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# Collembola from Jan Mayen, Bjørnøya and Hopen with additions to the species list from Spitsbergen

ARNE FJELLBERG

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Some new collections from the arctic islands of Norway are reported. 28 species were collected from Jan Mayen, 24 at Bjørnøya and 12 at Hopen. The fauna of the islands is dominated by Holarctic species, of which *Hypogastrura* sp. near *sensilis* (Folsom), *Willemia similis* Mills, *Folsomia stella* Grow & Christiansen and *F. taimyrica* Martynova are reported for the first time from the European arctic. *Isotomina gracilis* Stach, 1962 is transfered to *Folsomia* and made senior synonym of *Folsomia alpha* Grow & Christiansen, 1976. *Onychiurus ursi* n.sp. is described (Holarctic) and *Onychiurus groenlandicus* (Tullberg, 1876) is redescribed (Holarctic). Several corrections and additions are made to the species list from Spitsbergen, and 47 species are recognised from the island.

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## INTRODUCTION

The European arctic islands have been visited by numerous scientific expeditions, and the collembole fauna is fairly well known. In spite of this, the last few years have brought to light a number of species previously not reported from the islands. This is partly due to taxonomic refinement, but also because of more extensive field collections. Valpas (1967) gave a synopsis of the literature on Collembola from Spitsbergen which has the most extensive record list. Information on the smaller islands are more scattered. Gisin (1953) and Macfadyen (1954) summarise the available information on Jan Mayen. Reports on Collembola from Bjørnøya are found in Carpenter & Phillips (1922) and Summerhayes & Elton (1923). A few species are published from Hopen by Linnaniemi (1935).

The present paper does not aim on giving a complete list of species from the above islands, but only reports the species present in some recent collections that has been sent me for identification.

## MATERIAL

During June/July 1972 a Danish expedition visited Jan Mayen and Klaus Vestergaard collected a large number of Berlese samples from various plant communities. In addition pitfall traps were used. The material is kept at Zoological Museum, Copenhagen.

In August 1983 Ola Skifte from Tromsø Museum visited Bjørnøya and brought back 24 large soil/vegetation samples from a number of different habitats. At the same time Fritz Richardsen (Tromsø Museum) collected a few (6) samples from mainly grass/moss vegetation at Hopen. These samples were extracted in Tromsø after 4—5 weeks storage in a fridge. The material is kept at Tromsø Museum.

In August 1973 an expedition from Zoological Museum in Bergen (S.A. Bengtsson, T. Solhøy and A. Fjellberg) investigated the soil fauna around Ny Ålesund, Spitsbergen. A number of large samples from all major plant communities were extracted in situ. Here are reported only those species not listed by Valpas (1967). The material is kept at Tromsø Museum.

## RESULTS AND DISCUSSION

The species present in the collections from Jan Mayen, Bjørnøya and Hopen are listed in Table I. Most of the 40 species have a wide distribution in northern parts of the Holarctic Region. A significant element of European or Palaearctic species are present, but some of these are poorly known. A few species which are present in Bjørnøya and/or Jan Mayen are so far not seen from Spitsbergen and may represent more southern elements of the fauna *(Isotomiella minor, Isotoma olivacea)*. Likewise, some of the common Spitsbergen species were not found in the pre-

Table I.

| H: Holarctic, P: Palaearctic | | Jan Mayen | Bjørnøya | Hopen |
|---|---|---|---|---|
| H | Hypogastrura viatica (Tullberg, 1872) | | x | x |
| H | H. (Ceratophysella) succinea (Gisin, 1949) | x | x | x |
| H | Willemia scandinavica Stach, 1949 | x | x | |
| H | W. similis Mills, 1934 | | x | |
| H | W. anophthalma Börner, 1901 | x | | |
| H | Xenylla humicola (Fabricius, 1780) | x | x | x |
| H | Micranurida pygmaea Börner, 1901 | x | x | x |
| H | Anurida polaris (Hammer, 1954) | x | x | x |
| P | Onychiurus arcticus (Tullberg, 1876) | x | x | |
| H | O. groenlandicus (Tullberg, 1876) | ? | x | x |
| H | O. ursi Fjellberg, 1984 | | x | x |
| H | O. duplopunctatus Strenzke, 1954 | x | | |
| P | O. macfadyeni Gisin, 1953 | x | x | |
| H | Tullbergia arctica Wahlgren, 1900 | x | | |
| H | T. simplex Gisin, 1958 | | x | |
| P | T. tenuisensillata (Rusek, 1974) | x | x | |
| P | T. jirii (Rusek, 1982) | | x | |
| H | T. macrochaeta (Rusek, 1976) | x | | |
| H | Tetracanthella arctica Cassagnau, 1959 | | x | |
| H | Pseudanurophorus binoculatus Kseneman, 1934 | x | | |
| H | P. inoculatus Bödvarsson, 1957 | | x | |
| H | Folsomia bisetosa Gisin, 1953 | x | x | |
| H | F. gracilis (Stach, 1962) | x | | |
| H | F. quadrioculata (Tullberg, 1871) | x | x | x |
| H | F. sexoculata (Tullberg, 1871) | x | x | x |
| H | F. stella Grow & Christiansen, 1976 | x | | |
| H | F. taimyrica Martynova et al.,1973 | | | x |
| H | Isotomiella minor (Schäffer, 1896) | x | | |
| H | Archisotoma besselsi (Packard, 1877) | x | | |
| P | A. megalops (Bagnall, 1939) | x | | |
| P | A. theae Fjellberg, 1979 | x | | |
| H | Agrenia bidenticulata (Tullberg, 1876) | | | x |
| H | Isotoma notabilis Schäffer, 1896 | x | x | |
| H | I. anglicana Lubbock, 1862 | x | x | |
| H | I. nanseni Fjellberg, 1978 | | x | x |
| H | I. neglecta Schäffer, 1900 | | x | |
| P | I. olivacea Tullberg, 1871 | | x | |
| H | Neelus minimus (Willem, 1900) | x | | |
| H | Arrhopalites principalis Stach, 1945 | x | | |
| P | Sminthurinus concolor (Meiner, 1896) | x | | |
| | 40 | 28 | 24 | 12 |

sent material and may represent more northern forms *(Friesea quinquespinosa, Hypogastrura longispina)*. However, a detailed discussion of biogeography of the collembole fauna of this area is still premature.

## Comments and taxonomical remarks

*a).* *Willemia similis* Mills is a Holarctic species that has been confused with *anophthalma* (Börner) (Fjellberg 1984 a).

*b).* *Anurida polaris* (Hammer) ( = *frigida* Fjellberg, 1973) is also a common Holarctic species (Fjellberg 1984 a). Previous records of *A. remyi* Denis — possibly also *A. granaria* (Nicolet) — from the arctic islands probably refer to this species.

c). *Onychiurus ursi* n.sp. Figs. 1—3. Within the Holarctic region there are a number of underscribed species which fit more or less to the broad consepts of the classical *groenlandicus* of Tullberg (1876). The present *O. ursi* n.sp. is one of the best marked and is described below.

*Type locality:* Norway. Hopen, at Radio Station (76°30'N, 24°4'E).

*Type material: Holotype:* Female (slide in Gisin medium), labelled «Norway. Hopen Radio Station. 12.VIII. 1983. Moss. F. Richardsen leg.», deposited at Tromsø Museum, Norway. *Paratypes:* 17 (7 slide, 10 alc.) from the holotype sample. 15 (6 slide, 9 alc.) from «Norway. Bjørnøya. Besstjørnene, 21.VIII. 1983. Turf, moss & lichens. O. Skifte leg.», 9 (alc.) from «Norway. Bjørnøya. Kapp Posadowsky, 20.VIII. 1983. Grass at pond. O. Skifte leg.», 1 (slide) from «Norway. Bjørnøya. S of Avtjønn, 20.VIII. 1983. Moss, bird manure. O. Skifte leg.» and 3 (slide) from «Norway. Bjørnøya. Between Radio St. and Besstjørnene. 21.VIII. 1983. O. Skifte leg.» All the above paratypes deposited at Tromsø Museum, Norway. In addition 3 paratypes (slide) from the holotype sample are deposited at British Museum (Natural History), London.

*Additional material studied:* Many specimens from: Norway (Svalbard: Pr. Heinrich Isl. at Ny Ålesund, Adventdalen. Saltdal: Solvågtind. Lom: Staurust), Sweden (Abisko), Greenland (Kugssuatsiaq), Alaska (Pribilof Isls., Cape Thompson, Norton Bay), NE Siberia (Chaun Bay).

*Derivation of the name:* Named after the polar bear, *Thalassarctos* (formerly *Ursus*) *maritimus*.

*Diganosis:* Close to *groenlandicus* (Tullberg) but differing by absence of lateral microsensilla on Th. 3, only 8 setae on Ant. 1 (9 in *groenlandicus*), coarser Abd. 6 granulation, shorter $m_1$ setae on Abd. 5, smaller body size and more elongate shape.

*Description*

*Colour* pure white.
*Body size* 1.3 mm.
*Body shape* slender, cylindrical. Abd. 6 from above short, semicircular (Fig. 2).
*Ant. 3 organ* with 5 long, finger-like papillae, 5 guard setae and two rugose sense clubs. The lateral one curved, much larger than the other.
*Ant. 1* with 8 setae.
*PAO* rather irregular, with 2, 3 or 4 lobes, about twice as wide as diameter of nearest pseudocellus (Fig. 3).
*Maxilla* not studied in detail, but apparently of normal shape. Outer lobe with two sublobal hairs.
*Dorsal ps.oc.* 32/133/33343. Subcoaxe 1-1-1. Head with 2 + 2 ventral.
*Body* hairs short, fine. Macrochaetae hardly differentiated. Abd. 5 with $m_1$ subequal to or shorter than $p_1$, apex curved, pointed. Setae $p_1$ and $a_1$ thicker than $m_1$, blunt-tipped, erect (Fig. 2). Unpaired median seta sometimes present in front of $m_1$-$m_1$. Lateral microsensilla present on Th. 2, absent on Th. 3 (Fig. 1). Th. 2—3 with 1 + 1 or 2 + 2 (3,4) ventral setae, number quite variable. Body granulation fine, except on Abd. 6 which is strikingly coarser than anterior tergites. Claws without visible teeth. Unguiculus lamellate. about 2/3 of claw inner length. Tenent hairs acuminate. Furca reduced to a small flap. Anal spines slender, pointed, curved and subequal to length of claw 3. Male ventral organ absent. Males generally present.

*Discussion*

The new species differs from all other forms of the *groenlandicus* group examined so far, by absence of the lateral microsensilla on Th. 3. The relative small size, slender body, pure white colour and coarse Abd. 6 granulation is constant in the various holarctic samples seen. The relative length of $m_1$ setae on Abd. 5 is somewhat variable within samples, usually it is 1/2 to 2/3 of $p_1$, sometimes they are subequal, but $m_1$ is never distinctly longer than $p_1$ as in *groenlandicus* s.str. (see below).

*Distribution and ecology*

Available material (see above) indicate a wide distribution in northern parts of the Holarctic, probably confined to tundra or tundra-like habitats. It is generally collected in damp or mesic moss and meadow vegetation, sometimes together with *groenlandicus* s.str. Specimens from S. Norway (Lom) were collected among gravel and pebbles at a lake shore.

d). *Onychiurus groenlandicus* (Tullberg, 1876). Arctic *Onychiurus*-forms with few (2—4) PAO lobes, lamellate unguiculi and pseudocellar formula 32/133/33343 have usually been refered to as *groenlandicus*. Tullberg (1876) gave a very brief and general diagnosis of the species based on material from Greenland and Spitsbergen (no type locality given). Unfortunately there is no type material present in Naturhistoriska Riksmuseet in Stockholm. At least two different species (*ursi* n.sp. and *groenlandicus* s.str.) are present both in Spitsbergen and Greenland. The most common species is selected as *groenlandicus* s.str. and is redescribed below.

*Redescription*

*Colour* white or slightly yellow.
*Size* 1.6 mm.
*Body shape* rather thick, cylindrical or somewhat pear-shaped with broad abdomen. Abd. 6 from above conical, not semicircular (Fig. 4).
*Ant. 3 organ* with 5 finger-like papillae, 5 guard setae and two rugose sense clubs. The lateral sense club not or only slightly larger than the other.
*Ant. 1* with 9 setae.
*Maxilla* normal, outer lobe with two sublobal hairs.
*PAO* with 2—3 lobes, total width about the diameter of nearest ps.oc.
*Dorsal ps.oc.* 32/133/33343. Head with 2 + 2 ventral. Subcoxae 1-1-1.
*Body* hairs short, fine, macrochaetae hardly differentiated. On Abd. 5 setae $m_1$ longer than $p_1$ and $a_1$ (Fig. 4). Unpaired median seta sometimes present. Th. 2—3 with with 1 + 1 and 2 + 2 (1) ventral setae. Both Th. 2—3 with lateral microsensilla present. Body granulation fine, only slightly or not enlarged on Abd. 6. Claws with small lateral teeth. Unguiculus lamellate, about 2/3 of claw inner length. Tenent hairs acuminate. Furca only present as a small pit or undistinct flap. Anal spines rather short and thick, hardly curved, about 2/3 as long as claw inner edge. Only females are seen.

*Discussion*

A large, Holarctic species recognised by combination of the following characters: Th. 1 with 1 + 1 pseudocelli, Th. 3 with lateral microsensilla present, Abd. 5 with $m_1$ longer than $p_1$ and $a_1$. From the above *ursi* n.sp. it also differs by having 9 Ant. 1 setae and subequal Ant. 3 sense clubs. The large size, somewhat yellow colour (alcohol), stout body shape, short and thick anal spines and fine Abd. 6 granulation appears fairly constant throughout the many holarctic samples at hand.

A single specimen from S. Norway (Liavatn in Skjåk) differs by exceptionally slender body shape, short $m_1$ on Abd. 5, very fine body granulation, 8 Ant. 1 setae and unusually long finger-like papillae in Ant. 3 organ. This could be an abberant specimen of *ursi* n.sp. (though lateral microsensilla is present on Th. 3, anal spines are short and thick and Abd. 6 granulation is fine), but may also represent a third species — possibly *schoetti* (Lie-Pettersen, 1896) described from Bergen in SW Norway. Stach (1947, 1954) redescribed *schoetti* from specimens collected in a Polish cave. According to him the Polish specimens have 3 + 3 ps.oc. on Abd. 4. My Liavatn specimen has 4 + 4 but otherwise fits well to the description of the Polish form. Lawrence (1960) reported *schoetti* from British caves. Although he does not describe the pseudocellar formula, a specimen with 3 + 3 ps. oc. on Abd. 4 is figured. Unfortunately the type material of *schoetti* seems lost and nobody except the original author has seen it. The brief original description gives no clues, and the position of the Norwegian *schoetti* and its relation to Polish and British populations remains obscure.

*Distribution and ecology*

Probably present in most of the northern Holarctic. Specimens are seen from: Norway (Svalbard: Ny Ålesund, Longyearbyen, Kongsøya, Hopen, Bjørnøya), Greenland: (L. Pendulum Isl., Murray Isl., Kapp Stewart, coll. Swedish Greenland Exp. 1899), Canada (Ellesmere Isl.: Alexandra Fiord, Sverdrup Pass, Lake Hazen, Grice Fiord. Cornwallis Isl.: Resolute Bay), Alaska (many samples, mainly from North Slope), NE Siberia (Chaun Bay). Often abundant in damp arctic/alpine tundra. Probably a parthenogenetic species.

e). *Tullbergia tenuisensillata* (Rusek), *T. jirii* (Rusek) and *T. macrochaeta* (Rusek) are recently described and earlier confused with *T. krausbaueri* (Börner) (Rusek 1974, 1976, 1982). Their distributions are not clear, but at least *macrochaeta* is Holarctic.

f). *Tullbergia arctica* Wahlgren. The species was originally described from jan Mayen and is recognised by the pseudocellar formula: 11/122/22221. According to Gisin (1960) Th. 1 has 2 + 2 pseudocelli, but this is not verified from recent specimens. Chaetotaxy of Abd. 5 is characteristic with the long $a_2$ setae (Fig. 6). Distribution probably covers most of the Holarctic: Norway (Jan Mayen, Spitsbergen: Ny Ålesund, Tromsø, Oppdal: Gjevilvasskamman), Sweden (Abisko), Alaska (Pribilof Isls.), Colorado (Boulder). It is usually found in dry arctic/alpine tundra, especially in calcareous meadows.

g). *Tullbergia simplex* Gisin. The species was described from the Italian Dolomites. Syntypes were compared with Norwegian specimens and no differences were found. It is recognised by the pseudocellar formula 11/111/11111 and chaetotaxy of Abd. 5 with short $a_2$ and long $p_2$ setae (Fig. 5). The total distribution covers the northern Holarctic: Norway (Spitsbergen: Ny Ålesund, Bjørnøya, Tromsø), Sweden (Abisko), Canada (Ellesmere Isl.: Alexandra Fiord, Lake Hazen), Alaska (Brooks Range). The species occurs in similar habitats as *arctica* and the two species may be found together.

A third species of this group — as yet underscribed — may be found in the arctic islands. Chaetotaxy is very similar to *arctica*, but Abd. 4 usually has an unpaired dorsomedian seta. Pseudocellar formula is characteristic: 11/122/11121. Material of this species is seen from Norway (Raudhellerskorane on Hardangervidda), Alaska (Paxon in Alaska Range, Juneau, Pribilof Isls.) and Colorado (Boulder).

h). *Folsomia stella* Grow & Christiansen. The species was recently described from Barrow (Alaska) (Christiansen & Bellinger 1980). It is related to *bisetosa* Gisin but differs by presence of some ventral setae on Th. 3 and as much as 4 + 4 ventral setae on manubrium set in two nearly parallel rows. It is a Holarctic species also seen in materials from Canada (Ellesmere Isl.) and NE Siberia (Chaun Bay).

i). *Folsomia gracilis* (Stach, 1962) n.comb.
*Isotomina gracilis* Stach, 1962: 11.
*Folsomia alpha* Grow & Christiansen, 1976: 616, syn. nov.
*Folsomia alpha* Christiansen & Tucker, 1977: 371, syn. nov. The species was described by Stach (1962) from Hornsund on Spitsbergen. Recent specimens from Alaska and Canada were found to be conspecific with specimens from Jan Mayen and Spitsbergen. Following Christiansen & Bellinger (1980), the Nearctic specimens would key to *Folsomia alpha* originally described from Barrow, Alaska (*note:* Christiansen & Bellinger (1980) refer to Christiansen & Tucker (1977) as authors of this species. However, Grow & Christiansen (1976) named the species *alpha* and gave a differential diagnosis of the new species. Thus they are the formal authors of the species. *F. alpha* Christiansen & Tucker, 1977 falls as a junior objective synonym). One of Stach's syntypes (Institute of Syst. & Exp. Zool., Krakow) was examined and proved to be the same form as the specimens from Spitsbergen/Jan Mayen and Alaska/Canada. The species is recognised by absence of ocelli, prosence of 2 + 2 thickened sensillae on Abd. 5 (Fig. 7), presence of 2 + 2 (1—3) ventral setae on Th. 3 and the chaetotaxy of dens and manubrium. The ventral chaetotaxy of manubrium is somewhat variable, but there are usually 3 + 3 distal setae in oblique rows and 2—3 pairs of subdistal setae in more or less parallel rows (Fig. 9). Dens has typically 7 dorsal setae. The outer median seta (Fig. 8, arrow) is characteristic, beeing absent in the related species *sensibilis* which also differs by simpler ventral chaetotaxy on Th. 3 (1 + 1 setae) and manubrium (only 2 + 2 (3) oblique distal setae).

Specimens of *gracilis* are seen from Norway (Spitsbergen: Hornsund (type), Longyearbyen, Berzeliusdalen, Kong Karls Land. Jan Mayen), Canada (Ellesmere Isl.: Alexandra Fiord), Alaska (Kotzebue, Canning River Delta, Icy Cape, Barrow), NE Siberia (Chaun Bay).

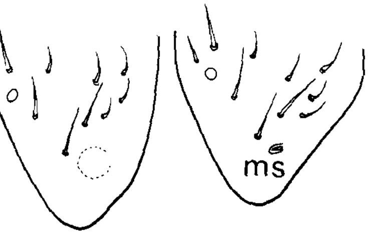
j). *Folsomia taimyrica* Martynova et al., 1973. The species was described by Martynova et al. (1973) from Taimyr and Wrangel Island. It is related to *diplophthalma* (Axelson) in having 1 + 1 ocelli, 1 + 1 ventro-apical manubrial setae, sparse body pigmentation and moderately long macrochaetae. The two species differ in dorsal chaetotaxy of manubrium (Fig. 10, 11).

A large number of specimens from Hopen and a few from Spitsbergen (Adventdalen) differ from the original description by absence of ocelli and body pigment. A large material from North and Central Alaska indicate considerable variation in number and size of ocelli (0, 1 + 1, 2 + 2), intensity of pigmentation, length of macrochaetae, etc. Several species may be involved, but until a more thorough study can be made I refere to both the Alaskan and Norwegian specimens as *taimyrica*.

k). *Isotoma olivacea* Tullberg. Numerous specimens from Bjørnøya probably belong to this species, though adults differ by having 5 + 5 lateral setae on ventral tube (4 + 4 in *olivacea*) and manubrium has frequently 2 + 2 (1) ventro-apical short setae (1 + 1 in *olivacea*). Other body marks are identical (short abdominal macrochaetae, simple subapical pinseta on Ant. 4, labral edge, maxillary palpe, claws, colour). If this form really belongs to *olivacea* s.str., Bjørnøya is the only arctic site where both *olivacea* and *nanseni* occure together. In other arctic sites *nanseni* appears to be present alone.

