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New records of Norwegian Coleoptera II: Species new to the fauna and notes on some little known species

TORSTEIN KVAMME

Kvamme, T. 1985. New records of Norwegian Coleoptera II: Species new to the fauna and notes on some little known species. *Fauna norv. Ser. B*, 32, 49–51.

Melanotus erythropus (Gmelin, 1790), *Apion sanguineum* (Degeer, 1775) and *Neosirocalus pyrrhorhynchus* (Marsham, 1802) are reported new to the Norwegian fauna. *Trogoxylon impressum* (Comolli, 1837) is reported intercepted to Norway and registered to oak-wood in a house. New faunal divisions are presented for *Stenolophus mixtus* (Herbst, 1784) and *Colydium elongatum* (Fabricius, 1787). The occurrence of *Hylastes angustatus* (Herbst, 1793) is discussed. Additional finds of *Agapanthia villosoviridescens* (Degeer, 1775) and a new host-plant is presented.

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Below are presented species, which not previously have been reported from Norway. In addition informations on some rare or little known species are discussed. The faunal codes are in agreement with Økland (1981), and the EIS-grid numbers are added in parenthesis. The nomenclature follows Silfverberg (1979).

SPECIES NEW TO THE FAUNA

Elateridae

Melanotus erythropus (Gmelin, 1790) (*rufipes* Herbst, 1784).

One male and three female were sampled from an about 4 m. tall *Ulmus glabra* Huds. at VE:Stavern (EIS:19), 23. June 1981. *M. erythropus* is very similar to *M. castanipes* (Paykull, 1800), and was treated as one species by Lindroth (1960) and others. Lohse (1976) concluded that they are two different species. Palm (1978) has studied the species in Sweden and found that *M. erythropus* is rare and probably restricted to the southern and central parts of Sweden, while *M. castanipes* is widely distributed and common. Fig. 1 shows the distribution of *M. castanipes* in Norway. The Norwegian material of *Melanotus* needs an examination to check whether specimens of *M. erythropus* and *M. castanipes* have been mixed.

Lyctidae

Trogoxylon impressum (Comolli, 1837).

This south-palaearctic species was caught in great numbers at AK:Frogn, Søndre Hallangen (EIS:28), 6. June 1983. The beetles swarmed in a summer cottage, and appeared to have hatched from stems of oak (*Quercus robur* L.) used ornamentally.

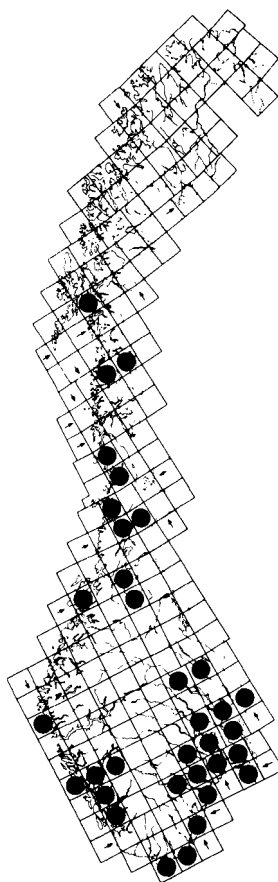


Fig. 1. The distribution of *Melanotus castanipes* (Paykull) depicted on EIS-grid map.

The history of introduction is «classical»: The owner of the cottage spent his vacation in Northern Italy 6–7 years ago. He brought back some nice wood-pieces of grapevine as a souvenir. When specimens of *T. impressum* from the grapevine hatched, they established in oakstems. The cottage is not artificial heated in long periods of the year, but still the beetles survived.

T. impressum is known to live in wood of grapevine, fruit trees and poplar (Freude et al. 1969). Earlier, *T. impressum* has been introduced to Denmark (Silfverberg 1979).

Apionidae

Apion sanguineum (Degeer, 1775) (*miniatum* Germar, 1833).

A revision of the subgenus *Erythrapion* showed that former reports of *A. sanguineum* from Norway were based on misidentifications (Kvamme 1981). One specimen of this species was found in a pit-fall trap on the little island Skurvene in AAY:Hisøy (EIS:6), 4. August–23. September 1981 (Leg. Torstein Solhøy). *A. sanguineum* is living in the rootcollar and the lower parts of the bigger species in the genus *Rumex* (Dieckmann 1977).

Curculionidae

Neosirocalus pyrrhorhynchus (Marshall, 1802).

One specimen was found by sweep-netting *Sisymbrium* sp. in AK:Oslo (EIS:28), 4. June 1982. This is an expected species, while *N. pyrrhorhynchus* is known from several faunal divisions in South-Sweden (Lindroth 1960).

NOTES ON LITTLE KNOWN SPECIES

Carabidae

Stenolophus mixtus (Herbst, 1784) has expanded northwards in this century, and was first recorded in Norway in 1977 (Kvamme 1978). Two new localities have been found: Five specimens were sampled at VE:Hedrum, Roppestad (EIS:19), 5. June 1979. One specimen was also recorded at AK:Vestby, Tjenn (EIS:28), 19. June 1979. Both records were made close to the water-line among dead plants on muddy soil.

Colydiidae

Colydium elongatum (Fabricius, 1787) and *C. filiforme* Fabricius, 1792.

The two species belonging to the genus are rare in Norway. *C. filiforme* is only known from TEY:Porsgrunn, Brevik (EIS:11). The only specimen is stored in Museum of Zoology in Bergen. This record was made in the last century (Ex coll. N.G. Moe), and the species is not found later. The occurrence in Norway today needs to be verified. *C. elong-*

atum was first reported from AAY:Risør (EIS:11) (Påsche & Zachariassen 1976). In June 1981 more than 25 specimens were caught in pipe-traps and window-traps at VE:Brunlanes, Solbergstua (EIS:18). The traps were placed at a sun-exposed clearcut. The clearcut was surrounded by stands of Norway spruce (*Picea abies* (L.) Karst.) and mixed forest. The spruce stands were heavily attacked by *Ips typographus* (Linnaeus, 1758). Two specimens of *C. elongatum* were also sampled from a window-trap at BØ:Hurum, Filtvedt (EIS:28) (Leg. F. Midtgaard) in the period 1. July to 1. September 1983. *C. elongatum* is living under the bark of both conifer and deciduous trees attacked by bark beetles (Palm 1959, Hansen 1964). The heavy attacks by *I. typographus* has probably made temporary optimal conditions for *C. elongatum*.

Cerambycidae

Agapanthia villosoviridescens (Degeer, 1775).

This longhorn beetle is usually regarded to be rare, and is found only sporadically in South-Eastern Norway. The larva is observed in different plants: *Eupatorium cannabinum* L., *Cirsium oleraceum* (L.), and *Arctium tomentosum* Mill. (Palm 1953). Horion (1974) mention also *Anthriscus*, *Angelica*, *Carduus*, *Chaerophyllum*, *Heracleum*, *Senecio*, *Urtica* and especially *Cirsium arvense* (L.) Scop. and *C. palustre* (L.) Scop. as hostplants. At HES:Ringsaker, Mengshol (EIS:45) were eleven specimens sampled from the lower parts of the stalk of *Aconitum septentrionale* Koelle, 23. May 1981 (Leg. L. Aarvik). One specimen was also sampled under the same condition at HES:Stange, Rotlia (EIS:46), 3. June 1981 (Leg. L. Aarvik). The beetles were found as pupae or newly hatched imago, and these finds represent a new faunal division besides a new host.

Scolytidae

Hylastes angustatus (Herbst, 1793).

The opinion on the occurrence of *H. angustatus* in Norway has been divided. Lekander et al. (1977) have deleted this species from the Norwegian list in their revision of the Scandinavian Scolytidae. They have included the finds of *H. angustatus* in *H. attenuatus* Erichson, 1836. Strand (see Lindroth 1960) mention *H. angustatus* from Ø, AK, TEY, AAY and Ry. Fjellberg (1966) has published a find from VE.

I have seen two specimens of *H. angustatus* from VE:Sandar (EIS:19) (Leg. A. Vik) determined by Strand. These specimens agree with *H. angustatus* sensu Grocholski et al. (1976). Since Strand's identifications were correct, I find it correct to include the finds examined by him. Specimens from Ø, AK, VE and TEY have been examined by Strand (Strand pers.com.). Other records made by Münster and Hellesen must be verified before they are included in the list.

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Agonum dorsale (Pontoppidan) (Col., Carabidae), an expanding species in Norway

ARILD ANDERSEN

Andersen, A. 1985. *Agonum dorsale* (Pontoppidan) (Col., Carabidae), an expanding species in Norway. *Fauna norv. Ser. B.* 32, 52–57.

Agonum dorsale has expanded its distribution in Norway since it was first reported from the country in 1965. New districts reported are BØ, TEY, VAY, VAI and AAI. Its present distribution covers the EIS grid numbers 1, 2, 4–6, 9–12, 16–21, 26–29 and 36.

The species was found in 40 of 112 locations, mainly cereal fields, visited in 1983–1984. It immigrated into three intensively investigated areas in Østfold and Akershus counties during 1978–1984.

A. dorsale is at present often a common beetle in preferred habitats in parts of southern Norway, and still immigrates into new areas. Possible immigration routes into Norway are discussed, and further expansion is hypothesized. The change to cereal monoculture in Norway during the 1960-ies may partly explain the expansion.

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INTRODUCTION

The carabid beetle *Agonum dorsale* is widespread and very common all over Europe and in parts of Asia and Africa. In Sweden and Finland it reaches north to about 60°N (Turin et al. 1977). It is a polyphagous predator appearing mainly in warm, dry and light agricultural fields (Thiele 1977). By feeding on pest species like aphids and lepidopterous larvae it is considered a highly beneficial insect to agriculture (Basedow et al. 1976, Scheller 1984). *A. dorsale* hibernates in aggregates under stones at the edge of fields, which makes it easy to detect at that time of the year. In spring and early summer the beetles migrate into nearby fields to reproduce. The larvae have been found in July–Aug., and in the autumn a new generation of beetles hatch and leave the fields to hibernate (Kreckwitz 1980).

The first Norwegian find was reported from Vestfold county (VE Tjøme: Kjære (EIS 19)) in 1965 (Fjellberg 1966). For all locations the revised Strand-system (Økland 1981) and the EIS-system (European Invertebrate Survey, Norwegian grid numbers, Økland 1976) are used. Until 1980 the following locations were added:

Ø Moss: Ramberg (EIS 19) 20 July 1975 (Andersen 1982); Moss: Alby (EIS 19) 10 April 1976 (Kvamme 1977). VE Tjølling: Svinevika (EIS 19) 23 March 1975 (Kvamme 1977); Tjølling: Bisjord (EIS 19) 25 May 1979 (Borgersen pers. comm.). AAY Grimstad: Grimstad (EIS 6) before 1970 (Strand 1970); Tromøy: Brekka

(EIS 6) 2 July 1979 (Simonsen pers. comm.).

In spite of the seemingly restricted distribution in Norway before 1980, some of the data suggested a wider distribution and that the species was expanding. This was first suggested by Kvamme (1977). An expansion of *A. dorsale* into a new area was demonstrated in swede fields at a farm at Jeløy, south-east Norway during 1975–1981: Ø Moss: Ramberg (EIS 19) (Andersen 1982).

The purpose of the present investigation was to find the current distribution of *A. dorsale* in Norway. The material, together with older data, will be analysed to see whether an expansion has occurred or not.

MATERIAL AND METHODS

Different investigators caught carabids in pitfall traps in vegetable fields at a farm located at AK Ås: Gårdsbruket NLH (EIS 28) during 1981–1984. During 1983–1984 handpicking was used at the farms Moss: Ramberg and Ås: Gårdsbruket NLH and at a farm located at AK Ski: Enga (EIS 28) in Sept.–Nov. to decide whether *A. dorsale* was present or not.

To find the total distribution of the species in Norway, selected fields, mainly cereals, were investigated by handpicking at short visits in Apr.–May or Aug.–Oct. 1983–1984. A total of 112 fields were visited in 24 EIS grids in southern Norway.

Table 1. Trapping data at Jeløy, Ås and Ski 1975–1984. % = percent of total carabid catch

Year	Trapping method	Trapping period	No. of trap days	No. of carabids	<i>A. dorsale</i> No. %		Investigator*
Jeløy							
1975	Pitfall traps	30 May–10 Oct.	10530	1697	2	0.1	
1976	Pitfall traps	31 May–4 Oct.	10206	2776	0	—	
1978	Pitfall traps	8 June–14 Sept.	4410	1012	0	—	
1979	Pitfall traps	1 June–29 Aug.	2670	540	25	4.6	
1980	Pitfall traps	23 May–29 Aug.	2940	1129	308	27.3	
1981	Pitfall traps	12 June–29 Aug.	1386	767	197	25.7	
1984	Handpicking	13 Sept.	—	—	673	—	
Ås							
1978–1981	Pitfall traps	May–Sept.	21812	11403	0	—	
1981	Pitfall traps	31 July–17 Sept.	1000	494	0	—	Østrem 1982, Semb 1982
1982	Pitfall traps	7 July–17 Sept.	756	151	2	1.3	Kjæraas and Svagård 1983
1983	Pitfall traps	27 May–8 Sept.	624	215	4	1.9	Hofsvang
1984	Pitfall traps	4 June–10 Sept.	582	286	4	1.4	Hofsvang
1983	Handpicking	14 Sept.–31 Oct.	—	—	122	—	
1984	Handpicking	12 Sept.	—	—	9	—	
Ski							
1979–1980	Pitfall traps	May–Aug.	13194	1107	0	—	
1983	Handpicking	4 Nov.	—	0	—	—	
1984	Handpicking	11 Sept.	—	—	200	—	

*Investigated by present author unless otherwise stated.

RESULTS

Population increases

The catches of *A. dorsale* in swede fields at Jeløy in 1975–1981 are shown in Table 1. In this period of time the species increased in abundance from a very rare carabid to a dominating one. The location was revisited in 1984, and a total of 675 specimens of *A. dorsale* were found under stones all over the farm (Table 1). Obviously it was still a dominating species at the farm.

During 1978–1981, carabids were caught in three swede fields (up to 1500 m apart) at Ås (Andersen 1982), but no specimens of *A. dorsale* was caught (Table 1). In 1981–1984 various investigators used pitfall traps in vegetables in another field at the same farm. As shown in Table 1, the species was caught in low numbers from 1982. In 1983–1984 the three fields investigated in 1978–1981 were visited again, and a total of 131 specimens (2 + 48 + 81) were found under stones (Table 1). Also at Ås the species has immigrated recently and established itself as a rather common beetle.

During 1979–1980, carabids were caught in a cabbage field at Ski (Andersen 1982), but *A. dorsale* was not present (Table 1). Searching for the species under stones in the same field in 1983 gave no specimens, but in 1984 more than 200 specimens were found (Table 1). It has probably immigrated into the field the same year.

Distribution in Norway

Table 2 shows the finds from 1980 or later and completes the list of known locations of the species in Norway. Fig. 1 shows the known distribution of *A. dorsale* in Norway before and after 1980. Table 3 and Fig. 1 summarize the sampling results from the 112 visited locations in southern Norway. The species was present in 35.7% of the locations, and it was found in 20 of the 24 searched EIS grids. It was often abundant in preferred habitats, especially in Telemark and Vestfold counties and in coastal areas of Østfold and Aust-Agder counties. It was found up to an altitude of 200 m (AAI Bygland: Lauvdal), and just north of 60°N (BØ Ringerike: Rytteråker).

Table 2. Locations of *A. dorsale* added after 1980.

Geographic region	EIS-grid number	Location	Date	No of specimens	Collector*		
Ø	12	Halden: Rødsvannet	27 Sept. 1983	69	P. Ottesen		
	19	Rygge: Ror	16 Apr. 1984	35			
	20	Halden: Fredriksten	13 Sept. 1981	2			
		Halden: Ysthede	16 Apr. 1983	16			
		Borge: Årum	16 Apr. 1984	4			
		Onsøy: Møklegård	16 Apr. 1984	1			
		Råde: Tom	16 Apr. 1984	29			
		Skiptvedt: Holstad	16 Apr. 1984	11			
		Skjeberg: Torsnes	16 Apr. 1984	1			
		Våler: Nordby	16 Apr. 1984	2			
		21	Aremark: Fange	16 Apr. 1983		1	
		29	Spydeberg: Heli	16 Apr. 1984		18	
	AK	28	Asker: Sem	18 June 1981		1	J.H. Simonsen
			Oslo: Ekebergsletta	27 Apr. 1982		1	Ligaard 1984
	BØ	19	Kongsberg: Hvittingfoss	22 Sept. 1983		25	F. Midtgaard
		27	Kongsberg: Skollenborg	22 Sept. 1983		5	
			Flesberg: Svene	21 Sept. 1984		2	
		28	Hurum: Filtvet	14 May 1982		nume- rous	
			Hurum: Tofte	May 1982		nume- rous	
		Hurum: Kana	30 Aug. 1983	5			
		Lier: Tuverud	31 Aug. 1983	1			
		Lier: Lierbyen	26 Sept. 1983	10			
	36	Ringerike: Rytteråker	23 Sept. 1983	1			
VE	19	Stavern: Rugland	2 May 1980	1	T. Kvamme		
		Tønsberg: Tønsberg gym.	19 June 1981	2	S. Ligaard		
		Tjøme: Gon	Apr. 1982	nume- rous	A. Fjellberg		
		Tjøme: Havna	Apr. 1982	nume- rous	A. Fjellberg		
		Borre: Bastøy	30 May 1982	2	T. Kvamme		
		Borre: Røre	25 Sept. 1982	4			
			23 Apr. 1983	85			
		Sem: Akersmyra	8 Oct. 1983	25			
		Andebu: Askjemvannet	20 Apr. 1984	5			
		Lardal: Hem	21 Sept. 1984	15			
	28	Svelvik: Knem	30. Aug. 1983	4			
TEY	11	Bamble: Stokkavatnet	7 Apr. 1983	14			
		Bamble: Våg	7 Apr. 1983	1			
	18	Skien: Gjerpen	7 Apr. 1983	68			
TEI	16	Tokke: Dalen	19 Sept. 1984	7	Ligaard 1984		
	17	Kviteseid: Sundkilen	25 Aug. 1982	nume- rous			
		Seljord: Seljord kirke	19 Sept. 1984	39			
	26	Seljord: Flatdal	19 Sept. 1984	3			
	27	Notodden: Tveiten	22 Sept. 1983	3			
AAY	6	Tromøy: Revesand	25 Apr. 1980	1	J.H. Simonsen		
		Moland: Brekka	7 Apr. 1983	96			
		Lillesand: Sangereid	7 Apr. 1983	19			
	10	Tvedestrand: Lunde	31 May 1984	1			
	11	Risør: Indre Søndeled	8 Oct. 1983	11			
AAI	9	Bygland: Lauvdal	19 Sept. 1984	9			
VAY	1	Farsund: Hananger	10 Oct. 1983	13			
	2	Mandal: Berge	8 Oct. 1983	2			
		Songdalen: Rosseland	8 Oct. 1983	15			
	5	Kristiansand: Hamre	7 Apr. 1983	22			
VAI	4	Kvinesdal: Slimestad	10 Oct. 1983	1			
			20 Sept. 1984	5			

*Investigated by present author unless otherwise stated

Table 3. Survey of *A. dorsale* in southern Norway 1983–1984

EIS-grid number	Negative search	Positive search	
		No. of locations	No. of specimens
1	4	1	13
2	1	2	17
3	8	0	—
4	5	1	6
5	0	1	22
6	3	2	115
7	8	0	—
9	1	1	9
10	1	1	1
11	0	3	26
12	0	1	69
16	1	1	7
17	0	1	39
18	0	1	68
19	0	6	169
20	0	7	64
21	1	1	1
26	2	1	3
27	0	3	10
28	12	4	20
29	10	1	18
35	5	0	—
36	6	1	1
37	4	0	—
Totals	72	40	678

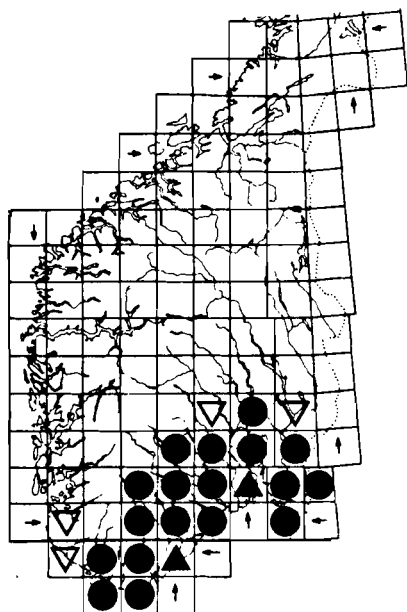


Fig. 1. Distribution of *A. dorsale* in Norway.

▲ = Known distribution before 1980.

● = The present distribution (1984).

▽ = Searched areas where it was absent in 1983–1984.

DISCUSSION

In Finland and Sweden *A. dorsale* has been present north to about 60°N for a long time (Lindroth 1945). In Finland no recent expansion has been observed (Silfverberg pers. comm.). In Sweden the species has become more common in later years and it was caught new to Dalsland in south-western Sweden in 1982 (Baranowski pers. comm.).

A. dorsale was reported from Norway for the first time in 1965 and today it is widespread in the area shown in Fig. 1. It is not easy to recapitulate the pattern of expansion, but a few remarks will be done. The species appears in one of the most intensively investigated areas of Norway as to entomology (Kvamme 1977), and it is also easily recognized due to its typical colours. Accordingly it is unlikely that the species have been a fairly common beetle here for long without being discovered. However, since it is a common species in such a large area today, the expansion has probably been going on for several years. The species may have been rare in parts of the area for some time, but most of the

expansion in distribution and commonness must have taken place during the last 20 years.

A. dorsale is always macropterous (Lindroth 1945) and has been observed flying (Kreckwitz 1980). This makes migration by flight a reasonable hypothesis, which is strengthened by the sudden appearance of the species in new areas like at Ski in 1984. Flight is expected to be an important factor in the rapid expansion of *A. dorsale* in Norway.

The most probable immigration route into Norway is from south-western Sweden to Østfold county (Fig. 2). If so, the Oslofjord may have acted for some time as a barrier for further expansion westwards. The species is uncommon around the northern parts of the fjord, but has probably crossed the fjord at narrower parts (Jeløy Ø) — Horten (VE): 5 km, Drøbak (AK) — Hurum (BØ): 1.5 km). An alternative immigration route is by wind-drift across Skagerak (120 km) from northern Denmark to Aust-Agder county (Fig. 2), as the species has been shown to be transported in this way about the same dis-

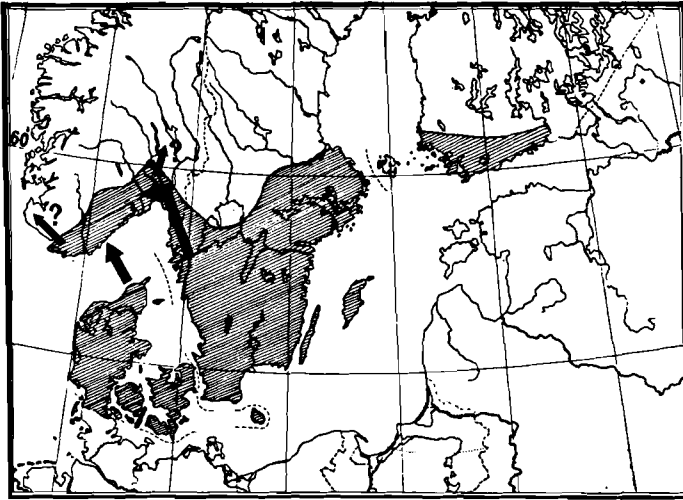


Fig. 2. The present distribution (1984) of *A. dorsale* in Fennoscandia and Denmark.

