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Fungus gnats from Jostedalen, West Norway (Diptera; Diadocidiidae and Mycetophilidae)

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During a study of terrestrial invertebrates in Jostedalen in 1988, more than 3.000 specimens of fungus gnats were caught. 214 species were recognized, belonging to the families Diadocidiidae and Mycetophilidae. The number of species in Jostedalen is exceptionally high when compared to number of species recorded from other local areas in Europe. The genus *Drepanocercus* (Vockeroth, 1980) is recorded for the first time from the Palaearctic region. Other rare species are *Mycomya simulans* Väisänen, 1984, *Acnemia falcata* Zaitzev, 1982, *Zygomyia pseudohumeralis* Caspers, 1980, *Anatella aquila Zaitsev, 1989, A. fungina* Plassmann, 1984, *Exechia subfrigida* Lastovka & Matila, 1974. *Exechiopsis dryaspagensis* Chandler, 1977 and *E. pseudopulchella* (Lundström, 1909). Twenty species could not be identified, half of which undoubtly represent undescribed species. The fauna of Norwegian fungus gnats is poorly documented, and most species recorded here are new to Norway. According to the present knowledge on the distribution of fungus gnats, the fauna in Jostedalen seems to have an affinity to the central/eastern Palaearctic fauna, and has more species in common with the Finnish fauna than with the British.

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INTRODUCTION

The river Jostedøla has its origin in the glacier Jostedalsbreen, the largest ice cap on the European mainland, and runs through the valley Jostedalen. Since the late 1970's the river and its tributaries have been used for production of hydroelectric power, and a reservoir has been built at the lake Styggevatn. As a consequence of these rather pronounced human impacts on the watercourse and parts of the precipitation area, a series of documentation programs on the flora and fauna has been accomplished. In early 1988 a project dealing with the distribution of invertebrates was initiated. The field work was carried out the same year. Three groups of invertebrates were selected: soil mites, caddis flies and fungus gnats, with emphasize on the former. The caddis fly fauna is outlined by Andersen et al. (1990), and the present work deals with the fungus gnat families Diadocidiidae and Mycetophilidae.

Diadocidiidae and Mycetophilidae make up two of seven families in the superfamily Sciaroidea, viz. Ditomyiidae, Diadocidiidae, Keroplatidae, Bolitophilidae, Lygistorrhinidae, Sciardae and Mycetophilidae. Fungus gnats are distributed all over the world, but their taxonomy, biology and biogeography are only superficially known. In Europe, the fauna of fungus gnats has been well documented from England, France, Germany, Finland and from some regions in the former USSR. However, only a restricted number of faunal lists from definite locations has been published, most of them from The British Isles and Germany.

The first and only survey dealing with Norwegian fungus gnats in details is that by Siebke (1877). Siebke listed 67 species which can be referred to Mycetophilidae, but the validity of these records can only be stated by a thoroughly examination of Siebke's material. In the period from 1877 to 1940 only a few scattered records were published (for references, see Soot-Ryen 1943). More recently some Norwegian records have been published in systematical revisions (Hackman 1970, 1971; Gagné 1981; Väisänen 1984).

STUDY AREA

The valley Jostedalen, is situated in West Norway (between 61°15' and 61°45'NF, and between 7°10' and 7°20'E), and stretches from Gaupnefjorden, a branch of Lustrafjorden in the inner Sognefjorden, to about 60 km northwards along the eastern part of the huge glacier Jostedalsbreen (Fig. 1). The ice cap of this glacier and its satellites covers an area of about 800 sq.km. The river Jostedøla runs through the valley, and wide flood plains are forming terraces, separated by rather steep slopes. The valley, thus covers altitudes from sea level up to 1150 meters. For further details concerning the study area, see Andersen et al. (1990).

Øyastrondi constitutes the main sampling area, and is situated at the eastern rim of a huge flood plain, Fåbergstølsgrandane. A rather undisturbed birch forest *(Betula pubescens)* is stretching from the flood plain and about 200 meters up the valley side. The forest has a rich and diverse undergrowth, mainly ferns and perennial herbs.

Additional samples were obtained from locatities at different altitudes along the valley, and from one side valley, Geisdalen (Tab. 1). In addition to Øyastrondi, Sprongdalen-Loc. 1 was situated in birch forest. Three other localities, Sprongdalen-Loc. 2 & 3 and Geisdalen-Loc. 2, were situated above the timber line, in oligotrophic alpine heaths. The remaining localities were all situated in mixed forests.

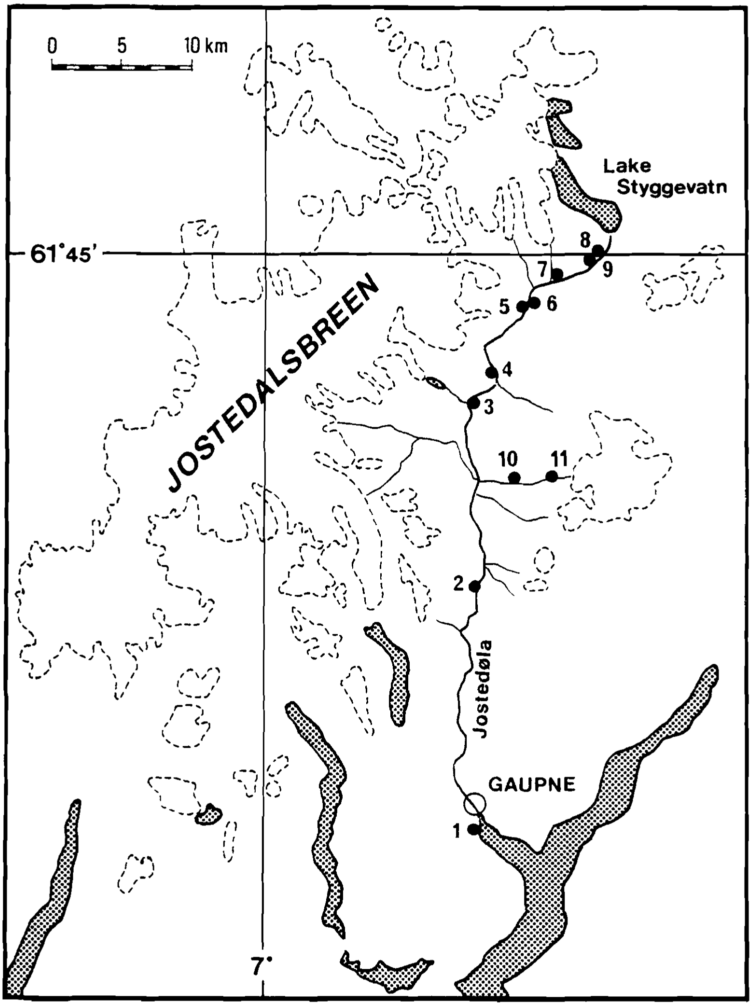

Fig. 1. The glacier Jostedalsbreen and the valley Jostedalen in Luster, West Norway, showing the position of the localities. The localities are 1) Marheimgilet, 2) Fossen, 3) Nigard, 4) Buhaug, 5) Fåbergstølen, 6) Øyastrondi, 7—9 Sprongdalen and 10—11) Geistdalen. (See also Tab. 1.)

Table 1. Localities in Jostedalen, West Norway, visited during the survey. All localities are situated in the municipality of Luster, EIS-square no. 60.

Locality		UTM-ref.	M.a.s.l.	Method
1	Marheimgilet, Gaupne	32VMP092063	30	Net
2	Fossen	32VMP0824	100	Net
3	Nigard	32VMP0837	250	Ligth trap
4	Buhaug	32VMP106401	360	Net
5	Fåbergstølen	32VMP1343	520	Net
6	Øyastrondi	32VMP139448	560	Malaise/net
	Sprongdalen			
7	Loc.1	32VMP1545	660	Net
8	Loc.2	32VMP1847/1948	1000	Net
9	Loc.3	32VMP180470	870	Ligth trap
	Geisdalen			
10	Loc.1	32VMP1132	700	Net
11	Loc.2	32VMP1331	900	Net

MATERIAL AND METHODS

The material comprises about 3.000 specimen, collected in malaise traps, light traps and with sweep nets. The malaisetrap at Øyastrondi was operated from June 24 to September 13 1988. The trap was filled with a mixture of 50% alcohol and 50% ethylenglycol, and emptied at irregular intervals. The samples have been united to cover three collecting periods: June 24 to July 12, July 12 to August 17 and August 17 to September 13. Light traps were used at two locatiies (Nigard and Sprongdalen-Loc. 3), during a short period in September. Sweep nets were used extensively at Øyastrondi and at most other localities (See Tab. 1). Except for some slide mounted specimens, the material is stored in 70% alcohol. All specimens are kept in the collection of the Museum of Zoology, Bergen.

Where nothing else is stated, information on distribution is taken from Soós & Papp (1988).

RESULTS

The material comprises 214 species belonging to the families Diadocidiidae and Mycetophilidae. Emphasize has been put on the identification of males, as very few females have been satisfactorily described. Twenty species were not identified, and more thoroughly examinations are needed to clearify their taxonomical position. However, more than half of them do probably represent undescribed species.

Table 2. Number of species of fungus gnats from different countries and locations in Europe. No refers to number of species in Sciaroidea, excl. Sciaridae; No* refers to number of species in Mycetophilidae.

Country, location	No	No*	References
FINLAND:			
TOTAL	491	434	Hackman 1980; Väisänen 1984
ENGLAND:			
Cambridgeshire, Monks Wood	153	124	Cole & Chandler 1979
Kent, Blean Woods	107	104	Russel-Smith 1979
TOTAL:	505	-	Chandler, pers.com.
GERMANY:			
Allgäu	282	245	Plassmann 1978b, 1980b
Bayern	349	299	Plassmann & Plachter 1986
Breitenbach	193	-	Caspers 1987
Mornauer Mooses	38	34	Plassmann 1982
Mellum and Memmert	78	67	Plassmann 1988
Thüringens	103	85	Plassmann & Joost 1986
AUSTRIA:			
Lunz	134	129	Caspers 1984
RUSSIA:			
Moscow Province	-	175	Sakharova 1977
SWEDEN:			
Messaure	326	296	Plassmann 1978a, 1979, 1980a
POLEN:			
Nida-valley	175	153	Mikolajczyk 1967

SPECIES LIST

The species are listed according to Soós & Papp (1988). As all specimens were collected during 1988 only dates are listed.

Family DIADOCIDIIDAE

Diadocidia (D.) ferruginosa (Meigen, 1830)

Fossen 24 June 1♂; Øyastrondi 24 June-12 July 5♂♂ 5♀♀, 17 Aug. -13 Sept. 5♂♂ 3♀♀.

D. (D.) spinosula Tollet, 1948

Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.

D. (Adidocidia) valida Mik, 1874

Øyastrondi 24 June -12 July 1♂, 17 Aug. -13 Sept. 2♂♂ 2♀♀.

Family MYCETOPHILIDAE
Subfamily SCIOPHILINAE

Mycomya annulata (Meigen, 1818)

Øyastrondi 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 52♂♂ 2♀♀.

M. bicolor (Dziedzicki, 1885)

Øyastrondi 12 July-17 Aug. 1♂.

M. cinerascens (Macquart, 1826)

Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.

M. denmax Väisänen, 1979

Øyastrondi 17 Aug. -13 Sept. 5♂♂.

M. disa Väisänen, 1984

Øyastrondi 24 June-12 July 3♂♂.

M. egregia (Dziedzicki, 1885)

Øyastrondi 24 June-12 July 1♂, 17 Aug. -13 Sept. 1♂.

M. fasciata (Zetterstedt, 1838)

Marheimgilet 22 June 1♂; Fåbergstølen 23 June 1♂; Øyastrondi 24 June-12 July 7♂♂ 2♀♀, 12 July-17 Aug. 1♂.

M. hackmani Väisänen, 1984

Geisdalen (Loc. 1) 24 June 1♂ 1♀.

M. lambi Edwards, 1941

Fåbergstølene 17 Aug. 1♂; Øyastrondi 12 July-17 Aug. 4♂♂.

M. maculata (Meigen, 1804)

Sprongdalen (Loc. 1) 17 Aug. 1♂ 1♀.

M. neohyalinata Väisänen, 1984

Øyastrondi 24 June-12 July 2♂♂; Geisdalen (Loc. 1) 24 June 1♂.

M. nigricornis (Zetterstedt, 1852)

Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

M. nitida (Zetterstedt, 1852)

Buhaug 23 June 1♂ 2♀♀; Fåbergstølen 23 June 1♂ 2♀♀; Øyastrondi 24 June-12 July 3♂♂ 4♀♀; Sprongdalen (Loc. 1) 23 June 12 ♂♂ 6♀♀; Geisdalen (Loc. 1) 24 June 2♂♂ 2♀♀.

M. shermani Garrett, 1924

Fåbergstølene 17 Aug. 1♂ 4♀♀; Øyastrondi 12 July-17 Aug. 24♂♂ 1♀, 17 Aug. -13 Sept. 102♂♂ 6♀♀; Sprongdalen (Loc. 1) 17 Aug. 7♂♂ 1♀; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

M. simulans Väisänen, 1984

Øyastrondi 17 Aug. -13 Sept. 1♂.

M. trivittata (Zetterstedt, 1838)

Øyastrondi 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 2♂♂; Sprongdalen (Loc. 1) 17 Aug. 1♂.

M. tumida (Winnertz, 1863)

Marheimgilet 22 June 2♂♂; Buhaug 23 June 1♂ 2♀♀; Fåbergstølen 23 June 2♂♂; Øyastrondi 24 June-12 July 11♂♂ 3♀♀, 17 Aug. -13 Sept. 3♂♂; Sprongdalen (Loc. 1) 23 June 2♂♂; Geisdalen (Loc. 1) 24 June 1♂ 1♀.

M. vittiventris (Zetterstedt, 1852)

Fåbergstølene 17 Aug. 1♂ 1♀; Øyastrondi 12 July-17 Aug. 22♂♂, 17 Aug. -13 Sept. 181♂♂.

M. wankowiczii (Dziedzicki, 1885)

Nigard 8.-13 Sept. 1♂; Øyastrondi 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 7♂♂.

M. winnertzi (Dziedzicki, 1885)

Øyastrondi 17 Aug. -13 Sept. 1♂;

M. sp. (cf. *tamerlani* Väisänen, 1984)

Øyastrondi 17 Aug. -13 Sept. 1♂.

Neoempheria pictipennis (Haliday, 1833)

Øyastrondi 17 Aug. -13 Sept. 1♂.

Acnemia nitidicollis (Meigen, 1818)

Øyastrondi 24 June-12 July 5♂♂, 12 July-17 Aug. 26♂♂, 17 Aug. -13 Sept. 60♂♂.

A. falcata Zaitzev, 1982

Øyastrondi 12 July-17 Aug. 20 ♂♂, 17 Aug. -13 Sept. 26♂♂.

Allocotocera pulchella (Curtis, 1837)

Øyastrondi 12 July-17 Aug. 1♂.

Monoclona rufilatera (Walker, 1837)

Øyastrondi 24 June-12 July 7♂♂, 12 July-17 Aug. 1♀, 17 Aug. -13 Sept. 1♂ 2♀♀.

Neuratelia nemoralis (Meigen, 1818)

Fossen 24 June 1♂.

N. sp.

Marheimgilet 22 June 1♂ 2♀♀.

Paratinia sciarina Mik, 1874

Øyastrondi 17 Aug. -13 Sept. 2♂♂ 1♀.

Phthinia humilis Winnertz, 1863

Øyastrondi 24 June-12 July 7♂♂, 17 Aug. -13 Sept. 3♂♂.

Polylepta borealis Lundström, 1912

Fossen 24 June 1♂; Øyastrondi 24 June-12 July 3♂♂; Sprongdalen (Loc. 1) 23 June 1♂; Geisdalen (Loc. 1) 24 June 2♂♂.

P. guttiventris (Zetterstedt, 1852)
Øyastrondi 24 June-12 July 1♂; Geisdalen (Loc. 1) 24 June 1♂.

Sciophila fenestella Curtis, 1837
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 4♂♂, 17 Aug. -13 Sept. 3♂♂.

S. nigronitida Landrock, 1925
Fåbergstølene 17.08, 1♂.

Syntemna hungarica (Lundström, 1912)
Øyastrondi 12 July-17 Aug. 4♂♂ 1♀, 17 Aug. -13 Sept. 1♀.

S. relicta (Lundström, 1912)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 2♂♂.

S. sp. (cf. *nitidula* Edwards, 1925)
Øyastrondi 17 Aug. -13 Sept. 2♂♂.

Apolephthisa subincana (Curtis, 1837)
Øyastrondi 24 June-12 July 4♂♂ 2♀♀, 12 July-17 Aug. 1♀.

Boletina basalis (Meigen, 1818)
Marheimgilet 22 June 6♂♂; Fossen 24 June 2♂♂; Buhaug 23 June 3♂♂ 9♀♀; Øyastrondi 24 June-12 July 82♂♂ 9♀♀; 12 July-17 Aug. 1♂ 3♀♀; 17 Aug. -13 Sept. 7♂♂; Sprongdalen (Loc. 1) 23 June 1♀; Sprongdalen (Loc. 2) 23 June 2♂♂; Geisdalen (Loc. 1) 24 June 1♂ 1♀.

B. borealis Zetterstedt, 1852
Øyastrondi 24 June-12 July 1♂.

B. brevicornis Zetterstedt, 1852
Øyastrondi 17 Aug. -13 Sept. 2♂♂; Geisdalen (Loc. 2) 24 June 1♂

B. cincticornis (Walker, 1848)
Fåbergstølen 23 June 1♂; Øyastrondi 24 June-12 July 3♂♂ 5♀♀; Sprongdalen (Loc. 1) 23 June 7♂♂; Sprongdalen (Loc. 2) 23 June 20♂♂ 3♀♀; Geisdalen (Loc. 1) 24 June 1♂; Geisdalen (Loc. 2) 24 June 7♂♂ 3♀♀.

B. dubia (Meigen, 1804)
Øyastrondi 17 Aug. -13 Sept. 1♂ 2♀♀_; Sprongdalen (Loc. 2) 23 June 2♂♂.

B. edwardsi Chandler, 1992 (New name for *B. brevicornis* sensu Edwards; nec Zetterstedt.)
Øyastrondi 17 Aug. -13 Sept. 1♂.

B. gripha Dziedzicki, 1885
Øyastrondi 17 Aug. -13 Sept. 10♂♂; Sprongdalen (Loc. 2) 23 June 27♂♂ 7♀♀; Sprongdalen (Loc. 3) 8.-12 Sept. 2♂♂; Geis-dalen (Loc. 1) 24 June 1♂ 2♀♀; Geisdalen (Loc. 2) 24 June 13♂♂ 110♀♀.

B. groenlandica Staeger, 1845
Øyastrondi 24 June-12 July 3♂♂.

B. lundstroemi Landrock, 1912
Øyastrondi 17 Aug. -13 Sept. 1♂.

B. moravica Landrock, 1912
Øyastrondi 24 June-12 July 1♂.

B. nasuta (Haliday, 1839)
Øyastrondi 24 June-12 July 2♂♂.

B. nigricans Dziedzicki, 1885
Øyastrondi 12 July-17 Aug. 1♂.

B. nigrofusca Dziedzicki, 1885
Øyastrondi 24 June-12 July 1♂; Sprongdalen (Loc. 1) 17 Aug. 1♂.

B. pectinunguis Edwards, 1932
Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

B. plana (Walker, 1856)
Marheimgilet 22 June 1♂; Øyastrondi 24 June-12 July 2♂♂; 12 July-17 Aug. 22♂♂ 3♀♀; 17 Aug. -13 Sept. 21♂♂ 17♀♀; Geisdalen (Loc. 2) 24. 06. 1♂.

B. sciarina Staeger, 1840
Nigard 08.-13 Sept. 1♂.

B. trivittata (Meigen, 1818)
Buhaug 23 June 2♂♂; Fåbergstølen 23 June 4♂♂ 1♀; Øyastrondi 24 June-12 July 8♂♂ 2♀♀; 17 Aug. -13 Sept. 2♂♂; Sprongdalen (Loc. 2) 23 June 3♂♂ 2♀♀.

B. sp. (cf. *maculata* Holmgren, 1870)
Sprongdalen (Loc. 2) 23 June 1♂.

Coelosia tenella (Zetterstedt, 1852)
Sprongdalen (Loc. 3) 8.-12 Sept. 5♂♂.

Drepanocercus spinistylus Söli, 1993
Øyastrondi 24 June-12 July 1♂.

Dziedzickia marginata (Dziedzicki, 1885)
Øyastrondi 12 July-17 Aug. 5♂♂, 17 Aug. -13 Sept. 4♂♂.

Gnoriste bilineata Zetterstedt, 1852
Øyastrondi 24 June-12 July 2♂♂.

G. harcyniae von Röder, 1887
Marheimgilet 22 June 1♂.

Grzegorzekia collaris (Meigen, 1818)
Øyastrondi 24 June-12 July 2♂♂, 12 July-17 Aug. 1♂.

Palaeodocosia janickii (Dziedzicki, 1923)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 2♂♂.

Synapha vitripennis (Meigen, 1818)
Øyastrondi 24 June-12 July 2♂♂.

Ectrepesthoneura hirta (Winnertz, 1846)
Øyastrondi 24 June-12 July 1♂ 1♀, 12 July -17 Aug. 1♀.

Leia subfasciata (Meigen, 1818)
Øyastrondi 24 June-12 July 5♂♂; Buhaug 23 June 2♂♂ 1♀.