## Additions and corrections to the Spitsbergen species list

Valpes (1967) reports 40 species of Collembola from Spitsbergen and adds a further 9 species of



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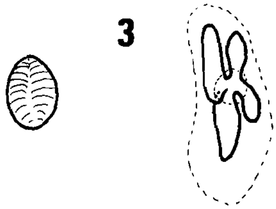
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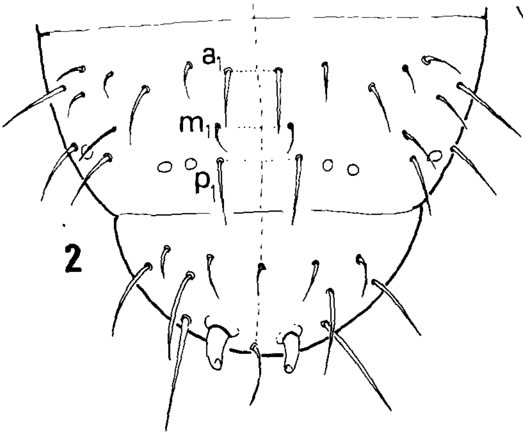

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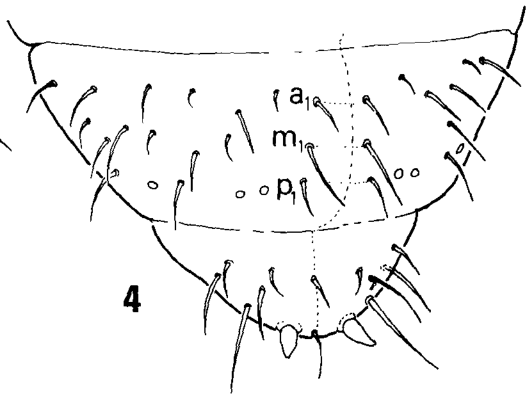

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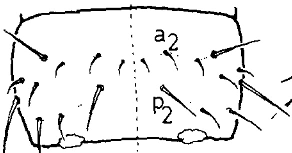

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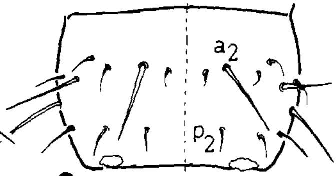

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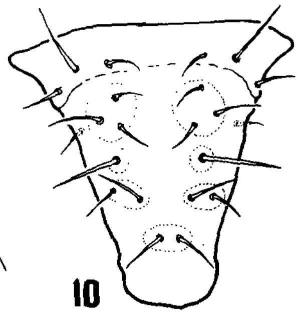
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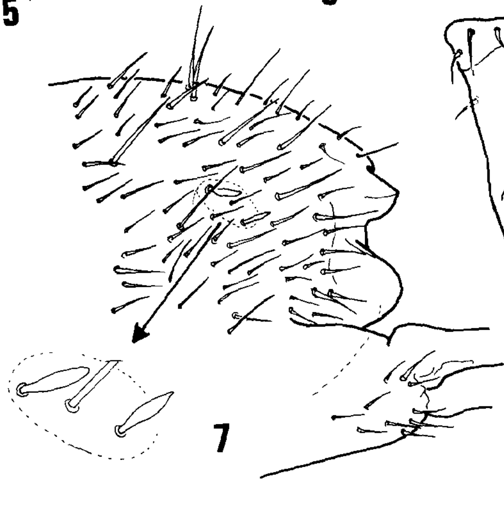
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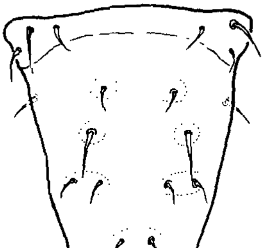
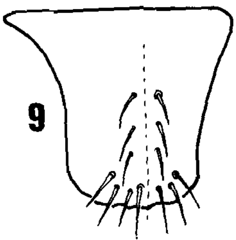
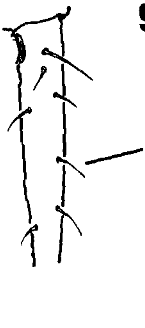

11


9


8

Figs. 1—11.—1—3. *Onychiurus ursi* n.sp. — 1. Right side of Th. 2—3 with microsesilla (ms) beeing absent on Th. 3 (encircled). — 2. Abd. 5—6. — 3. Left PAO and nearest ocellus. — 4. *Onychiurus groenlandicus*. Abd. 5—6. — 5. *Tullbergia simplex*, Abd. 5. — 6. *Tullbergia arctica*, Abd. 5 — 7—9. *Folsomia gracilis*. — 7. Abd. 4—6, sensillae enlarged. Paratype. — 8. Dorsal chaetotaxy of right dens. — 9. Ventral chaetotaxy of manubrium. — 10. *Folsomia taimyrica*, dorsal chaetotaxy of manubrium. — 11. *Folsomia diplophthalma*, dorsal chaetotaxy of manubrium.

uncertain systematic position. The following species are previously not reported from Spitsbergen or are published after Valpas' paper:

*Hypogastrura concolor* (Carpenter, 1900). Probably confused with *tullbergi*, but differs by absence of accessory spines in Ant. 3 organ and darker body colour. Holarctic species, common at Ny Ålesund (Fjellberg 1984a).

*H*. sp. near *sensilis* (Folsom, 1919). From Ny Ålesund I have som specimens of a form which is also seen from northern parts of Canada, Alaska and NE Siberia. It is not clear wether it is a distinct species or just a form of the Nearctic *sensilis* (Fjellberg 1984a).

*H. (Ceratophysella) longispina* (Tullberg, 1876) (= *hirsuta* Valpas, 1967). Holarctic species common at Ny Ålesund (Fjellberg 1984a).

*Willemia scandinavica* Stach, 1949 and *W. similis* Mills, 1934. Both species are Holarctic and are probably confused with *anophthalma* Börner. For separation, see Fjellberg (1984a). All three species were found at Ny Ålesund.

*Friesea quinquespinosa* Wahlgren, 1900 (= *nauroisi* Cassagnau, 1958). This Holarctic species is reported from Spitsbergen by Cassagnau (1958) and Valpas (1967) under the name *F. nauroisi* Cassagnau which is a junior synonym (Fjellberg 1984a).

*Anurida polaris* (Hammer, 1954) (= *frigida* Fjellberg, 1973). Previous records of *remyi* Denis from Spitsbergen probably refer to *polaris* and *remyi* should be delated from the list. Also *granaria* (Nicolet) may have been confused with *polaris*, but *granaria* does occur in Spitsbergen. I have some specimens from birds cliffs at Blomstrandfjellet, Ny Ålesund.

*Onychiurus macfadyeni* Gisin, 1953. An European species originally described from Jan Mayen. Some specimens from Midtholmen at Ny Ålesund.

*O. ursi* Fjellberg, 1984. Certainly confused with *groenlandicus* (Tullberg). Both these Holarctic species are present at Ny Ålesund.

*Tullbergia simplex* Gisin, 1958. Probably confused with *arctica* Wahlgren. Both Holarctic species are found at Ny Ålesund (see above).

*T. macrochaetae* (Rusek, 1976). Holarctic species present at Ny Ålesund.

*Pseudanurophorus inoculatus* Bödvarsson, 1957. Holarctic species found at Ny Ålesund.

*Folsomia gracilis* (Stach, 1962). Published from Hornsund by Stach (1962) as *Isotomina gracilis*. This Holarctic species is also seen from Longyearbyen and Berzeliusdalen. Valpas (1967) record of *F. sensibilis* Kseneman is probably *gracilis* and should be deleted from the list until verified.

*F. taimyrica* Martynova et al., 1973. Holarctic species found in Adventdalen and at Hopen (see above).

*Archisotoma polaris* Fjellberg & Poinsot, 1975. Holarctic species described from Ny Ålesund (Fjellberg & Poinsot 1975). Recently found on Ellesmere Island (Alexandra Fiord, A. Fjellberg leg. 1983).

*A. megalops* (Bagnall, 1939). European species found at Prins Heinrichøya, Ny Ålesund.

*Isotoma nanseni* Fjellberg, 1978. Holarctic species common at Ny Ålesund. Certainly confused with *olivacea* Tullberg which should be deleted from the list until verified.

*I. tshernovi* Martynova, 1974. Palaearctic species reported from Berzeliusdalen by Fjellberg (1978).

*I. neglecta* Schäffer, 1900. Holarctic species found at Ny Ålesund. Earlier authors might have confused this species with *violacea* Tullberg which should be deleted from the list until verified (Fjellberg 1978).

*I. fennica* Reuter, 1895. The species was reported from Spitsbergen by Stach (1962). It is quite likely that Stach confused this species with either *nanseni*, *tshernovi* or *neglecta* (winter form) and *fennica* should be deleted from the list until verified.

*Entomobrya subarctica* Stach, 1962. Described by Stach (1962) from one specimen collected at Hornsund. The identity of the species is obscure and future specimens from Spitsbergen should be compared with the similar species *comparata* Folsom which is common in arctic parts of North America.

*Arrhopalites principalis* Stach, 1945 (*binoculatus* auct.). Holarctic species found at Ny Ålesund. Former authors referred to this species as *binoculatus* (Börner).

*Sminthurinus aureus* (Lubbock, 1862) and *S. niger* (Lubbock, 1876). The older Spitsbergen records of these two species are doubtful and should be deleted from the list until verified. They are probably confused with *concolor* (Meinert, 1896) which appear to be common in Spitsbergen (Ny Ålesund, Kong Karls Land).

*Neelus minimus* (Willem, 1900). Holarctic species found at Ossian Sarsfjellet at Ny Ålesund.

*Sminthurides pumilis* (Krausbauer, 1898). Holarctic species found at Ny Ålesund.

Some older records of various species have not been verified and should be considered dubious. These include *Proisotoma schoetti* (Dalla Torre, 1895) reported by Schäffer (1900) and *Xenyllodes armatus* Axelson, 1903, *Isotomina thermophila* (Axelson, 1900) and *Sira flava* Ågren, 1903 ( = *Willowsia buski* (Lubbock, 1869)) reported by Thor (1930).

Considering the above additions and deletions, there are now 47 known species of Collembola from Spitsbergen.

## ACKNOWLEDGEMENT

I am indepted to Niels Haarløv, Denmark, for sending me the Jan Mayen material for identification and to Ola Skifte and Fritz Richardsen, Tromsø, for collecting the samples from Bjørnøya and Hopen.

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# The sex ratios of three species of thrips, *Mycterothrips latus* (Bagnall), *Thrips vulgatissimus* Haliday, and *Taeniothrips picipes* (Zetterstedt) in the Dovrefjell mountains (Thys., Thripidae)

ANDERS OLSEN

Olsen, A. 1984. The sex ratios of three species of thrips, *Mycterothrips latus* (Bagnall), *Thrips vulgatissimus* Haliday, and *Taeniothrips picipes* (Zetterstedt) in the Dovrefjell mountains (Thys., Thripidae). *Fauna norv. Ser. B, 31,* 77—80.

The sex ratios of adult and larvae of populations of *Mycterothrips latus* (Bagnall), *Thrips vulgatissimus* Haliday, and *Taeniothrips picipes* (Zetterstedt) living in the Dovrefjell mountains are discussed.

The sex ratios for *M. latus* larvae (♂♂ : ♀♀) recorded in 1977 and 1978 were 1:3,4 and 1:3.3, respectively. These values are close to the sex ratio of 1:4 which, according to Lewis (1973), indicates reproduction by haploid facultative arrhenotoky. It seems reasonable, nevertheless, to assume that also *T. picipes* reproduces arrhenotokously in the area, despite larval sex ratio values of 1:1.3 being recorded in both 1977 and 1978. The only alternative explanation, involving diploid males and ordinary sexual reproduction, would be expected to yield a sex ratio of about 1:1.

Male *T. vulgatissimus* were not recorded on Dovrefjell, and this species is therefore considered to reproduce by female to female parthenogenesis (thelytoky) in this area.

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## INTRODUCTION

Because of their reproductive systems, the sex ratios of most populations of species of thrips tend to deviate from a value of 1:1 (♂♂ : ♀♀). Moreover, for several thrips species, the sex ratios are known to vary between localities, and different explanations for such variation have been proposed. Nevertheless, our knowledge in this respect is, for most species, still extremely deficient, and the main aim of the present paper is to add yet another piece to the jig-saw puzzle. However, I would also like to draw attention to the dangers involved in drawing conclusions based on sex ratios obtained from adult populations alone, because of differences in the biology, and often also in the longevity of the two sexes.

The present information is based on material collected in the sub-alpine birch forest zone (900 to 1100 m above s.l.) near Kongsvoll in the Dovrefjell mountains, Central Norway, during the summers of 1977 and 1978. These collections formed part of a broader investigation comprising the ecology and distribution of the thrips fauna on Dovrefjell, and detailed accounts of the habitats, sampling sites, and sampling procedure will be published later. For the purpose of the present paper the following information should suffice:

Adult and larval *Mycterothrips latus* (Bagnall) were collected from leaves and twigs of their host plant, *Betula pubescens*, as a rule at weekly intervals throughout the summer. The procedure adopted involved cutting off infested plant parts, putting them into plastic bags, and later washing out the animals in a solution of soap and water (Newell 1947, Taylor & Smith 1955, Cederholm 1964). A similar procedure was followed when collecting *Thrips vulgatissimus* Haliday from leaves and catkins of different *Salix* species, and *Taeniothrips picipes* (Zetterstedt) from *Aconitum septentrionale* and *Geranium sylvaticum*. In addition, newly hatched adult specimens of *T. vulgatissimus* were collected from flowering host plants by beating and net-sweeping.

For separation of the sexes at the larval stage I used the characters cited by Priesner (1958). Only second instar larvae were involved. Zoological nomenclature follows Mound et al. (1976),

Table 1. Total numbers and sex ratios of three species of thrips collected in the sub-alpine birch forest in the Dovrefjell mountains during the summers of 1977 and 1978 (see text for further explanations). L II = second instar larvae, Ad = adult, N = number, SR = sex ratio.

| | 1977 L II | | 1978 L II | | 1978 Ad | |
|---|---|---|---|---|---|---|
| | N | SR | N | SR | N | SR |
| *Mycterothrips latus* | 84 | 1:3.4 | 34 | 1:3.3 | 286 | 1:8.6 |
| *Thrips vulgatissimus* | 100 | — | 100 | — | > 1000 | — |
| *Taeniothrips picipes* | 135 | 1:1.4 | 190 | 1:1.4 | 131 | 1:25.2 |

and plant names are given in accordance with Lid (1974).

## RESULTS

The total number of adult specimens collected in 1978, and the numbers of second-instar larvae investigated are shown in Table 1. In addition, the sex ratios for both adults (entire collection 1978) and larvae are given. The larval data refer to the collections made in July.

Adults of both sexes of *M. latus* were recorded in 1978, and the sex ratio for the entire collection was 1:8.6. Throughout the season, however, the sex ratios varied considerably. From the time of the snow-melt up to the end of July only two of a total of 159 adults captured were males, in contrast to a sex ratio of 1:3.6 for 128 adults collected during August and September. This may be due to a differential longevity of the two sexes; viz. the females hibernate, whereas the males do not (Olsen unpubl.). In adult collections from the final part of the summer season newly hatched specimens predominated, and the sex ratio of 1:3.6 found agrees well with that recorded for the larvae in July.

Adults of *T. picipes* were almost exclusively captured in the spring, but only five of the total of 131 were males. This contrasts with the much higher proportion of males recorded among the larvae (see Tab. 1). The low proportion of adult males may perhaps be ascribed to differences in the mortality rates for the two sexes, during hibernation or post-hibernation, or may simply be due to the fact that the larval host plants are invaded by the males to only a minor extent after hibernation (Olsen unpubl.).

Although several hundred adult specimens were examined, I was unable to find a single male *T. vulgatissimus* on Dovrefjell. Correspondingly, all the investigated larvae were female. Males must therefore be either very uncommon in the area, or entirely absent.

## DISCUSSION

Female thrips are diploid, males always haploid (Whiting 1945, Stannard 1968). This follows from the method of reproduction, by haploid facultative arrhenotoky, whereby unfertilized eggs develop into males, fertilized eggs into females. A number of thrips species ordinarily follow this reproductive pattern (e.g. *Taeniothrips simplex* (Morison), *Thrips linarius* Uzel, *Caliothrips faciatus* (Pergande), *Scirtothrips citri* Moulton, *Haplothrips verbasci* (Osborn), and *Liothrips oleae* (Costa)) (Lewis 1973). Arrhenotoky generally yields a sex ratio which deviates from a 1:1 value (Hamilton 1967) and, according to Lewis (1973), thrips species which reproduce by haploid facultative arrhenotoky often produce males/females in a ratio of 1:4. This is not far from the sex ratio obtained for *M. latus* larvae on Dovrefjell, and may indicate that this species reproduces arrhenotokously. Even though, by this method of reproduction, a sex ratio of 1:4 should be usually found, deviating sex ratio values have been recorded for several thrips species (Köppä 1969, Lewis 1973). Thus, I can see no reason to doubt that *T. picipes* on Dovrefjell also reproduces in this manner, despite the sex ratio value recorded for the larvae. The only other possible explanation would imply the existence of diploid males, which would involve a probable sex ratio of about 1:1 in the population.

Thrips also often reproduce by thelytoky, females giving birth only to further females. For some species of thrips (e.g. *Heliothrips haemorrhoidalis* (Bouche), *Hercinothrips bicinctus* (Bagnall), *Heliothrips errans* (Williams), *Scirtothrips longipennis* (Bagnall), *Leucothrips nigripennis* (Reuter), and *Chaetanaphothrips orchidii* (Moulton)) males have scarcely ever been recorded (Lewis 1973). These species must therefore be assumed to reproduce more or less wholly parthenogenetically (obligate thelytoky). Other species (e.g. *Thrips tabaci* Lindem., *Taeniothrips inconsequens* (Uzel) and *Haplothrips tritici* (Kurdjumov)) reproduce thelytokously in some areas, whereas in some other areas the sex ratio values indicate arrhenotoky. This also applies to *T. vulgatissimus,* the sex ratio of which are known to vary geographically (Lewis 1973). Since males were not recorded on Dovrefjell, thelytoky must at least be the prevailing reproductive strategy for this species in this particular area. A similar situation has been reported from Southern England, the Fränkische Alb and the Rhein Main regions of Germany, and the eastern coast of North America. On the western coast of North America and in northern England males are scarce, but in Scotland sex ratios near to 1:1 are reported (O'Neill & Bigelow 1964, Lewis 1973). Near to Trondheim, I only found two males among several thousand females, and in Lavangen in Troms province (Northern Norway), a collection of 293 adults had a sex ratio of 1:3.6 (Olsen & Solem 1982).

The reproduction strategy adopted by a species is ultimately determined by the natural selection acting upon the species and its local populations (Charnov 1982). But the strength and evolutionary consequences of the selection pressure will vary with environmental factors and pre-existing properties of the organisms involved. Hence, it should be possible to correlate geographical differences in reproduction strategy and sex ratios within a species with observable variables. Thus, attempts have been made to correlate geographical differences in sex ratios of thrips species with the prevailing meteorological conditions, viz. males becoming scarcer with increasing air temperature (Lewis 1973). This is supported by the observation made by Morison (1957) that males of *T. tabaci* have never been recorded in greenhouses, but have been found in outdoor populations. Nevertheless, in the warm climate of Iran, *T. tabaci* has the sex ratio 1:1, and much lower ratios have been recorded in other, often colder, parts of the world.

An alternative explanation may be that the parthenogenetic forms are able to spread more easily than the sexual forms, in which case males should be more numerous in the areas of origin of the species and scarcer in areas invaded later (O'Neill 1960, Mound 1976). Unfortunately, for several species this proposal runs into trouble when actually comparing the geographical distribution of the sex ratios with the assumed dispersal routes for the species.

A most valuable contribution to the understanding of how sex allocation function in nature is the book of Charnov (1982). Although he is treating all the reproduction strategies commonly observed among plants and animals, a rather large fraction of his modelling efforts is based on organisms reproducing arrhenotokously, notably parasitic Hymenoptera and certain mites. In his view, competition for resources or a mate is the key-factor for the understanding of the observed sex ratios, but its effect on the sex ratio may be quite different depending on the life history of the species and the degree of crowding. To a remarkable degree his models agree with experiments, and an interesting question, from my point of view, is whether or not they are predictable also for thrips species populations. Unfortunately, at present the data in this field are much to scanty for drawing extensive conclusions.

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# The life cycle of *Halesus radiatus* (Curtis, 1834) (Trich., Limnephilidae) in a West Norwegian lowland stream.

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Andersen, T. & Tysse, Å. 1984. The life cycle of *Halesus radiatus* (Curtis, 1834) (Trich., Limnephilidae) in a West Norwegian lowland stream. *Fauna norv. Ser. B.* 31, 81—87.

*Halesus radiatus* is frequently found in West Norwegian streams and rivers, and has a vertical range from sealevel up to about 1150 m. The annual cycle of the larval population in a small, rapid stream was studied by regular sampling of larvae and pupae throughout one year. The species has five larval instars, which were easily separable by head capsule measurements.

*H. radiatus* was found to be univoltine with a very synchronous moulting pattern. First instar larvae were sampled in November and December. The larvae showed no stagnation in growth in the winter. The larvae in fact grew rapidly during the cold period, and fourth instar was reached in March. Fifth instar larvae were sampled from April to early August, prepupae from late June to early August and pupae in August and September. The flight period lasted from late August to late October. The median day of the flight period was September 29 for the males and October 1 for the females.

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## INTRODUCTION

*Halesus radiatus* (Curtis, 1834) is a Palaearctic caddis fly, distributed in most parts of Europe (Schmid 1955, Botosaneanu & Malicky 1978). It ranges as far north as northern Fennoscandia (Brekke 1946, Nybom 1960, Tobias 1969). The species is quite variable concerning genital structures and size, and was previously believed to consist of two separate species. In Fennoscandia *H. radiatus* (auct.) was considered to be distributed in the Atlantic western regions, while *H. interpunctatus* (Zetterstedt, 1840) had a more eastern continental distribution, with a zone of hybridization occurring in the mountainous border areas between Norway and Sweden (Forsslund & Tjeder 1942). However, Svensson & Tjeder (1975) stated that: «*interpunctatus* Zett. must be considered as the same species as *radiatus*», a view that is generally accepted today.

