leg. LOH; **ON** Nord-Fron: Hesteskobakken (EIS 62), 5♀♀ and 3♂♂ 6 August - 19 September 1992, MT, leg. KMy & LOH. Distribution: Palaearctic, known from Sweden.

Trychosis neglecta (Tschek, 1871)

TEI Notodden: Lisleherad (EIS 27), 4♀♀ 27 May- 22 June 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

Trychosis tristator (Tschek, 1871)

VE Våle: Langøya (EIS 19), 1♂ 8 July - 2 August 1991, MT, leg. LOH, **ON** Nord-Fron: Hesteskobakken (EIS 62), 1♀ 6 August - 19 September 1992, MT, leg. KMy & LOH. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Xylophrurus lancifer (Gravenhorst, 1829)

TEI Notodden: Lisleherad (EIS 27), 1♀ 27 May - 22 June 1993 and 2♀♀ 22 June - 6 August 1993, MT, leg. ABa; **BØ** Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 1♀ and 2♂♂ May 1994, MT, leg. YBe & LOH; Drammen: Underlia (EIS 28), 1 ♀ May 1994, MT, leg. LOH; Røyken: Kinnartangen (EIS 28), 2 ♀ 28 May - 6 July 1991, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Hemigasterini

Aptesis cretata (Gravenhorst, 1829)

Ø Rygge: Ekeby, Telemarkslunden (EIS 19), 1♂ 21 July - 24 August 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Finland and Sweden.

Aptesis jejunator (Gravenhorst, 1807)

Ø Rygge: Ekeby, Telemarkslunden (EIS 19), 1♂ 19 May - 17 June 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Colocnema rufina (Gravenhorst, 1829)

BØ Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 2♂♂ July 1988, leg. D. Ruud. Distribution: Palaearctic, known from Denmark and Sweden.

Demopheles corruptor (Taschenberg, 1865)

BØ Hurum: Tofteholmen (EIS 19), 1♀ 7-31 July 1991, MT, leg. LOH. Distribution: Holarctic, new record for Scandinavia.

Plectocryptus digitatus (Gmelin, 1790)

Ø Rygge: Ekeby, Telemarkslunden (EIS 19), 2♂♂ 19 May - 17 June 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Denmark and Sweden.

Phygadeuontini

Bathythrix linearis (Gravenhorst, 1829)

Ø Sarpsborg: Råkil (EIS 20), 1♀ 7 July 1997, leg. TJO. Distribution: Palaearctic, known from Sweden.

Bathythrix prominens (Strobl, 1901)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 1♀ 24 August - 16 October 1992, leg. LOH & GWa. Distribution: Palaearctic, known from Sweden.

Chirotica maculipennis (Gravenhorst, 1829)

TEI Notodden: Lisleherad (EIS 27), 1♀ 22 June - 6 August 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

Endasys alutaceus (Habermehl, 1912)

Ø Sarpsborg, Råkil (EIS 20), 1♂ 15 June 1997, leg. TJO. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Endasys striatus (Kiss, 1924)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♂ 10 July 1994, leg. TJO. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Glyphicnemis vagabunda (Gravenhorst, 1829)

BØ Røyken: Kinnartangen (EIS 28), 1♂ 8 July 1989, leg. LOH. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Mastrus longicauda Horstmann, 1990

VE Stokke: Melsomvik (EIS 19), 1♀ 22 July - 27 August 1995, window trap, leg. O. Hanssen & LOH. Distribution: Known from Denmark and Sweden.

Orthizema obscurum Horstmann, 1993

BV Rollag: Vårviken (EIS 35), 1♀ July 1992, MT, leg. BAS. Distribution: England and Austria, new record for Scandinavia

Phygadeuon elegans (Förster, 1850)

The specimens are brachypterous. **Ø** Moss: Jeløy, Hvittingbukta (EIS 19), 2♀♀ 30 June - 31 July 1995, pitfall-trap, leg. O. Hanssen & G. Hardeng. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

CTENOPELMATINAE

Ctenopelmatini

Xenoschesis nigricoxa Strobl, 1903

HOI Ulvik: Finse (EIS 42), 1♀ 19 July 1991, leg. O.J. Lønnve. Distribution: Palaearctic, new record for Scandinavia.

Pionini

Pion crassipes (Holmgren, 1857)

Ø Fredrikstad: Gansrød/Øra (EIS 20), 1♀ 12 July 1996, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Rhorus chrysopus (Gmelin, 1790)

Ø Sarpsborg: Maugesten (EIS 20), 1♀ 29 June 1992, leg. TJO; **BØ** Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 1♂ July 1988, leg. D. Ruud. Distribution: Palaearctic, known from Finland.

Sympherta ullrichi (Tschek, 1869)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 3♂♂ 19 May - 17 June 1992, leg. LOH & GWa. Distribution: Palaearctic, known from Finland.

Trematopygus dubitor Hinz, 1982

BV Rollag: Kjomme (EIS 27), 1♀ 13 June 1995, leg. BAS. Distribution: Palaearctic, known from Sweden.

Trematopygus lethierryi (Thomson, 1893)

BØ Nedre Eiker: Ryghsetra (EIS 28), 1♂ May 1994, MT, leg. YBe & LOH. Distribution: Palaearctic, known from Sweden.

Perilissini

Lathrolestes verticalis (Brischke, 1871)

Ø Rygge, Ekeby, Gunnarsbybekken (EIS 19), 1♂ 21 July - 24 August 1992, 1♂ 24 August - 16 October 1992, leg. LOH & GWa. Distribution: Palaearctic, known from Finland and Sweden.

Perilissus limitaris (Gravenhorst, 1829)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 3♀♀ 19 May - 17 June 1992, leg. LOH & GWa; **BØ** Drammen: Underlia (EIS 28), 1♂ 1 October 1985, leg. LOH; Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 1♂ 15 September 1988, leg. D.W.B. Johansen, Distribution: Palaearctic, known from Denmark and Finland.

Perilissus lutescens Holmgren, 1857

RY Randaberg: Grødem (EIS 7), 1♀ 3 June 1995, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Mesoleiini

Alexeter coxalis (Brischke, 1871)

Ø Halden: Enningdalen, Kirkebøen (EIS 12), 1♀ 1 August 1997, leg. TJO, Rygge: Sildebauen (EIS 19), 1♀ 26 August 1995, leg. ØBe, Råde: Tomb (EIS 20), 1♀ 11 August 1995, leg. LOH. Distribution: Palaearctic, new record for Scandinavia.

Barytarbes adpropinquator (Gravenhorst, 1829)

BØ Lier: Garsjø (EIS 28), 1♂ 4 July 1993, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Campodorus caligatus (Gravenhorst, 1829)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 27 October 1985, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Campodorus clypealis (Thomson, 1893)

BV Rollag: Veggli (EIS 35), 1♀ 19 June 1995, leg. BAS. Distribution: Palaearctic, new record for Scandinavia.

Hyperbatus sternoxanthus (Gravenhorst, 1829)

VE Våle: Langøya (EIS 19), 1♀ September - October 1987, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Lamachus coalitorius (Thunberg, 1822)

VE Våle: Langøya (EIS 19), 1♀ 8 July 1991, leg. LOH. Distribution: Palaearctic, introduced into Canada and U.S.A., known from Finland and Sweden.

Lamachus frutetorum (Hartig, 1838)

VE Våle: Langøya (EIS 19), 1♀ 8 July - 2 August 1991, MT, leg. LOH; **BØ** Drammen: Underlia (EIS 28), 1♀ 1 October 1985, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Protarchus testatorius (Thunberg, 1822)

STI Midtre Gauldal: Elgshøgda 700m, 1♀ leg. 13 March 1996, hatched 27 April 1996 from pupa of Cimbicidae spec. attached to twig of *Betula pubescens*, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Scopesis gesticulator (Thunberg, 1822) [syn. *nigricollis* Gravenhorst]

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 1♂ 21 July - 24 August 1992, leg. LOH & GWa. Distribution: Holarctic, known from Finland and Sweden.

Euryproctini

Hadrodactylus flavofacialis (Horstmann, 2000*)*
[syn. *flavifrontator* Thunberg]

BØ Røyken: Kinnartangen (EIS 28), 1♂ 29 May 1989, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

ICHNEUMONINAE

Alomyini

Aethecerus discolor Wesmael, 1845

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♂ 21 July - 24 August 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Finland and Sweden.

Centeterus major Wesmael, 1845

VE Våle: Langøya (EIS 19), 1♂ 8 July - 2 August 1991, MT, leg. LOH; **Ø** Sarpsborg: Råkil (EIS 20), 1♀ 15 July 1995, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Dicaelotus punctiventris (Thomson, 1891)

AK Oslo: Kværner (EIS 28), 1♀ 12-26 June 1990, leg. MFa. Distribution: Palaearctic, known from Sweden.

Eriplatys ardeicollis (Wesmael, 1845)

Ø Sarpsborg: Skjeberg, Grimsøy (EIS 20), 1♀ 22 April 1992, leg. TJO; **BØ** Drammen: Underlia (EIS 28), 1♀ June 1993, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Heterischnus anomalus (Wesmael, 1857)

This species is probably a colour form of *Heterischnus truncator* (Fabricius). **BØ** Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 1♂ 13 July 1988, leg. D.W.B. Johansen; **Ø** Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♂ 17 June - 21 July 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Finland.

Heterischnus truncator (Fabricius, 1798)

Ø Fredrikstad: Gansrød (EIS 20), 1♀ 10 June 1996, leg. TJO. Distribution: Palaearctic, known from Finland.

Tycherus cephalotes (Wesmael, 1845)

RY Sandnes: Dale (EIS 7), 1♀ 21 May 1988, hatched from *Pammene regiana* (Lepidoptera), leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Platylabini

Platylabus decipiens Wesmael, 1848

BØ Nedre Eiker: Mjøndalen, Miletjern (EIS 28), light trap, 1♂ June 1988, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Heresiarchini

Amblyjoppa fuscipennis (Wesmael, 1845)

BØ Hurum: Mølen (EIS 19), 1♂ 1 August 1991, leg. LOH; Røyken: Kinnartangen (EIS 28), 1♀ June 1993, MT, leg. LOH; Nedre Eiker: Ryghsetra (EIS 28), 1♂ June 1994, at light, leg. D. Ruud. **VE** Sande: Kommersøya (EIS 19), 2♂♂ 28 May - 9 July 1991, leg. LOH.; **BV** Rollag: Rollag (EIS 35), 1♀ 18 June 1993, leg. BAS. Distribution: Palaearctic, known from Finland.

Amblyjoppa proteus (Christ, 1791)

AK Oslo: Nøklevann (EIS 28), 1♀ 11 July 1992, leg. MFa. Distribution: Palaearctic, known from Finland and Sweden.

Coelichneumon opulentus (Taschenberg, 1871)

BØ Hurum: Tofteholmen (EIS 19), 1♀ 1 September - 26 October 1991, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Coelichneumon orbitator (Thunberg, 1822)

Ø Sarpsborg: Råkil (EIS 20), 1♂ 4 June 1996, leg. TJO. Distribution: Palaearctic, known from Sweden.

Coelichneumon pumilionobilis Heinrich, 1951

TEI Notodden: Lisleherad (EIS 27), 1♀ 22 June - 6 August 1993, MT, leg. ABa. Distribution: Holarctic, new for Scandinavia.

Ichneumonini

Cratichneumon coruscator (Linnaeus, 1758)

VE Larvik: Brunlanes, Lerungsand (EIS 11), 2♂♂ 23 June 1996, leg. ØBe; **TRY** Tromsø: Telegrafbukta, 1♂ 21 July 1994, leg. H. Elven. Distribution: Palaearctic, new for Scandinavia.

Cratichneumon infidus (Wesmael, 1848)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♀ 21 July- 24 August 1992, leg. LOH & GWa. Distribution: Palaearctic, known from Finland and Sweden.

Diphyus bicingulatus (Gravenhorst, 1829)

BV Rollag: Rollag (EIS 35), ♀ 18 June 1993, leg. BAS; Rollag: Stærnes (EIS 27), ♀ May 1994 and ♀ 20 April 1994, leg. BAS. Distribution: Palaearctic, known from Finland and Sweden.

Diphyus castanopyga (Stephens, 1835)

VAY Flekkefjord: Hidra, Dragøy (EIS 4), 1♀ 6 May - 20 June 1982 MT, leg. A.J. Nielsen. Distribution: Palaearctic, known from Sweden.

Diphyus indocilis (Wesmael, 1845)

Ø Sarpsborg: Skjeberg, Skjebergdalen (EIS 20), 1♀ 24 April 1993, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Diphyus palliatorius (Gravenhorst, 1829)

BØ Hurum: Skatvedt (EIS 28), 1♂ 18 July 1994, leg. J. Engdal. Distribution: Palaearctic, known from Finland and Sweden.