➡ = possible immigration routes into Norway.
 ➡ = possible further expansion in Norway.

tance across the Baltic Sea from the Continent to the shores of south-eastern Sweden (Baranowski and Gårdenfors 1974). *A. dorsale* is common in areas with human activity, and the species may also have followed plant material, soil etc. imported into Norway from other European countries. Similarly, dispersal by human activity may have occurred within Norway.

The species is very common in cereal crops (Geiler 1956/1957), and during the 1960-ies large agricultural areas in Norway changed to cereal monoculture. This has favoured *A. dorsale* and may explain at least part of its increased distribution and commonness.

It is presumed that Fig. 1 gives the correct present distribution of *A. dorsale* in Norway. However, the species is expected to further expand its distribution. The most suitable areas will be westward to Rogaland county (RY, EIS 3 and EIS 7) and to the north in Akershus and Buskerud counties (AK, BØ and BV, EIS 35 and EIS 37) (Fig. 2). As the species prefer warm and dry areas the expansion in western Norway probably at last will be stopped by the high humidity and in eastern Norway by the long winters.

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Studies of shortwingedness in stoneflies (Plecoptera)¹

ALBERT LILLEHAMMER

Lillehammer, A. 1985. Studies of shortwingedness in stoneflies (Plecoptera). *Fauna norv. Ser. B.* 32, 58–61.

Capnia atra Morton, *Amphinemura standfussi* Ris and *Leuctra hippopus* Kempny were analysed for shortwingedness.

L. hippopus and *A. standfussi* had a significant relationship between wing length and body length. Small-body populations of *A. standfussi* were shortwinged and those of *L. hippopus* longwinged.

The most pronounced shortwingedness occurred in marginal or isolated populations and is probably genetic bound and a result of a selection process in the postglacial period.

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INTRODUCTION

Shortwingedness has been mentioned and discussed by several authors and more than one explanation for the phenomenon has been suggested. Hynes (1941) stated, that shortwingedness increases with increasing altitude and Brinck (1949) found that the tendency to shortwingedness in *Amphinemura standfussi* Ris was more abundant in the mountain areas than in the lowland of Sweden. Lillehammer (1976) noted that a tendency to shortwingedness was fairly common in local populations and that shortwinged populations were mainly found at high altitudes. However, shortwinged populations may occur in lowland localities such as reported from lake Vättern in southern Sweden (Brinck 1949). Müller (1978) suggested that especially low temperature during the egg stage induced shortwingedness in *Capnia atra* Morton. Recent studies by Donald and Patriquin (1983) suggest that shortwingedness is genetically bound and that shortwingedness in three Nearctic *Capnia* species is related to the lakes' geological age. There are indications that shortwingedness occurs both occasionally and regularly in populations. A study of three species, *C. atra*, *Leuctra hippopus* Kempny and *A. standfussi*, occurring in Fennoscandia and other parts of Europe was therefore made. Shortwingedness is normally found in the males of a number of species. Often this shortwingedness is so prominent that the wings are less than half of normal size (Micropterous). In species with great variations in the wing length

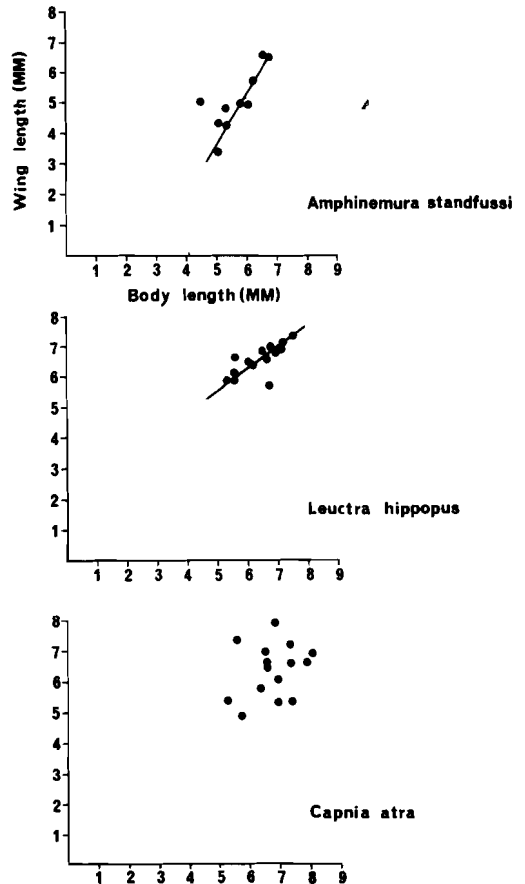


Fig. 1. The relationship between wing length and body length of *Capnia atra* (A), *Leuctra hippopus* (B) and *Amphinemura standfussi* (C). The regression analysis, see Table 1.

¹ Contribution No. 181 from the Zoological Museum, University of Oslo.

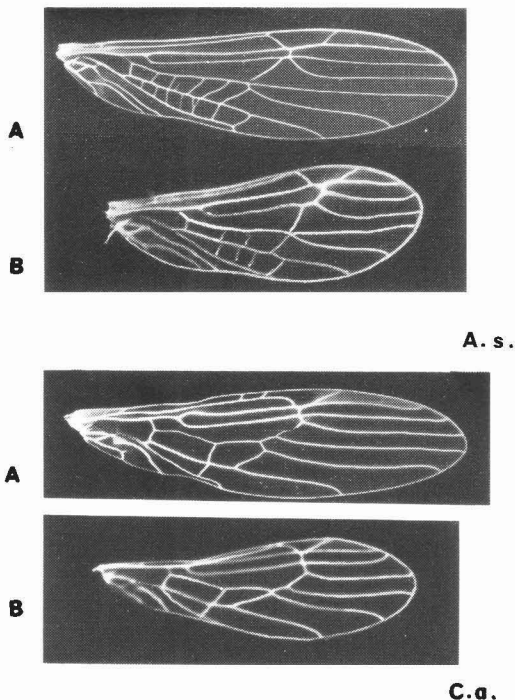


Fig. 2. (A) normal and (B) short wings of *Amphinemura standfussi* and *Capnia atra*.

in one or both sexes, the reduction is less prominent (Brachypterous). All the three species studied are brachypterous.

MATERIAL.

The material consisted of 400 ♀♀ and 300 ♂♂ of *C. atra*, 600 ♀♀ and 400 ♂♂ and 150 nymphs of *L. hippopus*, 540 ♀♀ and 350 ♂♂ *A. standfussi* collected in different parts of Norway during the period 1966–1979.

RESULTS

Regular and irregular shortwingedness

Specimens from several populations were analysed for the relationship between body length (B) and wing length (W) in a simple linear regression. Shortwingedness is then a function of two factors, body length and wing length.

A. standfussi and *L. hippopus* had a significant relationship between wing length and body length, while this was not found in *C. atra* (Tab. 1). However, there were clear differences between *A. standfussi* and *L. hippopus*. The reduc-

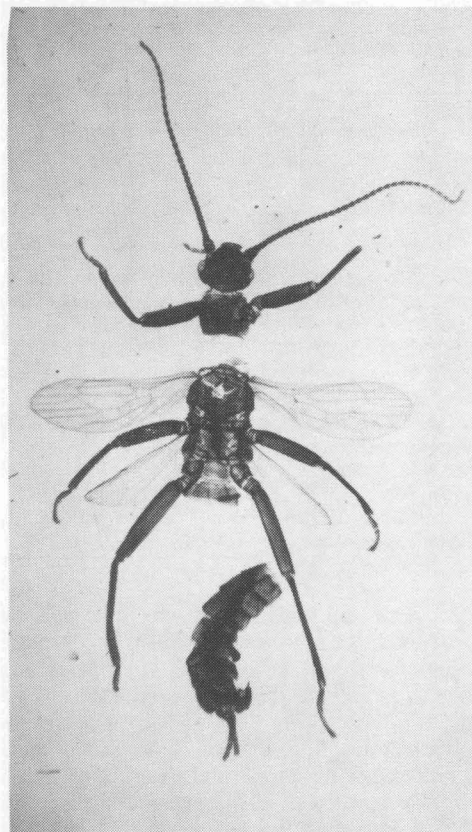


Fig. 3. *Capnia atra* from the «Devil's Punch Bowl», a small lake 700 m a.s.l. in the Mangerton Mountains, Ireland (O'Connor, 1978). Fore wing 2.3 mm, hind wing 1.8 mm.

tion of body length in *A. standfussi* was followed by a stronger reduction of wing length and shortwingedness occurred regularly in small-body sized populations (Fig. 1). In *L. hippopus* the reduction of body length was followed by a less prominent reduction in wing length, resulting in longwingedness in small-body sized populations. Shortwingedness occurred regularly in *A. standfussi* and irregularly in *C. atra* and *L. hippopus* populations.

Form of reduced wings

In all the species studied the reduction of the wing length was mainly in the apex of the wings (Fig. 2), often followed by irregularities of the wing ribs. In high altitude populations of *A.*

Table 1. Regression analysis of the relationship between wing length and body length, expressed by a simple regression equation $y = a + bx$ in which a and b are constants. N is number of populations used for measurements.

Species	N	a	b ± 95% CL	r	p
<i>C. atra</i>	15	4.059	0.326 ± 0.564	0.304	> 0.1
<i>L. hippopus</i>	13	1.983	0.704 ± 0.268	0.856	< 0.001
<i>A. standfussi</i>	9	-4.102	1.547 ± 0.533	0.945	< 0.001

Table 2. Wing length and percent of wings with irregular veins in females of *Leuctra hippopus* from five different localities situated from the coastal area to the high altitudes of inner fjord areas in western Norway.

Locality	N	M a.s.l.	Wing length m.m. -x ± sd	Irregular wing veins %
Sveio, Coastal area	26	30	7.32 ± 0.31	0
Sandeid, Midler	32	30	6.70 ± 0.40	5
Sauda, Inner fjord	31	30	6.47 ± 0.30	6
Sauda, Subalpine	20	500	6.27 ± 0.35	23
Sauda, Lowalpine	45	700	5.89 ± 0.34	46

standfussi this irregularity was followed by a weakened line in the cubitus area, and a reduced ability for flight. In some *C. atra* populations such as in Ireland (Fig. 3) the reduction of wing length is very prominent and gives a clear evidence of reduced flying ability. The combination of reduced wing length and irregularity in wing ribs was studied in *L. hippopus* along a transect of five localities from the coast to the alpine areas in western Norway. Normal wings occurred in the lowland while the reduced wings in specimens living at high altitude had a high frequency of irregularity of wing veins (Tab. 2). However, irregularities in wing ribs may also occur in the lowland, e.g. in the western marginal shortwinged population of *C. atra* at lake Suldalsvatn where about 80% of the population had irregularities in wing veins.

DISCUSSION

Donald & Patriquin (1983) suggested that the shortwingedness is genetically bound, and some of the data from this study support this assumption. The irregular shortwingedness found in *C. atra* and *L. hippopus* is probably a result of a selection pressure from the environment. However, the gradual reduction of wing length found in *A. standfussi* (Lillehammer 1976) may also be influenced by environmental factors such as food quality and temperature differences. Irregular shortwingedness can occur also in *A.*

standfussi, such as in that of the Lovidalen population.

L. hippopus is usually long-winged in marginal areas of distribution, and the only short-winged populations are found where the special temperature isolates the local population from those of the surrounding areas, such as in the lake outlets.

There are differences in the distribution between *L. hippopus* and *A. standfussi*. *L. hippopus* mainly occur below the tree line and is not recorded above the low-alpine vegetation belt. *A. standfussi* is frequently recorded also in the middle-alpine areas where the climate is hard and the temperature low. Shortwingedness of *A. standfussi* is mainly recorded in alpine and marginal populations and the ability of active dispersal seems interconnected with functional wing length. In alpine areas shortwingedness might be favourable in order to prevent too large loss of mature adults, in reducing the active dispersal ability. Shortwinged populations mainly occur at high altitudes also in *C. atra* (Lillehammer 1976). In low altitudes the shortwinged populations are sometimes recorded in the margin of the distribution, such as at lake Suldalsvatn in western Norway, or in isolated populations outside the continuous distribution of the species, such as at lake Vättern in Sweden. The mentioned Irish population, which is also a marginal one, was recorded at a lake shore about 700 m a.s.l. (O'Connor 1978).

Müller (1978) suggested that especial low

temperatures during the egg stage may induce shortwingedness. If so, the same temperature has not influenced *L. hippopus* and *C. atra* in the same manner in the short river between the lakes Galten and Istern, in southeastern Norway. *L. hippopus* and *C. atra* occur as adults at the same time, but while *L. hippopus* is shortwinged, *C. atra* is not. At lake Suldalsvatn in western Norway, the same species occur together, and they are both shortwinged. In these two outlets the life cycle of *L. hippopus* differs from that of the surrounding populations. Because of the special water temperature of the outlets *L. hippopus* emerges much earlier here than what it usually does at the surrounding streams.

C. atra, however, occurs in the middle of its distribution area at lake Galten, and the outlet population emerges simultaneously with the surrounding local populations. At Suldalsvatn *C. atra* occurs outside the normal climatic distributional area and is isolated from other populations.

It seems obvious that low temperatures alone cannot explain the shortwingedness. It seems necessary that some selection process influence the tendency to shortwingedness which occurs in several populations of the three species such as mentioned by Lillehammer (1976).

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Distribution and biology of caddisflies (Trichoptera) in Dovrefjell mountains, Central Norway

JOHN O. SOLEM

Solem, J.O. 1985. Distribution and biology of caddisflies (Trichoptera) in Dovrefjell mountains, Central Norway. *Fauna norv. Ser. B*, 32, 62–79.

The caddisfly fauna of the middle, low, and sub-alpine zones, ranging from 1630 m to 870 m a.s.l., in the Dovrefjell National Park, was investigated. Only three species, *Apatania zonella* Zetterstedt, *Chaetopteryx villosa* (Fabricius), and *Asynarchus lapponicus* (Zetterstedt) inhabited the middle alpine zone, 23 species the low alpine zone, and 60 species the sub-alpine zone. The caddisfly community of the lake outlets in the middle and low alpine zone did not differ markedly from the typical stream fauna, and consisted of limnephilids, except at one lake where the phryganeid *Agrypnia obsoleta* (Hagen) was present. At the lake outlet in the sub-alpine zone polycentropodids, leptocerids, hydroptilids, and phryganeids, but no hydroptilids, accompanied the limnephilids. Temporary vernal pools were inhabited by *Asynarchus contumax* McLachlan, *A. lapponicus* (Zetterstedt), *Grammotaulius signatipennis* McLachlan, and *Limnephilus stigma* Curtis. Pools that have water during the entire warm season, but freeze solid deep down into the bottom substrate in wintertime, were inhabited by *A. obsoleta*, *Oecetis ochracea* (Curtis), and *Molanna albicans* (Zetterstedt).

Emergence, Malaise, and light trap data showed that most species peaked early in the flight period. Based on the flight periods the caddisflies can be grouped as follows: 1) Late winter species, with adults in April, May; 2) Summer and autumn species, with adults in June to September (*R. nubila* into October); 3) Autumn species, with adults in late August, September, October. In emergence traps the sex ratio was close to 1:1 in most species. Significantly more females emerged of *Halesus digitatus* (Schrank) and *Eclisopteryx dalecarlica* Kolenati, and significantly more males emerged of *Parachiona picicornis* (Pictet) and *Plectrocnemia conspersa* (Curtis). The dominant feeding group in the middle alpine zone were scrapers, represented by *A. zonella*. Based on dominant species the proportions of scrapers:shredders:predators:collectors in the low alpine zone were 3:3:2:0 and in the sub-alpine birch forest 1:3:3:1. The parthenogenetic *Apatania* spp. were dominant in low-competitive early succession habitats which change relatively slowly.

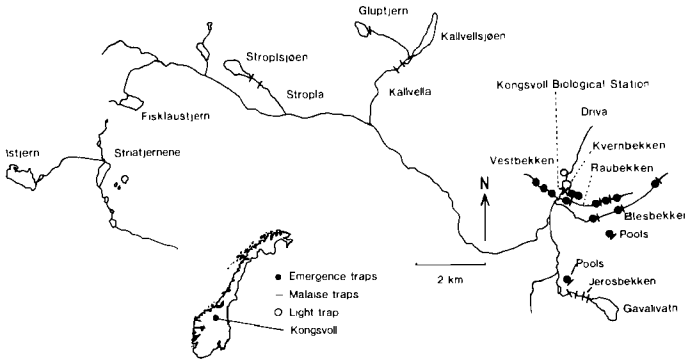
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INTRODUCTION

The first comprehensive, and still the greatest contribution to the distribution and occurrence of caddisflies in Norway was given by Brekke (1946). Later, several authors (e.g. Solem 1967, 1970a, b, 1977, Tobias & Tobias 1971, Andersen, T. 1974, 1975, 1979, 1980, 1983, Lillehammer 1978, Andersen et al. 1978) have given reports on caddisflies in selected areas, mostly from the lowland. But we still have major gaps in our knowledge of the occurrence and distribution of caddisflies in Norway, in particular of vertical distribution. The vertical distribution of caddisflies at Hardangervidda was reported by Andersen (1979), and from the Øvre Heimdalen, Jotunheimen by Lillehammer and Brittain (1978).

The present paper deals with the caddisfly fauna of the surroundings of Kongsvoll in the Dovrefjell mountains. The area is entirely within the Dovrefjell National Park and the adjacent protected area. Basic requirements for the erection of National Parks in Norway have been topography, vegetation and the composition of birds species. One stimulus to the present study was the need to increase knowledge of the invertebrate fauna in the Dovrefjell National Park. Our National Parks are areas with a high degree of protection, and the invertebrate fauna is of great interest in connection with taxonomy, long and short term changes of the fauna, and auto- and synecology problems. Objectives for the present study were in taxonomy and auto- and synecology of caddisflies. Earlier papers on

Fig. 1. Map of the area showing collecting sites.



caddisflies which have dealt with selected parts of the collections for the present paper are Solem (1978, 1979, 1981, 1983a, b, c, d, 1984, 1985).

STUDY AREA

The study area was the surroundings of Kongsvoll Biological Station (62°17'N, 09°59'E) between the elevations 870 and 1630 m in the Dovrefjell National Park, Central Norway (Fig. 1). The River Driva is the main water course into which all the smaller streams empty. In general the streams are fairly fast-flowing, except for the Jerosbekken.

Following the definitions of the biotic zones in Sjørs (1967) and Rønning (1972), the sampling sites were in three zones. The sampling sites of the sub-alpine zone, below 1080 m, were in the River Driva, the streams Kvernbeekken, Raubeekken, Blesbeekken, Vestbeekken, Jerosbeekken, the lake Gávalivatn and temporary pools near the Jerosbeekken. In the low alpine zone (1080 to 1400 m) collections were made at the streams Raubeekken, Blesbeekken, Kallvella and Stropla, the lakes Kallvellsjøen and Stroplesjøen, and temporary pools near the Blesbeekken. The sampling sites in the middle alpine zone (above 1400 m) were the lakes Istjern, Stråtjernene, Fisklaustjern and Gluptjern, their outflowing streams, and temporary pools. The highest locality sampled was lake Istjern at 1630 m.

There are two types of temporary pools in the Dovrefjell mountains (Solem 1983b); one contains water throughout the entire warm season and freezes solid during the winter-time; the second type contains water in spring only, or may have short droughts at irregular time periods during the summer season. The type that has water only in spring is termed a temporary vernal pool by Wiggins (1973). The pools that have a short drought at irregular time periods during the

summer season, are inhabited by the same species as the temporary vernal pools, and although the pools with drought at irregular time periods do not fit exactly into the definition of temporary vernal pools, I refer them to this category because of the caddisfly fauna.

Two large geological regions in the southern Scandinavian Calidonides meet in the field area, and the border roughly follows the River Driva. On the eastern side is the Trondheim region, which contains mainly medium-grade mica schists and green-stones of cambro-silurian age. The western side is mainly a basal gneiss region built up of high-grade gneisses and schists of precambrian age.

The climate of the area is mainly continental, with a yearly precipitation of 473 mm at Kongsvoll. The yearly mean temperature at Hjerkin (959 m a.s.l. and 10 km south of Kongsvoll) is -0.1°C , and only 19 days a year have daily mean temperature above 10°C (Nordhagen 1943).

METHODS

The data are mostly based on light, emergence, and Malaise trap collections, but also hand net collections of adults and picking of larvae were periodically made. The numbers of traps and the years in which they were used are given in Table 1. Fig. 2 shows emergence and Malaise traps. In the most remote and highest areas, above 1500 m, hand picking of larvae from rocks and net sampling of adults were the only methods used.

The light, emergence, and Malaise traps were normally emptied once a week. On a few occasions the most remote traps were emptied at two-week intervals.

Table 1. Number of traps used for adult collections in the Dovrefjell mountains

Sites	Light traps			Emergence traps					Malaise traps		
	1971	1973	1974	1978	1979	1980	1981	1980	1981	1982	1983
Driva	1	1	1								
Vestbekken				16							
Kvernbekken				4							
Raubekken				6	8	11	11	2	3		
Blesbekken				2	9	5	11	1	3	1	
Jerosbekken										8	
Stropla										2	
Kallvella											2
Gluptjern											1
Pool A					4	4		1	1		
Pool B						5		1			
Pool C						3		1			

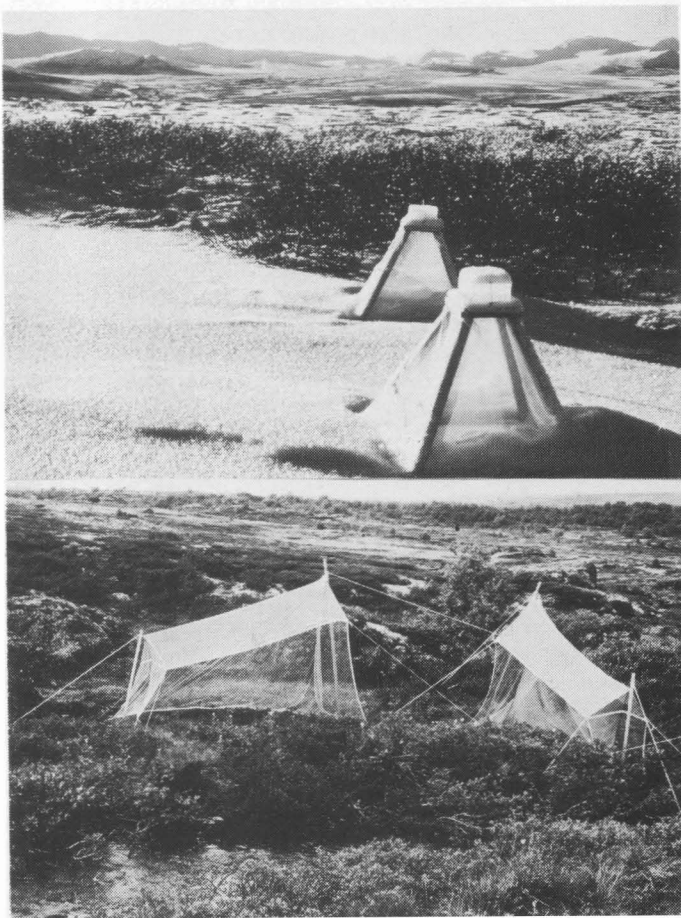


Fig. 2. Emergence (above) and Malaise traps (below) used.

COMMENTS ON TAXONOMIC DIFFICULTIES

The males and females of *Potamophylax cingulatus* (Stephens) and *P. latipennis* (Curtis) are not always easy to assign to species. The females are so much alike that I have made no attempt to distinguish *P. cingulatus* and *P. latipennis* when they occurred together. The females have been assigned to *P. cingulatus* and *P. latipennis*, using the proportion of the males as an approximation. A few males appeared with such intermediate characters that they could be assigned to either *P. cingulatus* or *P. latipennis*, as also reported by Ulfstrand (1970). Thus, there may be a small error in the identifications reported, but this is only a minor obstacle and the main conclusions of this study are not affected.