According to Lepneva (1971) the larvae of *H. radiatus* live in running water, usually in parts with slow current, and on open lake shores. In Fennoscandia *H. radiatus* larvae have been taken from brooks, streams and rivers and also from stagnant waters (e.g. Svensson 1974, Bagge & Salmela 1978). In a lake in the mountains of central Norway larvae were found both on stony substrate in the exposed zone and on soft bottom with sand and mud (Lillehammer 1978). In western Norway *H. radiatus* is frequent in most streams and rivers, and reach an altitude of about 1150 m a.s.l. in the western parts of the Hardangervidda mountain plateau (Andersen 1976, 1979a, Andersen et al. 1978).

In this study we examined the annual cycle of the larval population of *H. radiatus* in a small, rapid West Norwegian lowland stream, and also provide information on the flight period at the same river system. The life cycle of *Chaetopteryx villosa* (Fabricius, 1798) in the same stream was recorded by Andersen & Tysse (1984).

## STUDY AREA

The larvae were collected in a stream near Fitjahjellen (60°32'N, 5°33'E) on the Island of Osterøy, east of Bergen, Fig. 1. The stream is a tributary to Lono River, and flows through a valley intensively used as pasture land. Single hardwoods, mainly birch *(Betula)* and oak *(Quercus)* grow along the banks. At the sampling site the stream is an average of 3 m wide, and rather shallow. The bottom substratum consists of small and medium sized stones, with pebbles and coarse and in between. Most of the larger stones were covered with moss, mainly *Fontinalis* spp.

The stream was never completely ice covered

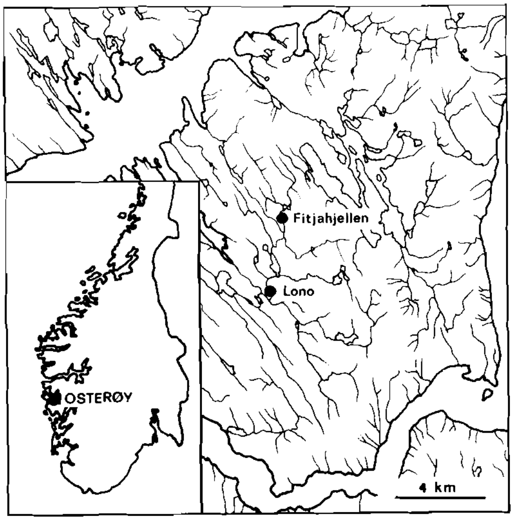


Fig. 1. Map of the central parts of the island of Osterøy, showing the exact location of the sampling sites of *Halesus radiatus*.

during the sampling period in 1982. The water temperature rose above 5°C in April and above 10°C in late May (Fig. 2). Maximum temperature of 21°C was reached in early August and the temperature fell below 10°C in October. Western Norway has a super-oceanic climate, with a yearly mean precipitation on Osterøy of more than 2000 mm. In periods of heavy rain, large scale fluctuations of discharge from one day to the next often occur. The summer of 1982 was, however, exceptionally dry, and during July and early August only a few small ponds were left of the stream.

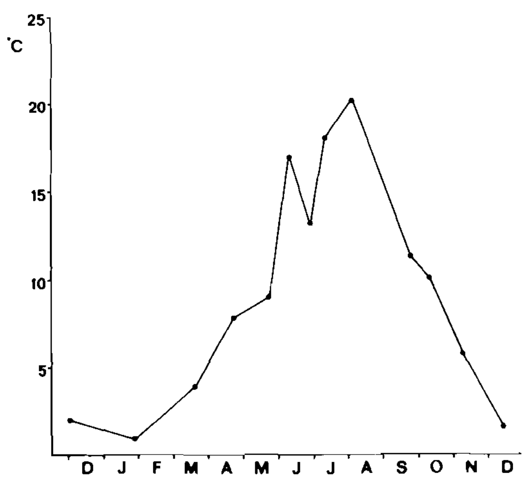


Fig. 2. Yearly variation in the water temperature in the Fitjahjellen stream in 1982.

The imagines were sampled near Lono (60°31'N, 5°32'E), some 3 km downstream the same river system, Fig. 1. Here, the stream also flowed through a valley used as pasture land. Along the eastern bank single hardwoods, mainly birch *(Betula)*, alder *(Alnus glutinosa)* and European bird cherry *(Prunus padus)* are growing, while the western bank is planted with spruce *(Picea)*. At this sampling site the stream is an average of 4 m wide and rather shallow. The bottom substratum consists of medium sized stones, covered with moss *(Fontinalis* spp.)

A total of more than 60 Trichoptera species were captured, in light traps along this branch of the Lone River system (Andersen 1976, 1979b, unpubl.). In the stream in Fitjahjellen the most abundant limnephilids apart from *H. radiatus*, were several *Limnephilus* spp., *Potamophylax cingulatus* (Stephens, 1837) and *Chaetopteryx villosa* (Fabricius, 1798).

## METHODS AND MATERIAL

In the Fitjahjellen stream larvae were sampled on eleven occasions between December 1981 and December 1982. A total of 506 larvae, 5 prepupae and 12 pupae were collected by searching the bottom of the stream, picking all larvae and pupae seen until an adequate sample was obtained. In Lono a total of 860 imagines (688

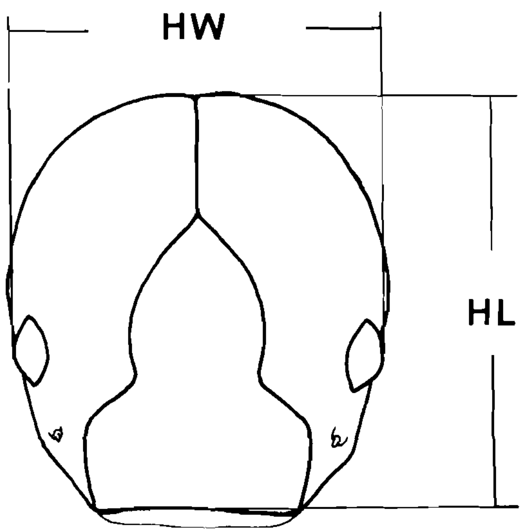


Fig. 3. Measured head capsule dimensions of *Halesus radiatus* larvae. HL — head length, HW — head width.

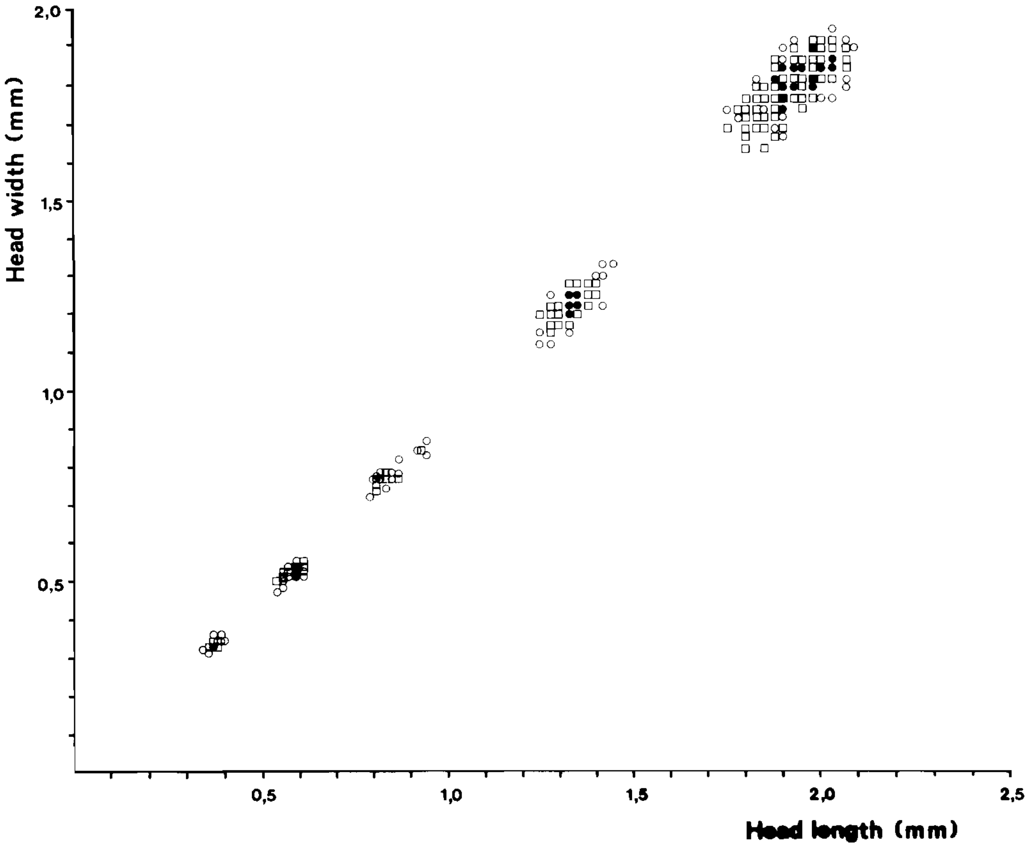


Fig. 4. Instar discrimination of *Halesus radiatus* larvae by head length and head width. ○:1 specimen, □:2—5 specimens, ●:6—10 specimens, ■: > 10 specimens.

males, 172 females) were taken with a modified Robinson light trap equiped with a mercury vapour bulb (Philips HPL-N 125W) in 1972.

The larval instars were separated according to head length and head width, Fig. 3. All larvae were measured with the aid of a stereo microscope. Measurements of first and second instar

Table 1. Head length and headh width (mean, standard deviation and range, in mm) and factor of increase at each moult of *Halesus radiatus* (Curtis, 1834) larvae in the Fitjahjellen stream in 1982.

| | | Head length | | | | Head width | | | |
|---|---|---|---|---|---|---|---|---|---|
| Instar | n | $\bar{x}$ | S.D. | range | factor of increase | $\bar{x}$ | S.D. | range | factor of increase |
| I | 31 | 0.371 | 0.011 | 0.34—0.40 | | 0.333 | 0.009 | 0.31—0.36 | |
| | | | | | 1.57 | | | | 1.57 |
| II | 57 | 0.584 | 0.018 | 0.54—0.61 | | 0.524 | 0.017 | 0.47—0.55 | |
| | | | | | 1.46 | | | | 1.49 |
| III | 30 | 0.852 | 0.040 | 0.79—0.94 | | 0.782 | 0.034 | 0.73—0.87 | |
| | | | | | 1.57 | | | | 1.56 |
| IV | 98 | 1.336 | 0.042 | 1.25—1.45 | | 1.223 | 0.041 | 1.12—1.33 | |
| | | | | | 1.45 | | | | 1.47 |
| V | 290 | 1.935 | 0.073 | 1.76—2.09 | | 1.799 | 0.065 | 1.63—1.94 | |

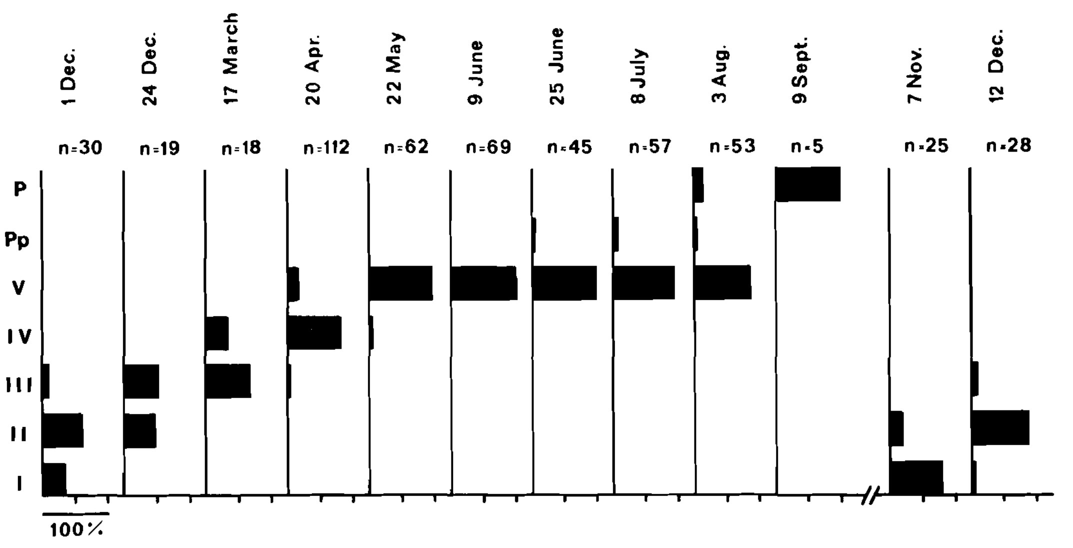


Fig. 5. Relative frequencies of the larval instars and of prepupae and pupae of *Halesus radiatus* in the Fitjahjellen stream in 1981—82.

larvae were made with an accuracy of 12µ, and of third, fourth and fifth instar larvae of 25µ.

## RESULTS

The five larval instars of *H. radiatus* were easily separated according to head length and head width, Fig. 4. The standard statistics of head length and width of each instar, as well as the factor of increase at each moult are listed in Tab. 1. Both head width and head length increased on an average by a factor of 1.5 at each moult, the increase in both dimensions being somewhat less during the second and fourth moult than during the first and third.

The larvae had a very synchronous moulting pattern, Fig. 5. First instar larvae were captured in November and December. Second instar larvae were modal in December, third instar from January to March, and fourth instar larvae in April. Fifth instar larvae were sampled from April to early August. Prepupae were found from late June to early August, and pupae in August and September.

The fligth period of the imagines lasted from late August to late October, Fig. 6. The median day of the fligth period, i.e. the day when 50% of the individuals had been caught, was September 29 for the males and October 1 for the females.

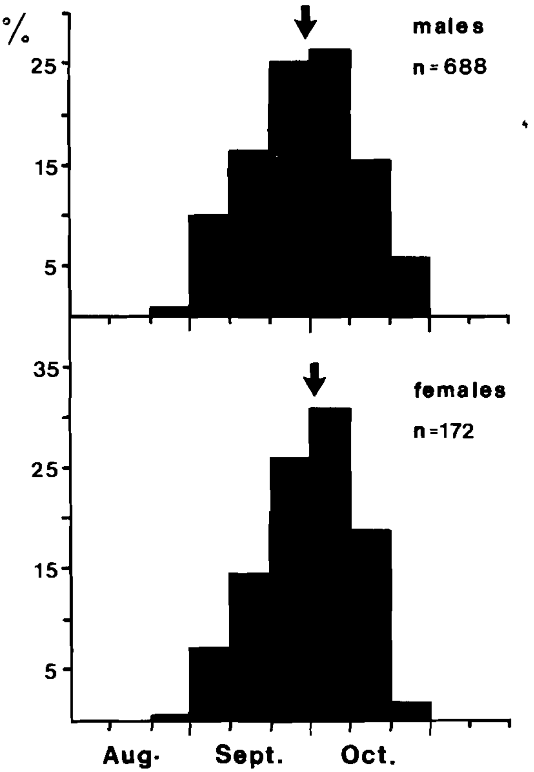


Fig. 6. The flight periods of male and female *Halesus radiatus* at Lono 1972. Vertical arrows indicate when 50 per cent of the annual total had been caught.

## DISCUSSION

The life cycle of Trichoptera generally takes one year, but two or three year life cycles have been recorded, and some species might even be bivoltine (Nielsen 1948, Decamps 1967, Hickin 1967, Elliott 1968, Ulfstrand 1968, Gower 1973). In temperate latitudes various life cycle strategies have been recorded (Hynes 1970). Most species overwinter as larvae, but some species can overwinter as eggs (Solem 1981, Andersen & Tysse 1984), as prepupae (Nielsen 1950, Resh 1976) or as imagines (Berté & Pritchard 1983). During the summer some species have resting stages as first instar larvae within the egg-mass jelly (Hiley 1978), in the final instar, or as prepupae (Cummins 1964, Denis 1979) or as imagines (Novák & Sehnal 1963).

Crichton (1971) grouped limnephilids in three categories according to their flight periods: 1) Species with a extended flight period, probably involving an imaginal diapause, from spring through summer into autumn. 2) Species with a shorter flight period, without a diapause, in spring and summer, and sometimes extending into autumn. 3) Species with a short flight period, without a diapause, in autumn. Crichton (1971) and Crichton & Fisher (1981) regarded *H. radiatus* as a clearly autumnal species, i.e. belonging to category 3.

Species belonging to this category generally emerge with their oviducts packed with eggs (Novák & Sehnal 1963), in fact pupae of *Halesus* spp. frequently contain well-developed ovaries (Denis 1978, Hiley 1978). In southern Sweden Svensson (1972) found that emerging females of *H. radiatus* had maturing of fully developed eggs, and females that had oviposited were captured throughout most of the flight period. The egg-laying period was thus not long delayed after emergence, and probably coincided with most of the flight period, except for the first few days.

In addition to *H. radiatus,* Crichton (1971) and Crichton & Fisher (1981) listed ten English species belonging to category 3, of which *Anabolia nervosa* (Curtis, 1834), *Halesus digitatus* (Schrank, 1781) and *Chaetopteryx villosa* (Fabricius, 1798) are lotic species also taken in Scandinavia. Several studies of the life cycles of these species in Central and North Europe have appeared: *A. nervosa* (Nielsen 1942, Hanna 1957, Elliott 1971, Denis 1972); *H. digitatus* (Nielsen 1942, Illies 1952); *C. villosa* (Elliott 1971, Andersen & Tysse 1984). All of these species complete their life cycle in one year in Central and North Europe, although *C. villosa* can change to a semivoltine life cycle in the mountains of western Norway (Andersen & Tysse 1984).

According to Dittmar (1955) the life cycle of *H. radiatus* takes one year in Germany. In Fitjahjellen *H. radiatus* was univoltine also, with a very synchronous moulting pattern. First instar larvae were found in November and December, and there was no indication of a delayed hatching of eggs, as has been noted for the other lotic species mentioned above (Nielsen 1942, Elliott 1971, Andersen & Tysse 1984). In spite of the low water temperatures, the larvae of *H. radiatus* in Fitjahjellen grew rapidly during late autumn and winter, and fourth instar was reached in March. In England the larval development seems to proceed more rapidly as Garside (1979) recorded fourth instar larvae of *H. radiatus* as early as in January. In most Trichoptera there is a marked retardation of the larval growth during winter, and some species can stop growth for several weeks (Elliott 1967, Iversen 1976). However, Otto (1971) found that the growth rate of *Potamophylax cingulatus* (Stephens, 1837) larvae in a South Swedish stream was comparatively high during the autumn, and that the growth was only slightly retarded during the winter. Although classified as belonging to group 1 by Crichton & Fisher (1981), *P. cingulatus* has a fairly late flight period in Scandinavia (Tobias 1969, Svensson 1972, Andersen 1983, Solem 1983).

In Fitjahjellen fifth instar larvae of *H. radiatus* were sampled from April to early August, while prepupae appeared in late June and pupae in early August. Garside (1979) recorded fifth instar larvae from early summer until autumn in England. According to Denis (1973, 1978, 1979) the fifth instar larvae of *H. radiatus* enters a diapause either at the end of the larval growth or at the beginning of metamorphosis. The diapause is induced by a summer photoperiod, and it often merely reduces the rate of the development. In France, *H. radiatus* larvae enter diapause at the end of May or in June, metamorphosing at the end of August or in September.

*H. radiatus* has a late flight period throughout its northern range, occurring progressively earlier with increasing latitude (Tobias 1969, Göthberg 1970, Ulfstrand 1970, Crichton 1971, Svensson 1972, Koponen 1977, Andersen 1983). In southern England the flight period lasted from late August to mid November with the median week of the flight period as the second week of October, while the flight period in Scotland lasted from late July to late October with the median week as the first week of September (Crichton 1971). In southern Sweden the flight period lasted from late August to mid November with the median day of the flight period on October 5 and 8 for males and females, respectively (Svensson 1972). In Osterøy the flight period lasted from late August to late October, with the median days of males and females in the last days of September and first days of October, respectively.

When systematically related species coexist in the same river system they are often found to differ ecologically (e.g. Grant & Mackay 1969). Ecological separation between potentially conflicting species is often expressed in terms of temporal or habitat differences. The larvae of most lotic limnephilids are shredders which often are totally dependant of the annual leaf fall (Otto 1981). The three abundant limnephilids in the Fitjahjellen stream, *H. radiatus, P. cingulatus* and *C. villosa,* are all leaf eating shredders. There was a clear habitat segregation between the larvae. *P. cingulatus* inhabited the middle part of the stream where the older larvae were taken in the gravel beneath the larger stones. The larvae of *H. radiatus* and *C. villosa* were taken along the edges of the stream or on the top of the stones, sitting on bare rock or in between the moss tufts. Although the flight periods overlap, there was also a temporal sequence between the species. In Osterøy *P. cingulatus* flies from late July until late October, *H. radiatus* from late August to early November, and *C. villosa* from late September to mid December (Andersen 1983). Of the two species that coexist in the same habitat, *H. radiatus* has a rapid larval development during late autumn and winter with first instar modal in November and second instar modal in December. *C. villosa,* which is the smaller species, has a much slower larval growth during the winter with first instar modal until March and second instar modal in April (Andersen & Tysse 1984). The three abundant species seem thus to be clearly separated ecologically, both by habitat segregation and by a temporal sequence.

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# Distribution and flight periods of Bibionidae (Dipt.) in the Dovrefjell mountains near Kongsvoll, Central Norway

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Greve, L., Solem, J.O. & Olsen, A. 1984. Distribution and flight periods of Bibionidae (Dipt.) in the Dovrefjell Mountains near Kongsvoll, Central Norway. *Fauna norv. Ser. B, 31,* 88—91.

