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Twentyeight Chironomidae (Diptera) new to Norway

ØYVIND A. SCHNELL

Schnell, Ø.A. 1988. Twentyeight Chironomidae (Diptera) new to Norway. *Fauna norv. Ser. B 35,* 1—4.

Twentyeigth species of Chironomidae (Diptera) new to the Norwegian fauna, including some previously questionable finds are reported or comfirmed. One species is new to the Palaearctic fauna.

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INTRODUCTION

Fittkau & Reiss (1978, in Limnofauna Europaea) listed 331 species of Chironomidae from region 20 and 182 species from region 21. Together these two regions cover nearly all of Norway, but they also include parts of western Sweden, northern Finland, and parts of the Kola peninsula. The provinces of Østfold and Oslo and part of the province of Akershus is included in region 14 in Limnofauna Europaea. It thus is difficult to find out from their list which species are reported from Norway, a record from region 20 in Limnofauna Europaea may well represent a find in Sweden. The species reported below are (with three exceptions, see comments below) not included in neither region 20 nor in region 21 in Limnofauna Europaea.

Since the publication of Limnofauna Europaea several papers on Norwegian chironomids including species lists have appeared (Aagaard 1978a, 1978b, 1982, Aagaard & Sivertsen 1980, Holtan et al. 1980, Raddum & Sæther 1981, Halvorsen et al. 1982, Raddum et al. 1984, Nøst et al. 1986, Raddum et al. 1986, Aagaard et al. 1987). These papers have been checked to avoid that the list below contain species that already are recorded from Norway. I have found one paper only (Raddum et al. 1984) dealing with Norwegian chironomids from region 14 in Limnofauna Europaea. No up to date checklist on Norwegian Chironomidae exists. The last attempt was made by Soot-Ryen (1943). His list is outdated both faunistically and taxonomically, and an updated checklist is highly warranted.

The specimens were sampled by the author except when otherwise stated, and are deposited at the Museum of Zoology, University of Bergen.

SYSTEMATIC LIST

Subfamily Tanypodinae

Trissopelopia flavida Kieffer
HOY, Vaksdal: Ekse, 6 June 1985, 1 adult male reared from larva.

Xenopelopia nigricans Fittkau
VE, Tjøme: Mostranda, 10—20 July 1985, 1 male, leg.: A. Fjeldså.

Zavrelimyia barbatipes (Kieffer)
HOY, Vaksdal: Ekse, 17 July—4 August 1984, 12 pupae, leg.: G.G. Raddum; 13 May—29 August 1985, 17 males and 10 females.

Subfamily Orthocladiinae

Acamptocladius submontanus (Edwards)
MRY, Volda: Litlebøvatn, 26 July 1986, 18 males.

This species is reported from region 20 in Limnofauna Europaea, but this find refers to Brundin (1956), who recorded it from the lake Stora Blåsjön in the province of Jämtland in Sweden. This lake lies within region 20 as defined in Limnofauna Europaea. The species has later been redescribed by Cranston & Sæther (1982), and according to these authors, *Acamptocladius submontanus* previously has been recorded from Scotland and Sweden only.

Brillia longifurca Kieffer
MRY, Volda: Litledalsvatn, 27 July 1986, 1 pupal exuviae.

Bryophaenocladius subvernalis (Edwards)
HOY, Bergen: Åsane, December 1986, 2 males, leg.: J. Haugsbø.

Corynoneura edwardsi Brundin
AAY, Birkenes: Repstadvatn, 19 September 1986, 1 male.

Corynoneura fittkaui Schlee
HOY, Vaksdal: Ekse, 13 May 1985, 1 male.

Cricotopus (Cricotopus) curtus Hirvenoja
HOY, Vaksdal: Ekse, 29 August—17 September 1985, 2 males.

Raddum & Sæther (1981) reported *Cricotopus* cf. *curtus* from larvae found in two lakes in Southern Norway, but these finds are uncertain since few larvae are described in the *tremulus*-group, and those described are very similar (Hirvenoja 1973).

Cricotopus (Cricotopus) similis Goetghebuer
HOY, Vaksdal: Ekse, 24 August 1986, 1 male pupa.

Heterotrissocladius scutellatus (Goetghebuer)
HOY, Vaksdal: Ekse, 20 June 1986, 1 larva and 1 male.

This species previously is recorded from the Alps and Schwartzwald only (see, however, Sæther 1975 p. 43).

Heterotrissocladius Pe 1 (Langton 1984)
AAY, Birkenes: Store Hovvatn, 6 September 1986, 6 pupal exuviae; Repstadvatn, 19 September 1986, 6 males, 4 females, 11 pupal exuviae and 6 larval exuviae.

Langton (1984) described a distinct exuviae of *Heterotrissocladius* from Scotland as *Pe 1*. I have now found all life stages of this species, and it will be described elsewhere.

Limnophyes er Sæther
HOY, Vaksdal: Eksetjørni, 27 June 1987, 1 male.

This peculiar species was described by Sæther (1985) on two specimens from Finland. The specimen found at Eksetjørni is the first reported find outside the type locality.

Nanocladius (Nanocladius) balticus (Palmén)
HOY, Bergen: Frotveitvatn, 22 June 1986, 2 pupal exuviae. MRY, Volda: Litlebøvatn, 26 July 1986, 2 pupal exuviae.

Nanocladius (Nanocladius) rectinervis (Kieffer)
HOY, Vaksdal: Storelvi, 19 June 1986, 15 pupal exuviae; Ekse, 24 August 1986, 1 female and 5 pupal exuviae.

Orthocladius (Orthocladius) annectens Sæther
HOY, Vaksdal: Ekse, 13 May—29 August 1985, 4 males and 3 females, 15 May—24 August 1986, 3 males and 2070 pupal exuviae. Numerous larvae found in bottom samples taken in the river Ekso in the years 1967, 1976 and 1984, leg.: R. Larsen and G.G. Raddum.

One of the dominant chironomid species in the upper parts of the river Ekso. This is the first record of the species from the Palaearctic region. It was first described by Sæther (1969) from southern Canada. Later it has been reported from several places on the North American continent.

Parakiefferiella smolandica (Brundin)
HOY, Bergen: Frotveitvatn, 22 June 1986, 1 male with pupal exuviae attached.

Psectrocladius (Mesopsectrocladius) barbatipes Kieffer
AAY, Birkenes: Repstadvatn, 19 September 1986, 1 pupal exuviae. MRY, Volda: Litledalsvatn, 27 July 1986, 1 pupal exuviae; Sulvatn, 28 July 1986, 2 pupal exuviae.

Psectrocladius (Psectrocladius) schlienzi Wülker
HOY, Vaksdal: Ekse, 5 August—17 September 1985, 3 males and 4 pupal exuviae, 24 August 1986, 13 pupal exuviae.

Pseudorthocladius (Pseudorthocladius) filiformis (Kieffer)
MRY, Gjemnes: Litlevatn, 2 August 1987, 2 males.

Pseudosmittia recta (Edwards)
HOY, Vaksdal: Ekse, 24 August 1986, 2 males.

Aagaard et al. (1987) reported *Pseudosmittia* cfr. *recta* from Blesbekken at Dovrefjell. The specimens found at Ekse, however, without doubt belongs to *Pseudosmittia recta.*

Pseudosmittia ruttneri Strenzke
HOY, Vaksdal: Ekse, July and November 1984, 24 larvae, leg.: G.G. Raddum; Eksetjørni, 27 June 1987, 9 males, 6 females.

This species is recorded with a questionmark from region 20 in Limnofauna Euro-

paea, although Brundin (1956) found it to be rather common at the shores of the lake Stora Blåsjön in Sweden. It has, however, never previously been reported from Norway.

Tvetenia bavarica (Goetghebuer)
HOY, Vaksdal: Ekse, 17 July 1967, 1 pupa, leg.: R. Larsen. SFI, Lærdal: Ulvhaugselva, 16 August 1982, 1 pupa, leg.: G.G. Raddum.

Aagaard et al. (1987) reported *Tvetenia* cfr. *bavarica* from Blesbekken, Dovrefjell. These specimens, however, without doubt belongs to *Tvetenia bavarica.*

Zalutschia tornetraeskensis (Edwards)
HOY, Vaksdal: Eksetjørni, 20 June 1985, 1 male with pupal exuviae attached, about 40 pupal exuviae.

The species is, as the name implies, described from specimens collected near the lake Torneträsk in Sweden. This lake is situated within the border of region 20 in Limnofauna Europaea. It is, however, previously not recorded from Norway. Raddum et al. (1984) reported *Zalutschia* cf. *tornetraeskensis* from larvae found in Lake Søre Boksjø on the border between Norway and Sweden. This determination was based on the assumption by Sæther (1976, p. 241) that two species described by Chernovskii on larvae merely are synonyms of *Zalutschia tornetraeskensis.* The larva of *Zalutschia tornetraeskensis* still is not known with certainty.

Subfamily Chironominae

Tribe Chironomini

Paracladopelma undine (Townes)
HOY, Vaksdal: Ekse, 17 July 1984, 4 male pupae, leg.: G.G. Raddum.

Stenochironomus fascipennis (Zetterstedt)
AAY, Birkenes: Store Hovvatn, 6 September 1986, 1 male.

Tribe Tanytarsini

Micropsectra junci (Meigen)
HOY, Bergen: Sandviken, 21 April—15 May 1986, 5 males.

Rheotanytarsus pentapoda Kieffer
HOY, Vaksdal: Ekse, 17 July—6 November 1984, 9 pupae, numerous larvae found in bottom samples taken in the river Ekso in the years 1967, 1976 and 1984, leg.: R. Larsen and G.G. Raddum. MRY, Volda: Litledalsvatn, 27 July 1986, 3 pupal exuviae.

This genus previously has been reported only once from Norway, in Økland (1964) as Group *Rheotanytarsus* indet. (3 larvae).

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The collembole fauna of Troms and Finnmark, North Norway (Collembola)

ARNE FJELLBERG

Fjellberg, A. 1988. The collembole fauna of Troms and Finnmark, North Norway. *Fauna norv. Ser. B 35,* 5—20.

Based on analysis of more than 500 qualitative samples from North Norway, a total of 179 species of Collembola are reported from Troms and Finnmark. Nineteen of these are reported for the first time from Norway: *Hypogastrura assimilis* Krausbauer, *Hypogastrura arctandria* Fjellberg, *Xenylla grisea* Axelson, *Xenylla brevicauda* Tullberg, *Xenella xavieri* Gama, *Axenyllodes echinatus* Fjellberg, *Anurida granulata* Agrell, *Onychiurus schilovi* Martynova, *Tullbergia bella* Fjellberg, *Tullbergia petterdassi* Fjellberg, *Micranurophorus musci* Bernard, *Anurophorus fulvus* Fjellberg, *Isotomodes bisetosus* Cassagnau, *Archisotoma quadrioculata* Fjellberg, *Isotoma propinqua* Axelson, *Mackenziella psocoides* Hammer, *Stenacidia violacea* (Reuter), *Arrhopalites secundarius* Gisin, *Sminthurinus albifrons* (Tullberg). Details on distribution and ecology of the various species are discussed.

Arne Fjellberg, Tromsø Museum, N-9000 Tromsø, Norway.

1. INTRODUCTION

The published information on Collembola in North Norway is scanty. In his survey of Norwegian Collembola, Lie-Pettersen (1896) mentioned *Podura aquatica* from Tromsø as the only species collected north of Trondheim. However, there are a few records from the Swedish Jenisej-expedition of 1875 made along the cóast of Troms and Finnmark (Schött 1893). In 1901 Embrik Strand collected several places in Nordland and Finnmark, and in 1905 Lie-Pettersen visited Vega (Nordland) and Tromsø. The results were published by Lie-Pettersen (1906). When Ivar Agrell studied collembola in Swedish Lappland, he also made a small collection from the mountain Beisfjordstøtta at Narvik, including 19 species (Agrell 1941). In 1961 an expedition from the University College of Swansea, organized by Prof. A. Macfadyen, made ecological studies in Olderfjord in Kvænangen. Cadwalladr (1969) published 27 species of Collembola from this study. Another English expedition (University of Leicester) visited Lyngen in 1969, and four species of Collembola were published by Goddard (1973) as the result of one month catch in 50 pit-fall traps! Finally some of my own papers refere to species collected in North Norway (Fjellberg 1973, 1975a, 1975b, 1977, 1979, 1980).

During the years 1982—1986 I have collected extensively in Troms and Finnmark (Fig. 1), and the results are published here.

2. MATERIAL AND METHODS

This study is based on analysis of the species content in 563 samples of variable sizes. The common sample size has been about 200—500 ml, including vegetation, litter and upper soil with plant roots. Extraction has been through open Tullgren funnels heated by light bulbs. In addition, species has been collected in field by hand. No attempt was made to estimate the exact numbers of specimens in each sample. However, the following discussion is based not just on the presence/absence of species (frequency), but also on a subjective evaluation of the abundance of each species both in the samples and in the field.

New species discovered during this study, are described in another paper (Fjellberg 1988). The material is kept at Tromsø Museum, Tromsø.

3. RESULTS AND DISCUSSION

3.1. Species, habitats and distribution

Family Poduridae

Podura aquatica (Linne, 1758)
Only a few records from wet habitats (TRI: Bardu, FN: Porsanger, FØ: S. Varanger). There is an old record from Tromsø (Lie-Pettersen 1896).

Family Hypogastruridae

Schoettella inermis (Tullberg, 1871)
Only one record from Valjok, FI: Karasjok, at foot of a pine tree.

Hypogastrura lapponica (Axelson, 1902)
A few records from TRI: Bardu, in bark on live trees.

H. assimilis Krausbauer, 1898
Only two records from Rundhaug, TRI: Målselv, and Langbunes, FN: Vardø, in wet habitats (river banks and edge of a pool in a sandpit). The species has not been reported from Norway before, but some specimens are also collected on the banks of river Gaula in STI: Melhus and STI: Midtre Gauldal.

H. purpurescens (Lubbock, 1867)
Some records from algae, manure and fish debris in bird cliffs and farm yards (TRY: Berg, Tromsø, FV: Måsøy, FN: Tana).

H. sahlbergi (Reuter, 1895)
Some records from river banks, debris on lake shore and in bogs (TRI: Målselv, FN: Porsanger, FØ: S. Varanger).

H. socialis (Uzel, 1891)
Only a few records from TRI: Målselv and TRI: Bardu (pine litter, on melt-water pool in conifer forest).

H. vernalis (Carl, 1901)
Only in beach meadows on Bleiksøy in NNV: Andøy, and Hillesøy and Trondjord in TRY: Tromsø.

H. viatica (Tullberg, 1872)
Common in wrack beds along the coast and in bird cliffs. Sometimes in damp inland habitats (*Salix* thickets, lake shore) (NNV, TRY, TRI, FV, FN).

H. arctandria Fjellberg, 1988
This new species which is described from arctic Canada, Northeast Siberia and North Norway (Fjellberg 1988), is locally common in debris and sea-weeds in the upper littoral zone on sandy beaches (TRY: Berg, Tromsø, FN: Berlevåg, Vardø, Vadsø).

Ceratophysella denticulata (Bagnall, 1941)
Common all over the area. Abundant in organic debris in damp habitats (beaches, bird cliffs, river banks, *Salix* thickets, wet meadows). Also in the mountains. Sometimes in live fungi (NNV, TRY, TRI, FI, FV, FN, FØ).

C. scotica (Carpenter & Evans, 1899)
Common, but less frequent than the previous species. Most abundant in wet alpine habitats (snow-edge, wet meadows, *Salix* thickets), but also in lowland habitats (meadows, bogs, lake shores) (NNV, TRY, TRI, FI, FV, FN, FØ).

C. succinea (Gisin, 1949)
In wrack-beds along the coast. Once in a cormorant nest (TRY: Tromsø, FV: Måsøy, FN: Porsanger).

Xenylla boerneri Axelson, 1905
Some records along the coast from Vesterålen to Tromsø. Usually abundant in moss and lichens on trunks of live trees, but also on rocks and stones above tree-line (NNV, TRY).

X. brevicauda Tullberg, 1869
Only in dry forest litter — usually pine — in inner, continental parts of the area (TRI: Målselv, Storfjord, Nordreisa).

X. corticalis Börner, 1901
Under bark on dead trees (TRY, TRI, FN).

X. grisea Axelson, 1900
Only one record from moss on an old drift-log on a sandy beach meadow in Breivikstranda on Rebbenesøy, TRY: Tromsø. This is the first record of the species from Norway (verified by Da Gama). Previous records (Fjellberg 1980) are misidentified *X. brevisimilis* Stach.

X. humicola (O. Fabricius, 1780)
Usually abundant in organic debris on beaches, among algae in bird cliffs, and in nitrophilous lichens and algae on bird stones above tree-line. No records from inner part of the area (NNV, TRY, FV, FN).

X. maritima Tullberg, 1869
Common in dry habitats (moss and lichens on stones, tree trunks, dry meadows, exposed ridges), also above tree-line (TRY, TRI, FI, FV, FN, FØ).

X. xavieri Gama, 1959
Rather common in dry habitats (stones, meadows, ridges) on the islands along the coast from Vesterålen to West Finnmark, often together with *X. maritima.* No inland records (NNV, TRY, FV).

Willemia anophthalma Börner, 1901
A common species all over the area. Most frequent in forest litter, but also in alpine meadows (NNV, TRY, TRI, FV, FI, FN, FØ).

W. denisi Mills, 1932 (*aspinata* Stach, 1949)
Common in same habitats as *anophthalma.* Usually more frequent than this species in alpine habitats (NNV, TRY, TRI, FI, FV, FN, FØ).

W. intermedia Mills, 1934
Rather common in various habitats, mainly above tree-line. Most frequent in dry meadows, ridges and *Salix* thickets, but also in beach meadows and dunes along the coast. Contrary to the previous species, it seems to avoid closed forest habitats (TRY, TRI, FI, FV, FN).

W. scandinavica Stach, 1949
Most frequent in dunes and beach meadows along the coast, but also in alpine meadow habitats (TRY, TRI, FI, FV, FN). No forest records.

Family Odontellidae

Xenyllodes armatus Axelson, 1903
Only a few records from river banks and birch forest litter (FI: Kautokeino, FN: Tana, FØ: S. Varanger). One record from the Finnish side of the river Tana (24 km N of Utsjoki).

Axenyllodes echinatus Fjellberg, 1988
A few specimens collected among roots of *Elymus arenarius* and *Festuca rubra* growing on sand dunes in the beach front in Persfjord in FN: Vardø.

Family Neanuridae

Friesea claviseta Axelson, 1900
Only a few records from dry pine litter and from dry moss and lichens on bird stones above tree-line (TRY: Torsken, Tromsø, FI: Karasjok, FN: Tana).

F. mirabilis (Tullberg, 1871)
Probably the most common and widespread collembole in North Norway. It was found in all habitats except on live tree trunks. The highest frequency was noted from forest litter and from dry thickets, meadows and ridges above tree-line (NNV, TRY, TRI, FI, FV, FN, FØ).

Pseudachorutes asigillatus Börner, 1901
Only one record from Fosshaug in TRI: Bardu, collected from the surface of a meltwater pond in mixed pine/birch forest.

P. corticicolus (Schäffer, 1896)
Two records from bark on dead trees (aspen, birch) in Dividalen in TRI: Målselv.

P. dubius Krausbauer, 1898
A few records from litter in meadows, forests and bogs (TRY: Torsken, Berg, Tromsø, FØ: S. Varanger).

P. subcrassus Tullberg, 1871
Rather common in forest litter of both conifers and hardwood (TRY, TRI, FI, FV, FØ).

Micranurida forsslundi Gisin, 1949
A common species in many habitats including meadows, sand dunes, river banks, forest litter and alpine heaths and meadows (TRY, TRI, FV, FN, FØ).