Apatania zonella (Zetterstedt) is the only species captured of the *A. zonella*-group. Sub-species and several species belonging to the *A. zonella*-group have been described (Svensson & Tjeder 1975, Tobias 1981, Malicky 1983), but I was not able to recognize any gap in the morphology, distribution or flight periods of *A. zo-*

nella that would justify a distinction into several species, e.g. *A. zonella*, *A. dalecarlica* Forsslund or *A. forsslundi* Tobias. Only 1.47 males per 100 females were captured (N = 5450) (Solem 1985).

DISTRIBUTION OF THE CADDISFLIES

Middle alpine zone

The Malaise trap collection at the outlet of lake Gluptjern (Table 2) revealed that *A. zonella* was the dominant species. *Chaetopteryx villosa* (Fabricius) is also an inhabitant of this biotic zone, while only one or two individuals of *P. cingulatus*, *Limnephilus coenosus* (Curtis), and *L. bipunctatus* Curtis were collected; they may have been accidental visitors (Table 2). Larvae and adults of *A. zonella* were collected at lake Istjern at 1630 m, but no *C. villosa* were found. I cannot definitely state that *C. villosa* is not present at this altitude, but it cannot be abundant here. Downstream of lake Istjern, in the area of the lakes Striätjernene at 1500 m, *C. villosa* was commonly collected as larvae. *A. zonella* and *C. villosa* inhabited both lotic and lentic waters.

Table 2. Percentage composition of caddisflies collected in Malaise traps in the alpine zone in the vicinity of Kongsvoll biological station

m a.s.l.	Middle alpine zone	High low alpine zone		Low low alpine zone		
	Gluptjern 1452 m	Stropla 1289 m	Blesbekken 1350 m	Kallvella 1220 m	Blesbekken 1200 m	Raubekken 1100 m
<i>Apatania zonella</i>	97.3	16.3	2.1	18.5	1.3	5.7
<i>Chaetopteryx villosa</i>	2.7	5.9	3.0	14.1	0.4	1.6
<i>Potamophylax cingulatus</i>	+	14.3	6.2	16.3	3.9	4.4
<i>P. latipennis</i>				18.8		
<i>Limnephilus coenosus</i>	+		3.0	3.7	0.5	4.1
<i>Apatania hispida</i>		0.5	11.4	9.8	1.3	2.2
<i>A. multibris</i>			20.1	0.1	41.9	68.6
<i>Ecclisopteryx dalecarlica</i>		33.0	53.7	3.9	24.6	2.5
<i>Rhyacophila nubila</i>		30.0	0.2	14.2	21.4	3.8
<i>Philopotamus montanus</i>			0.2			
<i>Potamophylax nigricornis</i>					3.2	5.7
<i>Limnephilus bipunctatus</i>	+		0.2		0.8	
<i>L. pantodapus</i>				0.1		
<i>L. algosus</i>				0.1		
<i>Halesus digitatus</i>				0.2	0.1	
<i>Apatania stigmatella</i>				0.1		1.0
<i>Beraea pullata</i>					0.2	
<i>Micropterna sequax</i>						0.3
Total number of individuals collected	5332	163	568	1016	836	312

Table 3. Species recorded in the sub-alpine zone in the vicinity of Kongsvoll biological station

Hydroptilidae	Limnephilidae
<i>Oxyethira flavicornis</i> (Pictet)	<i>Apatania stigmatella</i> (Zetterstedt)
<i>Oxyethira frici</i> (Klapalek)	<i>Apatania hispida</i> Forsslund
<i>Hydroptila forcipata</i> (Eaton)	<i>Apatania zonella</i> (Zetterstedt)
<i>Hydroptila tineoides</i> Dalman	<i>Apatania muliebris</i> McLachlan
Rhyacophilidae	<i>Ecclisopteryx dalecarlica</i> Kolanati
<i>Rhyacophila nubila</i> (Zetterstedt)	<i>Limnephilus algosus</i> (McLachlan)
Glossosomatidae	<i>Limnephilus auricula</i> Curtis
<i>Glossosoma intermedia</i> (Klapalek)	<i>Limnephilus bipunctatus</i> Curtis
Philopotamidae	<i>Limnephilus borealis</i> (Zetterstedt)
<i>Philopotamus montanus</i> (Donovan)	<i>Limnephilus coenosus</i> (Curtis)
Polycentropodidae	<i>Limnephilus extricatus</i> McLachlan
<i>Plectrocnemia conspersa</i> (Curtis)	<i>Limnephilus fenestratus</i> (Zetterstedt)
<i>Polycentropus flavomaculatus</i> (Pictet)	<i>Limnephilus femoralis</i> Kirby
<i>Holocentropus picicornis</i> (Stephens)	<i>Limnephilus flavicornis</i> (Fabricius)
Psychomyiidae	<i>Limnephilus fuscicornis</i> (Rambur)
<i>Psychomyia pusilla</i> (Fabricius)	<i>Limnephilus nigriceps</i> (Zetterstedt)
Molannidae	<i>Limnephilus pantodapus</i> McLachlan
<i>Molanna albicans</i> (Zetterstedt)	<i>Limnephilus rhombicus</i> (Linnaeus)
<i>Molannodes tinctus</i> (Zetterstedt)	<i>Limnephilus sparsus</i> Curtis
Leptoceridae	<i>Limnephilus stigma</i> Curtis
<i>Ceraclea nigronevosa</i> (Retzius)	<i>Limnephilus subcentralis</i> Brauer
<i>Mysticoides azureus</i> (Linnaeus)	<i>Colpotaulius incisus</i> (Curtis)
<i>Oecetis ochracea</i> (Curtis)	<i>Grammotaulius signatipennis</i> McLachlan
Beraeidae	<i>Phaenopteryx brevipennis</i> (Curtis)
<i>Berea pullata</i> (Curtis)	<i>Anabolia concentrica</i> (Zetterstedt)
Lepidostomatidae	<i>Asynarchus contumax</i> McLachlan
<i>Lepidostoma hirtum</i> (Fabricius)	<i>Asynarchus lapponicus</i> (Zetterstedt)
Sericostomatidae	<i>Potamophylax cingulatus</i> (Stephens)
<i>Sericostoma personatum</i> (Spence)	<i>Potamophylax latipennis</i> (Curtis)
<i>Noitidobia ciliaris</i> (Linnaeus)	<i>Potamophylax nigricornis</i> (Pictet)
	<i>Micropterna sequax</i> McLachlan
	<i>Halesus digitatus</i> (Schränk)
	<i>Halesus radiatus</i> (Curtis)
	<i>Halesus tessellatus</i> (Rambur)
	<i>Parachiona picicornis</i> (Pictet)
	<i>Chaetopteryx villosa</i> (Fabricius)
	<i>Annitella obscurata</i> (McLachlan)
	<i>Chilostigma sieboldi</i> McLachlan
	Phryganeidae
	<i>Phryganea bipunctata</i> Retzius
	<i>Agrypnia obsoleta</i> (Hagen)

The temporary pools in the middle alpine zone were populated by only one species, *A. lapponicus* (Zetterstedt). In total 6 species were found in the middle alpine zone.

Low alpine zone

Twelve species were recorded in the upper part of the low alpine zone. In addition to the species recorded in the middle alpine zone, *Apatania muliebris* McLachlan, *A. hispida* Forsslund, *Ecclisopteryx dalecarlica* Kolanati, *Rhyacophila nubila* Zetterstedt, and *Philopotamus montanus*

(Donovan) were captured in Malaise traps at running water. At standing water *Agrypnia obsoleta* (Hagen) was found.

When defining dominant species as making up more than 20% of the total number collected at one site, *E. dalecarlica* and *R. nubila* dominated the caddisfly fauna at the Stropla and *E. dalecarlica* and *A. muliebris* at the Blesbekken (Table 2).

In the lower part of the low alpine zone 23 species were captured. Species additional to Table 2 and those mentioned under the high low alpine zone, are *Grammotaulius signatipennis*

McLachlan, *Limnephilus stigma* Curtis, *L. fenestratus* (Zetterstedt), and *Chilostigma sieboldi* McLachlan.

In the Raubekken *A. muliebris* outnumbered all other species. *A. muliebris*, *E. dalecarlica*, and *R. nubila* were dominant species from the Blesbekken which runs parallel to the Raubekken, but only 300 to 400 m away. The Raubekken and Blesbekken are on the eastern side of the valley. When collecting larvae in the streams of the low low alpine zone, *Apatania stigmatella* (Zetterstedt) and *Beraea pullata* (Curtis) were never found. I did not search in small springs,

which are the habitat of *B. pullata*, but the few specimens of *A. stigmatella* have probably flown in from habitats at lower elevation.

At Kallvella, a stream on the western side of the valley, no particular species dominated the caddisfly community, but five species, *A. zonella*, *C. villosa*, *P. cingulatus*, *P. latipennis* and *R. nubila* each represented between 14 and 19% of the total catch. It should be noticed that in this stream *P. latipennis* takes the place of *P. nigricornis* (Pictet) in accompanying *P. cingulatus*. One obvious difference between the Raubekken and Blesbekken, which are inhabited by *P. cing-*

Table 4. Percentage composition of Malaise trap collections and light trap collections from rapid mountain streams and rivers in the sub-alpine zone in the vicinity of Kongsvoll biological station

	Blesbekken 1000 m	Raubekken 900 m	Jerosbekken 900 m	Driva river 870 m
<i>Apatania zonella</i>	2.1	1.8	0.3	
<i>A. hispida</i>	3.2			
<i>A. muliebris</i>	4.4	5.4		
<i>Ecclisopteryx dalecarlica</i>	8.8	2.4	0.2	4.2
<i>Potamophylax cingulatus</i>	3.7	21.0	34.6	4.2
<i>P. latipennis</i>			0.5	11.2
<i>Philopotamus montanus</i>	5.5	1.2		
<i>Rhyacophila nubila</i>	65.2	8.4	20.0	61.5
<i>Chaetopteryx villosa</i>	0.2	3.6	3.0	0.3
<i>Limnephilus coenosus</i>	3.1	20.4	0.2	0.1
<i>Potamophylax nigricornis</i>	2.8	7.8		0.1
<i>Limnephilus bipunctatus</i>	0.2			
<i>Halesus digitatus</i>	0.5		0.4	5.7
<i>Beraea pullata</i>	0.2			
<i>Limnephilus sericeus</i>	0.2			0.1
<i>L. incisus</i>		0.6		
<i>Plectrocnemia conspersa</i>	0.2		0.2	0.1
<i>Apatania stigmatella</i>		1.2		11.2
<i>Micropterna squax</i>		4.8		1.7
<i>Parachiona picicornis</i>		20.4		
<i>Limnephilus sparsus</i>				0.1
<i>L. dispar</i>			0.1	1.2
<i>Halesus radiatus</i>			29.1	0.6
<i>Anitella obscurata</i>				0.1
<i>Polycentropus flavomaculatus</i>			2.9	0.1
<i>Halesus tessellatus</i>			0.1	0.1
<i>Glossosoma intermedium</i>				0.1
<i>Hydroptila tineoides</i>			3.2	
<i>Lepidostoma hirtum</i>			2.1	
<i>Hydroptila forcipata</i>			0.7	
<i>Oxyethira frici</i>			0.5	
<i>Sericostoma personatum</i>			0.9	
<i>Limnephilus fenestratus</i>			0.3	
<i>Ceraclaea nigronervosa</i>			0.2	
<i>Holocentropus picicornis</i>			0.1	
<i>Anabolia concentrica</i>			0.1	
<i>Limnephilus algosus</i>			0.1	
<i>L. extricatus</i>			0.1	
Total number of individuals collected	619	167	1649	6126

ulatus and *P. nigricornis*, and the Kallvella, where *P. cingulatus* and *P. latipennis* coexist, is that Kallvella is a larger stream. Two new species appeared at the Kallvella, *Limnephilus pantodapus* McLachlan and *L. algosus* (McLachlan).

Sub-alpine zone

Sixty species of caddisflies were recorded in this biotic zone (Table 3). The percentage composition in Malaise traps from different streams is given in Table 4 and in emergence traps in Table 5. Malaise traps were not used at the Vestbekken and Kvernbecken.

Only three species *R. nubila*, *P. cingulatus* and *C. villosa* were collected from all six streams or rivers. The few species lacking in one or two localities included *E. dalecarlica*, *P. montanus*, *L. coenosus*, *P. nigricornis*, *Halesus digitatus* (Schrank) and *Plectrocnemia conspersa* (Curtis). All the above mentioned species must be regarded as widespread in the sub-alpine zone, but some seem to have a relatively low abundance. The remaining species of Tables 4 and 5 have a more restricted distribution, but they may be locally abundant, e.g. *Parachiona picicornis* (Pictet) and *Halesus radiatus* (Curtis). The widespread species *R. nubila* and *P. cingulatus* are also those that, in general, were most abundant in the streams and the river. *C. villosa* should probably be counted together with *R. nubila* and *P. cingulatus*, because I assume *C. villosa* to be underestimated in Malaise trap collections.

Outlets of lakes

The species composition of streams and lake outlets in the alpine zone did not show great differences. The only difference was that *A. obsoleta*, a standing water or slowly-running water species, occurred at the outlet of lake Stroplsjøen. No leptocerids or polycentropodids occurred in the alpine zone. At the outlet of lake Gávålivatn in the sub-alpine zone (Table 6), a number of limnephilids, e.g. *Limnephilus borealis* (Zetterstedt), *L. pantodapus* and *L. rhombicus* (Linneanus), belonging to standing water, appeared together with hydroptilids, e.g. *Hydroptila tineoides* Dalman and *Oxyethira frici* (Klapálek), the leptocerid *Ceraclaea nigronervosa* (Retzius), the polycentropodids *Holocentropus picicornis* (Stephens) and *Polycentropus flavomaculatus* (Pictet) and the molannid *Molannodes tinctus* (Zetterstedt). *P. latipennis* was the dominant spe-

Table 5. Percentage composition of emergence trap collections from rapid streams in the sub-alpine zone in the vicinity of Kongsvoll biological station

	Vestbekken	Kvernbecken
<i>Rhyacophila nubila</i>	33.6	13.2
<i>Plectrocnemia conspersa</i>	21.8	
<i>Philopotamus montanus</i>	12.7	2.6
<i>Potamophylax cingulatus</i>	10.9	13.2
<i>Chaetopteryx villosa</i>	10.0	5.3
<i>Halesus digitatus</i>	3.6	
<i>Potamophylax nigricornis</i>	2.7	47.4
<i>Apatania muliebris</i>	1.8	
Other		
Limnephilidae ♀ ♀	1.8	18.4
<i>Micropterna sequax</i>	0.9	
Total number of individuals collected	110	38

cies in trap no 1 and *H. radiatus* in trap no 2. In trap no 1 at standing water each of six species represented between 10 and 19% of the total number collected. Additionally, *Phryganea bipunctata* Retzius and *A. obsoleta* were captured regularly in net collections close to the lake.

Temporary pools

The warm season pools, which are intermediate between permanent standing water and the temporary vernal pools, contain *A. obsoleta*, *Oecetis ochracea* (Curtis), and *Molanna albicans* (Zetterstedt), while the temporary vernal pools are inhabited by *A. lapponicus*, *A. contumax* McLachlan, *G. signatipennis* and *L. stigma*. Table 7 shows the percentage composition of the caddisfly community in the temporary vernal pools located in the low alpine zone and the sub-alpine zone. *A. lapponicus* is the dominating species in the alpine zone, while *A. contumax* is the dominant species in the sub-alpine zone. In temporary pools at 1500 m a.s.l. in the middle alpine zone only larvae of *A. lapponicus* were collected.

A COMPARISON BETWEEN EMERGENCE AND FLIGHT PERIODS

Six species occurred in sufficient numbers to allow a comparison and the general trends are shown in Figs. 3, 4, 5 and 6. *R. nubila*, *E. dalecarlica*, and *P. nigricornis* did not show any differences between the emergence and flight peri-

Table 6. Number of individuals of caddisflies captured in Malaise traps at the outlet of lake Gáválivatn and at the outflowing Jerosbekken. M = males, F = females

	Slow flowing water at outlet				Rapid flowing water downstream the outlet			
	Trap 1		Trap 2		Trap 3		Trap 4	
	M	F	M	F	M	F	M	F
<i>Hydroptila tineoides</i>				13		2	9	42
<i>H. forcipata</i>						2	8	1
<i>Oxyethira frici</i>				2	2	2	2	2
<i>Limnephilus rhombicus</i>	25	39	7	13		1		2
<i>L. extricatus</i>	2	23	25	71	1	1		
<i>L. coenosus</i>	6	2	9	3		1	2	2
<i>L. borealis</i>	13	58	3	30	1	3		
<i>L. subcentralis</i>	20	16	8	15				
<i>L. fenestratus</i>	1	2		4		3		
<i>L. algosus</i>					1			
<i>L. pantodapus</i>	21	7	17	6				
<i>Potamophylax cingulatus</i>	3		29	34	189	198	98	82
<i>P. latipennis</i>	43	65	14	19	2		6	
<i>Halesus radiatus</i>	40	18	177	49	179	77	164	58
<i>H. digitatus</i>	1				3		4	1
<i>H. tessellatus</i>					1		1	
<i>Chaetopteryx villosa</i>	30	34	25	18	26	14	8	2
<i>Anabolia concentrica</i>					1			
<i>Apatania zonella</i>				1				
<i>Ecclisopteryx dalecarlica</i>					1	1		2
<i>Ceraclea nigranervosa</i>	18	3	49	33	1	1	1	
<i>Holocentropus picicornis</i>	1		1	1	1			
<i>Polycentropus flavomaculatus</i>	26	42	2	14	2	15	3	31
<i>Plectrocnemia conspersa</i>						1	2	1
<i>Rhyacophila nubila</i>	14	6	31	33	87	42	128	71
<i>Mollanodes tinctus</i>			4					
<i>Sericostoma personatum</i>							9	5
<i>Lepidostoma hirtum</i>					1	3	7	23

Table 7. Percentage relative abundance of caddisflies in Malaise traps at temporary pools in the alpine and sub-alpine zones in the Dovrefjell mountains

	Alpine zone			Sub-alpine zone
	Pool A	Pool A	Pool B	Pool C
	1979	1980	1980	1980
<i>Asynarchus lapponicus</i>	82.4	84.9	78.7	13.9
<i>A. contumax</i>				66.7
<i>Grammotaulius signatipennis</i>	16.0	9.7	3.3	6.3
<i>Limnephilus coenosus</i>	2.5	4.3	16.7	
<i>L. stigma</i>				13.2
<i>L. fenestratus</i>			0.7	
<i>Agrypnia obsoleta</i>		1.0	0.7	
Total number of individuals collected	119	93	150	288

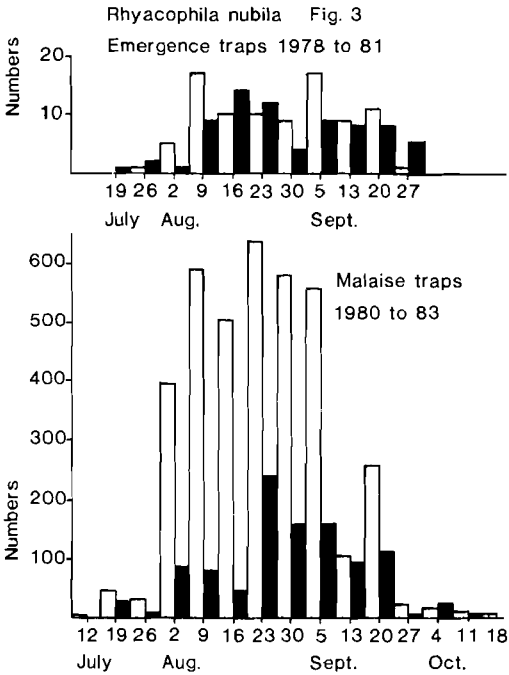


Fig. 3. Numbers of males (white) and females (black) of *Rhyacophila nubila* captured in emergence and Malaise traps.

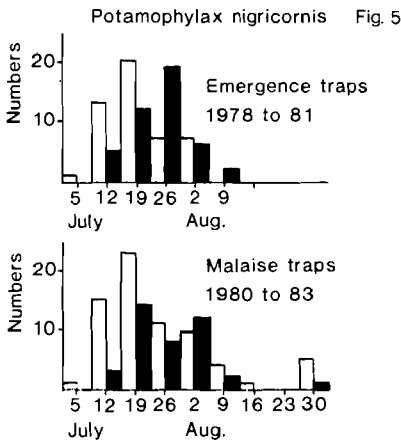


Fig. 5. Number of males (white) and females (black) of *Potamophylax nigricornis* captured in emergence and Malaise traps.

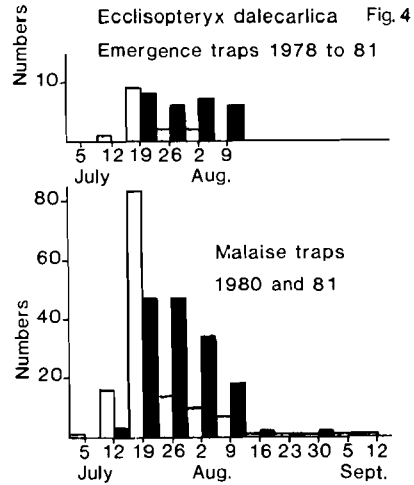


Fig. 4. Number of males (white) and females (black) of *Ecclisopteryx dalecarlica* captured in emergence and Malaise traps.

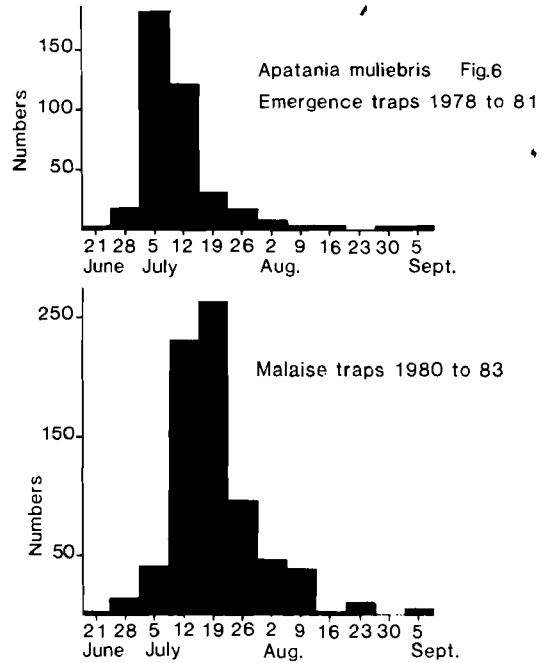


Fig. 6. Numbers of females of *Apatania muliebris* captured in emergence and Malaise traps.

ods, and the peak of individuals occurred simultaneously in the Malaise and emergence traps.

One species, *A. muliebris*, had a different pattern (Fig. 6). The emergence and flight periods covered approximately the same time, but the

peak in numbers appeared two weeks later in the Malaise traps. *A. muliebris* is a parthenogenetic species, so there is no need for it to fly around searching for a mate. A female in captivity, kept at a temperature of 10°C, oviposited bet-

Table 8. Percentage composition of the various stage in the maturation of eggs in *Apatania muliebris*

	Emergence traps	Malaise traps
Small eggs	49.4	5.8
Medium sized eggs	9.2	8.7
Large eggs	40.2	52.4
Spent or partly spent females	0	33.0
Total number of females	87	103

ween 2 and 3 weeks after emergence. This difference in time between emergence and oviposition coincides with the difference between the peak in numbers in emergence and Malaise traps. It is likely that specimens of *A. muliebris* rest quietly for about two weeks and that the activity recorded by the Malaise trap represents the oviposition flight (Table 8).