Diphyus trifasciatus (Gravenhorst, 1829)

Ø Sarpsborg: Tune, Råkil (EIS 20), 2♀♀ 10 and 15 April 1994, leg. TJO; **AK** Asker: Hval (EIS 28), 1♀ 30 April 1995, leg. ØBe. Distribution: Palaearctic, new for Scandinavia.

Homotherus varipes (Gravenhorst, 1829)

Ø Sarpsborg: Skjebergdalen (EIS 20), 1♀ 7 July 1996, leg. TJO. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Ichneumon analis Gravenhorst, 1829

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♂ 25 August 1993, leg. TJO. Distribution: Palaearctic, new for Scandinavia (a questionable record was given by Strand, 1913 from VAY).

Ichneumon minutorius Desvignes, 1856

VE Larvik: Brunlanes, Lerungsand (EIS 11), 1♀ 6 July 1996, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Ichneumon tuberculipes Wesmael, 1848

Ø Aremark: Bøensætre (EIS 21), 1♀ 5 June 1994, 1♀ 22 June 1996, leg. TJO; Hvaler: Kjærkøy, 1♀ 5 July 1994, leg. LOH. **VE** Larvik: Brunlanes, Lerungsand (EIS 11), 1♀ 23 June 1996, leg. ØBe; **TEI** Notodden: Lisleherad (EIS 27), 1♀ 27 May-22 June 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

Patrocloides lapponicus (Holmgren, 1871)

HOI Ulvik: Finse (EIS 42), 3♀♀ 22 and 26 July 1991, leg. O.J. Lønnve. Distribution: Palaearctic, known from Finland and Sweden.

Stenobarichneumon basalis Perkins, 1960 [syn. *basiglyptus* auct. nec Kriechbaumer]

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♂ 15 June 1995, leg. TJO. Distribution: Palaearctic, known from Finland.

Stenobarichneumon citator (Thunberg, 1822)

Ø Sarpsborg: Tune, Råkil (EIS 20) (EIS 20), 1♀ 21 June 1994, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Thyrateles haereticus (Wesmael, 1854)

Ø Fredrikstad: Fredrikstad (EIS 20), 1♀ 1 August 1991, leg. O. Sørlibråten; **AK** Bærum: Kjaglidalen (EIS 28), 1♀ 11 - 22 June 1990, MT, leg. MFa;

Asker: Nesøya (EIS 28), 8♀♀ hatched from pupa of *Inachis io* (Linnaeus) (Lepidoptera) in July 1993 leg. LOH; **HEN** Rendalen: Ytre Rendal, Storsjøen (EIS 64), 1♀ 27 July 1945, leg. L.R. Natvig col. ZMO. Distribution: Palaearctic, known from Finland and Sweden. According to Hinz (1973) this species is mainly a parasitoid of *Aglais urticae* (Linnaeus); *I. io* seems to be an exceptional host at least in Central Europe.

Virgichneumon maculicauda (Perkins, 1953)

Ø Fredrikstad: Onsøy, Rauer (EIS 19), 1♂ 29 July 1989, leg. LOH. Distribution: Palaearctic, new for Scandinavia

Vulgichneumon deceptor (Scopoli, 1763)

ON Nord-Fron: Hesteskobakken (EIS 62), 1♂ 11 July 1994, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Vulgichneumon saturatorius (Linnaeus, 1758)

BØ Røyken: Kinnartangen (EIS 28), 1♂ 17 July 1989, leg. LOH. Distribution: Palaearctic and Oriental, known from Denmark, Finland, and Sweden.

Zanthojoppa lutea (Gravenhorst, 1829)

AK Bærum: Kjaglidalen (EIS 28), 1♀ 11 - 26 July 1990, MT, leg. MFa. Distribution: Palaearctic, new to Scandinavia.

MESOCHORINAE

Astiphromma anale (Holmgren, 1860)

BV Rollag: Rollag (EIS 35), 1♂ 5 June 1995, leg. BAS. Distribution: Palaearctic, known from Finland and Sweden.

Astiphromma dorsale (Holmgren, 1860)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♂ 15 June 1994, leg. TJO; Fredrikstad: Fredrikstad (EIS 20), 1♀ 1 August 1991, leg. O. Sørlibråten. Distribution: Palaearctic and Oriental, known from Finland and Sweden.

Astiphromma tenuicorne Thomson, 1886

BØ Røyken: Kinnartangen (EIS 28), 1♀ 6 July 1989, leg. LOH; Hurum: Tofteholmen (EIS 19), 1♀ 7-31 July 1991, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Mesochorus brevipetiolatus Ratzeburg, 1844

BØ Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 2♀♀ June 1988, light trap, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Mesochorus pictilis Holmgren, 1860

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), 3♀♀ 21 July - 24 August 1992, MT, leg. LOH & GWa. Distribution: Holarctic, known from Finland and Sweden.

Mesochorus testaceus Gravenhorst, 1829

BØ Røyken: Kinnartangen (EIS 28), 1♀ 6 July 1989, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

METOPIINAE

Exochus albicinctus Holmgren, 1873 var.

Temples enlarged, costulae absent, head, thorax and gaster black, legs with coxae predominantly black, all femora apically, basal ring and dorsal face of tibiae I and basal rings of tibiae II and III yellow-white. **Ø** Hvaler: Asmaløy, Huser (EIS 12), 1♂ 27 May 1995, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Exochus alpinus (Zetterstedt, 1838)

TEI Notodden: Lisleherad (EIS 27), 1♀ 22 June - 6 August 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

Exochus ratzeburgi Holmgren, 1858

BØ Drammen: Underlia (EIS 28), 1♂ July 1994, MT, leg. LOH. Distribution: Northern and Eastern Europe, known from Finland and Sweden.

Metopius brevispina Thomson, 1887

TEI Seljord: Blika (EIS 26), 1♂ 5 - 8 August 1993, leg. H. Elven & A. Dahl. Distribution: Palaearctic, known from Finland.

Triclistus aethiops (Gravenhorst, 1829)

VE Sande: Kommersøya (EIS 19), 1♀ 28 May - 9 July 1991, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

Trieces tricarinatus (Holmgren, 1858)

Ø Sarpsborg: Sandbakken (EIS 20), 1♂ 10 July 1996, leg. TJO; **VE** Våle: Langøya (EIS 19), 1♀♀ 8 July - 2 August 1991, MT, leg. LOH. Distribution: Palaearctic, known from Finland and Sweden.

ORTHOCENTRINAE

Aperileptus microspilus Förster, 1871

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 1♀ 24 August - 16 October 1992, leg. LOH & GWa. Distribution: Germany, Finland, and Sweden

Gnathochorisis crassulus (Thomson, 1888)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 2♀♀ 24 August - 16 October 1992, leg. LOH & GWa. Distribution: Holarctic, known from Finland and Sweden.

Helictes erythrostoma (Gmelin, 1790)

BØ Hurum: Ramvikholmen (EIS 19), 1♂ 12 August 1990, leg. LOH. Probably 1♀ belonging to this species: **TEI** Notodden: Lisleherad (EIS 27), ♀ 6 August - 19 October 1993, MT, leg. ABa. Distribution: Holarctic, known from Finland and Sweden.

Megastylus excubitor (Förster, 1871)

HEN Rendalen: Ytre Rendal, Solbakken (EIS 64), 1♀ 25 August 1957, leg. L.R. Natvig, col. ZMO. Distribution: Palaearctic, known from Sweden.

Megastylus flavopictus (Gravenhorst, 1829)

VE Våle: Langøya (EIS 19), 1♂ 8 July - 2 August 1991, MT, leg. LOH. Distribution: Holarctic, known from Denmark, Finland, and Sweden.

Megastylus impressor Schiødte, 1838

FV Måsøy: Rolvsøy, Gunnarnes (EIS 186), 1♀MT August 1992, leg. PAT. Distribution: Holarctic, known from Denmark, Finland, and Sweden.

Megastylus orbitator Schiødte, 1838

TEI Notodden: Lisleherad (EIS 27), 1♀ 6 August - 19 October 1993, MT, leg. ABa; **Ø** Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 2♀♀ 21 July - 24 August, leg. LOH & GWa; Rygge: Ekeby, Telemarkslunden (EIS 19), 1♀ 17 June - 21 July 1992 and 1♀ 21 July - 24 August 1992, MT, leg. LOH & GWa; **AK** Sørum: Lørenfallet, Egner (EIS 37), 1♀ October 1994, MT, leg. LOH & O. Sørlibråten; **ON** Nord-Fron: Hesteskobakken (EIS 62), 1♀ 6 August - 19 September 1992, MT, leg. KMy & LOH. Distribution: Holarctic, known from Finland.

Orthocentrus asper Gravenhorst, 1829

AK Bærum: Kjaglidalen (EIS 28), 1♀ 26 May - 11 June 1990, MT, leg. MFa; **Ø** Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♀ 24 August - 16 October 1992, MT, leg. LOH & GWa. Distribution: Holarctic, known from Finland and Sweden.

Orthocentrus sannio Holmgren, 1858

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), 1♂ 24 August - 16 October 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Finland and Sweden.

Pantisarthrus luridus Förster, 1871

TEI Notodden: Lisleherad (EIS 27), 1♀ 6 August - 19 October 1993, MT, leg. ABa; **AK** Sørum: Lørenfallet, Egner (EIS 37), 1♂ October 1994, MT, leg. LOH and Sørlibråten; **Ø** Sarpsborg: Tune, Råkil (EIS 20), 1♂ 22 May 1994, leg. TJO. Distribution: Holarctic, known from Greenland, Finland and Sweden.

Proclitus praetor (Haliday, 1871)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 1♂ 21 July - 24 August 1992, leg. LOH & GWa; **BØ** Drammen: Underlia (EIS 28), 1♀ October 1994, MT, leg. LOH. Distribution: Holarctic, known from Denmark, Finland, and Sweden.

ORTHOPELMATINAE

Orthopelma mediator (Thunberg, 1822)

BØ Nedre Eiker: Ryghsetra (EIS 28), 1♀ and 3♂♂ May 1994, hatched from galls on *Rosa* sp., leg. LOH; **AK** Rælingen: Tveter, 16♀♀ and 12♂♂ May 1994, hatched from galls on *Rosa* sp., leg. LOH. Distribution: Holarctic, known from Finland and Sweden.

OXYTORINAE

Oxytorus armatus Thomson, 1883

BØ Nedre-Eiker: Mjøndalen, Miletjern (EIS 28), 1♂ September 1988, leg. D.W.B. Johansen. Distribution: Palaearctic, known from Finland and Sweden.

PAXYLOMMATINAE

Hybrizon buccatum (Brebisson, 1825)

Ø Sarpsborg: Tune, Råkil (EIS 20), 4♀♀ 16-20 July 1994, 8 August 1995, 20 July 1995, leg. TJO; **BØ** Røyken: Kinnartangen (EIS 28), 1♀ 28 May-6 July 1991, leg. LOH; Drammen: Underlia (EIS 28), 2♀♀ June 1992, MT, leg. LOH; **VE** Våle: Langøya (EIS 19), 2♀♀ 8 July - 2 August 1991, leg. LOH; Stokke: Melsomvik (EIS 19), 1♀ 6 June-22 July 1995, pitfall trap, leg. O. Hanssen & LOH; **TEY** Porsgrunn: Helleåsen (EIS 11), 1♀ 13 July-27 August 1995, pitfall-trap, leg. O. Hanssen & LOH. Distribution: Palaearctic, known from Finland.

PHRUDINAE

Astrenis paradoxa Schmiedeknecht, 1907

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 1♀ 21 July - 24 August 1992, leg. LOH & GWa. Distribution: Central Europe, new for Scandinavia.

Phrudus monilicornis Bridgman, 1886

BØ Drammen: Underlia (EIS 28), 1♀ June 1992, MT, leg. LOH. Distribution: Palaearctic and Oriental, known from Finland and Sweden.

PIMPLINAE

Ephialtini

Dolichomitus pterelas (Say, 1829)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 7 August 1995, leg. TJO. Distribution: Holarctic, new for Scandinavia.

Ephialtes brevis Morley, 1914

BV Rollag: Bråtåsen (EIS 35), 1♀ July 1994, MT, leg. LOH and BAS; Rollag: Vårviken (EIS 35), 1♀ August 1992, MT, leg. BAS. **AK** Fet: Nordre Øyeren, Ekholt (EIS 29), 1♀ 2 May 1988, leg. K. Sund, col. ZMO; **TEI** Notodden: Lisleherad (EIS 27), 7♀♀ 22 June - 6 August 1993 and 1♀ 6 August - 19 October 1994, MT, leg. ABa. Distribution: Holarctic, known from Finland.