Subfamily MYCETOPHILINAE

Dynatosoma fuscicorne (Meigen, 1818)
Øyastrondi 24 June-12 July 2♂♂.

D. reciprocum (Walker, 1848)
Buhaug 23 June 1♂; Øyastrondi 12 July-17 Aug. 2♂♂ 1♀, 17 Aug. -13 Sept. 1♀.

D. thoracicum (Zetterstedt, 1838)
Øyastrondi 24 June-12 July 1♂.

Epicypta aterrima (Zetterstedt, 1852)
Øyastrondi 12 July-17 Aug. 1♂.

Mycetophila abbreviata Landrock, 1914
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 3♂♂.

M. bialorussica Dziedzicki, 1884
Øyastrondi 17 Aug. -13 Sept. 1♂.

M. confluens Dziedzicki, 1884
Fossen 24 June 3♂♂.

M. czizeki Landrock, 1911
Øyastrondi 24 June-12 July 2♂♂.

M. evanida Lastovka, 1972
Fossen 24 June 20♂♂; Nigard 8.-13 Sept. 8♂♂; Øyastrondi 24 June-12 July 2♂♂, 12 July-17 Aug. 23♂♂, 17 Aug. -13 Sept. 6♂♂; Sprongdalen (Loc. 1) 17 Aug. 1♂; Sprongdalen (Loc. 2) 23 June 2♂♂; Sprong-dalen (Loc. 3) 8.-12 Sept. 2♂♂.

M. fungorum (De Geer, 1776)
Nigard 8.-13 Sept. 34♂♂ 71♀♀; Buhaug 23 June 1♀; Øyastrondi 24 June-12 July 9♂♂ 8♀♀, 12 July-17 Aug. 18♂♂, 17 Aug. -13 Sept. 56♂♂ 79♀♀; Sprongdalen (Loc. 3) 8.-12 Sept. 14♂♂ 19♀♀.

M. ichneumonea Say, 1823
Nigard 8.-13 Sept. 1♂; Øyastrondi 12 July-17 Aug. 1♂.

M. marginata Winnertz, 1863
Sprongdalen (Loc. 1) 23 June 3♂♂; Geisdalen (Loc. 1) 24 June 1♂.

M. mohilivensis Dziedzicki, 1884
Fossen 24 June 2♂♂; Øyastrondi 17 Aug. -13 Sept. 1♂; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

M. ocellus Walker, 1848
Øyastrondi 17 Aug. -13 Sept. 3♂♂.

M. ornata Stephens, 1829
Øyastrondi 17 Aug. -13 Sept. 1♂ 4♀♀.

M. pumila Winnertz, 1863
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.

M. schnablii (Dziedzicki, 1884)
Øyastrondi 12 July-17 Aug. 1♂.

M. semifusca Meigen, 1818
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 2♂♂.

M. signatoides Dziedzicki, 1884
Øyastrondi 17 Aug. -13 Sept. 1♂.

M. strigatoides (Landrock, 1927)
Øyastrondi 12 July-17 Aug. 2♂♂.

M. sumavica (Lastovka, 1963)
Øyastrondi 17 Aug. -13 Sept. 5♂♂.

M. vittipes Zetterstedt, 1852
Buhaug 23 June 1♂; Øyastrondi 17 Aug. -13 Sept. 1♂; Geisdalen (Loc. 1) 24 June 1♂.

Phronia austriaca Winnertz, 1863
Øyastrondi 17 Aug. -13 Sept. 3♂♂.

P. aviculata Lundström, 1914
Øyastrondi 17 Aug. -13 Sept. 5♂♂.

P. biarcuata (Becker, 1908)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 4♂♂.

P. braueri Dziedzicki, 1889
Øyastrondi 17 Aug. -13 Sept. 1♂.

P. caliginosa Dziedzicki, 1889
Øyastrondi 17 Aug. -13 Sept. 2♂♂.

P. cinerascens Winnertz, 1863
Fåbergstølene 17 Aug. 1♂; Øyastrondi 12 July-17 Aug. 1♂.

P. egregia Dziedzicki, 1889
Øyastrondi 17 Aug. -13 Sept. 2♂♂.

P. exigua (Zetterstedt, 1852)
Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

P. flavicollis Winnertz, 1863
Marheimgilet 22 June 1♂; Øyastrondi 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 3 ♂♂.

P. flavipes Winnertz, 1863
Øyastrondi 17 Aug. -13 Sept. 13♂♂; Sprongdalen (Loc. 1) 23 June 1♂; Sprongdalen (Loc. 3) 8.-12 Sept. 2♂♂.

P. forcipata Winnertz, 1863
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 3♂♂.

P. humeralis Winnertz, 1863
Marheimgilet 22 June 13♂♂; Øyastrondi 17 Aug. -13 Sept. 1♂; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

P. interstincta Dziedzicki, 1889
Øyastrondi 24 June-12 July 2♂♂, 17 Aug. -13 Sept. 1♂.

P. longaelamellata Strobl, 1898
Øyastrondi 24 June-12 July 1♂.

P. lutescens Hackman, 1970
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 6♂♂.

P. nigricornis (Zetterstedt, 1852)
Fossen 24 June 2♂♂.

P. notata Dziedzicki, 1889
Marheimgilet 22 June 1♂.

P. obscura Dziedzicki, 1889
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.

P. sp. (cf. *mutabilis* Dziedzicki, 1889)
Øyastrondi 24 June-12 July 3♂♂.
Sceptonia fumipes Edwards, 1925
Øyastrondi 17 Aug. -13 Sept. 3♂♂ 2♀♀.
S. fuscipalpis Edwards, 1925
Øyastrondi 17 Aug. -13 Sept. 2♂♂ 2♀♀.
S. nigra (Meigen, 1804)
Øyastrondi 17 Aug. -13 Sept. 2♂♂ 2♀♀.
Trichonta atricauda (Zetterstedt, 1852)
Buhaug 23 June 2♂♂; Fåbergstølene 17 Aug. 1♂.
T. bicolor Landrock, 1912
Øyastrondi 12 July-17.08 1♂.
T. facilis Gagné, 1981
Marheimgilet 22 June 1♂; Øyastrondi 24 June-12 July 3♂♂, 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.
T. fissicauda (Zetterstedt, 1852)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂; Sprongdalen (Loc. 1) 23 June 1♂.
T. hamata Mik, 1880
Marheimgilet 22 June 6♂♂; Fossen 24 June 1♂; Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 5♂♂, 17 Aug. -13 Sept. 4♂♂.
T. melanura (Staeger, 1840)
Øyastrondi 24 June-12 July 1♂.
T. submaculata (Staeger, 1840)
Marheimgilet 22 June 1♂; Fossen 24 June 1♂; Øyastrondi 17 Aug. -13 Sept. 6♂♂; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.
T. terminalis (Walker, 1856)
Buhaug 23 June 1♂; Fåbergstølen 23 June 1♂.
T. trivittata Lundström, 1916
Øyastrondi 17 Aug. -13 Sept. 1♂.
T. vulcani (Dziedzicki, 1889)
Øyastrondi 12 July-17 Aug. 6♂♂, 17 Aug. -13 Sept. 11♂♂.
T. sp. A (cf. *comis* Gagné, 1981)
Øyastrondi 12 July-17 Aug. 1♂.
T. sp. B (cf. *generosa* Gagné, 1981)
Øyastrondi 17 Aug. -13 Sept. 3♂♂.
T. sp. C
Øyastrondi 17 Aug. -13 Sept. 11♂♂.
Zygomyia pseudohumeralis Caspers, 1980
Øyastrondi 12 July-17 Aug. 1♂.
Z. notata (Stannius, 1831)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.
Allodiopsis (A.) domestica (Meigen, 1830)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.
A. (Notolopha) cristata (Staeger, 1840)
Fossen 24 June 1♀; Øyastrondi 24 June-12 July 2♂♂ 1♀, 12 July-17 Aug. 5♂♂, 17 Aug. -13 Sept. 15♂♂ 3♀♀.
Allodia (A.) anglofennica Edwards, 1921
Øyastrondi 17 Aug. -13 Sept. 7♂♂.
A. (A.) lugens (Wiedemann, 1817)
Fåbergstølene 17 Aug. 6♂♂; Øyastrondi 12 July-17 Aug. 8♂♂, 17 Aug. -13 Sept. 150♂♂; Sprongdalen (Loc. 1) 23 June 1♂; Sprongdalen (Loc. 3) 8.-12 Sept. 2♂♂.
A. (A.) lundstroemi Edwards, 1921
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 15♂♂; Sprongdalen (Loc. 2) 17 Aug. 1♂.
A. (A.) pyxidiiformis Zaitzev, 1983
Øyastrondi 17 Aug. -13 Sept. 14♂♂; Sprong-dalen (Loc. 3) 8.-12 Sept. 1♂.
A. (A.) septentrionalis Hackman, 1971
Øyastrondi 24 June-12 July 2♂♂, 17 Aug. -13 Sept. 17♂♂; Sprongdalen (Loc. 1) 23 June 1♂.
A. (A.) truncata Edwards, 1921
Øyastrondi 12 July-17 Aug. 7♂♂, 17 Aug. -13 Sept. 29♂♂.
A. (A.) sp. (cf. *pyxidiiformis* Zaitzev, 1983)
Øyastrondi 17 Aug. -13 Sept. 2♂♂.
A. (Brachycampta) barbata (Lundström, 1909)
Øyastrondi 24 June-12 July 1♂.
Anatella aquila Zaitzev, 1989
Øyastrondi 17 Aug. -13 Sept. 11♂♂.
A. ciliata Winnertz, 1863
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 3♂♂.
A. flavomaculata Edwards, 1925
Øyastrondi 24 June-12 July 1♂, 17 Aug. -13 Sept. 16♂♂.
A. fungina Plassmann, 1984
Øyastrondi 24 June-12 July 2♂♂, 12 July-17 Aug. 2♂♂ 1♀, 17 Aug. -13 Sept. 3♂♂ 4♀♀.
A. laffooni Plassmann, 1977
Øyastrondi 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 95♂♂.
A. lenis Dziedzicki, 1923
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 3♂♂.
A. longisetosa Dziedzicki, 1923
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 31♂♂.
A. minuta (Staeger, 1840)
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 28♂♂.
A. setigera Edwards, 1921
Nigard 8.-13 Sept. 1♂.
A. simpatica Dziedzicki, 1923
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 3♂♂.

A. turi Dziedzicki, 1923
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.

A. unguigera Edwards, 1921
Øyastrondi 12 July-17 Aug. 1♂.

A. sp. A
Øyastrondi 17 Aug. -13 Sept. 1♂.

A. sp. B
Øyastrondi 17 Aug. -13 Sept. 61♂♂.

A. sp. C
Øyastrondi 17 Aug. -13 Sept. 1♂.

Brevicornu (B.) bipartitum Lastovka & Matile, 1974
Øyastrondi 12 July-17 Aug. 1♂.

B. (B.) boreale (Lundström, 1914)
Fåbergstølen 23 June 1♂; Øyastrondi 12 July-17 Aug. 3♂♂, 17 Aug. -13 Sept. 3♂♂.

B. (B.) foliatum (Edwards, 1925)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 3♂♂.

B. (B.) griseicolle (Staeger, 1840)
Øyastrondi 17 Aug. -13 Sept. 2♂♂.

B. (B.) griseolum (Zetterstedt, 1852)
Fåbergstølen 23 June 1♂, 17 Aug. 3♂♂; Øyastrondi 24 June-12 July 2♂♂, 12 July-17 Aug. 14♂♂.

B. (B.) kingi (Edwards, 1925)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 1♂.

B. (B.) ruficorne (Meigen, 1838)
Fåbergstølene 17 Aug. 1♂; Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 4♂♂, 17 Aug. -13 Sept. 14♂♂.

B. (B.) sericoma (Meigen, 1830)
Fåbergstølene 17 Aug. 1♂; Øyastrondi 12 July-17 Aug. 12♂♂, 17 Aug. -13 Sept. 48♂♂; Sprongdalen (Loc. 1) 17 Aug. 1♂; Sprongdalen (Loc. 3) 8.-12 Sept. 9♂♂.

B. (B.) sp. A (cf. *bellum* (Johannsen, 1911))
Øyastrondi 12 July-17 Aug. 4♂♂.

B. (B.) sp. B (cf. *melanderi* Zaitzev, 1988)
Øyastrondi 17 Aug. -13 Sept. 1♂.

B. (B.) sp. C
Marheimgilet 22 June 2♂♂.

Cordyla brevicornis (Staeger, 1840)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 4♂♂.

C. fissa Edwards, 1925
Øyastrondi 17 Aug. -13 Sept. 1♂.

C. fusca Meigen, 1804
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 2♂♂.

C. pusilla Edwards, 1925
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 3♂♂.

C. semiflava (Staeger, 1840)
Øyastrondi 24 June-12 July 1♂, 17 Aug. -13 Sept. 1♂.

Exechia cincta Winnertz, 1863
Øyastrondi 17 Aug. -13 Sept. 1♂.

E. confinis Winnertz, 1863
Øyastrondi 17 Aug. -13 Sept. 2♂♂.

E. contaminata Winnertz, 1863
Øyastrondi 17 Aug. -13 Sept. 5♂♂.

E. cornuta Lundström, 1914
Øyastrondi 24 June-12 July 1♂.

E. exigua Lundström, 1909
Øyastrondi 12 July-17 Aug. 8♂♂, 17 Aug. -13 Sept. 9♂♂.

E. festiva Winnertz, 1863
Øyastrondi 12 July-17 Aug. 3♂♂.

E. frigida (Boheman, 1865)
Øyastrondi 17 Aug. -13 Sept. 30♂♂; Sprongdalen (Loc. 3) 8.-12 Sept. 2♂♂.

E. fusca (Meigen, 1804)
Fossen 24 June 1♂; Nigard 8.-13 Sept. 1♂; Øyastrondi 17 Aug. -13 Sept. 245♂♂; Sprongdalen (Loc. 1) 23 June 1♂; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

E. maculipennis (Stannius, 1831)
Sprongdalen (Loc. 3) 8.-12 Sept. 1♀.

E. nigra Edwards, 1925
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 10♂♂, 17 Aug. -13 Sept. 32♂♂.

E. parvula (Zetterstedt, 1852)
Øyastrondi 17 Aug. -13 Sept. 1♂.

E. pseudocincta Strobl, 1910
Øyastrondi 12 July-17 Aug. 1♂.

E. spinuligera Lundström, 1912
Øyastrondi 17 Aug. -13 Sept. 4♂♂.

E. subfrigida Lastovka & Matile, 1974
Øyastrondi 17 Aug. -13 Sept. 2♂♂; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂.

E. unimaculata (Zetterstedt, 1860)
Fåbergstølene 17 Aug. 1♂; Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 4♂♂.

Exechiopsis (E.) clypeata (Lundström, 1911)
Nigard 8.-13 Sept. 1♂; Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 3♂♂.

E. (E.) distendens (Lackschewitz, 1937)
Øyastrondi 12 July-17 Aug. 2♂♂, 17 Aug. -13 Sept. 32♂♂ 3♀♀.

E. (E.) dryaspagensis Chandler, 1977
Øyastrondi 12 July-17 Aug. 2♂♂.

E. (E.) fimbriata (Lundström, 1909)
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 4♂♂, 17 Aug. -13 Sept. 1♂ 2♀♀.

E. (E.) furcata (Lundström, 1911)
Øyastrondi 17 Aug. -13 Sept. 3♂♂; Sprongdalen (Loc. 3) 8.-12 Sept. 3♂♂.

E. (E.) grassatura (Plassmann, 1978)
Øyastrondi 12 July-17 Aug. 2♂♂ 2♀♀, 17 Aug. -13 Sept. 10♂♂ 6♀♀.

E. (E.) indecisa (Walker, 1856)
Nigard 8.-13 Sept. 5♂♂; Øyastrondi 12 July-17 Aug. 1♀, 17 Aug. -13 Sept. 2♂♂.

E. (E.) intersecta (Meigen, 1818)
Nigard 8.-13 Sept. 1♂; Øyastrondi 17 Aug. -13 Sept. 5♂♂ 1♀.

E. (E.) ligulata (Lundström, 1913)
Øyastrondi 12 July-17 Aug. 1♂ 1♀, 17 Aug. -13 Sept. 3♂♂ 1♀, 17 Aug. -13 Sept. 7♂♂ 3♀♀.

E. (E.) magnicauda (Lundström, 1911)
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 2♂♂.

E. (E.) pseudindecisa Lastovka & Matile, 1974
Øyastrondi 12 July-17 Aug. 1♂, 17 Aug. -13 Sept. 2♀♀.

E. (E.) pseudopulchella (Lundström, 1912)
Øyastrondi 24 June-12 July 1♂, 12 July-17 Aug. 8♂♂ 5♀, 17 Aug. -13 Sept. 45♂♂ 13♀♀.

E. (E.) pulchella (Winnertz, 1863)
Nigard 8.-13 Sept. 2♂♂; Øyastrondi 24 June-12 July 1♀, 12 July-17 Aug. 1♀, 17 Aug. -13 Sept. 10♂♂ 1♀; Sprongdalen (Loc. 3) 8-13 Sept. 1♂.

E. (E.) subulata (Winnertz, 1863)
Øyastrondi 12 July-17 Aug. 5♂♂, 17 Aug. -13 Sept. 2♂♂ 1♀.

E. (E.) sp. (cf. *forciposa* (Tollett, 1955))
Øyastrondi 17 Aug. - 13 Sept. 3♂♂, Nigard 8-13 Sept. 2♂♂.

E. (Xenexechia) crucigera (Lundström, 1909)
Øyastrondi 12 July-17 Aug. 2♂♂.

E. (X.) membranacea (Lundström, 1912)
Øyastrondi 17 Aug. -13 Sept. 1♂.

E. (X.) pollicata (Edwards, 1925)
Øyastrondi 17 Aug. -13 Sept. 1♂.

E. (X.) sp. (cf. *crucigera* (Lundström, 1909))
Øyastrondi 24 June-12 July 1♀.

Pseudobrachypeza helvetica (Walker, 1856)
Øyastrondi 17 Aug. -13 Sept. 2♂♂ 1♀.

Pseudoexechia trisignata (Edwards, 1913)
Øyastrondi 17 Aug. -13 Sept. 1♂.

Pseudorymosia foeva (Dziedzicki, 1910)
Øyastrondi 12 July-17 Aug. 1♀, 17 Aug. -13 Sept. 8♂♂.

Rymosia bifida Edwards, 1925
Øyastrondi 17 Aug. -13 Sept. 1♂.

R. fasciata (Meigen, 1804)
Øyastrondi 12 July-17 Aug. 1♂ 1♀.

R. guttata Lundström, 1912
Øyastrondi 24 June-12 July 1♂, 17 Aug. -13 Sept. 2♂♂.

R. placida Winnertz, 1863
Øyastrondi 12 July-17 Aug. 4♂♂, 17 Aug. -13 Sept. 1♂.

R. signatipes (van der Wulp, 1859)
Øyastrondi 12 July-17 Aug. 1♂.

R. sp. (cf. *acta* Dziedzicki, 1910
Øyastrondi 24 June-12 July 1♂, 12 July -17 Aug. 1♂, 17 Aug. -13 Sept. 2♂♂.

Tarnania fenestralis (Meigen, 1818)
Nigard 8.-13 Sept. 1♀; Øyastrondi 17 Aug. -13 Sept. 8♂♂ 1♀; Sprongdalen (Loc. 3) 8.-12 Sept. 1♂ 4♀♀.

T. tarnanii (Dziedzicki, 1910)
Øyastrondi 17 Aug. -13 Sept. 5♂♂ 1♀.

DISCUSSION

The species

The world distribution of most species of Mycetophilidae are only superficially known. However, several of the species reported must be considered rare, as they have previously only been recorded from one or a few localities. This holds for *Mycomya simulans,* recorded from Eastern Siberia (Väisänen 1984), *Acnemia falcata* from the Kola peninsula in Russia (Zaitzev 1982), *Zygomyia pseudohumeralis* from two locations in Germany (Caspers 1980, Plassmann 1988), *Anatella aquila* from Altai and Sakhalin in the former USSR (Zaitzev 1989), *A. fungina* from Lunz in Austria (Plassmann 1984), *Exechiopsis dryaspagensis* from Wales in England and *E. pseudopulchella* from southern Finland and Bavaria in Germany (Plassmann & Plachter 1986).

Three species have previously not been recorded outside the eastern parts of the Palaearctic Region, viz. *Mycomya simulans, Anatella aquila* and *Exechia subfrigida.* The latter is recorded from Mongolia and the central parts of the former USSR. The record of *M. simulans* is remarkable, and the specimen may cover an undescribed species. Nevertheless, more thoroughly examinitions have revealed several Eastern Palaearctic species to be more widespread than previously supposed. One such species recorded here is *Brevicornu bipartitum,* described from Mongolia, and not recorded outside this area untill two males were published from the St. Petersburg region (Zaitzev 1988).

The record of *Drepanocercus spinistylus* is noteworthy as it represent the first Palaearctic record of the genus, previously known by the Nearctic *P. ensiler* Vockeroth, 1980 only (see Vockeroth 1980 and Søli 1993).

Most species recorded from Jostedalen must be considered new to the Norwegian fauna. Exceptions from this are most species within the genus *Mycomya,* well treated by Väisänen (1984). Of these only *M. denmax, M. egregia, M. lambi, M. maculata* and *M. simulans* are new to Norway.