Malaise trap collections on eight sites between the elevations 900 m to 1350 m, in the Dovrefjell mountains showed *Bibio fulvipes* Zetterstedt, *B. rufipes* Zetterstedt, *B. pomonae* (Fabricius), *B. clavipes* Meigen, *Dilophus femoratus* Meigen, and two so far unidentified species to be present. *B. clavipes* and *D. femoratus* are fairly common in the sub-alpine birch forest and the lower part of the low alpine belt, and they fly in September—October. *B. fulvipes* was captured with highest numbers just above the tree-line and flies in July. *B. pomonae* and *B. rufipes* appeared with highest numbers in the sub-alpine birch forest and fly mainly in August.

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## INTRODUCTION

As early as in 1838 J.W. Zetterstedt listed Bibionidae among a total of 463 specimens of Diptera from Norway. In the paper Norwegian Diptera, Siebke (1877) included 13 species of *Bibio* (listed as *Hirtea)* and two species of *Dilophus,* and Schöyen (1884) made a note on mass swarming of *Bibio pomonae* Fabr. However, since then very few researchers have dealt with Norwegian material of this family.

Adult specimens of Bibionidae are, however, easily caught because of their awkwardness (may be easily picked by hand when resting in the vegetation), and also because they quite often are abundant when present.

## STUDY AREA AND METHODS

The area of sampling was the surroundings of the Kongsvoll Biological Station, and the sampling sites were located within or close to the Dovrefjell National Park. Data were collected from eight sites using Malaise traps. Collections were done on both the eastern side, the Knutshø mountains, and on the western side of the valley. The localities are located at streams and four lie on the western slope of the mountain S. Knutshø, two at the elevation of Kongsvoll Biological Station and the two remaining in the mountains west of Kongsvoll. Sampling was carried out on three sites in the sub-alpine birch forest belt and five sites in the alpine belt. All sites are in EIS 79 and the UTM references are:

1. Blesbekken, 1350 m a.s.l., low alpine belt, 32VNQ 342084,
2. Blesbekken, 1200 m a.s.l., low alpine belt, 32VNQ 332078,
3. Raubekken, 1200 m a.s.l., low alpine belt, 32VNQ 330080,
4. Kallvella, 1220 m a.s.l., low alpine belt, 32VNQ 266117.
5. Stroplsjöen, 1289 m a.s.l., low alpine belt, 32VNQ 222115.
6. Blesbekken, 1000 m a.s.l., sub-alpine belt, 32VNQ 320073,
7. Raubekken, 900 m a.s.l., sub-alpine belt, 32VNQ 314078,
8. Jerosbekken, 900 m a.s.l., sub-alpine belt, 32VNQ 315052

The Malaise traps were positioned across streams with the main objective to collect aquatic insects. Collecting have been done over four years, 1980 to 1983, and commenced every year in May or June and lasted into October.

The sub-alpine belt in the area is characterized by a birch forest and the upper limit for the birch forest is 1080 m. Areas above the tree line belong to the alpine belt which can be sub-divided further. We are here only dealing with the lowest part of the alpine belt. See Sjörs (1967) and Rönning (1972) for more details about the biotic zonation of Scandinavian mountains.

Table 1. Number of Bibionidae captured at the various sites. See text for site definitions.

| | Alpine belt | | | | | Sub-alpine belt | | |
|---|---|---|---|---|---|---|---|---|
| Sites no. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *Bibio clavipes* (Meigen) | | 10 | 10 | | 1 | 19 | 26 | 79 |
| *B. fluvipes* Zetterstedt | 1 | | 242 | 1 | | 14 | 3 | 1 |
| *B. rufipes* Zetterstedt | | 1 | 3 | | 1 | | 51 | |
| *B. pomonae* Fabricius | | | | 1 | | 15 | 61 | |
| *Bibio* spp. | | | | 17 | | | | |
| *Dilophus femoratus* Meigen | | 26 | 4 | | | | 15 | 85 |

## RESULTS AND DISCUSSION

A total of 145 specimens of *Bibio clavipes* Meigen, 77 specimens of *B. pomonae* Fabricius, 470 specimens of *B. fulvipes* Zetterstedt, 56 specimens of *B. rufipes* Zetterstedt, 130 of *Dilophus femoratus* Meigen, and 17 of *Bibio* spp. were captured. The data on the identified species are presented in Tables 1 and 2. All the unidentified specimens were captured at the stream Kallvella, in the western part of the mountains.

### Distribution

Since the Malaise traps were positioned across streams with the main objective to collect aquatic insects they were not ideally positioned for the collection of Bibionidae. Larvae of Bibionidae are phytosaprophagous, are terrestrial, and live in the soil (Pecina 1965a). However, regardless of the position of the Malaise traps, the collections gave data on the distribution and flight periods in the area.

All five species were collected in the sub-alpine and in the low alpine belts. However, only one individual of *B. fulvipes* was captured at 1350 m a.s.l., and only two individuals, one of each of *B. clavipes* and *B. rufipes,* at the elevation 1289 m. The specimens captured at these highest altitudes have their main distribution at lower elevations in the alpine belts or in the sub-alpine belt and must be regarded as accidental captures in the higher part of the low alpine belt.

Our interpretation of the data collected is that *B. fulvipes, Bibio* spp., and *D. femoratus* must be regarded as true inhabitants of the lower part of the low alpine belt. The species mentioned are also common in the sub-alpine belt, while *Bibio* spp. only were captured in the alpine belt. *B. fulvipes* should also be regarded as a true alpine species, but seems to be restricted to areas just above the tree line. When taking the number of specimens captured in the various traps as a measure for the distribution of the species we see from Tab. 1 that there are only two species, *B. clavipes* and *D. femoratus,* that have a fairly even distribution in the lower part of the alpine belt and in the sub-alpine belt. *B. fulvipes, B. rufipes, B. pomonae,* and *Bibio* spp. are much more confined to particular habitats. *B. rufipes* and *B. pomonae* are only distributed in the subalpine belt.

Previous reports on the distribution in Norway are few, but *B. clavipes* has been collected at a few localities in the southern and eastern part of Norway (Siebke 1877). The species is known from all over Sweden and Finland (Wahlgren 1919, Hackman 1980), and is probably widespread also in Norway. Pecina (1965a) states *B. clavipes* to inhabit both the lowland and the mountains in Czechoslovakia, and this supports the assumption made above.

*D. femoratus* has probably a similar distribution in Norway as *B. clavipes.* We identified *D. femoratus* according to Haenni (1982). Old records from Norway must be revised and/or new records made before more facts about the distribution can be achieved.

*B. pomonae* can not be regarded as an alpine species in the Dovrefjell mountains, but is considered as such at more southern latitudes (Pecina 1965a). *B. pomonae* is the only bibionid with a Norwegian name, viz. «Russeflue», which has been known from old days. The distribution of *B. pomonae* in Norway seems to be from the sea level (collected from Herdla westwards of Bergen) and the sub-alpine birch belt in the mountains. *B. pomonae* is assumed to be widespread in Scandinavia (Pecina 1965a). *B. fulvipes* was reported from Finmark (Siebke, 1877) and has later been recorded from middle Europe (Pecina, 1965b). *B. rufipes* has been recorded from the Dovrefjell mountains and Kongsvoll (Siebke, 1877) and the species is distributed in Norway, Sweden and Finland (Hackman 1980, Krivosheina 1969).

Table 2. Number of individuals of Bibionidae captured at different dates

| | July | | | | August | | | | September | | | | October | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dato | 10 | 17 | 24 | 31 | 7 | 14 | 21 | 28 | 7 | 14 | 21 | 28 | 5 | 13 |
| *Bibio fulvipes* Zetterstedt | | 5 | 99 | 112 | 34 | 11 | 1 | | | | | | | |
| *B. rufipes* Zetterstedt | | | | | 11 | 20 | 18 | 3 | 3 | 1 | | | | |
| *B. pomonae* (Fabricius) | | | 1 | 11 | 6 | 18 | 25 | 7 | 8 | | | | 1 | |
| *B. clavipes* (Meigen) | | | | | | | 1 | 3 | 8 | 4 | 20 | 24 | 82 | 3 |
| *Dilophus femoratus* Meigen | | | | | | | 3 | 3 | 18 | 15 | 25 | 14 | 42 | 10 |

## Flight periods

The Malaise traps were used in the field from early June or from the time of snow-melting to mid October. No bibionids were captured before mid July. The first species to appear was *B. fulvipes*. Highest number of individuals of *B. fulvipes* were captured in the late July, but the flight period extended into the second half of August.

The second species captured was *B. pomonae* with the main flight period in mid August. A very similar flight period was also shown by *B. rufipes*. *B. clavipes* and *D. femoratus* have their main flight periods in September—early October. One specimen of *B. pomonae* was captured as late as October also. *B. clavipes* and *D. femoratus* must be regarded as late autumn species. Our data on the flight period of *B. clavipes* agree with that reported from Czechoslovakia (Pecina 1965a) and England (Chandler & Ismay 1978). Pecina (1965a) mentioned that other authors have collected adults of *B. clavipes* in spring. A spring-summer (April to July) and an autumn (October—November) flight period occur in Belgium (Verbeke, 1971). Our Malaise trap collections in the Dovrefjell mountains covered the snowfree period of the ground, and there is no indication of two separate flight periods here. Siebke (1877), however, collected specimens from June to September. None of his localities were in the alpine belt. This indicates that the species either have an earlier flight period, or have two separate flight periods during the summer in the lowland in Norway. Before anything more firmly can be stated about the flight period(s), more data are needed. *D. femoratus* appeared in August in the Dovrefjell mountains, but mass swarming at June 16, 1955 was observed in the lowland at Espeland, Fana county in the Hordaland province. Pecina (1965 a) reported the flight period of *D. femoratus* to be later in the mountains than in the lowland. Judging from data in the literature, it seems likely that *D. femoratus* have only one flight period per year, and that the species flies in the summer in the lowland and in the autumn in the mountainous part of Norway.

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# Some recent records of Hybotidae and Microphoridae (Dipt. Empidoidea) from Norway

TERJE JONASSEN

Jonassen, T. 1984. Some recent records of Hybotidae and Microphoridae (Dipt., Empidoidea) from Norway. *Fauna norv. Ser. B. 31*, 92–95.

New faunal data are given for 46 species of Hybotidae and Microphoridae. Of these, 10 species are reported from Norway for the first time.

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## INTRODUCTION

During the last couple of years I have been collecting Diptera of the superfamily Empidoidea, mostly in the province of Rogaland, south-western Norway. This has yielded several species new to Norway, as well as new to many faunal divisions.

The present report covers the families recently dealt with by Chvála (1975, 1983) in his important works on the Scandinavian Empidoidea, viz. the Hybotidae and the Microphoridae. New faunal data are given for 46 species of these families. Of these, 10 species (marked with an exclamation mark (!)) are reported from Norway for the first time.

In his most recent work on the Scandinavian Empidoidea, Chvála (1983) introduces a «new» classification, i.e. he splits the former «Empididae» into four families: Hybotidae, Atelestidae, Microphoridae and Empididae. The present report follows Chvála (1975, 1983).

This paper forms the first of three projected reports on recent finds of Norwegian Empidoidea. The next two parts will deal with the Empididae (in the strict sense) and the Dolichopodidae, respectively.

The material which forms the basis of this study has, where nothing else is mentioned, been collected by the author and is deposited in the author's collection. The material has mainly been collected by means of a hand-net or a sweep-net. Furthermore, a malaise-trap and water-traps have been operated. Tree trunk- and other surface-running species (e.g. Tachypeza) have mostly been collected by putting a collector's glass directly over the specimen.

The geographical division follows Økland (1981).

## HYBOTIDAE

### Subfamily Tachydromiinae

*Platypalpus ciliaris* (Fallén)
— Rogaland, RY, Sandnes: Gravaren, EIS 7, 1 ♂ 27 September 1981; Høle, EIS 7, 1 ♂ 22 July 1982.

*Platypalpus stigmatellus* (Zetterstedt)
— Rogaland, RY, Sandnes: Kubbetjønn, EIS 7, 2 ♀♀ 22 June 1982; RI, Forsand: Songesand, EIS 7, 1 ♀ 10 July 1981; 1 ♀ 8 August 1982; 3 ♀♀ 9–11 September 1982; 1 ♂ 18 June 1983.

*Platypalpus pectoralis* (Fallén)
— Rogaland, RY, Sandnes: Høle, EIS 7, 1 ♀ 22 July 1982.

*Platypalpus maculus* (Zetterstedt)
— Rogaland, RY, Rennesøy: Vikevåg, EIS 14, 1 ♀ 29 June 1981.

*Platypalpus unguiculatus* (Zetterstedt)
— Rogaland, RI, Forsand: Røssdalen, EIS 7, 1 ♀ 27 June 1982; Songesand, EIS 7, 1 ♀ 5 August 1982; 1 ♂ 2 August 1983; Helmikstøl, EIS 8, 1 ♂, 1 ♀ 5 August 1982.

*Platypalpus longicornis* (Meigen)
— Rogaland, RY, Stavanger: Sunde, EIS 7, 1 ♀ 4 June 1982, K. Rognes; Rennesøy: Vikevåg, EIS 14, 1 ♀ 25 July 1982; RI, Forsand: Songesand, EIS 7, 1 ♀ 9 September 1982; 1 ♂ ♀ (in copula), 2 ♀♀ 19 August 1983; Daladalen, EIS 8, 1 ♀ 7 August 1983.

(!) *Platypalpus difficilis* (Frey)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♂ 18 May 1982; Rennesøy: Vikevåg, EIS 14, 1 ♀ 24 June 1981. Both specimens were hand-netted on garden shrubbery. The genitalia of the male specimen have been dissected and examined. They agree with the figures given by Chvála (1975). New to Norway.

(!) *Platypalpus pulicarius* (Meigen)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♀ 2 July 1981.
This single specimen was caught among low vegetation in a garden. Although no males are at

hand, the combination of 4-serial acrostichals, pale bristles, small antennal segment 3 with yellow basal segments, completely yellow legs including coxae, and a small, black tibial spur, should be enough to confirm the species. New to Norway.

*Platypalpus nigritarsis* (Fallén)
— Rogaland, RI, Forsand: Songesand, EIS 7, 1 ♀ 17 August 1981; 1 ♀ 7 August 1982; 1 ♂ 8 August 1982; 1 ♂, 1 ♀ 20 August 1982; 1 ♂ 2 August 1983; 1 ♀ 10 August 1983; Helmikstøl, EIS 8, 1 ♂ 22 July 1983.

*Platypalpus minutus* (Meigen)
— Rogaland, RY, Rennesøy: Vikevåg, EIS 14, 1 ♂ 6 June 1981; 1 ♀ 21 July 1981; 1 ♀ 26 July 1981; 1 ♀ 10 June 1982; 1 ♂, 2 ♀ ♀ 25 July 1982; 1 ♂, 1 ♀ 5 July 1983; RI Forsand, Songesand, EIS 7, 1 ♂ 4 July 1981; 1 ♀ 5 July 1981.

*Platypalpus maculipes* (Meigen)
— Rogaland, RY, Sandnes: Høle, EIS 7, 1 ♂ 22 July 1982; RI, Forsand: Songesand, EIS 7, 1 ♀ 12 November 1982.

*Platypalpus annulatus* (Fallén)
— Østfold, Ø, Fredrikstad: Øra, EIS 20, 1 ♀ 24 June 1979, K. Rognes.

*Platypalpus notatus* (Meigen)
— Rogaland, RI, Forsand: Songesand, EIS 7, 2 ♂ ♂ 3 July 1981; 1 ♂ 24 August 1982; Songesandstølen, EIS 7, 1 ♂ 20 August 1982; Moen, EIS 7, 1 ♂ 27 June 1983; Røssdalen, EIS 7, 1 ♀ 27 June 1982; Helmikstølen, EIS 8, 2 ♂ ♂, 4 ♀ ♀ 5 August 1982; Daladalen, EIS 8, 1 ♂ 7 August 1983.

*Platypalpus interstinctus* (Collin)
— Aust-Agder, AAY, Tromøy: Tromøy kirke, EIS 6, 1 ♂ 27 July 1983.

*Platypalpus ecalceatus* (Zetterstedt)
— Rogaland, RY, Klepp: Øksnevad, EIS 7, 3 ♀ ♀ 15 June 1982; RI, Forsand: Røssdalen, EIS 7, 3 ♀ ♀ 26 June 1982.

*Platypalpus longiseta* (Zetterstedt)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♀ 2 July 1981; Rennesøy: Vikevåg, EIS 14, 2 ♂ ♂, 1 ♀ 25 July 1982; 1 ♀ 6 July 1983; RI, Forsand: Songesand, EIS 7, 1 ♀ 17 August 1981.

*Platypalpus major* (Zetterstedt)
— Vest-Agder, VAY, Mandal: Hauge, EIS 2, 1 ♀ 30 May 1982; Rogaland, RY, Sandnes: Høle, EIS 7, 1 ♀ 22 July 1982; Rennesøy: Vikevåg, EIS 14, 1 ♀ 31 May 1981; 1 ♀ 7 June 1981; 1 ♀ 10 June 1982; 1 ♀ 5 July 1983; Finnøy: Kyrkjøy, EIS 14, 1 ♀ 4—5 June 1983, K. Rognes; RI, Forsand: Songesand, EIS 7, 1 ♀ 29 June 1982.

*Platypalpus candicans* (Fallén)
— Rogaland, RY, Sandnes: Sviland, EIS 7, 1 ♀ 9 July 1982.

*Platypalpus cursitans* (Fabricius)
— Rogaland, RY, Stavanger: Sunde, EIS 7, 1 ♀ 6 June 1981, K. Rognes: RI, Forsand: Songesand, EIS 7, 1 ♀ 1 June 1983.

*Platypalpus verralli* (Collin)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♀ 20 June 1981; 1 ♀ 4 June 1982; Stavanger: Nordre Sunde, EIS 7, 1 ♀ 17 June 1977, K. Rognes; Rennesøy: Vikevåg, EIS 14, 1 ♂, 1 ♀ 10 June 1982; Morkavatn, EIS 14, 3 ♂ ♂ 11 June 1982; Førsvoll, EIS 14, 1 ♀ 11 June 1982; RI, Forsand: Songesand, EIS 7, 1 ♀ 18 June 1983.

*Tachypeza nubila* (Meigen)
— Rogaland, RY, Sandnes: Lutsi, EIS 7, 2 ♀ ♀ 4 June 1982; Dale, EIS 7, 1 ♂ 9 June 1982; Melshei, EIS 7, 1 ♂ 6 July 1982; Stavanger: Kvernevikskogen, EIS 7, 1 ♂ 6 July 1981, K. Rognes; RI, Forsand, Songesand, EIS 7, 1 ♀ 16 August 1982; 1 ♂ 28 May 1983; Helmikstøl, EIS 8, 1 ♂ 5 August 1982.

(!) *Tachypeza fennica* Tuomikoski
— Rogaland, RI, Forsand: Skurvedalen, EIS 7, 1 ♂ 19 June 1982; Songesand, EIS 7, 1 ♀ 8 June 1983; 1 ♀ 20 June 1983; 1 ♀ 23 June 1983.
Easily distinguished in the males due to the characteristic pattern of maculations on the anterior side of the front femora and the ventral tubercle at the base of femur 2. The male specimen was captured on the standing trunk of a dead pine. The females were all taken on the outside walls of my house. One of the females carried a *Sciaridae* sp. as prey. New to Norway.

*Tachydromia aemula* (Loew)
— Rogaland, RI, Forsand: Songesand, EIS 7, 1 ♀ 13 June 1981; 1 ♂ 26 June 1983, 1 ♀ 5 August 1982; Moen, EIS 7, 1 ♀ 27 June 1983; Hordaland, HOI, Odda: Odda, EIS 32, 2 ♀ ♀ 24 July 1983.

*Tachydromia umbrarum* Haliday
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♀ 18 October 1981; Melshei, EIS 7, 1 ♂ 14 June 1982; Stavanger: Madlaforen, EIS 7, 1 ♂, 1 ♀ 4 July 1981, K. Rognes; RI, Forsand: Songesand, EIS 7, 1 ♀ 13 June 1981; 1 ♂ 25 June 1983.

(!) *Chersodromia cursitans* (Zetterstedt)
— Rogaland, RY, Hå: Brusand, EIS 3, 2 ♀ ♀ 7 July 1982. These two specimens were caught running around on the semi-wet surface of a sandy beach. New to Norway.

*Chersodromia arenaria* (Haliday)
— Rogaland, RY, Rennesøy: Vikevåg, EIS 14, 1 ♀ 26 July 1981.
This specimen was caught under sea-weed on a rocky beach. Previously not recorded south of NT.

**Subfamily Hybotinae**

*Hybos grossipes* (L.)
— Telemark, TEI, Kviteseid: Skredi, EIS 17, 1 ♂ 25 June 1980, K. Rognes; Rogaland, RY, Sandnes: Sviland, EIS 7, 1 ♂ 9 July 1982; Kubbetjønn, EIS 7, 1 ♀ 22 June 1982; Melshei, 1 ♀ 6 July 1982; Rennesøy: Vikevåg, EIS 14, 1 ♀ 25 July 1982.

(!) *Hybos culiciformis* (Fabricius)
— Rogaland, RY, Rennesøy: Vikevåg, EIS 14,

1 ♀ 20 July 1981; 1 ♂ ♀ (in copula) 2 September 1981; 1 ♀ 11 July 1983; RI, Forsand: Songesand, EIS 7, 1 ♂ 21 August 1983.
New to Norway.

*Hybos femoratus* (Müller)
— Aust-Agder, AAY, Tromøy: Tromøy kirke, EIS 6, 1 ♂ 27 July 1982; Vest-Agder, VAY, Mandal: Skjernøy, EIS 2, 1 ♀ 17 July 1977, K. Rognes; Rogaland, RY, Rennesøy: Vikevåg, EIS 14, 1 ♀ 2 September 1981; Sel, EIS 14, 1 ♂ 10 July 1983; RI, Forsand: Songesand, 1 ♂ 10 July 1981.