A COMPARISON BETWEEN RELATIVE ABUNDANCE AND NUMBER OF SPECIES IN EMERGENCE AND MALAISE TRAPS

The percentage composition of the caddisflies in emergence and Malaise trap catches at 11–1200 m a.s.l. from the Raubekken had a high degree of similarity (Table 9). *A. muliebris* which dominated the fauna, was collected in closely similar percentages by the two collecting

Table 9. Species and percentage relative abundance in emergence and Malaise traps in a given area of the Raubekken in the years 1980–81

	Emergence traps	Malaise traps
<i>Philopotamus montanus</i>	2.7	0
<i>Apatania muliebris</i>	69.5	68.6
<i>A. zonella</i>	1.1	5.7
<i>A. hispida</i>	0.2	2.2
<i>A. stigmatella</i>	0	1.0
<i>Potamophylax nigricornis</i>	3.9	5.7
<i>P. cingulatus</i>	1.4	4.4
<i>Chaetopteryx villosa</i>	12.1	1.6
<i>Limnephilus coenosus</i>	0.5	4.1
<i>Ecclisopteryx dalecarlica</i>	0.7	2.5
<i>Micropterna sequax</i>	0.2	0.3
<i>Halesus digitatus</i>	0.9	0
<i>Rhyacophila nubila</i>	7.1	3.8
Total number of individuals collected	439	312

methods. *C. villosa* was the only species that seems likely to be underestimated in the Malaise traps. This may be because *C. villosa* adults do not fly, but rather walk on the ground, and therefore its trapability in Malaise traps is less than for flying insects. This particular behaviour will not influence the catches in the emergence traps, which will therefore give a better estimate of the proportion of *C. villosa*. This have been taken into consideration when dominant species are listed in relation to trophic ecology. The numbers of species collected were 12 in the emergence traps and 11 in the Malaise traps.

FLIGHT PERIODS

The flight periods of the species captured in Malaise traps at permanent waters are shown in Fig. 7; and the total flight period extended from early June to mid October. The first species to appear was *B. pullata*, followed by *Apatania hispida*, *A. zonella* and *A. muliebris*. Five species were recorded as late as October, *R. nubila*, *H. digitatus*, *H. radiatus*, *C. villosa* and *Limnephilus subcentralis* Brauer. The shortest flight periods lasted only two weeks, as shown by *Sericostoma personatum* Spence, *Hydroptila forcipata* (Eaton), *H. tineoides*, *Oxyethira frici* (Klapalek), *A. obsoleta* and *L. fenestratus*. The longest flight periods extended for three months and were exhibited by *R. nubila* and *A. zonella*. *A. muliebris* and *L. coenosus* had flight periods only a week or two less than three months. A fairly sharp peak in numbers of captured specimens during the first half of the flight periods was the most common pattern; examples were: *E. dalecarlica*, *P. nigricornis*, *A. muliebris*, and *H. radiatus* (Figs. 4, 5, 6, 8). A different pattern, where individuals appeared over a longer time with no sharp peak, was shown by *R. nubila* (Fig. 3). Of 37 species recorded in Malaise and light traps, at permanent running and standing water, 8 species was recorded in June, 27 in July, 25 in August, 16 in September and 5 in October.

The flight periods of the species inhabiting the temporary vernal pools showed that *A. contumax* and *A. lapponicus* emerged earliest, followed by *G. signatipennis* and the last to emerge was *L. stigma* (Fig. 9).

The family Limnephilidae makes up a high proportion of the caddisfly fauna in high northern latitudes. Of all the collected caddisflies in Malaise and light traps the Limnephilidae made up 68.6% in the area of Kongsvoll. The temporal distribution of Limnephilidae and non-Lim-

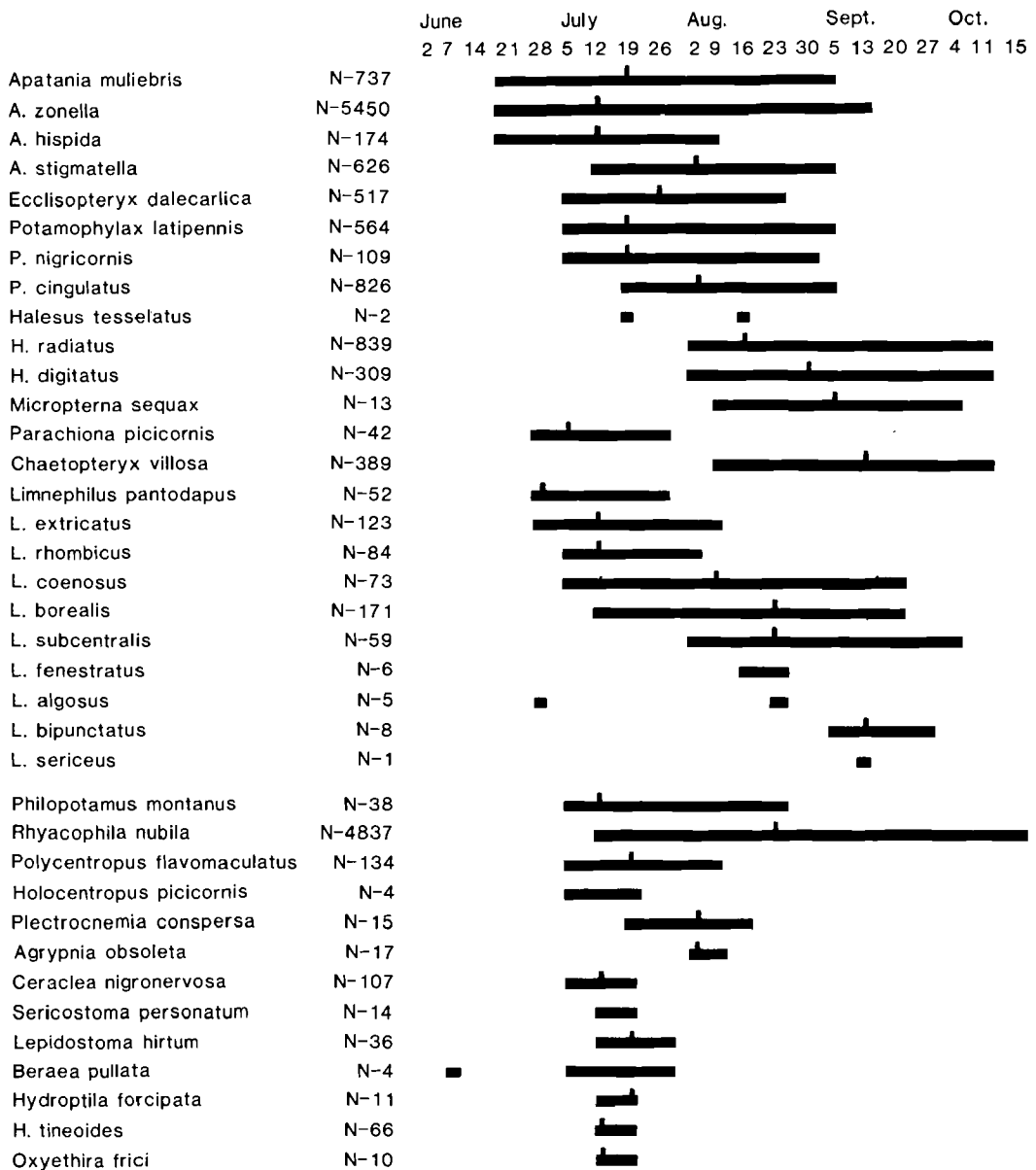


Fig. 7. Flight periods of species collected in emergence traps 1978 to 1981 and Malaise traps 1980 to 1983 from permanent water. Vertical bars denote 50% of total catch.

nephilidae is shown in Fig. 10. The limnephilids represented more than 50% of the flying caddisflies in June, July, early August, late September and October. Only for about one month, in

the second half of August and first half of September, did non-limnephilids dominate the fauna. The non-limnephilids were heavily dominated by *R. nubila*.

The temporal distribution at Dovrefjell was different from that reported from South Sweden (Svensson 1972).

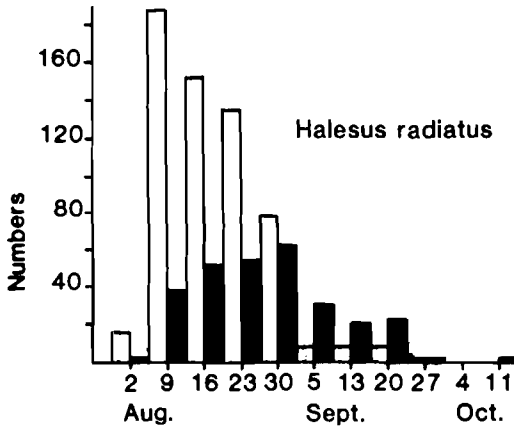


Fig. 8. Numbers of males (white) and females (black) of *Halesus radiatus* captured in Malaise traps.

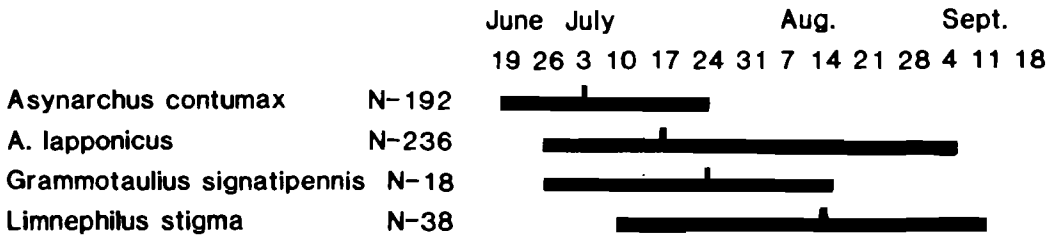


Fig. 9. Flight periods of species living in temporary vernal pools.

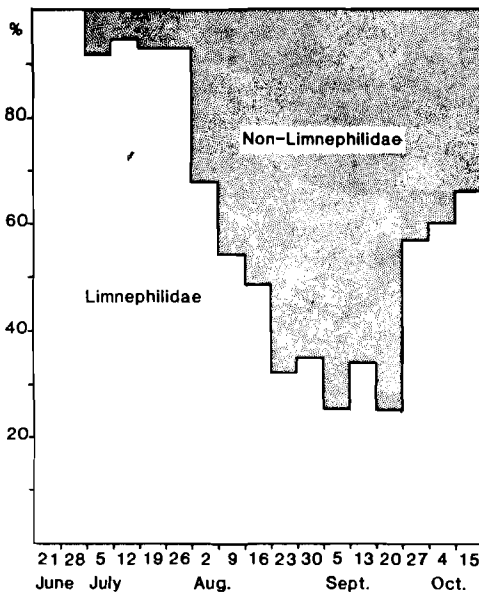


Fig. 10. Temporal percentage composition of Limnephilidae species and non-Limnephilidae species based on numbers.

SEX RATIOS

During the years 1978 to 1981 15 species were identified from emergence traps, and 14 of them also from Malaise traps (Table 10). The only species captured only in an emergence trap, was the single male of *Glossosoma intermedium* (Klapalek).

No males of *Apatania* species (*A. hispida*, *A. muliebris*, *A. zonella*) were collected in emergence or Malaise traps at these sites. *P. montanus*, *P. nigricornis*, *P. cingulatus*, *L. coenosus*, *M. sequax* McLachlan, *C. villosa*, and *R. nubila* did not show any significant differences between the numbers of males and females captured in emergence traps, but, except for *L. coenosus*, the numbers of emerging males were a little higher. Significantly more females than males emerged of *H. digitatus* and *E. dalecarlica*, while significantly more males than females emerged of *P. picicornis* and *P. conspersa*.

Table 10. Numbers of male and female caddisflies recorded in emergence traps during 1978 to 1981 and Malaise traps in Raubekken and Blesbekken 1980 to 1981. * = $p < 0.5$, ** = $p < 0.01$, *** = $p < 0.001$, χ^2 -test

	Emergence traps		Malaise traps	
	Males	Females	Males	Females
<i>Philopotamus montanus</i>	26	18	19	21
<i>Apatania hispida</i>		7		33
<i>A. zonella</i>		8		47
<i>A. muliebris</i>		354		712
<i>Potamophylax nigricornis</i>	48	44	77**	48
<i>P. cingulatus</i>	49	44	80	83
<i>Halesus digitatus</i>	3	10	2	5
<i>Parachiona picicornis</i>	13*	4	9	33***
<i>Limnephilus coenosus</i>	1	3	45	55
<i>Ecclisopteryx dalecarlica</i>	14	27*	136	160
<i>Micropterna sequax</i>	5	4	7	4
<i>Chaetopteryx villosa</i>	82	74	7	6
<i>Rhyacophila nubila</i>	90	73	374	397
<i>Glossosoma intermedium</i>	1	0	0	0
<i>Plectrocnemia conspersa</i>	25**	7	11*	2

TROPHIC ECOLOGY

Dominant species have a powerful effect on the community (Krebs 1972), and when trophic ecology is concerned, it is therefore legitimate to look at the feeding habits of the dominant species only. The abundance of each species varies from stream to stream (Tables 2, 3, 4, 5), but the general trend in the dominance hierarchy is clear, and the dominant species have been grouped according to their feeding habits in Table 11.

Wiggins and Mackay (1978) described the functional feeding groups of aquatic insects proposed by Cummins (1973) as follows: grazers (scrapers) were animals which nibbled and scraped periphyton and fine organic materials on rocks and vegetation; collectors were filter feeders and gatherers of suspended or loosely deposited fine organic particles; shredders fed on decomposing vascular plants; predators were carnivores whose main food items was animal prey. It seems that most of caddisfly larvae can be grouped under one or another of these headings.

The *Apatania* species are scrapers (grazers) (Wiggins and Mackay 1978), their food being largely diatoms and other algae (Nielsen 1942, Lepneva 1971). *C. villosa* is classified as a shredder, because its overall dominant food is plant material (Andersen, J. 1984). *E. dalecarlica* is, according to my own analysis of the gut contents of 10 4th and 5th instar larvae, a typical

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Table 11. Dominant running water species in the different biotic zones grouped according to their feeding habits

Scrapers	Shredders	Predators	Collectors
Middle alpine zone			
<i>A. zonella</i>	<i>C. villosa</i>		
Low alpine zone			
<i>A. zonella</i>	<i>C. villosa</i>	<i>R. nubila</i>	
<i>A. muliebris</i>	<i>E. dalecarlica</i>	<i>P. cingulatus</i>	
<i>A. hispida</i>	<i>P. cingulatus</i>	<i>P. nigricornis</i>	
	<i>P. nigricornis</i>		
Subalpine zone			
<i>A. stigmatella</i>	<i>C. villosa</i>	<i>R. nubila</i>	<i>P. montanus</i>
	<i>H. radiatus</i>	<i>P. conspersa</i>	
	<i>P. cingulatus</i>	<i>P. cingulatus</i>	
	<i>P. nigricornis</i>	<i>P. nigricornis</i>	

Table 12. The proportions of functional feeding categories of caddisflies. The genus is the basic unit for the data from North America, and the dominating species for the data from Norway. North American data taken from Wiggins and Mackay (1978)

	Scrapers	Shredders	Predators	Collectors
Western North American mountain forest biome	4.5	4	1	1.5
Eastern North American mountain forest biome	3	4	1	2
Norwegian mountain birch forest biome	1	3	3	1

shredder. *P. cingulatus* and *P. nigricornis* are, however, difficult to assign to shredders or predators, because the two species are opportunistic in their feeding in the 4th and 5th instars (Solem 1983a), and the proportion of animals in the gut content is likely to be underestimated. How difficult these problems are was demonstrated by Martin and Mackay (1982) who fed *Rhyacophila* larvae with known numbers of each of two prey taxa (Ephemeroptera: Ephemeridae and Diptera: Chironomidae) in an artificial stream under controlled conditions in the laboratory. They discovered that large numbers of heavily sclerotized fragments of legs, cerci, wing pads, head capsules and abdominal segments which are used in the identification of the prey, were cleaned of soft tissue, but not eaten. Soft tissues will appear as unidentified matter in the gut and are mostly referred to as detritus. It seems obvious that the predatory habit of *P. cingulatus* and *P. nigricornis* will be underestimated, and the species are likely to be more dependent on animal food than can be measured by the food analysis method used by Solem (1983a). I therefore record them as both shredders and predators. *R. nubila* and *P. conspersa* are typical predators (Siltala 1907, Wallace and Merritt 1980, Wiggins and Mackay 1978), while the only collector is *P. montanus*. Philopotamid larvae feed primarily on fine detritus and diatoms (Siltala 1907, Wallace and Merritt 1980).

Table 11 shows the dominant species and their assignment to the various functional feeding groups. When compared with Table 12 it can be concluded that the scrapers predominate in the middle alpine zone. The proportion between scrapers:shredders:predators:collectors in the low alpine zone is 3:3:2:0, and that in the sub-alpine birch forest is 1:3:3:1. There are recognizable differences in the proportions of the various functional units between all three biotic zones considered.

DISCUSSION

Clear differences in the numbers of species captured and inhabiting the various vegetation zones in the Dovrefjell mountains were found. Two species, *A. zonella* and *C. villosa*, were common in the middle alpine zone; *A. lapponicus* inhabited such peculiar habitats as temporary pools and thus had more restricted and fewer habitats than *A. zonella* and *C. villosa*, which live as larvae in permanent lotic and lentic waters. Only limnephilids occurred in the middle alpine belt, and one of the species, *A. zonella*, was also the only caddisfly recorded as far north as 80° on the island of Svalbard (Solem et al. 1977).

Some characteristics of the species occurring in the middle alpine zone are: *A. zonella* has mainly parthenogenetic reproduction, its feeding habit is scarping «Aufwuchs» on rocks, it flies in early summer, the life cycle may extend over two or more years (Solem 1985), and it inhabits permanent lentic and lotic water; *C. villosa* reproduce by mating of males and females, it is a shredder, adults appear in late summer and autumn, the life cycle extends over two years, inhabits lentic and lotic permanent water, and the individuals have not been seen flying; *A. lapponicus*, males and females participate in reproduction, feeds as a shredder, flies in summer, the life cycle is one year with very fast larval growth in early summer, and inhabits temporary pools. Judging from the known biological features (Solem 1983a, 1985) there is no niche overlap between these species. The reproductive strategy and the feeding habit of *A. zonella* is probably a great advantage for a caddisfly to be successful inhabitant of high altitudes and high latitude areas, e.g. the highest waters in the Dovrefjell area and on Svalbard. These are low-competitive, early succession habitats which change relatively slowly. These features are found also in the parthenogenetic *A. muliebris* and *A. hispida*,

even though the competition with other caddisflies is greater at these habitats, e.g. Raubekken and Blesbekken. However, the distribution of the parthenogenetic *Apatania* spp. agrees with the pattern of distribution reported for parthenogenetic weevils (Vepsäläinen & Järvinen 1979). At lower altitudes the competition between species is greater and populations consist of males and females.

C. villosa is active at night (Andersen, J. 1984) and because it is an autumn species it will be frequently exposed to temperatures below 0°C. In the year 1982 there was a snowfall in August above about 1500 m, and the snow stayed throughout the autumn. How do individuals cope with these conditions? Do they freeze or do they supercool? Supercooling points of *C. villosa* ranged from -4.5° to -14.5°C (mean -8.5°C, N = 10) (Solem 1984). This range was much wider than that found for summer species of caddisflies, *R. nubila*, *L. borealis* and *L. subcentralis*, which was -4.0° to -8.9°C (N total = 19). *C. villosa* disappeared in 1982 at the time when minimum night temperatures were down regularly to -8°C. Low air temperature is a limiting factor for adults of *C. villosa* to stay alive in autumn. The mean supercooling point of *C. villosa* is within the range that is recorded for species with no special adaptation for low temperatures (Sømme & Zachariassen 1981). However, the supercooling points indicates that *C. villosa* is better adapted to survive low temperatures than summer caddisfly species, and in habitats where frequent freeze-thaw cycles occur, it may be ecologically advantageous for a species to super-cool, at least moderately, to avoid disruption of the life cycle by a cold tolerance mechanism (Block 1982).

A. zonella and *C. villosa* have a slow growth and require several years to complete their life cycles. An opposite strategy was demonstrated by the univoltine *A. lapponicus*. This species inhabits temporary pools and has a fast growth and completes the maturation of larvae and pupae within a few weeks (Solem 1983c). *A. lapponicus* is a shredder, and fast growth of the larvae requires reasonably high temperatures and food of high quality. The habitats occupied by *A. lapponicus* are shallow pools and the water reaches fairly high temperatures as soon as the ice and snow have melted. It is also a reasonable assumption that the food is of high quality because Bärlocher et al. (1978) in temporary pools in southern Ontario reported that detritus in waterless pools contains more protein than similar detritus in sub-merged areas.

In total 60 species were recorded in the Dovrefjell mountains and this is about one third of the number of species of caddisflies reported from Norway. From the River Vindelelven in Swedish Lapland Ulfstrand (1970) identified 82 species, and Andersen, T. (1979) listed 32 species from the mountain plateau Hardangervidda. Göthberg (1970) reported 57 species from the stream Kaltisjokk (North Sweden) and Malicky (1978) 45 species from the birch forest in the area around Abisko (Swedish Lapland). In Norway, just west of Vindelelven, 32 species of caddisflies were recorded in light traps (Solem unpubl. data). These data indicate that fewer caddisfly species belong to the sub-alpine or alpine zones in South and Central Norway than in Sweden.

It should be noted that no *Hydropsyche* species were collected in this part in the Dovrefjell mountains, and only one *Rhyacophila* species was recorded. Most of the streams drain glacier areas and low temperatures and little organic drift may be a reason for the absence of the larvae of *Hydropsyche* which are filter-feeders.

In more southern latitudes, e.g. Britain (Crichton 1960, 1971), South Sweden (Svensson 1972) and Czechoslovakia (Novak and Sehnal 1963, Malicky 1981) some caddisfly species have two peaks in flight activity during a season. No such feature can be deduced from the data on flight periods in the Dovrefjell mountains. Denis (1981) found that imaginal quiescence of egg development in many limnephilids was controlled by the day length the specific larval instars experienced. Long day was followed by a direct development, and short days resulted in a quiescence. In the Dovrefjell mountains larvae are exposed to long days, more than 12 hrs, during April to October, and direct egg development is to be expected, and was found.

Crichton (1971) and Crichton and Fisher (1981) divided the flight periods of limnephilid caddisflies as follows:

1. An extended flight period probably involving a diapause, from spring through summer into autumn;
2. a shorter flight period, without a diapause, in spring and summer, and sometimes extending into autumn;
3. a short flight period, without a diapause, in autumn.

None of my species is applicable to Crichton's 1st group. When excluding the spring aspect in group no. 2, most of the species, e.g. *A. muliebris*, *A. zonella*, *A. hispida*, *P. picicornis*, *L. pantodapus* and the non-limnephilids belong to group

no. 2. Group no. 3 is represented by *H. radiatus*, *H. digitatus* and *C. villosa*. A fourth group that is present in the Dovrefjell mountains is the late winter species, *C. sieboldi*, which is present in April—May. If I divide group 2 into short and long flight periods, the phenological types are similar also to the distinction made by Malicky (1978).

The emergence and flight periods of caddisflies do not necessarily cover the same time period. Species that live in intermittent streams and temporary pools often have an emergence period restricted to spring, but have a flight period that extends into autumn (Crichton 1971, Svensson 1972, Malicky 1981). The emergence and Malaise trap collections in the present study had great similarities and was the most common pattern in caddisflies in the Dovrefjell mountains. Only *A. muliebris* had a delayed peak in Malaise trap captures when compared with that of emergence traps.