M. pygmaea Börner, 1901
A common species in many different habitats, often together with the previous species (NNV, TRY, TRI, FI, FV, FN, FØ).

Anurida alpina Agrell, 1939
Only a few records in wet moss/grass along alpine brooks in inner Troms (Liggafjellet, 1200—1300 m and Njunis, 1400 m, TRI: Målselv). Also reported by Cadwalladr (1969) from Olderfjord in TRI: Kvænangen.

A. calcarata (Denis, 1925)
Few records, but probably common in the littoral zone. Appears to prefere rather coarse calcareous sand *(Lithothamnion)* (TRY: Tromsø, FN: Tana).

A. granaria (Nicolet, 1847)
Common in organic debris in the marine littoral zone, more rare in similar inland habitats along lakes and rivers (NNV, TRY, TRI, FV, FN).

A. granulata Agrell, 1943
In forest litter and mesic alpine habitats (wet meadows, *Salix* thickets). The species, which has not been reported from Norway before, is

only found in low numbers, but appears to have a wide distribution (NNV, TRY, TRI, FI, FV, FØ).

A. marina (Willem, 1906)
Only one record from sand and sea-weeds on the beach in Hamningberg, FN: Båtsfjord.

A. maritima (Guerin, 1836)
Common in the marine littoral zone (NNV, TRY, FV).

A. polaris (Hammer, 1954) (*frigida* Fjellberg, 1973)
Only one record from wet moss together with *A. alpina* on the mountain Njunis (1400 m) in TRI: Målselv.

A. thalassophila (Bagnall, 1939)
Common in wrack and under stones in the littoral zone (NNV, TRY, FV).

A. tullbergi Schött, 1891
Only once in damp grass turf along a brackish pond at Kampevoll, TRY: Tranøy.

Paranura sexpunctata Axelson, 1902
Two records from bark on dead birch at Grindøya and Tromsøya in TRY: Tromsø.

Neanura muscorum (Templeton, 1835)
Common and widespread in many different habitats from the marine littoral to the alpine. Preferes rather damp sites in protected environments (NNV, TRY, TRI, FI, FV, FN, FØ).

Family Onychiuridae

Onychiurus absoloni (Börner, 1901)
A common species in forest litter, sometimes also in alpine meadows and heaths (TRY, TRI, FI, FV, FN, FØ).

O. arcitcus (Tullberg, 1876)
Common along the coast, in particular in seabird colonies where it may become very numerous in manured moss and grass turf. Normally it hides under vegetation, stones and in cracks. On one occasion it was observed swarming at mid-night in the littoral zone at low tide, grazing the soft algae on the rocks.

It also occurs in alpine inland habitats, under damp, thick moss *(Rhacomitrum)* on rocks, and in sites with bird manure (bird stones, cairns). As there are no records from the forested zone, the inland habitats appear isolated from the coastal ones (NNV, TRY, TRI, FV).

O. armatus (Tullberg, 1869) s. Gisin, 1960
Some records from dry beach meadows with shell-sand and lush vegetation (*Urtica, Rubus, Anthriscus, Angelica*). Once in damp vegetation along a manured pond (sea-birds) (TRY: Berg, Torsken, FV: Måsøy).

O. bicampatus Gisin, 1956
Like the previous one, this species appears to have a coastal distribution with highest frequency in dry beach meadows, bird cliffs and well decomposed wrack. Also some records in dry habitats in coastal mountains (NNV, TRY, TRI, FV, FN).

O. cancellatus Gisin, 1952
A few records from various coastal and inland habitats (beach meadows, alder forest, alpine meadows and *Salix* thickets) (TRY, TRI, FV, FN).

O. debilis (Moniez, 1890)
Rather common in littoral wrack beds along the coast (NNV, TRY, TRI, FV).

O. duplopunctatus Strenzke, 1954
Usually together with the previous species in littoral wrack beds. One record from a river bank a few kilometers up from sea (Syltefjordselva). (TRY, FN).

O. groenlandicus (Tullberg, 1871)
One specimen in moss/grass on the shore of lake Gædnjajavrre in FN: Berlevåg. This is the only record of *groenlandicus* s. Fjellberg, 1984 from the Norwegian mainland. Earlier records (Fjellberg 1980) refere to the species *ursi* and *schoetti. O. groenlandicus* is otherwise widely distributed in the high arctic.

O. islandicus Gisin, 1960
Only three records from dry beach meadows (FV: Måsøy), moss in bog (TRY: Tromsø) and grass from a river bank (TRY: Berg).

O. macfadyeni Gisin, 1953
Common in wrack and beach meadows along the coast (NNV, TRY, TRI, FN).

O. procampatus Gisin, 1956
A characteristic species in sandy beach meadows with closed vegetation. Avoids the littoral wrack beds. A few records in meadows and *Salix* litter in coastal mountains (NNV, TRY, FV, FN).

O. pseudovanderdrifti Gisin, 1957
One of the most common species in the area, present in nearly all kind of habitats with a certain amount of organic soil (NNV, TRY, TRI, FI, FV, FN).

O. schilovi Martynova, 1976
This species, first described from the northern Ural mountains (Martynova 1976), is locally common in the higher coastal mountains where it hides under moss and stones in alpine heaths and fell-fields, often in manured sites (bird droppings) in company with *O. arcticus* and *Vertagopus sarekensis* (Langdalsryggen in Kaperdalen, TRY: Tranøy; Tromsdalstind, Bentsjordstind, Nonstind and the Kvaløya mts. in TRY: Tromsø; Finnfjordtoppen on Sørøya in FV: Sørøysund).

O. schoetti (Lie-Pettersen, 1896)
A few specimens were collected by flotation from grass tufts growing in river bank gravel near Breivikeidet, TRY: Tromsø. The specimens are identical to a specimen from Liavatn, ON: Skjåk, refered to by Fjellberg (1984 p. 72). An additional specimen has been seen — together with *O. ursi* — from the cave Sirijordsgrotta, NSI: Vefsn (E. Østbye leg. 1986).

O. sibiricus (Tullberg, 1876)
Only one record from dry pine litter at Saraelv in TRI: Nordreisa. In addition it was collected on the Finnish side of the river Tana, 25 km N of Utsjoki, in deep litter in a subalpine stand of *Sorbus aucuparia.*

O. subarmatus Gisin, 1952
Rather common in many different habitats from coast to inland, also in mountains above tree-line (NNV, TRY, TRI, FV, FN).

O. tricampatus Gisin, 1956
Only a few records from beach meadows and hardwood forest litter (TRY: Torsken, Tranøy, Tromsø, TRI: Balsfjord).

O. ursi Fjellberg, 1984
A few records in wet alpine habitats (snowfields, wet meadows, melt water brooks) (TRY: Tromsø, TRI: Målselv, Nordreisa, FN: Båtsfjord, Berlevåg).

Tullbergia affinis Börner, 1902
Only three records from dry, warm sites in Ramfjord, TRY: Tromsø (ant-hill in deciduous forest), Lille Follesøya, TRY: Skjervøy (dry, S-faced hillside), and Persfjord, FN: Vardø (exposed limestone outcrop with *Dryas* and *Carex rupestris*).

T. arctica Wahlgren, 1900
Some records from dry beach meadows and sand dunes, also in exposed, alpine sites with calceophilous vegetation (TRY: Tromsø, TRI: Målselv, FN: Vardø, Båtsfjord).

T. bella Fjellberg, 1988
Scattered records in sand dunes and beach meadows along the coast (TRY: Tromsø, FV: Måsøy, FN: Vardø, Vadsø).

T. critica (Ellis, 1976)
A common species in dry, open habitats along the coast and in the mountains (beach meadows, sand dunes, alpine meadows, heaths and ridges). Only a few forest records (NNV, TRY, TRI, FI, FV, FN).

T. hylophila (Rusek, 1980)
Some records from dry, coastal habitats (beach meadows, sand dunes). No forest, alpine or inland records (TRY: Tranøy, Torsken, Tromsø, FV: Måsøy, FN: Vardø).

T. italica Rusek, 1971
Rather common in both coastal and inland habitats. Frequent in forest litter (NNV, TRY, TRI, FI, FV, FN).

T. jarmilae (Rusek, 1980)
Only two records from a dry, stony *Antennaria* meadow in an old river-bed at Avzi, FI: Kautokeino, and from a dry, exposed slope at Kvalneset, FN: Vadsø.

T. jirii (Rusek, 1980)
Scattered records from open coastland (beach meadows), forests, and alpine meadows and *Salix* thickets (NNV, TRY, TRI, FV, FN).

T. krausbaueri (Börner, 1901) s. Rusek, 1971
Only two records (several specimens) from moss on a stone in alpine fell-fields at Fagerlifjell in Ramfjord, TRY: Tromsø, and from moss and lichens in a stony fell-field on top of the mountain Finnfjordtoppen on Sørøya, FV: Sørøysund.

T. macrochaeta (Rusek, 1976)
Very common in most of the sampled habitats both in the mountains, forests and open coastland (NNV, TRY, TRI, FI, FV, FN, FØ).

T. petterdassi Fjellberg, 1988
Abundant in dry moss, grass and lichens in rock fissures near sea (two records), also from dry beach meadows (two records) (Sør-Lenangen in TRY: Lyngen, Tananeset in FN: Tana, Hamningberg in FN: Båtsfjord).

T. simplex Gisin, 1958
Only collected at Tromsdalstind in TRY: Tromsø (dry meadows and ridges with calceophilous vegetation, 300—700 m) and at Njunis in TRI: Målselv (dry ridge, 1100 m).

T. sylvatica Rusek, 1971
Scattered records, mostly from heaths and meadows above tree-line, but also a few from pine forest and beach meadows (TRY, TRI, FI, FV, FN).

T. tenuisensillata (Rusek, 1974)
Very common in most of the searched habitats, with highest frequency in forest litter, particularly pine and spruce (NNV, TRY, TRI, FI, FV, FN, FØ).

T. yosii Rusek, 1971
Only four records from litter and dry forests of pine and birch, once on a dry ridge above tree-line (NNV: Øksnes, TRI: Målselv, FØ: S. Varanger).

Karlstejnia norvegica Fjellberg, 1974
Scattered records from dry, sandy meadows, heaths and ridges, both coastal and inland (TRY: Tromsø, FV: Måsøy, FI: Kautokeino, FN: Tana, Vardø).

Wankeliella mediochaeta Rusek, 1975
Only a few records from dunes and sandy beach meadows in Persfjord and Komagvær in FN: Vardø, and from mixed deciduous forest with dense undergrowth in a beach slope at Kantornes in TRI: Balsfjord.

Family Isotomidae

Tetracanthella arctica Cassagnau, 1959
Only two records in moss/grass/*Sedum* in rock fissures near sea level in Store Follesøya, TRY: Skjervøy, and in Sør-Lenangen, TRY: Lyngen.

T. pilosa Schött, 1891
Only two records from dry vegetation in fissures on limestone near sea in Russøy, TRY: Bjarkøy and from a limestone ridge NE of Devdisjavrre, TRI: Målselv. These are the first definite records from Norway (Fjellberg 1987).

T. wahlgreni Linnaniemi, 1911
Very common in alpine habitats, notably in dry, exposed sites. Also in dry lowland habitats, but less frequent (NNV, TRY, TRI, FI, FV, FN, FØ).

Pseudanurophorus binoculatus Kseneman, 1934
Common and widespread in many different habitats in open coastland, forest and alpine areas (TRY, FI, FV, FN, FØ).

P. inoculatus Bödvarsson, 1957
A few records from sand dunes and beach meadows (TRY: Torsken, Skjervøy, FN: Vardø). Once in an alpine snow-edge moss community (NNV: Øksnes).

Micranurophorus musci Bernard, 1977
A few specimens collected in a depression with moss, *Juncus* and *Elymus* among sand dunes 200—300 m away from sea in Sandsvika at Gryllefjord, TRY: Torsken. The sample also contained such unusual species as *Pseudanurophorus inoculatus* and *Mackenziella psocoides,* indicating a rather special microhabitat.

M. musci was originally described from Michigan (Bernard 1977). I have also seen a specimen collected in Foret de Senard at Paris (Ponge leg.)

Anurophorus fulvus Fjellberg, 1988
A characteristic species in dry moss and lichens on rocks above tree-line in coastal mountains. The species rarely descends to the forests where *A. laricis* is common in similar habitats. Only one inland record (NNV, TRY, TRI, FV, FN).

A. laricis Nicolet, 1842
Common in bark on live trees, also in moss and lichens on rocks. Mainly in lowlands (TRY, TRI, FI, FN).

A. septentrionalis Palissa, 1966
Common in pine litter in the inland. Also in dry birch forests and in meadows and heaths above tree-line. No coastal records (TRI: Bardu, Målselv, Nordreisa, FI: Kautokeino, Karasjok, FV: Alta, FØ: S. Varanger).

Isotomodella pusilla Martynova, 1967
In dry, alpine meadows on limestone and in sandy beach meadows along the coast (TRY: Skjervøy, Tromsø, TRI: Målselv, FV: Måsøy, FN: Båtsfjord, Vardø).

Folsomia agrelli Gisin, 1944
Common in damp, high-alpine snow-edge communities. So far only from Troms, but probably also present in the higher Finnmark mountains (TRY: Tromsø, TRI: Målselv).

F. bisetosa Gisin, 1953
Common in sand dunes and dry beach meadows. Also in dry inland meadows and in alpine *Salix* thickets. No records from forests (NNV, TRY, TRI, FI, FV, FN).

F. brevicauda Agrell, 1939
Common in meadows and open heathland,

both along the coast and in the inland. Most frequent above tree-line (NNV, TRY, TRI, FI, FV, FN).

F. diplophthalma Axelson, 1902
Common in drier habitats along the coast and in the inland. Frequent in meadows, heaths and thickets above tree-line. Less common in forests (TRY, TRI, FI, FN, FØ).

F. dovrensis Fjellberg,
In same habitats as previous species, but less frequent. Most records come from beach meadows along the Varanger coast (TRY, TRI, FI, FN).

F. fimetaria (Linne, 1758)
Rather common in littoral wrack beds. Also in litter in damp, lush deciduous forest and in river bank deposits (NNV, TRY, TRI, FN).

F. microchaeta Agrell, 1939
In snow-edge communities and other wet high-alpine habitats. Often in company with *F. agrelli.* (Bentsjordstind and Nonstind in TRY: Tromsø; Høgskardfjell, Høgligga and Njunis in TRI: Målselv).

F. nana Gisin, 1957
Common in dry meadows in open lowland sites, both coastal and inland. Most frequent in dry, stony river bank meadows. Less common in forests and alpine habitats (NNV, TRY, TRI, FI, FV, FN).

F. norvegica Altner, 1963
A strictly marine littoral species occuring under stones in the tidal zone. Also in wrack and wet beach meadows. (TRY: Bjarkøy, Torsken, Tromsø, TRI: Balsfjord, FN: Porsanger).

F. quadrioculata (Tullberg, 1871)
One of the most common and widespread species in North Norway, present in nearly all searched habitats both in the lowlands and in the mountains (NNV, TRY, TRI, FI, FV, FN, FØ).

F. sensibilis Kseneman, 1936
Common in forest litter, both hardwood and conifer. Also in protected habitats in open areas (lush beach meadows, willows and thickets above tree-line) (TRY, TRI, FI, FV, FN, FØ).

F. sexoculata (Tullberg, 1871)
A marine littoral species, rather common in wet beach meadows (TRY, TRI, FN).

F. stella Grow & Christiansen, 1976
Rather common in beach meadows, sand dunes and bird cliffs along the coast. Less common in damp forest litter and river bank deposits in the inland (NNV, TRY, TRI, FV, FN). The first Norwegian record was reported from Jan Mayen by Fjellberg (1984).

Isotomodes bisetosus Cassagnau, 1959
Only in three localities on the outer coast in Troms, but here rather frequent among roots of *Elymus, Lotus, Festuca,* etc. on sand dunes (Sandsvika, TRY: Torsken; Otervika (Kvaløya) and Breivikstranda (Rebbenesøy) in TRY: Tromsø).

The Norwegian specimens have been compared with paratypes from the Pyrenees, and no differences were found. From Vancouver Island, British Columbia, I have specimens which will key to *I. klostermani* (Bernard) according to Christiansen & Bellinger (1980). I can find no major differences between these and the examined material of *bisetosus,* and the two species are possibly synonyms.

Isotomiella minor (Schäffer, 1896)
Very common and widely distributed, also above tree-line. Highest frequency in deciduous forest litter (NNV, TRY, TRI, FI, FV, FN, FØ).

Archisotoma besselsi (Packard, 1877)
Frequent under stones in the marine tidal zone (TRY, TRI, FN).

A megalops (Bagnall, 1939)
Frequent in same habitats as previous species. Once it was observed in millions grazing algae on stone at low tide (TRY, FV, FN).

A. theae Fjellberg, 1979
Common in the tidal zone of sandy beaches, often very abundant under sea-weed which is not too rotten. Sometimes in sand dunes and beach meadows at some distance from the littoral zone (TRY, FN).

A. quadrioculata Fjellberg, 1988
In sand among beach front vegetation, usually well above high tide mark. Probably common, but easily overlooked due to the small size (Breivikstranda (Rebbenesøy) and Breivikeidet, TRY: Tromsø; Sandsvika, TRY: Torsken; Sørkjosleira, TRI: Balsfjord; Persfjord, FN: Vardø; Hamningberg, FN: Båtsfjord).

Proisotoma abiskoensis Agrell, 1939
Only two records from pine litter (Gargia, FV: Alta, Øvre Pasvik, FØ: S. Varanger).

P. admaritima Murphy, 1953
A few records among vegetation on rocks and cliffs near sea. On one occasion it was observed creeping on rocks under a thin film of rain water. They did not float on top of the water like other collemboles would have done, which indicates that the cuticle has very special properties. Fjellberg (1980) reported specimens creeping on the bottom of brackish rock-pools (Hallvardsøy, TRY: Tranøy; Nord-Svellingen, TRY: Torsken; Vikran, TRY: Tromsø).

P. borealis (Axelson, 1905)
Some records in wet litter and vegetation along lakes and rivers in inner parts of the district (Lille Rostadvatn, Moen and Rundhaug in TRI: Målselv; Bergmo, TRI: Nordreisa; Gievdneguoikka, FI: Kautokeino).

P. buddenbrocki Strenzke, 1954
Only a few littoral records from beach front vegetation (moss, *Triglochin*) and in debris on a river bank some distance from sea (Sandsvika at Gryllefjord, TRY: Torsken; Tranøybotn, TRY: Tranøy; Maskjok Bru, FN: Tana).

P. clavipila Axelson, 1903
Only once, under bark on a rotten birch at Tromsøya, TRY: Tromsø.

P. minima (Absolon, 1901)
Some records in rather diverse habitats: Under bark on rotten birch, in moss, grass and debris on a river bank, and in moss and grass along a brook in a sandy beach meadow (Sandsvika at Gryllefjord, TRY: Torsken; Grindøya, TRY: Tromsø; Rundhaug, TRI: Målselv).

P. minuta (Tullberg, 1871)
Only once in grass and algae on manured rocks in a gannet colony on Skarvklakken, NNV: Andøy.

P. subarctica Gisin, 1950
Usually in wet, alpine habitats in inner parts of the district. Once together with *P. borealis* on a lake shore (Langdalsryggen in Kaperdalen, TRY: Tranøy; Tromsdalstind, TRY: Tromsø; Njunis, Høgskardfjell, Liggafjell, Moskogiassa and Lille Rostadvatn, TRI: Målselv; Javreoaivek, TRI: Nordreisa; Bidjovagge, FI: Kautokeino).