The fauna

Most species recorded from Jostedalen are widespread and common in Europe. Notwithstanding, several species tend to have their main distribution in the central/eastern parts of Europe, that means, they have not been recorded west of Germany, Switzerland and Italy. Such species are *Mycomya denmax, M. egregia, M. hackmani, M. simulans, Acnemia falcata, Polylepta borealis, Syntemna relicta, Boletine borealis, Dynatosoma thoracicum, Mycetophila abbreviata, M. sumavica, Phronia aviculata, P. caliginosa, P. longaelamellata, Trichonta facilis, T. fissicauda, T. trivittata, Zygomyia pseudohumeralis, Allodia pyxidiiformis, A septentrionalis, Anatella aquila, Brevicornu bipartitum, Exechia cornuta, E. maculipennis, E. subfrigida, E. unimaculata, Exechiopsis distendens, E. pseudopulchella, E. membranacea* and *Rymosia guttata. Exechiopsis dryaspagensis* is the only species recorded in western Europe only. This points to an affinity between the fauna in Jostedalen and the fauna in Central and Eastern Europe. Such an affinity is also emphasized when comparing the species list with other lists from England and Finland (for references see Tab. 2). Thus, 19% of the species here recorded have not been recorded from the British Isles, while only 9% have not been recorded from Finland.

As fungus gnats seem to have their optimal habitats at northern latitudes, one should except a rather rich and diverse fauna in Norway. Nevertheless, the very high number of species in this submontans area is noteworthy. Results obtained from other parts of Europe can be used to evaluate the diversity found in Jostedalen (Table 2). In doing this, only Allgäu in South Germany and Messaure in Northern Sweden reveals a species richness which outnumbers the one presented here. Still, the numbers are not fully comparable. The species list presented from Allgäu is the result of more than three years collecting. From Messaure the material originated from an extensive collecting programme, including various methods such as suction traps, light traps and pitfall traps. This contrasts the present survey, where, in addition to sweep nets, only one malaisetrap was operated at one location for less than 3 months. Hence, a more thoroughly study of fungus gnats in the Jostedalen area would undoubtly add several more species to the list.

In England and Finland the total numbers of species in Sciaroidea (excl. Sciaridae) are more than 510 (Chandler, pers. com) and 492 (Hackman 1980; Väisänen 1984). respectively. Given these numbers, one must suppose the Norwegian fauna of fungus gnats to comprise more than 500 species. If so, the fauna of Jostedalen includes at least 40% of the Norwegian species of fungus gnats.

Based on the present survey, Jostedalen seems to have an extremely rich and diverse fauna of fungus gnats, with several undescribed and rare species. This fits well with the results obtained from a study of a small sample of chironomids (Chironomidae) from the same area. Based on this single sample one new genera and two new species were described (Sæther & Schnell 1988, Schnell & Sæther 1988). Hence, more comprehensive studies of the invertebrate fauna in the Jostedalen area should be initiated. If the river is not allowed to dry out completely for longer periods, the terrestrial fauna will most probably not be seriously affected by the construction of the reservoir at lake Styggevatn.

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SAMMENDRAG

I forbindelse med en undersøkelse av evertebrater i Jostedalen sommeren 1988, ble det samlet inn mer enn 3000 individer av soppmygg. 214 arter ble identifisert innen familiene Diadocidiidae og Mycetophilidae. Tyve arter er ikke artsbestemt, og minst halvparten av disse er ubeskrevne. Funnet av *Drepano-*

cercus spinistylus er bemerkelsesverdig da slekten tidligere bare er representert med én art i Nord Amerika. Andre sjeldne arter er *Mycomya simulans* Väisänen 1984, *Acnemia falcata* Zaitzev, 1982, *Zygomyia pseudohumeralis* Caspers, 1980, *Anatella aquila* Zaitzev, 1989, *A. fungina* Plassmann, 1984, *Exechia subfrigida* Lastovka & Matile, 1974, *Exechiopsis dryaspagensis* Chandler, 1977 og *E. pseudopulchella* (Lundström, 1909). Disse artene er tidligere bare kjent fra et fåtall lokaliteter i verden.

Forekomsten av soppmygg er svært dårlig undersøkt i Norge, og de fleste artene er nye for vår fauna. Antall arter i materialet er meget høyt sammenlignet med resultater fra andre deler av Europa, og det totale artsantallet i Norge må anslås til minst 500. En vurdering av faunaen i Jostedalen viser affinitet til den sentrale/østlige palearktiske faunaen av soppmygg. Dette understrekes også ved at den har flere arter til felles med den finske faunaen enn med den engelske.

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Light trap catches of Caddis flies (Trichoptera) from a regulated and acidified Southwest Norwegian river

TROND ANDERSEN & FINN E. KLAUSEN

Andersen, T. & Klausen, F. E. 1994. Light trap catches of Caddis flies (Trichoptera) from a regulated and acidified Southwest Norwegian river. *Fauna norv. Ser. B 41:* 13—18.

Light trapping at two sites along the Sira river system in inner Vest-Agder in 1989 yielded a total of 9881 Trichoptera specimens belonging to 27 species in 7 families. At Tonstad, in the lower reaches of the River Sira, altogether 6772 specimens belonging to 22 species in 6 families were caught. *Oxyethira frici* Klapálek, 1891 (86.3%), *Polycentropus flavomaculatus* (Pictet, 1834) (2.6%) and *Rhyacophila nubila* (Zetterstedt, 1840) (2.5%) were the most abundant species. The family Limnephilidae made up only 6.7% of the material. At Fidjeland near the lake Fidjelandsvann 3109 specimens belonging to 22 species in 7 families were taken. The family Limnephilidae made up 96.5% of the material; *Apatania stigmatella* (Zetterstedt, 1840) (42.8%), *Limnephilus vittatus* (Fabricius, 1798) (35.4%) and *L. sericeus* (Say, 1824) (8.6%) were the dominant species.

The River Sira watershed is strongly regulated for hydroelectric power and the water flow in the river is reduced. The area is also affected by acid precipitation; average pH at the two trapping sites in 1988 were 5.36 and 5.44, respectively.

No previous surveys of the invertebrate fauna in the river have been undertaken. However, the caddis fly fauna shows similarities with the fauna in regulated river systems in central and inner parts of southwest and west Norway. The fauna in inner Vest-Agder also seems impoverished compared to the fauna in less acidified areas in southeast and west Norway. The total number of species now recorded from inner Vest-Agder is 34.

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INTRODUCTION

The river Sira and the neighbouring River Kvina watersheds are extensively exploited for hydroelectric power. Together the yield some 6 TWh/yr, equal to approximately 6% of the Norwegian energy consumption. The development started in 1963, and there are constructed 7 power stations, altogether. The water is directed through extensive tunnel systems from large water reservoirs in the surrounding mountains. This has led to a strongly reduced discharge in the two rivers. To secure a permanent water flow several wears have been constructed.

The area is also affected by acid precipitation, and today the lakes and rivers in the area are strongly acidified. The bedrock is mostly gneissic, with low buffer capacity.

The invertebrate fauna in the two river systems were not studied prior to the development. Neither seems there to have been carried out any studies on the consequences of the regulation, nor of the more recent acidification. Both hydroelectric exploitation and acidification are known to have harmful effects on the invertebrate fauna. The aim of this study is to give some information on the present status of the caddis fly fauna in one of the river systems.

STUDY AREA

The River Sira is running through the valley Sirdal in Vest-Agder in the southernmost part of Norway. The river originates in the southwestern parts of the mountain Langfjellene and has its outlet at Åna-Sira. The catchment area is about 1900 km^2. Several lakes are situated along the watercourse. After regula-

Table 1. Trichoptera, given as males/females, taken in light traps at two localities along the Sira river system in inner Vest-Agder in 1989.

Species	Tonstad	Fidjeland
RHYACOPHILIDAE		
Rhyacophila nubila (Zetterstedt, 1840)	70/99	19/8
HYDROPTILIDAE		
Oxyethira frici Klapálek, 1891	179/5662	-/1
PSYCHOMYIIDAE		
Tinodes waeneri (Linnaeus, 1758)	1/2	1/-
POLYCENTROPODIDAE		
Cyrnus flavidus McLachlan, 1864	7/1	1/-
C. trimaculatus (Curtis, 1834)	4/-	-
Neureclipsis bimaculata (Linnaeus, 1758)	-	-/3
Plectrocnemia conspersa (Curtis, 1834)	21/18	6/1
Polycentropus flavomaculatus (Pictet, 1834)	142/37	55/12
P. irroratus (Curtis, 1835)	1/-	-
PHRYGANEIDAE		
Agrypnia obsoleta (Hagen, 1864)	-	1/-
LIMNEPHILIDAE		
Apatania stigmatella (Zetterstedt, 1840)	80/53	1120/209
Limnephilus borealis (Zetterstedt, 1840)	7/-	69/1
L. coenosus Curtis, 1834	9/1	5/-
L. extricatus McLachlan, 1865	-	56/11
L. griseus (Linnaeus, 1758)	16/-	34/1
L. lunatus Curtis, 1834	31/19	-
L. luridus Curtis, 1834	1/-	-
L. marmoratus Curtis, 1834	4/-	-
L. rhombicus (Linnaeus, 1758)	5/3	61/11
L. sericeus (Say, 1824)	-	192/76
L. sparsus Curtis, 1834	9/3	10/1
L. vittatus (Fabricius, 1798)	99/49	927/173
Halesus radiatus (Curtis, 1834)	29/3	32/-
Micropterna sequax McLachlan, 1875	-	1/1
Potamophylax cingulatus (Stephens, 1837)	23/2	4/1
P. latipennis (Curtis, 1834)	10/-	4/-
LEPTOCERIDAE		
Mystacides azurea (Linnaeus, 1761)	48/24	1/-

tion minimum discharge is 3.7 m³/sek. during summer and 1.3 m³/sek. during winter.

At Tonstad (UTM:32VLL673053) (55 m a.s.l.) the light trap was situated close to the River Sira, approximately 400 m above the outlet in Lake Sirdalsvann. The bottom material in the river at the trapping site consists of medium sized stones, gravel and course sand. There is constructed a wear near the trapping site and the river flows rather slowly. Close to the trapping site the Stream Finsåni has its outlet in Sira. At the outlet Finsåni is rather slowflowing and the bottom material consists of small stones and sand. Between June 1987 and March 1988 the acidity of the River Sira near the trapping site varied between pH 4.9 and 6.2, with an average of pH 5.36 (Sanni & Skogheim 1988). In August 1989 the acidity at the trapping site was pH 4.77.

At Fidjeland (UTM:32VLL806373) (566 m a.s.l.) the light trap was situated close to the Lake Fidjelandsvann. At the trapping site the bottom material consists mostly of fine sand, and there are practically no vegetation in the lake. Some 100 m from the trapping site the small Stream Høna has its outlet. The stream is rather rapid and the bottom material consists of larger stones. Between June 1987 and March 1988 the acidity at the outlet of Lake Fidjelandsvann varied between pH 5.0 and 5.9, with an average of pH 5.44 (Sanni & Skogheim 1988).

METHODS

The light traps used were modified Robinson traps, fitted with mercury vapour bulbs (Philips HPL-N 125W). The caddies flies were caught in a container filled with aethyleneglycol and later transferred to alcohol.

The traps were operated from 15 July to 1 October 1989, and emptied at irregular intervals.

RESULTS

The total material comprises 9881 specimens of 27 species in 7 families, Table 1. At Tonstad 6772 specimens belonging to 22 species in 6 families were caught. Six species had a dominance of 1% or more, Fig. 1. The most abundant species, *Oxyethira frici* Klapálek, 1891 with 5841 specimens (86.3%), belong to the family Hydroptilidae. *Polycentropus flavomaculatus* (Pictet, 1834) with 179 specimens (2.6%) ranged second. This species belong to the family Polycentropodidae, a family represented by 5 species and 231 specimens, i.e. 3.4% of the material. The only representative of the family Rhyacophilidae, *Rhyacophila nubila* (Zetterstedt, 1840) ranged third with 169 specimens (2.5%). Of the family Limnephilidae 13 species and 456 specimens were taken, i.e. 6.7% of the material. The families Psychomyiidae and Leptoceridae were represented by one species each.

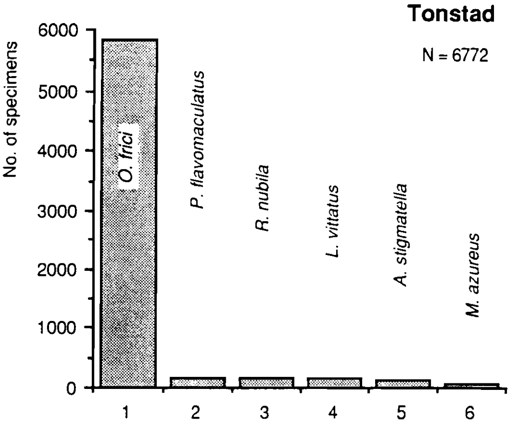

Fig. 1. Trichoptera species with a dominance of 1% or more in the light trap catches at Tonstad in inner Vest-Agder in 1989.

Vårflue arter med en dominans på 1% eller mer i lysfellefangstene ved Tonstad i Vest-Agder indre i 1989.

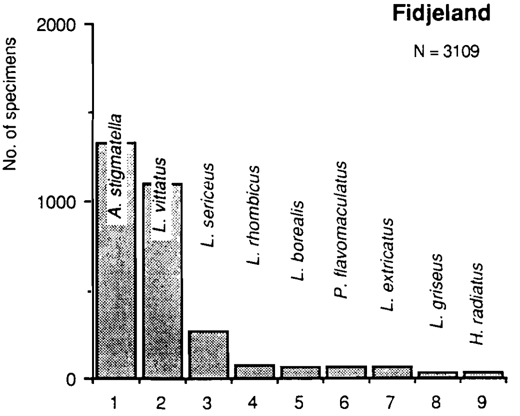

Fig. 2. Trichoptera species with a dominance of 1% or more in the light trap catches at Fidjeland in inner Vest-Agder in 1989.

Vårflue arter med en dominans på 1% eller mer i lysfellefangstene ved Fidjeland i Vest-Agder indre i 1989.

At Fidjeland a total of 3109 specimens belonging to 22 species in 7 families were taken. Nine species had a dominance of 1% or more, Fig. 2. Limnephilidae was represented by 13 species and 3000 specimens, i.e. 96.5% of the total. The three most abundant species all belong to this family: *Apatania stigmatella* (Zetterstedt, 1840) with 1329 specimens (42.8%), *Limnephilus vittatus* (Fabricius, 1798) with 1100 specimens (35.4%) and *L. sericeus* (Say, 1824) with 268 specimens (8.6%). Four species belonging to the family Polycentropodidae were taken, while the families Rhyacophilidae, Hydroptilidae, Psychomyiidae, Phryganeidae and Leptoceridae were represented by one species each.

DISCUSSION

The species taken are, with one exception, all common and widespread in South Norway; most of them do even reach the northernmost parts of Norway. *Limnephilus luridus* Curtis, 1834 is, however, found mostly in coastal areas in south Norway up to outer Sogn and Fjordane (Andersen 1974).

No comprehensive study of the adult caddis fly fauna in any of the larger river systems in southern or southeastern Norway has been undertaken. However, based on species records from e.g. River Numedalslågen (Andersen 1975, Andersen et al. 1993), the Trichoptera fauna in the River Sira seems to differ strongly both in species diversity and species composition. On the other hand, it clearly shows similarities with the fauna taken in light traps near river systems in central and inner parts of western Norway, most of which are regulated (Andersen 1980, Andersen & Tysse 1985, Andersen et al. 1978). In the more coastal parts of western Norway, the Trichoptera fauna in streams and rivers is usually much more diverse (Andersen 1976, Andersen & Tysse 1985).

The most abundant species at Tonstad, *O. frici,* is among the dominant species in several larger rivers in western Norway, like e.g. the River Storelvi near Odda (Andersen 1980). Also *P. flavomaculatus* and *R. nubila* are among the most abundant species in western Norway, inhabiting all types of running water, of these *P. flavomaculatus* can also be found in lakes. The most abundant species at Fidjeland, *A. stigmatella,* is a common species in larger inland rivers in western Norway, and was also the most abundant species in light trap catches from Lake Vassbygdvann in inner Sogn and Fjordane (Andersen 1980). *L. vittatus* is frequently taken in western Norway, but it rarely takes up a dominant position. The species was, however, abundant on muddy bottom in the River Suldalslågen prior to regulation (Lillehammer 1966). *L. sericeus* is more occasionally met with in western Norway, but it can be rather common in the lower mountain regions in the central and inner parts up to above 1000 m a.s.l. (Andersen 1979).

The effects of regulations on the bentic fauna in streams and rivers are often complex. However, species diversity is generally reduced and the relative abundance of the species altered (e.g. Ward 1976). As there was no survey of the bottom fauna prior to the regulation of the Sira and Kvina watersheds, the consequences of the regulation on this fauna can not be documented. However, the bottom fauna in the River Suldalslågen in southwest Norway was studied both prior to regulation (1961—1962), and again after regulation (1978—1979) (Lillehammer 1966, 1984, Lillehammer & Saltveit 1984). Based on larvae samples 11 species were recorded from this river prior to regulation: *R. nubila, O. frici, Plectrocnemia conspersa* (Curtis, 1834), *P. flavomaculatus, Hydropsyche angustipennis* (Curtis, 1834), *Lepidostoma hirtum* (Fabricius, 1775), *A. stigmatella, Chaetopteryx villosa* (Fabricius, 1798), *L. vittatus, Halesus tesselatus* (Rambur, 1842) and *Potamophylax latipennis* (Curtis, 1834). After regulation altogether 8 species were recorded. The regulation had the most serious effect on the case-bearing species, reducing their number from 6 to 2; only *P. latipennis* and *A. stigmatella* were still present. On the other hand, *P. flavomaculatus* strongly increased in relative abundance, as did all the other caseless species. Two species, *Hydropsyche pellucidula* (Curtis, 1834) and *H. siltalai* Döhler, 1963, not taken prior to the regulation, were also recorded.

At Tonstad the present study also show a high abundance of the caseless species *P. flavomaculatus* and *R. nubila,* but the most abundant species, *O. frici* is, in fact case-bearing. No less than 14 case-bearing species were taken at this locality. In the catches at Fidjeland case-bearing species were even more dominant. However, as many caddis flies, particularly among the limnephilids are known to be strong flyers (e.g. Crichton

1971), some of the species might have originated in ponds and streams not affected by the regulation.

Bentic invertebrates are influenced by acidification both indirectly through changes in the trophic level and directly through physiological mechanisms. As a result both species richness and diversity are often reduced (e.g. Meriläinen & Hynynen 1990, Schell & Kerekes 1989). Polycentropodids are often found to be abundant in acidified water, while many limnephilids and leptocerids seem to be more sensitive (e.g. Fjellheim & Raddum 1988). In his check-list on Norwegian caddis flies, Brekke (1946) recorded 15 Trichoptera species from inner Vest-Agder; four of these were not taken during the present study. Brekke gives no information on localities, but one of the species, *H. pellucidula* is a typical inhabitant of larger rivers (e.g. Edington & Hildrew 1981). According to Raddum & Fjellheim (1984) *Hydropsyche* species lack in the more acidified southwest Norwegian river systems. *H. pellucidula* might thus be a species which have disappeared from the River Sira in recent years due to acidification.

Recently, Johanson (1991) recorded 5 Trichoptera species from Audnedal in inner Vest-Agder. As 14 of the present species are «new» to inner Vest-Agder, the total number of species now taken in the province is 34. More species can certainly be encountered, but, as pointed out by Andersen et al. (1990) the caddis fly fauna in the southernmost regions of Norway seems to be impoverished when compared to the fauna in southeastern or western Norway.

SAMMENDRAG

Lysfellefangst av vårfluer (Trichoptera) langs et regulert og forsuret vassdrag i Sørvest Norge

Vårfluer (Trichoptera) ble fanget i lysfeller på to lokaliteter i Sirdal i 1989. Tilsammen ble det tatt 9881 eksemplarer fordelt på 27 arter tilhørende 7 familier. Ved Tonstad sto fellen plassert ved Sira ca. 400 meter over utløpet i Sirdalsvann. Her utgjorde *Oxyethira frici* Klapálek, 1891 86,3% av fangsten, *Polycentropus flavomaculatus* (Pictet, 1834) 2,6% og *Rhyacophila nubila* (Zetterstedt, 1840) 2,5%. Ved Fidjeland sto fellen plassert nær Fidjelandsvann. *Apatania stigmatella* (Zetterstedt, 1840) med 42,8%, *Limnephilus vittatus* (Fabricius, 1798) med 35,4% og *L. sericeus* (Say, 1824) med 8,6% var de mest dominerende artene.

Både Sira og naboelven Kvina er sterkt utbygget. Tilsammen gir de 6 milliarder KWh pr. år eller omkring 6% av Norges kraftforbruk. Det er bygget 7 kraftverk og vannet ledes i tuneller direkte fra magasiner i fjellet. Dette fører til at vannføringen i elvene er redusert. I tillegg har sur nedbør ført til forsuring i området i løpet av de senere årene. Vi vet at både kraftutbygging og forsuring har negative følger for bunnfaunaen.

Dessverre ble det ikke foretatt noen undersøkelser av denne faunaen før utbyggingen startet, og den er heller ikke blitt undersøkt senere. Det er derfor ikke mulig å trekke direkte konklusjoner angående endringer i artssammensetning eller dominansforhold. I Suldalslågen ble det derimot foretatt undersøkelser av bunndyrfaunaen både før og etter utbygging. Her forsvant de fleste av de husbyggende artene, mens nettspinnende arter som *P. flavomaculatus* og rovformer som *R. nubila* tok over. Faunaen vi finner i Sira i dag er ellers ikke ulik den vi finner i regulerte vassdrag i midtre og indre deler av Vestlandet.