The sex ratios of *P. picicornis* was opposite to each other in emergence and Malaise trap collections, 24.5% females were counted in the emergence traps while only 78.6% females were captured in the Malaise traps. This suggests that the swarming or flight prior to mating occurred at areas not covered by the Malaise traps above the running water. For most species the similarities in the sex ratio between the emergence and Malaise traps indicate very similar flight habits and flight areas of males and females. However, Malaise traps above running water and on the banks of the Jerosbekken gave a sex ratio of *P. cingulatus* very close to 1:1 above running water while it was about 3 males to 1 female on the banks. Pre-mating flight of *P. cingulatus* is carried out in the bushes on the bank (own observations), and a similar feature may be the case also in *P. picicornis*.

The sex ratio of *P. conspersa* was fairly similar in the emergence and Malaise traps, 21.8% and 18.2% females respectively, and resembles sex ratios found earlier, 8.8% females in light traps by Svensson (1972), 15.7% females in light traps by Crichton et al. (1978), and 4.1% females in light traps by Göthberg (1970). However, Tachet (1967) recorded 57% females in emergence traps and Svensson (1972) 48% females in Malaise traps. The different sex ratios recorded in Malaise traps, may be explained by different collecting sites of the traps.

Collections of caddisflies in the mountains of Saltfjellet, Nordland county (own unpubl. collections), Jotunheimen, Oppland county (Lillehammer 1978, own coll.) and Hardangervidda,

Hordaland county (Andersen, T. 1978) show fairly similar compositions of species, and indicate that the proportion of the functional feeding groups revealed at Dovrefjell are representative also of other mountainous areas of South and Central Norway. Combining the middle and the low alpine zones, the scrapers are the dominant group here, with the shredders and the predators dominant in the sub-alpine birch forest.

Wiggins and Mackay (1978) gave the proportions of the various functional feeding groups in caddisfly communities in North America (Table 12). The dominating species in the sub-alpine birch forest at Dovrefjell are shredders and predators, and deviate from the proportions reported by Wiggins and Mackay (1978). However, their basic unit is the genus which they regarded as a taxonomic and ecological unit. As I have used the species as a basis in the description of the functional feeding units this might be a reason for the differences. Vannote et al. (1980) gave approximate proportions of the functional feeding units for the total invertebrate community in North American streams, but the Trichoptera as a group at Dovrefjell differ from their scheme also. The proportions found in the present study are different also from the general picture described by Winterbourn et al. (1981) for New Zealand streams. It is inferred by Vannote et al. (1980) that their model of the structure and function of stream ecosystems is universal. It is too early yet to say how the total picture will look in Norway, but what has been shown here is that Norwegian Trichoptera communities are different from what is assumed to be the structure and function of North American Trichoptera communities. This implies that other groups of aquatic invertebrates may be different from the basic units used by Vannote et al. (1980), if their general model should be similar in North America and Norway.

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Female sex pheromones in *Rhyacophila nubila* (Zetterstedt) (Trichoptera, Rhyacophilidae) and arrival pattern to sticky traps

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Using live caged females and extracts of females of the caddisfly *Rhyacophila nubila* (Zetterstedt), I have shown female sex pheromones to be present. Live caged males did not attract females. The pheromones are produced on sternite 4; they are present in very young pupae, and probably in old prepupae also. The peak in the arrival pattern of adults at the sticky traps was in early night.

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INTRODUCTION

Within the insect order Trichoptera we know of two behavioural patterns used when sexes meet for reproduction. One pattern is that the male approaches the female and this is probably the most wide-spread and ancient pattern. It has been reported from several families (Keller-Pillault 1975, Solem 1976, 1984, Wood and Resh 1984). The second pattern is that the females fly into a swarm of males, and make physical contact to facilitate sexual recognition. This second pattern has been reported in fam. Hydropsychidae (Fremling 1960) and fam. Lep-toceridae (Hickin 1953, Solem 1978, 1984, Tozer et al. 1981). It seems reasonable to assume that the two patterns have different attraction mechanisms. The attraction mechanism in leptocerids and hydropsychids is unknown, but recently Wood & Resh (1984) demonstrated that female sex pheromones are involved in the attraction of males in the sericostomatid *Gumaga griseola* McLachlan.

This paper reports the results of field experiments concerning sexual communication in *Rhyacophila nubila* (Zetterstedt) (Rhyacophilidae).

MATERIAL AND METHODS

Field experiments were carried out at the Driva River (880 m a.s.l.) at Kongsvoll Biological Station in the Dovrefjell mountains, Central Norway, during the summers 1983 and 1984. Pupae were collected and reared in separate chambers until adult stage. Virgin males and females,

one to five days old, were placed separately in cylindrical screened cages (30 x 45 mm). Two females which were reared together with several individuals, and had most likely mated, were also used. The cages were placed in square sticky traps measuring 20 x 30 cm.

Various parts of the body of females were placed in a glass vial with 0.5 to 1 ml of dichloromethane. After 1.5 hrs extraction the tissue were removed, and the extracts were infused to rubber septa (F-138 Septa from Supelco Inc.). The extracts were made just before darkness. In order to isolate the segment that produced the pheromones, the abdomens were dissected and the different parts tested against each other for male attraction; e.g. segments one to four were tested against the rest of the abdomen, the sternites of segments one to four were tested against the tergites of segments one to four, the sternites of segments one and two were tested against the sternites of segments three and four, the sternite of segment three were tested against sternite of segment four, and at last, the sternite of segment four were tested against the rest of the body.

Extracts of females collected in light traps, mature pupae, young pupae, and prepupae were also tested.

The traps were placed in the field before darkness. In early August they were checked regularly during the night. The number of specimens caught was counted in order to get information about the arrival pattern of adults. In late August the traps were checked only one time during a night.

Table 1. Pheromone tests of *Rhyacophila nubila*

Test no.		Average number of males caught per trap/day	No. of traps	
1	Controls	0.7	10	p < 0.01
	Live females	10.66	13	
	Live males	0	3	
2	Females, extract (2 inds)			p < 0.001
	Head + thorax	1.0	3	
	Abdomen	24.33	3	
3	Controls	0.6	3	p < 0.001
	Females from light traps, extracts			
	Abdomen (3 inds)	32	2	
4	Controls	0.75	4	p < 0.01
	Female pupae (mature)			
	Extracts (5 inds)	9	3	
5	Controls	0.75	4	p < 0.001
	Female pupae (young)			
	Extracts (3 inds)	20.25	4	
6	Controls	2.4	8	p < 0.05
	Pre-pupae			
	Extracts (3 inds)	13	2	
7	Controls	4	4	p < 0.001
	4th sternite of female abdomen			
	Extracts (3 inds)	2	3	
	Female minus 4th sternite			p < 0.001
	Extracts (3 inds)	38.8	5	
	Controls	1.3	4	
	Controls	1.3	3	

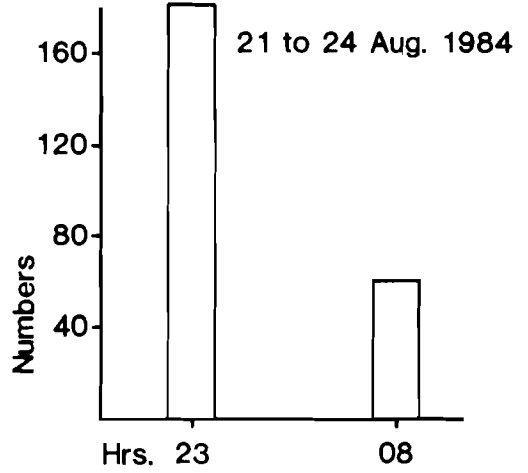
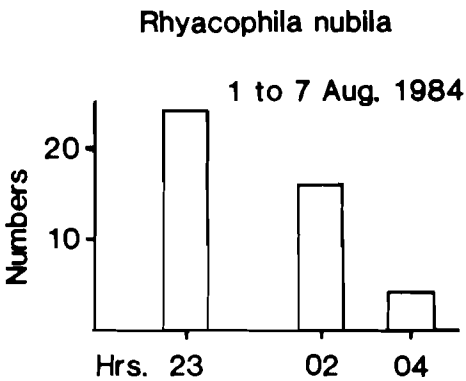


Fig. 1. Numbers of *Rhyacophila nubila*, males and females, which arrived at sticky traps from 2100 to 0400 hours during 1 to 7 August 1984, and 2100 to 0800 hours during 21 to 24 August 1984.

RESULTS

Data from the field experiments are presented in Table 1, and they show that: 1) Live virgin females attracted males; 2) Live males did not attract females; 3) Extracts of abdomen of virgin females attracted males, while head and thorax were not attractive; 4) Extracts of abdomen of females which were caught in light traps, attracted males; 5) Sternite 4 was most attractive to males; 6) Young pupae were also attractive; 7) One trap with extracts of prepupae attracted a significant higher number of males than the controls. However, three other traps baited with prepupal extracts did not differ from the controls.

The highest number of *R. nubila* males were caught in early night, just after darkness (Fig. 1). This arrival pattern corresponds to that of light traps reported by Göthberg (1978).

DISCUSSION

The attraction of males to females and to abdominal extracts of females indicate that female sex pheromones are involved in the sexual communication in *R. nubila*. The presence of female sex pheromones using extracts has been demonstrated only once before in the order Trichoptera, in *Gumaga griseola* McLachlan (Sericostrimatidae) (Wood and Resh 1981). *R. nubila* and *G. griseola* belong to two different groups of caddisflies.

However, Kelner-Pillault (1975) reported that caged females attracted conspecific males in *Enoicyla pusilla* Burm., and similar phenomenon was reported in *Phryganea bipunctata* (Retzius) by Solem (1976). Even though, the two last observations are not as conclusive as using female extracts, they do indicate that female sex pheromones are present in many different groups of caddisflies, and may be they will show to be as common as in the sister order Lepidoptera. The attraction of males to one trap baited with extracts of prepupae indicates that pheromones might be produced at the prepupal stage. It is possible that these prepupae were older than those used in the three other, which were not attractive. Testing sternite 4 against the rest of the body is a strong indication that pheromones are produced on sternite 4. However, glands in this segment have not been detected. SEM photos of the sternite did not show any structure that co-

uld be identified as glands for releasing pheromones.

Solem (1984) reported that *R. nubila* congregated and flew in bushes along the banks of streams and rivers, but detailed features in the flight pattern were not detected. This flight is very likely males searching for females, because the females rarely fly on the bank (own unpubl. data). The experiments carried out on *R. nubila* have focused on long distance pheromones. It is of paramount importance for the interpretation of the flight behaviour in caddisflies to know if such pheromones are present or not.

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The geographical range extension of *Heterhelus scutellaris* (Heer 1841) (Coleoptera, Nitidulidae) and its host plant *Sambucus racemosa* (L.) (Caprifoliaceae) in Scandinavia

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Ottesen, P. & Kvamme, T. 1985. The geographical range extension of *Heterhelus scutellaris* (Heer 1841) (Coleoptera, Nitidulidae) and its host plant *Sambucus racemosa* (L.) (Caprifoliaceae) in Scandinavia. *Fauna norv. Ser. B.* 32, 83–88.

In Scandinavia *Heterhelus scutellaris* (Heer 1841) was recorded for the first time in Finland 1901, Denmark 1916, Sweden 1947 and Norway 1979. At present the species is exceedingly common in Southern Scandinavia, and is still spreading. Two independent dispersal routes have been identified: across the Gulf of Finland to Finland, and from Germany to Denmark. The latter population has spread to Sweden and further to Norway. This natural dispersal has followed the human introduction and cultivation of its host plant, *Sambucus racemosa* (L.), which 100 to 150 years ago rapidly became naturalized through seed dispersal by birds. In Europe both species today have disjunct distribution patterns: the new Scandinavian one, and the original one at higher elevations in the central and southern parts of Central Europe. The warm lowlands in between apparently act as a barrier. In Scandinavia the beetle has today reached 300 km south of the northern distribution limit of fertile *S. racemosa*, the latter being found at 65°N.

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INTRODUCTION

Geographical range extensions of animal species are frequently reported, but the reasons underlying such extensions are rarely known (Krebs 1972). The best understood cases are found when monophagous species have spread to areas where their host plants have been introduced. However, few good examples are available (Lattin 1967).

The present paper will document the natural dispersal of the Nitidulid beetle *Heterhelus scutellaris* (Heer 1841) in Scandinavia. This dispersal has clearly been possible due to the introduction and ensuing naturalization of its host plant *Sambucus racemosa* (L.). Although Scandinavian coleopterologists have recorded catches of the beetle for more than eighty years and botanists have followed the bush for more than 150 years, all information on the two species concerns single records or observations within limited geographical areas. To obtain a comprehensive picture of their biology, range extension and current distribution, we have, with emphasis on

the beetle, compiled published and unpublished records up to 1983.

BIOLOGY

H. scutellaris is a 2.0 to 2.5 mm long, yellow-reddish beetle which belongs to the subfamily Kateretinae of the Nitidulidae family (Fig. 1). It is readily distinguished from related species in having two segments only (not three) in the antennal club (Hansen 1950). Its life history is closely associated with the bush *S. racemosa* on which larvae and imago feed on pollen. Other parts of the flowers may be eaten as well. Occasionally imago may visit other flowering trees, like *Sorbus aucuparia* L. Pupation takes place in or on the ground below fallen flowers (Rupert-berger 1872). Its annual period of activity coincides with the flowering of *S. racemosa*, which is in the spring, usually in May or June. It is often seen flying around the bushes and is usually found in large numbers in the flowerheads.

LIST OF RECORDS

The district abbreviations follow Lindroth (1960), but the faunal divisions for Norway agree with Økland (1981). EIS-numbers for Norway refer to the European Invertebrate Survey, Norwegian grid numbers (Økland 1976).

Finland

The first record of *H. scutellaris* in Scandinavia is from Finland. In 1901 several specimens were found on *S. racemosa* close to Helsinki (Sahlberg 1902). We have not been able to find any other published records, but Olof Biström has kindly sent us information on the specimens in the Helsinki Zoological Museum. The years of first capture in the various faunal provinces of Finland, judged from this material, are: N: 1901, Ik: not dated, but probably collected early in this century, Ta: 1902, Ab: 1914, Sa: 1932, Kl and Ka: 1938, Tb: 193? (not specified), St: 1952, and Sb: 1956. It is also found in Kon (Lindroth 1960). In several of these provinces the species has later been rerecorded (O. Biström, pers. comm.).

Denmark

The first Danish specimen of *H. scutellaris* was caught on 8 June 1916 in Boller Skov in the neighbourhood of Horsens, Jylland (Høeg 1919). The next record was on 20 May 1920 at Nørholm close to Esbjerg, Jutland, where three specimens were beaten down from flowering *Sorbus aucuparia* (Larsen 1923–24). The third record was from Svendborg, Fyn, where the species was found in large numbers on *S. racemosa* (West 1936–37) (the bush was published as *S. ebulus*, but corrected by West (1947)). The date was 19 May, but the year was not given, although it probably was from the early thirties. West (1940–41) concluded that the beetle was «very rare», although one additional record was given in the addendum: Frøslev Plantage, Zealand, 2 June. However, some years later West (1947) gave eight additional records from various parts of the country: Oens, Hylke, Slukefter (NW Odense), Boserup, Nybro Skov, Furesøparken, Gelsskov, Ørholm — and concluded that the species had spread considerably the last years. This observation was confirmed by Hansen (1952).

Sweden

The first Swedish specimen was caught at Sk, Bökeberg on 27 May 1947 (Leiler 1947). It

quickly established itself in Skåne. On 25 May 1950 it was registered to be common on *Sorbus aucuparia* and *S. racemosa* in Sk, Sövde (Palm 1951), and Israelson (1956) found it in several localities in the Hässleholm area, Sk on every bush he investigated, even isolated ones. In 1957 two specimens were caught, at least one on *S. aucuparia*, in Vg, Göteborg (Arvall), and on 29 April 1961 it was found to be numerous on *S. racemosa* in the same area (Hagström 1962). It was also recorded in Sm by Dahlgren (Klefbeck 1962). On 6 June 1962 it was found in Hall, Fjäråsbräcka (Lundberg 1963) and the same year in Bl, Listerby by N. Gyllensvärd (Lundberg 1968). Early in the seventies the species appeared in several localities of Central Sweden. The first three records were all from Dlr, which is remarkably far north in relation to the previous Swedish catches: Dlr, Borlänge, 26 May 1971 (G. Sjödin); Dlr, Orsa, 2 June 1971 (A. Petrelius); and Dlr, Säter, 17 May 1972 (B. Ehnström). All subsequent recordings are further south: Vrm, Eje, 25 May 1972 (B. Ehnström); Ög, Omberg, 6 June 1973 (Å. Lindelöv); Upl, Lunda, 15 Sept. 1973 (A. Anderberg); Sdm, Vårdinge, 4 April 1974 (C. Holmquist); and Öl, 1983 (J.R. Bergwall). In several of the districts mentioned above the species has later been rerecorded, often in large numbers (S. Lundberg, pers. comm.).

Norway

The first Norwegian specimen was found on 12 July 1979 at AK: Asker, Semsvannet (EIS:28) (P.O.). The next year, 1980, it was found in large numbers on *S. racemosa* at AK: Bærum, Jar (EIS:28), 17 May (A. Fjellberg); eleven specimens in AK: Frogn, Drøbak (EIS:28), 20 May (R. Fardal); and several specimens in VE: Horten (EIS:19), 27 May (T.K.). In 1981 it was found in large numbers on every single bush of *S. racemosa* that was investigated in the Oslo area (EIS:28), and it was also found in Ø: Halden (EIS:20), 27 May and AK: Ullensaker, Hershøen (EIS:37), 26 May (P.O.). Between 26 May and 3 June 1982 it was found on every single bush of *S. racemosa* that was investigated in coastal districts of Southern Norway: Ø: Fredrikstad (EIS:20); BØ: Øvre Eiker, Fiskum (EIS:27); BØ: Kongsberg, Sagrenda (EIS:27); BØ: Kongsberg city (EIS:27); TEY: Skien (EIS:18); TEY: Bamble, Valle (EIS:11); and AAY: Arendal (EIS:6) (T.K.). On 11 July 1982 a search was made for the species in BV: Ål (EIS:43). Between the railway station and Ål centre 705 flowerheads on a total of 31 bushes of *S. racemosa*

were examined. Only five specimens were found, although *S. racemosa* was abundant in the area and all the way down the Hallingdal valley southwards toward the coast (P.O.).

DISCUSSION

The range extension of *S. racemosa*

The range extension of *H. scutellaris* in Scandinavia is undoubtedly connected with the range extension of its host plant *Sambucus racemosa*, which is found throughout the Holarctic region. Prior to the invasion of Scandinavia, the northern range of this bush in Europe stretched from Belgium and Central Germany to Lithuania, and in the south from the Pyrenees to Southern Bulgaria (Tutin et al. 1976). As in Scandinavia it has become naturalized in the USSR from Lithuania to Lake Ladoga, although scattered from Lake Peipus (between the two arrows on Fig. 1) and eastwards (Hultén 1971). The bush probably prefers cold climates. It does not occur naturally in the warm northern lowlands of Central Europe, including Great Britain, although it was probably present in the latter country in earlier interglacials (Godwin 1975). In Southern Germany it is considered to be a characteristic species of the phytosociological class *Epilobietea angustifolii*, alliance *Sambuco-Salicion capreae*, which typically occurs on fresh, loose, humic soils with a good nutrient supply, especially on old forest felling areas, and usually in submontane and montane regions (Oberdorfer 1973).

More than 150 years ago the bush was introduced to Scandinavia and cultivated for ornamentation (Lagerberg et al. 1957). With the aid of man, the warm Central European barrier was thus crossed. In 1837 it was first observed to spread naturally in the Stockholm area (Hylland 1971), and around 1870 in the Oslo and Bergen areas (Blytt 1874, Holmboe 1941). The following natural dispersal was fast, and within a few decades the species was fairly common in Sweden (Almquist 1929). Schübeler (1888) reported that the species thrived well in Norway, even close to the timberline, and in several localities it spread like a weed. Today the bush is common over the whole of Southern Scandinavia, especially in areas with human settlement. Although its northern distribution limit has probably been reached (Fig. 1), it still seems to be expanding within the present range. In recent years it has become increasingly common on old forest felling areas (Lundqvist 1983), which, as

mentioned above, is a typical habitat for the species in Southern Germany.

The rapid dispersal in Scandinavia is most likely due to two factors: man and birds. Lagerberg et al. (1957) wrote that the bush was frequently used to camouflage «certain necessary small buildings» at railway stations all over Norway! Also in Sweden the bush was frequently planted around railway stations and other railway buildings (Almquist 1928). Concerning birds, it has long been observed that a number of species feed on its red berries. Holmboe (1900) reported that the berries were successfully used as bait in thrush (*Turdus* sp.) traps, and Schuster (1930) listed 36 species of birds which have been observed to feed on the berries of *S. racemosa*. Meidell (1937) found seeds of *S. racemosa* in the stomachs of fieldfares (*Turdus pilaris* L.) and noted that they were all undamaged. It is therefore reasonable to conclude that the main factor in the naturalization of the species is birds. However, vegetative reproduction is quite successful, and may locally produce dense stands in cold areas where fertile specimens are absent (Conrad & McDonough 1972).

The range extension of *H. scutellaris*

H. scutellaris is found in Europe to East Siberia (Reitter 1919), but not, like its host plant, in the Nearctic region. Its range in Europe coincides with that of *S. racemosa* (Freude et al. 1967) (Fig. 1). Both organisms are thus rare in the warm lowland parts of Northern Central Europe. However, once this climatic barrier was crossed, the two species have obviously met excellent conditions in the cooler areas further north.

Fig. 1 shows the range extension of *H. scutellaris* in Scandinavia. It must be emphasized that the 10-year distribution fronts are approximations only, since the number of observations is few, and since the years of first captures are probably not identical with the years of colonization. However, several trends are apparent and will be discussed below.