Agrenia bidenticulata (Tullberg, 1876)
Common in alpine wet habitats (moss on stones along cold-water streams). Also along swift-running lowland streams (TRY, TRI, FN).

A. riparia Fjellberg, 1986
The species was originally described from the river Gaula (STI) and Driva (MRI), and also reported from Alaska and NE Siberia (Fjellberg 1986). It has now proved to be common on the banks of most of the larger rivers in Troms and Finnmark. It is usually found in abundance in moss and litter among wet stones at water edge. The species is so far not observed along the cold, alpine streams where *A. bidenticulata* is common. (Straumsbotn, TRY: Berg; Ånderdalselva, TRY: Tranøy; Breivikeidet, TRY: Tromsø; Rostaelva, Målselv (Rundhaug) and Dividalselva, TRI: Målselv; Reisaelva (Bergmo), TRI: Nordreisa; Repparfjordelva, FV: Kvalsund; Gievdneguoikka, FI: Kautokeino, Tanaelva (Levajok), FN: TAna; Gædnajokka, FN: Berlevåg; Syltefjordselva and Sandfjordselva, FN: Båtsfjord; Komagelva, FN: Vardø).

Pseudisotoma sensibilis (Tullberg, 1876)
Common in many different habitats, mainly in open, exposed sites both in lowland and mountains. Most records from alpine fell-fields (NNV, TRY, TRI, FV, FN).

Vertagopus arboreus (Linne, 1758)
Cadwalladr (1969) reports five specimens in a dry sample from Olderfjord in TRI: Kvænangen. There are no other records of this species from North Norway, and Cadwalladr possibly misidentified either *V. sarekensis* og *V. arcticus*. The standard handbook of Gisin (1960), which Cadwalladr used, does not separate these species.

V. arcticus Martynova, 1969
Usually found in damp, cold, high-alpine moss communities. In inner parts of Troms mainly above 1300 m, descending to about 800 m on the coast (Tromsø area). On the Varanger peninsula nearly to sea level in N-facing snow-beds (Bentsjordstind, Tromsdalstind and Kattfjordeidet, TRY: Tromsø; Høgskardfjell, Njunis, Liggafjell, TRI: Målselv; Goatto, FN: Berlevåg; Seglodden, FN: Båtsfjord).

V. cinereus (Nicolet, 1841)
Rather common under bark on dead trees (TRY, TRI, FN).

V. pseudocinereus Fjellberg, 1975
The only records from North Norway are those reported by Fjellberg (1975b) from Pasvik, FØ: S. Varanger, collected under bark on dead birch. The species has later been repor-

ted from North America (Christiansen & Bellinger 1980) and NE Siberia (Fjellberg, unpublished).

V. sarekensis (Wahlgren, 1906)
Common in dry, exposed sites bove tree-line in coastal mountains. It appears to be less frequent in inner and northern parts of the region (NNV, TRY, TRI, FV).

V. westerlundi Reuter, 1897
In moss and lichens on live trees. Also in dry habitats above tree-line, in particular among nitrophilous lichens on bird-stones (TRY, TRI, FI, FN, FØ).

Isotoma agrelli Delamare, 1950
Appears to be common in litter in beach front vegetation (*Elymus, Festuca, Potentilla,* etc.) around Tromsø (TRY). Otherwise seen from Spildrøy, TRI: Balsfjord and Vestertana, FN: Tana.

I. anglicana Lubbock, 1862
Very common in litter in many different habitats. Less frequent in forests than in open land (beach meadows, alpine heaths) (NNV, TRY, TRI, FI, FV, FN).

I. blekeni Leinaas, 1980
Only once, in a rotten pine trunk above Gargia, FV: Alta. The species is known from South Norway and Finland.

I. blufusata Fjellberg, 1978
In litter and debris along lakes and rivers. Sometimes on snow in winter (TRI, FI, FN, FØ).

I. ekmani Fjellberg, 1977
Scattered records from forest litter and alpine meadows, heaths and thickets (TRY, TRI, FI, FV, FØ).

I. hiemalis Schött, 1893
Rather common in forest litter, both conifer and hardwood. Less frequent in open sites (beach meadows and alpine heaths) (TRY, TRI, FI, FV, FN, FØ).

I. infuscata (Murphy, 1959)
A characteristic species in wet, alpine snowfield communities. Often on snow or glacier ice. Descends to lower altitudes in western and northern parts of the district (NNV, TRY, TRI, FV, FN).

I. maritima Tullberg, 1871
A marine littoral species, rather common in wrack beds and wet beach meadows (NNV, TRY, TRI, FN).

I. neglecta Schäffer, 1900
Rather common in alpine bogs and wet meadows, less frequent below tree-line (TRY, TRI, FI, FV, FN, FØ).

I. nivea Schäffer, 1896
Under bark on dead trees (birch) (Tromsøya, TRY: Tromsø; Setermoen, Karlstadskogen, TRI: Bardu; Høgskardet, TRI: Målselv).

I. notabilis Schäffer, 1896
Very common both in lowlands and mountains. No clear habitat preferences (NNV, TRY, TRI, FI, FV, FN, FØ).

I. olivacea Tullberg, 1871
Very common in mesic habitats (bogs, lake shores, river banks, wet meadows, damp forests, etc.) both in lowlands and mountains. Dry, exposed sites are avoided (NNV, TRY, TRI, FI, FV, FN, FØ).

I. propinqua Axelson, 1902
Only two records: In mouse nests in cultivated grass fields just after snow melt at Bardujord, TRI: Bardu, and from pine litter at Valjok, FI: Kautokeino (ecomorphic juveniles with abdominal spines).

I. ruseki Fjellberg, 1979
Only twice in moss and leaf litter on river banks at Tromsdalselva and Breivikeidet, TRY: Tromsø. The species was originally described from SE Norway (Fjellberg 1979), but is later seen from the banks of river Gaula in STI.

I. tenuicornis Axelson, 1903
So far only collected in a *Sphagnum* bog in Upper Pasvik, FØ: S. Varanger.

I. tigrina (Nicolet, 1843)
Some records from damp leaf litter in alder forest, from river bank debris and from mouse runways in a tall *Heracleum* beach meadow (TRY: Tromsø, TRI: Balsfjord).

I. violacea Tullberg, 1876
Rather common in forests, where it might be found both in litter and on stems of live and dead trees. Also a few records from beach meadows and from dry, exposed ridges above tree-line (TRY, TRI, FI, FV, FØ).

I. viridis Bourlet, 1839
Common in most of the searched habitats. Compared to *anglicana,* which has been confused with *viridis* in the past, *viridis* is less frequent in beach meadows and more frequent in forests (TRY, TRI, FI, FV, FN, FØ).

Isotomurus balteatus Reuter, 1876
Only a few records from Finnmark in wet bogs and damp river bank vegetation (Valjok Bru, FI: Kautokeino; Gjøkåsen, FØ: S. Varanger).

I. palustris (Müller, 1776)
In wet habitats, mainly in forests (TRY: Tromsø, Skånland; TRI: Balsfjord, Målselv, Bardu).

Family Entomobryidae

Entomobrya marginata (Tullberg, 1871)
Only once in moss and lichens on old birch trunks on Spildrøy, TRI: Balsfjord.

E. multifasciata (Tullberg, 1871)
Some records from pine litter in Upper Pasvik, FØ: S. Varanger.

E. nicoleti (Lubbock, 1876)
A few records from beach meadows near Tromsø (Langnes on Tromsøya, Breivikstranda on Rebbenesøy, Grindøya, Gjøssøy, Hillesøy, TRY: Tromsø).

E. nivalis (Linne, 1758)
Common in moss and lichens on tree trunks, but also in forest litter and in dry, alpine habitats (TRY, TRI, FI, FV, FN, FØ).

Orchesella bifasciata Nicolet, 1841.
Lie-Pettersen (1906) reports this species from birch forest in Tromsdal, TRY: Tromsø. I have not seen the species in North Norway.

O. cincta (Linné, 1758)
According to Lie-Pettersen (1906) two specimens were collected by E. Strand in 1901 in Bosekop, FV: Alta. I have not seen the species in North Norway.

Willowsia buski (Lubbock, 1873)
Only two records from tree trunks (aspen, pine) (Høgskardet in Dividalen, TRI: Målselv; Ånderdalen, TRY: Tranøy). Lie-Pettersen (1906) reports the species from a hotel room in Tromsø.

W. nigromaculata (Lubbock, 1873)
Many specimens in a bathroom in a hotel at Sørkjosen, TRI: Nordreisa.

Lepidocyrtus lignorum (Fabricius, 1781)
Very common in all kind of habitats both in lowlands and mountains (NNV, TRY, TRI, FI, FV, FN, FØ).

L. violaceus (Lubbock, 1873)
Only once, picked from the under side of a wrack-board on a dry beach meadow in Bleiksøya, NNV: Andøy.

NOTE: Cadwalladr (1969) report *L. curvicollis* Bourlet, 1839 and *L. cyaneus* Tullberg, 1871, from Olderfjord in TRI; Kvænangen. The records should be verified. The former species is most likely *L. lignorum.*

Pseudosinella alba (Packard, 1873)
Only two records: Grass tuft in a puffin slope in Bleiksøya, NNV: Andøy, and from *Elymus* roots among stones at the beach of the larger Gapøyholman, TRY: Kvæfjord.

Family Tomoceridae

Tomocerus minutus (Tullberg, 1876)
Rather common in forest litter (both pine and hardwood) in northern and eastern (inner) parts of the district. Also in meadows and thickets above tree-line (TRI, FI, FV, FN, FØ).

NOTE: Lie-Pettersen (1906) reports *Tomocerus plumbeus* (Templ.) Aagr. syn. *T. niger* Bourl. from both Alta and Tromsø. The only *Tomocerus* seen by me in North Norway is *T. minutus.* Lie-Pettersen possibly misidentified specimens of *minutus,* with which he had no experience, even though he refers to a record from «Lavangsfjeld at Hindø» made by the swedish Jenisej expedition in 1875, published by Schött (1893).

Family Mackenziellidae

Mackenziella psocoides Hammer, 1953
Two adult females (size 0.3 mm) were extracted from moss/*Juncus* in a depression among sand dunes on the beach at Sandsvika (Gryllefjord), TRY: Torsken. Only three specimens of this species have been reported before: The two original type specimens from Mackenzie River in North Canada (Hammer 1953), and a single specimen from South Germany (Hüther 1964). After examination of the holotype, Christiansen & Bellinger (1980) would rather classify the specimen as a first-instar sminthurid of unknown position. My specimens are clearly mature and will be discussed in another publication.

Family Neelidae

Neelus minimus (Willem, 1900)
Common in forest litter, both conifer and

hardwood. Also in less exposed habitats in open land (lush beach meadows, alpine thickets) (TRY, TRI, FI, FV, FØ).

Family Sminthuridae

Spaeridia pumilis (Krausbauer, 1898)
A common litter species all over the area, both in coastal, inland and alpine habitats. Less frequent in dry, exposed sites (NNV, TRY, TRI, FI, FV, FN, FØ).

Sminthurides aquaticus (Bourlet, 1843)
Probably common, but only a few records from ponds and lake shores (TRY: Bjarkøy, TRI: Målselv, FV: Måsøy, FN: Vadsø).

S. malmgreni (Tullberg, 1876)
Common in bogs and wet habitats along ponds, ditches, rivers and lakes. Both lowland and alpine (TRY, TRI, FI, FN).

S. parvulus (Krausbauer, 1898)
In same habitats as previous species, but less frequent (FI, FN, FØ). Cadwalladr (1969) reports the species from Olderfjord in TRI: Kvænangen.

S. pseudassimilis Stach, 1956
A few specimens from a Sphagnum bog in Upper Pasvik, FØ: S. Varanger.

S. schoetti (Axelson, 1903)
Common in various wet habitats (TRY, TRI, FI, FN, FØ).

Stenacidia violacea (Reuter, 1881)
Two specimens were extracted from wet moss with *Phippsia algida* in a snow-bed on Høgskardfjellet, 1170 m, TRI: Målselv. The species has not been reported from Norway before.

Arrhopalites principalis Stach, 1945
Scattered records from damp forest litter (birch, alder, aspen, willow), also in bogs above tree-line (TRY, TRI, FI, FN, FØ).

A. secundarius Gisin, 1958
A single specimen was collected from litter in a birch forest with tall undergrowth at Stabburtjern in Upper Pasvik, FØ: S. Varanger. The species was originally described from France, but is little known.

Sminthurinus albifrons (Tullberg, 1871)
A few specimens in litter in a dry pine forest at Stabburtjern in upper Pasvik, FØ: S. Varanger. This is the first Norwegian record, but the species is known from Sweden and Finland.

S. aureus (Lubbock, 1862)
Scattered records from wet beach meadows, *Salix* bogs, snow-field meadows and river banks (TRY: Bjarkøy, TRI: Nordreisa, FN: Porsanger, Tana, Berlevåg, Båtsfjord, Vardø).

S. concolor (Meinert, 1896)
Rather common in dry, alpine habitats (grass, moss and lichens in places with bird manure, under flat stones in screes and fell-fields). Also some records from dry beach meadows (TRY, TRI, FV, FN).

S. elegans (Fitch, 1863)
Only two records from a dry beach meadow (sheep pasture) at Bleik, NNV: Andøy, and from a dry meadow on a S-facing rocky hill in Lille Follesøya, TRY: Skjervøy.

Bourletiella pistillum Gisin, 1946
Usually in dry, exposed habitats above tree-line (limestone outcrops), but also in dry pine forest (TRY, TRI, FI, FN).

Deuterosminthurus repandus (Ågren, 1903)
A few records from undergrowth in lush birch forests and from dry, rocky habitats above tree-line (NNV, FN, FØ). Cadwalladr (1969) reports on specimen (male) from Olderfjord in TRI: Kvænangen.

Heterosminthurus claviger (Gisin, 1958)
Some records from bogs and wet meadow both below and above tree-line (TRY, TRI, FI, FØ).

H. insignis (Reuter, 1876)
Scattered records from wet habitats both in the lowlands and in the mountains (bogs, meadows, lake shores, ponds) (TRY, FN, FØ).

Dicyrtoma fusca (Lucas, 1842)
A few records from tall beach meadows and from moss and litter in birch/aspen forest (TRY, TRI, FV).

Dicyrtomina minuta (Fabricius, 1783)
Some records in lush beach meadows, ponds, willow thickets, etc. Also above tree-line (TRY, FV, FN).

D. saundersi (Lubbock, 1862)
Only one juvenile specimen collected from a grass meadow on Anda, NNV: Øksnes.

3.2. Elements of distribution

Certain requirements have to be fullfilled before questions about patterns in the geographical distribution of the entire collembole

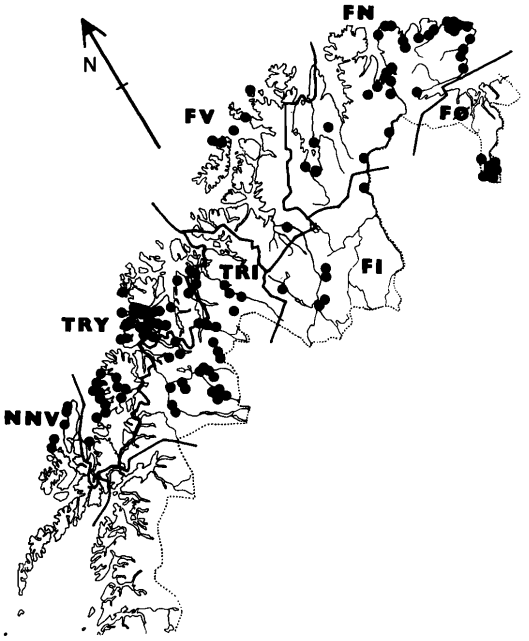

Fig. 1. Collecting sites for Collembola in North Norway (NNV: Nordland north-west, TRY: Troms outer, TRI: Troms inner, FV: Finnmark west, FI: Finnmark inner, FN: Finnmark north, FØ: Finnmark east). One dot usually represents several samples.

fauna could be raised. The whole area should be surveyed, and all habitat types in a local area should be examined. As fig. 1 shows, the area is rather well covered with sampling sites. However, there is an uneven selection of the examined habitats, which impose a certain bias. The higher mountains in Finnmark (the coastal mountains and the Gaissa mountains) are nearly unexplored. Many of the typical alpine species of Troms certainly also occure in Finnmark, even though they were not found in the present survey. The species confined to trees, both live and dead, are collected just a few places, mainly in Troms. Also bogs, ponds and edges of lakes are scarcely collected — both in Troms and Finnmark. The list of hygrophilous species will certainly be longer when these habitats are extensively sampled. The beach line on southern side of Varangerfjord is not at all examined.

Considering these limitations, it is possible to give some indications conserning distribution of species living in the following habitats:

a). Coastal habitats including sand dunes, beach meadows, bird cliffs, wrack beds and the tidal zone (not examined in eastern Finnmark, FØ).

b). Litter of the forest floor, including both conifer and hardwood.

c). Habitats above tree-line. High-alpine snow-edge communities mainly in Troms.

3.2.1. Coast-bound species

The halophilous species, living in wrack beds and the tidal zone, are distributed more or less along the entire coast from NNV to FØ: *Hypogastrura arctandria, Anurida calcarata, A. marina, A. thalassophila, Onychiurus arcticus, O. debilis, O. duplopunctatus, O. macfadyeni, Folsomia norvegica, F. sexoculata, Archisotoma besselsi, A. megalops, A. quadrioculata, A. theae, Isotoma agrelli, I. maritima.*

Among species living in þeach meadows and sand dunes, some appear to be southern, not extending into Finnmark: *Hypogastrura vernalis, Tetracanthella arctica, Isotomodes bisetosus, Proisotoma admaritima, Entomobrya nicoleti, Lepidocyrtus violaceus, Pseudosinella alba, Sminthurinus elegans.*

The repeated collecting of *Axenyllodes echinatus* from a single beach front dune in Persfjord on the Varanger peninsula, is not easily explained. The species is certainly an ecological specialist, but it should have been collected in the well examined sand dunes in Troms if it was present there. Possibly it belongs to an eastern element, analogous to some of teh plants in the same area *(Dianthus superbus, Oxytropis campestris).*

Another oddity is the dune sample from Sandsvika at Gryllefjord (TRY: Torsken) containing both *Micranurophorus musci* and *Mackenziella psocoides.* The previous records of these species from both North America and Middle Europe, indicate that they are possibly overlooked, either due to their small size, or — which is more likely — that they have very special ecological requirements which are not well known at present.

3.2.2. Forest species

Among the numerous species which are present in forests, there is a distinct element of continental species occuring in the inner and eastern parts of the area, roughly following

the distribution of the pine in inner Troms (TRI), inner Finnmark (FI) and eastern Finnmark (FØ): *Schoettella inermis, Hypogastrura lapponica, H. socialis, Xenylla brevicauda, Xenyllodes armatus, Pseudachorutes asigillatus, P. corticicolus, Onychiurus sibiricus, Anurophorus septentrionalis, Proisotoma abiskoensis, P. borealis, Isotoma blekeni* and *Isotomurus balteatus.* A small group of species are only found in Pasvik in eastern Finnmark (FØ): *Vertagopus pseudocinereus, Isotoma tenuicornis, Sminthurides pseudassimilis, Arrhopalites secundarius* and *Sminthurinus albifrons.* Some of these *(I. tenuicornis, S. pseudassimilis)* reappear in the eastern parts of South Norway (Fjellberg 1976).