**Subfamily Ocydromiinae**

(!) *Trichinomyia flavipes* (Meigen)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♀ 18 October 1981; RI, Forsand: Songesand, EIS 7, 1 ♀ 10 September 1982; 1 ♂ 8 September 1983; Helmikstøl, EIS 8, 1 ♀ 13 October 1983.
An autumnal species. Thus, the relatively sparse Scandinavian records may be due to low collecting activity at this time of year. The few captures I have made indicate a rather wide variety of biotopes for this species. I have caught it in a garden, on a wet, vertical rock-surface and on mushrooms (Amanita). New to Norway.

(!) *Trichina clavipes* Meigen
— Rogaland, RY, Sandnes: Sviland, EIS 7, 1 ♂ 9 July 1982; Rennesøy: Vikevåg, EIS 14, 1 ♀ 25 July 1982; RI, Forsand: Songesand, EIS 7, 2 ♀ ♀ 5 August 1982; 1 ♀ 17 July 1983; 1 ♂ 6 August 1983; Helmikstøl, EIS 8, 1 ♀ 5 July 1981.
New to Norway.

(!) *Trichina bilobata* Collin
— Aust-Agder, AAY, Tromøy: Tromøy kirke, EIS 6, 1 ♀ 27 July 1983; Rogaland, RI, Forsand: Røssdalen, EIS 7, 1 ♀ 26 June 1982.
New to Norway.

*Bicellaria pilosa* Lundbeck
— Rogaland, RI, Forsand: Songesandstølen, EIS 7, 1 ♂ 18 June 1982; 1 ♂, 2 ♀ ♀ 25 June 1983.

*Bicellaria austriaca* Tuomikoski
— Rogaland, RI, Forsand: Songesand, EIS 7, 1 ♂ 4 June 1983; 1 ♂ 10 June 1983; Songesandstølen, EIS 7, 1 ♂ 25 June 1983.

*Bicellaria subpilosa* Collin
— Rogaland, RY, Gjesdal: Madlandsheia, EIS 7, 1 ♂, 2 ♀ ♀ 7 July 1983, K. Rognes; RI, Forsand: Songesandstølen, EIS 7, 1 ♂ 25 June 1983.

*Bicellaria sulcata* (Zetterstedt)
— Aust-Agder, AAY, Tromøy: Gjerstad, EIS 6, 1 ♂ 22 May 1982; Rogaland, RY, Rennesøy: Førsvoll, EIS 14, 1 ♂ 1 ♀ 23 May 1981; Vikevåg, EIS 14, 1 ♂ 12 May 1982; Eltarvåg, EIS 14, 2 ♂ ♂ 15 May 1982; RI, Forsand: Songesand, EIS 7, 1 ♂ 16 May 1983; 1 ♂ 31 May 1983; 1 ♂ 2 June 1983; 1 ♂, 1 ♀ 4 June 1983; 1 ♂ 16 June 1983; Songesandstølen, EIS 7, 1 ♀ 25 June 1983; Kallestein, EIS 8, 1 ♂ 24 May 1983.

*Bicellaria intermedia* Lundbeck
— Rogaland, RI, Forsand: Songesand, EIS 7, 1 ♀ 17 July 1983; Songesandstølen, EIS 7, 1 ♀ 27 August 1983; Helmikstøl, EIS 8, 1 ♀ 5 September 1982.

*Bicellaria nigra* (Meigen)
— Aust-Agder, AAY, Tromøy: Gjerstad, EIS 6, 1 ♂ 22 May 1983; Vest-Agder, VAY, Mandal: Skrøvje, EIS 2, 1 ♀ 30 May 1982; Rogaland, RY, Sandnes: Gravaren, EIS 7, 1 ♂ 20 July 1981; Dale, EIS 7, 1 ♂ 9 June 1982; Høle, EIS 7, 1 ♂ 4 June 1982; 1 ♀ 22 July 1982; RI, Forsand: Songesand, EIS 7, 1 ♂, 2 ♀ ♀ 4 June 1983; 1 ♀ 20 June 1983; 1 ♀ 2 August 1983.
These are the southernmost finds from Norway. Previously not recorded south of NNØ. In order to secure a correct determination, the male genitalia of all Bicellaria species have been dissected and examined.

(!) *Oedalea flavipes* Zetterstedt
— Rogaland, RY, Sandnes: Melshei, EIS 7, 1 ♂ ♀ (in copula) 14 June 1982; Rennesøy, Vikevåg, EIS 14, 1 ♂ 10 June 1982.
These are the northernmost records frøm Scandinavia. New to Norway.

*Euthyneura myrtilli* Macquart
— Rogaland, RI, Forsand: Songesand, EIS 7, 1 ♂ 4 June 1983; Songesandstølen, EIS 7, 1 ♀ 25 June 1983.

(!) *Euthyneura gyllenhali* (Zetterstedt)
— Rogaland, RY, Sandnes: Sviland, EIS 7, 1 ♀ 9 July 1982; RI, Forsand: Røssdalen, EIS 7, 1 ♀ 27 June 1982.
New to Norway.

*Ocydromia glabricula* (Fallén)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♂ 20 May 1981; Gravaren, EIS 7, 1 ♀ 20 July 1981; Høle, EIS 7, 2 ♀ ♀ 22 July 1982; Rennesøy: Vikevåg, EIS 14, 1 ♀ 2 September 1981; RI, Forsand: Røssdalen, EIS 7, 1 ♀ 27 June 1982; Helmikstøl, EIS 8, 1 ♀ 5 August 1982.

*Ocydromia melanopleura* Loew
— Rogaland, RY, Rennesøy: Sel, EIS 14, 1 ♀ 10 July 1983.

*Leptopeza flavipes* (Meigen)
— Rogaland, RY, Stavanger, Godalen, EIS 7, 1 ♂ 3 June 1980, K. Rognes; Sandnes: Melshei, EIS 7, 1 ♂ 14 June 1982; Klepp: Øksnevad, EIS 7, 2 ♀ ♀ 15 June 1982.

*Leptopeza borealis* Zetterstedt
— Rogaland, RI, Forsand: Songesand, EIS 7, 1 ♂ 24 May 1983; 1 ♀ 1 June 1983; 1 ♀ 4 June 1983; 1 ♀ 7 June 1983; 1 ♂ 19 June 1983; 1 ♀ 20 June 1983.

## MICROPHORIDAE

*Microphorus holosericeus* (Meigen)
— Rogaland, RY, Rennesøy: Vikevåg, EIS 14, 1 ♀ 6 June 1981; 1 ♂ 10 June 1982.

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# Cluster analysis of milliped communities of different altitudes and distances from the coast in Setesdalen, Southern Norway

ÅGE SIMONSEN

Simonsen, Åge 1983. Cluster analysis of milliped communities of different altitudes and distances from the coast in Setesdalen, Southern Norway. *Fauna norv. Ser. B. 31,* 96—102.

Milliped communities along a gradient from the coast up to the alpine zone are compared. The communities are clustered together by help of similarity indices and the homogeneity/heterogeneity of the area investigated. Changes in the relative abundances of the species with distances from the coast are illustrated and the species turnover rate calculated.

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## INTRODUCTION

Different invertebrate groups have previously been investigated with respect to the altitudinal zonation of their species composition. Lindberg (1945) studied the Heteroptera-fauna in the Bulgarian mountains, Lindroth (1949) studied the Carabidae in Scandinavia and Hågvar (1976) studied altitudinal zonation in number of species of Heteroptera, Homoptera, Coleoptera and Araneida from Norway.

The general trend seems to be that the number of species decrease with increasing altitude, and that the magnitude of a species' latitudinal range is correlated with that of its altitudinal range.

No studies of altitudinal zonation milliped communities have previously been reported. My investigation is part of a teamwork. Lars Tveit has investigated spider communities from the same area. He found a great negative association between number of species and elevation (Lars Tveit, pers.comm.). Nevertheless, Zapfe (1961) found the highest number of species in the middle ranges of the gradient in his studies of Araneida in Chile.

## STUDY AREA

The Otra river runs from the mountain area (Hovden, 59°30'—7°30') almost straight south, and has its outlet near the city of Kristiansand (58°10'—5°9'). The river run though four main vegetation zones: the boreonemoral zone, the boreal zone and the alpine zone. The height above sea level increases from zero at the coast up to 900 meter at Hovden with the greatest slope between Bykle and Hovden. The distance from the coast to Hovden is about 220 km. The climate is moderately continental. Mean yearly precipitation decreases significantly between Evje and Valle (table 1).

### Sampling sites

During the sampling period 20 localities from six main areas along the river valley were investigated (table 2). The objective was to obtain samples from the different types of habitats in

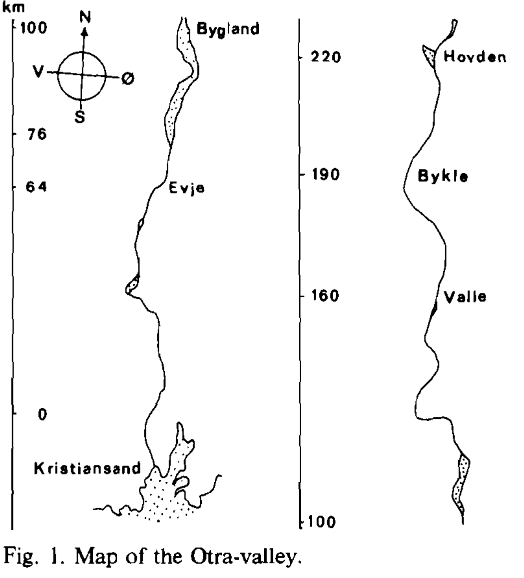


Fig. 1. Map of the Otra-valley.

Table 1. Climate

| Main areas | Mean annual temperature C | Mean temperature C July | Jan. | Annual temp. range |
|---|---|---|---|---|
| Kristiansand | 7,0 | 16,4 | −0,8 | 17,2 |
| Hægeland | 5,0 | 15,2 | −3,3 | 18,5 |
| Byglandsfjord | 5,3 | 15,2 | −3,0 | 18,2 |
| Austad | 5,5 | 15,3 | −3,6 | 18,9 |
| Brokke | | | | |
| Bykle | 1,0 | 12,9 | −3,9 | 16,8 |

| Main areas | Number of days from $t > 9°C$ to $t < 9°C$. | Mean yearly percipitation mm. |
|---|---|---|
| Kristiansand | 151 | 1412 |
| Hægeland | | |
| Byglandsfjord | 139 | 1349 |
| Austad | 132 | |
| Brokke | | 735 |
| Bykle | 115 | 687 |

each main area. Localizations (UTM-grid refs.) and description of the localities are given in table 2.

## SAMPLING

The field work was carried out during the period 28/4—28/9 1980. During this period all localities were visited three times (28—30/4, 25—28/6 and 25—28/9). Vegetational data were collected at midsummer. At each visit at each locality three bags with litter and upper soil (about 4,5 liter) were collected and extracted in modified Tullgren funnels. Species were sampled in ten pitfall-traps per locality. The traps were replaced twice.

## MATHEMATICAL ANALYSES OF THE RESULTS

As a starting point for a faunistic comparison both the coefficients of similarities of Sørensen and of Bray-Curtis were calculated (Southwood, 1978).

The similarity indices shown in Trellis diagrams (fig. 4 and 5) were clustered using the method of Mountford (1962). The clustering analysis are shown in the dendrograms (fig. 6 and 7). Beta-diversity were calculated using the method of Pielou (1969). Common 2 X 2 tables were used to find associations between species. The aim of this association analysis was to test the homogeneity of the area. An area is regarded as homogeneous if there are neither positive nor negative associations among the species. Changes in relative abundances of the species with altitude are shown in a Kite-diagram (fig. 2). Kendalls rank correlation coefficient were used to find the correlation between number of species and distance from coast/altitude.

## FAUNAL CHANGE WITH ALTITUDE

The species number decrease with increasing altitude or distance from the coast (table 4). Kendolls correlation coefficient shows a significant negative correlation (−0.87, p 0.001) between these values. The beta-diversity (based upon Sørensen's indices) are large (0.75). Thus the species turnover are rapid.

Three species, *Cylindroiulus londinensis* (Leach 1815), *Leptoiulus proximus* Nemec 1896, and *Polydesmus denticulatus* (C.L. Koch 1887) disappear between Kristiansand and Evje i.e. 10—70 km. from the coast.

*Cylindroiulus punctatus* (Leach 1814) occurs up to Bygland (100 km. from the coast).

*Glomeris marginata* (Villers 1879) and *Schizophyllum sabulosum* (L. 1758) occur up to Valle (140 km. from the coast).

At Bykle (190 km. from the coast, 560 m.o.s.) only two species, *Polyxenus lagurus* (L. 1758)

Table 2. Description of sampling localities.

| Main Areas. | Loc. nr. | Grid Ref. | Vegetation association | Slope | Description of locality |
|---|---|---|---|---|---|
| Kristiansand 50 m.a.s. | 1 | 32VMK379487 | Populus-Quercetum | 20 W | Oak dominated hardwood with sparce shrub layer. Stony. |
| 15 km.f.coast | 2 | 32VMK378489 | Grassland | — | Open moist grassland. |
| | 3 | 32VMK378489 | Populus-Quercetum | 20 W | Hardwood with oak aspen, sloe, sycamore. Sparce shrub layer. Rotten logs. |
| | 4 | 32VMK368529 | Populus-Quercetum | — | Open calcareous pine wood. |
| Evje 300 m.a.s. | 5 | 32VMK293947 | Vaccinio-Pinetum | 20 E | Mixed wood of aspen, pine, birch and sloe. |
| 64 km.f.coast | 6 | 32VMK283966 | Vaccinio-Pinetum | 30 E | Relatively dense pine wood. |
| | 7 | 32VMK342973 | Vaccinio-Pinetum | 5 SE | Mixed wood of pine and birch. |
| | 8 | 32VMK308987 | Vaccinio-Pinetum | — | Open pine wood with same birches. Rotten logs. |
| Bygland 320 m.a.s. | 9 | 32VML302195 | Eu-Piceetum | — | Dense spruce wood. |
| 100 km. from | 10 | 32VML304198 | Eu-Piceetum | 20 W | Open pine wood, with birch, sloe and spruce. Stony. |
| | 11 | 32VML294226 | Eu-Piceetum | 5 W | Open pine wood, without shrub layer. |
| | 12 | 32VML284247 | Eu-Piceetum | — | Pine and spruce wood Very stony. |
| Valle 400 m.a.s. | 13 | 32VML153521 | Eu-Piceetum | 20 E | Pine wood with sparse shrub layer. |
| 160 km. from | 14 | 32VML156529 | Melico-Piceetum | 30 E | Hardwood of sloe, birch and mountain ash, same pines and spruce. Very rich field layer with 22 herbs. |
| | 15 | 32VML151534 | Eu-Piceetum | — | Coniferous wood. |
| | 16 | 32VML149553 | Eu-Piceetum | — | Heterogenous site. Dry pine wood and more open moist areas with Sphagnum. |
| Bykle 600 m.a.s. | 17 | 32VML058775 | Eu-Piceetum | 5 N | Dense pine wood |
| 190 km. from coast | 18 | 32VML055783 | Eu-Piceetum | 20 SE | Mixed wood of birch and pines with many stones and sparse ground and field layer. |
| Hovden 900 m.a.s. 220 km. from | 19 | 32VMM094058 | Eu-Piceetum -Myrtilosum | — | Shrub layer of Betula spp. Ground layer Cladonia dominated. |
| coast. | 20 | 32VMM106086 | Eu-Piceetum -Myrtilosum | — | Like loc. 19 |

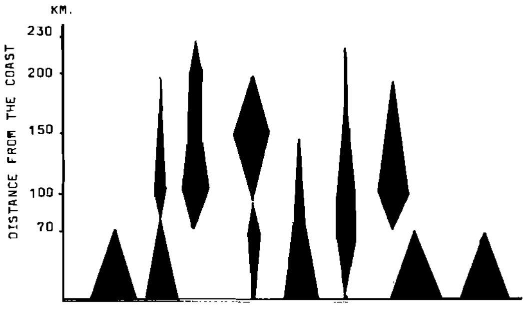


Fig. 2. Kite-diagram showing change in relative abundance with distance from the coast. The species are from left to right: *Cylindroiulus londinensis, Glomeris marginata, Polyxenus lagurus, Schizophyllum sabulosum, Cylindroiulus punctatus, Proteroiulus fuscus, Polydesmus complanatus, Polydesmus denticulatus* and *Leptoiulus proximus*.

Table 3. Species occurrences at the localities.

| loc. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Polyxenus lagurus* | | | | | | | | | | X | | | | X | | | X |
| *Glomeris marginata* | X | | X | X | | | | | | X | | | | X | | | |
| *Polydesmus complanatus* | | | | | | | | | | X | | X | | X | | X | |
| *P. denticulatus* | X | X | X | | | | | | | | | | | | | | |
| *Proteroiulus fuscus* | X | | | | X | X | X | X | X | X | X | X | X | | X | X | X |
| *Leptoiulus proximus* | X | | X | | | | | | | | | | | | | | |
| *Cylindroiulus londinensis* | | X | X | X | | | | | | | | | | | | | |
| *C. punctatus* | X | X | X | X | X | | X | | X | X | | | | | | | |
| *Schizophyllum sabulosum* | | X | X | | | | X | | | | | | | X | | | |

Table 4. Species occurrences in the main areas.

| | Kristiansand | Evje | Bygland | Valle | Bykle | Hovden |
|---|---|---|---|---|---|---|
| *Cylindroiulus londinensis* | X | | | | | |
| *Leptoiulus proximus* | X | | | | | |
| *Polydesmus denticulatus* | X | | | | | |
| *Cylindroiulus punctatus* | X | X | X | | | |
| *Glomeris marginata* | X | | X | X | | |
| *Schizophyllum sabulosum* | X | X | X | X | | |
| *Polydesmus complanatus* | | | X | X | | |
| *Polyxenus lagurus* | | | X | X | X | |
| *Proteroiulus fuscus* | X | X | X | X | X | |

and *Proteroiulus fuscus* Am Stein 1857 occur.

The Kite-diagram (fig. 2) show that *C. punctatus* and *G. marginata* were most abundant at the coast, while *Schizophyllum sabulosum* were most abundant uppermost in the Setesdal valley. *Polyxenus lagurus* and *Polydesmus complanatus* L. 1758 occur in the boreal zone only.

### Discussion

Hågvar (1976) found that the number of species decreased with the height above sealevel for different invertebrate taxa. The same seems to be true for millipeds. Correlations between altitudinal and latitudinal distributions usually are found. Hågvar (1976) found no such correlation in his investigations from Norway. Among the millipeds such a correlation was not found either, but the two species which occur uppermost in the valley also are the species which occur northernmost in Norway. As supposed by Hågvar, the Gulf Stream may well be responsible for this lack of correlation.

In Setesdalen lack of favourable habitats seems to be the main reason for the decrease in species number with altitude. Only with regard to one species, *Cylindroiulus punctatus*, does it seems probable that the decrease in precipitation may limit the distribution.

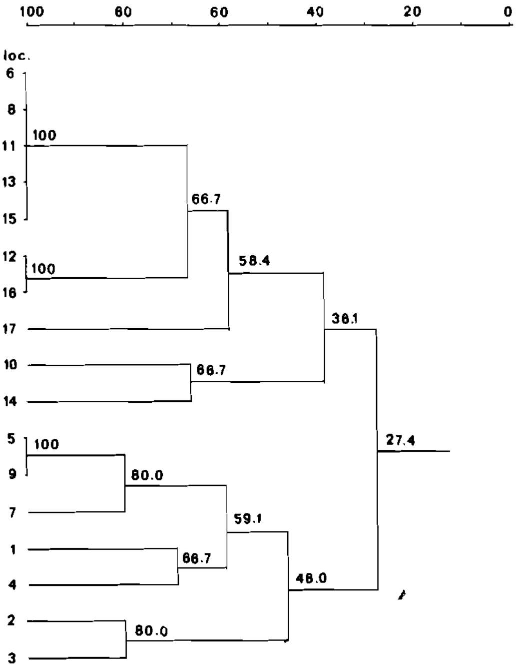


Fig. 3. Dendrogram showing similarities in species composition between the main areas based on the Sørensen Index. A = Kristiansand, B = Evje, C = Bygland, D = Valle, E = Bykle, F = Hovden.

## COMPARISON AMONG MAIN AREAS AND LOCALITIES

The clustering analysis based upon Sørensen's index show that Kristiansand and Evje, which are placed in the nemoral and boreonemoral zone respectively, group together. The same is true for the boreal zone areas. The alpine zone is characterized by lack of millipeds (fig. 3).

*Cylindroiulus punctatus* is the dominant species in the nemoral zone and together with *Proteroiulus fuscus* it also dominates in the boreonemoral zone. *Proteroiulus fuscus* is the dominant species in the boreal zone. *Polydesmus denticulatus, Cylindroiulus londinensis* and *Leptoiulus proximus* are discriminant species for the nemoral zone, and *Polydesmus complanatus* is discriminant species for the boreal zone together with *Polyxenus lagurus*.

The association coefficient of Cole shows significant negative associations between *Proteroiulus fuscus* and all other species except *Polydesmus complanatus* and *Polyxenus lagurus*. Thus, the area as a whole is heterogeneous and *Proteroiulus fuscus* may be regarded as critical species for the area. Further analysis shows that the *Vaccinio-Pinetum* localities together with all *Eu-Piceetum* localities make a homogeneous subgroup.

The localities are separated into two main parts (fig. 6 and 7). The general pattern seems to be marked differences between coniferous (group 1) and hardwoods (group 2). The mean number of species were 3.9 in group 1 localities and 1.4 in group 2 localities.

Exept for loc. 9 and 10 all group 1 localities are placed in the nemoral and boreonemoral zone, while all group 2 localities except loc. 7 and 8 are from the boreal zone.