Fredegunda dilutus (Ratzeburg, 1852)

Ø Fredrikstad: Fredrikstad (EIS 20), 1♀ 1 August 1991, leg. O. Sørlibråten. Distribution: Palaearctic, known from Finland and Sweden.

Liotryphon caudatus (Ratzeburg, 1848)

TEI Notodden Lisleherad (EIS 27), 1♀ 27 May - 22 June 1993, MT, leg. ABa. Distribution: Palaearctic, introduced into U.S.A. and New Zealand, known from Sweden.

Scambus pomorum (Ratzeburg, 1848)

A variant specimen with red marks on thorax. **BØ** Nedre Eiker: Ryghsetra (EIS 28), 1♀ May 1994, MT, leg. YBe and LOH. Distribution: Palaearctic, known from Sweden.

Tromatobia ornata (Gravenhorst, 1829)

Ø Sarpsborg: Råkil (EIS 20), Tune, 1♀ 20 September 1994, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Zaglyptus multicolor (Gravenhorst, 1829)

TEI Notodden: Lisleherad (EIS 27), 1♀ 6 August - 19 October 1993, MT, leg. ABa; **BØ** Røyken: Kinnartangen (EIS 28), 1♂ 8 September - 24 October 1991, MT, leg. LOH. Distribution: Palaearctic and Oriental, known from Finland and Sweden.

Polysphinctini

Zatypota albicoxa (Walker, 1874)

BØ Hurum: Mølen (EIS 19), 1♀ 2 - 4 July 1990, leg. LOH; Drammen: Underlia (EIS 28), 1♀ July 1992, MT, leg. LOH. Distribution: Palaearctic and Oriental, known from Denmark and Sweden.

Pimplini

Apechthis capulifera (Kriechbaumer, 1887)

Ø Aremark: Bøensætre (EIS 21), 1♀ 5 June 1994, leg. TJO. Distribution: Palaearctic, known from Sweden.

POEMENIINAE

Deuteroxorides elevator (Panzer, 1799)

TEI Tinn: Håkenes (EIS 26), 1♂ July 1995, MT, leg. BAS. Distribution: Palaearctic, known from Finland and Sweden.

Poemenia brachyura Holmgren, 1860

Ø Sarpsborg: Tune, Råkil (EIS 20), 2♀♀ 10 June 1993, 10 August 1994, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Poemenia collaris (Haupt, 1917)

Ø Sarpsborg, Sandbakken (EIS 20), 1♀ 27 July 1996, leg. TJO. Distribution: Palaearctic, known from Sweden.

Poemenia notata Holmgren, 1859

TEI Notodden: Lisleherad (EIS 27), 2♀♀ 22 June - 6 August 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

RHYSSINAE

Megarhyssa perlata (Christ, 1791)

TEI Notodden: Lisleherad (EIS 27), 1♀ 6 August - 19 October 1993, MT, leg. ABa. Distribution: Palaearctic, known from Sweden.

TERSILOCHINAE

Barycnemis gracillima Thomson, 1889

BV Rollag: Rollag (EIS 35), 1♀ 5 June 1995, leg. BAS. Distribution: Palaearctic, known from Finland and Sweden.

Phradis interstitialis (Thomson, 1889)

ON Nord-Fron: Hesteskobakken (EIS 62), 3♀♀ 1-25 May 1992, MT, leg. KMy & LOH. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Probles microcephalus (Gravenhorst, 1829)

BØ Røyken: Kinnartangen (EIS 28), 1♀ 11 July 1991, leg. LOH. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Spinolochus laevifrons (Holmgren, 1860)

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 30 July 1994, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

TRYPHONINAE

Tribus Phytodietini

Netelia tarsata (Brischke, 1880)

Ø Sarpsborg: Råkil (EIS 20), Tune, 1♀ 1994 (without date), leg. TJO. Distribution: Holarctic, known from Finland.

Phytodietus polyzonias (Forster, 1771)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), MT, 1♀ 19 May - 17 June 1992, leg. LOH & GWa. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Tryphonini

Cosmoconus nigriventris Kasparyan, 1971

BØ Nedre Eiker: Mjøndalen, Miletjern (EIS 28), 2♀♀ and 2♂♂ 31 August 1988, leg. D.W.B. Johansen. Distribution: Palaearctic, known from Finland.

Ctenochira angulata (Thomson, 1883)

Ø Sarpsborg: Sandbakken (EIS 20), 1♂ 20 June 1996, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Ctenochira propinqua (Gravenhorst, 1829)

BV Rollag: Kjomme (EIS 27), 1♀ 13 June 1995, leg. BAS. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Erromenus analis (Brischke, 1871)

Ø Sarpsborg: Råkil (EIS 20), Tune, 1♀ 22 July 1994, leg. TJO. Distribution: Holarctic, known from Finland and Sweden.

Neleges proditor (Gravenhorst, 1829)

AK Oslo: Røa (EIS 28), 1♀ 7 July 1995, leg. ØBe. Distribution: Palaearctic, new record for Scandinavia

Polyblastus pallicoxa Thomson, 1888

AK Oslo: Kværner (EIS 28), 1♀ 12-26 June 1990, MT, leg. MFa. Distribution: Palaearctic, known from Finland and Sweden.

Tryphon heliophilus (Gravenhorst, 1829)

VE Våle: Langøya (EIS 19), 1♀ 8 July - 2 August 1991, MT, leg. LOH; **Ø** Sarpsborg: Tune, Råkil (EIS 20), 1♀ 28 July 1994, leg. TJO. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Exenterini

Cycasis rubiginosa (Gravenhorst, 1829)

Ø Sarpsborg: Råkil (EIS 20), 2♀♀ 10 July 1996 and 20 June 1997, leg. TJO. Distribution: Palaearctic, known from Finland and Sweden.

Eridolius schiodtei (Holmgren, 1857)

Ø Rygge: Ekeby, Gunnarsbybekken (EIS 19), 2♂♂ 17 June - 21 July 1992 and 20♀♀ 24 August - 16 October 1992, MT, leg. LOH & GWa. Distribution: Known from Finland, Russia, and Sweden.

Excavarus apiarius (Gravenhorst, 1829)

BV Rollag: Veggli (EIS 35), 1♀ 9 July 1995, leg. BAS; **AK** Sørum: Lørenfallet, Egner (EIS 37), 1♂ 7 July 1994, leg. O. Sørlibråten. Distribution: Palaearctic, known from Denmark, Finland, and Sweden.

Exyston pratorum (Woldstedt, 1874)

Ø Sarpsborg: Sandbakken (EIS 20), 1♀ 6 July 1996, leg. TJO; Sarpsborg: Tune, Råkil (EIS 20), 1♀ 22 June 1994, leg. TJO; **BV** Rollag: Veggli (EIS 35), 1♂ 23 June 1995, leg. BAS; **VE** Larvik: Brunlanes, Lerungsand (EIS 11), 1♀ 15 June 1997, leg. ØBe. Distribution: Palaearctic, known from Finland and Sweden.

Smicroplectrus erosus (Holmgren, 1857)

BV Rollag: Veggli (EIS 35), 1♂ 23 June 1995, leg. BAS. Distribution: Palaearctic, known from Sweden.

Idiogrammatini

Idiogramma alysiina (Thomson, 1888)

Ø Råde: Tomb (EIS 20), 1♀ and 2♂♂ 18 May 1995, leg. TJO. Distribution: Known from Finland and Germany.

XORIDINAE

Ischnoceros caligatus (Gravenhorst, 1829)

Ø Rygge: Ekeby, Telemarkslunden (EIS 19), MT, 1♀ 17 June - 21 July 1992, 1♀ 17 June - 21 July 1992, leg. LOH & GWa. Distribution: Palaearctic, known from Finland and Sweden.

Xorides gravenhorstii (Curtis, 1831)

BV Rollag: Djupdal (EIS 27), 1♀ 28 July 1993, leg. BAS; **Ø** Rygge: Telemarkslunden (EIS 19), 1♀ 21 July - 24 August 1992, MT, leg. LOH & GWa. Distribution: Palaearctic, known from Sweden.

Xorides irrigator (Fabricius, 1793)

TEI Notodden: Lisleherad (EIS 27), 3♀♀ and 1♂ 27 May - 19 October 1993, MT, leg. ABa. Distribution: Palaearctic, known from Finland and Sweden.

Xorides niger Pfeffer, 1913

Ø Sarpsborg: Tune, Råkil (EIS 20), 1♀ 22 August 1996, leg. TJO. Distribution: Palaearctic, new record for Scandinavia

DISCUSSION

About 1100 different species of Ichneumonidae have been found in Norway so far (Yu 1999). This paper gives distributional records of 169 additional species. Although the number of known Norwegian Ichneumonidae is substantially increased by this publication, many more of these parasitoid wasps can be expected to occur in Norway. With respect to other Scandinavian countries such as Sweden with approximately 2,500 reported ichneumonid species (Yu 1999), we estimate that not more than 1/2 to 2/3 of the Norwegian ichneumonid fauna have been reported so far. Therefore, the Ichneumonidae form the most species-rich family of animals in Norway as well as in most other countries in the Palaearctic region (Gauld & Bolton 1988, Yu 1999).

Most of the species mentioned in this paper are widespread in Europe and were previously found in other Northern countries. However, fifteen species which were collected in the warmer Southeastern and Southern parts of Norway are reported from Scandinavia for the first time.

Acknowledgements. For the collection and loan of their ichneumonid material we would like to thank all the collectors in Norway who generously donated their material for this study, especially Mr Thor Jan Olsen.

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Received 5 October 2000,
accepted 2 November 2000

Aculeata of Norway. 3. Eleven species of bees new to Norway (Hymenoptera: Apoidea)

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Berg, Ø. 2000. Aculeata of Norway. 3. Eleven species of bees new to Norway (Hymenoptera: Apoidea). Norw. J. Entomol. 47, 177–181.

The following eleven species of bees (Apoidea) are published from Norway for the first time: *Colletes marginatus* F. Smith, 1846, *C. similis* Schenck, 1853, *Hylaeus annularis* (Kirby, 1802), *H. rinki* (Gorski, 1852) (Colletidae), *Andrena fulvida* Schenck, 1853, *A. ovatula* (Kirby, 1802), *Panurginus romani* Aurivillius, 1914 (Andrenidae), *Lasioglossum xanthopus* (Kirby, 1802) (Halictidae), *Dasypoda hirtipes* (Fabricius, 1793) (Melittidae), *Osmia aurulenta* (Panzer, 1799) and *Megachile lapponica* Thomson, 1872 (Megachilidae). A total of 184 species of bees are now recorded from Norway.

Key words: Hymenoptera, Apoidea, solitary bees, distribution in Norway.

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INTRODUCTION

Nearly all publications on Norwegian bees the last 60 years have been restricted to the family Apidae. The bumblebees (Apidae, Bombinae) have been thoroughly worked by Løken (1973, 1984). The honeybee, *Apis mellifera* L., 1758 (Apidae, Apinae), has been intensively studied in several aspects. The non-apid bees, sometimes called solitary bees, have been largely ignored. The only two complete checklists of Norwegian bees are old, being published by Siebke (1880) and Strand (1898). Regional lists have been published by Soot-Ryen (1925) for North Norway and by Meidell (1934) for Rogaland. Additional records have been published by Sommerfelt (1824–27), Zetterstedt (1838), Nylander (1852a, b), Schøyen (1880, 1887), Sparre Schneider (1895, 1909), Strand (1900, 1901, 1903, 1906, 1910), Friese (1902), Hellén (1933), Meidell (1945), Løken (1958, 1967), Tkalců (1974, 1975, 1977a, 1977b, 1983), Greve & Hauge (1989) and Fjellberg (1993). A survey of this literature shows that approximately 173 species of bees have been published from Norway. To establish an exact number requires a revision of museum material to fully understand certain names used in old literature. This is beyond the scope of the present work.

Some years ago a few Norwegian entomologists took up an interest in the aculeate Hymenoptera. This article is number 3 in a planned series of works on Norwegian aculeates. The previous two articles were published by Hansen (1995) and Hansen & Olmi (1996).

SPECIES LIST

Nomenclature follows Schwarz *et al.* (1996, p. 190). Biogeographic regions are given according to J. Økland (1976) and EIS-squares according to K.A. Økland (1981). The following abbreviations have been used: AF=Arne Fjellberg, LOH=Lars Ove Hansen, ØB=Øistein Berg.

The author has identified specimens unless otherwise noted in the text. The material is deposited in the private collections of ØB or AF unless otherwise noted.