Fjorten av artene er ikke tidligere tatt i indre Vest-Agder, og tilsammen er det nå rapportert 34 arter fra denne regionen. Selv om det sikkert kan påtreffes flere arter, synes de sørligste områdene av landet å ha en fattig vårflue fauna. Dette kan muligens skyldes forsuring.

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Overlapping geographical zones of two *Nemastoma* sibling species (Opiliones) in Norway, with a contribution to character displacement

INGVAR STOL

Stol, I. 1994. Overlapping geographical zones of two *Nemastoma* sibling species (Opiliones) in Norway, with a contribution to character displacement. *Fauna norv. Ser. B 41:* 19—28.

Two overlapping geographical zones between *Nemastoma bimaculatum* (Fabricius, 1775) and *N. lugubre* (Müller, 1776), were detected in southern Norway.

One lying in the neighbourhood of Trondheim and a second lying close to Kristiansand.

Six morphological characters were analysed with regard to character displacement, which was found within body width. Body length and length of pedipalpal tarsus was governed by the same forces.

Regarding the last three (spot) characters studied, significant differences ($p \leq 0{,}001$) between the two species existed both in sympatry and allopatry. Here, however, character convergence might occur.

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INTRODUCTION

In 1987 a program was carried out trying to locate sympatric populations of *N. bimaculatum* and *N. lugubre* in southern Norway.

A part of this program was to perform an analysis on character displacement, which may occur in overlapping geographical zones of closely related species.

The two *Nemastoma* sibling species here concerned display a very confusing taxonomic history in Norway (Stol 1982, Meidell & Stol 1990). For instance the name *N. lugubre-bimaculatum* was used.

In addition a couple of small overlapping geographical zones between the same species are reported from Belgium and northwestern Germany (Gruber & Martens 1968, Martens 1978).

Since the concept character displacement was defined (Brown & Wilson 1956) and up to now, much have been debated and written about these phenomena. Scarcity of convincing and illustrating examples have been prevailing.

More recently the concept has been thoroughly investigated by Fenchel (1975) and Cherrill & James (1987a,b), who have once more actualized and brought the concept into discussion.

MATERIAL AND METHODS

In the period from July to November 1987, 38 localities were visited in southern Norway, from Trondheim in the north to Kristiansand in the south (Fig. 1 and Tab. 1).

Totally 502 *Nemastoma* specimens were taken at 31 localities, of these 493 specimens were taken by pitfall traps.

Classifying the 502 specimens into species, sexes and allopatric-sympatric occurrences, the individuals were divided into the following eight groups: The four sympatric groups were 57 females, 67 males *N. bimaculatum* and 87 females, 57 males *N. lugubre.* The four allopatric groups were 49 females, 36 males *N. bimaculatum* and 92 females, 57 males *N. lugubre.*

These individuals were all examined for six morphological characters of which each attribute was believed to have indirectly ecological, trophic or behaviorial consequences.

1. Dorsal length of body: Measurements were taken from the middle (centre) of tuberculum oculorum to the most posterior point when tilting the posterior end up and down.
2. Dorsal, frontal width of body: Measurements were taken on a line through the middle of tuberculum oculorum falling at each side just behind the second walking leg.

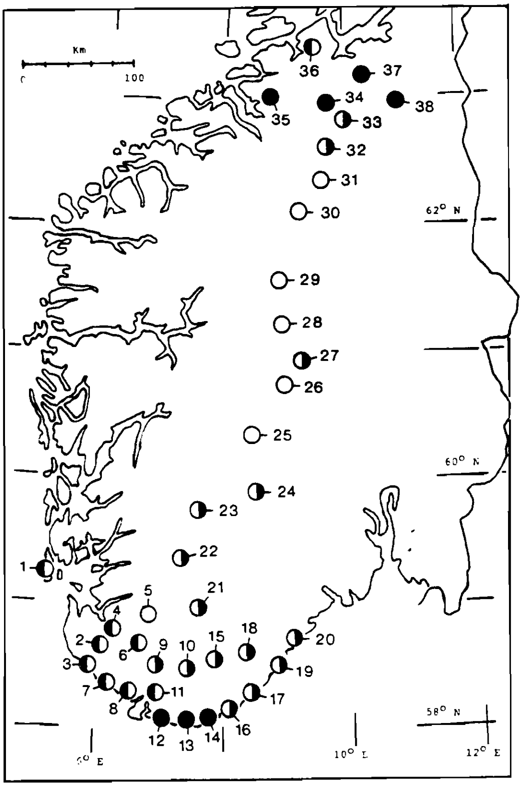


Fig. 1. Map of southern Norway showing the 38 localities visited in 1987. ◐ = *N. bimaculatum* taken (allopatric). ◑ = *N. lugubre* taken (allopatric). ● = *N. bimaculatum* + *N. lugubre* taken (sympatric). ○ = no *Nemastoma* specimens taken. Locality numbers as in Tab. 1.

In order to find this line it was necessary to tilt the anterior end up and down.

Body sizes may determine the ability of penetrating soil, pore sizes and soil types wherein the species can live or find shelter.

3. Length of pedipalpal tarsus: Dorsal measurements of the outermost part of the left pedipalp were taken. The pedipalp may have trophic functions of chemical nature, i.e. smell and taste, in addition to a sense of touch (Immel 1954, Sankey & Savory 1974).

4. Width of left, dorsal light spot: Measurements were taken through the middle of the left spot.

5. Relation between length and width of left spot. This relation indicates to which extent the spot has shape like a square. Measurements of length were taken through the middle of the left spot.

6. Area of left spot. Found by multiplying length by width.

The spots might be ascribed behaviorial functions. Different shape and quantity of light reflected might be important in species recognition at sympatric areas and prohibit attempts of hybridization.

It was a more requiring task to separate the *Nemastoma* females than the males.

The means from each locality for a given character are shown in Fig. 3 a-f. Unfortunately there are few individuals, and the influence of chance on locality-means may therefore be a drawback when interpreting these diagrams.

Adding up all measurements belonging to a given group and character, the diagrams in Fig. 4 a-f result. The mean in each group are based on more than 30 measurements and thus chance is almost eleminated from the results. All means are presented with limits of 95% confidence.

For a given character in Fig. 4 a-f all combinations of two allopatric groups are tested for significant differences between their means, as well as all combinations of two allopatric-sympatric groups and two sympatric groups. For a given character 28 t-tests are employed, and totally 168 t-tests. To compare repeatedly two means is possible as noted by Bishop (1971).

Coefficients of variation in allopatry and sympatry are shown in Tab. 2. The formula follows Sokal & Rohlf (1981), and is corrected for bias.

Physical parameters of localities visited are shown in Fig. 2 a-b.

Some frequently used abbreviations are: Ml = male *N. lugubre,* Mb = male *N. bimaculatum,* Fl = female *N. lugubre,* Fb = female *N. bimaculatum.*

The material is preserved at the Museum of Zoology, Bergen.

RESULTS

The map shows a northern sympatric area lying in the neighbourhood of Trondheim and a southern area close to Kristiansand. In extent, the sympatric overlapping zones are rather small, about 50—120 km in the east-west direction (Fig. 1).

The existence of more sympatric zones between these two is complicated by the inner-lying chain of mountains in the north-south direction.

Tab. 1. A list showing all 38 localities visited in 1987.

NO & NAME OF LOCALITY	AIR DISTANCE FROM A PLACE	BIOTOPE / WOOD	NO TRAPS / PERIOD	NO INDIVID. N.b-N.I
1. SANDVATN	RY 3km E of Stol Karmøy	Coniferous	4* 27.06-29.11.87	1m,7f -----
2. VIKESÅ	RY 40km SE of Stavanger	Deciduous	3* 03.07-24.10.87	2m,2f -----
3. TENGS	RY 4km NW of Eigersund	Deciduous	1* 10.07-31.10.87	0m,1f -----
4. BYRKJEDAL	RI 40km SE of Stavanger	Deciduous	4* 03.07-24.10.87	3m,8f -----
5. SINNES	VAI 65km E of Stavanger	Mixed	4* 03.07-24.10.87	-----------
6. TONSTAD	VAI 65km SE of Stavanger	Mixed	4* 03.07-24.10.87	10m,5f ----
7. ÅVENDAL	RY 7km NW of Hauge i D	Deciduous	4* 10.07-31.10.87	12m,20f----
8. FJELLSÅ	VAY 3km W of Flekkefjord	Mixed	3* 09.07-31.10.87	3m,2f -----
9. KVINLOG	VAI 90km SE of Stavanger	Mixed	3* 03.07-24.10.87	-------- 7m,5f
10. SVEINDAL	VAI 50km NW of Kristiansand	Coniferous	4* 03.07-24.10.87	-------- 1m,1f
11. ÅSE	VAY 3km S of Kvinesdal	Mixed	4* 09.07-07.11.87	3m,3f --------
12. NYLAND	VAY 7km S of Lyngdal	Deciduous	3* 09.07-07.11.87	12m,5f - 5m,24f
13. KIGE	VAY 4km E of Mandal	Mixed	4* 09.07-07.11.87	13m,9f - 1m,1f
14. SØGNE	VAY 16km SW of Kristiansand	Mixed	4* 09.07-07.11.87	1m,1f - 5m,10f
15. EVJE	AAI 50km N of Kristiansand	Coniferous	4* 03.07-24.10.87	------- 9m,4f
16. RANDESUND	VAY 7km E of Kristiansand	Deciduous	3* 04.07-07.11.87	------- 6m,4f
17. EIDE	AAY 7km E of Lillesand	Deciduous	4* 04.07-28.11.87	------- 4m,31f
18. HYNNEKLEIV	AAY 55km NE of Kristiansand	Mixed	3* 04.07-24.10.87	------- 3m,2f
19. FLOSTA	AAY 12km NE of Arendal	Mixed	3* 04.07-28.11.87	------- 6m,10f
20. RISØR	AAY 2km W of Centrum	Deciduous	3* 04.07-28.11.87	------- 3m,9f
21. OSE	AAI 92km N of Kristiansand	Coniferous	4* 05.07-09.10.87	------- 1m,1f
22. BYKLE	AAI 140km N of Kristiansand	Mixed	3* 05.07-09.10.87	------- 1m,0f
23. EDLAND	TEI 180km N of Kristiansand	Mixed	4* 05.07-09.10.87	------- 2m,1f
24. RJUKAN	TEI 2km W of Centrum	Deciduous	4* 05.07-09.10.87	------- 0m,4f
25. VASSTULAN	BV 50km N of Rjukan	Deciduous	2* 05.07-09.10.87	--------------
26. GOL	BV 90km N of Rjukan	Mixed	4* 05.07-10.10.87	--------------
27. ÅBJØR	OS 75km W of Gjøvik	Coniferous	4* 06.07-10.10.87	------- 3m,4f
28. BEITO	ON 110km NW of Gjøvik	Coniferous	4* 06.07-10.10.87	--------------
29. BESSHEIM	ON 100km NW of Lillehammer	Deciduous	4* 06.07-10.10.87	--------------
30. DOMBÅS	ON 6km E of Centrum	Deciduous	3* 06.07-10.10.87	--------------
31. KONGSVOLL	STI 130km S of Trondheim	Deciduous	3* 06.07-10.10.87	--------------
32. OPPDAL	STI 95km S of Trondheim	Deciduous	4* 06.07-10.10.87	-------- 3m,4f
33. BERKÅK	STI 70km S of Trondheim	Deciduous	2* 06.07-10.10.87	-------- 4m,4m
34. GORSET	STI 60km SW of Trondheim	Deciduous	3* 07.07-11.10.87	0m,1f - 0m,5f
35. SKEI	MRI 100km SW of Trondheim	Mixed	4* 07.07-11.10.87	20m,17f - 25m,21f
36. SNILLFJORD	STY 44km W of Trondheim	Mixed	4* 07.07-11.10.87	2m,2f -----------
37. FLÅ	STI 25km S of Trondheim	Mixed	4* 07.07-11.10.87	22m,23f - 14m,22f
38. REITSTØA	STI 57km SE of Trondheim	Mixed	4* 07.07-11.10.87	0m,1f - 7m,5f

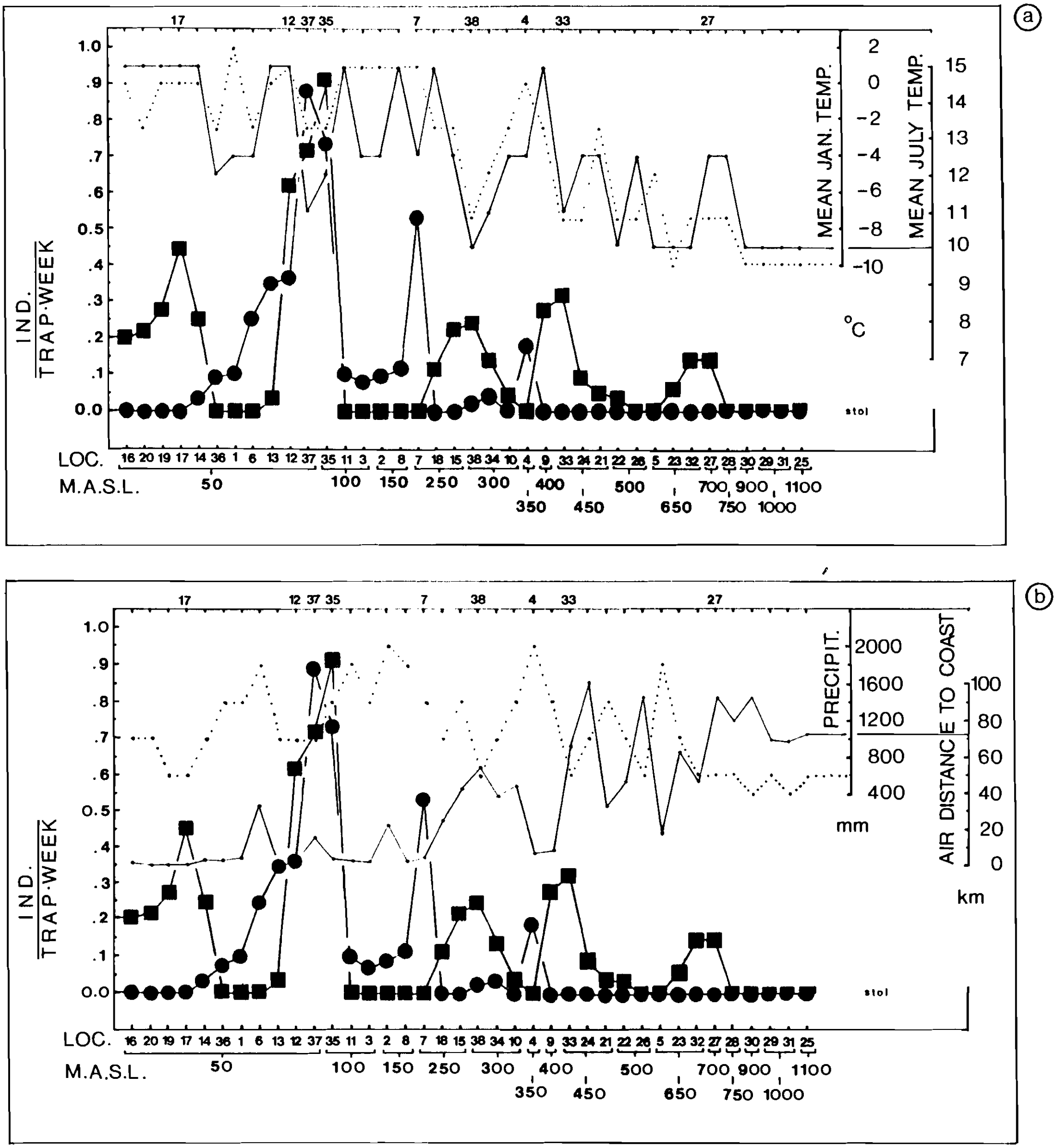
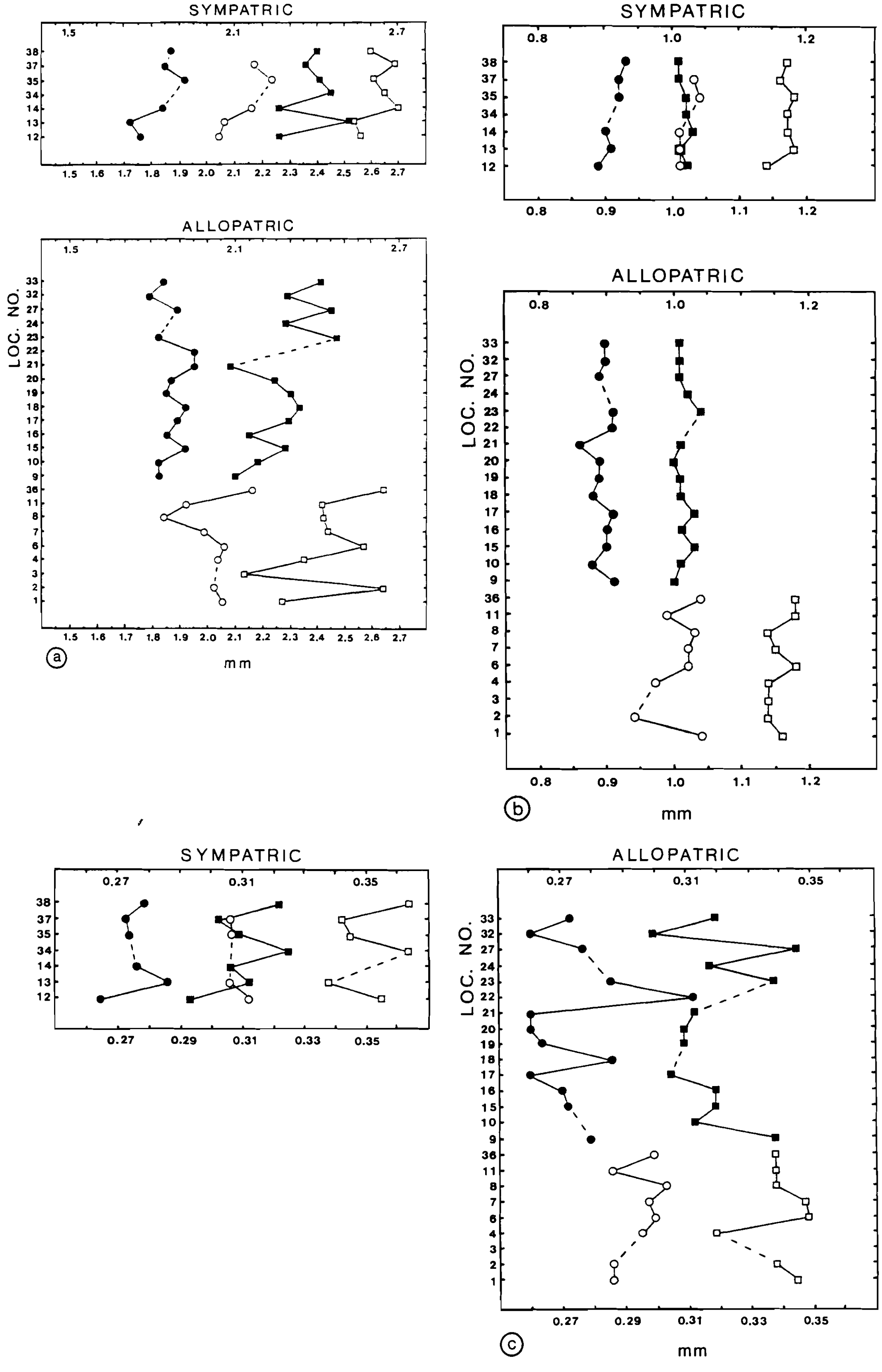


Fig. 2 a-b. Physical parameters of localities visited.
a. Mean January temperatures (= stippled line) and mean July temperatures (= continuous line).
b. Mean annually precipitations (= stippled line) and air-distance to coast (= continuous line).
● = *N. bimaculatum.* ■ = *N. lugubre.* Locality numbers as in Tab. 1.