3.2.3. Alpine species

Most of the strictly alpine species are probably present in all the higher mountains of the area. But at least in Troms, there is a slight differentiation in coastal mountains and inland mountains. The following species were only found in inland mountains, or are more common there than in coastal mountains: *Anurida alpina, A. polaris, Tullbergia simplex, Proisotoma subarctica, Stenacidia violacea* (one record only). The reverse holds for the following species: *Onychiurus schilovi, Anurophorus fulvus, Vertagopus sarekensis, Isotoma infuscata.*

3.2.4. Species with a split alpine and coastal lowland distribution

A few species are rather common in beach habitats and reappear in inland mountains: *Onychiurus arcticus, Tullbergia arctica, Tetracanthella pilosa, Isotomodella pusilla, Sminthurinus concolor.* The *Onychiurus* species is clearly attracted to the rich growth of algae following bird manure which is most common along the sea and in certain alpine spots. The other species are more or less bound to limestone communities in the mountains, which might explain their presence in light, sandy soils with a high content of shell fragments at the sea.

3.2.5. Arctic species

A large fraction of the 179 species which were found in this survey, belongs to an element with a general arctic or northern distribution. They are too numerous to be listed. There is however, a group of about 15 high arctic species, present on the arctic island of Norway (Svalbard, Jan Mayen), which seems to be absent from the mainland: *Hypogastrura tullbergi* (Schäffer), *H. concolor* (Carpenter), *H.* sp. near *sensilis* (Folsom), *H. longispina* (Tullberg), *Willemia similis* Mills, *Friesea quinquespinosa* Wahlgren, *Onychiurus groenlandicus* (Tullberg), *Folsomia alpha* Grow & Christiansen, *F. taimyrica* Martynova, *Archisotoma polaris* Fjellberg & Poinsot, *Isotoma nanseni* Fjellberg, *I. tshernovi* Martynova, *Entomobrya subarctica* Stach. The only exception is the single record of *O. groenlandicus* from Berlevåg, which is the only mainland record of this holarctic species (earlier mainland records of *groenlandicus* are either *ursi* og *schoetti*).

3.3. Habitat and species diversity

The present 563 samples have been associated with thirty different habitats, defined by soil properties and vegetation (Fig. 2). A direct comparison of species richness in the various habitats is not possible, due to different levels of sampling. However, in fig. 2 the total number of species being present in each of the thirty habitats, are related to the number of samples from each habitat. At low numbers of samples (15—20), there are no clear separation between habitats. From that on, adding samples will still increase species number in the more complex habitats, whereas the simpler ones reach a saturation level rather soon. The lower group encircled on Fig. 2, are all habitats with a simple structure, while the upper group has habitats with a higher complexity in soil properties and vegetation.

If the habitats are grouped in larger units, the beach region — including bird cliffs, tidal zone, and dunes/meadows/heaths where the effect of salt and wind is still evident — will have 113 species in 180 samples. The forest habitats, including both conifers and hardwood, have 100 species in 104 samples. Alpine habitats have 98 species in 196 samples. There is no doubt that increased sampling in the forest would have added considerably to the species list, but even so the 113 species from the open, exposed and often harse coastland seems very high in comparision. This high number of species is partly explained by the fraction of strictly halophilous forms,

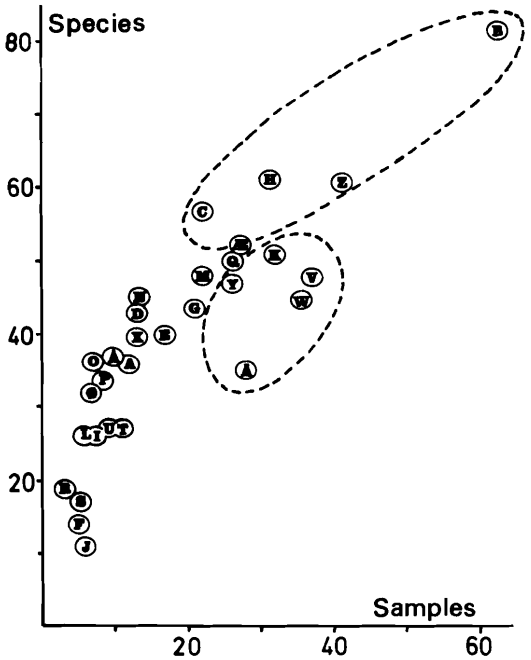

Fig. 2. Correlation between number of species and number of samples from 30 different habitats, Ä—Å.

Beach region
Ä. Littoral zone. Sand, stones, cliffs. Fresh seaweeds and wrack.
A. Supralittoral wrack beds, decomposing. Some vegetation.
B. Dry beach meadows, short vegetation — usually on sand mixed with sea-shells. Vegetation affected by salt.
C. Wet beach meadows, affected by salt.
D. Tall beach meadows (*Angelica, Urtica, Rubus, Filipendula,* etc.)
E. Aeolic sand dunes (*Elymus, Festuca rubra, Potentilla,* etc.)

Bird cliffs
F. Mesic turf and vegetation, strongly affected by manure.
G. Drier turf and vegetation. As above.

Open lowland habitats
H. Dry heaths and meadows.
I. Wet meadows, swamps, bogs.
J. Moss, lichens, grass, etc. on rocks and stones. Dry, exposed.

Rivers, lakes
K. River banks. Sand, mud, stones, litter deposits. Sparse vegetation.
L. Shores of lakes. As above.

Forest habitats
M. Dry deciduous forests *(Betula, Alnus, Sorbus)*
N. Mesic birch forest, tall vegetation (ferns, etc.)
O. Mesic alder forest, usually along rivers and brooks. Tall undergrowth.
P. Wet moss along brooks.
Q. Dry pine-woods of the inland.
R. Spruce/larch/pine of the coastland. Usually planted.
S. Moss and lichens on trunks of live trees.
T. Under bark on dead trees.
U. Forest bogs (East Finnmark only).

Alpine habitats
V. Wet moss, etc. in meltwater and along snow-fields.
W. Dry moss, lichens, grass on rocks and stones.
X. High alpine fell-fields. Sparse vegetation.
Y. Wet meadows and bogs.
Z. Dry meadows.
Æ. Dry, exposed outcrops. Rich flora on limestone.
Ø. Dry thickets of *Juniperus, Betula nana, Empetrum.*
Å. *Salix*-thickets, usually mesic or wet.

counting about 15 species. Also the reappearence in the beach habitats of some alpine inland forms (5 species) is part of the explanation. But the fact that five of the six new species which were discovered in this survey come from beach habitats, probably reflects the high diversity of the open coastland.

The bird cliffs, despite their intense expression of life, have a meagre collembole fauna counting 48 species in 26 samples. More samples would have added some species, but the low diversity was observed already during sampling. Guanophilic species like *Hypogastrura purpurescens, Ceratophysella denticulata* and *Xenylla humicola* might bloom in spots with strong manuration and algal growth, but few other species were present. Most species occurred in sites which were less affected by manure.

3.4. Habitat selection of individual species

In order to examine differences in habitat selection between related species of the same genus, some of the more common species were listed in Table 1. The table shows the frequency of the species, expressed as percentages of samples in which they were present, in the three habitat types beach meadows (114 samples), forest floor (82 samples) and all habitats above tree-line (196 samples).

Table 1. Frequency (%) of some common species in three major habitat types based on presence/absence in the samples (N).

	Beach meadows N = 114	Forest N = 82	Alpine N = 196
Ceratophysella denticulata	17.5	2.4	2.6
C. scotica	3.5	1.2	11.2
Willemia anophthalma	3.5	42.7	4.1
W. denisi	0.9	14.6	5.6
W. intermedia	3.5	1.2	6.6
W. scandinavica	23.1	-	6.1
Tullbergia critica	15.8	3.3	7.1
T. italica	6.1	12.2	4.1
T. macrochaeta	41.2	8.5	12.8
T. tenuisensillata	6.8	46.3	14.8
Onychiurus absoloni	1.8	40.2	3.6
O. armatus s.str.	3.5	-	-
O. pseudovanderdrifti	20.2	57.3	29.6
O. subarmatus	1.8	11.0	8.2
Folsomia bisetosa	21.1	2.4	4.6
F. brevicauda	2.6	7.3	28.6
F. fimetaria	8.8	1.2	-
F. quadrioculata	36.0	67.1	58.7
F. sensibilis	6.1	42.7	6.1
Isotoma anglicana	29.8	7.3	17.3
I. hiemalis	3.4	34.2	4.1
I. notabilis	32.5	47.6	27.6
I. olivacea	2.6	26.8	23.5
I. viridis	13.2	26.8	21.4

Ceratophysella
The species *denticulata* is clearly more frequent in beach meadows than in other sites, while *scotica* is most common in alpine habitats.

Willemia
The two species *anophthalma* and *denisi* are most common in forest habitats, while *scandinavica* preferes the beach meadows. *W. intermedia* is a rather uncommon species, but is more frequent in alpine habitats than in other sites.

Onychiurus
The common species *pseudovanderdrifti* was most frequent in forest habitats, but is also quite common in other sites. *O. absoloni* has a strong affinity to forests, and is uncommon in other sites. *O. subarmatus* has a weak preference to forests and alpine habitats in relation to beach meadows, while *O. armatus* was only found in beach meadows — though rather infrequent.

Tullbergia
The two species *arctica* and *macrochaeta* are clearly prefering the beach meadows above other habitats, while *italica* and — in particular — *tenuisensillata* prefere the forest habitats.

Folsomia
The classical species *quadrioculata* is common in all habitats, with a weak preference to forests. The same preference is more strongly expressed by *sensibilis,* which is rather uncommon outside forests. The similar species *bisetosa* has a low frequency in forests, but is common in beach meadows. The same applies to *fimetaria,* while *brevicauda* has highest frequency in alpine habitats.

Isotoma
The familiar species *viridis* has the highest frequency in forests, where it was collected twice as often as in beach meadows. The situation is reversed for the closely related species *anglicana,* which was four times as frequent in beach meadows as in forests. *I. hiemalis* shows the strongest affinity to forests. *I. notabilis* is even more frequent in forests than *hiemalis,* but it is also quite common in other habitats as well. The hygrophilous species *olivacea* is common both in forests and alpine habitats, but is sporadic in the generally dry beach meadows.

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Annual patterns of activity, reproduction and development in some Norwegian Carabidae (Col.).

DAGFINN REFSETH

Refseth, D. 1988. Annual patterns of activity, reproduction and development in some Norwegian Carabidae (Col.). *Fauna norv. Ser. B 35,* 21—30.

At three localities situated at altitudes ranging from 20 to 1120 m a.s.l. the life cycles of a total of 17 species of Carabidae were examined. A large proportion of the species was found to need two years to develop and become mature, as opposed to previous recordings. Some species also appear to be both univoltine autumn-breeders and semivoltine spring-breeders within their geographical range, and it is suggested that most carabid species of northern Europe possess rather variable life cycle patterns. The actual extent of variation in carabid phenology seems to have been underestimated, mainly because descriptions of life cycle patterns merely have been based on samples from restricted geographical areas.

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INTRODUCTION

According to the times of breeding and the stage in which hibernation takes place some general classifications of carabid breeding types have been proposed (Larsson 1939, Lindroth 1949, Thiele 1977). With a few exceptions most species are thought to possess a particular, and rather fixed, annual reproductive pattern, mainly governed by photoperiods and ambient temperatures.

In recent years quite extensive geographical variations in the life cycle patterns of several carabid species have been revealed. In particular this applies to populations in northern and alpine areas, where the times of breeding generally seem to be around midsummer, and the development frequently takes two years (Forsskåhl 1972, De Zordo 1979, Houston 1981, Refseth 1984, 1986).

The ability of changing the course of the annual breeding rhythm according to differing light and temperature conditions generally promotes dispersal and adaptability. And since most carabid species are widely distributed and therefore subject to a variety of light and temperature conditions, some interspecific variations in annual reproductive patterns are to be expected.

During a study on adaptation, distribution and dispersal in Carabidae it proved necessary to get additional information on the extent of such phenological variations. A survey of annual life cycle patterns of several Norwegian species was therefore carried out.

MATERIAL AND METHODS

The material was collected by pit-fall trapping at three localities in south and central Norway:

a: an alder forest habitat at Melhus, Sør-Trøndelag (63°16'N, 20 m a.s.l.).

b: a subalpine birch forest habitat at Budalen, Sør-Trøndelag (62°43'N, 830 m a.s.l.).

c: a subalpine birch forest habitat and a low-alpine heather habitat at Sjodalen, Oppland (61°36'N, 980—1120 m a.s.l.).

At each locality 20—40 traps were used during the snow-free period, i.e. May—October at Melhus and June—September at Budalen and Sjodalen.

A total of 17 species were examined regarding the seasonal activity patterns of adults and the development of female gonads. To correct for differences in the length of the seasonal trapping periods the results were converted to the number of specimens caught per 100 trap-days.

The seasonal patterns of maturation of the female gonads were determined by dissection, the gonads being classified as 1) immature, 2) developing, 3) mature or 4) spent (cf. Luff 1973, Refseth 1986).

Table 1. The total number of specimens of each species trapped at Melhus in 1981 and 1982.

Species	1981	1982
Trechus secalis (Payk.)	2.845	1.726
Nebria rufescens (Strøm)	1.748	860
Pterostichus oblongopunctatus (F.)	385	910
Agonum assimile (Payk.)	711	405
Calathus erratus (Sahlb.)	677	205
Pterostichus niger (Schall.)	104	95
Loricera pilicornis (F.)	100	87
Carabus nemoralis Müll.	50	95
Carabus hortensis L.	54	81
Leistus terminatus (Hellw.)	61	73
Calathus melanocephalus L.	34	24
Harpalus quadripunctatus Dej.	23	28

In most species the occurrence of larvae and newly emerged adults (tenerals) provided additional information on the course of the life cycles. The different larval instars were separated by measurements of the head widths, moreover the first instar larvae could be recognized by the presence of egg-bursters.

The number of specimens of each species which were trapped at Melhus is shown in Table 1; for the other localities the numbers are given in Fig. 2 and Fig. 3.

The concepts 'univoltine' and 'semivoltine' are used for life cycles of one year and more than one year, respectively.

THE LIFE CYCLES OF THE SPECIES

Pterostichus oblongopunctatus (F.) and *Agonum assimile* (Payk.) (Fig. 1, Table 2).

The adults of both species had their main period of activity in early spring, with a peak in late April—early May. In 1981 the sampling, which had to be postponed because of spring floods of the river Gaula, probably commenced too late for this peak to be included. From late May the activity declined and very few specimens were caught after July, except in *A. assimile,* where a number of tenerals were caught in early August 1981.

The females mature during May, and since spent females were found in June—July and second instar larvae in July, the eggs must have been laid in late May—early June. The larval development seems to be completed in August, and adults of the next generation emerge in September—October, judging from the occurrence of immature females at that time. Hence both species have univoltine life cycles, and the adults hibernate. This seems to be the common pattern in populations of northern and western Europe (Thiele 1971, 1975, Neudecker and Thiele 1974, Jørum 1976, Brunsting 1981, Andersen 1982, Heessen et al. 1982, Kålås 1985, Loreau 1985). However, a few tenerals of both species were trapped in May and June, indicating that the hibernation occasionally takes place also in the larval stage.

Harpalus quadripunctatus Dej. (Fig. 1, Table 2).

No larvae were recorded, but the pronounced peak of activity in late May, which was associated with the gonadal development, indicates that the egg-laying takes place mainly in June. Also in other parts of Scandinavia the species has been found to breed in spring (Larsson 1939, Lindroth 1945, Andersen 1982). Tenerals occurred both in August—September and in May, which means that larvae may hibernate in addition to the adults. A similar pattern is reported by Lindroth (1945), which suggests that the species under certain conditions may need two years to develop. Probably the life cycle at Melhus is mainly univoltine, but occasionally larvae which hatch rather late may be forced to hibernate before being able to complete the development.

Loricera pilicornis (F.) (Fig. 1, Table 2).

The activity was mainly restricted to May and June, corresponding with the sexual maturation. In August—September the larval development is completed and tenerals and immature females appear. The life cycle is univoltine and the adults hibernate. A similar pattern is described by other authors (e.g. Greenslade 1965, Andersen 1985) although Loreau (1985) assumes that the species in Belgium may breed both in spring and in the autumn.

Carabus nemoralis Müll. (Fig. 1, Table 2).

Two peaks of activity were recorded, one in late May and another in July, after which only a few specimens were caught. Similar activity patterns have been described from western Norway (Kålås 1985) and central Europe (Hurka 1973). The females mature during May, and the eggs are laid mainly in May—June. The occurrence of larvae from late June to early August is consistent with

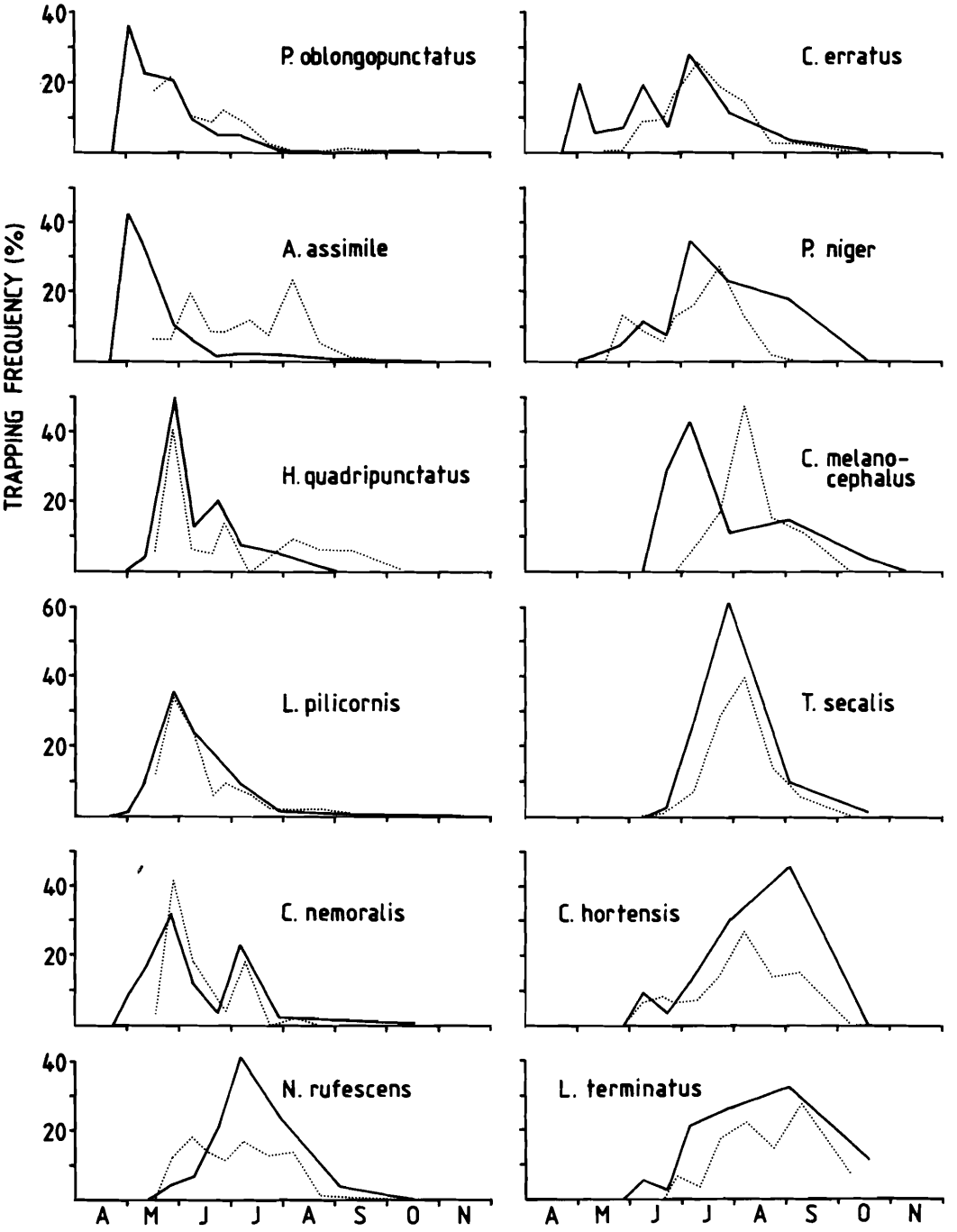

Fig. 1. The seasonal activity patterns of 12 species at Melhus in 1981 (dotted lines) and 1982 (solid lines).