Colletidae

Colletes marginatus F. Smith, 1846

AK Oslo: Gressholmen (EIS 28) 3 ♀♀, 2 ♂♂ 10–24 June 1992 on *Vincetoxicum rossicum* (Asclepiadaceae) leg. Emmy Gram, det. AF, coll. Zoological Museum, Oslo; Bærum: Kalvøya (EIS 28) 3 ♂♂ 8 July 1995 leg. ØB; Asker: Nesøya (EIS 28) 1 ♂ 21 June 1992 leg. & coll. LOH; **VE** Tjøme: Moutmarka (EIS 19) 1 ♂ 3 July 1992 leg. & det. AF; Tjøme: Hellesmo (EIS 19) 2 ♀♀ 26 July 1995 and 1 ♂, 1 ♀ 4 August 1996 leg. ØB.

C. similis Schenck, 1853

AK Bærum: Kalvøya (EIS 28) 1 ♀ 6 July 1991 leg. & det. AF, 2 ♂♂ 8 July 1995 and 1 ♂ 12 July 1999 leg. ØB; Bærum: Fleskumåsen (EIS 28) 1 ♀ 24 August 1998 on *Achillea millefolium* (Compositae) and 1 ♂ 3 July 1999 leg. ØB; Asker: Hval (EIS 28) 1 ♀ 2 ♂♂ from a row of cells found in ground 30 April 1995. An agricultural vehicle had cut a vertical profile in the soil and thus exposed the cells. Pupae were kept indoors and hatched 30, 28 and 27 May 1995 respectively. Leg. ØB; **BØ** Røyken: Kinnartangen (EIS 28) 1 ♀ 11 July 1993, leg. ØB; Kongsberg: Labru (EIS 27) 1 ♀ 29 June 1993 leg. Bjørn A. Sagvolden; **VE** Våle: Langøya (EIS 19) 1 ♀ Malaise-trap 8 July–2 August 1991 leg. LOH; Tjøme: Moutmarka (EIS 19) 1 ♂ 8 June 1992 leg. & det. AF; Tjøme: Sandø (EIS 19) 1 specimen 7 June 1992 leg. & det. AF; Tjøme: Hvasser, Fyn (EIS 19) 2 ♂♂ 4 August 1996 on *Tanacetum vulgare* (Compositae) leg. ØB; Larvik: Mølen (EIS 11) 1 ♂ 24 June 1992 leg. AF; **TEY** Porsgrunn: Sandøya (EIS 11) 1 ♀ 16 July 1998 leg. ØB.

Hylaeus annularis (Kirby, 1802)

VE Tjøme: Moutmarka (EIS 19) 1 ♂ 8 June 1992 leg. ØB; Tjøme: Sandø (EIS 19) 2 ♂♂ 7 June 1992 leg. ØB; Larvik: Oddane Sand (EIS 11) 1 ♀ 3 August 1999 leg. ØB; **AAY** Arendal: Merdøy (EIS 6) 1 ♂ 13 June 1992 leg. ØB; Arendal: Flostaøya, Arnevik (EIS 6) 3 ♀♀, 1 ♂ 13 July 1997 leg. ØB; **VAY** Søgne: Lyngmyr (EIS 2) 1 ♀ 29 July 2000 leg. ØB.

H. rinki (Gorski, 1852)

AK Bærum: Fleskumåsen (EIS 28) 1 ♂ 18 June 1999 leg. ØB; **OS** Gjøvik: Redalen (EIS 54) 1 ♀ 9 July 1999 leg. ØB; **BØ** Røyken: Hyggen, Kinnartangen (EIS 28) 1 ♂ 11 July 1993 leg. ØB; **VE** Lardal: Hukstrøm (EIS 19) 3 ♀♀ 15 August 1991 leg. ØB; **TEY** Nome: Ulefoss (EIS 18) 6 ♀♀ 31 July 1993 leg. ØB; **TEI** Bø: Verpe (EIS 17) 1 ♂ 11 June 1994 leg. ØB.

Andrenidae

Andrena fulvida Schenck, 1853

HES Eidskog: Leirsjøen (EIS 38) 2 ♀♀ 3 July 1991 leg. ØB.

It is interesting to note that this species was also recently published for the first time from Sweden (Svensson, Erlandsson & Janzon 1990).

A. ovatula (Kirby, 1802)
(syn. *albofasciata* Thomson, 1870)

VE Tjøme: Hvasser, near Sønstegård (EIS 19) 1 ♀ 7 June 1993 leg. ØB.

This species belongs to the subgenus *Taeniandrena* (*sensu* Warncke 1968) that has very distinct white bands across gaster. The other Norwegian species of this subgenus are *gelriae* van der Vecht, 1927, *intermedia* Thomson, 1870, *lathyri* Alfken, 1899 and *wilkella* (Kirby, 1802). Niemelä (1949) gives a key to these species.

Panurginus romani Aurivillius, 1914

OS Lillehammer: Smestad (EIS 54) 1 ♀ 14 June 1978 leg. Svein Svendsen, coll. Tore R. Nielsen; **STI** Midtre Gauldal: Støren (EIS 87) 1 ♀ 14 July 1993, leg. & coll. Tore R. Nielsen; **NTI** Stjørdal: Vikan (EIS 92) 3 ♂♂ 21 June 1998, 2 ♀♀ 1 ♂ 15 July 1998, 1 ♀ 17 July 1998, leg. Lay & Rykken, coll. Scott Armbruster, Norwegian University of Science and Technology, Trondheim; **NSI** Grane: Trofors (EIS 115) 2 ♀♀ 25 July 1946 leg. Tron Soot-Ryen, coll. Zoological Museum, Tromsø.

This is the first record of this genus in Norway, and the *only* boreal non-apid bee species recorded in Norway.

Halictidae

Lasioglossum xanthopus (Kirby, 1802)

Ø Fredrikstad: Gansrød/Øra (EIS 20) 1 ♀ 30 August 1991, leg. Thor Jan Olsen.

Melittidae

Dasypoda hirtipes (Fabricius, 1793)

Ø Råde: Åven (EIS 19) 5 ♂♂ 9–11 August 1996, leg. & coll. LOH; **VE** Tjøme: Hellesmo (EIS 19) 4 ♂♂ 26 July 1995, 4 ♀♀ 4 August 1996, leg. ØB; a colony with about 800 nests was established at Hellesmo in August 1997 (AF pers. comm.); Tjøme: Hvasser, Nessletta (EIS 19) 1 ♀ 4 August 1996, leg. ØB; also observed at Tjøme: Sandø (EIS 19) by AF.

Megachilidae

Osmia aurulenta (Panzer, 1799)

VE Tjøme: Sandø (EIS 19) 1 male 16 June 1991, 2 ♀♀ 30 May 1992 leg. & coll. AF; Tjøme: Hvasser, near Sønstegård (EIS 19), abandoned shells of *Cepaea nemoralis* with the opening plugged by a mastic of chewed leaves were collected on the 6 November 1991, leg. ØB. In April and May 1992 5 ♂♂ of *O. aurulenta* emerged. Same locality: 1 ♀ 7 June 1993 leg. ØB.

Megachile lapponica Thomson, 1872

AK Fet: Enebakkneset (EIS 29) 1 ♀ 27 June 1990 leg. ØB; **BV** Rollag: Rollag (EIS 35) 1 ♂ 8 September 1993 leg. Bjørn A. Sagvolden.

DISCUSSION

Including the species listed above, there are now recorded some 184 species of bees in Norway. As will be seen from the species list, most of the material examined for this study has been collected in the lowlands of southeastern Norway. This area appears to have the highest species diversity of non-apid bees in Norway. Most species of non-apid bees are known to be xerothermophilous, thus, the number of species increases towards the south. This is true both within Norway and further south. Austria is known to have a total of 647 species of bees (Schwarz *et al.* 1996), while Israel has an estimated 1500–2000 species (O'Toole & Raw 1991). The highest diversity of bees is found in warm temperate areas, such as the Mediterranean area. Michener (2000) estimates that about 17 000 different species of bees have been described so far, while he believes the total number of species could be as high as 30 000.

Both above mentioned species of *Hylaeus* belong to the subgenus *Lambdopsis* Popov, which is here reported from Norway for the first time. It is interesting to note that in the small material so far examined, all records of *H. annularis* are from localities very close to the sea. Most records of *H. rinki* are from inland localities.

HINTS ON USEFUL LITERATURE

A brief general introduction to solitary bees, in Norwegian, is given by Fjellberg (1995). A very useful article by Nilsson & Svensson (1986) contains a lot of basic information needed if one wishes to start studying North European aculeates. In particular there is a long list of identification literature. The most useful to start with is probably Landin (1971), which gives a key to the Swedish genera. Recently there have been published excellent keys in German by Scheuchl (1995, 1996) and Schmid-Egger & Scheuchl (1997). These contain many figures and should enable identification of all Central European species of the families Andrenidae, Melittidae, Megachilidae and Anthophoridae. All species published from Norway are included except *Panurginus romani* Aurivillius. The disadvantage of such comprehensive works employed on the Norwegian fauna is that they contain a large number of species not occurring in Norway. Many excellent photographs and a lot of information on biology can be found in Westrich (1990). The same can be said about two smaller books by O'Toole & Raw (1991) and Müller et al. (1997). A standard reference work for bees will be Michener (2000) that contains, among other, keys to all genera and subgenera of the world.

Acknowledgements. For help with identification I wish to thank F. Gusenleitner, Austria (*Andrena*), Lars Norén, Sweden (*Lasioglossum*) and the late Gijs van der Zanden, the Netherlands (*Megachile*). For gift and loan of material I would also like to thank Scott Armbruster, Emmy Gram, Lars Ove Hansen, Tore R. Nielsen, Arne Nilssen (Zoological Museum, Tromsø), Tor Jan Olsen and Bjørn A. Sagvolden. For useful comments and additional records, thanks to Arne Fjellberg and Lars Ove Hansen.

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Received 7 March 2000,
accepted 25 October 2000

Short communication

The genus *Pteromicra* Lioy, 1864 (Diptera, Sciomyzidae) in Norway

Lita Greve

Greve, L. 2000. The genus *Pteromicra* Lioy, 1864 (Diptera, Sciomyzidae) in Norway. Norw. J. Entomol. 47, 182–183.

The distribution of the genus *Pteromicra* in Norway is reviewed. Two species *Pteromicra angustipennis* (Staeger, 1845) and *Pteromicra glabricula* (Fallén, 1820) have been recorded from southern Norway north to Nordland province and both are rare.

Key words: *Pteromicra*, Sciomyzidae, Diptera.

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INTRODUCTION

Rozkošný (1984) listed five species of the genus *Pteromicra* Lioy, 1864 in his review of the Sciomyzidae of Fennoscandia and Denmark. Of these *Pteromicra oldenbergi* (Hendel, 1902) is a rare species which has only been recorded from the most south-easternly parts of Finland and Russian Karelen and should not be expected to occur in Norway. Two other species have a southern distribution in Fennoscandia, *P. leucopeza* (Meigen, 1838) is recorded from south-eastern Sweden, southern Finland and Denmark, *P. pectorosa* (Hendel, 1902) is recorded only from south-eastern Sweden and in Denmark, and not from Finland (Rozkošný, 1984).

One species, *P. glabricula* (Fallén, 1820), was recorded from Norway by Zetterstedt (1838). The distribution of *P. glabricula* was given as the provinces ON, VE and NSI by Knutson & Berg (1971), and they listed only one record from each province. According to Rozkošný (1984) *P. glabricula* is recorded «in Norway several records from ON to NSI», but the correct number of records are the three mentioned by Knutson & Berg (1971).

A second species, *Pteromicra angustipennis* (Staeger, 1845), was recorded as new to Norway from the provinces ON and NSI by Greve & Rozkosny (1981). No additional records of this species were noted by Rozkosny (1984).

Collection of Sciomyzidae for several decades has turned up very few new records of the genus *Pteromicra,* but no new species for Norway. All this new material is deposited in Zoological Museum, University of Bergen. Regional abbreviations are given in accordance with Økland (1981).

NEW RECORDS

Pteromicra angustipennis (Staeger, 1845)

RY Finnøy: Kyrkøy (EIS 14) 22 June 1986 1♀ leg. & det. T. Jonassen (ZMB). **HOI** Kvam: Gravdal, Svevatn (EIS 31) Malaise trap 29 July - 11 Sept. 1997 1♀ leg. J. Skartveit. **SFY** Hyllestad: Botnen (EIS 48) Malaise trap 21 May - 21 June 1999 1♂ 1♀ 21 June - 25 July 1999 3♂♂ 3♀♀ leg. Lita Greve & Liv Sognes.