SYMPATRIC
ALLOPATRIC
LOC. NO.
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1.6
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1.8
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mm
a
0.8
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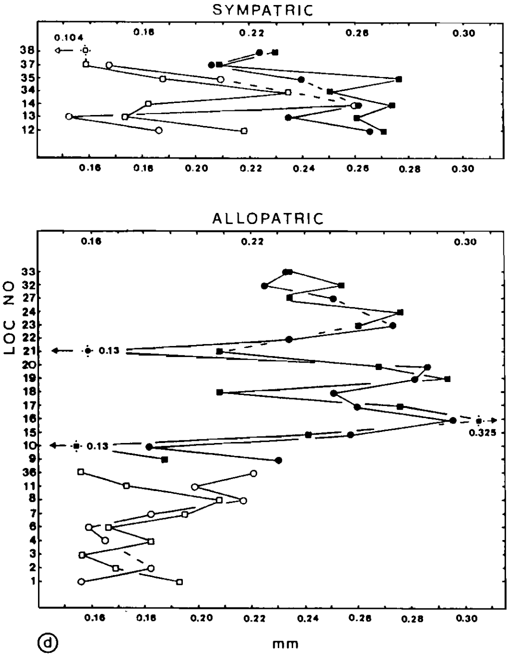

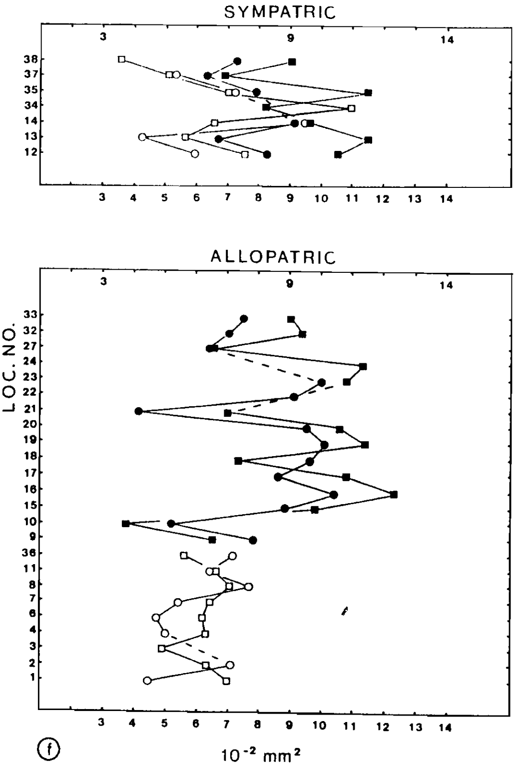

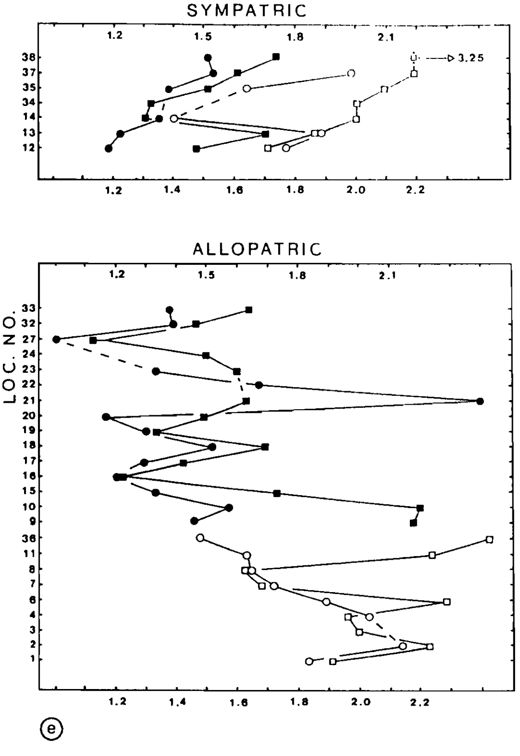

Northern sympatric localities (no. 34, 35, 37, 38) are MRI, Surnadal: Skei; STI, Rennebu: Gorset; Melhus: Flå; and Midtre Gauldal: Reitstøa. Locality 37 (Flå) and 35 (Skei) lying at 50 and 100 m.a.s.l. respectively, were together responsible for about 90% of the sympatric individuals taken in the northern area.

In this area the mean winter temperature is —2,5°C and mean summer temperature 11—12°C. Mean annual precipitation is 1000—1400 mm and distance to the coast less than 20 km (Fig. 2 a-b and Tab. 1).

Southern sympatric localities (no. 12, 13, 14) are VAY, Søgne: Søgne; Mandal: Kige; Lyngdal: Nyland. All are lowland localities situated about 50 m.a.s.l. Mean winter temperature is 0- (+) 1°C and mean summer temperature 15°C. Mean annual precipitation lies about 1000 mm and distance to the coast less than 5 km (Fig. 2 a-b and Tab. 1).

Some important facts will appear when considering Fig. 4 a-f.

Fig. 3 a-f. Diagrams of six morphological characters showing means from each locality in sympatry and allopatry for the sexes of both species: a. Length of body, b. Width of body, c. Length of pedipalpal tarsus, d. Width of spot, e. Shape of spot, f. Area of spot. ● = Ml. ○ = Mb. ■ = Fl. □ = Fb. Locality numbers as in Tab. 1 and abbr. as in text.

The first three allopatric overlapping characters show the same trend towards creating a gap between the species in sympatry. Using Fig. 4b (width of body) one will immediately see that the established gap between the species (i.e. Fl-Mb) in sympatry is even significant (at a $p \leq 0,02$).

The last three spot-characters show original significant allopatric gaps between the species at a $p \leq 0,001$. The gaps also exist in sympatry. The spots of *N. lugubre* are the widest, the most square-like and have the greatest area. Ml, however, have spots that are significantly narrower and of smaller area in sympatry. This is character convergence in sympatry.

DISCUSSION

Complete competitors cannot coexist (Gause 1934, Hardin 1960). This principle has been much debated as it is difficult to prove it in nature.

The same is to be said about the principle of character displacement. Both principles are, however, closely related and must be considered in connection with the process of speciation.

Roughgarden (1983) emphasized that competition may cause each of the competing species to evolve in response to the other, thus producing coevolution. But it must be taken into consideration that this process may be very slowed down by genetic homeostasis (Mayr 1975).

Species differences may result from competition between an invader and the members of the residing fauna (Roughgarden 1983). In the case of *Nemastoma* the southern overlapping area is narrow, and it is therefore likely to consider the residing fauna in sympatry to be the same as that of each side of the coexisting zone.

Character displacement denotes a stage or level in the process of evolution in sympatry. It gives an indication of the result of selection so far. Genetic homeostasis and input of allopatric genes may delay evolution. The ability of a differential resource utilisation (Fenchel 1975, 1988) will facilitate it.

Character displacement is of universal importance in evolution, and there is no other way in which the diversification of resource in guilds of related species can be understood (Fenchel 1988).

In a sympatric area the most favourable genes will be selected for, reducing competition. This should partly imply less genetic variation among sympatric populations of a species with regard to a character. Fig. 3 and Tab. 2 may support this.

By partly using the criteria cited in Cherrill & James (1987a), character displacement may be a reality concerning width of body, a possible objection being that no significant difference between allopatric Fl and sympatric Fl exists. This reveals the other species being mainly responsible for the changes observed. Grant (1972) proposed 12 possible directions for changes.

Cherrill & James (1987a) inquire in addition a confirmation of the genotypic nature of the character, and its resulting from interspecific competition.

The genetic variation of width of body is rather small (Fig. 3b and Tab. 2). Interspecific competition has yet to be proved, but its occurrence is likely. At the small overlapping area close to Kristiansand the climate and fauna is perhaps identical to those of the neighbouring allopatric zones.

Some comments to the discussion of com-

Tab. 2. Coefficients of variation in allopatry and sympatry.

	ALLOPATRY				SYMPATRY			
	Fb	Fl	Mb	Ml	Fb	Fl	Mb	Ml
BODY LENGTH	9,53	7,09	8,03	5,41	6,66	6,79	6,14	4,97
BODY WIDTH	2,95	2,19	3,08	2,34	2,18	1,78	2,56	1,71
PED.TARSUS	4,86	6,74	4,37	5,24	4,15	6,18	4,82	4,81
SPOT WIDTH	22,61	17,87	22,92	14,71	26,35	15,93	21,88	16,26
SPOT SHAPE	22,31	24,14	25,38	17,65	31,11	14,53	19,84	16,20
SPOT AREA	29,78	24,34	31,75	21,18	34,26	25,26	28,60	24,39

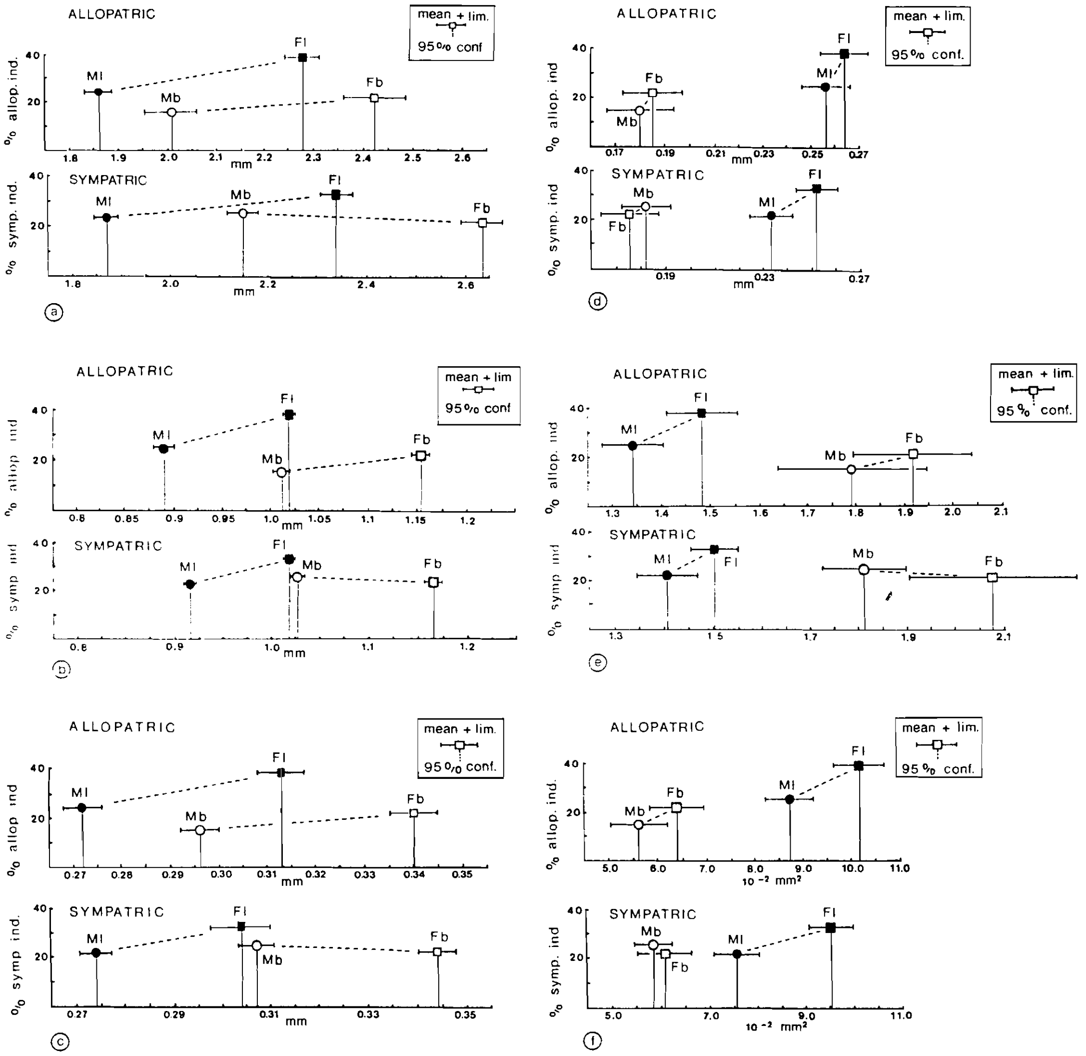

Fig. 4 a-f. Diagrams showing means of males and females of both species totally, based on six morphological characters in sympatry and allopatry: a. Length of body, b. Width of body, c. Length of pedipalpal tarsus, d. Width of spot, e. Shape of spot, f. Area of spot. ● = Ml. ○ = Mb. ■ = Fl. □ = Fb.

petition in Cherrill & James (1987a,b) is needed. The local phenotypic size variations of *Hydrobia* species could be accounted for without invoking genetical changes. It would be unfortunate to invoke character convergence in this case as done by Cherrill & James (1987a). Character convergence as used by Brown & Wilson (1956) is merely the opposite direction of character displacement, Grant (1972), involving genetical changes. It would here be partly illogical to discuss a selection pressure creating similarities in food particle sizes and shell heights, which are thought to be so closely related, and thereby increase competition. Convergence will normally be found when the character is of no importance for coexistence.

Analogous similarities were here observed within characters of *N. lugubre*. Males will in sympatry show more similarity to the other species with regard to width of spot and area of spot. These trends will not affect coexistence.

The insufficient amount of data in the previously cited examples of character displacement do not illustrate much at all. The case might be the same concerning the *Sitta* species reported by Vaurie (1951) with an alternative explanation of Grant (1972) based on the same informations. Too little data exist on populations at the border of coexistence for one species *(S. neumayer).* Displacement in the latter species cannot totally be excluded as also Grant (1972) is aware of.

Afterall the example might display character displacement combined with geographic variation.

Looking at Fig. 3 a-c the allopatric means representating different environmental conditions are found to possess a potential of fluctuation. This should imply that differences between more geographical distant populations easily could be detected if selection pressures from the environments were different.

Several aspects were discussed by T. Solhøy (in letter). There are strong indications for both *Nemastoma* species to live more than a year (Phillipson 1959, Meinertz 1964, Sankey & Savory 1974, Stol 1982). Perhaps adults of some populations wouldn't survive winters and consequently become smaller. Looking at Fig. 3 a-c and mountains means, however, there is no support for age induced biases affecting means.

In Phillipson's (1959) study of the life history of *N. bimaculatum,* he incorrectly referred to *N. lugubre* (Gruber & Martens 1968, Meidell & Stol 1990). He observed that a hatched generation (in April) has a life span of about 15 months.

A part of the trapping period used could give second year adults together with first year adults in the traps. It is likely that age and size biases among adults, if existing in traps, would be small and smooth out.

Juvenils of both species resamble the adults, but the color is yellow-brown.

Most probable the life history of *N. lugubre* resambles that of *N. bimaculatum.*

The diets may be different among populations, but there is no indication of size biases of major importance among highland and lowland means illustrated. Using the incorrect and vague name *N. lugubre-bimaculatum,* Rimsky-Korsakow (1924), cited in Immel (1954), reports the diet to the insects and Acari specimens. It applies to *N. lugubre* with reference to notes in Sokolow (1929). Generally, Opiliones are carnivorous, but also feed on plants and dead organic material (Sankey & Savory 1974).

In Japan Suzuki & Tsurusaki (1981) studied overlapping geographical zones of two other Opiliones sibling species. In this case the taxonomic work displayed the species to be no more than two forms of the same species.

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SAMMENDRAG

Geografiske overlappingssoner til to *Nemastoma* sibling arter (Opiliones) i Norge med et bidrag til karakterforskyvning.

Det ble funnet to geografiske overlappingssoner mellom *Nemastoma bimaculatum* og *N. lugubre* i Sør-Norge. Den ene overlappingssonen ligger nær Trondheim og den andre nær Kristiansand.

Seks morfologiske karakterer ble analysert med hensyn til karakterforskyvning. Karakterforskyvning ble funnet angående karakteren kroppsvidde. Kroppslengde og lengde av

pedipalpal tarsus ble styrt av de samme krefter.

Når det gjelder de tre siste flekk-karakterene, så eksisterte det signifikante forskjeller ($p \leq 0,001$) mellom de to artene både i sympatry og allopatry. Her derimot forekommer kanskje karakterkonvergens.

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The insect fauna associated with carpophores of the fungus *Fomitopsis pinicola* (Fr.) Karst. in a southern Norwegian spruce forest

BJØRN ØKLAND AND SIGMUND HÅGVAR

Økland, B. and Hågvar, S. 1994. The insect fauna associated with carpophores of the fungus *Fomitopsis pinicola* (Fr.) Karst. in a southern Norwegian spruce forest. — *Fauna norv. Ser. B 41:* 29—42.

The insect fauna of *Fomitopsis pinicola* in three developmental stages was studied in different ways: (1) Rearing; (2) carpophore traps; (3) odour traps with carpophores as the odour source (4) observations and experiments on a common species, *Gyrophaena boleti* (L.).

The rearings yielded 23 species. Few species were reared from more than one of the stages, indicating a pronounced fauna succession in the carpophores. Highest diversity was found in the dead carpophores. Four species seem to be clearly associated with *F. pinicola,* while the majority is described from other habitats. Four Diptera and three Hymenoptera species are new to Norway.

The long species list in the carpophore traps indicate a high activity of insects close to the carpophores. The majority of the species are previously described from fungus or saproxylic habitat, but few were reared from *F. pinicola* in this study. However, some relation to the carpophores is indicated, since most species showed significant difference among the carpophore stages in the traps.

Attraction to carpophore scent was not found for the beetle species tested, but is not excluded as a factor in host selection. However, *Gyrophaena boleti* was exclusively observed under living carpophores with opened hymenium, and moisture of between 28—100%, while this restriction was not demonstrated in the carpophore traps, in which this species also occurred in the other stages of the carpophores. Thus, stimuli from direct or close contact with the substrate appears to be a major factor in the host selection.

Even high densities of spore-eating *G. boleti* had no visible impact on the hymenia of sporulating carpophores. Dissecting a large number of carpophores in different developmental stages revealed relatively few galleries or other traces of insect activity. It is unclear whether the major role in the decomposition of *F. pinicola* Carpophores is played by insects, micro-organisms or these in combination.

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INTRODUCTION

The present article comprises a study of the insect fauna associated with *Fomitopsis pinicola* within a forest reserve, and forms the basis for a later comparative study with managed forests. Generally, polypores are considered to be a habitat for many specialized invertebrates. There are several publications on the fauna and ecology of polypores (Bendick 1952, Nuss 1975, Paviour-Smith 1960, Graves and Graves 1985, Klopfenstein and Graves 1989, Pielou 1966, Pielou and Verma 1968, Klimaszewski and Peck 1987). However, this faunal element is poorly studied in Scandinavia. Our primary goal is to increase the knowledge about saproxylic insect communities in order to achieve species conservation in forestry practices. We chose carpophores of *F. pinicola* as object for our study, because they appear both in managed and less-disturbed forests, and may be used in comparisons between these forest types.

F. pinicola is widely distributed in the

Taiga forests of Europe and North America, and is also reported from South America, Africa, Australia, Central and East Asia, Japan and the Philippine Islands (Perrin 1979, Mounce 1929). This species is reported from more than 100 tree species (Perrin 1979). It grows mainly on coniferous trees, but is common on deciduous trees as well. Experimental logging of Douglas fir in USA showed that *F. pinicola* appeared about 3 years after logging, and gradually came to dominate in the degradation of the wood during the 11-years study (Wright and Harvey 1967). Cracks in the outer bark are assumed to be the major entrance for the fungi. However, *F. pinicola* has been isolated from as many as 39% of in-flight bark beetles *(Ips pini, Dentroctonus brevicomis, D. ponderosae, D. valens),* indicating that such bark beetles may be important in the dissemination of this fungus (Pettey and Shaw 1986).

F. pinicola produces relatively big, perennial carpophores, which represent suitable habitats for many invertebrate species. Midtgaard (1985) presents a list of Teneidae (Lepidoptera) and their polypore hosts, among these *F. pinicola.* In Karelian forests Yakovlev (1986) has reared insects from *F. pinicola,* and Yakovlev and Myttus (1989) have conducted experiments on the attraction of Diptera to aromatic substances from *F. pinicola.*

The essential questions in the present study are:

1. How does the fauna associated with *F. pinicola* differ between the successive stages of the carpophores?
2. What kind of species are trapped, and what relationship do they have to the carpophores?
3. What kind of stimuli are important for host selection?
4. Do insects feeding intensively on the underside of the carpophores effect the vitality of the fungus?

STUDY AREA

The studies were conducted in 1991—92 near Tappenberg lake (UTM: N 636100, E 148000) in the Østmarka Nature Reserve (12.5 km^2) east of Oslo in Norway. The reserve is dominated by old spruce forest (*Picea abies)* with scattered birchs (*Betula verrucosa* and *B. pubescens),* aspens *(Populus tremula,* sallows *(Salix caprea),* rowans *(Sorbus aucuparia),* hoary alders *(Alnus incana)* and bird cherries (*Prunus padus).* Generally, the area has a high density of dead wood and of the dominat polypore species, *Fomitopsis pinicola* (up to 37 cubic meter dead wood and 300 carpophores pr. 1000 m^2).

METHODS

Classification of carpophore stages

The carpophores were classified into three developmental stages: Stage I, small, live capophores with undeveloped hymenium; stage II, live carpophores with open, moist hymenioum; stage III, dead carpophores (Fig. 1). By dissecting a large number of carpophores, we did not find any individual with heavily insect-infested interior parts, which could constitute a separate stage between living and dead carpophores caused by insect penetrations (see Graves 1960). Dry carpophores were not treated as a separate stage (Graves 1960), since they comprised both living and dead fungi in our registrations: We selected 50 dry carpophores (moisture content <20%; moisture content = weight of water/dry weight x 100, Protimeter III) on 11 May 1992, and repeated the measurement of the moisture content and tested for sporulation 11—15 June. At that time half had moisture above 28% (20 carpophores with moisture as

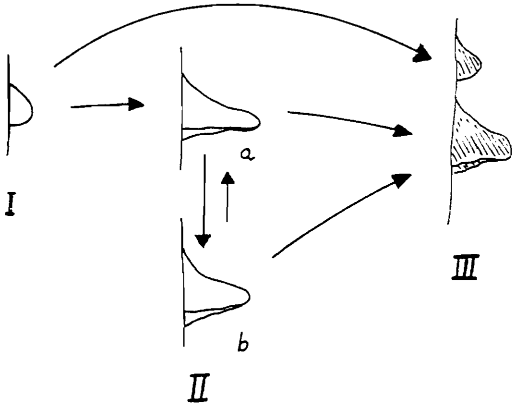


Fig. 1. Schematic representation of the developmental stages of *Fomitopsis pinicola* recognized in our study. I: Carpophores with undeveloped hymenium. II: Living carpophore with opened hymenium (a, moist individual; b, dry individual which is alive and may recover). III: Dead carpophore.

high as 50—80%), and 16 carpophores sporulated (microscope slides with vaseline were mounted 1—2 cm below the hymenia). Clearly, this fungus has a great ability to survive dry periods by stopping spore production and reducing the water content in the carpophore. In our study, stage III comprised only black carpophores which were certainly dead.