H. scutellaris has obviously entered Scandinavia via two independent routes: to Finland across the Gulf of Finland or from the Leningrad area (Fig. 1, two arrows), and to Denmark from Schleswig-Holstein, Germany (Fig. 1, arrow). The distance across the Gulf of Finland seems short, but in the previous century *S. racemosa* was probably far more uncommon along the USSR coast than it is today (see discussion under *S. racemosa*). In Finland *H. scutellaris* ra-

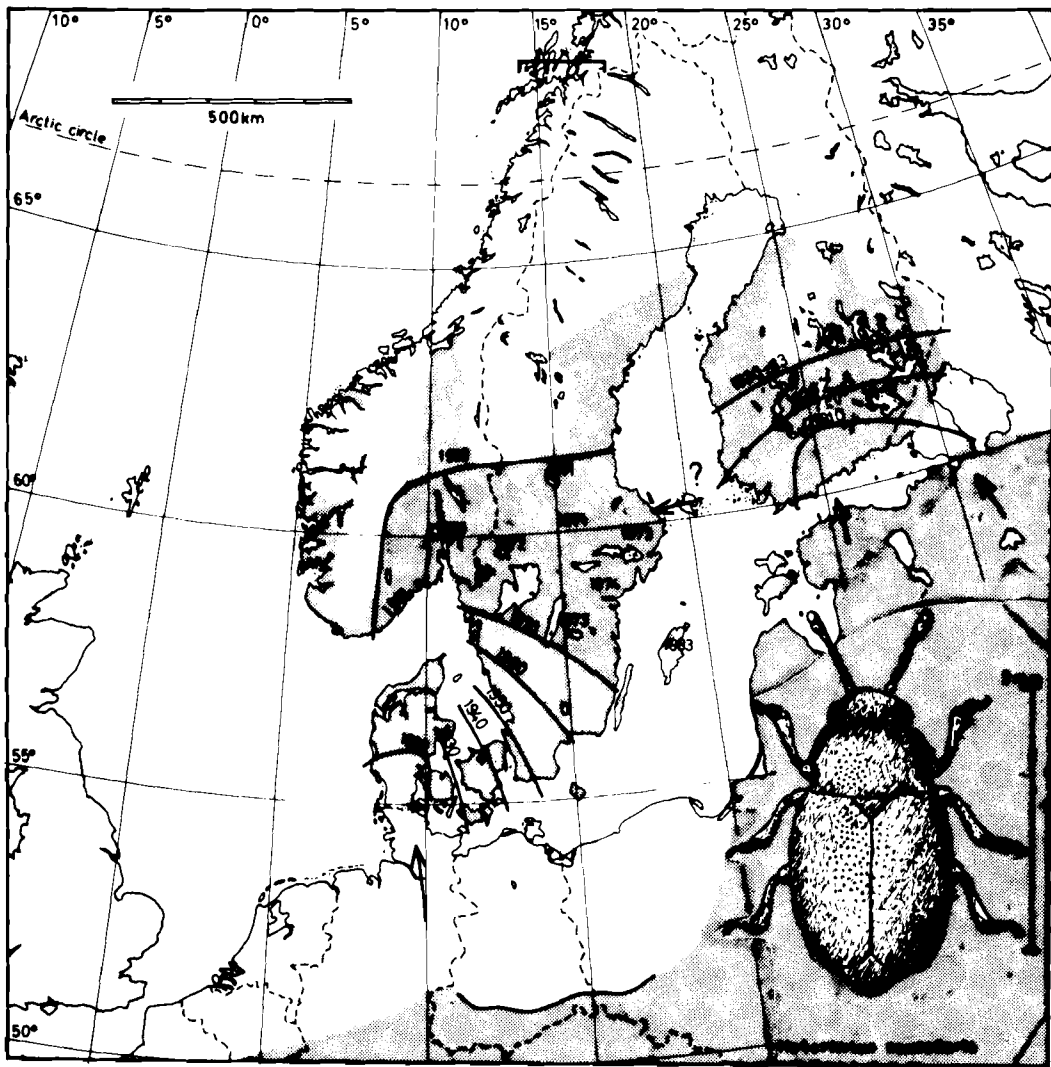


Fig. 1. The range extension of *H. scutellaris* in Scandinavia shown by approximate 10-year distribution fronts. In some districts of Central Sweden and South-Eastern Norway the years of first captures are indicated. Arrows (\rightarrow) indicate plausible routes of invasion. Shaded areas (\blacksquare) show the distribution of *S. racemosa* in Northern Europe according to the map by Hultén (1971), and in Central Europe, where limited by a solid line (—), according to the map by Waldenburg (1934), while the remaining southern areas are drawn approximately according to text information from Tutin et al. (1976). The bush is not a native of Great Britain.

According to R. Elven (pers. comm.), the shaded areas show the distribution of fertile *S. racemosa*, while vegetatively reproducing specimens in Norway may be found north to the solid line with vertical

bars (┆┆┆). The distribution of *S. racemosa* along the USSR coast of the Baltic is, according to Hultén (1971), a result of recent cultivation, and the bush is still scattered from Lake Peipus (between the two arrows) and eastwards.

pidly spread towards the north, apparently with a speed of 5–10 km a year, until the thirties when expansion seems to have ceased around 62.5°N. However, this should not be taken for granted until northern Finland is more closely investigated. In Denmark the species has expanded at approximately the same speed as in Finland, 6–10 km a year. In the mid-forties it spread from Denmark to Sweden and continued

to disperse north and east. The speed of dispersal seems to have increased during the last decades. During the seventies several specimens were found in Central Sweden, and the species was obviously well established in Dir as early as 1971. The dispersal from Southern Sweden may thus have been faster than the distribution fronts indicate. Similarly, that the beetle was common in all South-Eastern Norway when it was first actively searched for, strongly indicates that it had been present for several years prior to its discovery. Another explanation of the apparent rapid expansion in Sweden may be that the Finnish population has spread across the Gulf of Bothnia via the Åland archipelago (Fig. 1, arrow with ?). However, no records of the beetle from these islands exist, although this may be due to insufficient searching. It must be once more remembered that observations are too few and casual to allow any exact interpretation.

Human introduction of *H. scutellaris* should not be completely ruled out. If young seedlings of *S. racemosa* were introduced, the beetle, which pupates and hibernates below the bushes, may have followed in the soil. According to Hansell (1969), new bushes even grow from pieces of root which have been thrown away. However, since the species is a good flier, and since it has entered the southern areas first, it most likely has dispersed naturally with the wind.

For permanent colonization to be successful, the chance of finding a favourable site for reproduction must be greater than the risk of extinction. The establishment of *H. scutellaris* in Scandinavia was probably first possible when *S. racemosa* had reached a certain critical density level, which may explain the time lag between the initial naturalization of the plant and the arrival of the beetle. Thus, the results above indicate that such a level was reached somewhere between 50 and 100 years after the naturalization of the bush had started.

At present the Scandinavian distribution of *H. scutellaris* has reached about 300 km south of the northern distribution limit of *S. racemosa* (Fig. 1). The latter limit, which is taken from Hultén (1971), seems to apply to fertile bushes. Non-reproductive bushes may be found up to 69°N latitude (Reidar Elven, pers.comm.), but these are of course useless to the pollen-feeding beetle.

It will be interesting to see how far the beetle will extend its range, i.e. whether the climatic tolerance of the beetle will allow it to invade the entire range of its host plant or not. The species should be looked for up to 65°N latitude, or

even further north if flowering bushes of *S. racemosa* are found in spring. The species should also be expected to colonize the coastal districts of Western Norway, where *S. racemosa* is common. However, the high mountains may represent a geographical barrier that will retard dispersal.

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A check-list of¹ Norwegian blow-flies (Dipt., Calliphoridae)

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Calliphorid material from Norway in the museum collections of the Universities in Bergen, Oslo, Trondheim and Tromsø and in my own collection has been revised and a check-list of the 39 species known at present from Norway is presented. *Pollenia obscura* Bigot, 1888, preoccupied in *Pollenia* by *Musca obscura* Fabricius, 1794, is redescribed and removed from the synonymy of *Pollenia rudis* (Fabricius, 1794); *pseudorudis* nom.nov. is proposed as a replacement name.

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The check-list presented below, which replaces previously published lists (Siebke 1877, Schøyen 1889, Bidentkap 1892, 1901, Ringdahl 1944a, 1944b, 1952) is based upon a revision of the blow-fly material from Norway in the museum collections of the Universities in Bergen (mainly O. Bidentkap, L. Greve, A. Løken, N. Knaben, T.R. Nielsen leg.), Oslo (mainly J. Knaben, J.H.S. Siebke leg.), Tromsø (mainly T. Soot-Ryen leg.) and Trondheim (DKNVS-Museet) (mainly J.O. Solem leg.) (about 1820 specimens) and in my own collection (about 2500 specimens). In addition a few small private collections have been examined (B. Sagvolden, Rollag, J.H. Simonsen, Oslo). I have only seen parts of the V. Storm collection in Trondheim revised by Ringdahl (1944a). I have examined specimens from Norway of all the species listed. Ringdahl (1944b, 1952) listed 18 species from Norway. Ardö (1957) added 1 and Rognes (1980, 1982, 1983a, 1985) 9 bringing the total to 28 species. The present revision lists 39 species from Norway. In comparison it may be noted that 20 species have been published from Denmark (Lundbeck 1927), 34 from Finland (Hackman 1980), 32 from Sweden (Ringdahl 1952) and 33 from the British Isles (Pont 1975). Note that *Helicobosca palpalis*, treated as a tachinid or sarcophagid by the cited authors, is not included in these numbers.

Four subfamilies are represented in the Nor-

wegian calliphorid fauna. The nomenclature adopted is based on Zumpt (1956), Peus (1960) and Schumann (1964, 1973a, 1973b, 1974). Synonyms have mostly been taken from Aubertin (1933), Ringdahl (1945), Zumpt (1956), Peus (1960), Schumann (1964, 1973b, 1974), Pont (1981) and Rognes (1983b, 1985 and in press). Generic synonyms have been cited when the type-species is on the list (as valid name or synonym), specific synonyms when based on type-specimens from Scandinavian type-localities, when being the basis for cited genus names or when commonly met with in literature dealing with the Scandinavian fauna.

Many of the currently used names are unfortunately preoccupied and name-changes are to be expected in the future. I have mostly held on to established names, except in a few cases. Neither have I made any changes as to the currently recognised generic limits, even though a few changes appear quite justified and necessary. These are indicated in the annotations at the end of the paper.

In the list generic and specific synonyms are indented. Superscript numbers refer to the numbered annotations.

Family Calliphoridae

Subfamily Calliphorinae

Bellardia Robineau-Desvoidy, 1830
agilis (Meigen, 1826)¹
amplectens (Pandellé, 1896)
pusilla (Meigen, 1826)²

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aculeata (Pandellé, 1896)
zetterstedti (Enderlein, 1933)
stricta (Villeneuve, 1926)
unxia (Walker, 1849)
pandia (Walker, 1849)
biseta (Kramer, 1917)
Calliphora Robineau-Desvoidy, 1830
Acrophaga Brauer & Bergenstamm, 1891
Abonesia Villeneuve, 1927
Stobbeola Enderlein, 1933
genarum (Zetterstedt, 1838)
laticornis (Zetterstedt, 1838)
alpina (Zetterstedt, 1838)
loewi Enderlein, 1903
germanorum (Villeneuve, 1907)
stelviana (Brauer & Bergenstamm, 1891)
norwegica (Enderlein, 1933)
alpina: authors, not Zetterstedt (mis-
 identification)
subalpina (Ringdahl, 1931)
uralensis Villeneuve, 1922
vicina Robineau-Desvoidy, 1830
erythrocephala (Meigen, 1826), preocc.
vomitorea (Linnaeus, 1758)
Cynomya Robineau-Desvoidy, 1830
mortuorum (Linnaeus, 1758)
Lucilia Robineau-Desvoidy, 1830
Phaenicia Robineau-Desvoidy, 1863
BufoLucilia Townsend, 1919
Francilia Shannon, 1924
Acrophagella Ringdahl, 1942
bufonivora Moniez, 1876
caesar (Linnaeus, 1758)
cadaverina (Linnaeus, 1758)
splendida (Meigen, 1826)
fuscipalpis (Zetterstedt, 1845)
magnicornis (Siebke, 1863)
alaskensis (Shannon, 1924)
illustris (Meigen, 1826)
simulatrix (Pandellé, 1896)
regalis (Meigen, 1826)
longilobata (Pandellé, 1896)
richardsi Collin, 1926
sericata (Meigen, 1826)
silvarum (Meigen, 1826)
Melinda Robineau-Desvoidy, 1830
Xerophilophaga Enderlein, 1933
cognata (Meigen, 1830)
caerulea (Meigen, 1826), preocc.
anthracina (Meigen 1838)
gentilis Robineau-Desvoidy, 1830
Onesia Robineau-Desvoidy, 1830
Macrophallus Mueller, 1922
Macronesia Villeneuve, 1926
sepulcralis (Meigen, 1826)
subapennina Rondani, 1862

retrocurva (Pandellé, 1896)
Pseudonesia Villeneuve, 1920³
puberula (Zetterstedt, 1838)
pubicornis (Zetterstedt, 1838)
dolens (Zetterstedt, 1838)

Subfamily Helicoboscinae⁴

Helicobosca Bezzi, 1906⁴
Theria Robineau-Desvoidy, 1830, preocc.
palpalis (Robineau-Desvoidy, 1830)
distinguenda Villeneuve, 1924

Subfamily Phormiinae

Boreellus Aldrich & Shannon, 1923⁵
atriceps (Zetterstedt, 1845)
boganidae (Erichson, 1851)
aristatus Aldrich & Shannon, 1923
Protocalliphora Hough, 1899
Avihospita Hendel, 1901
Orneocalliphora Peus, 1960
azurea (Fallén, 1817)
sordida (Zetterstedt, 1838)
chrysorrhoea (Meigen, 1826)
nuortevai Grunin, 1972
proxima Grunin, 1966
Protophormia Townsend, 1908⁵
terraenovae (Robineau-Desvoidy, 1830)
groenlandica (Zetterstedt, 1838)
Trypocalliphora Peus, 1960
braueri (Hendel, 1901)
hirudo (Shannon & Dobroscky, 1924)
lindneri Peus, 1960

Subfamily Polleniinae

Pollenia Robineau-Desvoidy, 1830
angustigena Wainwright, 1940⁶
griseotomentosa (Jacentkovsky, 1944)⁷
varia: Wainwright 1932, Emden 1954,
 not Meigen (misidentification)
intermedia Macquart, 1835
nitens (Zetterstedt, 1845)⁸
vespillo: authors, not Fabricius (mis-
 identification)
pseudorudis nom.nov.⁹
obscura Bigot, 1888, preocc., stat.n.
rudis (Fabricius, 1794)¹⁰
obscura (Fabricius, 1794)¹¹
vagabunda (Meigen, 1824)

Annotations

- (1) *Bellardia agilis* (Meigen). *Musca agilis* Meigen, 1826 is a junior primary homonym of *Musca agilis* Harris, 1780 (Tachinidae) (Crosskey 1975)
- (2) *Bellardia pusilla* (Meigen). *Musca pusilla* Meigen, 1826 is a junior primary homonym of *Musca pusilla* Gmelin, 1790 (Syrphidae).
- (3) *Pseudonesia* (monotypic) should be included in *Bellardia* by virtue of phallosome and ovipositor structure as well as external features, according to own observations.
- (4) My reasons for treating *Helicobosca* as a calliphorid rather than a paramacronychine (agriine) sarcophagid as done by e.g. Verves (1980, 1982) and for assigning it to a separate subfamily will be given in a forthcoming paper.
- (5) The monotypic genera *Boreellus* and *Protophormia* should probably be merged. Rognes (1985) cites a number of synapomorphies common only to these genera, and Collin (1925), Rodendorf (1926) and Séguy (1928) regard the constituent species as congeneric.
- (6) Contrary to Wainwright (1940) and Pont (1975) I regard *angustigena* as a good species, not merely a subspecies of *rudis*. I do not accept the synonymisation made by Zumpt (1955, 1956).
- (7) British material of «*varia*» agrees very well with Zumpt's (1956) and Mihályi's (1976) descriptions of *griseotomentosa*. The terminalia of British and Norwegian material also agree with Mihályi's (1979) figures. Mihályi (1976) describes the basicosta as black, but not all the specimens I have seen are that dark. This feature varies. Neither Wainwright (1932, 1940), Emden (1954) nor Mihályi (1976, 1979) refer to the single *ph* seta (outer one lacking), an apparently constant feature of this species.
- (8) *Pollenia nitens* (Zetterstedt). Zetterstedt (1845:1340) cites Meigen to the effect that Meigen's *Musca sepulcralis* (a species with yellow palpi) according to Wiedemann is present in Fabricius' collection under the name *Musca vespillo*. He also points out that Fabricius' older name *vespillo* should be used for this species and not for the *Pollenia* species with black palpi and shining blackish abdomen to which the name *vespillo* was erroneously assigned by Meigen (and subsequently by most modern authors, e.g. Zumpt 1956 and Mihályi 1979) and for which Zetterstedt introduced the name *Musca nitens*. The two specimens (probably syntypes) of *Musca vespillo* Fabricius, 1794 present in Fabricius' collection (the Kiel collection) (cf. Zimsen 1964) in fact both belong in *Bellardia* according to own observations, and the correctness of Zetterstedt's view is thus confirmed. Unfortunately *Musca nitens* Zetterstedt, 1845 is a junior primary homonym of *Musca nitens* de Villers, 1789 (Syrphidae).
- (9) Among *Pollenia* material from Europe, North America and even New Zealand I have seen numerous specimens belonging to an hitherto unrecognised species. It runs to *rudis* in Mihályi's key (1976), but is easily distinguished from both *rudis* and *angustigena* (not considered by Mihályi) in both sexes by the presence of a bundle of pale hairs on the underside of the wing at the junction of *h* and *sc*. The male can also be recognised by the absence on the middle third of the hind tibia of any erect *av* hairs, only normal decumbent setulae are present besides the *av* setae. In *rudis* males there are numerous erect longish *av* hairs in addition to the *av* setae (usually less conspicuous in *angustigena*). Neither is the ventral vestiture of the male abdominal tergites in any way as dense and fine as in *rudis* males, but rather similar to the one present dorsally (as in *angustigena*). There are also constant and distinct differences in the structure of the distiphallus from both *rudis* and *angustigena*. I have recently been able to examine the ♂ holotype of *Pollenia obscura* Bigot, 1888: 597 from «Amér. septentr.» (in BMNH, London). It belongs to the present taxon. Bigot's name, treated as a synonym of *rudis* by Hall (1965), is a junior secondary homonym, preoccupied in *Pollenia* by *Musca obscura* Fabricius, 1794. I have used the proposed replacement name on determination labels in various collections.
- (10) Nothing but an empty pin carrying a label reading «*rudis*» in Fabricius' hand remains of the holotype of *Musca rudis* Fabricius, 1794: 314 in the Kiel collection in ZM Copenhagen. A neotype corresponding to the concept of *rudis* of Wainwright (1940) (very tight ventral abdominal vestiture of male, cf. above note 9) should be designated.

(11) I have recently examined the ♂ holotype of *Musca obscura* Fabricius, 1794: 315 in the Kiel collection in ZM Copenhagen. It lacks the head and all legs. It clearly belongs to *rudis* in the sense of Wainwright (1940).

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A check-list of Norwegian Fanniidae (Diptera)¹

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Fanniid material from Norway in the museum collections of the Universities in Bergen, Oslo and Tromsø and in my own collection has been revised and a check-list of 42 species of *Fannia* Robineau-Desvoidy known at present from Norway is presented. *Fannia bigelowi* Chillcott, 1961 is recorded from the Palaearctic Region for the first time.

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The check-list of Fanniidae presented below is based upon material from Norway in the museum collections of the Universities in Bergen (mainly O. Bidentkap, A. Fjellberg, L. Greve, A. Løken, N. Knaben, T.R. Nielsen leg.), Oslo (mainly J. Knaben, R. Krogerus and J.H.S. Siebke leg.) and Tromsø (mainly O. Ringdahl, T. Soot-Ryen leg.) about 700 specimens) and in my own collection (about 800 specimens). In addition a few specimens in the private collections of K. Berggren, B. Sagvolden and J.H. Simonsen have been examined. I have not seen the V. Storm collection in Trondheim revised by Ringdahl (1944a). Some unidentified material collected by P. Ardö, H. Andersson and R. Dahl in Northern Norway has also been examined (material in Lund). I have examined specimens from Norway of all the species listed except 2. My reasons for listing these are given in the annotations at the end of the list.

Ringdahl (1952) listed 21 species of Fanniidae from Norway, but did not include *Fannia norvegica* described from Tromsø (Ringdahl 1934). His list summarised previous work into the Norwegian fauna (Ringdahl 1928, 1944a, 1944b) and unpublished examination of parts of the Oslo collection. Ringdahl (1954) added 1 species and Rognes (1982) 1, bringing the total number known from Norway to 24. The present revision lists 42 species from Norway. In comparison it may be noted that 39 species have been published from Finland (Hackman 1980), 50 species from Sweden (Ringdahl 1952, Rognes 1982) and 60 species from the British Isles (Pont

1975, 1983). Undoubtedly many species still await discovery in Norway.

The nomenclature used follows the one of A.C. Pont in his Fanniidae contribution for the forthcoming Catalogue of Palaearctic Diptera (editor A. Sóos, Budapest). Specific synonyms have been included when based on type-specimens from Scandinavian localities, or when necessary for species recognition. In the list all synonyms have been indented relative to valid names. Superscript numbers refer to annotations at the end of the list.

Family Fanniidae

- Fannia* Robineau-Desvoidy, 1830
- Homalomyia* Bouché, 1834
- Coelomyia* Haliday in Westwood, 1840
- Ivalomyia* Tiensuu, 1938
 - armata* (Meigen, 1826)
 - atra* (Stein, 1895)
 - bigelowi* Chillcott, 1961¹
 - canicularis* (Linnaeus, 1761)
 - lateralis* (Linnaeus, 1758) (suppressed)
 - carbonaria* (Meigen, 1826)
 - carbonella* (Stein, 1895)
 - coracina* (Loew, 1873)
 - corvina* (Verrall, 1892)
 - halterata* Ringdahl, 1918
 - cothurnata* (Loew, 1873)²
 - difficilis* (Stein, 1895)
 - fuscata* (Fallén, 1825)
 - genualis* (Stein, 1895)
 - glaucescens* (Zetterstedt, 1845)
 - hirticeps* (Stein, 1892)
 - incisurata* (Zetterstedt, 1838)
 - impura* (Zetterstedt, 1838)
 - lepida* (Wiedemann, 1817)

1) Paper no. 3 in a series based on investigations financed by a grant («vikarstipend») from Stavanger Lærerhøgskole 1982–1983.

lugens (Zetterstedt, 1845)
mutica (Zetterstedt, 1845)
limbata (Tiensuu, 1938)
lugubrina (Zetterstedt, 1838)
albinervis (Zetterstedt, 1845)
lustrator (Harris, 1780)
hamata (Macquart, 1835)
viduata (Zetterstedt, 1845)
zetterstedti (Bidenkap, 1892)
manicata (Meigen, 1826)
armillata (Zetterstedt, 1838)
melania (Dufour, 1839)
ciliata (Stein, 1895)
minutipalpis (Stein, 1895)
molissima (Haliday in Westwood, 1840)
spathulata (Zetterstedt, 1845)
faroensis (Lyneborg, 1962)
monilis (Haliday, 1838)
norvegica Ringdahl, 1934³
pallitibia (Rondani, 1866)
parva (Stein, 1895)
polychaeta (Stein, 1895)
postica (Stein, 1895)
parapostica Hennig, 1955
posticaria d'Assis Fonseca, 1968 (unavailable)
posticata (Meigen, 1826)
pretiosa (Schiner, 1862)
rondanii (Strobl, 1893)
aerea: authors, not Fallén (misidentification)
scalaris (Fabricius, 1794)
serena (Fallén, 1825)
similis (Stein, 1895)
sociella (Zetterstedt, 1845)
spathiophora Malloch, 1918
nodulosa Ringdahl, 1926
stigi Rognes, 1982
subatripes d'Assis-Fonseca, 1967
subpellucens (Zetterstedt, 1845)
tuberculata (Zetterstedt, 1849)
umbrosa (Stein, 1895)
subumbrosa Ringdahl, 1934
verralli (Stein, 1895)

Annotations

- (1) *Fannia bigelowi* Chillcott, 1961. There are two specimens in the Oslo collection: Oppland, ON, Sel: Lårgård 1 ♂ 27 June 1861 (Siebke) (ZMO no. 8395) and ON, Dovre: Fokstua 1 ♂ 17 July 1953 (Krogerus) (ZMO no. 10272), both EIS 71. These are the first ones recorded from the Palaearctic Region.

I have compared the specimens with Nearctic material (including 2 ♂ ♂ paratypes) in the CNC, Ottawa. The cercal plate which is illustrated by Chillcott (1961) is very characteristic. The Norwegian specimens and the paratypes examined lack postoccipital setulae in the upper part of the occiput.

- (2) *Fannia cothurnata* Loew, 1873. Not seen. Included on the basis of record in Ringdahl (1928:26, «Von Strand bei Lødingen gefunden. Bisher nicht mit sicherheit anderswo in Skandinavien gefunden.»). Ringdahl may not have seen Strand's specimen(s), but Strand (1906:104) reports the identification to have been made by P. Stein.
- (3) *Fannia norvegica* Ringdahl, 1934. Not seen. Holotype ♂ taken at Tromsø, Northern Norway, 10 July 1926 (Ringdahl 1934).