Table 2. The seasonal distribution (fortnightly) of the development classes of female gonads and of the larval stages at Melhus (1981 and 1982 combined). (I: immature, D: developing, M: mature, S: spent).

		May		June		July		Aug.		Sept.		Oct.		Nov.
		I	II	I	II	I	II	I	II	I	II	I	II	I
P. oblongopunctatus	I									5				
	D	1												
	M	6	3	1										
	S			2	3	5		1						
	L2					1	1							
	L3					1		6	2					
A. assimile	I	1						2		1				
	D	4												
	M	2	3	2	1									
	S		1			4		3						
	L1		1	1	4	3	2	2						
	L2				8	6	14	7						
	L3					31	22	54	9					
H. quadripunctatus	I		1		1				1					
	D		4											
	M		1											
	S							1	1					
L. pilicornis	I								2			1		
	D	2	1											
	M		2	1		3								
	S				1									
	L1				1	2		1						
	L2				4	4	1	3						
	L3					19	1	32	11	12				
C. nemoralis	I		1			8		1						
	D	2	4											
	M	1	3	2										
	S		2	2		3	1	1		1				
	L1				7	4								
	L2				1	1	1	1						
	L3					1	2	5						
N. rufescens	I		2	1										
	D		2		2	2								
	M				1	2	3	2						
	S			1				3		2				
	L1					1	10	116	72	98		7		4
	L2							102	187	556		32		13
	L3	128	13						4	138		211		412
C. erratus	I	9					1		5	5				
	D		3	4										
	M			3		4	2	7						
	S							1	1	7		1		
	L1					1		4		2				
	L2		1						2	3				
	L3	3	2	1						1		4		10
P. niger	I		4					3		1				
	D		1	4		2	1							
	M					1	3	4						
	S									1				
	L1						1	14	9	7		1		
	L2	1							2	12		14		1
	L3	1	2		1									
C. melanocephalus	I					1	2							
	D							2						
	M							1						
	S								1	4		2		
C. hortensis	I					3		2		4				
	D						2	2		1				
	M									3		1		
	S									1		2		
	L1													2
	L3		1	1										
L. terminatus	I													
	D					1	1							
	M							6		1		1		
	S													
	L2					1						2		1
	L3		2									1		4

litterature data (Larsson 1939, Lindroth 1945, Hurka 1973, Kålås 1985).

One teneral specimen was found in late May, and immature females occurred from May to August, although mainly in July, which explains the second peak of activity. They must have emerged the same year, being descendants from the generation which bred one year earlier. And since they would not have been able to breed until the following spring, the life cycle is semivoltine. Lindroth's (1945) data on tenerals occurring in July—August indicate that the species may need two years to develop also in other parts of Scandinavia.

Nebria rufescens (Strøm) (Fig. 1, Table 2). In 1982 the activity commenced in May and reached its maximum in early July, while in 1981 it extended from June to early August. In both years mature females occurred from late June, representing the start of the egg-laying period. First and second instar larvae were most abundant in August and September, and third instar larvae in October—November. Third instar larvae were also caught in spring, after having hibernated. Tenerals were trapped in large numbers in late June, which might be just in time for the maturation to be completed before breeding that year. However, some tenerals were caught in July, when most females were fully mature. It is reason to believe that they would have had to hibernate as adults and delay breeding until the following summer. Also Lindroth (1945) suggests that the species may hibernate both as adults and larvae, and in northern Scandinavia it is found to be semivoltine (Forsskåhl 1972). The life cycle pattern thus seems to be rather variable, in the present case probably being partly univoltine, partly semivoltine.

Calathus erratus (Sahlb.) (Fig. 1, Table 2). The activity pattern resembled that of the former species, with a peak in early July. In 1982 a number of immature specimens were caught in early spring. The females become mature in June, which is somewhat earlier than in Great Britain (Gilbert 1956) and southern Norway (Andersen 1982, 1985). From the catches in May it is evident that third, and even some second, instar larvae hibernate. Immature females, including a few tenerals, occurred from July onwards, and they would have had to hibernate before being able to breed. Consequently the development takes two years.

Pterostichus niger (Schall.) (Fig. 1, Table 2). Both the activity pattern and the seasonal distribution of the development classes of the female gonads and of the various larval stages were fairly similar to those of *N. rufescens* and *C. erratus*. And since both larvae and immature adults were found in August and September, this species too must have a semivoltine life cycle with adult and larval hibernation. A similar pattern is found also in Denmark (Jørum 1976, 1980).

Calathus melanocephalus L. (Fig. 1, Fig. 2, Table 2, Table 3).
At Melhus (Fig. 1, Table 2) there was a single peak of activity in early August in 1981, while in 1982 a peak of activity in June—July was followed by a smaller one in Au-

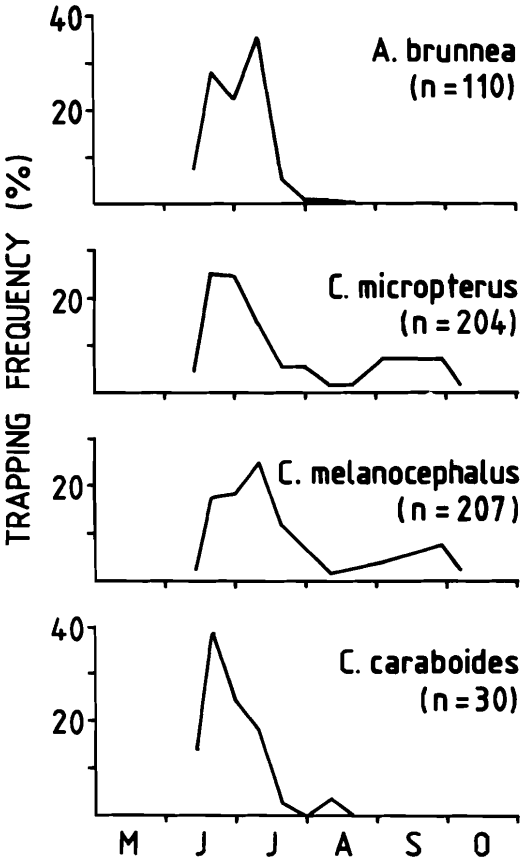

Fig. 2. The seasonal activity patterns of four species at Budalen (1975).

Table 3. The seasonal distribution (fortnightly) of the development classes of female gonads and of larvae at Budalen. (I: immature, D: developing, M: Mature, S: spent).

		May		June		July		Aug.		Sept.		Oct.	
		I	II	I	II	I	II	I	II	I	II	I	II
A. brunnea	I				2	2	1	3	3		1		
	D		1	6		1							
	M			2	2	1							
	S					2	1	1	3	2			
	L3									6	3	1	
C. micropterus	I		1								1	3	4
	D		1	4	1	2							
	M				1	2	2	1					
	S						2	2	2				
C. melanocephalus	I								1	3			
	D		1	1									
	M				2	5	2	2					
	S							1	1				
C. caraboides	I						1		1				
	D		1	2	1								
	M			3	2	3	1						
	S								1				
	L1									1			
	L2		1						1	1	1		
	L3		2							1	8	8	

gust—September. However, in both years spent females occurred from late August to October, which shows that the breeding and egglaying mainly takes place in August, as in more southern areas (Gilbert 1956, Greenslade 1965, van Dijk 1972, Andersen 1982, 1985). Although no larvae were found, the late breeding implies larval hibernation, as in *N. rufescens, C. erratus* and *P. niger*. Tenerals which were caught in late August had to be descendants of the generation which bred one year earlier, and they would have been unable to reproduce until the next year. Hence at least part of the population needs two years to develop.

At Budalen (Fig. 2, Table 3) the breeding takes place in July, considering the high level of activity recorded in late June and the occurrence of mature and spent females in July—August. Tenerals and immature females appeared in August and September, hence both larvae and adults hibernate and the life cycle is semivoltine. This is also the case in northern Scandinavia (Forsskåhl 1972) and in the Austrian mountains (DeZordo 1979).

Trechus secalis (Payk.) (Fig. 1).
Both in 1981 and in 1982 there was a pronounced peak of activity in July—August. Although no larvae were recorded, the occurrence of several tenerals in June—July indicates that the life cycle is univoltine, with larval hibernation, which is consistent with litterature data (Larsson 1939, Lindroth 1945, Andersen 1982).

Carabus hortensis L. (Fig. 1, Table 2).
This species was trapped in all months from June to October, although mainly in August—September. Mature females appeared in September, which seems to be the main period of breeding, as in other parts of Europe (Hurka 1973, Jørum 1976, Andersen 1982).

Two second instar larvae were found in October—November and two third instar larvae were found in May and June, respectively. According to the late time of breeding probably both second and third instar larvae may hibernate. Two teneral specimens were caught, in early August, which might have

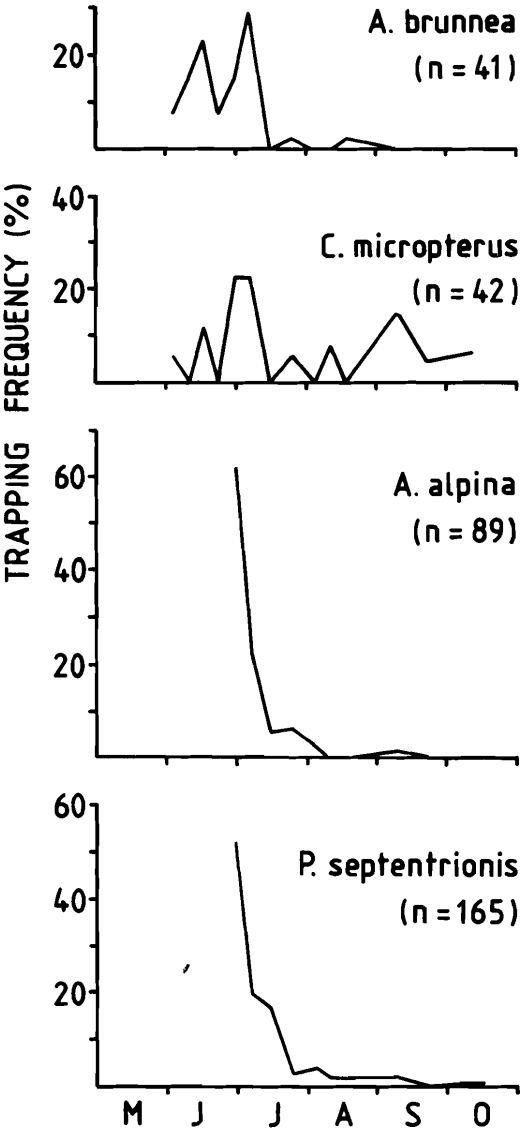

Fig. 3. The seasonal activity patterns of four species at Sjodalen (1973).

been able to reproduce that year. But immature females occurred even in late September, and they would have had to postpone the breeding till the next season. It therefore seems most likely that the development takes two years.

Leistus terminatus (Hellw.) (Fig. 1, Table 2). The patterns of activity and of gonadal and larval development resemble those of *C. hortensis*. But since tenerals were found in June, obviously in due time to breed the same year, the life cycle appears to be univoltine (cf. Larsson 1939, Lindroth 1945, Murdoch 1967).

Amara brunnea (Gyll.) (Fig. 2, Fig. 3, Table 3, Table 4).
Both at Budalen and at Sjodalen the activity was mainly restricted to June—July. Only a few females were caught at Sjodalen, but the maturation obviously takes place during early summer at both sites. Third instar larva were found in the autumn and at Sjodalen also in June. Immature and even teneral specimens occurred from June to September, hence both larvae and adults hibernate and the life cycle is semivoltine. According to Larsson (1939) and Lindroth (1945) mainly larvae, and to some extent adults, hibernate, while Forsskåhl (1972) suggests that the species in northern Scandinavia is a spring breeder with adult hibernation. Apparently the life cycle pattern is rather variable.

Calathus micropterus (Duft.) (Fig. 2, Fig. 3, Table 3, Table 4).
Both at Budalen an at Sjodalen two peaks of activity were recorded. The one in June—July was associated with reproduction, and the smaller one in September was due to newly emerged adults. No larvae were caught, but as the seasonal distribution of the various development classes of female gonads closely resembles that of *A. brunnea,* the life cycle appears to be semivoltine.

Like *A. brunnea* this species seems to be rather variable concerning life cycle patterns. June—July is reported to be the main period of breeding (DeZordo 1979, Andersen 1982, Kålås 1985), but both larvae and adults have been found to hibernate (Larsson 1939, Lindroth 1945).

Cychrus caraboides (L.) (Fig. 2, Table 3).
The activity was mainly restricted to late June—early July, corresponding with the period of progressing sexual maturation. Larvae of all instars were found in the autumn, and both second and third instar larvae hibernate, judging from their occurrence in May. Immature females were recorded in July—August, thus the life cycle is semivoltine, which is also suggested to be the case in Austrian moutains (DeZordo 1979). As Larsson (1939) and Lindroth (1945) also mention hi-

Table 4. The seasonal distribution (fortnightly), of the development classes of female gonads and of larvae at Sjodalen. (I: immature, D: developing, M: mature, S: spent).

		May		June		July		Aug.		Sept.		Oct.	
		I	II	I	II	I	II	I	II	I	II	I	II
A. brunnea	I			1	1								
	D												
	M			3									
	S				2								
	L3				1						1	2	
C. micropterus	I							1	1	4		1	
	D			1									
	M				1	1							
	S								1	1			
A. alpina	I							1		1			
	D				2								
	M				3	3	4						
	S						1						
	L2						1						
	L3				2	1							
P. septentrionis	I						1	1	1	2		1	
	D				1								
	M				4	3	1						
	S						2						

bernation of both adults and larvae, the species may need two years to develop even in other parts of Scandinavia.

Amara alpina (Payk.) and *Patrobus septentrionis* Dej. (Fig. 3, Table 4).
At Sjodalen the trapping did not commence until 26 June, due to the late snow-melt at the low-alpine sampling site. The largest catches were achieved during the first trapping period, indicating that both species have their main period of activity in June—July.

Third instar larvae of *A. alpina,* which must have hibernated, were caught in June—July. One second instar and three third instar larvae of *P. septentrionis* were caught in traps being in operation from 17 October to 26 November, and 15 third instar larvae were found in traps which were left out during the winter. Since immature females of both species also occured in late summer, the development must take two years. Also in other parts of Scandinavia these species have been found to exhibit semivoltine life cycle (Lindroth 1945, Forsskåhl 1972).

DISCUSSION

At Melhus six species possess life cycle patterns which are in accordance with previously published data: *P. oblongopunctatus, A. assimilis, L. pilicornis,* and *H. quadripunctatus* breed in spring and hibernate mainly as adults, and *T. secalis* and *L. terminatus* breed in autumn and have winter larvae. Although the remaining species fairly well fit earlier descriptions regarding adult activity patterns, they have — at least partly — semivoltine life cycles.

At Budalen and Sjodalen all the species, including four species which have been treated earlier (Refseth 1984, 1986), breed in spring and need two years to complete the life cycle. The activity patterns represent only one year of sampling, still they are considered to be reliable and representative. Other results have shown that although the peaks of activity may be displaced by a couple of weeks from one year to another, the general course of the life cycles remain unchanged (Refseth 1980, 1984). Evidently, reliable descriptions of carabid life cycles have to include information on the seasonal occurrence of larvae and premature adults.

Semivoltine life cycles are obviously a consequence of adaptations to cool climates. Due to short growing seasons, particularly in the subalpine areas, the larvae are unable to complete their growth and development in

one summer, and the species are forced to hibernate both as larvae and as adults. Semivoltine life cycles seem to occur rather frequently in northern and alpine areas (cf. Forsskåhl 1972, DeZordo 1979, Refseth 1984, 1986), supporting the assumption that the majority of carabids of high altitudes and latitudes need two years to develop (Refseth 1986).

However, even at Melhus about 50% of the species are semivoltine, although the length of the growing season there is ca. 170 days compared with 100 and 120 days at Sjodalen and Budalen, respectively (Bruun 1967, see also Refseth 1986). Also according to other studies it is obvious that semivoltine life cycles may occur in areas with less extreme climates. *Pterostichus niger* (Schall.) and *P. melanarius* (Illig.) have been shown to be semivoltine in Denmark (Jørum 1976, 1980), and in northern England populations of *Carabus problematicus* Hbst. are semivoltine at altitudes above 250 m (Butterfield 1985). In these areas the length of the growing season is approximately 200 days (Wallén 1970).

Apparently phenological variations within carabid species are more frequent than hitherto assumed. Despite the fact that carabids are among the most thouroughly studied insect groups only minor attention has been paid to this important aspect of their ecology, probably because data on life histories usually have been available only from small parts of the species' geographical ranges. Even the comprehensive studies of Larsson (1939) and Lindroth (1945, 1949) contain only a few indications of such variations. Their conclusions agree with the commonly held view that semivoltine life cycles mainly are confined to populations in arctic and alpine areas (cf. Thiele 1977).

A major weakness of Larsson's (1939) work is that data from various parts of Scandinavia have been pooled. Thereby valuable informations about phenological differences between populations may have been concealed. Lindroth (1945, 1949) has to some extent been aware of such variations, as he separated the data from northern and southern Sweden. Accordingly he noted a certain degree of inconsistency between his data and those of Larsson (1939), the most notable difference being that Lindroth (1945) frequently found both adults and larvae of the same species to occur during the winter, particularly in northern populations. In autumnbreeding species this seems to be a fairly common pattern, due to some degree of postreproductive hibernation of adults (e.g. Thiele 1977). However, as hibernation of both adults and larvae is a distinctive property of semivoltine species, some of Lindroth's (1945) observations might as well indicate the occurrence of semivoltine life cycles. This assumption is further supported by the fact that in nearly all the species which so far have been proved to be semivoltine, Lindroth (1945) reports hibernation of both stages. Larsson (1939) also mentions such cases, e.g. *P. niger,* which later actually has been found to be semivoltine, even in Denmark (Jørum 1980).

Intraspecific phenological variation may also account for the discrepancies which often are discovered when various author's descriptions of a species' life cycle pattern are compared. *C. melanocephalus* and *C. caraboides* are described as univoltine autumn breeders in southern areas, whereas they are semivoltine spring breeders in northern and alpine areas (cf. Forsskåhl 1972, DeZordo 1979). These species thus possess patterns of phenological variation resembling that of *Patrobus atrorufus* (Strøm), which also has proved to be both an univoltine autumn breeder and a semivoltine spring breeder within its geographical range (Refseth 1986). Such variations are due to adaptations to differing light and temperature conditions and are likely to be found also in other species, particularly those being widely distributed.

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Biological and morphological characteristica of a marginal population of *Capnia atra* (Plecoptera) in Suldalslågen, Western Norway

ALBERT LILLEHAMMER

Lillehammer, A. 1988. Biological and morphological characteristica of a marginal population of *Capnia atra* (Plecoptera) in Suldalslågen, Western Norway. *Fauna norv. Ser. B. 35:* 31—34.

The isolated, local population of *Capnia atra* Morton in the Suldalslågen river and Suldalsvatn lake, in Rogaland province in southwestern Norway, occurs west of the main distributional area of this species. This population diverges both morphologically and ecologically from other populations studied. The hypothesis is that during the postglacial period, differences in the life cycle of the Suldalslågen population have evolved allowing the species to survive outside its optimale distribution area. Biometrical differences are also visible in such characters as the body length of 1st instar nymph, and the wing length and shape of the genitalia appendages of the adults. Similar populations also occure in Ireland, England and Southern Sweden. They have probably all resulted in a similar way to that in Suldal.