### Discussion

The classification into vegetation associations are based mainly upon the field and ground layer vegetations. *Populus-Quercetum* sites are relatively hot, dry and mineral rich habitat types. *Vaccinio-Pinetum* sites are dry and mineral poor. Associations belonging to the *Piceion* community are mineral poor but more humid than

| | 3 | 2 | 4 | 1 | 7 | 9 | 5 | 10 | 14 | 17 | 16 | 12 | 15 | 13 | 11 | 8 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | | | | | | | | | |
| 2 | 60 | | | | | | | | | | | | | | | | |
| 4 | 54.5 | 50 | | | | | | | | | | | | | | | |
| 1 | 72.7 | 44.4 | 66.7 | | | | | | | | | | | | | | |
| 7 | 44.4 | 57.1 | 57.1 | 50 | | | | | | | | | | | | | |
| 9 | 25 | 33.3 | 66.7 | 57.1 | 60 | | | | | | | | | | | | |
| 5 | 25 | 33.3 | 66.7 | 57.1 | 60 | 100 | | | | | | | | | | | |
| 10 | 36.4 | 22.2 | 66.7 | 60 | 50 | 57.1 | 57.1 | | | | | | | | | | |
| 14 | 40 | 25 | 25 | 22.2 | 57.1 | 0 | 0 | 66.7 | | | | | | | | | |
| 17 | 0 | 0 | 33.3 | 26.6 | 40 | 50 | 50 | 57.1 | 33.3 | | | | | | | | |
| 16 | 0 | 0 | 33.3 | 28.6 | 40 | 50 | 50 | 57.1 | 33.3 | 50 | | | | | | | |
| 12 | 0 | 0 | 33.3 | 26.6 | 40 | 50 | 50 | 57.1 | 33.3 | 50 | 100 | | | | | | |
| 15 | 0 | 0 | 40 | 33.3 | 50 | 66.7 | 66.7 | 33.3 | 0 | 66.7 | 66.7 | 66.7 | | | | | |
| 13 | 0 | 0 | 40 | 33.3 | 50 | 66.7 | 66.7 | 33.3 | 0 | 66.7 | 66.7 | 68.7 | 100 | | | | |
| 11 | 0 | 0 | 40 | 33.3 | 50 | 66.7 | 66.7 | 33.3 | 0 | 66.7 | 66.7 | 66.7 | 100 | 100 | | | |
| 8 | 0 | 0 | 40 | 33.3 | 50 | 66.7 | 66.7 | 33.3 | 0 | 66.7 | 66.7 | 66.7 | 100 | 100 | 100 | | |
| 6 | 0 | 0 | 40 | 33.3 | 50 | 66.7 | 66.7 | 33.3 | 0 | 66.7 | 66.7 | 66.7 | 100 | 100 | 100 | 100 | |

100—81 percent similarity

80—61 percent similarity

60—41 percent similarity

40—21 percent similarity

Fig. 4. Trellis diagram showing similarities between the localities based on the Bray-Curtis Index.

| | 1 | 3 | 10 | 5 | 7 | 9 | 2 | 4 | 14 | 13 | 15 | 17 | 16 | 11 | 12 | 6 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | |
| 3 | 62 | | | | | | | | | | | | | | | | |
| 10 | 43.5 | 52.7 | | | | | | | | | | | | | | | |
| 5 | 30.2 | 41 9 | 47.3 | | | | | | | | | | | | | | |
| 7 | 29.8 | 40 | 47.6 | 76.5 | | | | | | | | | | | | | |
| 9 | 19.8 | 28.1 | 32 | 76.2 | 55.2 | | | | | | | | | | | | |
| 2 | 30 | 50 | 25.7 | 23.9 | 37.5 | 23.9 | | | | | | | | | | | |
| 4 | 7.3 | 34 | 11.8 | 35.3 | 20 | 35.3 | 23.1 | | | | | | | | | | |
| 14 | 6.4 | 8.6 | 15.9 | 0 | 23.8 | 0 | 5.0 | 0 | | | | | | | | | |
| 13 | 0 | 0 | 4.7 | 0 | 9.1 | 0 | 0 | 0 | 0 | | | | | | | | |
| 15 | 0 | 0 | 4.7 | 0 | 9.1 | 0 | 0 | 0 | 0 | 100 | | | | | | | |
| 17 | 0 | 0 | 9.1 | 0 | 8.7 | 0 | 0 | 0 | 8.7 | 66.7 | 66.7 | | | | | | |
| 16 | 0 | 0 | 31.4 | 0 | 13.3 | 0 | 0 | 0 | 9.1 | 20 | 20 | 18.2 | | | | | |
| 11 | 0 | 0 | 4.1 | 0 | 14.3 | 0 | 0 | 0 | 0 | 25 | 25 | 22.2 | 25 | | | | |
| 12 | 0 | 0 | 7.0 | 0 | 13.8 | 0 | 0 | 0 | 6.9 | 22.2 | 22.2 | 20 | 35.3 | 93.3 | | | |
| 6 | 0 | 0 | 4.2 | 0 | 14.8 | 0 | 0 | 0 | 0 | 28.6 | 28.6 | 25 | 20 | 92.3 | 65.7 | | |
| 8 | 0 | 0 | 3.5 | 0 | 11.1 | 0 | 0 | 0 | 0 | 12.5 | 12.5 | 11.6 | 6.3 | 63.6 | 60.9 | 57.1 | |

100—81 percent similarity

80—61 percent similarity

60—41 percent similarity

Fig. 5. Trellis diagram showing similarities between the localities based on the Sørensen Index.

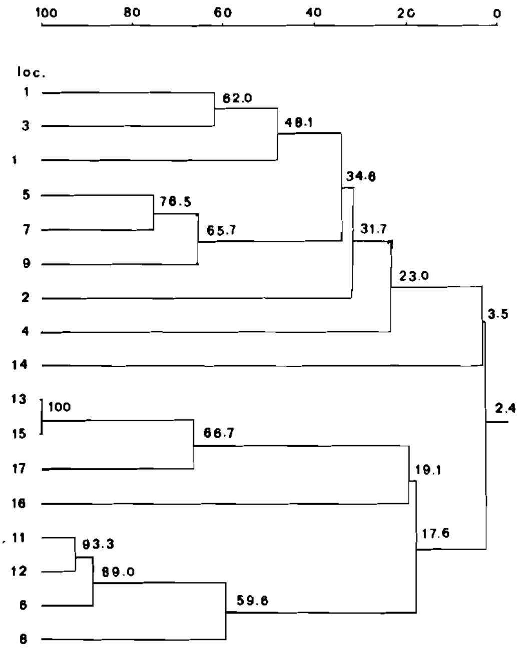


Fig. 6. Dendrogram showing similarities between the localities based on the Bray-Curtis Index.

*Vaccinio-Pinetum* associations. *Melico-Piceetum* associations occur on relatively dry but mineral rich soil and some of the differences in the milliped fauna may be due to this. In the oakwoods *(Populus-Quercetum)* xerophilic and termophilic species with an eastern distributional range (like *Glomeris marginata, Leptoiulus proximus* and *Cylindroiulus londinensis*) are found together with more eurytopic hardwood-species like *Polydesmus denticulatus* and *Schizophyllum sabulosum. Glomeris marginata* and *Schizophyllum sabulosum* also occur in the *Melico-Piceetum* site.

Nevertheless, the differences cannot be explained from edaphic and climatic reasons alone. Obviously, much of the differences are due to presence or absence of different trees at the localities. Leaf litter are the most important food for millipeds, and English investigations have shown that different millipeds prefer different leaves (Fairhurst & Armitage, 1979). This is shown most clearly in the boreonemoral zone (Evje) where the coniferous leaves dominated and the deciduous leaves dominated *Vaccinio-Pinetum* sites group differently.

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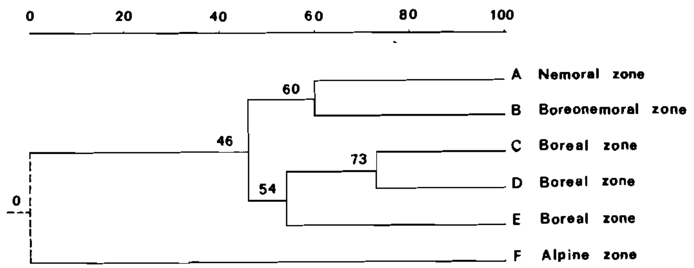


Fig. 7. Dendrogram showing similarities between the localities based on the Sørensen Index.

# Short communications

## *BIDESSUS GROSSEPUNCTATUS* VORBRINGER (COL., DYTISCIDAE) NEW TO NORWAY

GÖSTA HAGENLUND

*Bidessus grossepunctatus* Vorbringer is reported for the first time in Norway in the lake Østre Kalvvann (Gjerstad, Aust-Agder county). The lake was a typical brown water lake in the lowland coniferous region of Southern Norway.

*B. grossepunctatus* seemed to be closely associated to the *Spagnum*-mire surrounding the lake. The habitat could explain the fairly sudden discovery all over Scandinavia in a few years.

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### INTRODUCTION

During investigations of the dytiscid fauna in the province of Aust-Agder, South Norway, I found several species in *Sphagnum*-mires surrounding the lakes. The methods used are given in Huggert & Nilsson (1978). Several species of Dytiscidae select *Sphagnum* as optimal habitat for reproduction (e.g. Galewski 1971). The discovery of *Bidessus grossepunctatus* Vorbringer in Sweden (Huggert & Nilsson 1978), Finland (Rutanen 1979) and Denmark (Holmen 1979) made me reinvestigate some of my specimens.

### RESULTS

In lake Østre Kalvvann (AAy, Gjerstad, UTM 32V NL 0826, Tab. 1) one species turned out to be *Bidessus grossepunctatus* Vorbringer (det. M. Holmen, Copenhagen). The species was common in the *Sphagnum* during June and July 1979 and July 1980.

This was the only species found in the *Sphagnum* at this lake. In the lake were *Hyphydrus ovatus* (L.), *Hygrotus inaequalis* (Fabricius), *H. versicolor* (Schaller), *H. quinquelineatus* (Zetterstedt), *Coelambus novemlineatus* (Stephens), *Hydroporus obscurus* Sturm, *Graptodytes pictus* (Fabricius), *Agabus sturmi* (Gyllenhal), *Ilybius aenescens* Thomson, *I. fuliginosus* (Fabricius), *Rhantus suturellus* (Harris) and *Graphoderus zonatus* (Hoppe).

Table 1. Some characteristics of lake Østre Kalvvann (Gjerstad, Aust-Agder county). Water samples are taken at the shore. Mean values of samples taken during the ice free season are given.

| pH | $K_{18}$ µS/cm | pT | Water fluctuations cm | $Ca^{++}$ mg |
|---|---|---|---|---|
| 5,5 | 21 | 20 | 10 | 2,4 |

### DISCUSSION

The species has recently been recorded from Fennoscandia (Huggert & Nilsson 1978, Holmen 1979, Rutanen 1979), though it was distributed all over Europe south of Scandinavia (Ienistea 1978). The gaps in the distribution in Sweden and Norway was large (Huggert & Nilsson 1978, Nilsson 1983), but would confirm a dispersal from Denmark along the coast of Norway and Sweden. A few specimens were dissected. Although several were young (cf. Jackson 1973, no flight muscles (cf. Jackson 1952, 1956a, 1956b) were discovered. Passive migration (e.g. Freeman 1945, Baranowski & Gärdenfors 1974) of this small (length about 1,9 mm) species would be assumed, but other reasons of the distribution seemed more plausible (cf. Huggert & Nilsson 1978); It bears a close resemblance to the more common *B. unistriatus* Schrank (Schaeflein 1962, 1971), it was «flightless» (cf. Jackson 1952), and few investigations seemed to have been done in this habitat type. Thus the unusual habitat could well explain the apparent recent dispersal in Fennoscandia.

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## NYE FUNN AV AKVATISKE COLEOPTERA I SØR-NORGE

GÖSTA HAGENLUND

Thirty species of water beetles, mostly Dytiscidae, were reported from new districts in Norway. The habitats were described. The most important environmental parameters were the area of the water, the water current and the vegetation- and bottom structure. Habitat descriptions were given only for reproducing animals, as many species were capable of flight and could therefore be temporary inhabitants of the locality. Reproduction way assumed to have occurred when larvae were found or when phenological observations suggested it.

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### INNLEDNING

Siden Lindroth (1960) er «Catalogus Coleopterorum Fennoscandiae et Daniae» delvis ajourført flere ganger (e.g. Østby 1969, Strand 1970a, 1970b, 1977, Fjellberg 1972, Zachariassen 1977, Dolmen & Hansen 1982, Hansen & Olsvik 1982). De fleste av disse syntes å mangle gode habitat-beskrivelser, ofte ble bare biotopen beskrevet. Med habitat menes her det sted arten valgte å reprodusere. Siden mange vannbillelarver fremdeles er ubeskrevet (e.g. Nilsson 1982a) er habitat-beskrivelser også gitt der imago ble funnet å ha helt myk kutikula eller fenologiske observasjoner antyder reproduksjon.

Regionangivelsene følger Strand (1943). 1-km UTM ruter er angitt hvis mulig (Østby 1971). Nomenklaturen følger Silferberg (1979) med ett unntak. *Agabus solieri* Aubé er regnet som underart til *A. bipustulatus* (L.) (Nilsson 1982b).

### FAM. DYSTISCIDAE

*Laccophilus stroehmi* Thomsen. AAy, Gjerstad, Heilandsvann UTM ML 9032. Vegetasjonsfattig innsjø med sand- og siltbunn. Starr *(Carex* sp.) og botnegress *(Lobelia dortmanna)* dominerte. Vanlig.

*Bidessus grossepunctatus* Vorbringer. AAy, Gjerstad, Østre Kalvvann UTM NL 0826. Første funn i Norge (se Hagenlund 1984).

*Coelambus novemlineatus* (Stephens). HEn, Stor-Elvdal, dam nær Atnsjøen UTM NP 6260 og Myrtjørni UTM NP 5863. On, Vinstra, tjern nord for Musvoldkampen UTM NP 5563. Andre funn: Dominerende Dytiscidae i oligotrofe innsjøer i AAy og VAy (Hagenlund upubl.).

*Hygrotus quinquelineatus* (Zetterstedt). Ø, Halden, Nordre Boksjø UTM PL 5349 og Søre Boksjø UTM PL 5447.

Større oligotrofe innsjøer, N. boksjø med mer dy enn S. Boksjø. Habitat omtrent som for *L. stroehmi.* Vanlig. AAy, Gjerstad, Store Finntjern UTM ML 9332 (leg. F. Kroglund) og Østre Kalvvann UTM NL 0826. Begge var innsjøer typiske for barskogsbeltet med lite utviklet littoralsone og dy-bunn.

*Hydroporus lapponum* (Gyllenhal). HEn, Stor-Elvdal, dam nær Atnsjøen UTM NP 6260 og Kamptjørni UTM NP 6064.

*H. angustatus* Sturm. AAy, Risør, Kvennevann UTM NL 1003. Eutrof, humøs innsjø med velutviklet helofytt-belte på dy-bunn. Mye detritus. Sporadisk.

*H. palustris* (L.). SFy, Fjaler, semitemporær pytt på beitemark UTM LP 0409. Noe flaskctarr *(C. rostrata)* på jordbunn.

*H. melanocephalus* (Marsham). SFy, Fjaler, habitat se *H. palustris.*

*H. obscurus* Sturm. SFy, Fjaler, habitat se *H. palustris* og *Sphagnum*-dam nær Krokavatn UTM LP 0714.

*H. planus* (Fabricius). SFy, Fjaler, brakkvannspytt på fjellbunn i geolittoralsonen på Øyna i Dalsfjorden UTM LP 0309.

*H. obsoletus* Aubé. SFy, Fjaler, semitemporær pytt i Helleberget UTM LP 0711. Små groper på bart fjell, noe detritus på bunnen.

*H. longicornis* Sharp. HEn, Stor-Elvdal, Atnsjøen UTM NP 6062.

*Stictotarsus duodecimpustulatus* (Fabricius). SFy, Fjaler, habitat se *H. palustris* og Gaular, Haukedalsvann (leg. G. Raddum).

*Potamonectes g. griseostriatus* (Degeer). SFy, Gulen Furesdalsvann ved Yndstad UTM LN 0263 (leg. G. Raddum). VAy, vanlig i flere innsjøer (leg. G. Halvorsen).

*P. g. multilineatus* (Falkenström). HEn, Stor-Elvdal, Kamptjørni UTM NP 6064 og Folldal, Reivtjørni UTM NP 5467.

*P. depressus* (Fabricius). HOi, Granvin, Granvinvann UTM LN 71 (leg. G. Raddum).

*Oreodytes sanmarki* Sahlberg *(rivalis* Gyllenhal). HEn, Folldal, vanlig i Atnaelva.

*Platambus maculatus* (L.). SFy, Fjaler, habitat se *H. palustris.*

*Agabus nigroaeneus* Erichson. HEn, Stor-Elvdal, dammer nær Atnsjøen UTM NP 6260.

*A. bipustulatus* ssp. *solieri* Aubé. HEn, Stor-Elvdal, sammen med *H. lapponum.*

*A. sturmi* (Gyllenhal). SFy, Fjaler, Nedre Fossedalsvann UTM LP 0713. Innsjø med isoetider på sandbunn. Gulen, Furesdalselv ved Yndstad UTM LN 0263(leg. G. Raddum).

*A. labiatus* (Brahm). HEn, Stor-Elvdal, sammen med *A. nigroaeneus*.
*Illybius fenestratus* (Fabricius). AAy, Gjerstad, Heilandsvann, se *L. stroehmi* og Lundvann UTM ML 9731, samme habitat-type som i Heilandsvann.
*I. fuliginosus* (Fabricius). SFy, Fjaler, habitat se *H. palustris*.
*I. guttiger* (Gyllenhal). AAy, Gjerstad, Lille Finntjern UTM ML 9332. Tjern omgitt av *Sphagnum* spp.
*I. aenescens* Thomson. SFy, Fjaler, habitat se *H. palustris* og *Sphagnum*-dam nær Krokavatn sammen med *H. obscurus*.
*Rhantus suturellus* (Harris). HEn, Stor-Elvdal, dam nær Atnsjøen UTM NP 6260 og Myrtjørni UTM NP 5863 og Folldal, Reivtjørni UTM NP 5467.
*Colymbetes dolabratus* (Paykull). HEn, Folldal, Reivtjørni UTM NP 5467.
*Graphoderes zonatus* (Hoppe). AAy, Gjerstad, Østre Kalvvann, Reproduserte neppe.
*Dytiscus lapponicus* (Gyllenhal). AAy, Gjerstad, i 1979 til 1981 vanlig i flere typer større vann med dy-bunn. Flere individer ble dissekert og hadde antagelig flyvemuskler (cfr. Jackson 1956, Eriksson 1972).

## FAM. GYRINIDAE

*Gyrinus suffriani* Scriba. AAy, Risør, første funn i Norge (Hagenlund *in prep.*).

## FAM. ELMIDAE

*Elmis aenea* (Müller) *(maugei* Bedel). HOi, Granvin, tilløpselv til Granvinvann UTM LN 71 og SFy, Gaular, Gaula over Osfossen UTM LP 2308 (leg. G. Raddum).

## DISKUSJON

Habitat-klassifiseringen fulgte et system som vil bli publisert senere. Avgjørende var størrelsen på habitatet — også om det tørket ut eller ikke, vannstrøm gjennom habitatet — i et funksjonelt lentisk habitat kunne det være noe strøm der det samtidig var mye vegetasjon, vegetasjonsstruktur og bunnforhold. Kjemiske parametre var i de fleste tilfelle av liten betydning i lite forutensede lokaliteter. Fiskepredasjon kunne eliminere enkelte arter som helst reproduserte i vegetasjonsfattige større vannsamlinger, men hadde neppe noe å si for habitat-valget. De fleste nye registreringer ble gjort i større innsjøer, antagelig fordi dette var en relativt lite undersøkt habitat-type. I Norge fantes det flest Dytiscidae arter i mindre vannsamlinger, ulike arter i vegetasjonsrike- og fattige habitater, og i habitater med *Sphagnum* sp. (Hagenlund *in prep.*).


## *TAKK*

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## OBSERVATIONS ON DISPERSAL IN SPRUCE BARK BEETLES *(IPS TYPOGRAPHUS* L.)

NILS CHR. STENSETH

Observations are reported on longrange movement in the spruce bark beetle *(Ips typographus)* attracted to a pheromone trap placed within the downtown region of Oslo. The caught beetles must have dispersed several kilometers.

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During the early summer of 1981 I made some observations on longrange movement in the spruce bark beetle *(Ips typographus* L.). On my balcony on the top floor (5th) in Valdresgt. 9, Oslo (just south of Torshov) I placed a pheromone trap of the kind used during the bark beetle campaign in Norway of the late 1970-ies and the early 1980-ies (Bakke 1981, Bakke and Strand 1981). The pheromone trap was loaded with a 1 meter Ipslur$^R$ dispenser containing the attractance pheromones of *Ips typographus* (Bakke et al. 1977). This pheromone trap was located at least 3 km from the nearest stand of Norway spruce *(Picea abies)* and probably — at that time — more than 5 km away from an *Ips typographus* attack on spruce.

During three days in the middle of May I caught 19 beetles in this pheromone trap (Table 1); altogether, I caught 29 individuals over a period of 45 days.

To my knowledge, these observations are among the most unambiguous ones demonstrating that *Ips typographus* regularly disperse for — and become attracted to a pheromone source (such as a pheromone trap or a newly attacked tree) from — rather long distances. Earlier, Nilssen (1978) caught (with an unknown catching effort) 2 individuals of *Ips typographus* some 35 km away from the nearest Norway spruce stand. Botterweg (1982) found in a mark release experiment, inside a forested area, that *Ips typographus* dispersed for at least 750 m. In another mark release experiment, outside a forested area, he found that *Ips typographus* dispersed for at least 8 km; also he caught, however, only 2 beetles at the longest distances.

My observations therefore strengthen the impression that *Ips typographus* has a highly developed ability of colonizing habitable patches.