Rearing and trapping methods

Insects from each of the three stages of *F. pinicola* were collected with three methods: Rearing from enclosed carpophores, «carpophore traps» close to carpophores in situ, and «odour traps» with carpophores as the odour source. The rearing and trapping periods were (period 1) from 28 April to 30 May, (period 2) from 30 May to 27 June, (period 3) from 27 June to 13 August, and (period 4) from 13 August to 29 September, 1991. Ethylen-glycol was used as a preservation in all trap types.

Insects were reared from 198 carpophores, 66 for each stage. Ninety carpophores were kept in an outdoor cage house with a natural climate. Each carpophore was placed in a plastic funnel closed with black textile on the top and a collecting vial in the bottom. The remaining 108 carpophores were situated in the boxes of the odour traps (see beneath). Carpophores in the funnels were collected at the beginning of periods 1, 2 and 4, and the collecting vials were emptied in all of the four periods. After rearing had ceased, all carpophores were dissected and inspected for traces of insect activity.

Carpophore traps were mounted on 30 carpophores *in situ,* 10 from each of the three developmental stages. The carpophore trap consisted of a transparent plastic sheet inserted vertically through the carpophore, ending in a plastic funnel with a collecting vial about 5 cm beneath the humenium (Fig. 2A). Volatile insecticide («Vapona strip») was mounted beneath the plastic barrier in order to increase the trapping of insects under the hymenium. The traps did not seem to disturb the growth of the carpophores.

The odour traps were arranged in a regular grid of 6 x 6 traps with 2 m intervals, and the trap categories were alternated in order to avoid clustering effects within the grid. There were nine traps within each carpophore stage, and nine control traps without carpo-

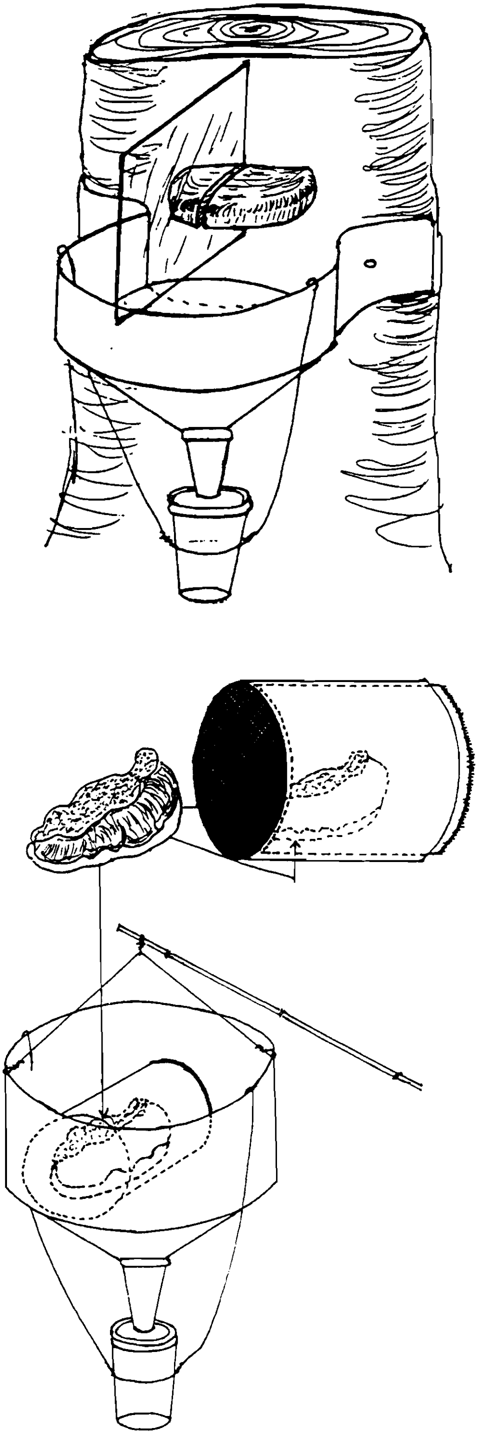


Fig. 2. Traps used in the present study. A: Carpophore trap. B: Odour trap.

Table 1. Insect species reared from carpophores of *Fomitopsis pinicola* (Fr.) Karst in different developmental stages in our study, and habitat references in literature. I: Before development of ripe spores. II: Active production of ripe spores. III: Dead. *New species for Norway.

TAXA	STAGE			HABITAT REFERENCES
	I	II	III	
Cisidae (Coleoptera)				
Cis glabratus Mellie	0	2	75	fungivores, in polypores (Paviour-Smith 1960 etc.)
Cis quadridens Mellie	0	0	18	fungivores, in polypores (Paviour-Smith 1960 etc.)
Cis dentatus Mellie	0	1	0	fungivores, in polypores (Paviour-Smith 1960 etc.)
Ennearthron laricinum (Mellie)	0	0	3	fungivores, in polypores (Paviour-Smith 1960 etc.)
Staphylinidae (Coleoptera)				
Leptusa pulchella (Mannerheim)	0	0	2	stumps, trunks, and polypores (Hansen 1954)
Leptusa fumida (Erichson)	0	0	1	stumps, trunks, and polypores (Hansen 1954)
Gyrophaena boleti (L.)	1	0	0	fungivores, especially spores (Ashe)
Rhizophagidae (Coleoptera)				
Rhizophagus dispar (Paykull)	0	0	1	hunt larvae under bark (Hansen 1950)
Ptinidae (Coleoptera)				
Ptinus fur (L.)	0	3	0	non-saproxilic habitats (Hansen 1951)
Latheridae (Coleoptera)				
Stephostethus rugicollis (Paykul)	1	0	0	non-saproxilic habitats (Hansen 1951)
Microphysidae (Hemiptera)				
Loricula elegantula Bärenspr.?	0	0	4	prey on wood lice and springtails ((Chinery 1973)
Tineidae (Lepidoptera)				
Archinemapogon yildizae Kocak	0	3	0	F.pinicola, and other polypores (Midtgaard 1985)
Cecidomyiidae (Diptera)				
*Winnertzia nigripennis Kieff.?	0	0	9	
Winnertzia Rondani sp.	0	0	1	
*Camptomyia maxima Mamaev	0	9	0	mycelium of F.pinicola (Mamaev 1961)
Camptomyia Kieffer sp.1	0	0	14	fungi/under bark (Panelius 1965)
Lestodiplosis polypori (Loew)	0	44	8	hunt insect larvae (Hingley 1971)
Sciaridae (Diptera)				
*Lycoriella solani (Winnerts)	0	89	0	occurs as "mushroom pest" (Hussey et al.1969)
Lycoriella Frey sp.	0	7	0	
*Corynoptera forcipata (Winnerts)	0	0	1	
Corynoptera Winnerts sp.	0	1	0	
Chloropidae (Diptera)				
*Gaurax dubius (Macquart)	0	0	1	reared from Piptoporus betulinus (Smith 1965)
Encyrtidae (Hyenoptera)				
*Coelopencyrtus araenarius (Erd.)	1	0	0	parasite in wasp larvae (Tryapitsyn 1987)
Ichneumonidae (Hymenoptera)				
*Lissonota deversor (Gravenhorst)	0	0	2	parasite in butterfly larvae (Hedqvist pers.comm.)
Plectiscidea Viereck sp.	0	1	0	unknown (Hedqvist pers.comm.)
Braconidae (Hymenoptera)				
*Bracon atrator Nees	0	0	1	parasite in butterfly larvae (Hedqvist pers.comm.)
SUM SPECIES	3	8	15	
SUMSPECIMENS	3	160	141	

phores. The trap was a hanging plastic funnel with collecting vial (Fig. 2B). The carpophores were placed in a metal box inside the funnel; they were not visible from outside, but the fungal smell could escape through the fine-meshed netting walls of the box. Attracted insects were empied from the collecting vials, and reared insects were collected from the metal box. The traps were operated during periods 1, 2 and 3, and the carpophores were replaced at the beginning of each period.

All reared adult insects were determined to species except Collembola. *Corynoptera sp.* (Diptera) were not determined to species due to the lack of male individuals. In the carpophore and odour traps only Cisidae, Staphylinidae and Ptilidae (Coleoptera) were determined to species.

Gyrophaena boleti

On 4 June 1991, we counted the number of *Gyrophaena boleti* and measured the moisture content under 100 carpophores in a locality with a high density of *F. pinicola.* Further, the feeding damage of the hymenium was tested in a small experiment. On the 8 June 1991, 12 pairs of test chambers were mounted under sporulating carpophores. One chamber confined feeding beetles within a small area of the hymenium, while the other was kept empty (control). Three densities of beetles were tested (3.5, 7.0 and 14.0 beetles pr. cm^2). The hymenia in all of the chambers were inspected under a stereo microscope after 24 days. Several *G. boleti* were collected in order to check if other species of *Gyrophaena* were represented.

RESULTS

Rearing from carpophores

Rearing from 198 carpophores yielded totally 23 species representing five orders: Diptera, Coleoptera, Hemiptera, Lepidoptera and Hymenoptera (Table 1). The majority of the species belonged to Diptera and Coleoptera, and the highest species number was found in the families Cecidomyidae (Dipt.) and Cisidae (Col.). The species numbers increased with the stage number; three species in stage I, eight in stage II and 15 in stage III. Only three individuals were reared from stage I, while stage II and III yielded 159 and 141 specimens respectively. Only two species were reared from more than one carpophores stage.

Carpophore traps

The total capture in the carpophore traps comprised 96 Staphylinidae species, 12 Cisidae and three Ptilidae species (Appendix 1). Most frequent staphylinids were *Lordithon lunulatus, Gyrophaena boleti* and *Oxypoda alternans,* which all were most numerous in stage II. *Cis glabratus* and *Cis quadridens* were the most abundant species in Cisidae, and *Acrotrichis intermedia* in Ptilidae. These three species appeared most often in the stage III traps. Table 2 shows the test results for the difference between the carpophore stages. Significant differences were found in 11 of the 16 individually tested species, and also between the sums of the less numerous species ($n<15$).

An analysis of the habitat requirements of the trapped species is given in Table 3. The majority of the species, including species with few individuals, have been reported from saproxylic and fungal habitats (Newton 1984, Lawrence 1973, Sundt 1958). By and large, frequent capture and clear significance between stages corresponded with species described as obligatory fungi or dead wood inhabitants. Few of the trapped species were reared in this study. The three most frequently reared species showed a significant difference between the stages in the carpophore traps, while four species reared in low numbers were also seldom trapped.

Odour traps

The odour traps captured 55 Staphylinidae species, three Cisidae species and six Ptilidae species. Most species were few in numbers, and seemed to occur just as often in the control (Appendix 2). Generally, the tests showed no significant difference between the carpophore-containing traps and the control (Table 4). Only four species were numerous enough to be tested indicidually, of which two species showed a significant difference between traps with and without carpophores (Table 4).

Table 2. The results of chi-square test on the distribution of the species among the developmental stages of the carpophores in the traps under carpophores of *Fometopsis pinicola* (Fr.) Karst. I: Undeveloped humenium. II: Opened hymenium. III: Dead. ***$p<0.001$, **$p<001$, *$p<0.05$, ns $p>0.05$.

		main test	a posteriori test	
Species	Max.in stage	Chi-square	I=II,III?	II=III?
Lordithon lunulatus (L.)	II	94,0625 ***	ns	***
Gyrophaena boleti (L.)	II	41,54688 ***	**	***
Oxypoda alternans (Gravenhorst	II	89,18 ***	**	***
Acrotrichis intermedia (Gillmeister	I	32,46667 ***	***	**
Cis glabratus Mellie	I	44,93103 ***	***	***
Quedius plagiatus (Mannerheim)		3,875 ns		
Cis quadridens Mellie	I	51,31818 ***	**	***
Ischnoglossa prolixa (Gravenhorst)		1,1875 ns		
Placusa tachyporoides Waltl	I	13,46154 **	**	ns
Phloeonomus sjoebergi Strand		3,714286 ns		
Placusa incompleta Sjöberg	I	31,14286 ***	***	***
Anthophagus omalinus Zetterstedt		3,1 ns		
Sepedophilus littoreus (L.)		1,6 ns		
Acrotrichis insularis (Mäklin)	I	10,84211 **	ns	**
Lordithon thoracicus (Fabricius)	II	15,64706 ***	**	*
Mniusa incrassata (Mulsant&Rey)	I,III	8,375 *	**	ns
Other species		17,73214 ***	***	ns
SUM TOTAL		92,8045 ***	***	**

Table 3. Distribution of species number among ecological groups, and among the levels of significance of the difference between carpophore stages in the traps under *Fomitopsis pinicola*. The differences between the stages were chi-square tested in species with a mean number of specimens at least 5 in each stage. ***$p<0.001$, **$p<0.01$, *$p<0.05$, ns $p>0.05$. The ecological categories are judged from hatching results and literate descriptions.

	Total	<5 in stage	>5 in stage			
			Difference between stages			
			ns	*	**	***
Frequently hatched from F.pinicola	3	0	0	0	0	3
Few hatched from F.pinicola	4	4	0	0	0	0
Obligatory saproxylic	38	30	2	1	1	4
Facultative saproxylic	74	58	5	1	2	8
Obligatory in fungi	22	16	0	0	0	6
Facultative in fungi	55	44	1	0	2	8
Not saproxylic or in fungi	33	33	0	0	0	0

Table 4. The result of chi-squre test on the distribution of the species among the developmental stages of the carpophores and the control in the odour traps. I: Undeveloped hymenium. II: Opened hymenium. III: Dead. C: Control (without carpophore). ***p<0.001, **p<0.01, *p<0.05, ns p>0.05.

		main test	a posteriori test		
Species	Max.in stage	Chi-square	I-III=C?	I=II&III?	II=III?
Acrotrichis intermedia (Gillmeister)	II	13,36 **	*	ns	*
Acrotrichis insularis (Mäklin)		7,740741 ns			
Placusa tachyporoides Waltl	I	39,75 ***	*	***	***
Atheta (Microdota) nesslingi Bernhauer	I	17,14493 ***	ns	**	**
Other species		5,777251 ns			
SUM TOTAL		5,380261 ns			

Gyrophaena boleti

The staphylinid *Gyrophaena boleti* occurred in large numbers under stage II carpophores from spring to mid summer (up to 160 under one carpophore) (Fig. 3). It was represented in carpophore traps of all three stages, but was significantly most numerous in the stage II (Table 2, Appendix 1). By counting beetles and measuring moisture under the hymenia of 100 carpophores on 4 June, we found this species restricted to stage II hymenia with at least 28% moisture. It occurred in large numbers and almost independently of moisture in the interval 28—100% (Kendall Rank corr = 0.04, p = 0.65) (Fig. 4) Our registrations on 15 June showed that sporulation intensity (No. of spores pr. area) was correlated with hymenium moisture (Kendall Rank corr = 0.60, p<0.0004), but was not correlated for carpophores above 28% (Kendall Rank corr = 0.18, p = 0.27).

The experimental feeding experiment showed that even a high density of *G. boleti* confined to a small area of sporulating hymenium for 24 days did not make any visible impact on the hymenium.

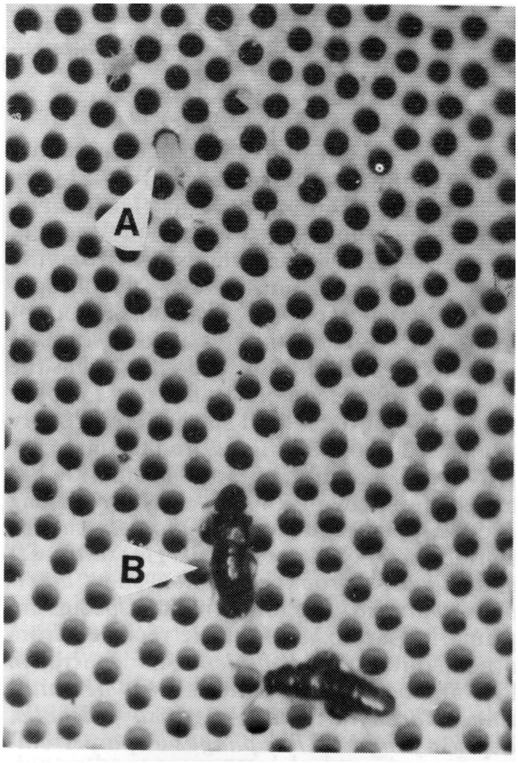


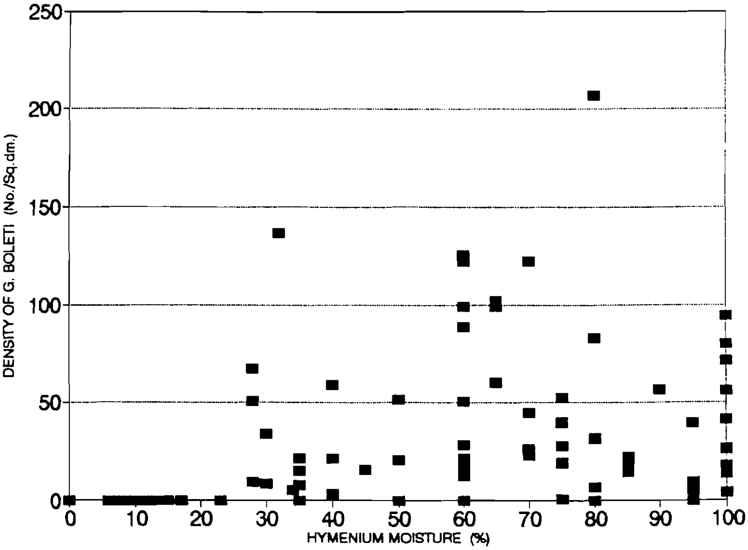
Fig. 3. Photos from the hymenium of living carpophores of *Fomitopsis pinicola.* Invertebrates moving from pore to pore under a fresh sporulating carpophore of *Fomitopsis pinicola.* A: Porricondylinae larva on its way up from a pore. B: Staphylinid beetles of the species *Gyrophaena boleti,* visiting pores and feeding on spores (body length about 1 mm).

DISCUSSION

Rearing from carpophores

As most of the species were only reared from one stage, there seems to be a pronouced succession of the fauna during the life of the carpophore. Stage I had few species, and seems to be too early a stage for most of the insect species. However, it cannot be excluded that certain species oviposit in stage I carpophores and hatch in a later stage. The

Fig. 4. Density of *Gyrophaena boleti* under the hymenium of 100 different carpophores of *Fomitopsis pinicola* plotted against the percent moisture in the hymenium.



death of the host fungi is certainly an important change for many species, and was clearly demonstrated in our study of *Gyrophaena boleti.* Dead fungi have no spore production, they no longer extract moisture from the wood and may become quite dry. While species on living carpophores can take favour of living mycelium and spores as food sources, the activity within dead carpophores has the character of a decomposition process. Apparently, few of the reared species are strongly associated with *F. pinicola,* and the majority also occur in other habitats. Considering habitat references (Table 1), and our rearing and trapping frequencies, *F. pinicola* may be a preferred host species for *Cis glabratus, Cis quadridens, Gyrophaena boleti* and *Camptomyia maxima.* The following ten species are primarily saproxylic, but are reported from other habitats than *F. pinicola,* or occurred in low numbers in our material: *Cis dentatus, Ennearthron laricinum, Leptusa pulchella, Leptusa fumida, Rhizophagus dispar, Archinemapogon yildizae, Winnertzia nigripennis (?), Camptomyia sp. 2, Lestodiplosis polypori* and *Gaurax dubius.* The remaining 12 species (Table 1) are not mentioned as primarily saproxylic, and their relationships to *F. pinicola* are quite unclear. Generally, sciarid species are associated with a wide range of decaying organic matter, including rotten wood and fungi (Freeman 1983), but we have not found specific literature information about our reared species. Of four parasitic wasp species, only two are described with hosts which occurred in our rearings (Table 1). There appears to be considerable regional variation in the faunal composition in *F. pinicola.* Rearings from *F. pinicola* in Karelian forests gave the follwing Diptera: *Mycetophila laeta* Walk., *M. signatoides* Dz., *Dynatosoma fuscicorne* Mg., *Sciophila buxtoni* Edw., *Scaptosciara calamophila* Frey, *Sc. nacta* Joh., *Lestodiplosis* sp. (Yakovlev 1986): None of these Diptera taxa were reared in our study, except for the genus *Lestodiplosis.* However, the rearing methods must have contributed to the difference. Some species (*Mycetophila sp.)* require access to earth or sand for pupation, and were probably lost with our rearing method.

Carpophore traps

The carpophore traps proved to be very effective and captured a large number of species. Even though few of the species have been reared from *Fomitopsis pinicola* in the present study, both the tests and the descriptions in literature indicate that the majority of the species have a connection with the carpophores. The frequently reared species were all numerous (n>15) and showed a marked difference among the carpophore stages in the traps. All species which were numerously trapped and significantly different among the carpophore stages, have been described as obligatory inhabitants of fungi or saproxylic habitats. The majority of the less numerous species are at least facultatively saproxylic. Therefore, the carpophore traps seem to be rather effective in capturing saproxylic fauna in general. Further, it can be concluded that comparative studies by means of this trap should take into consideration the developmental stage of the carpophores.

Staphylinid beetles dominated in the carpophore traps. Members of this family are generally considered to be predatory or mycophagous, but feeding habits have not been observed in many of the species (Newton 1984). In our carpophore traps, the strongest indication on active host preference was found in species described from fungal and saproxylic habitats. These species were the most numerous and showed the clearest difference among the carpophore stages. E. g. *Oxypoda alternans* was numerous and showed a significant preference for living carpophores, while the other six *Oxypoda* species were few in the traps. In literature, *O. alternans* is said to be especially associated with fungus, while fungus is only one of many habitats for the other species (Hansen 1954).