P. angustipennis has previously been recorded from ON & NSI, and is here reporteed new to RY, HOI and SFY.

Pteromicra glabricula (Fallén, 1820)

HES Vang: Blæstad, Hedmark Distrikthøyskole 17 June 1996 1♀ leg. L. Greve. **VAY** Flekkefjord: Hidra, Dragøy 8-15.Aug.1992 1♂ leg. A.- J.Nilsen (ZMB).

P. glabricula has been recorded from ON, VE & NSI, and is here reported new to HES and VAY.

DISCUSSION

The genus *Pteromicra* in the tribe Sciomyzini is a well defined genus which contains generally small species with dark brown to black and yellow ground colour. The anterior orbital seta is often short and the cheeks very narrow. The propleuron carries a rather weak, but distinct seta above base of fore coxa, the anal vein reaches the posterior margin of the wing. Wings are either hyaline or completely infuscated. The fore tibia has one preapical seta. They are not very difficult to identify and should therefore not have been overlooked or mistaken for other species or genera of Sciomyzidae.

Based on the records presented here both *P. angustipennis* and *P. glabricula* must be considered rare species in Norway. The records of both species are few and widely scattered.

Acknowledgements. I am grateful to Terje Jonassen who collected and determined the specimen of *Pteromicra angustipennis* from Rogaland, and to the following persons who have provided material: John Skartveit and the research programme «Forest ecology and multiple use», Alf-Jacob Nilsen, Hidra and Liv Sognes, Hyllestad .

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Received 5 June 2000,
accepted 15 August 2000

Book review • Bokanmeldelse

Aarvik, L., Berggren, K. & Hansen, L.O. (red.) 2000. Catalogus Lepidopterorum Norvegiae. 192 pp. Lepidopterologisk arbeidsgruppe, Zoologisk Museum, Universitetet i Oslo og Norsk institutt for skogforskning, Ås, Norway. ISBN 82-995095-1-3. [NOK 200,- (paperback) NOK 250,- (hardback), bestilles fra Insektavdelingen, Zoologisk Museum, Sarsgate 1, 0562 Oslo].

Så har den endelig kommet, katalogen over Norges sommerfugler, nesten 70 år etter at den forrige fullstendige oversikt over Norges sommerfuglfauna så dagens lys. Den gang var 1567 arter påvist fra landet. Med Lepidopterologisk arbeidsgruppe (LepArb) sitt kjempeverk, kan det nå dokumenteres at hele 2123 arter av sommerfugler er påvist i Norge. Katalogen er basert på det aller meste av tilgjengelig sommerfuglmateriale i offentlige og private samlinger i Norge, til sammen ca. 100 000 registreringer. Mange feilkilder er eliminert ved at hvert enkelt individ er kontrollbestemt av LepArbs medlemmer. Deler av dataene er også tilgjengelig via internett, hvor landsdekkende utbredelseskart for alle arter samt oversikter over hvilke arter som er funnet i landets kommuner er tilgjengelige.

Katalogen har både norsk og engelsk tekst og har et lekkert design som gjør boken både innbydende og tilgjengelig for en bred gruppe av lesere. Innledningen gir en oppsummering av sommerfuglforskningen i Norge fra midten av 1700-tallet og fram til i dag med LepArbs registreringsarbeid. Systematikken og nomenklaturen som er brukt i katalogen er svært godt oppdatert og blir grundig gjennomgått. De mange bidragsyterne takkes til slutt i innledningen. I sum er innledningsteksten informativ og nyttig, men kunne vært noe mer gjennomarbeidet. Det forekommer bl. a. bastante påstander som opplagt kan diskuteres, og i tillegg er tituleringen av bidragsyterne noe inkonsekvent.

Selve katalogen er bokens hoveddel og består av en sjekkliste for alle Nordens sommerfugler. Den norske utbredelsen til alle arter er angitt etter det reviderte Strand-systemet som deler landet inn i 37 regioner basert på fylkes- og kommunegrenser.

Lesbarheten er svært god siden Strand-kodene er repetert for alle region-registreringer til forskjell fra «prikkangivelsene» som var vanlig å bruke før. Forekomst i de andre nordiske land er også angitt. Katalogens faglige verdi økes betraktelig ved at 500 arter er kommentert spesifikt utfra bestemte kriterier som få funn, uavklart taksonomisk status, ubekreftet funn mm. Katalogen angir til sammen 44 arter som ikke tidligere er nevnt fra Norge, mens 25 arter blir strøket som norske.

Til slutt presenteres en liste over tilfeldig importerte arter. Arter som regelmessig forekommer innendørs samt vandrende arter (de som mer eller mindre regelmessig kommer til Norge av egen hjelp, men som ikke reproduserer her) behandles alle som gode norske arter. Artene som tilhører disse to kategoriene kunne godt vært avmerket i selve katalogdelen med egne symboler, selv om noen av dem er nevnt i fotnoter.

Noen momenter kunne kanskje økt tilgjengeligheten og anvendelsesområdene av katalogen enda mer. Storsommerfuglene og mange «mikros» har nå fått norske navn som savnes i katalogen. Når man har tatt seg bryet med å lage disse navnene, hadde det jo vært en kjempesjanse til å etablere bruken av disse i en bok som vil fungere som standardverk i mange år. Rødlistestatus for de enkelte artene kunne også vært tatt med da denne katalogen også vil være viktig underlagsmateriale i forvaltningssammenheng. Videre hadde det vært ønskelig å få med tidsaspektet for funnene ved å skille mellom gamle og nye funn. Dette fordi store endringer har skjedd både gjennom menneskeinduserte og naturlige fluktuasjoner i arters utbredelse de siste 200 år.

Datakravene til materialet som ligger til grunn for katalogen kan virke noe strenge, spesielt når det gjelder storsommerfugler. Ved å eliminere litteraturangivelser og observasjoner står man i fare for å miste mer informasjon enn man tjener ved å følge den valgte arbeidsmetoden. Full sikkerhet kan man dessuten aldri oppnå siden man ikke har noen garanti mot f eks feiletikettering, men dette er trolig et lite problem. Det er forståelig at man er kritisk til litteraturangivelser når det gjelder vanskelige artskomplekser, men mange arter er tross alt enkle å identifisere. Upålitelige og slurvete samlere finnes det heldigvis ikke mange av selv om alle kan gjøre en og annen feil. Jeg ser derfor ingen åpenbare grunner til ukritisk å tvile på publiserte funn hvor beleggene har gått tapt, f eks i klannerangrep.

Ignorering av litteraturangivelser er i strid med vitenskapelig arbeidsmetode og må strengt tatt betraktes som feil når målet er å lage Catalogus Lepidopterorum Norvegiae. Resultatet blir da snarere en utskrift av LepArbs database enn en utbredelsesstatus over Norges sommerfugler. En litteraturangivelse må betraktes som gyldig inntil den er dementert eller det er ført saklige argumenter for hvorfor den er tvilsom. Det er med andre ord LepArbs oppgave å argumentere for hvorfor et publisert funn av *Plebejus idas* fra STY skulle være tvilsomt.

Ignorering av litteraturangivelser kan også få dramatiske konsekvenser for produksjon av nye faunistiske notiser som i verste fall kan slå tilbake på fremdriften i kartleggingen. Når det gjelder f eks dagsommerfugler, bør også observasjoner kunne godkjennes etter lignende rutiner som ornitologene fører. Dette er standard metode for atlas-prosjekter f eks i Danmark, England og Nederland. En ide kunne vært å markere litteraturangivelser og observasjoner med egne symboler, slik at sikkerheten i datagrunnlaget ikke svekkes.

I sum representerer denne katalogen et kjempearbeid utført av dyktige amatører og fagfolk. Verket vil helt sikkert tjene som en inspirasjonskilde og et faglig basisdokument for alle med entomologisk interesse, nybegynnere så vel som fagfolk. Gratulerer med stort og verdifullt bidrag til norsk entomologi.

Frode Ødegaard

Norw. J. Entomol. 47, 185–195. 2000

Distribution of Trichoptera in Øvre Heimdalen, Jotunheimen Mountains, Norway

Sigve Reiso & John E. Brittain

Reiso, S. & Brittain, J.E. 2000. Distribution of Trichoptera in Øvre Heimdalen, Jotunheimen Mountains, Norway. Norw. J. Entomol. 47, 185–195.

The distribution of lotic trichopterans was studied in different vegetational zones, ranging from 1090 m a.s.l to 1550 m a.s.l, in the Øvre Heimdalen area in the Jotunheimen Mountains of southern Norway. Five species were recorded in the mid-alpine zone, eleven species in the low alpine zone, and twenty-four species in the subalpine zone. In the mid-alpine zone the community was dominated by *Apatania* species and *Apatania zonella* was the only species found at 1550 m a.s.l. The dominant feeding modes were scrapers in the mid-alpine zone, and both shredders in the low alpine and subalpine zones. Temperature and food were important factors influencing species distribution.

Many common running water species such as *Potamophylax cingulatus*, *Halesus digitatus* and *Rhyacophila nubila* had their altitudinal distribution limit in the low alpine zone. Filter feeding polycentropodids were found in lake outlets in the subalpine and low alpine zones. In the outlet of the small lake Blåtjern, in the mid-alpine zone, no filter feeding species were found. Many species we recorded in the subalpine zone had low abundance, indicating that these species lived at their altitudinal limit in this area.

The first axis of DCA (Detrended Correspondence Analysis) clearly showed a gradient of species in the Øvre Heimdalen area. The analyses indicated the species changes to be most distinct at the transition from the low alpine to the mid-alpine.

Keywords: Trichoptera, distribution, vegetation, alpine zones.

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INTRODUCTION

The Trichoptera are a large and diverse order of aquatic insects numbering about 10,500 described species world-wide (Solem & Gullefors 1995). North-west Europe has about 250 species (Andersen & Wiberg-Larsen 1987). Due to their ability to produce silk, they can exploit a variety of habitats and feeding modes.

Previous studies on distribution of Norwegian species have mostly been carried out in lowland areas (Solem 1985b). Studies of the vertical distribution of Trichoptera in mountain areas are sparse, although Dovrefjell (Solem 1985b), Hardangervidda (Andersen 1979) and Øvre Heimdalen (Lillehammer & Brittain 1978) have been investigated.

Several Norwegian studies stress the importance of temperature as a major factor influencing life cycles and distribution of freshwater invertebrates (Andersen & Tysse 1984, Brittain 1978, 1983,1990, Eikeland 1982, Lillehammer 1974, Lillehammer et al. 1989, Sand 1996 and Solem 1985b). Solem (1985b) and Lillehammer & Brittain (1978) compared the distribution of aquatic insects in different vegetational zones. From these studies and other studies on Plecoptera (Lillehammer 1974, 1975, 1984), it is clear that riparian vegetation is an important factor influencing aquatic insect distribution in addition to temperature.

The aim of the study was to describe and undertake a quantitative analysis of the distribution of trichopteran species at altitudes ranging from 1095 m a.s.l in the subalpine zone to 1550 m a.s.l in the mid-alpine zone in the Øvre Heimdalen area. It was hypothesised that species richness decreases with altitude as a result of reduction in temperature and allochthonous inputs.