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INTRODUCTION

The continuous distribution in Europe of *Capnia atra* is restricted to northern Fennoscandia. Only isolated, marginal populations occur south of Dalarna in central Sweden (Fig. 1) (Hynes 1941, Brinck 1949, Illies 195x, Zwick 1973, Lillehammer 1974 and O'Conor 1981).

Marginal populations is characterised by relatively great fluctuation in abundance Soulé (1973). Their morphological characters tend to be relatively stable. Some consists entirely of short-winged forms, e.g. the populations of Plecoptera in Sweden (Brinck 1949), and in Ireland (O'Connor 1981).

Previous studies of the life-cycle have all been made for populations occurring in more typical *C. atra* environments, such as Øvre Heimdalen in the mountains of southern Norway, in the Biggesjavrit lake in Finnmark north of the Polar Circle and in the river Lomma near Oslo (Brittain et al. 1984, Brittain et al. 1986). All these localities are characterised by a long and cold winter.

The Suldalslågen lake, the site of the present study, is situated in an area which has a more Atlantic climate than those of the previously described populations, and an annual water temperature regime differs from that in the Lomma river and at the three other localities so far studied. The water temperatur in winter in the Suldalslågen river is relatively high, lying between 1 and 3°C during the coldest month, January. In the summertime, however, the temperature seldome rises to more than 12°C.

It was hoped, therefore, that a study of the morphology of the adults, the duration of the egg incubation period, the size of newborn nymphs, and of nymphal growth would yield valuable information about the capability of the species to form local populations in marginal areas in a stream with a water temperature regime different from that found in normal *Capnia atra* biotopes.

AREA DESCRIPTION

The Suldalsvatn lake is situated in the north of Rogaland province in western Norway (59°40'N, 6°20'E). The lake covers an area of 29 km² and is 375 m deep. It is situated 68 m above sea-level and has the form of a fjord. The Suldalslågen river is 22 km in length, from the lake outlet to the mouth. The riparian vegetation consists mainly of grey alder *Alnus incana.* The annual mean water temperature 1—2°C in winter and reach 12—13°C in the warmest months in summer.

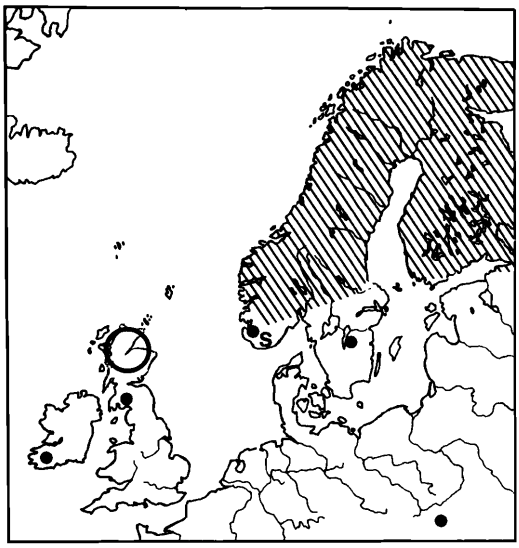

Fig. 1. The european distribution of *Capnia atra* Morton. The filled and open circles indicate the marginal population at Suldal (S) and the relict populations outside the main area. The main distributional area in Fennoscandia is shaded.

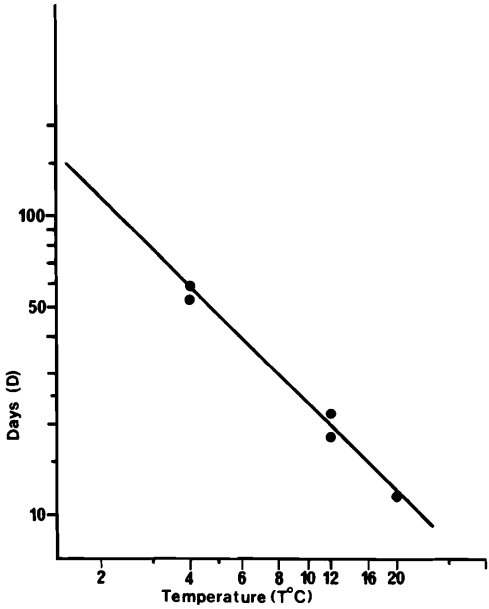

Fig. 2. The linear relationship between the length of the incubation period and temperature, plotted on a logaritmic scalew for *Capnia atra* Morton, as given by the regression equation $y = aT^{-b}$, in which a and b are constant.

MATERIAL AND METHOD

The samples studied were collected at one locality on the lake shore (Helganes) and at one locality in the river, about 3 km below its the outlet from the lake (Prestaviká). The adult material used in the taxonomical studies consisted of 18 females and 9 males. The length of the incubation period was studied for a total of 1136 eggs at temperatures of 4°, 12° and 20°C, collected from six of these females, together with a study of the growth of 30 nymphs reared at 12°C. The latter temperature (12°C) was chosen because this has been found to be the best rearing temperature for *Capnia atra* nymphs, involving the lowest mortality rate (Brittain et al. 1986). The rearing methods has been described previously by Lillehammer (1975), and by Brittain et al (1984). The body length, head width and cerci length of 10 first instar nymphs were measured.

RESULTS

1. Egg incubation period and nymphal growth

Hatching was succesful at all the temperatures at 4°, 12° and 20°C (Tab. 1). A highly significant relationship was found (r^2 =

Table 1. Development of *Capnia atra* eggs incubated at different temperatures, and the mean day-degree requirement for 50% hatching.

Water temp.	No of eggs used	Hatch rate %	Incubation period (days)	Mean day-degree C
4°C	75	96	52	208
	154	98	54	216
12°C	382	99	21	252
	284	97.9	18	216
20°C	213	97.9	11	220

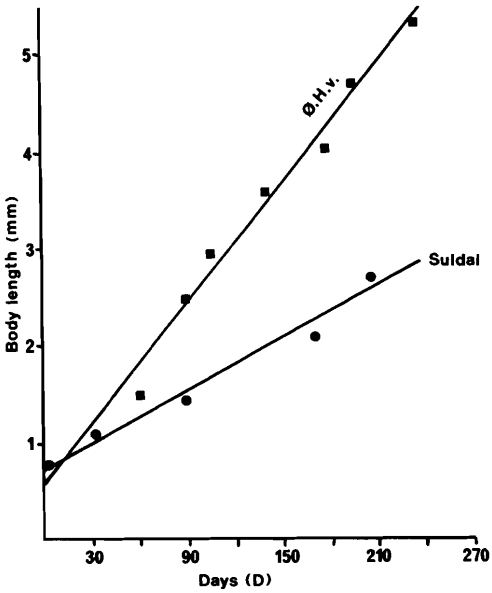

Fig. 3. The relationship between mean growth (mm) and age in days (D) at 12°C for *Capnia atra* Morton populations from Suldalslågen and Øvre Heimdalsvatn. The relationship is given by the simple linear regression equation: G = a + bD, in which a and b are constant.

0.995, $p<0.001$) between the incubation period (y days) and temperature (T°C) when plotted on a logaritmic scale and expressed by the equation log y = log a-b log T or $y = aT^{-b}$. The values of the two constant were 201.1 and 0.954 ± 0.167 (± 95% C.l.) for a and b respectively (Fig. 2). The mean day-degree requirement for å successful hatching was 226 ± 11.1.

At 12°C nymphal growth (G) in mm was found to be significantly ($r^2 = 0.976$, $p<0.001$, N = 15) linear related to time used (D) in days as given by a simple linear regression equation: G = a + bD, in which the value of constant a was 0.846 and b 0.009 (95% C.l.) 0.001 (Fig. 3).

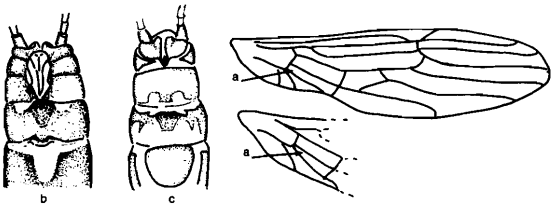

Fig. 4. Morphological characteristica of the Suldalslågen population of *Capnia atra* Morton. a) the typical cubital ribs (above) and the normal (below). b) the typical form of 7th segment of male. c) the female subgenital plate.

2. Morphology

A general description of *Capnia atra* adults are given by Lillehammer (1974a).

The mean body length of the first instar nymphs from Suldalslågen, (N = 10) orginating from eggs reared at a water temperature of 8°C, was 0.88 ± 0.03 mm (s.d.). The values for head width was 0.17 ± 0.005 mm (s.d.), and the length of cerci were 0.40 ± 0.02 mm (s.d.). (Tab. 2).

The 27 adult specimens (18 ♀♀ and 9 ♂♂) were all short-winged. The wing veins were often irregular, the cubitus veins forming a square (Fig. 4a).

The genitalian appendages of the males were all of the same type with a notch in the 7th tergite (Fig. 4b). The form of the females genitalia appendages also showed little variation (Fig. 4c).

The mean body length of females collected at Helganes were 7.67 mm ± 0.32, mean wing length 6.35 mm±0.36 (N = 13), the respective values for the males 6.77 mm±0.21, and 4.87 mm±0.41 (N = 7).

The respective values fot the Prestavika females were 7.24 mm± 0.51 and 4.46 mm± 0.40 (N = 5), and for the two males 5.9 mm and 5.9 mm long and 3.4 and 3.3 mm.

The wing factor (w/b) values for the Helganes females was 0.83, for the males 0.72, for the Prestavika females 0.62 and for the males 0.57. At both localities therefor the males were more short-winged than the females, and the river specimens had even shorter wings than the lake specimens.

DISCUSSION

The Suldalslågen population proved to be different from the three Norwegian populations studied by Brittain et al. (1984, 1986), both as regard to the form of the male genitalia, wing length, and the shape of the wing veins (Lillehammer 1974a). The first instar nymphs from Suldalslågen were also significantly larger than those from the three other populations studied (Brittain et al. 1984). The same feature was also observed for specimens of *Leuctra hippopus* from the same area (Lillehammer 1986).

The egg incubation period expressed in a linear regression $y = 201.1T^{-0.954}$ was not significantly different from the three other populations (Brittain et al. 1984) and the day-degree requirement was the same as for the other populations. The eggs from Suldalslågen develops at temperatures much the same as in the main distribution area.

The growth rate expressed in a simple li-

near regression between growth (G) in mm and time in (D) days, G = a + bD at 12°C showed that the growth rate of the Suldalslågen population was significantly lower than that of the three populations studied by Brittain et al. (1986).

Thus in *Capnia atra* there are significant differences in taxonomical characters, size of newborn nymphs and in the growth rate of nymphs. The Suldalsvatn population of *Capnia atra* that occurs outside the main distribution is morphological and ecological different. Vannot & Sweeney (1980) state that the size of adults are largest and the fecundity highest in the thermal optimum areas. Body size is reduced and the fecundity lowered both in warmer and colder areas. The optimal areas of *C. atra* is supposed to be in the mountainous areas in the continental Fennoscandia (Lillehammer 1985) and in streams with a water temperature close to 0°C during the winter (Lillehammer 1984, Brittain et al. 1984, 1986). At Suldalslågen the temperature is closer to 2°C during the winter. However, the body size is large, mean 7.67 mm for females, which is larger than in most of the Norwegian populations studied (Lillehammer 1974). It seems therefore likely that there have been an evolution and a genetic selection to a type that fits in with the surrounding temperature, keeping adults of a large body size that produce large first instar nymphs which have a special growth rate that produce adults at convinient time for mating and egg development. The low growth rate in the Suldalslågen population at 12°C compared to growth in the main distribution area such as continental or sub-arctic climate condition with temperatures close to 0°C for a long time during the winter (Brittain et al. 1986), seems to be an natural adjustment to an unnormal long growth period for this species in the marginal population at Suldalslågen. Differences that also are expressed in the morphological characters, such as the short-wingednes, wing veins and in the shape of the 7th tergit, and also in the size at the first instar nymph. There is thus the same tendency in *C. atra* such as in *L. hippopus* (Lillehammer 1986) to form local populations which are divergent both taxonomically and ecologically. This is subject to both genetic and environmental influence, such as mentioned by Tauber & Tauber (1981).

The hypothesis is that the flexibility in life-cycles that is documented alow the species to hold populations outside the main distribution area in northern Fennoscandia, such as in Suldalslågen, and probably also in southern Sweden, England, Scotland and Ireland.

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Six new species of Collembola from North Norway (Hypogastruridae, Odontellidae, Onychiuridae, Isotomidae)

ARNE FJELLBERG

Fjellberg, A. 1988. Six new species of Collembola from North Norway (Hypogastruridae, Odontellidae, Onychiuridae, Isotomidae). *Fauna norv. Ser. B 35,* 35—41.

The following new species are described: *Hypogastrura arctandria* n.sp. (Norway: Troms, Finnmark; Canada: Baffin Island; USSR: Chaun Bay), *Axenyllodes echinatus* n.sp. (Norway: Finnmark), *Tullbergia bella* n.sp. (Norway: Troms, Finnmark, Buskerud; Canada: British Columbia, Alberta; USA: Alaska, Colorado), *Tullbergia petterdassi* n.sp. (Norway: Troms, Finnmark), *Anurophorus fulvus* n.sp. (Norway: Troms, Finnmark), *Archisotoma quadrioculata* n.sp. (Norway: Vestfold, Troms, Finnmark). Notes are given on distribution and ecology.

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Introduction

Extensive field work in North Norway the last few years, have uncovered several undescribed species of Collembola (Fjellberg 1988). Some of these have probably been unnoticed until the present day because they are ecological specialists with rather cryptic ways of life. Other species have been confused with related ones, and their existence have been detected by taxonomic refinement. Some of these new species have a wide holarctic distribution.

The type material has been deposited in the following two institutions: British Museum (Natural History), London (BMNH) and Tromsø Museum, Tromsø (TM).

Family Hypogastruridae

Hypogastrura arctandria n.sp.
Figs. 1 A—E.

Type material. Holotype (alcohol) from «Norway. Troms: Tromsø. Otervika, Kvaløya. 20.vii.1985. Sandy beach. A. Fjellberg leg.», in TM.

Paratypes. 70 (alcohol) from the holotype sample, deposited in TM (50) and BMNH (20). 5 (slide) from «Norway. Finnmark: Vadsø. Store Ekkerøya, 15.vii.1985. Sandy beach. A. Fjellberg leg.», in BMNH. 4 (slide) from «Norway. Troms: Tromsø. Breivikstranda, Rebbenesøy, 13.ix.1985. Wrack bed, sandy beach. A. Fjellberg leg.», in TM.

Description

Size 1.2 mm.

Colour spotted grayish brown of variable intensity.

Head. Ant. 1 with 8 setae. Ant. 3 organ normal. Ant. 4 with elongate, entire apical bulb and about 10 angulare sensorial setae which are not thicker than the erect hairs. PAO variable, usually about 1.5 times as large as nearest ocellus. Lobes normally 4 (3—5), anterior pair slightly enlarged. An upright, finger-like process often present in proximal part of each lobe. Head with 2 + 2 vertical setae. Maxillary palp simple, outer lobe with two sublobal hairs. Maxilla as Fig. 1B. Characteristic is the long lam. 1 with a fringe of fine cilia along dorsal edge. The fringe continues around apex and becomes coarser along the ventral edge. Inner side with coarce, curved denticles in the middle part only.

Body with slender, rather short, smooth, pointed hairs. Only the longest setae on tip of abdomen with weak serrations. Chaetotaxy as Fig. 1 A. Variations and irregular setae frequent. A pair of characteristic lateral tubercles are found on the tergites of Th. 2 — Abd. 3 (Fig. 1A). Anal spines short, curved, on high basal papillae. Tibiotarsi with one long apical hair which is faintly knobbed at apex. Unguis without inner tooth, unguiculus without basal lamella, about half as long as inner edge of unguis (Fig. 1D). Ventral tube

with 4 + 4 setae. Tenaculum with 4 + 4 teeth. Dens 2.5—3.0 as long as mucro, with 7 dorsal setae and rather coarse dorsal granules (Fig. 1E). Ventroapical hyaline area very short. Mucro with a distinct, gently curved dorsal lamella which is usually set off by a notch from the blunt, hooked tip. Viewed from above/below, mucro is distinctly curved (Fig. 1E).

Discussion

The species is immediately identified by the lateral tubercles on Th. 2 — Abd. 3 which are seen in no other *Hypogastrura*. It comes close to the species *H. assimilis* Krausbauer, which has an identical maxilla and a similar PAO, though usually larger. The mucro of *assimilis* is more slender with a less distinct dorsal lamella (Fig. 1F).

Distribution and ecology

The species is common among sea-weed on sandy beaches in Troms and Finnmark, often together with *Hypogastrura viatica* (TRY: Berg, Tromsø; FN: Berlevåg, Vardø, Vadsø). Distribution is circumpolar, as specimens are also seen from the north coast of eastern Siberia (Chaun Bay) and from Baffin Island, Canada (Cape Hatt, E. Sendstad leg., specimens refered to *H. pannosa* in Fjellberg 1985 p. 26).

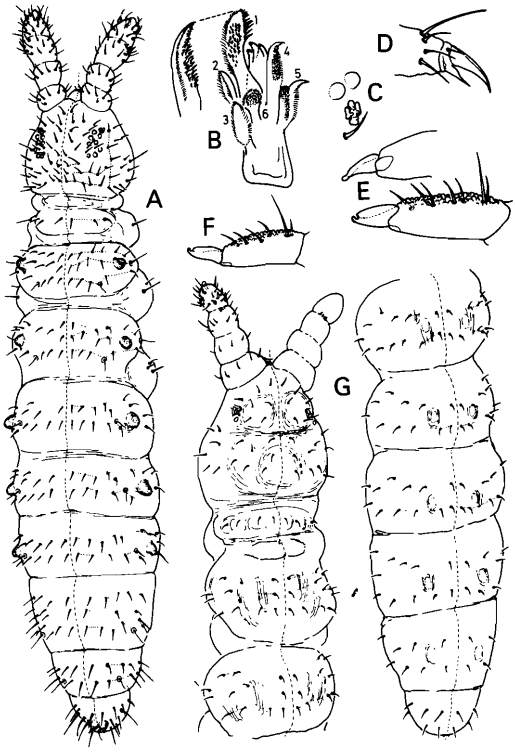

Fig. 1. A—E. *Hypogastrura arctandria* n.sp. A. Dorsal chaetotaxy. B. Right maxilla. C. Right PAO and ocelli. D. Tip of right foreleg. E. Right dens and mucro, lateral and ventral. F. *H. assimilis*. Right dens and mucro, lateral. G. *Axenyllodes echinatus* n.sp. Dorsal aspect.

Family Odontellidae

Axenyllodes echinatus n.sp.
Figs. 1 G, 2 A—F.

Type material. Holotype (slide) from «Norway. Finnmark: Vardø. Persfjord, 15.vii. 1985. Beach front dunes. *Elymus, Festuca.* A. Fjellberg leg.», in TM.

Paratypes. 8 (slide) from the holotype sample and 4 (slides) from the same locality collected 20.vi.1986, in TM. In addition 4 (slide) from the holotype sample are deposited in BMNH.

Description

Size 0.5 mm. Body shape narrow, *Willemia*-like.

Colour white.

Head. Ant. 4 with a large apical bulb and 6—7 angular, thickened sensillae which are sharply pointed at apex. Chaetotaxy of labial region and ventral side of head as Fig. 2A. Maxillary outer lobe with a simple palp. PAO triradiate, in a deep pouche. Ocelli 1 + 1 (Fig. 2E).