The most frequent staphylinids in the carpophore traps comprised both fungivorous and predatory species. *Lordithon lunulatus* and *L. thoracicus* showed a strong preferance for living carpophores. According to Hansen (1952), *Lordithon* species prey on other invertebrates in fungal fruiting bodies and in rotten wood, and the imago feeds on mycetophilid larvae. In our study area, the hymenia of *F. pinicola* often contained cecidomyiid larvae, which are likely to be the food source of this predator. *Gyrophaena boleti* was also frequent and preferred living carpophores. However, *Gyrophaena* belongs to the few staphylinid genera feeding exclusively on fungus both as larva and imago (Ashe 1984). Our studies indicate that *G. boleti* mainly feed on spores, and fresh and sporulating carpophores could harbour large numbers of this species (up to 160 individuals on the underside of one fruiting body).

Only three ptilid species were trapped. Most *Acrotrichis* species live in decaying, organic matter, such as litter, decaying herbs and excrement, and some of the species (e.g. *A. insularis)* are known to be attracted in large numbers to sites with large amounts of fungi and decaying, organic matter (Michael Sørensen pers. comm., Sundt 1958). The present species must probably be considered as facultative visitores to *F. pinicola.*

Thus, carpophores may serve serveral ecological functions beyond being the substrate for larval development of certain species. The high number of saproxylic and/or fungi-dependant species in the carpophore traps may indicate that the carpophores function as «attraction centres». Some species lay their eggs there, some are spore feeders, some may be visiting predators, and some might utilize the presence of carpophores in their orientation towards another saproxylic habitat.

Host attraction and selection

Yakovlev and Myttus (1989) have tested odour attraction to *Fomitopsis pinicola* in Karelian forests with a different method. They applied both ether- and water extracts of *F. pinicola* as bait in a type of sticky trap («atracon»). The ether solution seemed attractive to fungus gnats such as *Cordyla murina* and *Allodia* spp. (among them *A. pyxidiiformis* Zaitzev), and to *Megaselia* sp. (Phoridae) and *Fannia* sp. (Fanniidae). The function of the attraction seems unclear, since none of these taxa have been reared from *F. pinicola.* Only a few individuals of beetles (mainly Staphylinidae) were captured in these traps (not determined, Yakovlev pers. comm.).

Little attractive response in our experiments does not imply that attraction by fungal odour can be excluded for the beetles. A bigger part of the polypore fungi is mycelium inside the wood, and this fungal component was not involved in our experiment. Another explaination may be that the fungal odour from many fungi or fungi-infected pieces of wood within a site may have a common attractive effect on saproxylic insect species, but that olfactory responses may be less important for many species during short distance orientation. Further, our results may be due to the experimental design. The emission of odour from the dispensers may have been insufficient compared to the natural habitats. However, the majority of species develop in dead and dry carpophores, and these carpophores should not be drastically changed when they are removed from the trees.

Our results suggest that selection of host fungi does not take place in a directed determined movement, but rather the insects seem to be clustered in a sort of cloud around fungi and rotten wood, and that the final choice is made very close to, or in direct contact with the substrate. Our carpophore traps yielded a long list of species, but quite many of the species are associated with other habitats than *F. pinicola* in literature. A similar effect was observed in an experiment with sticky traps placed vertically near living sporophores (Agaricales) on the ground (Yakovlev and Myttus 1989). Many of the trapped species have not been reared from the respective fungi species. *Gyrophaena boleti* illustrates how a species depending on one specific microhabitat (the underside of spore-producing *F. pinicola,* stage II) also occurred in the «swarming clouds» around young and dead carpophores in the present study.

Apparently, many cisid species are active around polypores and dead wood if their search for food and breeding places, while only certain species prefer carpophores of *F. pinincola.* Of 12 cisid species in the carpophore traps, eight species were not reared in the present study. Paviour-Smith (1960) and Lawrence (1973) made groups of polypore and cisid species, in which certain cisids were associated with certain polypores. Paviour-Smith (1960) distinguished two groups («headquarters») in her study from Wytham Woods in England, and Lawrence (1973) ended up with four «host preference groups» in cisids of North America. Probably, corresponding groups may be found in Scandinavia. In our study, two cisid species *(Cis glabratus* and *C. quadridens)* were numerous both in the traps and the rearings from *Fomitopsis pinicola.* Secondly, some of our trapped but not reared species *(Cis nitidus, C. boleti, C. hispidus* and *Ennearthron cornutum)* have been associated with other polypore species by other authors (Paviour-Smith 1960, Nuss 1975, Klimaszevski and Peck 1987). Many of these popypore species are also present in our study area, and their fauna will be compared in a later publication (Økland in prep.).

The mechanism of host selection in Cisidae has been discussed by several authors, and here the general conslusion seems to be that the final host selection demands direct contact with the substrate. Paviour-Smith's (1960) and Lawrence's (1973) results indicate that the structure of the sporephore is the decisive factor in host selection. Paviour-Smith (1960) reasoned that the composition of mono-, di-or trimitic hyphal cells is important. The nutritive value may be of some importance, since *Hadraule blaisdelli* (Cisidae) showed preferences between fungal species even though the fungal tissue had been powdered (Klopfenstein 1971). Furthermore, the comsumption and survival rate of this species increased when the tissue was powdered, indicating that the hardness of the carpophore is important as well (Klopfenstein and Graves 1989). Paviour-Smith (1960) argued that olfaction must be less important, since so many cisids occur in dry and dead carpophores. However, we do not know to what extent cisids colonize carpophores before they die. Similar to results of many other authors (Klimaszewski and Peck 1987, Graves 1960, Lawrence 1973), most of our cisids were reared from dead carpophores. However, a considerable part of the cisids were captured in carpophore traps at living fungi.

Impact on the vitality of the carpophores

Spore-producing carpophores of *F. pinicola* clearly tolerate a very high grazing pressure by spore-eaters on the underside (e.g. by *G. boleti).* At the same time, the spore-eaters probably contribute in the spread of fungi to new sites.

Generally, cisid beetle have been described as a «major force »in the degradation of the host fungi (Klopfenstein and Graves 1989). Contrary to *Fomes fomentarius* in the same area, we did not find extensive penetration by insects inside the carpophores of *F. pinicola.* Apparently, the main degradation of the *F. pinicola* carpophores starts after the death of the carpophores. It is not yet clear wether the major role in the decomposition of *F. pinicola* carpophores is played by insects, microorganisms or these in combination.

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SAMMENDRAG

Insektfauna i fruktlegemer av rødrandkjuke *(Fomitopsis pinicola* (Fr.) Karst.) i en sørnorsk granskog

Insektfauna i rødrandkjuke *(Fomitopsis pinicola)* i tre utviklingsstadier er studert på forskjellige måter: (1) Klekking; (2) kjukefeller; (3) duftfeller med fruktlegemer som dispenser; (4) registreringer og eksperimenter med en vanlig art, *Gyrophaena boleti* (L.).

Klekking ga totalt 23 arter. Det synes å være en markert fauna-suksesjon i fruktlegemene, ettersom få arter klekket fra mer enn et stadium. Flest arter ble funnet i de døde fruktlegemene. Fire arter synes å være spesielt knyttet til rødrandkjuke, mens majoriteten er også beskrevet fra andre habitater. Fire arter av tovinger og tre arter av årevinger er nye for Norge.

Den lange artslisten fra kjukefellene tyder på en høy aktivitet av insekter nær kjukene. De fleste av artene er tidligere beskrevet fra sopp- og dødvedhabitater, men få ble klekket fra rødrandkjuke i dette studiet. De fleste synes imidlertid å være relatert til fruktlegemene, ettersom deres kjukefelle-fangster var signifikant forskjellig mellom kjukestadiene.

Det ble ikke påvist tiltrekning til duft fra fruktlegemene for de testede billeartene (Staphylinidae, Cisidae og Ptilidae).

Gyrophaena boleti ble bare funnet under levende fruktlegemer med åpent hymenium og fuktighet i intervallet 28—100%, mens denne begrensningen ikke gjorde seg gjeldende i kjukefellefangstene, hvor arten også ble fanget fra andre stadier av kjukene. Dette tyder på at stimuli ved direkte substratkontakt er en avgjørende faktor ved vertsvalg for denne arten.

Selv store tettheter av sporespisene *G. boleti* hadde ingen synlig virkning på hymenitet av de sporulerende kjukene. Gjennomskjæring av et stort antall fruktlegemer viste relativt få ganger og spor etter insektaktivitet. Det er uklart om den viktigste nedbrytningen av fruktlegemene hos rødrandkjuke besørges av insekter, mikroorganismer eller en kombinasjon av disse.

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Appendix 1. Staphylinidae, Cisidae and Ptilidae beetles trapped under carpophores of *Fometopsis pinicola* in different successional stages. I: Carpophores with undeveloped hymenium. II: Carpophorus with open hymenium. III: Dead carpophores. C: Control (without carpophores). * = species hatched from *F. pinicola* in this study.

	I	II	III	SUM
STAPHYLINIDAE:				
Acidota crenata (Fabricius)	0	1	2	3
Acrulia inflata (Gyllenhal)	1	1	2	4
Amischa analis (Gravenhorst)	4	4	4	12
Anomognathus cuspidatus (Erichson)	2	0	0	2
Anthobium melanocephalum (Illiger)	0	0	1	1
Anthophagus omalinus Zetterstedt	3	9	8	20
Atheta (Amidobia) talpa (Heer)	1	0	0	1
Atheta (Anopleta) picipes (Thomson)	1	2	8	11
Atheta (Atheta) incognita (Sharp)	0	0	1	1
Atheta (Atheta) crassicornis (Fabricius)	0	0	6	6
Atheta (Atheta) nigricornis (Thomson)	0	2	1	3
Atheta (Atheta) castanoptera (Mannerh.)	0	3	0	3
Atheta (Atheta) fungicola (Thomson)	0	2	1	3
Atheta (Atheta) pilicornis (Thomson)	0	0	1	1
Atheta (Megacrotona) lateralis (Mannerh.)	0	0	1	1
Atheta (Microdota) subtilis (Scriba)	1	1	5	7
Atheta (Microdota) atomaria (Kraatz)	1	0	0	1
Atheta (Notothecta) sodalis (Erichson)	3	1	3	7
Atheta (Notothecta) flavipes (Gravenh.)	3	2	0	5
Atheta (Notothecta) pallidicornis (Thoms.)	0	1	0	1
Atheta (Xenota) myrmecobia (Kraatz)	1	3	4	8
Atrecus pilicornis (Paykull)	3	6	5	14
Autalia Samouelle sp.	1	0	0	1
Bolitobius cingulatus Mannerheim	0	4	2	6
Bolitochara mulsanti Sharp	0	2	0	2
Bolitochara lucida (gravenhorst)	0	1	0	1
Coryphium angusticolle Stephens	0	0	1	1
Dadobia immersa (Erichson)	1	0	0	1
Deliphrum tectum (Paykull)	0	0	1	1
Dinaraea arcana (Erichson)	2	1	1	4
Dinaraea aequata (Erichson)	0	1	0	1
Elonium striatulum (Fabricius)	2	3	2	7
Euryusa castanoptera Kraatz	0	1	0	1
Gabrius splendidulus (Gravenhorst)	2	2	1	5
Gabrius astutoides (Strand)	0	0	1	1
Geostiba circellaris (Gravenhorst)	0	1	0	1
Gyrohypnus angustatus Stephens	2	0	0	2
*Gyrophaena boleti (L.)	24	77	27	128
Gyrophaena strictula Erichson	0	2	0	2
Gyrophaena bihamata Thomson	0	0	1	1
Hapalarea linearis (Zetterstedt)	4	5	4	13
Haploglossa villosula (Stephens)	6	3	2	11
Ischnoglossa prolixa (Gravenhorst)	8	11	13	32
Lathrobium brunnipes (Fabricius)	1	2	2	5
Lathrobium fulvipenne Gravenhorst	0	1	0	1
*Leptusa pulchella (Mannerheim)	2	2	4	8
*Leptusa fumida (Erichson)	0	2	0	2
Liogluta letzneri (Eppelsheim)	0	1	7	8
Liogluta alpestris (Heer)	0	1	0	1
Lordithon lunulatus (L.)	50	105	5	160
Lordithon thoracicus (Fabricius)	0	13	4	17
Lordithon speciosus (Erichson)	2	1	5	8
Megarthrus sinuatocollis (Lacordaire)	0	1	0	1
Mniusa incrassata (Mulsant&Rey)	0	7	9	16
Mycetoporus punctus (Gravenhorst)	1	0	3	4
Mycetoporus lepidus (Gravenhorst)	2	1	0	3
Mycetoporus clavicornis (Stephens)	0	0	2	2
Mycetoporus rufescens (Stephens)	0	0	1	1
Mycetoporus splendidus (Gravenh.)	0	1	0	1
Nudobius lentus (Gravenhorst)	0	0	2	2
Olophrum fuscum (Gravenhorst)	1	1	0	2
Omalium rugatum Mulsant&Rey	1	0	3	4
Othius angustus Stephens	0	0	1	1
Oxypoda alternans (Gravenhorst)	19	77	4	100
Oxypoda skalitzkyi Bernhauer	0	8	4	12
Oxypoda umbrata (Gyllenhal)	0	0	2	2
Oxypoda amoena Fairmaire&Laboul.	0	1	0	1
Oxypoda annularis Mannerheim	0	0	1	1
Oxypoda lividipennis Mannerheim	0	1	0	1
Pachygluta ruficollis (Erichson)	1	0	0	1
Phloeonomus sjoebergi Strand	3	8	10	21
Phloeonomus punctipennis Thoms.	2	1	4	7
Phloeonomus monilicornis (Gyllen.)	1	3	2	6
Phloeonomus pusillus (Gravenhorst)	0	0	2	2
Phloeopora angustiformis Baudi	0	0	1	1
Phymatura brevicollis (Kraatz)	1	0	0	1
Placusa tachyporoides Waltl	17	7	2	26
Placusa incompleta Sjöberg	0	2	19	21
Placusa depressa Mäklin	0	2	0	2
Quedius plagiatus (Mannerheim)	10	21	17	48
Quedius xanthopus Erichson	1	4	2	7
Quedius fulvicollis (Stephens)	1	3	0	4
Quedius tenellus (Gravenhorst)	0	1	0	1
Quedius brevis Erichson	2	1	0	3
Quedius mesomelinus (Marsham)	0	0	1	1
Quedius fellmani (Zetterstedt)	0	1	0	1
Quedius molochinus (Gravenhorst)	0	1	0	1
Sepedophilus littoreus (L.)	8	8	4	20
Stenus argus Gravenhorst	0	1	0	1
Stenus bifoveolatus Gyllenhal	0	1	0	1
Syntomium aenum (Müller)	1	4	1	6
Tachinus pallipes Gravenhorst	0	2	1	3
Tachinus marginatus Gyllenhal	0	1	1	2
Tachinus marginellus (Fabricius)	1	0	0	1
Thyasophila inquilina (Märkel)	2	2	0	4
Zyras cognatus (Märkel)	2	1	11	14
CISIDAE:				
*Cis glabratus Mellie	1	15	42	58
*Cis quadridens Mellie	5	2	37	44
Cis boleti (Scopoli)	7	1	2	10
Cis lineatocribratus Mellie	2	0	4	6
*Cis dentatus Mellie	0	0	4	4
Cis nitidus (Fabricius)	0	0	2	2
Cis bidentatus (Olivier)	1	0	0	1
Cis hispidus (Paykull)	0	1	0	1
Cis punctulatus Gyllenhal	0	0	1	1
Cis sp.	1	0	0	1
*Ennearthron laricinum (Mellie)	1	0	3	4
Ennearthron cornutum (Gyllenhal)	2	0	2	4
PTILIDAE:				
Acrotrichis intermedia (Gillmeister)	9	28	53	90
Acrotrichis insularis (Mäklin)	4	2	13	19
Acrotrichis rugulosa Rosskothen	0	1	0	1

Appendix 2. Staphylinidae, Cisidae and Ptilidae beetles captured in traps with odour from carpophores of *Fometopsis pinicola* in different successional stages. I: Carpophores with undeveloped hymenium. II: Carpophorus with open hymenium. III: Dead carpophores. C: Control (without carpophores). * = species hatched from *F. pinicola* in this study.

	I	II	III	C	SUM
STAPHYLINIDAE:					
Acidota crenata (Fabricius)	2	0	0	5	7
Acrulia inflata (Gyllenhal)	4	0	0	1	5
Aloconota gregaria (Erichson)	1	1	0	2	4
Amischa analis (Gravenhorst)	2	0	0	2	4
Amischa bifoveolata Mannerheim	0	0	2	0	2
Amischa nigrofusca Stephens	0	0	0	1	1
Anomognathus cuspidatus (Erichson)	0	2	0	1	3
Anthophagus omalinus Zetterstedt	3	2	1	2	8
Atheta (Anopleta) picipes (Thomson)	0	0	1	0	1
Atheta (Atheta) incognita (Sharp)	0	1	2	7	10
Atheta (Atheta) nigricornis (Thomson)	0	2	0	0	2
Atheta (Atheta) castanoptera (Mannerh.)	0	1	0	0	1
Atheta (Atheta) pilicornis (Thomson)	0	0	1	0	1
Atheta (Dimetrota) cinnamoptera (Thoms.)	2	0	1	0	3
Atheta (Megacrotona) lateralis (Mannerh.)	0	3	0	0	3
Atheta (Microdota) nesslingi Bernhauer	0	2	14	7	23
Atheta (Microdota) subtilis (Scriba)	4	2	1	0	7
Atheta (Notothecta) sodalis (Erichson)	0	0	1	1	2
Atheta (Notothecta) flavipes (Gravenh.)	0	0	1	0	1
Atheta (Xenota) myrmecobia (Kraatz)	2	0	2	3	7
Atrecus pilicornis (Paykull)	2	1	1	1	5
Dadobia immersa (Erichson)	0	2	2	2	6
Deliphrum tectum (Paykull)	0	0	0	0	0
Dinaraea arcana (Erichson)	1	0	2	0	3
Dinaraea aequata (Erichson)	0	0	0	2	2
Elonium striatulum (Fabricius)	0	0	0	1	1
Gabrius splendidulus (Gravenhorst)	1	0	0	0	1
*Gyrophaena boleti (L.)	1	0	0	1	2
Hapalarea linearis (Zetterstedt)	2	0	0	2	4
Ischnoglossa prolixa (Gravenhorst)	7	2	0	4	13
*Leptusa pulchella (Mannerheim)	2	2	0	3	7
Lordithon lunulatus (L.)	6	6	0	0	12
Megarthrus fennicus Lahtinen	1	0	0	0	1
Megarthrus nitidulus Kraatz	0	0	0	1	1
Oxypoda alternans (Gravenhorst)	1	0	0	0	1
Oxypoda skalitzkyi Bernhauer	0	0	1	2	3
Oxypoda nigicornis Motschulsky	0	0	1	0	1
Phloeonomus lapponicus (Zett.)	0	3	1	2	6
Phloeopora angustiformis Baudi	0	0	0	1	1
Phloeopora testacea (Mannerheim)	1	0	0	0	1
Placusa tachyporoides Waltl	0	1	21	2	24
Placusa incompleta Sjöberg	0	0	1	1	2
Placusa depressa Mäklin	0	3	9	4	16
Quedius plagiatus (Mannerheim)	3	0	0	0	3
Quedius xanthopus Erichson	4	1	0	2	7
Quedius fulvicollis (Stephens)	0	0	1	0	1
Quedius tenellus (Gravenhorst)	1	0	0	3	4
Quedius maurus (Sahlberg)	0	0	4	0	4
Quedius mesomelinus (Marsham)	0	0	1	0	1
Sepedophilus littoreus (L.)	1	1	2	1	5
Tachinus pallipes Gravenhorst	1	1	0	1	3
Tachinus laticollis Gravenhorst	0	0	1	3	4
Tachinus proximus Kraatz	0	2	0	0	2
Tachinus elegans Eppelsheim	0	0	0	1	1
Tachinus subterraneus (L.)	0	0	1	0	1
CISIDAE:					
*Cis glabratus Mellie	0	0	0	1	1
Cis boleti (Scopoli)	3	2	4	2	11
Cis lineatocribratus Mellie	0	0	1	0	1
PTILIDAE:					
Acrotrichis intermedia (Gillmeister)	88	113	84	65	350
Acrotrichis insularis (Mäklin)	26	14	27	14	81
Acrotrichis rugulosa Rosskothen	1	0	0	1	2
Acrotrichis parva Rosskothen	0	1	0	1	2
Acrotrichis silvatica Rosskothen	0	0	1	0	1
Ptenidium nitidum (Heer)	0	0	1	0	1

Short communications

TREMEX FUSCICORNIS (FABRICIUS) (HYMENOPTERA, SIRICIDAE) A NEW WOODWASP FOR THE NORWEGIAN FAUNA

MIDTGAARD, F., STOKLAND, J. N. & SVERDRUP-THYGESON, A.

ABSTRACT

The woodwasp *Tremex fuscicornis* (Fabricius) (Hymenoptera, Siricidae) was found in numbers in two dead birch trees at Sæteråsen, Hof near Sande in Vestfold county, southeastern Norway. The trees had been killed several years ago by *Scolytus ratzeburgi* Janson (Coleoptera, Scolitidae). They were approximately 6 m tall and 40 cm in diameter with numerous holes from the wasp. The specimens were found as remnants from the preceeding autumn in their exit holes April 17th. 1991. The species has not formerly been found in Norway.