Site description

The area investigated was the catchment area of the subalpine lake, Øvre Heimdalsvatn (61°25'N, 8°52'E), together with an adjacent stream catchment, Flybekken, on the eastern slopes of the

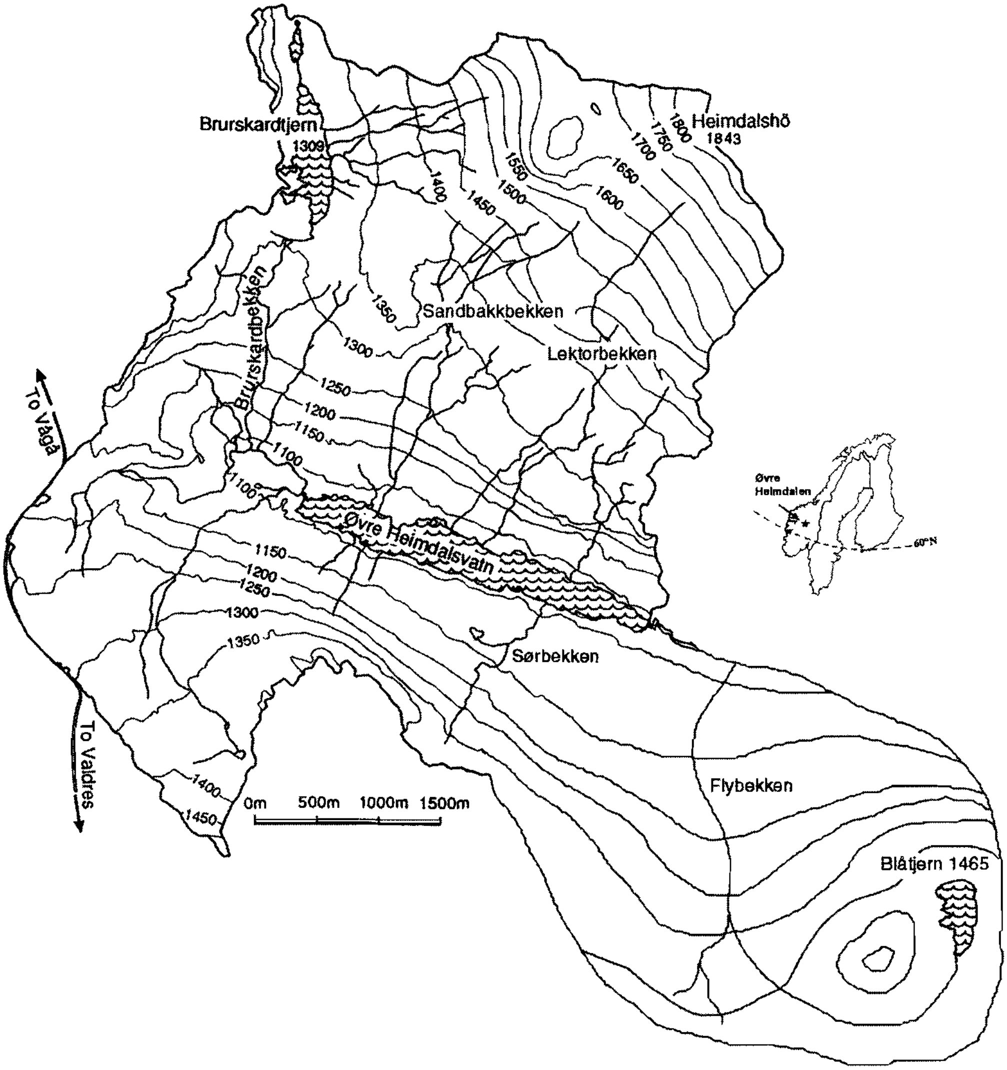


Figure 1. Map of the catchment of Øvre Heimdalsvatn and the adjacent stream catchment, Flybekken. Altitudes in m a.s.l.

Jotunheimen Mountains in southern Norway (Figure 1). The bedrock in the area consists almost entirely of basic Precambrian rocks, which are part of a large Caledonian thrust complex known as the «Jotundekke» (Skjeseth & Kloster 1978).

The area has a subarctic or tundra microclimate (Johannesen 1978). The northern side of the Øvre Heimdalen valley has a favourable combination of slope angle and radiation exposure allowing subalpine birch forest to reach an altitude of about 1200 m a.s.l. The southern side of the valley is dominated by willow scrub, with only a few scattered birch trees. The vegetation along the stream Flybekken is mostly willow and heath vegetation up to 1200-1300 m a.s.l. At altitudes above 1300 m a.s.l grasses dominates the vegetation.

Following the vegetation zone definitions of Østhagen & Egelie (1978), the low alpine vegetation occurs between 1200 and 1300-1400 m a.s.l. and the mid-alpine up to about 1800 m a.s.l. (Figure 1). The dominating vegetation types in the subalpine zone are mesotrophic birch forest and willow thickets, bilberry heath in the low alpine zone and heath, grass vegetation and snowbed communities in the mid-alpine zone.

The supply of allochthonous matter to freshwaters is significant in the subalpine zone, decreasing in the low alpine zone and mid-alpine zone (Lillehammer 1974, Larsson & Tangen 1975). The Heimdal area has long winters and the lake Øvre Heimdalsvatn is ice-covered from mid-October to early June. The annual mean air temperature close to the lake is estimated to be -1.2 °C, with a yearly precipitation of 800 mm (Johannessen 1978).

This study was mainly carried out in five streams, Brurskardbekken, Sandbakkbekken, Lektorbekken, Sørbekken and Flybekken (Figure 1). Several other small streams in the catchment area were also sampled but less intensively. A wide range of sites were sampled to represent different vegetation belts between the elevations 1090 and 1550 m a.s.l. Three lake outlets were sampled, the outlet of Øvre Heimdalsvatn in the subalpine zone (1090 m a.s.l), Brurskardtjern at the upper limit of the low alpine zone (1306 m a.s.l) and Blåtjern in the mid-alpine zone (1465 m a.s.l).

Water temperatures were recorded by digital loggers in the main inlet and outlet of Øvre Heimdalsvatn. The temperature data showed a rapid increase in temperature after the ice disappeared in early June, reaching over 10 °C in the inlet and over 12 °C in the outlet in July/August. Water temperatures began to fall in late August approaching 0 °C during October (Figure 2).

METHODS AND MATERIAL

The trichopteran material was collected on seven occasions during the summer of 1998. Two sam-

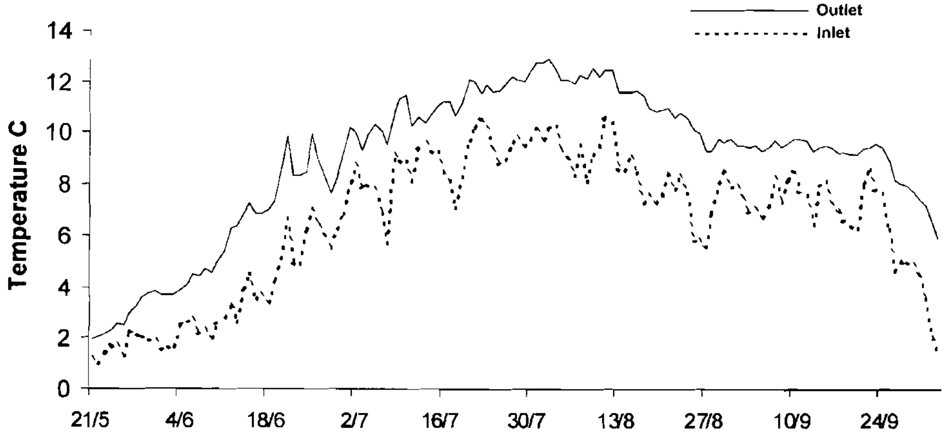


Figure 2. Mean daily water temperatures (°C) in the outlet and inlet of Øvre Heimdalsvatn during 1998. The inlet temperature was recorded in Brurskardbekken, 250 m upstream of the lake.

ples were taken both during June and July then once in August, September and October.

Larvae and pupae were collected by a kicking technique (Frost et al. 1971) (30x30 cm net, mesh size 350 µm) and hand picked from the stone substrates. Adults were collected in three malaise traps, one ultraviolet light trap and by sweep netting in the vegetation along streams. Malaise traps were all placed in the subalpine zone, two close to the lake Øvre Heimdalsvatn, and one in the birch forest by the stream Brurskardbekken at 1130 m a.s.l. An ultraviolet light trap was placed close to the outlet of Øvre Heimdalen. Sweepnet samples were taken at all altitudes when sampling the streams.

All samples were preserved in 70% alcohol in the field, sorted and identified in the laboratory. The larvae were identified to genus using Solem & Gullefors (1995) and to species using Edington & Hildrew (1981), Hiley (1976) and Solem (1985a). Adults were identified using Malicky (1983). No attempt was made to distinguish larvae of the closely related species *Potamophylax cingulatus and P. latipennis* or *Halesus digitatus* and *H. radiatus*. Due to similarities in morphology they are refered to as *Potamophylax* spp. and *Halesus* spp., respectively. All the species were grouped into three categories based on their feeding habits (scrapers, shredders or predators/filter feeders), according to Solem & Gullefors (1995), Solem (1969, 1985a, pers. com.).

Detrended Correspondence Analysis (DCA) was used to illustrate the altitudinal gradient in species composition using the ordination analysis programme, CANOCO (Ter Braak 1995). A «downweighting of rare species» option of CANOCO was used so that species that occured at few sites were given low weighting to minimise their influence on the analysis. The aim of ordination is to arrange points such that those that are close to-

Table 1. Species in different vegetation zones grouped according to their feeding habits.

Zone	Scrapers	Shredders	Predators
Mid-alpine	*A. zonella* *A. muliebris* *A. hispida*	*C. villosa* *L. coensous*	
Low alpine	*A. hispida* *A. stigmatella*	*Potamopylax* spp. *Halesus* spp. *E. dalecarlica* *C. villosa* *L. coensous*	*Potamopylax* spp. *R. nubila* *P. conspersa* *P. flavomaculatus*
Subalpine	*A. stigmatella* *A. hispida*	*Potamopylax* spp. *A. lapponicus* *C. villosa* *Halesus* spp. *L. algosus* *L. bipunctatus* *L. borealis* *L. coenosus* *L. extrincatus* *L. femoralis* *L. flavicornis* *L. nigriceps* *L. subcentralis* *M. lateralis* *M. sequax* *H. clathrata* *A. obsoleta*	*Potamopylax* spp. *R. nubila* *P. conspersa* *P. flavomaculatus* *H. clathrata* *A. obsoleta*

gether correspond to sites that are similar in species composition and those that are far apart correspond to sites that are dissimilar in species composition. The data was analysed as species presence/absence in ten different 50 m altitudinal zones, from 1050 m a.s.l to 1550 m a.s.l (Figure 3).

RESULTS

Subalpine zone

Twenty-four species were recorded in the subalpine zone (Figure 3). Shredders were clearly the most dominant feeding group (Table 1). The nine *Limnephilidae* spp.; *Asynarchus lapponicus*, *Micropterna lateralis*, *Micropterna sequax* and *Oxyethira frici* were only found in low numbers as adults close to the lake, Øvre Heimdalsvatn. *P. flavomaculatus* (36.5 %) dominated the malaise trap catches in the outlet area of Øvre Heimdalsvatn.

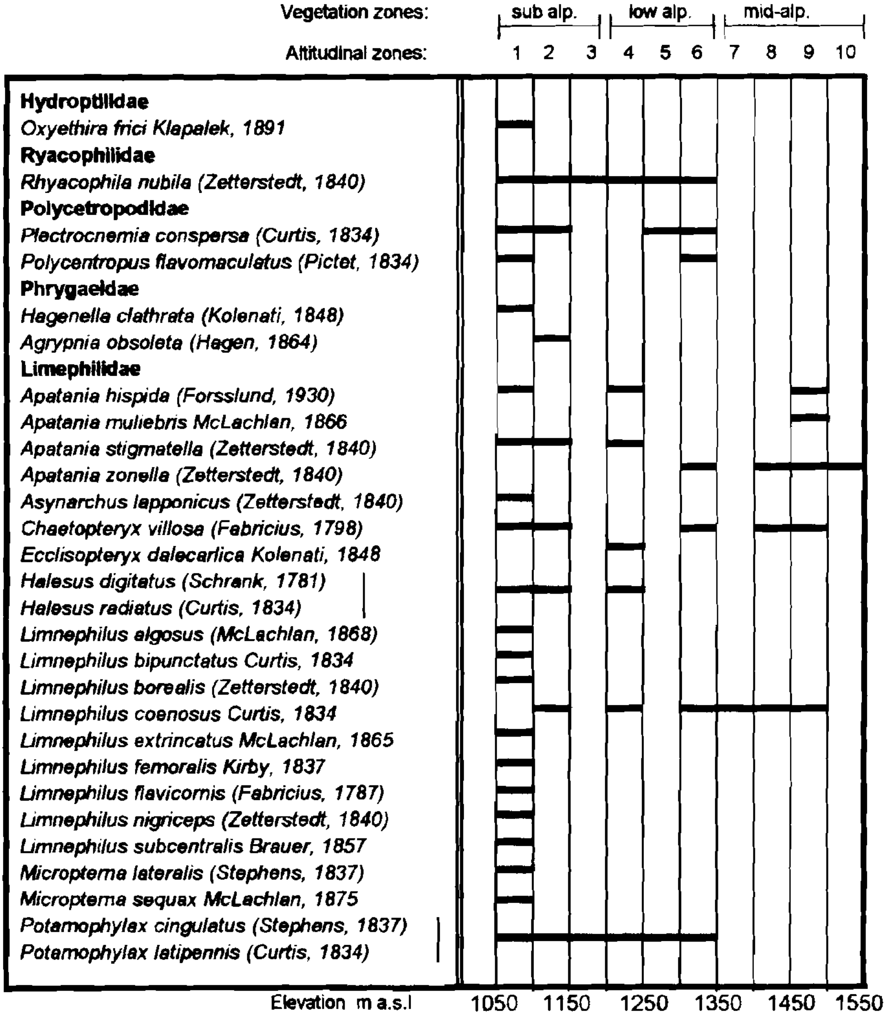


Figure 3. Distribution of Trichoptera in different vegetational and altitudinal zones in the Øvre Heimdalen area.