Body. Dorsal chaetotaxy as Fig. 1 G. Th. 2—3 with one or two setae in m_{3-4} position. No lateral microsensillae. m-setae absent on abdomen. Positions of sensillae on thorax and abdomen unclear, due to weak differentiation of the sensorial hairs. According to Deharveng (1981) the sensillae are in position p_4 on Th. 2 — Abd. 4 and p_3 on Abd. 5. Anal spines very small, only slightly larger than ordinary papillae of the integument. Sometimes only one median anal spine present, or they are both absent. Body integument with strong papillae, each with 1—3 spinules on top, giving the animal a very

«spiny» appearence (Fig. 2D). On dorsal side of head the papillae are more or less arranged in rows, making up definite fields. On Abd. 1—5 there is one pair of peashaped fields with fine structure devoid of papillae (position indicated on Fig. 1G). Ventral tube with 3 + 3 setae. Furca as Fig. 2 F. Dens with two posterior setae. The hook-shaped mucro long and slender, in-curved. Tenaculum with 2 + 2 teeth. Unguis strongly curved, with a broad lateral lamella of oval shape viewed from above. Unguiculus reduced to a small spine (Fig. 2B).

Discussion

The four known species of *Axenyllodes* have either 2 + 2 ocelli (*bayeri* (Kseneman, 1935), *ghilarovi* (Martynova, 1964), *minitaurus* (Ellis, 1976) or none (*caecus* Gisin, 1952)). The new species is the only known having 1 + 1 ocelli. Also the short anal spines differ from most known forms. The species has been compared with *bayeri* (Spain) and an undescribed species from Nepal. (Deharveng leg.). *A. bayeri* has much slender claws, longer anal spines and no distinct spinules on the integumentary papillae. The Nepalese species has 2 + 2 ocelli, distinct anal spines and a spinulate integument, like *echinatus.*

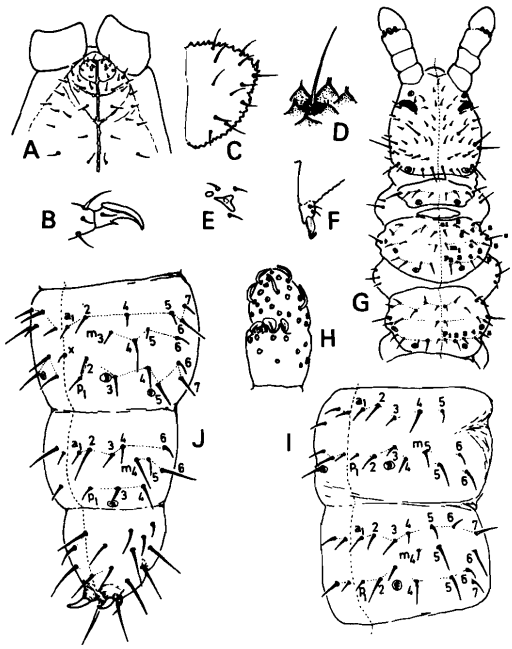

Fig. 2. A—F. *Axenyllodes echinatus* n.sp. A. Head, ventral. B. Tip of foreleg. C. Abd. 6, ventral. D. Granules with spinules on Abd. 6. E. Right PAO and ocellus. F. Furca. G—J. *Tullbergia bella* n.sp. G. Head and thorax, dorsal chaetotaxy. H. Left Ant. 3—4 with sensillae. I. Dorsal chaetotaxy of Abd. 1—2. J. Dorsal chaetotaxy of Abd. 4—6.

Distribution and ecology

The species is only known from the type locality where it occurred in samples from beach front sand dunes with a sparse cover of *Elymus arenarius* and *Festuca rubra.* Samples including the grass roots were cut directly from the vertical abration edge facing the sea and on the dunes two meters inside the edge. Several samples a further 20 m away from the edge did not contain this species. The species was associated with *Tullbergia bella, T. arctica, Karlstejnia norvegica, Wankeliella mediochaeta, Willemia scandinavica, Folsomia bisetosa, Archisotoma theae* and *A. quadrioculata.* This is an exclusive assemblage of very small euedaphic forms, and the two latter species indicate a high salt content — which is also quite obvious from the position of the site. *A. echinatus* might be a halophilous species.

Apart from the nepalese species, the other known species of the genus *Axenyllodes* have a mediterranean and central European distribution (Deharveng 1981). They usually occure singularly in xeric habitats and are not well known. Thus it is premature to discuss the Norwegian record in a larger biogeographical context.

Family Onychiuridae

Tullbergia bella n.sp.
Figs. 2 G—J.

Type material. Holotype (female, slide) from «Norway. Finnmark: Båtsfjord. Sandfjord, 20.vi.1986. Sand dune. A. Fjellberg leg.», in TM.

Paratypes. 3 (slide) from «Norway. Finnmark: Måsøy. Gustavvika, Hjelmsøya. 27.vii. 1984. Bird mound, 180 m a.s.l.», and 3 (slide) from «Norway. Buskerud: Uvdal. Raudhellerskorane, 10.vii.1973. Dryas.», in TM. 1 (slide) from «Norway. Finnmark: Måsøy. Hjelmsøya. Sandfjordbukta, 26.vii.1984. Sand dunes.», in BMNH.

Description

Body slender, 0.8 mm, white. Granulation rather coarse, distinctly enlarged on Abd. 6. Ant. 4 with five thickened, curved sensillae. Apical bulb small, indistinct. Ant. 3 organ with three dorsal sensorial clubs and one ventral (Fig. 2H). PAO with four rows of sensillae (about 30 in each), in a narrow slit. Chaetotaxy as Fig. 2 G, I, J. Head with p_1 longer than p_2 . Th. 2 with p_1 absent, present on Th. 3. Setae a_2 on Th. 2—3 slightly longer than a_1. Abd. 4 usually with an unpaired, median x-seta (rarely absent or doubled). Abd. 5 simple, without crests. Setae a_2 are long, a_1 and a_3 short. Anal spines about as long as claws. Pseudocelli with 2—3 blunt transverse ridges, distributed as 11/122/11121.

Males not seen.

Discussion

The species is very similar to *arctica* Wahlgren, which has the same chaetotaxy except on Abd. 4 where seta x is always absent and setae p_1 are usually wider separated. Also *arctica* has one additional (often weak!) pseudocellus on each side of Abd. 1—3 (11/122/22221). The third Norwegian species in this group, *simplex* Gisin, differs from both *arctica* and *bella* by pseudocellar formula (11/111/11111) and presence of a macrochaeta in position p_2 on Abd. 5 (Fjellberg 1984a, Fig. 6).

Distribution and ecology

The species has been published from Raudhellerskorane on Hardangervidda (BV: Uvdal) in South Norway (Fjellberg 1980 p. 59, Fjellberg 1984a, p. 73), and appears to be rather common in dry beach meadows and sand dunes in North Norway (TRY: Tromsø, FV: Måsøy, FN: Vadsø, Vardø). There is one record from a turfy, manured «bird mound» 180 m a.s.l. on Hjelmsøya, but so far no records from inland high mountains in North Norway where both *simplex* and *arctica* are present in dry limestone habitats. Further investigations will probably uncover *bella* also in these habitats. *T. bella* is present in North America (Alaska, British Columbia, Alberta, Colorado), published as *Tullbergia* sp. by Fjellberg (1984b).

Tullbergia petterdassi n.sp.
Fig. 3 A.

Type material. Holotype (female, slide) from «Norway. Troms: Lyngen. Sør-Lenangen, 10.iv.1983. Moss on rocks. A. Fjellberg leg.», in TM.

Paratypes. All from holotype sample, deposited as follows: 13 (slides) in TM, 2 (slide) in BMNH. In addition 14 specimens (slide) from «Norway. Finnmark: Tana. Tananeset, 9.vii.1985. Beach meadow» are in TM.

Description

Body slender, 0.5 mm, white. Body granulation uniform, coarse, slightly finer on head. Ant. 4 with sensillae a, b, and c thick, d and e thinner, notably d which hardly differs from an ordinary seta. Ant. 3 organ with two microsensillae between the clubs. PAO with 20—25 regular sensillae in two tows. Chaetotaxy as Fig. 3 A. Th. 3 without seta a_2. Abd. 4 with p_1 moved forward, the line p_1 -p_2 -p_3 nearly stright. Setae m_5 present. Abd. 5 with crescentic ridges, seta a_2 only slightly longer than a_1 and a_3 . Abd. 6 with anal setae a_2 present. Lateral sensillae on Th. 2—3 long, slender, hair-like. Abdominal tergites with slender, hair-like sensillae except p_3 on Abd.

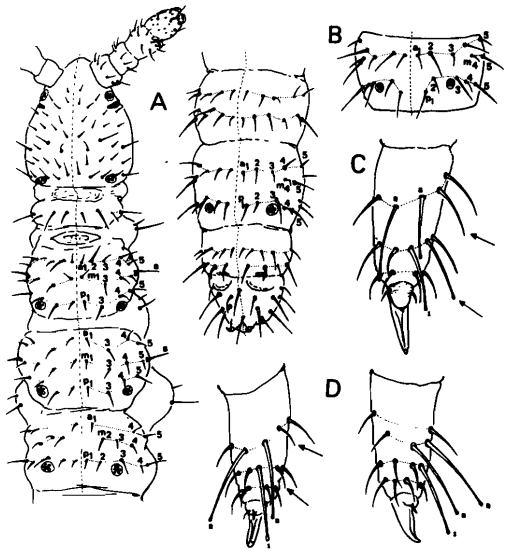

Fig. 3. A. *Tullbergia petterdassi* n.sp. Dorsal chaetotaxy. B. *Tullbergia macrochaeta.* Chaetotaxy of Abd. 4. C. *Anurophorus laricis.* Inner side of right foreleg. D. *Anurophorus fulvus* n.sp. Inner side of righ foreleg, different views.

5 which is moderately thickened. Pseudocellar formula 11/011/10011, pseudocelli normal, with radiating ribs. Position on Th. 2—3 is behind and slightly outside p_4 . Males are present.

Note: Petter Dass was a priest and poet living in Nordland in last half of the sixteenth century. Among Norwegian people, his poems are much cited and have a strong impact on the image of «North Norway» even today.

Discussion

The species belongs to the *macrochaeta*-group, differing from the nominal species by absence of setae a_2 on Th. 3, and by Abd. 4 having setae p_1 moved forward, nearly on line with setae p_2 -p_3 (compared Figs. 2A and 2B). Absence of a_2 on Th. 3 puts the species closer to *betchi* (Rusek), *massoudi* (Rusek) and *pongei* (Rusek) which are described from France (Rusek 1979, 1982). It differs from *betchi* by having long, slender sensillae on Abd. 3 (p_3) and Th. 2-3 (lateral s) (short, thick in *betchi*). From *massoudi* it differs by having slender, hair-like d-sensillae on Ant. 4 (short and thick in *massoudi,* which apparently also has somewhat thickened sensillae on Th. 2—3 and Abd. 3). Probably *pongei* is the one that comes closest, differing mainly by the strongly prolonged p_2 setae on Abd. 5. From all these species, *petterdassi* differs by the forward position of p_1 setae on Abd. 4 and possibly a lower number of PAO sensillae (20—25 in *petterdassi,* 38—40 in *macrochaeta* and 27—31 in the three other species). Body granulation appears to be coarser in *petterdassi* than in the other species, though it has only been directly compared to *macrochaeta.* In *petterdassi* there are 4—5 granules between bases of setae p_1 on Abd. 4, in *macrochaeta* at least 15.

Distribution and ecology

Several records in dry habitats near sea in Troms and Finnmark (Sør-Lenangen, TRY: Lyngen; Tananeset, FN: Tana; Hamningberg, FN: Båtsfjord). The presence of numerous specimens in moss, grass and lichens in fissures on exposed rocks and boulders, indicate a rather unusual ecology.

Family Isotomidae

Anurophorus fulvus n.sp.
Fig. 3 D.

Type material. Holotype (alcohol) from «Norway. Troms: Tromsø. Humpen, Kvaløya. 1.v.1985. Rocks, 530 m. A. Fjellberg leg.», in TM.

Paratypes. 100 (alc.) from the holotype sample, deposited in BMNH (50) and TM (50). 4 (slide) from «Norway. Finnmark: Båtsfjord. Goarvencærro, 12.vii.1985» in BMNH, 9 (slide) from «Norway. Finnmark: Lebesby. Ifjordfjellet, 18.vii.1985» in TM.

Description

Size. Largest specimen 1.5 mm, mature from about 0.9 mm.

Colour variable, typical specimens are uniformly yellowish brown with bluish pigment present in eyes only. Frequently specimens are more or less darkened, brown or bluish. But even in the darkest specimens the legs, antennae and ventral side of head are pale.

Head. Ant. 4 with a distinct apical bulb which is simple or more or less bilobed. A smaller bulb is usually present in ventromedian position. Antennae with normal sensillary equipment. Ant. 1 with 15 setae. PAO small, elongate, slightly longer than diameter of largest ocellus. Ocelli 8 + 8, G and H smaller, hardly visible as lenses. Maxillary outer lobe with simple palp and two sublobal hairs. Labrum with 5-5-4 setae. Frontoclypeal field with 3 + 1 setae. Three prelabral setae are present.

Body shape elongate, cylindrous. Abdomen not distinctly widenend towards tip. Dorsal side with reticulate integument, rather fine and uniform in anterior part of body, becoming successively coarser and more rugose towards tip of abdomen. Abd. 5—6 much coarser than Abd. 3, with a brownish lustre (cleared specimens). Body hairs uniformly short and fine. Coxae, Th. 2—3 and Abd. 4—6 with blunt or slightly knobbed macrochaetae. Median macrochaetae on Abd. 5 shorter than distance between their bases. The short setae in median parts of Abd. 5—6 sharply serrate (profile). Dorsolateral sensillae of Th. 2—Abd. 5 as 2(3),2/21114. Number of setae along median line of tergites on Th. 2—Abd. 3 as 6(7),4/3(4),3(4),4(5). Ventral setae present on Th. 3 (3—5 on each side). Ventral tube with 3 + 3 lateral and 4

caudal setae. Median parts of Abd. 2—3 with a few ventral setae (2—3). Tibiotarsi with 2-3-3 long, knobbed dorsal hairs and 3-3-1 ventral. The ventral tenent hairs are very distinct, subequal in length (Fig. 3D). Unguis without inner tooth, unguiculus short, spiniform, about 1/4—1/5 as long as inner edge of unguis, sometimes nearly redused on T1. Males without differentiated tibiotarsal setae.

Discussion

The species is very similar to *laricis,* and was first supposed to be a pale form of that species. However, the two species may be separated as follows: *A. fulvus* has two sublobal hairs on the maxillary outer lobe (one in *laricis*). Inner side of T1 and T2 has three strong, subequal tenent hairs. (1—3 in Fig. 3D). The other hairs on the inner side are all short. In *laricis* the inner tenent hairs are weaker and no. 3 (Fig. 3C) is shorter than the others. Some of the other inner hairs are nearly as long as the tenent hairs, and are sometimes even weakly knobbed (compare arrows in Figs. 3C and D). The cuticulare structure on Abd. 5—6 is much coarser in *fulvus* than in *laricis,* and *fulvus* has more strongly serrate dorsal short setae on abd. 5—6. The antennae of *fulvus* are slightly shorter with more swollen segments. Although the colour of both species is variable, I have never seen *laricis* with the uniform, pale yellowish-brown colour of typical *fulvus.*

Distribution and ecology

So far only found in Nordland (NNV: Øksnes), Troms (TRY: Bjarkøy, Tranøy, Tromsø; TRI: Målselv), and Finnmark (FV: Sørøysund, Måsøy; FN: Lebesby, Båtsfjord) where it is particularly common in the coastal mountains above the tree-line (300—1000 m). Usually found in moss and lichens on dry, rocky outcrops and boulders. In the same area *laricis* is common in similar habitats below tree-line, where it also inhabits tree-trunks. Although *laricis* frequently ascends above the tree-line, it was never observed in the higher alpine parts where *fulvus* is common. On one occasion the two species were found close to each other on a rocky outcrop on top of Tromsøya (Varden). *A. laricis* was found in moss cushions and thicker lichens, whereas *fulvus* occupied an exposed knob with crustose lichens only 40—50 cm away from *laricis.* Apparently *fulvus* will tolerate drier conditions than *laricis,* which is possibly reflected in their cuticular differences.

During prolonged draught, specimens of *fulvus* are densely aggregated and are nearly immobile. Apparently they have a strong «homing» and do not leave their stone even if conditions become severe. *A. laricis* seems to be a more mobile species. Grinbergs (1960) reports mass movements from pine litter onto the tree trunks during rainy weather, and I have a similar observation from Finnmark. Another indication of the strong «homing» of *fulvus* — contrary to *laricis* — is the observation that the frequency of pale (yellow) and dark (blue) forms is highly variable within a small area. On the type locality stones with more than 99% «yellow» are found less than 50 m away from a stone with a pure «blue» population. Significant differences are found between stones only 8 m apart (1—2% «blue» on the one stone, 80—85% «blue» on the other). There is no evidence that the colour forms correspond to habitat differences, reproductive cycle or season.

Archisotoma quadrioculata n.sp.
Fig. 4.

Type material. Holotype (alcohol) from «Norway. Troms: Tromsø. Sandbukta at Breivikeidet, 14.ix.1986. Sandy beach. A. Fjellberg leg.», in TM.

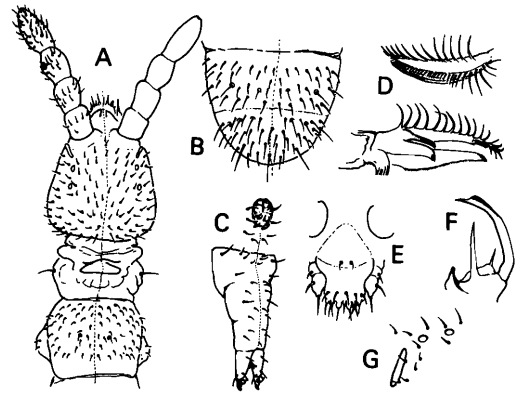

Fig. 4. *Archisotoma quadrioculata* n.sp. A. Dorsal chaetotaxy of head — Th. 2. B. Dorsal chaetotaxy of Abd. 5—6. C. Furca and male genital field. D. Left maxilla. Above: Longest lamella as viewed from outside. E. Labrum, maxillary palp and frontoclypeal field. F. Left labial hook. G. Left PAO and ocelli.

Paratypes. 60 (alc.) from the holotype sample in TM and 25 (ditto) in BMNH, 6 (slide) from «Norway. Finnmark: Båtsfjord. Hamningberg, 20.vi.1986» in BMNH and 1 (slide) from «Norway. Troms: Tromsø. Breivikstranda at Rebbenesøy, 13.x.1985» in TM.

Description

Size 0.4—0.5 mm (reproductive adults).

Colour pale, spotted brownish gray. Sometimes only ocelli dark.

Head. Sensillary equipment of antenna normal. Ocelli 2 + 2, singularly pigmented. PAO elongate, narrow (Fig. 4G). Labrum with 5-5-4 setae. Frontoclypeal field with two prelabral setae only (Fig. 4E). Ventral side of head with 4 + 4 setae along ventral line. Maxillary outer lobe with simple palp and 4 sublobal setae forming a bundle. Inner labial hooks flattened in apical part, tip pointed (Fig. 4F). Maxilla as Fig. 4D. Lamella l.v.e. and l.v.i. (cf. Poinsot 1965) with 2—3 fine fringes of cilia on the ventral side. Capitulum reduced to a small hook.