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I would like to thank L. Greve Jensen, Museum of Zoology, Bergen, J.E. Raastad, Museum of Zoology, Oslo and A. Fjellberg, Tromsø Museum, for having made the collections of calyptrate Diptera in their care available to me; A.C. Pont, London, for most generously having put his ms copy of his Fanniidae contribution for the Catalogue of Palaearctic Diptera at my disposal and for having checked some of my identifications; J.R. Vockeroth, Ottawa, for the loan of material in the CNC; K. Berggren, B. Sagvolden and J.H. Simonsen for letting me see their collections; and to B. Borgersen, T. Jonassen, F. Midtgaard, T.R. Nielsen, A.-J. Nilsen and S. Svendsen for gift of specimens. The grant from Stavanger Lærerhøgskole 1982—1983 is gratefully acknowledged.

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Additions to the Norwegian fauna of Dolichopodidae (Dipt.)

TERJE JONASSEN

Jonassen, T. 1985. Additions to the Norwegian fauna of Dolichopodidae (Dipt.). *Fauna norv. Ser. B*, 32, 97–99.

Fourteen species of Dolichopodidae are reported from Norway probably for the first time.

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INTRODUCTION

When Siebke published his *Enumeratio Insectorum Norvegicorum*, Fasc. IV in 1877, he listed 108 species of the family Dolichopodidae as part of the Norwegian fauna. Discounting the obvious errors of Siebke's list, e.g. his description of conspecific males and females under different names, the total number will be reduced to about one hundred. Nevertheless, Siebke's collection still make up the great bulk of the known Norwegian material of Dolichopodidae, new records have been few and scattered. However, species new to the Norwegian fauna were added by Schøyen (1889) — 1 sp., Bidenkap (1901) — 1 sp., Frey (1914) — 2 spp., Ringdahl (1928, 1954) — 8 spp., Thuneberg (1955) — 1 sp. and Hedström (1975) — 1 sp.

Below, 14 species of Dolichopodidae are reported from Norway probably for the first time. The material for this report has been collected by the author and is deposited in the author's collection, when nothing else is mentioned. The methods of collecting have been the same as specified in Jonassen (1984).

The arrangement of subfamilies and sequence of species largely follow C.E. Dytte's list in Kloet and Hincks (1975).

The geographical division of the districts follows Økland (1981).

SYSTEMATIC LIST

Subfamily Dolichopodinae

Dolichopus acuticornis Wiedemann, 1817

RY, Hå: Brusand, EIS 3, 4 ♂♂, 7 ♀♀ 7 July 1982. A typical sea coast species. These specimens were captured among low herbage between dunes on a dry, sandy beach.

Dolichopus atripes Meigen, 1824

RI, Forsand: Røssdalen, EIS 7, 1 ♂ 26 June 1982; Songesand, EIS 7, 1 ♀ 18 July 1984; Daladalen, EIS 8, 1 ♂ 26–27 July 1984.

Dolichopus caligatus Wahlberg, 1850

RI, Forsand: Helmikstøl, EIS 8, 1 ♂ 5 August 1982. An uncommon species with a sparse distribution in northern Europe. This specimen was captured among marsh vegetation. Later searches for this particular species at the same location have proved fruitless.

Dolichopus wahlbergi Zetterstedt, 1843

RY, Sandnes: Gravaren, EIS 7, 2 ♂♂, 1 ♀ 30 July 1982. The specimens were taken among shady foliage in a small deciduous wood growing on clayey soil.

Hercostomus cupreus (Fallén, 1823)

RY, Sandnes: Høle, EIS 7, 1 ♂, 2 ♀♀ 20 June 1981, 1 ♂ 4 June 1982; Ims, EIS 7, 1 ♀ 4 June 1982; Dale, EIS 7, 2 ♂♂ 9 June 1982; Melshei, EIS 7, 1 ♀ 14 June 1982; Klepp: Øksnevad, EIS 7, 1 ♀ 15 June 1982; Stavanger: Madlaforen, EIS 7, 1 ♂ 4 July 1981, K. Rognes; Rennesøy: Vikevåg, EIS 14, 1 ♂ 24 May 1981, 2 ♂♂, 1 ♀ 30 May 1981, 6 ♂♂, 4 ♀♀ 10 June 1982; Morkavatn, EIS 14, 1 ♀ 11 June 1982; Førsvoll, EIS 14, 1 ♂ 11 June 1982; RI, Forsand: Songesand, EIS 7, 1 ♂, 1 ♀ 14 June 1981, 1 ♀ 13 June 1981, 1 ♂ 19 June 1983, 1 ♂ 29 June 1983; Røssdalen, EIS 7, 2 ♂♂ 26 June 1982. Males are easily recognized because of the particular thickening and chaetotaxy of the mid tibia. This is one of the most common *Hercostomus* species in Rogaland.

Hercostomus nigrilamellatus (Macquart, 1827)

VAY, Vennessla: Frikstad, EIS 5, 1 ♂ 21 June 1983, B. Borgersen. This specimen was found in a hollow ash (*Fraxinus excelsior* L.).

According to the collector, Mr. Bjørnar Borgersen (in litt.), the fly was probably reared in this said hollow, since it appeared among the sieved detritus from the cavity of the tree, and because the specimen was immature.

Hypophyllus obscurellus (Fallén, 1823)

RY, Rennesøy: Vikevåg, EIS 14, 1 ♂ 6 September 1981, 5 ♂♂, 3 ♀♀ 25 July 1982, 1 ♂, 1 ♀ 26 August 1983. All specimens were captured on a wet, vertical rock close to a water-fall.

Subfamily Hydrophorinae

Hydrophorus albiceps Frey, 1915

RY, Rennesøy: Sel, EIS 14, 1 ♀ 18 April 1982; RI, Forsand: Songesand, EIS 7, 1 ♂ 22 August 1981, 3 ♀♀ 26 March 1983; Songesandstølen, EIS 7, 2 ♂♂ 20 August 1982; Helmikstøl, EIS 8, 1 ♂, 1 ♀ 5 August 1982, 3 ♂♂, 1 ♀ 5 September 1982. Even though this species has not been mentioned in previous Norwegian records, it is highly probably that an examination of Siebke's collection in ZMO will yield some specimens of this species among those determined by him as *Hydrophorus bipunctatus* Lehmann or *H. binotatus* Fallén.

Subfamily Mediterinae

Medetera excellens Frey, 1909

RI, Forsand: Songesand, EIS 7, 2 ♂♂ 14 August 1982. A rather rare species, described from Finnish specimens. Elsewhere it seems to be known only from 2 localities in Sweden (Ringdahl 1951), 3 Scottish specimens (Fonseca 1978), from East Germany and from the Leningrad area in the Soviet Union (Negrobov & Stackelberg (1972)).

Medetera fasciata Frey, 1915

RI, Forsand: Songesand, EIS 7, 1 ♂ 16 May 1983; 1 ♂ 4 June 1983, 2 ♂♂, 1 ♂ ♀ (in copula) 19 June 1983. These are the westernmost finds of this species from the Palaearctic region. Previously known from Sweden, Finland and the USSR (Negrobov & Stackelberg 1972). The genitalia have been dissected in four of the male specimens, and they all agree with the figures given by Negrobov & Stackelberg (1974).

Medetera infumata Loew, 1857

RY, Sandnes: Ims, EIS 7, 1 ♀ 4 June 1982; Melshei, EIS 7, 1 ♂, 1 ♀ 14 June 1982, 1 ♀ 6 July 1982; Strand: towards Prekestolen, EIS

7, 1 ♀ 20 June 1981, K. Rognes; Klepp: Øksnevad, EIS 7, 1 ♂ 15 June 1982; RI, Forsand: Songesand, EIS 7, 1 ♂ 19 June 1983, 1 ♂ 20 June 1983. An examination of the specimens under the name *Hydrophorus* (= *Medetera*) *muralis* Meigen, 1824 in the still existing parts of Siebke's collection in ZMO, will possibly yield some *infumata*. The genitalia of the four males in my collection have been dissected and agree with the figures given by Negrobov & Stackelberg (1974).

Subfamily Neurigoninae

Neurigona quadrifasciata (Fabricius, 1781)

OS, Sør-Fron: Harpefoss, EIS 62, 1 ♀ 16 July 1982, Ø. & K. Rognes.

Subfamily Campsinceminae

Campsincemus (Ectomus) alpinus (Haliday, 1833)

RI, Forsand: Songesandstølen, EIS 7, 1 ♀ 20 August 1982, 1 ♂ 30–31 July 1984.

Chrysotimus concinnus (Zetterstedt, 1843)

RY, Rennesøy: Vikevåg, EIS 14, 2 ♂♂, 1 ♀ 13 July 1982, 1 ♂ 14 July 1982, 1 ♀ 15 July 1982. The species occurred in numbers among sun-exposed deciduous trees and lower herbage during the short period which the above dates indicate. A rather uncommon species with a sparse Scandinavian distribution.

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Distribution and food habits of mayflies (Ephemeroptera) in streams in the Dovrefjell mountains, Central Norway

TERJE NÖST

Nöst, T. 1985. Distribution and food habits of mayflies (Ephemeroptera) in streams in the Dovrefjell mountains, Central Norway. *Fauna norv. Ser. B.* 32, 100–105.

Mayflies dominated the lotic communities in the subalpine and low alpine zones, although there was a marked decrease in number of individuals and species with increasing altitude. *Baetis rhodani* was the dominant species. Mayflies were absent above the low alpine zone. All species were herbivorous, feeding on ultrafine particulate organic matter (UPOM) in the subalpine and shifting to a mixture of algae and UPOM in the low alpine. This change in the diet is discussed in relation to available food items and their nutritive value. The results indicate that temperature rather than food resources is the major factor determining distribution of mayflies in the area.

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INTRODUCTION

During the last two decades a number of studies have been made on Norwegian Ephemeroptera from lotic habitats. The studies have focused mainly on distribution and relatively few have included ecological aspects, although papers by Elliott (1965), Larsen (1968), Steine (1972), Brittain (1975), Lillehammer & Brittain (1978), Bækken (1981), Raddum & Fjellheim (1982) should be mentioned. The aim of this paper was to compare the distribution of mayfly species and their feeding habits in the subalpine, low alpine and mid-alpine zones in the Dovrefjell mountains. Previously, only Lillehammer & Brittain (1978) have studied the vertical zonation of mayflies in Norway. Bækken (1981) examined food habits of *Baetis rhodani* Pictet, but the specimens were all sampled from the subalpine.

Several authors (e.g. Gledhill 1960, Egglis-haw 1969, Minshall & Kuehne 1969, Woodall & Wallace 1972, Allan 1975, Stoneburner 1977, Rabeni & Minshall 1977, Lillehammer & Brittain 1978, Macan 1980, Raddum & Fjellheim 1982) have investigated distribution of mayflies in lotic habitats. Factors considered important for their available food distribution are: latitude, altitude, allochthonous material, water chemistry, temperature and substrate.

Mayflies are largely herbivorous, although a few are omnivorous (Brittain 1982).

STUDY AREA

The Dovrefjell mountains (Fig. 1) in Central Norway cover about 1 100 km² with altitudes ranging from about 500 m up to 2 200 m a.s.l. The geology is rather complex because two large regions within the southern Scandinavian Caledonids meet in this area. The border approximately follows the river Driva. The western side of the valley have Precambrium high-grade gneisses and schists, the eastern side Cambro-silurian medium-grade mica schists and greenstones.

The climate of the area is rather continental, the central parts having an annual precipitation of 473 mm (Kongsvoll 900 m a.s.l.). The annual mean temperature is -0.1°C (Hjerkinn 959 m a.s.l.) and only 19 days a year have daily mean temperature above 10°C (Nordhagen 1943). The subalpine zone reaches an elevation of 1 000–1 100 m a.s.l. The border between low alpine and mid-alpine zones is about 1 300–1 450 m a.s.l. (Gjærevoll 1975).

The investigation was carried out in the river Driva and the watershed of its large tributaries, the streams Åmotselva, Grövu and Vinstra. Driva, Åmotselva and Grövu originate in the mid-alpine zone, while Vinstra originates in the low alpine zone. The streams are relatively fast flowing, but the upper parts of Åmotselva and a few sampling sites in the subalpine zone in Grövu, have stretches more lentic in character.

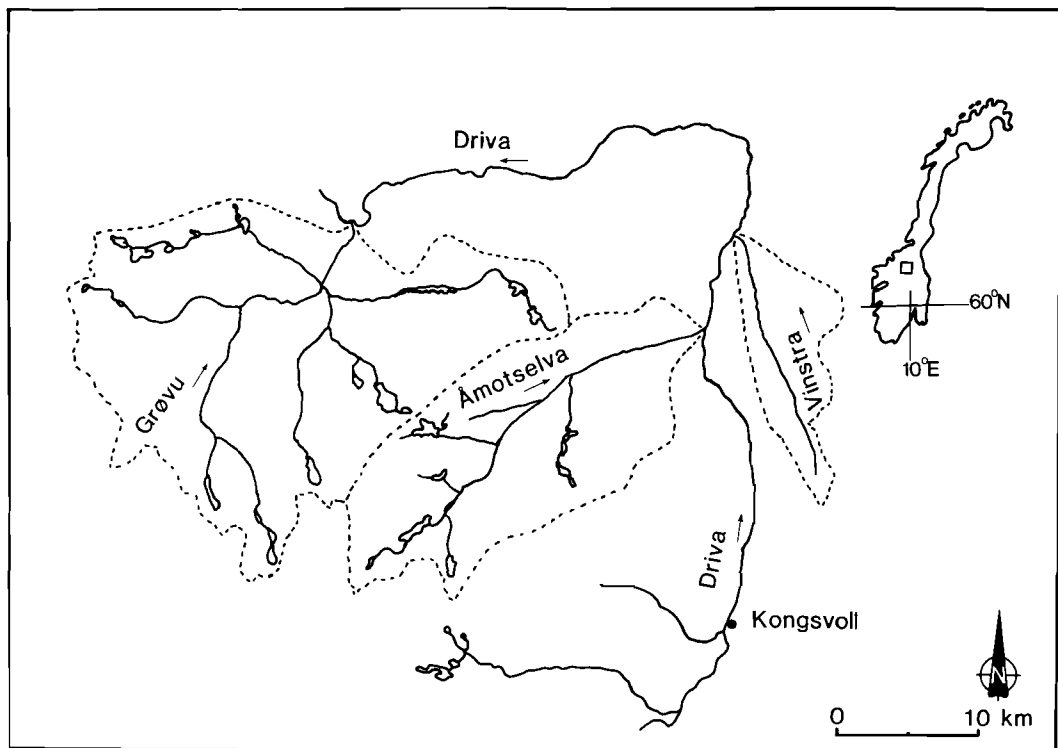


Fig. 1. The Dovrefjell mountain area, the main rivers and tributaries (watershed marked).

A few samples were also taken at outlets of lakes in the Grøvu system.

Allochthonous organic matter appeared to be much more abundant in the subalpine than the low and mid-alpine zones. No obvious decrease in amounts of algae towards higher altitudes was apparent.

The range in chemical parameters was: pH 6.4–7.3, Ca^{++} 0.5–13.5 mg l^{-1} , K_{18} 5–87 μmhos (Nöst 1981). Water temperatures rarely exceeded 10°C in the lower parts and 3–5°C in the highest located sites.

MATERIAL AND METHODS

Nymphs of mayflies were collected mainly from June to August 1979 and 1980, but a few samples were also taken in July 1984. A total of 17 548 nymphs were sampled using the kick method (Frost et al. 1971). The mesh size of the net used was 0.5 mm. At 54 sites 89 samples each covering 5 min. of sampling time were taken. The samples were fixed in 70% ethanol.

The food habits of the nymphs were determined by stomach analysis based on techniques described in Shapas & Hilsenhoff (1976). Foreguts of nymphs were removed and the contents were squeezed on to a glass slide and cleared in lactic acid. Five randomly chosen transects across the central portion of each mount were measured. Along the transects every food particle was counted and given an approximate percent by volume. The food particles were grouped into two main categories; 1. detritus and 2. algae. The classification of detritus was defined into fine particulate organic matter (FPOM 50 μm –1 mm) and ultrafine particulate organic matter (UPOM 0.5–50 μm) (Cummins & Klug 1979, Vannote et al. 1980). Algae were separated into diatoms and other algae. Food analysis was restricted to nymphs with wing pads moderately to nearly fully developed because of their dominance in the samples and their size.

The closely related species *Baetis fuscatulus/Baetis scambus* and *Baetis vernus/Baetis subalpinus* are difficult to separate in nymphal stage, and they were treated as «single» species.

Table 1. Occurrence and relative abundance (%) of ephemeropteran species in the subalpine and low alpine zones in the main watercourses

	Driva		Åmotsetva		Grövu		Vinstra	
	subalpine	low alpine	subalpine	low alpine	subalpine	low alpine	subalpine	low alpine
<i>Ameletus inopinatus</i>	0.1		1.7	13.3	0.2		0.4	5.6
<i>Parametetus chelififer</i>					0.7			
<i>Siphonurus lacustris</i>				0.8	30.1	12.4		
<i>Baetis lapponicus</i>	0.9	0.2	25.8	14.9	0.7		23.0	29.7
<i>Baetis macani</i>			0.1	1.2		31.3		
<i>Baetis rhodani</i>	98.3	99.8	65.4	34.3	44.8	18.8	75.9	64.3
<i>Baetis fuscatus/scambus</i>	0.1				3.0			
<i>Baetis vernus/subalpinus</i>	0.3		6.6	34.3	15.4	37.5		
<i>Baetis</i> spp.				0.7	2.3			
<i>Heptagenia dalearlica</i>	< 0.1				1.9			
<i>Leptophlebia vespertina</i>				< 0.1	0.1			
<i>Ephemerella aurivillii</i>	0.3		0.3		0.8		0.7	0.5
Number of individuals	11912	1318	1215	756	1356	16	544	431
Number of samples	20	9	10	10	18	4	6	2

RESULTS

Distribution

Mayflies dominated the invertebrate fauna at all sites in the subalpine and low alpine zones. In the river Driva and the stream Grövu, there was a marked decrease in the importance of mayflies when going from the subalpine to the low alpine zone. The opposite trend was found in the stream Vinstra, as more suitable substratum for mayfly nymphs occurred at 1 000 m or higher elevations (Nöst 1981). The upper limit for the distribution of mayflies in this area is about 1 350 m a.s.l., which coincides with the border between low and mid-alpine zones.

Other aquatic invertebrates of importance in the streams were stonefly (Plecoptera) nymphs and Chironomidae larvae. The latter accounted for 80–90% of numbers in the lotic community of the mid-alpine.

Seven genera and a minimum of 11 species of mayflies were recorded (Tab. 1). All species occurred in the subalpine, but only seven representing four genera were present in the low alpine. *Baetis* was the dominant genus with at least five species in the subalpine and at least four in the low alpine. *B. rhodani* was the most abundant species sampled in Driva and Vinstra, and accounted for almost 100% of total mayfly numbers in Driva and 65–75% in Vinstra. In Åmotsetva and Grövu the dominance of *B. rhodani* was not so apparent and a marked decrease in its importance with altitude was found. In the low alpine *B. vernus/subalpinus* and *B. lapponicus* in Åmotsetva and *B. vernus/subalpinus* and

B. macani in Grövu, made up more than 50% of the mayfly nymphs. In each of the remaining six genera only one species was recorded. Two of these (*Ephemerella aurivillii* and *Ameletus inopinatus*) occurred at several sampling sites, the other at only a few. Except for *Siphonurus lacustris* which was collected in large numbers at one sampling site in the subalpine in Grövu, all the remaining species had low densities.

The highest number of specimens was recorded in the river Driva, while highest number of species was recorded in the stream Grövu.

Food habits

A total of 527 nymphs were analyzed for their food habits, all rivers at different elevation being represented.

In the subalpine zone the different mayfly species had very similar food habits (Tab. 2). All nymphs fed on detritus, primarily ultrafine particulate organic matter (UPOM). With a few exceptions UPOM accounted for 90% or more in volume of the ingested material. Fine particulate organic matter (FPOM) was eaten by 50% or more of the nymphs, except *B. rhodani* in which the equivalent value was only 30%. FPOM rarely made up more than 10% of the volume of the gut contents. Algae were consumed in small amounts by a few nymphs of *S. lacustris*, *B. lapponicus* and *B. vernus/subalpinus*. Diatoms and filamentous algae occurred in all species except *S. lacustris* in which only filamentous algae were found.

western Norway Raddum & Fjellheim (1982) showed *B. rhodani* to be absent at pH below 6.0. However, in the Dovrefjell mountains pH is always above this level (Nöst 1981) and pH is not therefore a limiting factor. The distribution of mayflies should therefore be considered in relation to food resources and temperature.

In the subalpine zone birch trees and dwarf willow (*Salix*) vegetation give rise to a considerable input of terrestrial organic matter to the streams. Here mayflies feed on detritus. Above the subalpine zone the allochthonous input is considerably reduced. This is especially obvious in the mid-alpine zone, in which no continuous plant cover exists. The high percentage of algae in the diet of mayflies in the low alpine zone is probably a result of the reduced input of terrestrial organic matter into streams, but may also indicate a need for food of high quality. Within the range of food available, there is evidence of selection, as growth of mayflies may be influenced by different foods (McCullough et al. 1979, Cianciara 1980). The high nutritive values of living algae was demonstrated by Cummins & Klug (1979), and they reported differences of several hundred Calories per gram between diatoms and detritus. Utilized energy bound up in algae may, however, differ, depending on species of algae and mayfly nymph (Brown 1960, 1961, Cianciara 1980). The fact that there was an abrupt shift in the food habits leads to the conclusion that algae are of high nutritive value for mayfly species in the area. However, despite there being no obvious reduction of algae in the streams at higher altitudes, there was a considerable decline in numbers of specimens of mayflies at higher altitudes. Laboratory studies have demonstrated that mayfly nymphs can feed on algae only (McCullough et al. 1979) and therefore this feature of distribution may be explained more by a decrease in temperature than reduced input of terrestrial organic matter. A decrease in temperature can influence both the length of life cycle of several species and the composition of mayfly communities (Brittain 1975, 1976, Stoneburner 1977, Humpesch 1979). According to Dahl (1957) the mean temperature in the Dovrefjell mountains in June—August decreases by 0.7°C per 100 m elevation.

Temperature seemed to be the most important factor determining the distribution of mayflies in the study area. However, the abrupt shift in the food habits above the tree line seemed to be related to the reduced input of terrestrial organic matter and the high nutritive values of stream algae.

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Short communications

ODONTOMYIA ARGENTATA (FABRICIUS, 1794) (DIPT., STRATIOMYIDAE) NEW TO THE NORWEGIAN FAUNA

LITA GREVE AND FRED MIDTGAARD

Odontomyia argentata (Fabricius, 1794) is reported new to the Norwegian fauna, and a short description of the locality is given.

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In connection with a study of the insect fauna of Ostøya in the Oslofjord, a large material of several orders has been collected. Light-traps, Malaise-traps and window-traps have been used through-out the summer seasons 1983 and -84. In addition some material were collected with insect-nets on visits of the area.

On AK Bærum: Ostøya (EIS:28) one female of *Odontomyia argentata* (Fabricius, 1794) was collected with a net on 31 May 1984. The specimen was caught sweep-netting on a small grassy meadow, near Oust gård, surrounded by a rich vegetation of smaller trees and herbs. Ostøya was also visited on 2 June, but no more specimens were found.

O. argentata has not earlier been reported from Norway (Rozkošný 1973). The species seems rare, but widespread in Sweden northwards to Uppland and Värmland (Rozkošný 1982). Only two specimens are known from Finland, the Helsingfors area, and in Denmark the species has been reported as very rare from Zealand, Lolland and Falster (Lundbeck 1907; Rozkošný 1982). Rozkošný (1982) also map the European distribution of the species.