Rhyacophila nubila and *P. cingulatus* larvae and adults were collected in most of the localities in this zone and were the dominant species in malaise traps in the inlet area of Øvre Heimdalsvatn. *Halesus digitatus* adults were also common in this area. Adults of *C. villosa* were recorded in malaise traps close to Brurskardbekken. A few *P. conspersa* larvae were found in the lower part of the stream, Brurskardbekken.

Low alpine zone

Ten species were recorded in the low alpine zone (Figure 3). The dominating feeding groups were shredders and predators/filter feeders (Table 1). *Rhyacophila nubila* and *Potamophylax* spp. larvae were both found at most sampling sites in this zone, being common in streams up to about 1300 m a.s.l. *Halesus* spp. larvae were not found at altitudes higher than 1095 m a.s.l on the south side of the lake Øvre Heimdalsvatn. However, in the stream Brurskardbekken (1285 m a.s.l.) larvae were found in an area with large amounts of allochthonous material.

Chaetopteryx villosa larvae were abundant in the inlet area of Sørbekken, close to Øvre Heimdalsvatn. (1095 m a.s.l). *Limnephilus coensous* larvae were found in a marshy area in the outlet of a small lake at the headwaters of Sørbekken. One single *E. dalecarlia* larva was found in Flybekken at 1200 m a.s.l in an area with scattered willow bushes.

Polycentropus flavomaculatus and *Plectrocnemia conspersa* larvae were found in the outlet of the lake, Brurskardtjern. *Plectrocnemia conspersa* larvae and pupae were also found in high densities in a slow flowing reach of Brurskardbekken at about 1285 m a.s.l. *A. hispida, A. stigmatella* and *L. coenosus* larvae were found on several occasions in the stream, Flybekken, in this zone. *Limnephilus coensous* adults were also collected in a sweep net sample close to the outlet of Brurskardtjern.

Mid-alpine zone

Five species were collected in the mid-alpine zone (Figure 3). The dominant feeding group was scrapers (Table 1). *Apatania zonella* was collected both in Lektorbekken and Sandbakkbekken. It was the only species found at 1550 m a.s.l. However, the species was not recorded in the Flybekken area where *A. hispida* was the dominant *Apatania* species. *A. hispida* was not found at the same altitudes in either Lektorbekken or Sandbakkbekken.

Chaetopteryx villosa larvae were quite common in small streams and springs in this zone, occuring in the inlet streams of Brurskardtjern and in several springs feeding Lektorbekken and Flybekken. It was found up to 1465 m a.s.l in the outlet of Blåtjern. *Apatania muliebris* larvae were found in one spring in the headwaters of Lektorbekken (1460 m a.s.l). *Limnephilus coenosus* was found in springs in the mid-alpine zone up to 1460 m a.s.l.

DCA analysis

The results of the DCA analysis are summarised in Figure 4. The first and second ordination axes explained 60.5 % and 21.1 %, respectively, of the total variability (Table 2). Species like *A. zonella, C. villosa* and *L. coenosus* that were found at high altitudes in the mid-alpine zone showed high coordinate scores on the first axis. In contrast, species like *L. nigriceps* and *L. algosus,* only found in the subalpine zone, showed low coordinate scores. The second axis was more difficult to interpret. Species like *P. flavomaculatus, C. villosa* and *P. conspersa* showed high coordinate scores, while *A. hispida* and *A. stigmatella* showed low coordinate scores on the

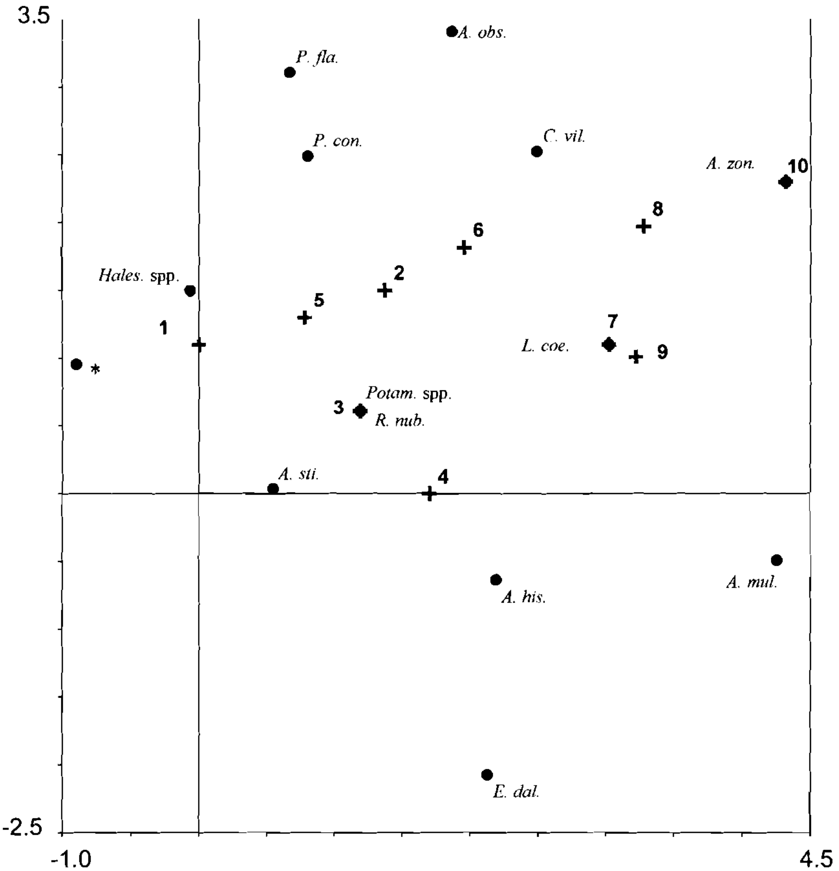
Table 2. Summary of the DCA analysis.

Axes	1	2	3	4	Total inertia
Eigen values:	0.605	0.211	0.070	0.005	1.1968
Lengths of gradient:	4.314	2.301	2.411	2.588	

second axis. The altitudinal zone points show a pattern of increasing altitude along the first axis. However, zone 6 does not fit into this pattern, showing lower coordinate scores than expected (Figure 4). Zones 1-4 (1350-1550 m a.s.l) and zones 5-10 (1050- 1350 m a.s.l) tended to form two separate groups along the first axis, indicating a change in species composition around 1350 m a.s.l.

DISCUSSION

Studies of the distribution of Trichoptera in the Øvre Heimdalen area showed differences in number of species captured in the various alpine vegetation zones. Studying stoneflies in the same area, Lillehammer (1984) found temperature and food to be the most important factors influencing the reduction of species with altitude. Species like *Apatania zonella*, *A. muliebris* and *Chaetopteryx villosa,* found in the mid-alpine zone, can adapt to different temperature regimes by switching from



** = B. bip., L. bor., L. nig., L. sub., H. cla., O. fri., L. fla., A. lap., L. lat., L. ext., L. fem., L. alg., M. seq. & M. lat.*

Figure 4. DCA ordination diagram of trichopteran species recorded in ten altitudinal zones, each occupying 50 m from zone 1 (1050-1100m a.s.l) to zone10 (1500-1550m a.s.l). Altitudinal zones are marked with crosses, while species are marked with circles. The scale marks are multiples of the standard deviation.

univoltine to semivoltine life cycles (Solem 1985b, Gislason 1981 and Andersen & Tysse 1984). However, other species such as *Potamophylax spp.* and probably *Halesus* spp. found in the low alpine and subalpine zones show constant life cycle length, being univoltine throughout their distributional range (Higler & Solem 1986, Solem & Gullefors 1995). The effect of food is related to reduction in both autochthonous and especially allochthonous production at high altitudes (Lillehammer 1984, Petersen et al. 1995). Lillehammer & Brittain (1978) found change in species distribution in Øvre Heimdalen to be paralleled by changes in terrestrial vegetation for Plecoptera, Ephemeroptera and Trichoptera. They found reduction in species to be greatest among the detritus feeders when comparing the subalpine and mid-alpine zones. However, production of plant material is closely related to temperature, making it difficult to separate these two factors.

In the mid-alpine zone only limnephilids occurred (Figure 3). Solem (1985b) also recorded this pattern from his study in the Dovrefjell Mountains in central Norway. Three of the five species found in the mid-alpine zone of the Øvre Heimdalen area belong to the genus *Apatania*. The three *Apatania* species are parthenogenetic, have preference for small streams and are scrapers (Solem 1985a). Having a semivoltine life cycle strategy at high altitudes (Solem 1985a), these species are well adapted to the harsh environment and short summers in the mid-alpine zone. In species having both sexual and parthenogenetic reproduction, parthenogenesis dominates at high altitudes and latitudes (Butler 1984) where swarming is difficult.

Feeding on periphyton, the *Apatania* species can survive in stream reaches where the terrestrial vegetation is sparse and allochthonous inputs are limited. In such areas, light is not limited, at least during summer. This enables benthic diatoms and algae to dominate the entire stream. In an alpine stream in northwestern Iceland, Odinsson (1988) found the macroinvertebrate benthic community to be dominated by scrapers.

Apatania zonella was the only species found above 1500 m a.s.l (Figure 3). The species is also the only trichopteran recorded as far north as 80° on the Arctic archipelago of Svalbard (Solem 1985b), indicating this species to be well adapted to extreme conditions. The distributions of *A. zonella* and *A. hispida* did not overlap in the Øvre Heimdalen area. The Flybekken area was dominated by *A. hispida*, while the streams to the north of the lake, Øvre Heimdalsvatn, were dominated by *A. zonella*. Aagaard et al. (1989) found *A. hispida* to be the dominating *Apatania* species in the subalpine zone, while *A. zonella* dominated the alpine zone. Some environmental factor must favour *A. zonella* on the north side of the lake. However, the south facing slopes of the north side of the lake have a higher radiation exposure, and conditions should be more favourable than the Flybekken area on the south side.

In contrast to *Apatania* spp., *Chaetopteryx villosa* show other characteristics (Andersen & Tysse 1984), it reproduces sexually and it is a shredder. However, like *Apatania* spp. it is able to adapt to low temperatures and short ice-free period by switching to a semivoltine life cycle at high altitudes (Andersen & Tysse 1984). *C. villosa* adults are also well adapted to supercooling, and are better able to survive low temperatures when emerging than other species found at lower altitudes like *R. nubila* and *L. borealis* (Solem 1985b).

In the low alpine zone shredders became a more dominant feeding group (Table 1), demonstrating the importance of allochthonous riparian inputs. According to Solem (1985b), *R. nubila, P. cingulatus, P. conspersa* and *E. dalecarlica* are common species in the low alpine and subalpine zones. This agrees with the observations in Øvre Heimdalen, although only one individual of *E. dalecarlica* was recorded. Therfore, the low alpine zone seems to be the upper altitudinal limit for many common lotic species.

Filter feeders are common in lake outlets (Allan 1995), but in the outlet area of Blåtjern (1465 m a.s.l) in the mid-alpine zone no filter feeding trichopterans were found. However, both the filter feeding *P. flavomaculatus* and *P. conspersa* occurred in the outlet of Brurskardtjern (1306 m a.s.l) at the upper limit of the low alpine zone. Andersen (1979) found neither *P. flavomaculatus* nor *P. conspersa* above 1275 m a.s.l in his study of trichopterans from the Hardangervidda mountain plateau. Solem (1985b) only recorded the two species in the subalpine zone in the Dovrefjell Mountains. Filter feeding trichopteran species are therefore probably at or near their altitudinal limit at 1306 m a.s.l in the outlet of Brurskardtjern. Lillehammer (1984) found potential prey species like chironomids and *Baetis* spp. to be numerous at a 1400 m a.s.l in a small lake on the nearby Valdresflya. This lake resembles the lake, Blåtjern. Temperature and not food seems therefore to be the limiting factor for filter feeders.

In the subalpine zone, the number of species is doubled compared to the low alpine zone (Figure 3). However, many species had low abundance, indicating that many species live at their altitudinal limit. In the subalpine zone the deciduous riparian vegetation influence the streams both by shading and organic inputs. This is reflected in the dominance of shredders. Larsson & Tangen (1975) have shown that the inlet streams of Øvre Heimdalsvatn transport large amounts of allochthonous material, explaining why shredders like *P. cingulatus*, *H. digitatus* and *C. villosa* were common in these areas.