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De norske bartreveps (Hymenoptera, Siricoidea) ble relativt nylig revidert (Midtgaard 1988). Det viste seg da at det var 5 arter fordelt på tre slekter i landet, i tillegg til 2 innførte arter. Utover dette var det to *Urocerus* arter og en *Tremex* som finnes i våre naboland som muligens kunne forekomme i Norge. Disse er *Urocerus augur (*Klug) og *U. fantoma* (Fabricius) og *Tremex fungicicornis* (Fabricius).

Det norske funnet ble gjort 17. april 1991 i et skogområde med et rikt innslag av døde trær i Sæteråsen, Hof kommune i Vestfold (EIS 28). Arten ble funnet i to døde bjørker som var omlag 6 m høye og ca. 40 cm i diameter. Begge trær hadde blitt drept for flere år siden av bjørkesplintboreren *(Scolytus ratzeburgi* Janson). Det var tallrike utboringshull av *Tremex* i trærne og i et antall hull ble det funnet døde individer av *Tremex fuscicornis.*

Tremex fuscicornis er den eneste av bartrevepsene som er aktuelle i Norge som er knyttet til lovtreved. Viitasaari (1984) nevner en lang rekke vertsarter og skriver utførlig om biologien, men dessverre på finsk. Arten finnes langt mot nord i våre naboland, jeg har sett dyr fra så langt nord som Lule Lappmark i Sverie (Coll. FM).

Arten kan ikke forveksles med våre andre bartreveps og er således neppe oversett som imago i Norge. Derimot kan den være oversett i døde trær. Utboringshull kan muligens ha blitt tatt for å være laget av trebukken *Necydalis major* Linnaeus (Col. Cerambycidae) og bjørketrevepsen *X. fuscicornis* kan på denne måten ha blitt oversett.

I Sverige regnes arten som sårbar (Anderson et al. 1987), og trues særlig av sluttavvirkning av områder hvor den finnes.

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GOOTIELLA TREMULAE. TULLGREN, 1925 (HEMIPTERA, HOM., PEMPHIGIDAE) NEW TO NORWAY

JAC. FJELDDALEN

The aphid species, *Gootiella tremulea,* Tullgren, 1925 is reported new to Norway. It was found on aspen, *Populus tremula,* in Strand, Ryfylke, Rogaland (RY) August 10 th, 1965.

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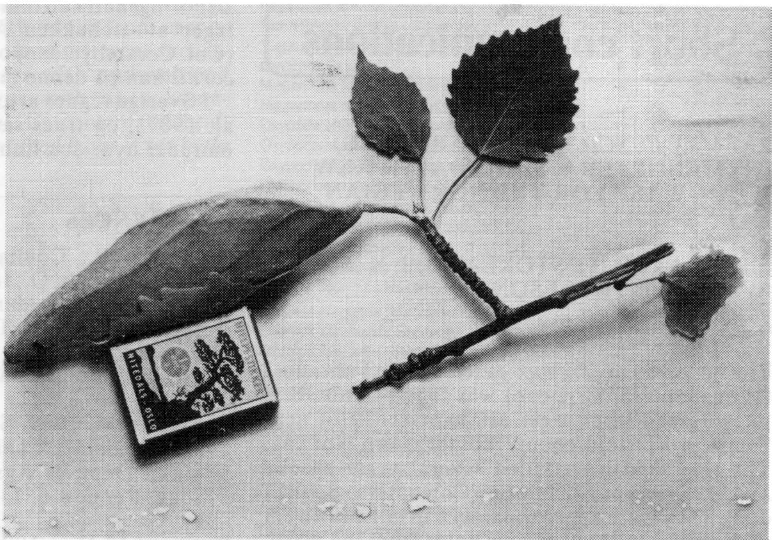
A leaf sample of aspen consisting of normal leaves and one single galled leaf heavily infested with aphids (alate migrants and larval instars) was sent to me for identifications via the newspaper Stavanger Aftenblad. The sample had been collected by E. Tjøstheim on August 10 th, 1965 in Strand, Ryfylke, Rogaland (RY). The cause of the gall were determined to be the species *Gootiella tremulea,* Tullgren, 1925.

The aphids stimulate the growth of the infested leaf, first by rolling the leaf together and gradually developing an extremely large bag-shaped gall (see photo). The colour of the gall was pall green which later turned yellowish and the length was 13 cm.

The primary host is *Populus tremula.* The sample was found rather high up on an older tree. No attacks could be found when the locality was visited 2 years later.

According to Danielsson (1989) the secondary



Gootiella tremulae, Tullgren, 1925. Leaf gall on aspen (*Populus tremula),* 24. aug., 1965. Photo: Stavanger Aftenblad.

host plant is *Juniperus communis,* where the apjids live on the roots. In September, alate sexuparae and return to the primary host. The author also states that anholocyclic hibernation on roots of *Juniperus* seems to be common.

Gootiella tremulea is very rare and has a rather restricted distribution. From the Nordic countries, there is one record from Sweden in 1912 (Tullgren, 1925) one from Finland in 1936 (Heikinheimo, 1940), one from Denmark in 1940 (Henriksen, 1944) and one from Norway in 1965 (Fjelddalen, 1993). Hele (1980) mentioned the species known from Norway, which presumably refers to my record in 1965.

Later records from Sweden have been added (Danielsson, 1989) and from Finland (Åland) catch of one alate in a wind net trap in 1962 (Heikinheimo, 1992).

Outside the Nordic countries the species has only been found in Poland (Heie, 1980).

ACKNOWLEDGEMENT

I am greatly indepted to Prof. F. Ossiannilsson who has verified the identification.

SAMMENDRAG

Bladlusarten *Gootiella tremulae,* Tullgren, 1925 er rapportert ny for Norge. Den ble funnet i en bladprøve av osp, *Populus tremula,* tatt i Rogaland (RY) 10. august 1965. Prøven besto av normale blad og et sterkt angrepet som utviklet seg til en stor sekkformet galle (se foto). Arten må ansees som meget sjelden med begrenset utbredelse, da det stort sett bare foreligger et funn i hvert av de nordiske land. Utenfor Norden er arten bare kjent fra Polen.

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Received 15 Dec. 1992.

OTHIUS VOLANS J. SAHLBERG, 1876 (COL., STAPHYLINIDAE) NY ART FOR NORGE

FRODE ØDEGAARD OG ARILD ANDERSEN

Othius volans J. Sahlberg is reported new to the Norvegian fauna. One male was collected in a pitfal trap in an agricultural field in Ås, Akershus on May 4th 1992.

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Arild Andersen, Statens Plantevern, N-1432 Ås-NLH.

En hann av *Othius volans* J. Sahlberg, 1876 ble funnet i et fallfellemateriale fra en åker på Bjørnebekk i Ås, Akershus, 4. mai 1992.

Palm (1963) oppgir arten fra en smågnagergang ved ei stor eik, ellers er svært lite kjent om artens levesett. *O. volans* ble tatt sammen med *Ptomaphagus medius* Rey og *Ptomaphagus subvillosus* (Goeze) som lever i tilknytning til smågnagere (Hansen 1968). Dette kan underbygge at *O. volans* har et lignende levesett.

O. volans er nærmest kjent fra Värmland i Sverige (Lundberg 1986), og er ellers funnet meget spredt i Sverige og Finnland (Lindroth 1960, Lundberg 1986). Arten er ikke kjent fra Danmark (Lundberg 1986).

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NYE COLEOPTERA FOR NORGE (COLEOPTERA NEW TO NORWAY)

FRODE ØDEGAARD

ABSTRACT

Helophorus fungidicollis Motschulsky, 1860 (Helophoridae), *Laccobius biguttatus* Gerhardt, 1877 (Hydrophilidae), *Atheta obfuscata* (Gravenhorst, 1802) (Staphylinidae). *Phytosus spinifer* Curtis, 1838 (Staphylinidae). *Anobium fulvicorne* Sturm 1837 (Anobiidae), *Ebaeus pedicularius* (Linnaeus, 1758), *Airaphilus elongatus* (Gyllenhal, 1813) (Cucujidae) *Longitarsus ganglbaueri* Heikertinger, 1912 (Chrysomelidae) and *Psylloides isatidis* Herkertinger, 1912 (Chrysomelidae) are reported new to Norwegian fauna. Remarks on ecology and distribution are given.

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INNLEDNING

Nedenfor følger en oversikt over ni nye Coleoptera fra Norge. Bemerkninger om økologi og utbredelse er også tatt med. Materialet er innsamlet av forfatteren og befinner seg i hans samling hvis ikke annet er nevnt. Nomenklaturen følger Silfverberg (1979) med etterfølgende korreksjoner av Biström & Silfverberg (1983, 1985, 1988)

ARTENE

Helphorus fulgidicollis Motchulsky, 1860 (Hydrophilidae). Flere individer av artene ble funnet i Ø, Råde: Oven, EIS:20, 29. juni 1990. Arten er nærmest kjent fra Skåne i Sverige (Lundberg 1986). Dette funnet representerer dermed ny nordgrense for arten. *H. fulgidicollins* ble tatt i en liten pytt i epilittoral sone i ei saltsiveng *(Juncetum gerardii)* sammen med *Berosus spinosus* (Steven). Disse artene er karakteristiske på slike lokaliteter (Hansen 1987).

Laccobius biguttatus Gerhardt, 1877 (Hydrophilidae). En hann av arten ble funnet i VE, Tjøme: Mostranda, EIS: 19, 27. juli 1992. Individet ble tatt i en nokså steril, liten brakkvannspytt helt nede ved sjøen. Arten er vanlig i Danmark. I Sverige og Finland er den funnet i de fleste regioner, med hovedtyngde mot sør og i kystområder (Hansen 1987).

Atheta obfuscata (Gravenhorst, 1802) (Staphylinidae). En hann av *A. obfuscata* ble funnet i STi, Melhus: Melhus, EIS:92, 15. mai 1992. Individet ble tatt krypende på sandbunn ved breddene av elva Gaula. Palm (1970) oppgir arten fra Salixstrøfall og elvedrift i Sverige. De få funnene som er gjort av arten tyder derfor på at den er knyttet til elvebredder. Alle tidligere funn av arten er såvidt meg bekjent gjort tidlig på våren. Dette kan indikere at *A. obfuscata* er en slik tidlig-art. Den norske lokaliteten er ellers svært godt undersøkt med hensyn til biller, men *A. obfuscata* kan være oversett på grunn av at aktivitetsperioden er begrenset til denne perioden. Arten er ellers i Norden kun kjent fra fem sydlige regioner i Sverige (Lundberg 1986).

Phytosus spinifer Curtis, 1838 (Staphylinidae). To hanner og en hunn av denne kortvingearten ble funnet i VE, Tjøme: Sandøy, EIS:19, 27. juli 1992. Individene ble funnet blant råtnende tang på sandstrand. I samme habitat fantes også store mengder av staphylinidene *Remus sericeus* Holme, 1837 og *Cafius xantholoma* (Gravenhorst, 1806). Arten er nærmest kjent fra to regioner i Syd-Sverige (Lundberg 1986). I Danmark er arten funnet spesielt på Jyllands vestkyst, men oppgis å være sjelden (Palm 1968).

Anobium fulvicorne Sturm, 1837 (Anobiidae). En hann ble funnet i TEy, Kragerø: Jomfruland, EIS:11, 14. juni 1990. Individet ble tatt sittende på et hasselblad. Freude, Harde & Lohse (1969) oppgir arten fra tørre stokker av løvtrær, fortrinnsvis eik. Det finnes store og gamle bestand av både eik og hassel i nærheten, slik at begge disse er mulige vertstre. Artens utbredelse ellers i Norden begrenser seg til Danmark og sydlige deler av Sverige og Finland (Lindroth 1960).

Ebaeius pedicularius L., 1758) (Malachidae). Arten ble funnet flere ganger i løpet av juli 1988 i Os, Sør-Fron: Hundorp, EIS:63, leg. Karl Erik Zachariassen og Frode Ødegaard. Den er også tatt i VE, Tjøme (leg. Trond Andersen). *E. pedicularius* utvikles hos solitære bier (Andersen & Hanssen 1989), og de voksne billene oppgis å gå i blomster, især tistler (Hansen 1973) Eksemplarene fra Gudbrandsdalen ble slaghåvet i tørre og varme skråninger med kalkkrevende vegetasjon. Arten er ellers i Norden funnet meget spredt (Lindroth 1960).

Airaphilud elongatus (Gyllenhal, 1813) (Cucujidae).
Denne arten ble første gang funnet i TEy, Kragerø: Jomfruland, EIS:11, 19. mai 1991, leg.: F. Ødegaard. Flere individer av arten ble funnet under nokså store steiner som stakk dypt ned i jordsmonnet. Vegetasjonstypen på lokaliteten kan karakteriseres som Gulmaure-markmalurt-tørreng og opptrer på lett sandjord (Hofsten & Vevle 1982). Vegetasjonen bærer også preg av beitepåvirkning. Landin (1970) og Freude, Harde & Lohse (1967) oppgir arten fra fuktig engmark, noe som ikke stemmer med den norske biotopen. Det at individene ble funnet nokså langt ned i jordsmonnet, der jorda var humusinnblandet og fuktig, kan imidlertid tyde på at arten har visse krav til fuktighet. Artens utbredelse ellers i Norden begrenser seg til sydlige deler av Sverige og Finland.

Longitarsus ganglbaueri Heikertinger, 1912. (Chrysomelidae).
Denne arten ble først funnet i et eksemplar i VE, Tjørme: Sønstegård, EIS: 19, 28 juli 1992. Den ble siden funnet tallrik i TEy, Kragerø: Stråholmen, EIS:11, 27. august 1992 og i fallfellemateriale fra AK, Ås, EIS: 28, 1992 (leg. Arild Andersen). Arten oppgis å leve på *Senecio*-arten (Freude, Harde & Lohse 1966). Alle de norske individene er funnet på *Senecio-viscosus* L. Arten er kjent fra flere regioner i Syd-Sverige, men ikke fra Danmark (Lundberg 1986). Det er grunn til å tro at arten er vel etablert i Oslofjord området.

Psylliodes isatidis Heikertinger, 1912 (Chrysomelidae).
En hann av arten ble slaghåvet i On, Nord-Fron: Hesteskobakken, EIS:62, 28. august 1988. Arten oppgis å leve på *Isatis tinctoria* (Freude, Harde & Lohse 1966), men i og med at denne planten ikke finnes i Norge, må arten ha en annen vertsplante her. Denne kan være hvitdodre *(Berteroa incana)* som er den vanligste korsblomsten på lokaliteten. *P. isatidis* er nærmest kjent fra sydøstlige deler av Sverige. Det norske funnet er derfor temmelig isolert, og kan mulignes forklares ved at det representerer en reliktpopulasjon fra postglacial varmetid.

TAKK

En stor takk til Stig Lundberg som har kontrollert bestemmelsene av *H. fungidicollis, A. fulvicorne* og *P. isatidis.*

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ZABRACHIA TENELLA (JAENNICKE, 1866) DIPT., STRATIOMYIDEA) NEW TO NORWAY

LITA GREVE & ODDVAR HANSSEN

ABSTRACT

Zabrachia tenella (Jaennicke, 1866) Dipt., Stratiomyidae) is reported new to Norway. Six females were collected in two Malaise traps in pine forest at 450 and 520 m a.s.l. in inner part of Sør-Trøndelad province, Oppdal, Lønset EIS 79 during the summer 1992. *Zabrachia minutissima* (Zetterstedt, 1836), one female, was collected at the same locality.

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Six species of the subfamily Pachygasterinae/-Stratiomyidae occur in NorthWest Europe. Two of these belong to the genus *Zabrachia* which compared to the other genera is characterized by the absence of the fork in R 4 +5. Until 1985 *Z. tenella* was only considered as a synonym of *Z. minutissima,* but Krivosheina & Rozkošný (1985) rised *Z. tenella* (Jaennicke, 1866) from synonymy. Krivosheina & Rozkošný presented a key able to separate the two species in Europe and one additional species from the Canary islands. Krivosheina & Rozkošný (1990) described a new species of *Zabrachia* from East Asia, thus the genus now consists of four species.

The females of *Z. tenella* as the only of the genus have yellow-brown antennae, the three others have black antennae. The females of *Z. tenella* have the costal section between R1 and R 2 +3 shorter than the section between R2 +3 and R 4 +5 while the females of *Z. minutissima* have the costal section between R1 and R2 +3 about as long as the section between R2 +3 and R 4 +5. Tibia is usually light in *Z. tenella* compared to somewhat darkened in Z. minutissima, especially is hind tibia in *Z. minutissima* extensively darkened. The hairs on abdomen of *Z. tenella* females are longer and in higher density than *Z. minutissima.* The females of *Z. minutissima* and *Z. stackelbergi* can be separated by differences in the postcular area. In *Z. stackelbergi* the upper half of this area is bare medianly, while *Z. minutissima* is only bare at eye margin. There are distinct differences in the male genitalia of *Z. tenella, Z. minutissima* and *Z. stackelbergi.* The male of the species from the Canary islands, *Z. occidentalis* Rozkošný & Baez, 1983, is till undescribed.

One of us (O. H.) operated two small Malaise traps at Lønset in Oppdal, Sør-Trøndelag province during the summer 1992. The traps were placed in pine forest in southern-faced slopes from 20 May until 13 August. The climate is slightly continental with a yearly precipitation of between 600—700 mm. The southernfaced slope have high temperature in the summer and thus the fauna and flora are richer than in other localities at the same altitude. The vegetation is open pine forest, the bottom vegetation consists of heather and much lichen, mostly éreindeer-moss». Several continental plants are recorded in the area around Lønset (pers. comm. Holten). Besides, this locality represents the northernmost known populations in Norway for some warmth preferring beetle species.

One female of *Z. tenella* was caught between 20 May—1 June, two females between 1—12 June and three females between 12 June—13 August 1992. All together six females and no males. These are the first specimens of *Z. tenella* collected in Norway. In Scandinavia *Z. tenella* is with certainly known from Sweden (Krivosheina & Rozkošný, 1985), and they have also reported the species from Russia, Germany and Czedchoslovakia. Beuk (1990) notes *Z. tenella* from England and refers to records from The Netherlands and Belgium in Brugge (1987). Beuk concludes that the species is fairly common in The Netherlands, where it occurs in coniferous and mixed forests on the Pleistocenean sandy soils. The dutch records are nearly all records of larvae, pupae and puparia from under bark of dead pine *(Pinus silvestris).* Beuk concludes that even if the adult flies are rare, larvae is not hard to find. Krivosheina & Rozkošný (1990) present a map of the distribution of *Z. tenella* (not including Beuk's (1990) records) and this shows a distribution east to Hakkaido, south to the Black Sea and north to Obozerkaya at Arkhangels.

Zabrachia minuttissima (Zett. 1838) was also collected at the locality as one female was caught in the Malaise traps between 12 June and 13 August 1992. This is the second time this species has been collected in Norway as it was reported from eastern parts of Buskerud province by Greve (1986).

Krivosheine & Rozkošný (1990) also map the distribution of *Z. minutissima* which shows a similar distribution as *Z. tenella.*

Including our records five species of Pachygasterinae are known from Norway: 1. *Neopachygaster meromaelaena* (Dufour, 1841) & 2. *Praomyia leachii* (Curtis, 1824) (Fjeldså, A. & Greve, L. 1984); 3. *Zabrachia minutissima* (Zetterstedt, 1838) (Greve, L. 1986; 4. *Berkshiria hungarica* (Kertész, 1921) (Olsen, T. J. 1992; Greve, L. & Jonassen, T. in press) and 5. *Zabrachia tenella* (Jaennicke, 1866) (Greve, L. & Hanssen, O. 199.).

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We are grateful to Prof. Dr. Rudolf Rozkošný, Brno, Czechoslovaika, and to Dr. Jarle Inge Holten, NINA for information.

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ACALLES PARVULUS (BOHEMAN, 1837) (COL., CURCULIONIDAE) NY ART FOR NORGE

STIG OTTO HANSEN

The curculionid beetle *Acalles parvulus* (Boheman, 1837) *(A. turbatus)* is reported new to Norway. Several specimens were collected on the island Jomfruland between 23 May and 20 June 1992 in the county of Telemark (TEY EIS 1). The specimens were found on Hassel *(Corylus avellana* L.) and Oak *(Quercus robur* L.) together with *Acalles roboris, Trachodes hispidus, Enedreyetes sepicola, Orthocis alni, Orchesia minor, O. fasciata, O. undulata, Phloiotrya rufipes, Grynobius planus, Pogonocherus hispidus* and *Aplocnemia nebulosa.*

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Snutebilleslekten *Acalles* har fem arter i Skandinavia, hvorav *Acalles roboris, echinatus* og *ptinoides* er tidligere kjent fra Norge (Lindroth 1960, Silferberg 1992). Billene utviklet seg i død ved, især tynnere grenser av forskjellige løvtrær. Jeg fant *A. parvalus* sittende på undersiden av døde greiner av hassel og eik. Flere steder på øya ligger det kvisthauger som gir ideelle utviklingsmuligheter for en rekke vedlevende billearter. Den lyse edelløvskogen på Jomfruland er forøvrig rik på dødt trevirke i forskjellige nedbrytningsfaser. Dette sammen med svært gunstige klimatiske forhold gjør at flere varmekrevende sjeldne trelevende billearter er tildels vanlig forekommende på øya.

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Chapter:
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Fauna norv. Ser. B 41 (1) 1994

Short communications