Among the six species of *Odontomyia* recorded from Fennoscandia (Rozkošný 1973); only *O. hydroleon* (L.) and *O. microleon* (L.) are known from south-eastern Norway. *O. hydroleon* has the abdomen marked with a pattern of black and yellow or green, *O. microleon* has a shining black abdomen with a light yellow lateral markings. *O. argentata* has a dull dorsal part of abdomen in both males and females. The male *O. argentata* has the dorsal abdomen covered with silvery hairs, the female has transverse stripes of golden-grey adpressed hairs. The genitalia of all the three species are figured in Rozkošný (1973, 1982).

O. argentata is an early summer species and therefore might have been overlooked. Lundbeck (1907) reports the female to be sluggish while the males were fast fliers. The species has been collected on *Berberis*, *Crataegus* and *Salix cinerea* (Rozkošný 1982). *Berberis vulgaris* L. and *Salix cinerea* L. are common on Ostøya. *S. cinerea* has a distinct south-eastern distribution in Fennoscandia (Hultén 1971). The two other plants are more widespread. The larvae

has been reported from floodrefuse and in moist, rotting alder tree (*Alnus*) (Rozkošný 1973).

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BAETIS DIGITATUS BENGTSSON (EPHEMEROPTERA), A NEW MAYFLY SPECIES FOR NORWAY

JOHN E. BRITTAİN

Abstract

The mayfly *Baetis digitatus* is recorded from Norway for the first time. The nymphs of this species have been collected at several localities in the large lowland river, Drammenselva, and two of its tributaries, Snarumselva and Bingselva, in south-eastern Norway.

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In connection with pollution monitoring studies of the Drammenselva watercourse in south-eastern Norway (59°50'N, 9°55'E) several nymphal specimens of the mayfly *Baetis digitatus* Bengtsson, 1912, were taken both in the main river, Drammenselva, and in two tributary rivers, Snarumselva and Bingselva.

The main river, Drammenselva, has a total catchment area of 17 096 km² and a mean discharge of 330 m³ sec⁻¹. The present localities are situated in the lowest part of the catchment (Drammenselva) along a 46 km stretch of river which falls 63 m before it enters the Oslofjord at Drammen. Snarum-

selva and Bingselva have mean discharges of 110 and $2 \text{ m}^3 \text{ sec}^{-1}$, respectively. All the localities have a moderately strong current and a stony substratum, sometimes with patches of aquatic mosses. The following values indicate the range in mean chemical composition at the localities: pH 6.7–7.0; conductivity $1.9\text{--}3.8 \mu\text{S m}^{-1}$; total phosphorous $6.5\text{--}19.5 \mu\text{gP l}^{-1}$.

The exact localities, and the number of nymphs collected are: Drammenselva at Vikersund (UTM ref.: NM557481), 6 nymphs; Drammenselva below Embretsfoss (UTM ref.: NM518409), 57 nymphs; Drammenselva below Døvikfoss (UTM ref.: NM510392), 3 nymphs; Drammenselva at Hokksund (UTM ref.: NM509270), 2 nymphs; Drammenselva at Nedre Eiker (UTM ref.: NM594248), 2 nymphs; Snarumselva (UTM ref.: NM527446), 13 nymphs and Bingselva (UTM ref.: NM492341), 78 nymphs. The nymphs were collected in the months of April, May, July, October, November and December during 1982, 1983 and 1984.

B. digitatus is closely related to *B. niger* and both species were recorded from several of the above localities. However, the hind margin of the last nymphal gill of *B. digitatus* is concave in contrast to that of *B. niger* which is convex. There are also other differences, such as the number of bristles on the tip of the glossa and in the antennae and cerci which can be used to distinguish the two species (Müller-Liebenau 1969). The two lighter patches on the abdominal terga are also characteristic in older nymphs. The adults are more difficult to separate (Müller-Liebenau 1969).

B. digitatus has a wide, but very patchy and generally eastern distribution throughout much of Europe from the Balkans to Fennoscandia (Müller-Liebenau 1969, Putz, 1978). It was initially described from central Sweden early this century (Bengtsson 1912). Subsequent records include Austria and England (in Müller-Liebenau 1969), France (Müller-Liebenau 1974) Poland (Sowa 1975, Keffermüller 1978), Italy (Belfiore 1979), Finland (Savolainen & Saarisalo 1980) and Denmark (Jensen 1984).

On account of its rarity, *B. digitatus* is a poorly known species, although it has been collected in a range of habitats. It has been recorded from slow-flowing small streams and rivers rich in aquatic vegetation (Müller-Liebenau 1969, Sowa 1975) and from the sheltered parts of fast-flowing rivers (Savolainen & Saarisalo 1980). In Denmark and Sweden it has been found in the lower parts of large rivers (Jensen 1984). Its disappearance from known localities in Denmark during the last 20–30 years indicates its susceptibility to human activity.

The wide range in nymphal size at any given time within the Norwegian material suggests a long emergence period and/or overlapping cohorts, which is typical of many *Baetis* species (Clifford 1982). Nymphs were also recorded throughout most of the year, although from the few mature nymphs collected the emergence period is probably between May and August.

Almost half the Norwegian mayfly fauna, 19 species, has been recorded from Drammenselva and its two tributary rivers Snarumselva and Bingselva. This area appears to be the western limit for a number of mayfly species which have reached Norway from the east. These include *Hepatica joernensis* (Bengtsson), *Metretopus borealis* (Eaton) and *Ephemerella mucronata* (Bengtsson). *Baetis digitatus* may well belong to this faunal group, although its occurrence in south-western Sweden and Denmark make this uncertain.

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MACHIMUS INTERMEDIUS HOLMGREN IN ZETTERSTEDT, 1852 (DIPTERA, ASILIDAE) NEW TO NORWAY

FRED MIDTGAARD

Machimus intermedius Holmgren in Zetterstedt, 1852 is reported new to the Norwegian fauna, and a short review of its present status, and distribution is given.

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In the collection of Asilidae in the Zoological Museum of Oslo a female of *Machimus intermedius* Holmgren in Zetterstedt, 1852 was found. The specimen was labelled: «Kristiania, Esmark, *Machimus intermedius* Z. det. Soot-Ryen 1926 ♀». This species has not formerly been reported from Norway.

It was synonymized with *Machimus setibarbus* Loew, 1849 by Lyneborg (1968). *M. setibarbus* was assumed to have a very wide distribution from Scandinavia to the Mediterranean and east to Middle Asia. Examination of the genitalia of *M. intermedius* and specimens from various localities in the Mediterranean showed that they differ distinctly from the genitalia of *M. setibarbus* from the type locality (Asia Minor). There are apparently several species which have been identified as *M. setibarbus* in the past (Theodor 1980).

Because of the present uncertainty concerning the status of the taxa the best will be to use Holmgren's name to the Scandinavian specimens (Lyneborg, pers. com.).

Machimus intermedius was only known from Sweden, Finland and USSR. In Sweden it has been found in Östergötland, Södermanland, Öland and Skåne. From Finland a few specimens are known from the southern and eastern parts, and in USSR one specimen has been recorded from the Leningrad area (Lyneborg, 1968). The Norwegian find is the first outside the Baltic area.

Little is known about the biology, but Melin (1923) reports one find from a little gravel pit with small birches, ferns and grass, in the neighbourhood of a mixed coniferous forest.

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ATTAGENUS SMIRNOVI ZHANTIEV (COL., DERMESTIDAE) NEW TO NORWAY — A COMING INSECT PEST?

PREBEN S. OTTESEN

On specimen of *Attagenus smirnovi* Zhantiev was found on 1. Nov. 1983 in an apartment in Oslo. This

synanthropic beetle was introduced to Europe in 1961, probably from Africa, and has later appeared in several North Western European cities. The species is known to feed on wool, fur, museum material, etc., and has become increasingly common in Scandinavia during the last twenty years.

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In 1961 a brown and golden hairy *Attagenus* sp., 2.5 to 4.0 mm long, suddenly appeared in Moscow, and later in several cities in North Western Europe. The systematic position of the species was much debated until Zhantiev (1973) finally proved it to be new to science and named it *Attagenus smirnovi*. It was found to interbreed with beetles collected on farms in Kenya, where African swift nests are thought to be its original habitat. Various synonyms are treated by Arevad (1975) and Peacock (1979), who also give more detailed descriptions of the species, the latter including larvae. Full-size drawings are found in Keiding (1970) and Hagström (1981).

The first specimen of *A. smirnovi* in Western Europe was caught in Gothenburg, Sweden in 1962. It was published as *A. piceus* Oliver (Hagström 1962, 1972; Hagström & Törnvall 1969), but later corrected (Hagström 1981). It appeared in Copenhagen 1963 (Hansen 1965) and London 1978 (Peacock 1979).

On 1 Nov. 1983 one specimen was caught on a curtain in a student dormitory at Majorstua, Oslo by Ingar Iversen. The species has not previously been recorded from Norway (Silfverberg 1979).

A. smirnovi is one of several foreign Dermestid beetles which have recently invaded Europe. In Africa, which is thought to be the species' continent of origin, it is now found in farm stores, warehouses, and in stored products. In Europe it is more restricted to human habitation, and has become a serious pest in the USSR, where the larvae feed on materials of animal origin, mostly those containing keratin, like wool, wool products, furs, hides, feathers, etc. (Peacock 1979). Wool and fur damage is recorded in Sweden, where also damage to museum collections has been noted (Hagström 1972). However, no such damage has yet been registered in Denmark, where the larvae seem to be omnivorous, although dead insects and bird seeds are preferred. In that country the species is usually found in bedrooms and kitchens of private homes, often in clean, modern apartments, and imago may be found at any time of the year (Arevad, pers. comm.). Imago does not feed (Zhantiev 1976).

In Denmark the species today has become firmly established in urban districts, especially in the Copenhagen area, but since 1977 also in some other towns. Danish Pest Infestation Laboratory now receives about 70 recordings per year which are with certainty due to *A. smirnovi*. No other species of *Attagenus* is reported more frequently from private homes (Arevad, pers. comm.). In Sweden it has been found in

eight districts from Skåne to Norrbotten (Palm 1982). The species may thus be expected to spread in Norway in the years to come.

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ZEIRAPHERA DINIANA (GUENÉE) (LEP., TORTRICIDAE) ATTACKING *PINUS CONTORTA* DOUGLAS IN PLANTATIONS IN THE FAROE ISLANDS

SEPPO KOPONEN

Larvae of the tortricid moth *Zeiraphera diniana* (Guenée) were found to feed on planted lodgepole pines on three islands of the Faroes. The heaviest damage

was observed on young pines in Tórshavn. This dense larval population of *Z. diniana* was parasitized by the ichneumonid wasp *Scambus eucosmidarum* (Perkins).

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INTRODUCTION

The vegetation of the Faroe Islands is dominated by grass heaths; no natural trees or higher shrubs grow there. Several plantations of coniferous and deciduous trees have been established on the islands (Ødum 1979, Hansen & Ødum 1982). One of the most commonly used and best growing conifers is the lodgepole pine, *Pinus contorta* Douglas (Flensburg 1947, Hansen & Ødum 1982).

In July 1984 I visited the Faroe Islands to study insect herbivores in the plantations, and attacks by tortricid larvae on the lodgepole pines are presented here.

RESULTS

Feeding marks, larvae and pupae of *Zeiraphera diniana* (Guenée) were found on shoots of *P. contorta* in late July on three Faroese islands: Streymoy, Eystu-

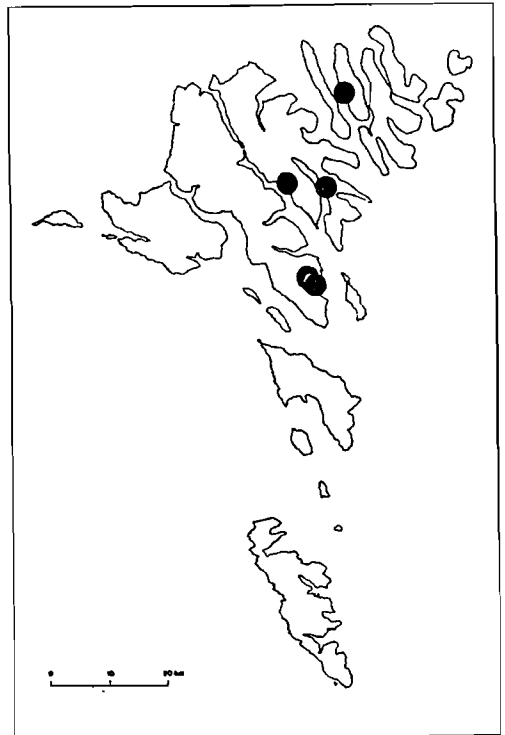


Fig. 1. Occurrence of *Zeiraphera diniana* on *Pinus contorta* in the Faroes, 1984.

roy and Kunoy (Fig. 1). The heaviest damage was observed on young lodgepole pines in a plantation near the Faroese Academy at Debesartred in Tórshavn. The average number of *Zeiraphera* larvae on two-metre tall pines was estimated to be about 100. However, a marked proportion of these were dead or in poor condition, mainly due to parasitizing by ichneumonid wasps. On trees with a high density of larvae, young green cones were also damaged by them.

High densities of *Zeiraphera* larvae were observed locally on older lodgepole pines, one hundred metres from the above plantation. In Tórshavn, *Zeiraphera* larvae also fed young lodgepole pines in plantations situated on a slope just below Hotel Føroyar and in private gardens. No damage was seen in two old and large plantations of Tórshavn: Gundadal (or the city park) and Høydalur.

Larvae of *Z. diniana* were observed in two plantations on Eysturoy, Selatrad and Sældarfjørður, and also in the remote plantation on Kunoy. Both young and older lodgepole pines were attacked. Unfortunately, the possible occurrence of *Z. diniana* in plantations on the two large islands in the south, Sandoy and Suduroy, was not investigated.

In rearing experiments, the first adults of *Z. diniana* emerged on July 29, and the parasitic wasps about one week later.

DISCUSSION

Attacks by moth larvae on *P. contorta* in the Faroese plantations have been observed earlier (Trondur Leivsson, pers. comm.). However, the identity of the pest has been unknown. The present pest species, *Z. diniana*, was recorded in the Faroes as early as the 1950s when a female was found on Eysturoy (Wolff 1970). *Z. diniana* is a wellknown pest of the larch (*Larix decidua* Miller) in the Alps (e.g. Schwenke 1978). In other parts of Europe it is known to feed on many conifers, such as *Pinus contorta* in Upland Britain (Day 1984) and the Scots pine (*P. sylvestris* L.) in Fennoscandia. The species has attacked heavily tree-line forests of *P. sylvestris* in southern Norway (Bakke 1969). Contrary to the situation in Britain, *Z. diniana* has not been found as a pest of planted *P. contorta* in Fennoscandia (Eidmann 1982, Annila et al. 1983, Karlman 1984).

Larval colour varied greatly in the present material, the light type dominated over the dark one. Thus the situation resembled that on lodgepole pine in Britain (Day 1984).

According to Wolff (1971), *Z. diniana* is absent on Orkney and Shetland (and Iceland), and a transport to the Faroes by human agency, for example with tree seedlings, is very probable. At least some of the lodgepole pines near the Faroese Academy, attacked by *Z. diniana*, originated from Scotland and were planted in 1960 (Nyholm 1970). There has been no phytosanitary control over the transfer of plants from Norway, Denmark, Scotland or Iceland to the Faroes. The most probably origin of *Z. diniana* in the

Faroes is Britain where the species feeds on lodgepole pines.

The occurrence of parasitoids in the dense *Zeiraphera* population in Tórshavn indicates a permanent and probably long-term colonization of the tortricid in the Faroe Islands. *P. contorta* has been planted on a large scale on the islands since the 1920s especially after the year 1928 (Søren Ødum pers. comm., Flensburg 1947). The ichneumonid parasitoid found, *Scambus eucosmidarum* (Perkins), is known as a parasite of some tortricids, including *Z. diniana*, and its range includes hitherto the British Isles, Sweden, Germany, Switzerland and France (Aubert 1969).

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TANYPEZA LONGIMANA FALLÉN, 1820 (DIPT., TANYPEZIDAE) AND STRONGYLOPHALMYIA USTULATA (ZETTERSTEDT, 1847) DIPT., STRONGYLOPHALMYIIDAE) IN NORWAY

LITA GREVE AND ÅGE SIMONSEN

ABSTRACT

Strongylophthalmyia ustulata (Zetterstedt, 1847) is reported new to Norway. Four specimens were found, one female near Valand, Mandal West Agder province and three females at the island Håøya, Frogn, Akershus province. For the first time since the survey of Norwegian Diptera made by Siebke (1877) new records are given from Norway for *Tanypeza longimana* Fallén, 1820. The distribution of both species in Norway is mapped.

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McAlpine et al. (1981) splits the old family *Tanypezidae* into *Tanypezidae* and *Strongylophthalmyiidae*. The families are placed together with *Psilidae* and *Diopsidae* in the superfamily *Diopsoidea*. *Tanypezidae* and *Strongylophthalmyiidae* are Acalyptratae flies.

The *Strongylophthalmyiidae* can be distinguished from the *Psilidae* and the *Tanypezidae* in the following characteristics: Notopleuron is usually with two bristles and anepisternum with outstanding bristles in addition to fine hairs. The ocelli are situated far forward, with the anterior one about midway between vertex and antennae (McAlpine et al. 1981).

Tanypezidae may be mistaken for *Micropezidae*. *Tanypezidae* are distinguished by their large eyes, distinctly higher than long. In Norwegian *Tanypezidae* the tarsus of last pair of legs is longer than the tibia — in *Micropezidae* the tarsus of last pair of legs is shorter than the tibia.

Tanypezidae and *Strongylophthalmyiidae* are distributed in the Holarctic. Each family is represented by one species only in the Fennoscandian fauna; *Tanypezidae* with *Tanypeza longimana* Fallén, 1820, *Strongylophthalmyiidae* with *Strongylophthalmyia ustulata* (Zetterstedt, 1847). Previous records from Norway are given by Zetterstedt (1847) and Siebke (1877) for *T. longimana* only.

The present paper includes all material in the Norwegian zoological museums. Abbreviations: ZMO—Zoological Museum, University of Oslo, ZMB—Zoo-

logical Museum, University of Bergen. The localities are presented according to the system of Økland (1981).

Tanypeza longimana Fallén, 1820

Published records: AK, Oslo: Oslo 1♂ 1♀ (ZMO), Bekkelaget 30 June 1847 1♂ 1♀ (ZMO); Enebakk: Enebakk 1♂ (ZMO). HES, Elverum: Grundset 1♂, 1 specimen (ZMO). OS, Søndre Land: Skøien 1♀ (ZMO). ON, Dovre: Dovre 6 August 1973 1♀ (ZMO). NTI, Levanger: Tynset (Zetterstedt in litt).

New records: AK, Frogn: Håøya 27 June—22 July 1984 2♂♂ (Malaise trap A), 22 July—18 August 1984 1♀ (Malaise trap B) (ZMB). BV, Ål: Torpo 10 July 1982 1♀ (ZMB). TEY, Kragero: Skåtøy 8 July 1983 1♀ (ZMB). HOY, Bergen: Eidsvåg, Vollane 9 July 1984 1♀ (ZMB).

The Norwegian records total eleven, older material included. *T. longimana* seems to be rare in Scandinavia and Lyneborg (1962) reports only six records from Denmark. It is, however, a common species in Central Europe where it can be found in shrubberies and on leaves on deciduous trees, especially *Populus tremula* L. and *Betula* spp. The localities are often situated near brooks and brooklets. *T. longimana* has (U. Qvick pers. comm.) been recorded in Sweden from humid sites with rich vegetation of bushes (*Prunus padus*) and trees (*Quercus robur*).

The new records from Norway are mainly from localities with mixed deciduous forests. At trap A, Håøya, the forest was dominated by *Tilia cordata* Mill., *Ulmus glabra* Huds. and *Quercus robur* L. There were also several old *Populus tremula* L. The area had been left untouched for many years and old and dead trees had not been removed. The ground vegetation was rich and varied. The area near trap B was of a similar type.

Only two females, from Skåtøy and Torpo, were netted. The female from Vollane was caught in a window inside a house. Bordering to the garden of the house was a mixed, open forest of *Tilia*, *Ulmus*, *Betula*, *Fagus* and *Ilex*.

The Norwegian distribution is mapped on Fig. 1 A. *Strongylophthalmyia ustulata* (Zetterstedt, 1847) New records: AK, Frogn: Håøya 3—16 June 1984 1♀, 27 June—22 July 1984 1♀, 22 July—18 August 1984 1♀ (All Malaise trap A) (ZMB). VAY, Mandal: Marnarvegen near road to Valand 6—22 July 1982 1♀ (Malaise trap) (ZMB).

These are the first records of *S. ustulata* from Norway. All specimens were found in material from Malaise traps. *S. ustulata* is reported both from Finland and Sweden.

S. ustulata at Håøya was found together with *T. longimana*. The locality near Mandal was a boggy area relatively rich in herbs and surrounded by mixed forests. U. Qvick (Pers. comm.) has found both species together in Sweden.

The records of the species indicate perhaps humid-loving, thermophilic species with preference for relatively mineral-rich habitat types.

The Norwegian distribution is mapped in Fig. 1 B.

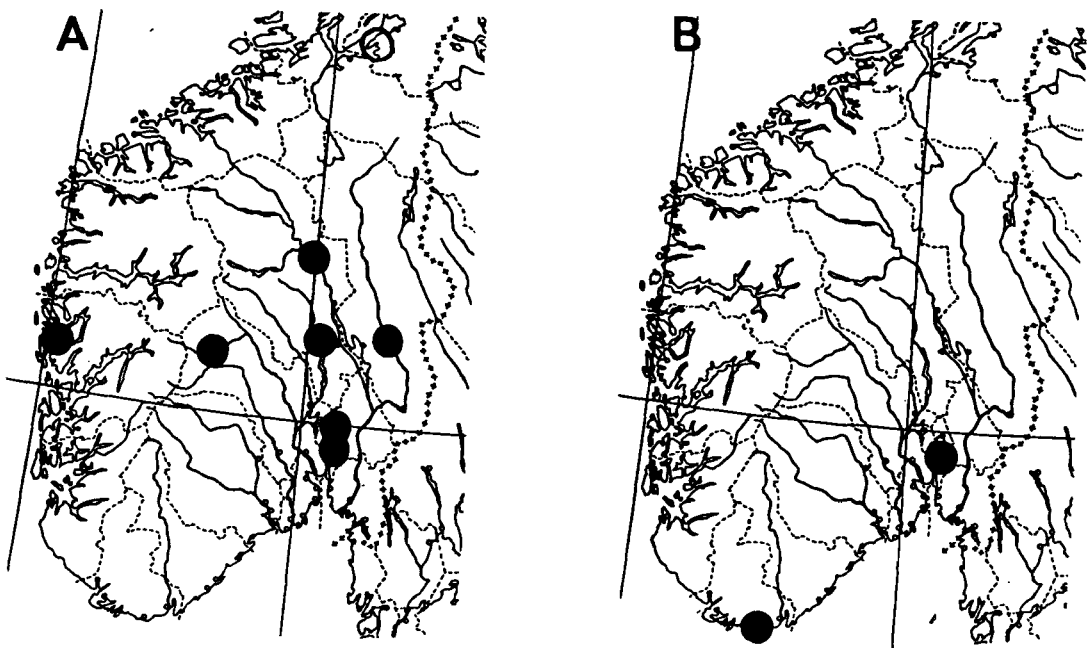


Fig. 1. Records of Tanypezidae and Strongylophthalmyiidae in Norway. A — *Tanypeza longimana* Falén, 1820, B — *Strongylophthalmyia ustulata* (Zetterstedt, 1847).

Open circle — Zetterstedt.

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