Body. Chaetotaxy as Fig. 4A, B. Sensillae hard to detect, but there is a pair of small sensillae in the median part of Th. 2, and 3 + 3 erect sensorial hairs in anterior part of Abd. 6. Furca as Fig. 4C. Dens shorter than manubrium, with two dorsal and one ventral seta. Mucro with three teeth, lateral seta absent. Tenaculum with 4 + 4 teeth. Ventral tube with 4 + 4 lateral setae. Hind leg with a thickened apical spur hair (like in *besselsi*). Claws without teeth.

Discussion

The species is identified at once by the 2 + 2 ocelli (other species of *Archisotoma* have 8 + 8 ocelli) and the short furca. It is probably most related to *A. theae* Fjellberg, 1980, which is of the same minute size and has the same type of maxilla, but a full set of eyes and a less reduced furca (dens with 4 ventral and 6 dorsal setae). In mixed samples of the two, *theae* is identified by the dark, confluent eye spot and generally darker colour on body.

Distribution and ecology

Probably rather common on sandy beaches, but not easy to collect in any quantity. Specimens are extracted from sand among roots of *Elymus arenarius, Festuca rubra* and *Lathyrus maritimus,* sometimes as much as 40—50 m inland from the shore-line. The small size and the reduced pigment, furca and number of ocelli, indicate that the species belongs to the interstitial community which penetrates rather deep into the sand. The related species *theae* usually lives on the same beaches as *quadrioculata,* but is mainly collected among debris of sea-weeds on sand in the tidal zone.

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Short communications

NOTES ON SOME STRATIOMYIDAE (DIPTERA) FROM NORDLAND

LITA GREVE AND PER STRAUMFORS

Some notes are given on the distribution of five species of the family Stratiomyidae from Nordland province. One of the species, *Beris strobli* Dusek & Rozkosný, 1968, is recorded for the first time from Norway.

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Per Straumfors, Rana Museum, Department of Natural History, N-8600 Mo, Norway.

Rozkosný (1973) has given a survey of the Stratiomyidae of Fennoscandia and Denmark and information about their distribution was included also in his biosystematic study of European Stratiomyidae (1982/83). Other records (i.e. from Nordland) have been published by Andersson (1971) and Greve (1980).

The following records taken from the collections of Rana Museum, Department of Natural History add knowledge to the distribution of Norwegian Stratiomyidae.

Beris chalybeata (Forster, 1771)
1 ♀ NSI Rana, Svartvasshei EIS 123 UTM 33W VP 7362 1 July 1983 leg. O. Myhre.

Beris chalybeata has previously not been recorded from Nordland. Rozkosný (1982) maps a distributional area in Northwestern and Central Europe including all Norway except the Lofoten Isles and some outer parts of Troms and Finnmark counties. The total number of records are limited, however, as Rozkosný (1973) has published records only from AK, HOI, STI, and FV, and later Greve (1980) from TEI. There are additional records from BØ, HOY and TRI. Still *B. chalybeata* must be considered a fairly rare species in Norway.

Beris strobli Dusek & Rozkosný, 1968
1 ♂ NSI Saltdal, Pothus EIS 127 UTM 33W VQ 1329 24 June 1982 leg. S.Z. Lundmo.

B. strobli is new to the fauna of Norway. The species has been found in neighbouring areas in Sweden (see Andersson, 1971). *B. strobli* is a rare species with two areas of distribution in Europe (see Rozkosný, 1982-map 14). The determination of this specimen by L. Greve was kindly verified by Dr. Rozkosný.

Saltdal belongs to the maritime birch and pine-forests in Nordland (Abrahamsen & al. 1977). This particular specimen was collected by netting in a medium rich alder/birch forest with an undergrowth of smaller ferns — i.e. *Athyrium, Dryopteris* and *Thelypteris* spp.

Exodonta dubia (Zetterstedt, 1838)
1 ♂ NSI Rana, Kvandalen EIS 122 UTM: 33W 4357 11 July 1973 leg. P. Straumfors.

Kvandalen is a mountain valley approximately 300 m above sea level. The underground is rich in lime. The vegetation therefore is rich, with *Salix* spp., *Prunus padus, Sorbus aucuparia* and a field layer consisting of among others *Aconitum septentrionale, Melandrium rubrum, Geranium silvaticum, Lactuca alpina* and *Origanum vulgare.*

E. dubia was collected by net-catching in the field layer.

E. dubia has earlier been recorded from Nordland province by Rozkosný (1973). He also recorded *E. dubia* from HEN, ON and HOI. There are, however, few records from Scandinavia as a whole (Rozkosný 1982). Several surveys of the insect fauna in different parts of Norway have been made since 1973 — including the order Diptera, but this record is the only one. Judged from the scantity of published records, *E. dubia* therefore must be considered a rare species in Scandinavia.

Sargus iridatus (Linné, 1758)
1 ♀ NSI Rana, Utskarpen EIS 118 UTM: 33W VP 3249 16 June 1980 leg. S.Z. Lundmo.

This specimen was hand-picked among several species of garden flowers.

S. iridatus is a fairly common species in Scandinavia even though there are still a limited number of records published (Rozkosný, 1973).

Sargus rufipes (Wahlberg, 1854)
1 ♀ NSI Rana, Børresteinlia EIS 118 UTM: 33W VP 3249 1 July 1984 leg. S.Z. Lundmo.

This is the first record of *S. rufipes* between Oppland province and Troms province. This particular locality is a thermophilous deciduous woodland situated on a steep hillside rising from the Rana fjord, well shielded from cold northern and eastern winds.

Rozkosný (1973) records *S. rufipes* from ON and TRY only. There is an additional record not earlier published: 1 ♀ from Bjerkeng, Målselv community (TRI), caught 13 June 1897 deposited in Tromsø Museum, University of Tromsø.

ACKNOWLEDGEMENTS

We wish to thank Dr. R. Rozkosný for verifying the determination of *Beris strobli.*

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PAROXYNA SOLIDAGINIS WHITE, 1986 (DIPT., TEPHRITIDAE) NEW TO NORWAY

LITA GREVE

Paroxyna solidaginis White, 1986 is reported new to the Norwegian fauna. Two males and eight females were hatched from pupae found in *Solidago virgaurea* L. (Fam. *Asteraceae*) collected at Tjøme, Treidene in Vestfold province, EIS 19, on 26 September 1984.

Lita Greve, Zoological Museum, University of Bergen, Muséplass 3, 5007 Bergen, Norway.

Two male and eight female tephritids were hatched from *Solidago virgaurea* L. (Fam. *Asteraceae*) collected at Treidene, Tjøme in Vestfold province, EIS 19. The plants were collected on 26 September 1984 and the flies hatched in May 1985. The specimens were first believed to be *P. loewiana* Hendel, 1927, but turned out to be the closely related *Paroxyna solidaginis* White, 1986 described from England. Both species have *S. virgaurea* as a host-plant. White (1986) also included a key which separates *P. solidaginis* from *P. loewiana* and *P. misella* (Loew, 1869). This is the first record from outside the British Isles. The material is deposited in Zoological Museum, University of Bergen.

Solidago virgaurea is a common plant in Norway as well as elsewhere in Scandinavia, and its total distribution is circumpolar (Lid, 1985). Vestfold province, however, represents the part of Norway with the highest summer temperatures, and fairly mild winters. Treidene is a dry locality close to the sea.

ACKNOWLEDGEMENTS

I am indepted to my collegue Arild Fjeldså who collected the material and to Dr. I.M. White, CAB International Institute of Entomology, c/o Department of Entomology, British Museum (Natural History) who determined the material.

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FRANKLINIELLA IRIDIS WATSON (*IRIDOTHRIPS IRIDIS* WATSON) (THYSANOPTERA) NY ART FOR NORGE

DAG SELNES

The thrips Frankliniella iridis (Iridothrips iridis) *is reported found in Norway for the first time. A male and a female were collected on* Iris pseudacorus *in Ås, Akershus county, in the end of June 1984.*

Dag Selnes, Statens plantevern, Postboks 70, 1432 Ås-NLH, Norway.

En hann og en hunn av *Frankliniella iridis* ble i slutten av juni 1984 funnet blant trips som var samlet på sverdlilje i Ås, Akershus fylke. Arten er ikke tidligere rapportert funnet i Norge.

Arten ble første gang funnet i 1923 i USA på iris fra Nederland og England. Den ble publisert som *Bregmatothrips iridis* Watson (Watson 1923). Priesner overførte den i 1940 til *Iridothrips* (Stannard 1968). Stannard (1968) beskriver morfologiske forskjeller mellom *Bregmatothrips* og *Iridothrips*. Mound (1976) regner imidlertid *Iridothrips* med til *Frankliniella* og betegner således arten *Frankliniella iridis*.

Hunnen er vanligvis mikropter, hannen alltid mikropter.

Kroppen er brun, mens fortibiene og 3. og 4. antennesegment er gule. Hodet er uvanlig stort. Metanotum har en svak, likevinklet nettstruktur. Tergitene er skulpturert mellom de midtre børstene (Mound 1976).

Arten er funnet i det fri i en rekke vest-europeiske land. Den ser ut til å være innført fra USA (Morison 1957). Vanligste vertplante er sverdlilje (Schliephake 1979).

ACKNOWLEDGEMENTS

I wish to thank Dr. Jenny Palmer, British Museum, Lodnon, for verifying my identification.

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AULACIDAE (HYMENOPTERA, EVANIOIDEA) A FAMILY NEW TO NORWAY

FRED MIDTGAARD

Aulacus striatus Jurine is reported new to Norway. The family Aulacidae (Hymenoptera, Evanioidea) has not formerly been reported from Norway.

Of the three Fennoscandian families of Evanioidea: Evanidae, Gasteruptiidae and Aulacidae, only the two first have been reported from Norway.

The family Aulacidae is represented by two genera and species in Sweden: *Pristaulacus gibbator* (Thunberg, 1822) and *Aulacus striatus* Jurine, 1807 (Hedqvist, 1973).

P. giabbator is rather rare in Sweden, only found on some few localities in Öland, Östergötland, Södermanland and Uppland. It has been reared from *Picea abies* attacked by *Callidium coriaceum* Paykull (Coleoptera, Cerambycidae) (Hedqvist 1973). I have not seen any specimens of this species from Norway.

The other species, *Aulacus striatus,* have been collected three times in Norway: NTI, Mosvik: Mosvik, Mossa, EIS 97, 7 and 22 Jul. 1982, leg. J.O. Solem: 3 ♀♀; VE, Brunlanes: Tvedalen, EIS 19, pr. Jun. 1986, leg. S.O. Hansen: ♀ and AK, Ås: Ås, EIS 28, 25 Jun. 1987, leg. F. Midtgaard♀.

A. striatus is widespread in Sweden, found in Skåne, Blekinge, Småland, Östergötland, Vestergötland, Uppland, Dalarna Jämtland and Västerbotten (Hedqvist 1973).

A. striatus is a parasite of *Xiphydria camelus* (L.) and *X. prolongata* (Geoffroy) (Hymenoptera, Xiphydriidae). Imagines are observed on the blossoms of Apiaceae (Umbelliferae) (Hedqvist 1973).

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Received 11 Aug. 1987

MAGNE OPHEIM — in memoriam

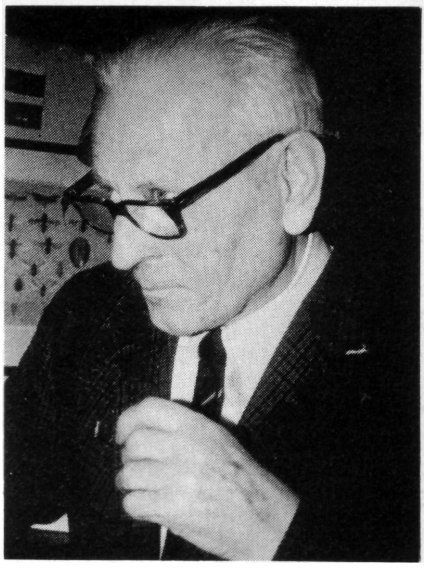
Den 2. desember 1987 døde sommerfuglspesialisten Magne Opheim etter et ganske kort sykeleie, 89 år gammel.

Opheim ble født 10. oktober 1898 i Bergen, der han også vokste opp. Etter eksamen artium dro han til Trondheim for å studere ved Norges tekniske høgskole der han ble uteksaminert som sivilingeniør fra Kjemilinjen i 1925. Året etter gikk ferden til Amerika hvor han var bosatt frem til 1936. Da vendte han tilbake til Norge der han startet malingsfabrikken A/S Norsk Oxyd på Bryn i Oslo.

Alt som gutt interesserte Opheim seg sterkt for insekter og insektsamling, og det var særlig sommerfuglene som opptok ham helt frem til de siste dager. Han søkte tidlig kontakt med Zoologisk museum på Tøyen i Oslo der han fikk studieplass, og etterhvert eget kontor.

Siden 1962, og i en rekke år, hadde Opheim forskningsstipendium fra Norges almenvitenskapelige forskningsråd til støtte for sitt vitenskapelige arbeid på mikrolepidoptera. Han reviderte flere familier og slekter innen denne gruppen sommerfugler. Særlig stor oppmerksomhet viet han arter som i sin utbredelse var knyttet til høyfjellet. *Albulina orbitulus* de Prunner, *Apamea maillardi* Geyer, *Eumedonia eumedon* Esper, *Parnassius apollo* L. og *Pyrgus centaureae* Rambur er verd å nevne. Han påviste adskillige arter som nye for Norges fauna, og noen beskrev han som nye for vitenskapen: *Catastia kistrandella* Opheim, *Epagoge grotiana* Opheim, *Parnassius apollo jotunensis* Opheim og *Tinea svenssoni* Opheim.

En lang rekke publikasjoner dokumenterer Opheims omfattende kunnskaper om forekomst og utbredelse av lepidoptere. Spesielt merker man seg hans initiativ i forbindelse med offentliggjørelsen av Arent Greve's vakre insekttegninger som hadde ligget arkivert i mer enn 150 år. Dessuten hans bidrag som medarbeider ved utgivelsen av Frithiof Nordstrøm's kartverk over utbredelsen av Fennoskandia's dagsommerfugler, svermere, spinnere og nattfly. I nær tilknytning til dette har Opheim utgitt kataloger over norske macrolepidoptere: Part I, Rhopalocera, Grypocera, Sphinges and Bombyces, 1958; Part II, Noctuoidea, 1962; Part III, Geometrae, Arctiina, Zygaenina, Psychina, Cossina and



Jugatae, 1972. Senere er dette fulgt opp av fem 'check-lists'. I 1983, det siste året Opheim publiserte, fikk han trykket hele fem arbeider.

Opheim har vært medlem av Norsk entomologisk forening siden 1938, og var i en rekke år foreningens kasserer. Han var medlem av Entomologiska Sällskapet i Lund og av Wien Entomologische Gesellschaft. I 1962 var han en av initiativtagerne til dannelsen av Norsk lepidopterologisk selskap, hvor han var primus motor og redaktør av medlemsbladet «Atalanta norvegica» som kom ut i 1967—83. I 1980 ble han utnevnt til æresmedlem i Norsk entomologisk forening etter i mange år å ha vært en levende legende.

Opheim fikk stor betydning for sine kolleger og venner i det entomologiske miljø der han bidro med et vell av kunnskaper. På Zoologisk Museum skjøttet han sin arbeidsplass til det siste, dog de siste årene med noe redusert kontortid. Insektavdelingen fikk i alle år stor glede av hans kapasitet. Han møtte alltid frem ved kollegiale tilstelninger der han bidro med sin charme. Med sin særegne personlighet var han en gentleman av det gode gamle slaget. Selv om han kunne virke noe sky overfor fremmede, var han en god venn og fremfor noe en hedersmann.

Jan Emil Raastad

Fauna norv. Ser. B 35: 46. Oslo 1988.

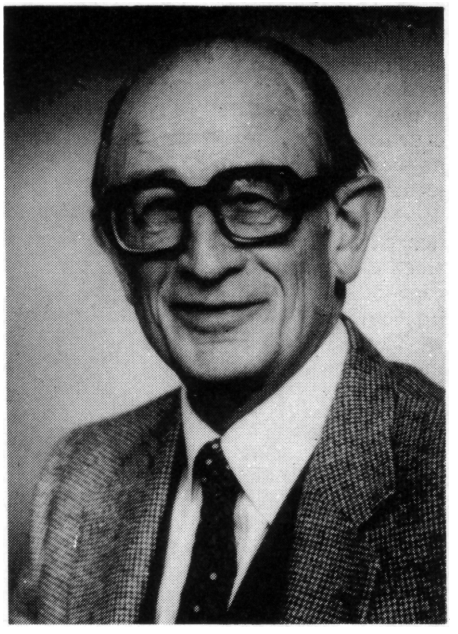
EIVIND SUNDT 1918—1987

Av Karl Erik Zachariassen

Norsk Entomologisk Forenings æresmedlem, brukseier Eivind Sundt, døde 21. august 1987, nær 70 år gammel. Med hans bortgang har Norge mistet en av landets få internasjonalt kjente entomologer. Ingen står klar til å etterfølge ham i hans spesielle felt innen entomologien, og hans bortgang betyr et betydelig tap for norsk entomologi.

Eivind Sundt er født i Oslo 15. november 1918. Han begynte allerede som ung gutt å samle på insekter, og han ble med i Norsk Entomologisk Forening i 1936, bare 18 år gammel. Sundt var foreningens kasserer fra 1939 til 1940, og revisor fra 1956 til 1979. Fra 1982 har han vært medlem av styret for foreningens fond. Allerede før sin inntreden i foreningen, tidlig i 30-årene kom Eivind Sundt i kontakt med bergmester Thomas Münster, som dengang var den mest ruvende skikkelse i norsk entomologi. Münster hjalp den unge Sundt igang med sin hobby, og da Münster døde i 1939 ble han satt i forbindelse med en annen stor norsk entomolog, telegrafbestyrer Andreas Strand. Dette ble innledningen til et livslangt og nært vennskap. De var begge interessert i coleopterne og foretok sammen en lang rekke innsamlingsreiser til forskjellige steder i Norge, bl.a. flere til Nord-Norge. Men mens Strand arbeidet med hele bredden av coleopterne, så Sundt den største utfordringen i å arbeide med en eneste, men lite utforsket, gruppe av coleopterne. Det var familien Ptilidae, som omfatter de minste av alle biller. Han kom etterhvert til å konsentrere seg særlig om slekten *Acrotrichis,* og i tidsrommet 1958 til 1971 beskrev han ikke mindre enn ni nye arter og én ny underslekt av denne slekten. Hans undersøkelser omfatter Ptilidaer fra de Palaearktiske, Nearktiske og Etiopiske regioner, og han har bearbeidet *Acrotrichis*-materiale fra flere utenlandske muséer, bl.a. en samling på mer enn 100 000 dyr fra Chicago museum. Hans arbeider har munnet ut i en rekke vitenskapelige publikasjoner. For sin betydelige vitenskapelige innsats ble Eivind Sundt i 1980 innvotert som æresmedlem i Norsk Entomologisk Forening.

Eivind Sundt er et fremragende eksempel på at privat-entomologer uten formell utdannelse i biologi kan gjøre en betydelig vitenskapelig innsats. Det er folk som Eivind Sundt, med sin vilje til å ta et tak uten økonomisk godtgjørelse, som bringer vitenskapen og verden fremover. Vi vil takke Eivind Sundt for det han har betydd for norsk og internasjonal entomologi. Måtte flere følge hans eksempel.



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Fittkau,E.J. 1962. Die Tanypodinae (Diptera, Chironomidae). Die Tribus Anatopyniini, Macropeloponi und Pentaneurini. *Abh. Larvalsyst. Insekten* 6: 453 pp.

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