Limnephilus borealis and *Asynarchus lapponicus* occur in ponds or lakes (Andersen 1979). The two species were only recorded as adults and might therefore originate from the lake, Øvre Heimdalsvatn, and not be part of the stream benthos. The filter feeding *P. flavomaculatus* was found in high densities, being the dominant trichopteran species in the outlet of Øvre Heimdalsvatn (Lillehammer and Brittain 1978, Eikeland 1982 and Reiso 1999). This indicates the importance of drift out of the lake for the fauna in outlet areas (Larsson et al. 1978). Adult *Halesus radiatus* was recorded close to the outlet of Øvre Heimdalsvatn, indicating that the *Halesus* larvae found in the inlet streams were *H. digitatus* larvae. In the Dovrefjell Mountains, Solem (1985b) found a similar pattern. He found *H. radiatus* to be common in a lake outlet, while *H. digitatus* was found in most localities in the subalpine zone. *Apatania stigmatella* showed a different distribution pattern than the other *Apatania* species. It was not recorded at altitudes over 1220 m a.s.l. Solem (1985a) described *A. stigmatella* as a species living below the tree line and being univoltine throughout its range. However, in Flybekken the species was recorded above the tree line in the low alpine zone.

The first axis in the DCA analyses shows clearly a gradient of species in the Øvre Heimdalen area (Figure 4). The first axis describes environmental factors that changes with altitude. The analyses indicated the species change in the Øvre Heimdalen area to be most obvious in the transition from low alpine to mid-alpine vegetation. The second axis, however, is more difficult to interpret when lacking environmental or physical data in the analysis. *Apatania muliebris*, *A. obsoleta, E. darlecarlia* and *P. flavomaculatus* are at the edge of the diagram. Such species have little influence on the analysis, lying there because they have few records (Ter Braak 1995). However, species at the edge of the diagram can also be rare because they prefer particular environmental conditions or habitats. This seems to be the case for *P. flavomaculatus*, restricted to lake outlets.

The length of the axis is expressed in multiples of the standard deviation. Sites that differ four standard deviations in scores can be expected to have no species in common (Ter Braak 1995). The length of the first axis is estimated to 4.314 s.d., indicating that zones 1 (1050-1100 m a.s.l) and 10 (1500-1550 m a.s.l) have no species in common. *Apatania zonella*, the only species found in zone 1, had a restricted mid-alpine distribution in Øvre Heimdalen. However, the species has previously been recorded down to sea level (Andersen 1979) and might be found at altitudes similar to zone 1. However, most species found in zone 1 are likely to reach their altitudinal limit before reaching zone 10.

According to the first axis of the analysis, zone 5 (1250- 1300 m a.s.l) tends to be closer to low altitude conditions This could be due to the presence of *Halesus* larvae at this site. Larvae were found in Brurskardbekken at this altitude in a pool rich in allochthonous material. *Halesus* spp. show a low coordinate score on the first axis resulting in a lower coordinate score for zone 5 than expected.

The most obvious change in species composition according to the first axis occurred between zones

6 (1300-1350 m a.s.l) and 7 (1350-1400 m a.s.l). According to Østhagen & Egelie (1978), 1350 m a.s.l is the transition between the low alpine and the mid-alpine. This is probably due to the reduction in riparian vegetation combined with lower temperatures.

Acknowledgements. We wish to thank Gunnar Halvorsen for valuable comments on the manuscript, and John Solem for important information on some of the species. Research facilities in Øvre Heimdalen were provided by the Zoological Museum, University of Oslo. The Norwegian Water Resources & Energy Directorate (NVE) kindly supplied temperature data from the outflow of Øvre Heimdalsvatn.

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Received 13 July 2000,
accepted 3 November 2000

The pteromalid subfamily Cerocephalinae (Hymenoptera, Pteromalidae) in Norway

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Hansen, L. O. 2000. The pteromalid subfamily Cerocephalinae (Hymenoptera, Pteromalidae) in Norway. Norw. J. Entomol. 47, 196.

The pteromalid subfamily Cerocephalinae is recorded for the first time in Norway. *Cerocephala cornigera* Westwood, 1832 is recorded from Oslo and Asker (AK) and *Cerocephala rufa* (Walker, 1833) is recorded from Larvik (VE). Notes on distribution and biology are briefly given.

Key words: *Cerocephala cornigera, Cerocephala rufa,* Chalcidoidea, Pteromalidae, Cerocephalinae.

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Introduction

The family Pteromalidae includes fifteen subfamilies in NW Europe (Graham 1969, Gauld & Bolton 1988). Among these, Cerocephalinae is certainly the most peculiar, often with heavily tridentated heads, and with tufts of black bristles on each parastigmus. Five species from three genera are recorded in NW Europe (Graham 1969, Gauld & Bolton 1988, Hansson 1991). However, this is the first record of this subfamily in Norway. The specimens are determined by the means of the keys in Graham (1969), and all material are deposited in the collections at the Zoological museum of Oslo.

The records

Cerocephala cornigera Westwood, 1832

AK Asker: Bjørkås (EIS 28) 1♀ 2 July – 24 Aug. 1994 leg. L.O. Hansen & O. Hanssen (Malaise-trap); Oslo: Østensjøvannet, Abildsø (EIS 28) 1 - 31 July 1996 1♂ 1♀, leg. Morten Falck (Malaise-trap). For further information about the localities, see Hanssen & Hansen (1998) for the former record, and Hansen & Falck (2000) for the latter.

Cerocephala rufa (Walker, 1833)

VE Larvik: Middagskollen (EIS 19) 1♂ 15 June – 6 July 1997, 1♀ 6 July – 20 Aug. 1997 leg. A. Fjellberg (Malaise-trap).

Biology and distribution

All the known N European species of Cerocephalinae are parasitoids of beetle larvae. The biology of *C. cornigera* is poorly known, but in Poland it has been hatched from the bark beetle *Leperesinus orni* (Col., Scolytinae) (Graham 1969). *C. rufa* may develop as a hyperparasitoid of certain wood-boring beetles of Scolytinae or Anobidae (Col.) via a primary parasitoid of Doryctinae (Hym., Braconidae) (Gauld & Bolton 1988). Both species are recorded from C Europe and Sweden, but *C. cornigera* is also recorded in Denmark (Graham 1969, Hansson 1991).

Acknowledgements. I am indebted to Oddvar Hanssen for help during the field work, and to Arne Fjellberg who kindly donated insect material to the Zoological museum. Also thanks to Østensjøvannets Venner (i.e. Friends of Østensjøvannet), represented by Finn Gulbrandsen, who financed the insect study at Lake Østensjøvannet.

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Received 10 October 2000,
accepted 17 November 2000

Norw. J. Entomol. 47, 197–198. 2000

Platyderus ruficollis (Marsham) (Coleoptera, Carabidae) new to Scandinavia.

John Skartveit, Frode Ødegaard & Torstein Solhøy

Skartveit, J., Ødegaard, F. & Solhøy, T. 2000. *Platyderus ruficollis* (Marsham) (Coleoptera, Carabidae) new to Scandinavia. Norw. J. Entomol. 47, 197–198.

The ground beetle *Platyderus ruficollis* (Marsham) is recorded as new to Scandinavia from a small islet near Arendal, South Norway. The nearest previous records of this eurytopical but rare species originate from the Netherlands and Britain.

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INTRODUCTION

One of us (TS) collected a material of epigaeic arthropods using pitfall traps in a number of small islets outside Arendal, South Norway in 1982-1983. At **AAY** Arendal: Svend Johnsens Holme (EIS 6, UTM 32 VMK 837746), the material included five specimens of the carabid *Platyderus ruficollis* (Marsham). This is the first North European record of the genus *Platyderus*. As this unexpected species is not described in the identification literature commonly used for Scandinavian carabids, it is briefly described and illustrated here.

BRIEF DESCRIPTION OF THE SPECIES

A medium-sized, rather slender carabid, 5-7 mm long, head dark brown to black, body and appendages reddish-brown. Its habitus (Figure 1) most resembles that of *Synuchus vivalis* (Illiger), but may also look like a small *Pterostichus* or *Olisthopus* species. The pronotum is relatively large and rounded, with the basal foveae deep and prolonged forward as sharp furrows almost reaching to the middle of the pronotum. The epipleurae are not crossed as they are in *Pterostichus*, and the elytra each have two small dorsal punctures in the third stria. The mentum carries a median tooth like in *Agonum*, and the claws are smooth.

DESCRIPTION OF THE LOCALITY

The islet Svend Johnsens Holme is small, approximately 100 by 150 meters, and sparsely vegetated, with heather (*Calluna vulgaris*) dominating on the higher parts of the islands, and with low herbs and grasses close to the seashore and in several crevices. The beetle fauna was dominated by xerophilous and heliophilous species and was rather rich in carabids, with 21 species collected (Skartveit & Solhøy, unpublished observations).

Platyderus species are considered to be mostly montane in South and Central Europe (Trautner & Geigenmüller 1987), whereas the Norwegian locality is coastal. Aukema & Baars (1986), however, found the species in small numbers on a heathland on the island Texel in the Netherlands. *Platyderus ruficollis* is an eurytopical species, occurring in forests as well as in open country (Koch 1989), but despite this it is quite rare. Its distribution is South-Western Europe, being hitherto recorded from Ireland, England, the Netherlands, France, Switzerland, Spain, Portugal and Italy (Aukema and Baars 1986).

POSSIBLE ORIGIN OF THE POPULATION

The population is rather remote from any previously known populations of this species. The

Arendal area was a Norwegian centre of sailship merchantry between the 17th and the late 19th Century. Numerous sailships landed in Norway from various parts of the world in this area. The islet is situated at the mouth of the river Nidelva and would be a quite likely anchoring site for sail vessels. In particular, many ships coming for timber entered from England and the Netherlands, and may have dumped earth or sand used as ballast. Any beetles in the ballast material may have floated ashore. Since the islet lies at the mouth of a rather large river, the surface water is quite fresh and beetles may survive in it for some time. Introduction of this species with the sailship trade is thus plausible.

REDLIST STATUS - SUGGESTION

The species is currently known from only one population in Norway. The locality is not protected (Arild Pfaff, personal comm.), and lies in area where nature is under heavy pressure from recreational activities. We suggest that *Platyderus ruficollis* should be included as a vulnerable (V) species in the next Red list for Norwegian beetles.

References

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Received 4 September 2000,
accepted 25 September 2000

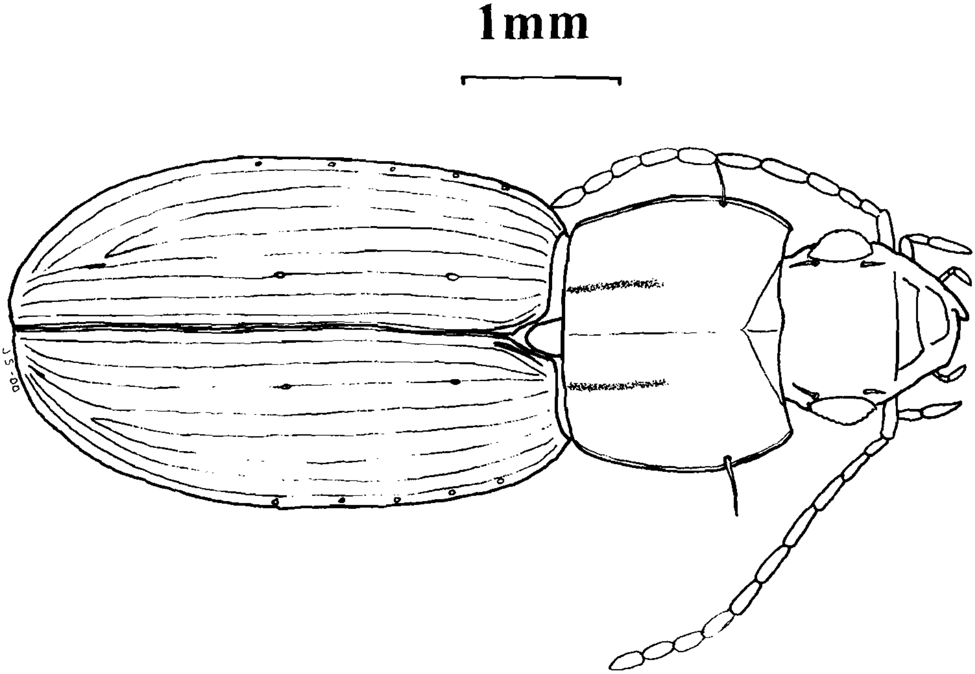

Figure 1. *Platyderus ruficollis* (Marsham), habitus.

Norwegian Journal of Entomology

Volume 46 • 1999

Articles

Short communications

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Norw. J. Entomol. 47 (2) 2000

ISSN 1501-8415.

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