Table 1. Number of spruce bark beetles *(Ips typographus* L.) caught in a pheromone trap in Oslo downtown during May—June, 1981.

| Date | Number caught | Rain (mm) (hr. 0700-1900) | Wind speed (m/sec.) (hr. 1300) | Temperature (°C) (hr. 1300) |
|---|---|---|---|---|
| May | | | | |
| 13 | 3 | 0.0 | 6.7 | 18.1 |
| 14 | 7 | 0.0 | 3.6 | 18.5 |
| 15 | 9 | 0.0 | 1.5 | 19.8 |
| 16 | 0 | 0.0 | 4.6 | 18.8 |
| 17 | 0 | 0.2 | 3.6 | 18.7 |
| 18 | 1 | 5.1 | 4.1 | 20.5 |
| 19 | 1 | 0.0 | 2.1 | 16.2 |
| 20 | 1 | 0.0 | 3.1 | 16.4 |
| 21 | 1 | 0.0 | 3.1 | 19.1 |
| 22 | 0 | 0.0 | 3.1 | 22.4 |
| 23 | 0 | 0.0 | 2.1 | 16.4 |
| 24 | 2 | 8.4 | 2.1 | 19.4 |
| 25 | 0 | 7.0 | 4.6 | 11.2 |
| 26 | 0 | 0.2 | 2.6 | 14.3 |
| 27 | 1 | 1.0 | 3.6 | 17.8 |
| 28 | 0 | 3.6 | 1.0 | 10.1 |
| 29 | 0 | 0.0 | 2.6 | 15.5 |
| 30 | 0 | 0.0 | 1.0 | 17.0 |
| 31 | 0 | 0.0 | 1.0 | 16.3 |
| June | | | | |
| 1—24 | 0 | — | — | — |
| 25 | 1 | 0.0 | 3.1 | 21.2 |
| 26 | 2 | 0.0 | 5.7 | 14.6 |


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## *ULOMA CULINARIS* (L.) (COL., TENEBRIONIDAE) NEW TO NORWAY

PREBEN S. OTTESEN & LARS OVE HANSEN

*Uloma culinaris* (L.) is reported new to Norway from eastern Buskerud (Bø:Røyken, EIS:28). A single specimen was found on 3 Aug. 1982, probably in a light-trap.

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On 3 Aug. 1982 a single specimen of the tenebrionid beetle *Uloma culinaris* (L.) was found by the second author close to the Drammen fjord in Bø:Røyken, Hyggen, Kinnartangen (EIS:28). The exact circumstances as to how it was caught cannot be recalled, but like the majority of beetles in the collection of L. O. Hansen, it was probably taken in a light-trap as a «by-product» of Lepidoptera catches. According to Silfverberg (1979) the species has not previously been recorded from Norway.

The natural habitat of *U. culinaris* in Scandinavia seems to be deciduous wood infected with fungi, where it may be found under bark or in the tunnels of large woodboring beetle larvae, f.ex. *Dorcus* and *Sinodendron*. However, like its congener *U. rufa* (Piller & Mitterpacher *(perroudi* Mulsant & Guillebeau), which in Norway is known from the southern coastal districts and north to Oslo (Lindroth 1960), it has become increasingly common in old piles of sawdust, and in Sweden the latter habitat is today reported to be the most important one. In favourable localities *U. culinaris* may be found in large numbers (Palm 1958, Landin 1970, Hansen 1973).

Outside Scandinavia *U. culinaris* is most frequently encountered under the bark of coniferous trees (Hansen 1973). To our knowledge the extent to which the beetle may utilize sawdust from such trees in Scandinavia has not been investigated.

The distribution of *U. culinaris* in Sweden (Lindroth 1960) indicates that its range in Norway is probably restricted to southern and south-eastern coastal districts.

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We wish to thank Stig Lundberg, Luleå for verifying the identification of the species.

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## *HABROPHLEBIA* (EPH., LEPTOPHLEBIIDAE) NEW TO NORWAY

HELGE HURU

In July 1979, a single nymph of *Habrophlebia* sp. was found in the small stream Cævresjåkka (UTM MT-292471) in the Lakselv river system, Finnmark, Northern Norway. The specimen was collected using the kicking method and a net with mesh size of 500 µm. *Habrophlebia* is a genus new to Norway. The specimen found was small. but most probable belongs to *Habrophlebia lauta* Eaton 1884.

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Lakselv is one of the largest rivers in Finnmark with a drainage area of 1500 km$^2$. The upper and middle part of the Lakselv river system consists of many small streams, one of which is the stream Cævresjåkka. This stream flows slowly (10—20 cm/sec) at the sampling station, 100 m a.s.l. The vegetation in this area consists of birch *(Betula pubescens),* pine *(Pinus sylvestris)* and some bogs (Mølster 1981). Cævresjåkka had the highest conductivity registered in Lakselv, 60—130 µS/cm during summer. pH was 7.0 and the water-temperature reached 16°C or more during summer.

The Lakselv river system has a rich mayfly fauna with 21 species. Ephemeroptera dominated the bottom fauna in the small streams comprising 40% (by numbers) of the bottom fauna. At the sampling station, the following Ephemeroptera species were found (listed according to numerical dominance): *Centroptilum luteolum* Müller, 1776), *Paraleptophle-*

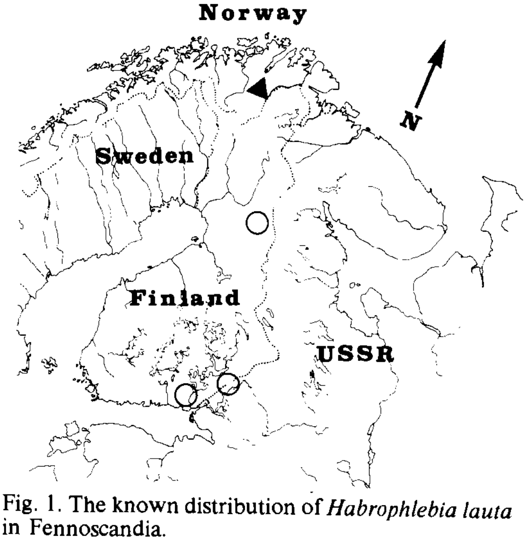


Fig. 1. The known distribution of *Habrophlebia lauta* in Fennoscandia.
▲ Present record in Lakselv, Finnmark.
○ Previous records in Finland.

*bia* sp. *Heptagenia joernensis* (Bengtsson, 1909), *Ephemera danica* Müller, 1764, *Baetis vernus* group (see Müller-Liebenau, 1969), *Caenis horaria* (L., 1758), *Baetis muticus* (L., 1758), *Ephemerella ignita* (Poda, 1761), *Heptagenia fuscogrisea* Retzius, 1783), *Ameletus inopinatus* Eaton, 1887, *Ephemerella aurivillii* (Bengtson, 1908), *Habrophlebia* sp. *(lauta?), Siphlonurus aestivalis* (Eaton, 1903).

Only two Plecoptera species were found at this station, while 18 species were recorded in the whole riversystem. Alhough not recorded from Norway (Dahlby 1973), *Habrophlebia lauta* has been found in Finland and the Soviet Union, but not in Sweden (Saaeisto and Savolainen 1980). *H. lauta* has been found north to Kuusamo in Finland (Fig. 1), but is rare also in Finland (Savolainen and Saaristo 1981, Tiensuu 1939). *H. lauta* occurs in most parts of central and northern Europe, including the Tundra region (Putz 1978).

In Fennoscandia *H. lauta* is characterized by having a southern distribution (Savolainen and Saaristo 1981). The distribution map (Fig. 1) shows a distinct eastern distribution in northern Fennoscandia. In central Europe, *H. lauta* has a fast growth from April—May to emergence in June—August (Illies 1980, Pleskot 1958). This lifecycle fits well for survival in the small streams in the Lakselv area with relatively high water temperatures during the summer compared with most of the other streams in Finnmark.

The rich Ephemeroptera fauna in Lakselv can be explained by the rich and varied water habitats, i.e. lotic and lentic waters of different size and productivity, the warm and dry summers giving the area a southern character and that there are potential immigration routes from Finland for flying insects.

ACKNOWLEDGEMENTS

John Brittain has checked the identification. Arne Nilssen and Rob Barrett (Tromsø Museum) have given valuable criticism to the manuscript.

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## THE DISTRIBUTION OF *TIPULA (ARCTOTIPULA) SALICETORUM* SIEBKE, 1870 (DIPT., TIPULIDAE) IN NORWAY

TROND HOFSVANG

The distribution of *Tipula (Arctotipula) salicetorum,* Siebke, 1870 is given. Tipulidae larvae collected from different water systems in Sør-Trøndelag, Nord-Trøndelag and Nordland show that the species is common in this part of Norway.

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The subgenus *Arctotipula* Alexander, 1933 of the genus *Tipula* L., 1758 is Holarctic in distribution (Savtshenko 1961). Only one species of this subgenus, *Tipula (Arctotipula) salicetorum* Siebke, 1870 has been recorded from Fennoscandia (Tjeder 1955, 1978,Hackman 1980).

Only a few specimens of *T. (A.) salicetorum* imagines have been collected in Norway, mainly from northern part of Oppland and from Troms and Finnmark (Lackschewitz 1933, 1935, Hofsvang 1979). The flight period is July.

The larvae of *T. (A.) salicetorum* is fully aquatic and was described from the lake Øvre Heimdalsvatn, northern part of Oppland (Hofsvang 1979). During the years 1974—1979 several water systems in Sør-Trøndelag, Nord-Trøndelag and Nordland were investigated by Royal Norwegian Society of Sciences and Letters, the Museum, in Trondheim. The Tipulidae larvae collected show that *T. (A.) salicetorum* is very common in this area. The species was recorded from 45 localities. The distribution of *T. (A.) salicetorum* in Norway is given in Fig. 1. The most southern locality is Valdresflya. During a four years study of Tipulidae at Finse, 110 km towards southwest and at approximately the same level above sea, no larvae or imagines of *T. (A.) salicetorum* were found (Hofsvang 1974). The distribution in Sweden is: northwestern Dalerne — Torne Lappmark (Tjeder 1978).

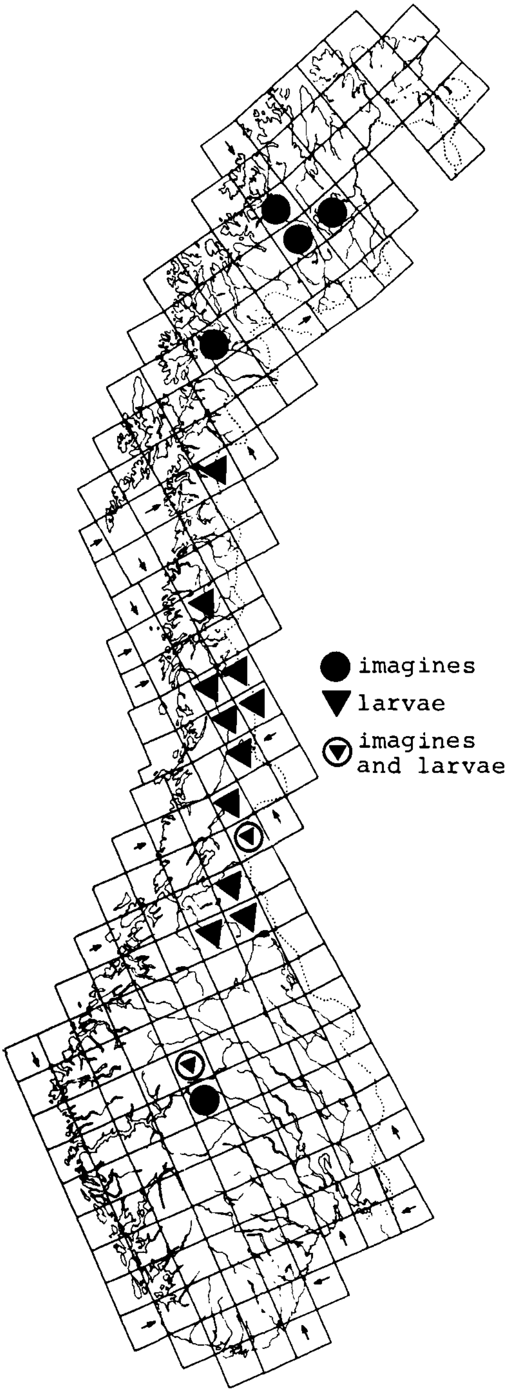


Fig. 1. The distribution of *Tipula (Arctotipula) salicetorum* Siebke, 1870 in Norway based on the EID grid system (50 x 50 km squares).

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## *DIXELLA FILICORNIS* (DIPT., DIXIDAE) FOUND IN NORWAY

ØYVIND HÅLAND

The meniscus midge *Dixella filicornis* (Edwards) has been found in the county of Vestfold, Norway. This is the first record of the species in Fennoscandia.

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During a preliminary investigation of the Norwegian Dixidae, I found 4 larvae (third instar) of the species *Dixilla filicornis* (Edwards, 1926). The finding place was the inlet stream to the pond Eikenesvannet in Hof, Vestfold county (UTM: NL 622944) on 19. Aug. 1983.

The stream is flowing rather slowly, on a substratum of clay and stones, with a rich vegetation along the banks. It is mildly polluted, pH between 5 and 6 on the day of collection (measured with indicator paper). The larvae of *D. filicornis* were found together with many larvae of *Dixella aestivalis* (Meigen, 1818) and *Dixa nebulosa* (Meigen, 1830). The water-scorpion, *Nepa cinerea* L., which is not very common in Norway, was found at the same place.

The larva of *D. filicornis* is very easily recognised by the dense hair-covering on the whole body. In this way it occupies a position somewhat between the other larvae of the genus *Dixella* with very short and fewer hairs and the larvae of the genus *Dixa* with hair-crowns on the dorsal side of the five to six body-segments before the last one. Size and shape of the interspiracular disc are also useful in identification (Disney 1975).

*D. filicornis* has hitherto been found as far north as Scotland (Disney 1975) and the Leningrad area of Russia (Peus 1936). Wagner (1978) gives its distribution as to the regions 4,5,6,8,9,13,15,16 and 18 of «Limnofauna Europaea». This means that it has not been found in North Germany or Fennoscandia before. The finding is interesting, but not very surprising when we consider the small amount of investigation that has been done on the Dixidae of Scandinavia.

The larvae are kept in the author's collection.

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## *ILIONE LINEATA* (FALLÉN, 1820) (DIPT., SCIOMYZIDAE) NEW TO NORWAY

RUDOLF ROZKOŠNÝ & LITA GREVE

*Ilione (= Knutsonia) lineata* (Fallén, 1820) is reported new to Norway. Four specimens were netted at Moutmarka, Tjøme county EIS 19, province of Vestfold, near a small lake, on 8. July 1983. This is the first record of the species in Norway.

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*Ilione* replaced the generic name *Knutsonia* that has been commonly used in the European special literature since 1964. *Knutsonia* was proposed by Verbeke (1964) for a clearly defined species-group, but already Collin (1966) considered this name to be only an incorrect replacement name for *Ilione* Haliday in Curtis. Recently Thompson and Mathis (1980) proved that *Ilione* is really a valid generic name and correctly designated its type-species.

The genus is restricted to the Palaearctic region where 8 species have been reliably found, but only 3 species have been recorded in Fennoscandia.

*Ilione albiseta* (Scopoli) as the most common species of the genus has been the only species recorded from Norway, found scattered in southern Norway in Provinces Ø, AK, RY and RI (see Økland 1981). It is reliably known to occur from the Orkneys, Scotland and central Scandinavia (including Sweden, Finland and Denmark) to Spain, Italy and Greece; in the USSR from the Leningrad area to Crimea and the Transcaucasus, eastwards across Soviet Central Asia and Siberia to Yakutia.

*Ilione lineata* (Fallén 1820) is widely distributed in Sweden (from Sk. to LY.Lpm.) rather common in Finland up to LkE and widespread in Denmark (Lesø, Jutland, Als, Zealand). Generally it represents a Euroasian element ranging from Scotland, Lapland and the vicinity of Arkhangelsk in the USSR to France and Jugoslavia, eastwards through Kazakhstan to the Lake Baikal and Komi.

Among material of Diptera collected on 8. July 1983 by Arild Fjeldså at Moutmarka UTM: 32 VNL 802483 in Tjøme county, Vestfold province, four specimens of *Ilione lineata* were found. Moutmarka is situated at the southernmost tip of Tjøme at Helgerød. The locality was at a small lake edged with *Scirpus tabernaemontani* and *S. uniglumis* both typical for brackish water near the sea shore. In the small lake *Potamogeton* sp. was present. Two other Sciomyzidae were collected at the same locality viz. *Tetanocera elata* Fabricius common all over Norway, and the rare *Sepedon sphegea* (Fabricius) known only from the provinces AK, HES and VE.

The third species *Ilione rossica* (Mayer) is known only from a few localities in Fennoscandia, all situated in its eastern part in the Karelian ASSR. Generally it shows a Eurasian type of distribution ranging from the White Sea coast in the Karelian ASSR and the vicinity of Arkhangelsk across the Baltic republics of the USSR to the northern Kazakhstan and eastwards through Sibiria to Yakutia. The Norwegian specimens are deposited in the Zoological Museum, University of Bergen.

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We would like to express our gratitude to Arild Fjeldså who collected the material.

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## *NEOPACHYGASTER MEROMAELAENA* (DUFOUR, 1841) AND *PRAOMYIA LEACHII* (CURTIS, 1824) (DIPT., STRATIOMYIDAE) NEW TO NORWAY

ARILD FJELDSÅ, LITA GREVE AND ALF-JACOB NILSEN

*Neopachygaster meromaelaena* (Dufour, 1841) and *Praomyia leachii* (Curtis, 1824) are reported new to the Norwegian fauna, with short descriptions of the localities. This is also the first time the subfamily *Pachygasterinae* is recorded from Norway.

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The subfamily Pachygasterinae is represented in Scandinavia and Finland by six species representing six different genera, and in Europe there are only seven species in all. The Fennoscandinavian and later the European Stratiomyidae have recently been surveyed by Rozkošný (1973, 1982, 1983).

The adult flies are small and dark, measuring from approximately 2 mm to 4.5 mm. The biology of the Pachygasterinae is not throughly known, some larvae, however, live in rotten wood and are partly saprophagous. The flies are probably easily overlooked on account of their small size.

*Neopachygaster meromaelaena* (Dufour, 1841)

Locality: VAy (Province of Vest-Agder), Flekkefjord county, Store Eikås near Gausdal (UTM: 32 VLK 703724) 21. June—6. July 1982 1 ♂ leg. A.-J. Nilsen.

The specimen was sorted out from insect material collected in a Malaise-trap, and this trapping period was the first of seven, until the trap was taken down on 10. Sept. 1982.

The locality was a wet meadow with decidious trees, among them alder. Conifers like *Picea excelsa* and *Pinus silvestris* were also present. Small ponds and some boggy area were present. The only other species of Stratiomyidae found at this locality was *Beris clavipes* (L. 1767), a common species in southern Norway.

*Praomyia leachii* (Curtis, 1824).

Locality: VE (Province of Vestfold), Tjøme county, Kolabekkilen (UTM: 32 VNL 805508) 19. Juli 1983 1 ♀ leg. A. Fjeldså.

The specimen was netted among reeds *(Phragmites communis* (Trin.) forming a large halophilous stand. The larvae of this species are reported to be saprophagous and has been reported from different plants varying from *Boletus* sp. to rotten wood. The locality is thus probably not typical for this species. Another Stratiomyidae, *Nemotelus uliginosus* (L. 1767), was also found at this locality.

Both species are mapped in Rozkošný (1983). *N. meromaelaena* has in Fennoscandia been found in some localities in south-east Sweden, at the Åland isles and the southernmost part of Finland. The species is not reported from Denmark, but found at several localities in England. *P. leachii* is apparently rare in northern Europe according to Dr. Rozkošný (pers. comm.). The species is found at Gotland and Øland, and near Leningrad in the USSR. There are several localities in southern England and in Ireland. Based on the hitherto known distribution both species make interesting additions to the Norwegian fauna. A better sampling throughout southern Scandinavia might yield more specimens in the future.

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## *XYLOPHAGUS COMPEDITUS* WIEDEMANN, 1851 IN NORWAY (DIPT., XYLOPHAGIDAE)

LITA GREVE, ANDERS OLSEN AND JOHN O. SOLEM

In the Dovrefjell mountains near Kongsvoll, Oppdal county, province of S. Trøndelag, 15 males and 2 females of *Xylophagus compeditus* Wiedemann, 1851 were caught in Malaise traps in 1980, 1981 and 1983. Most specimens occurred in a trap in the subalpine birch belt, one specimen was caught in the low alpine zone. The flight period extends from middle June throughout July. The distribution of *X. compeditus* in Norway is given based on material in Norwegian museums and private collections.

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### INTRODUCTION

The family Xylophagidae was mentioned from Norway for the first time by Zetterstedt (1838). Siebke

(1877) reported *Xylophagus ater* Meigen, 1804 and *Xylophagus cinctus* (De Geer, 1776) from Norway, and since his time the Norwegian material of Xylophagidae has not been revised. Szilady (1932) included four species of *Xylophagus* in his material from Central Europe, all of which later have been recorded from Finland and Scandinavia, according to more recent articles. Lyneborg (1960) in his revision of Danish Xylophagidae, reported *X. compeditus* Wiedemann, 1851 from Denmark and concluded that the closely related *X. ater* not has been found there. Andersson (1962) reported *X. compeditus* and *X. junki* Szilady, 1932 from Sweden. His examination of *Xylophagus* specimens labelled as *X. ater* at the Entomological Museum in Lund, showed all of them to be *X. compeditus*. Andersson, however, assumed that it is possible that *X. ater* might occur in Sweden.

Hackman (1980) included four species in his list of Finnish Diptera viz. *X. ater, X. cinctus, X. compeditus* and *X. junki*.

These are the same species reported by Szilady (1932) from middle Europe. Kloet & Hincks (1976) listed three of these species from England, but *X. compeditus* has not been found there.

*Xylophagus* species are large and slender flies with dark colours and quite easy to identify. Lyneborg (1960) reported the imagines to be rare in Denmark. This is also true in Norway, where one of the authors (L. Greve) has revised the material in the Norwegian Natural History museums. Zoological Museum, University of Oslo (ZMO) has the main bulk of older Norwegian Xylophagidae material, but they possess less than 15 specimens.

Malaise traps in 1980 and 1981 were operated in the lower part of the western slope of the mountain S. Knutshø, east of Kongsvoll, Oppdal county, Sør-Trøndelag province. All sites in EIS 79. The traps were operated from May until late October in all years.

In 1980 and 1981 15 males and one female of *X. compeditus* were collected in two Malaise traps used at Blesbekken, 1000 m a.s.l. in the subalpine birch forest, UTM 32VNQ3207. One female of *X. compeditus* was captured in a Malaise trap in the alpine zone at 1220 m a.s.l. at the stream Kallvella, UTM 32VNQ266117, in 1983. The traps were positioned across the stream with the prime objective to collect aquatic insects.

## RESULTS AND DISCUSSION

Table 1 shows the number collected at the various traps. The larvae of *Xylophagus* spp. are according to Lyneborg (1960) carnivorous and live under bark of rotten wood. The Malaise traps at Blesbekken were positioned in fairly dense birch forest, while the traps at Raubekken (400—500 m away), in more open areas, did not catch any specimen. The flight period of *X. compeditus* in the Dovre mountains covered the last half of June and all July in 1981.

## THE DISTRIBUTION OF *X. COMPEDITUS* IN NORWAY

*X. compeditus* is here recorded from Norway for the first time. To give an outline of the distribution in Norway, material from Norwegian museums and

Table 1. Number of individuals of *Xylophagus compeditus* collected in Malaise traps in the area of Kongsvoll, Dovre mountains, S. Trøndelag province. M = male, F = female.

Table 1

| | | June | July | | | | August |
|---|---|---|---|---|---|---|---|
| | | 30 | 7 | 14 | 21 | 28 | 4 |
| Blesbekken 1981 | | | | | | | |
| 2 | M | — | — | — | — | 2 | — |
| | F | — | — | — | — | — | — |
| 3 | M | 1 | — | 5 | 4 | 1 | — |
| | F | — | — | 1 | — | — | — |
| Kallvella 1983 | | | | | | | |
| | M | — | — | — | — | — | — |
| | F | — | 1 | — | — | — | — |

| | | June | | | July | | | |
|---|---|---|---|---|---|---|---|---|
| | | 12 | 19 | 26 | 10 | 17 | 24 | 31 |
| Blesbekken 1980 | M | 1 | — | — | — | 1 | — | — |
| | F | — | — | — | — | — | — | — |

private collections are listed below, revised by one of the authors (L. Greve). The material of *X. ater* in ZMO was examined. It contained both *X. cinctus* and *X. compeditus*, while. *X. ater* not seems to be present in Norwegian collections.

AK Oslo 0201 EIS 28, Tøyen 20 June 1847, 1 ♀ (ZMO 6619), AK Oslo 0201 EIS 28, Linderud 13 June 1846, 1 ♀ (ZMO 6620), VAY Kristiansand 1404 EIS 2, Hånes, 1 specimen, K. Berggren priv. coll. RY Sandnes 1602 EIS 7, Dale 8 June 1980, 1 ♂ (ZMB), HOY Bergen 1801 EIS 30, (Fana) Paradis 2 June 1968, 1 ♂ 1 ♀ (ZMB); HOY Bergen 1801 EIS 39, (Åsane) Vollane 28 May—1 June 1978, 1 ♀ (ZMB); HOY Os 1843 EIS 31, Hegglandsdalen June 1941, 1 ♂ (ZMB); HOI Kvinnherad 1924 EIS 31, Rosendal, Skeie 6 June 1943, 1 ♂ (ZMB); SFY Høyanger 2016 EIS 49, Vadheim, Kyrkjebø 18 June 1942, 1 ♀ (ZMB); STI Oppdal 2534 EIS 79, Kongsvoll, Blesbekken, Kaldvella, males + females (DKNVS M).

The male from Hegglandsdalen was determined to *X. compeditus* by T. Soot-Ryen, but this material has never been published. The list follows Økland (1981).

The female collected at Vollane was found in a colliding-trap operated throughout the summer 1978. No more specimens were caught. Where dates have been noted, all specimens of *X. compeditus* from the low-lands have been caught in the period late May up to June 20, viz. earlier than the material from the Kongsvoll area. Insect populations occurring in the mountains have often a postponed flight period compared to populations of the same species occurring in the low-lands, see e.g. Brinck (1949), who gives data on Plecoptera.


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## *MEGASELIA RUFIPES* MEIGEN (DIPT., PHORIDAE) AS A PREPUPAE PARASITE OF THE WINTER MOTH AND ALLIED SPECIES IN DECIDUOUS FORESTS IN WESTERN NORWAY

KÅRE HESJEDAL

Records of a previously unknown parasite, *Megaselia rufipes* Meigen, of the Geometridae larvae of *Opheroptera brumata* L., *Agriopis aurantiaria* Hubner and *Erannis defoliaria* Clerck is reportet. Laboratory experiments shows that the second generation of these scuttle fly was able to parasitize Noctuidae larvae. In this investigation *M. rufipes* showed to be a facultative parasite.

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## INTRODUCTION

The geometrids *Opheroptera brumata* L. *O. fagata* Scharfenberg, *Agriopis aurantiaria* Hubner, and *Erannis defoliaria* Clerck, have regular outbreak periods at 12—15 years interval in the deciduous forests and orchards in the Hardanger area, Western Norway.

Among these the winter moth, *O. brumata*, is the most abundant species often causing complete defoliation of the host trees (Edland 1981).

The ichneumonid, *Agrypon flaveolatum* Gravenhorst, and the tachinids, *Lypha dubia* Fallen and *Cyzensis albicans* Fallen, were during the outbreak period of 1960's found to parasitize *O. brumata* while very few of the *A. aurantiaria* and *E. defoliaria* larvae were parasitized. The main cause of the break down of the pest populations of Geometridae in the deciduous forests in Norway is not yet known. So far the break down cannot be explained by the effect of any of the above mentioned Ichneumonidae and Tachinidae species (Edland 1981).

This investigation reports the finding of a Phoridae species, *Megaselia rufipes* Meigen, previously unknown as a parasite of this important group of Geometridae pests (Clausen 1978, Edland 1981, Varley & al. 1973).

## MATERIAL AND METHODS

Last instar larvae of *O. brumata, A. aurantiaria,* and *E. defoliaria,* were collected on 12 June, 1981, from heavily infested food plants by use of a Stainer's bating funnel. The collection were done at two localities, Kinsarvik and Lofthus, in Ullensvang, Hordaland county, Western Norway. About 500 larvae of *O. brumata* were collected from each of five food plant species, *Salix caprea* L. *Sorbus aucuparia* L., *Corylus avellana* L., *Betula pubescens* Ehrhenberg, and *Prunus padus* L.

At each locality the collection was done from food plants grown in a habitat of about 500 m$^2$. The larvae were carried to the laboratory and the winter moth larvae were placed separately in plastic containers of 25 x 35 x 10 cm, according to food plants and locality. Each container were filled with a 5 cm layer of moistened peat moss and closed at the top with a white colored, perforated plastic sheet. About 250 larvae of *O. brumata* were placed in each container and fed with detached leaves from their respective food plants. Compared with *O. brumata*, the larvae of *E. defoliaria* and *A. aurantiaria* were far less abundant at each food plant and were placed together in two containers. The containers were placed at outdoor temperature in an insectary. Within five days all the larvae had burrowed in the peat moss for pupation.

The peat moss in each container was examined in primo July. Both the living Geometridae pupae and most of the parasite pupae were removed from the containers. The parasite pupae were placed in plastic Petri dishes lined at bottom with moistened filter paper, at outdoor temperature in the insectary. The Phoridae flies emerged in the first week of August. The adults were sexed and placed in small nylon cages of 2 liter volume at the laboratory together with some noctuid larvae collected from a strawberry field.

## RESULTS AND DISCUSSION

The mortality of the three geometrid species caused by the phorid species, *M. rufipes*, varied between 90—100 per cent. All the winter moth larvae collected on *P. padus* were parasitized while the parasitation of the larvae collected from the other food plants varied between 90—93 per cent. The result was the same for both localities, Kinsarvik and Lofthus. A very high number of *M. rufipes* pupae were found in each container.

The adults emergd in primo August, and the second generation females laid their eggs on or near by the noctuidae larvae in the cages at the laboratory. Each noctuid larvae were later killed by 5—10 phorid larvae.

The first generation of *M. rufipes* probably laid their eggs on or near the last instar larvae of the geometrids while they still were on the food plants. After the geometrid larvae were burrid in the peat moss, they were killed and totaly consumed by the phorid larvae. At the inspection of the peat moss medium in primo July, only a few remains of geometrid larvae were found still inhabitated with some phorid larvae.

*M. rufipes* is a polyphagous saprophage (Disney 1979). The insect is also commonly claimed to be a facultative parasite but no critical evidence has so far been published (Disney pers. comm.). According to Lundbeck (1922), the species, *Aphiochaeta (=Megaselia) rufipes*, is known as a general feeder in larval stage, and it is bred from wasps nests, bee-hives and from sick and dead larvae of *Stilpnotia salicis* as well as from decaying seed of lupines and from fungi. Disney (1979) published an extending list of the registered polyphagous/saprophagous activities of *M. rufipes*. According to this, the species once was reared from *O. brumata* caterpillars as well as from a noctuid caterpillar of *Naenia typica* L. However, in neither cases were there evidence to claim that the species was a facultative parasite. In accordance it has been reported found in bee-hives in Poland and caracterized as a non-parasitic species (Banaszak 1980). This experiment shows, however, that *M. rufipes* also seems to be a facultative parasite as it is able to parasitize apparently healthy noctuid and geometrid larvae. With this experimental design, however, I cannot say whether the parasitism was of a primary or a secondary nature or both.

The last outbreak period of the winter moth and allied species culminated in 1981 (Edland 1983). The finding of *M. rufipes* as a parasitizing agent should be of great interest in the future work finding an explanation of the sudden break down each 12.—15. years of the pest populations of this important group of geometrid species in the deciduous forests and orchards of Western Norway.


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# Bokanmeldelser

WELLS, S.M., PYLE, R.M. & COLLINS, N.M. 1983. *THE IUCN INVERTEBRATE RED DATA BOOK.* 632 pp. IUCN, GLAND, SWITZERLAND. (Bestilles fra IUCN Conservation Monitoring Centre, 219 c Huntingdon Road, Cambridge CB3 ODL, U.K. Pris ca. kr. 150).

Det zoologiske vernearbeidet verden over har hittil vært konsentrert om virveldyrene. I løpet av de siste 10 årene har imidlertid flere og flere land innlemmet også de virvelløse dyregruppene i vernearbeidet. Dette er i tråd med naturvernets overordnete mål, som er å bevare biologisk mangfold for ettertiden. Langt over 95% av alle verdens dyrearter er virvelløse dyr, og insektene alene utgjør vel 70% av artsrikdommen. I mange land er insektfaunaen blitt sterkt forarmert. Bl.a. er mange sommerfuglarter truet i Europa. I en særstilling står de tropiske regnskogene, der bare få prosent av insektartene er kjent. Kanskje finnes det så mye som 30 millioner insektarter, og ikke bare 1 million, som hittil er beskrevet. I tropene utryddes insektarter hurtigere enn zoologene klarer å beskrive dem, og vi vil aldri få vite hvor mange dyrearter vår klode egentlig inneholdt.

På denne bakgrunn hilser vi med glede at vern av virvelløse dyr nå er blitt prioritert som tema av den internasjonale naturvernorganisasjonen IUCN. Mens det tidligere er blitt lansert «Red Data Books» for truete arter innen ulike virveldyrgrupper, foreligger nå den første «Red Data Book» for virvelløse dyr. Med denne boka har denne delen av vernearbeidet fått internasjonal anerkjennelse.

Foran i boka redegjøres det for en rekke vernemotiver for disse dyregruppene. Deretter omtales et stort antall truete arter (eller dyresamfunn, som f.eks. korallrev) fra hele verden. For hver art finnes opplysninger om utseende (noen er avbildet), utbredelse, populasjonsstørrelse, habitat, økologi, vitenskapelige og potensiell verdi, trusler mot artens eksisten, eventuelle iverksatte vernetiltak og forslag til videre vernetiltak.

Det sies klart fra i boka at antallet truete arter og dyresamfunn blant virvelløse dyr sikkert er langt større enn det som er kommet med i denne boka. Den foreliggende oversikten er bare begynnelsen på et arbeidsfelt som blir stadig mere viktig og presserende, og som alle lands naturvernmyndigheter må ta alvorlig.

Selv om boka i stor grad bygger på status over enkeltarter, presiseres det at artene bare kan bevares ved at deres leveområder blir fredet. Også dette vernearbeidet går altså på etablering av reservater.

Mange fascinerende livsformer fremtrer i denne boka. Her kan vi f.eks. lese om verdens største sommerfugl, verdens største muslinger, merkelige, endemiske arter på isolerte øyer, osv.

Fra Norge er følgende arter tatt med: Elveperlemuslingen *Margaritifera margaritifera,* den spiselige sneglen *Helix pomatia,* legeiglen *Hirudo medicinalis,* ferskvannskreps *Astacus astacus* og apollosommerfuglen *Parnassius apollo.* Jeg vet ikke om dette egentlig er de beste eksempler fra Norge. Bl.a. har vi en rekke truete billearter som er knyttet til gamle og hule eiketrær, truete sommerfuglarter med spesielle vertsplanter (f.eks. på øyene i Oslofjorden), samt vann-nymfer og øyenstikkerarter som er truet fordi innslaget av små, næringsrike dammer blir sjeldnere.

Det er viktig nok at fagzoologene på denne måten blir minnet om å bidra med opplysninger om truete arter og samfunn, og å komme med forslag til verneområder. Men minst like viktig er det at boka kan være med å gi dette vernearbeidet politisk gjennomslag. Dette er virkelig en utfordring for Miljøverndepartementet og andre organer som har ansvar for at mangfoldet i norsk fauna blir bevart for ettertiden.

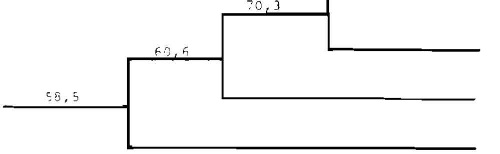
*Sigmund Hågvar*

# Erratum

*The spider fauna of Kristiansand and Setesdalen S Norway. Fauna norv. Ser. B. 31,* 23—45.

LARS TVEIT & ERLING HAUGE.

Figure 7 has been printed with the correct figure text, but the figure itself is erronously a duplicate of Figure 6. The correct Figure 7, with the correct numbers, is:



# Announcements

*ICSEB — III*
*THIRD INTERNATIONAL CONGRESS OF SYSTEMATIC AND EVOLUTIONARY BIOLOGY; 1985*

The Congress will be held on 4—10 July 1985 at the University of Sussex, near Brighton, England.

The foillowing Congress Symposia are being organised:

Symbiosis in Evolution
Conservation of Tropical Ecosystems
Biogeographic Evolution of the Malay Archipelago
Adaptational Aspects of Physiological Processes
Co-evolution in Ecosystems and the Red Queen Hypothesis
Angiosperm Origins and the Biological Consequences
The Measurement of Rates of Evolution
Molecular Biology and Evolutionary Theory
Co-Evolution and Systematics
Molecules vs. Morphology in Phylogency: Conflict or Compromise?
Random and Directed Events in Evolution
Biochemical Innovation in Microbial Communities

There will also be Special Interest Symposia on other topics, as well as sessions for contributed papers, films and poster papers.

For further information write to:

*Professor Barry Cox*
*ICSEB Congress Office*
*130 Queen's Road,*
*Brighton,*
*Sussex ON1 3WE, UK.*

*ENTOMOLOGISKE MEDDELELSER udsender i begyndelsen af 1984 et særnummer: ENTOMOLOGISK LITTERATUR (Ent. Meddr. 51, 1—2).*

21 danske entomologer har — hver med deres specialviden — bidraget til udarbejdelsen af en kommenteret litteraturfortegnelse over samtlige de i Danmark forekommende insektordener og andre landinvertebrater, der ofte antages for at være insekter.

ENTOMOLOGISK LITTERATUR henvender sig til såvel fag- som amatørentomologer.

Ved hjælp af kommentarerne kan man hurtig danne sig et indtryk af publikationernes anvendelighed. I indledningen til hver større systematisk enhed er der i korte træk gjort rede for, hvor godt gruppen er kendt.

Litteraturfortegnelsen er for de større systematiske enheders vedkommende (ordener, overfamilier) opdelt i henholdsvis 1) biologisk litteratur, 2) litteratur om indsamling, præparation, opbevaring m.m. og 3) bestemmelseslitteratur, artslister m.m.

Ved litteraturudvælgelsen er der især lagt vægt på dansksprogede publikationer, men det har ikke kunnet undgås — specielt med hensyn til de mindre godt kendte grupper — at afhandlinger på fremmede sprog er anført.

Bestemmelseslitteratur dækker i landt de fleste tilfælde store dele af faunaen i nordvesteuropa incl. fennoskandien.

Alle titler og tidsskrifsbetegnelser er skrevet helt ud, således at intet bibliotek skulle have vanskeligheder ved at fremskaffe den ønskede publikation.

ENTOMOLOGISK LITTERATUR kan erhverves ved henvendelse til ENTOMOLOGISK FORENING, c/o Zoologisk Museum, Universitetsparken 15, 2100 København Ø, Danmark.

ENTOMOLOGISK LITTERATUR koster 25 kr. excl. porto.

*Ole Lomholdt*

## GUIDE TO AUTHORS.

FAUNA NORVEGICA Ser. B. publishes papers in English, occasionally in Norwegian and German with an extensive English abstract. When preparing manuscripts for submission, authors should consult current copies of Fauna norvegica and follow its style as closely as possible. Manuscripts not conferring to the guide to authors will be returned for revision.

**Manuscripts** should be submitted to one of the members of the editorial committee or directly to the Editor-in-Chief. Send two copies. They must be typewritten, double spaced throughout, on one side of the paper, and with wide margins, 5-6 cm on the left. Separate sheets should be used for the following: 1) Title page, with author's name. 2) An abstract, with the name and full postal address of the author underneath. 3) Tables with their headings. 4) Legends to figures.

Dates should be referred to as 10-20 Aug. 1970.

Only Latin names should be underlined. Other underlinings should be left to the editor. Approximate position of figures and tables in the text should be indicated in the margin. All acknowledgements should be given under a single heading at the end of the text, but before the references.

**Figures and Tables.** Send two copies. All illustrations should be identified lightly with the author's name and the figure number. The figures and tables should be constructed in proportion to either the entire width of the typed area (140 mm) or to the column width (67 mm).

**Nomenclature.** The first time a binomen is used in the text the name of its author should be included. Author names should be written in full except L. for Linneaus. Dates can be included when considered necessary, i.e. *Ryacophila nubila* (Zetterstedt, 1840).

**References.** *In the text:* Black (1979), Black & Blue (1973:100), or «as noted by Green (1978) and Black (1979)». Multiple references should be given in chronological order, i.e. (Black & Blue, 1973, Green 1976, 1979, Black 1978).

List of references are to be unnumbered and in international alphabetical order (i.e. Å = AA, Æ and Ä = Ae, Ø and Ö = Oe). Titles of journals should be abbreviated according to the World List of Scientific Periodicals. Do not refer to papers «in prep.» among the references.

Examples:

*Journal:*

Løken,A. 1962. Social wasps in Norway (Hymenoptera, Vespidae). *Norsk ent. Tidsskr. 12,* 191 - 218.

*Book:*

Mayr, E. 1913. *Animal species and evolution.* Harvard University Press. Cambridge, Mass.

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

*Chapter:*

Whitman,L. 1951. The arthropod vectors of yellow fever.- In: Strode,K. (ed.), *Yellow Fever.* Mc. Graw - Hill, New York & London, pp 229 - 298.

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Referansemessig skal en *aldri ta hensyn til nummeret i øvre høyre hjørne på omslaget* (inne i firkanten). **Det en skal ta hensyn til er de oppgitte data for respektive serier.** De første heftene i hver serie vil i årgang 1981 hete henholdsvis Ser. B Vol. 28 No. 1. Ser. C Cinclus Vol. 4 No. 1, Ser. A Vol. 2 No. 1. Det er **disse data som gir den korrekte litteraturreferansen,** og det er disse forkortelsene som står oppført i *Abstract* til hver artikkel og på særtrykkene.

# Content

Fauna norvegica ser. B. Vol. 31, No. 2.



## Short communications



## Bokanmeldelse



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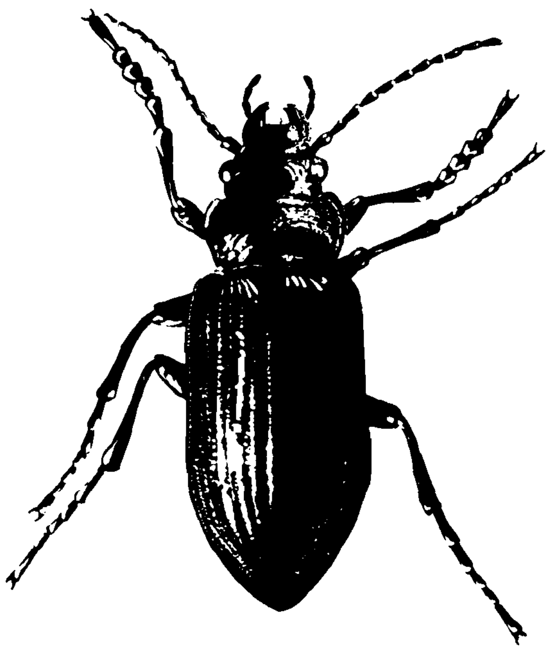

Kristiansen & Wøien, Oslo

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