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Entomologisk Forening og Norsk Ornologisk Forening.
Collembola from Jan Mayen, Bjørnøya and Hopen with additions to the species list from Spitsbergen

ARNE FJELLBERG


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 transferred to Folsomia and made senior synonym of Folsomia alpha Grow & Christiansen, 1976. Onychiurus ursi n.sp. is described (Holarctic) and Onychiurus greentalicus (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.

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-
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| 40 | 28 | 24 | 12 |
sent material and may represent more northern forms (*Friesa quinquespinosata, 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 *anophthalmata* (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* (Nicolaet) — 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 undescribed species which fit more or less to the broad concepts 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).


**Additional material studied:** Many specimens from: Norway (Svalbard: Pr. Heinrich Isl. at Ny Ålesund, Adventdalen. Svalbard: Sølvågåtind. Lom: Staurustl, 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 m₁ 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. Subcoxae 1-1-1. Head with 2 + 2 ventral.

**Body hairs** short, fine. Macrochaetae hardly differentiated. Abd. 5 with m₁ subequal to or shorter than p₁, apex curved, pointed. Setae p₁ and a₁ thicker than m₁, blunt-tipped, erect (Fig. 2). Unpaired median seta sometimes present in front of m₁-m₁. **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 flab. 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 m₁ setae on Abd. 5 is somewhat variable within samples, usually it is 1/2 to 2/3 of p₁, sometimes they are subequal, but m₁ is never distinctly longer than p₁ 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 referred 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. 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 m₁ longer than p₁ and a₁ (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 m₁ longer than p₁ and a₁. 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 m₁ 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 aberrant 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, Kongseya, Hopen, Bjørnøya), Greenland: (L. Pendulum Isl., Murray Isl., Kapp Stewart, coll. Swedish Greenland Exp. 1899), Canada (Ellesmere Isl.: Alexandra Fjord, Sverdrup Pass, Lake Hazen, Grice Fjord. Cornwallis Isl.: Resolute Bay), Alaska (many samples, mainly from North Slope), NE Siberia (Chaus Bay). Often abundant in damp arctic/alpine tundra. Probably a parthenogenetic species.

e) Tullbergia tenuisensillata (Rusek), T. jiri (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 a₂ 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 a₂ and long p₂ setae (Fig. 5). The total distribution covers the northern Holarc-
tic. 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 undescribed — may be found in the arctic islands. Chaetotaxy is very similar to arctica, but Abd. 4 usually has an unpaired dorso-median seta. Pseudocellar formula is characteristic: 11/12/12/11. Material of this species is seen from Norway (Raudhellerskorane 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 Holartic species also seen in materials from Canada (Ellesmere Isl.) and NE Siberia (Chaun Bay).

i). Folsomia gracilis (Stach, 1962) n.comb. Isotoma 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, presence 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, being 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 refer 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 occur 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

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

**Folsomia gracilis** (Stach, 1962). Published from Hornsund by Stach (1962) as *Isotoma 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).


**A. neglecta** (Bagnall, 1939). European species found at Prins Heinrichoya, 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. neglecta** Schaffer, 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, *Isotoma 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 indebted to Niels Haarlov, Denmark, for sending me the Jan Mayen material for identification and to Ola Skifte and Fritz Richardson, Tromsø, for collecting the samples from Bjørnøya and Hopen.

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

ANDERS OLSEN


The sex ratios of adult and larvae of populations of *Mycerothrips latus* (Bagnall), *Thrips vulgarissimus* 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. vulgarissimus* were not recorded on Dovrefjell, and this species is therefore considered to reproduce by female to female parthenogenesis (thelytoky) in this area.

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 *Mycerothrips 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 vulgarissimus* 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. vulgarissimus* 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.

<table>
<thead>
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<th>1977</th>
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<tr>
<td></td>
<td>N</td>
<td>L II</td>
<td></td>
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<td>34</td>
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</table>

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. vulgarissimus* 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* Moult., *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 (Koppa 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 lititici* (Kurd-
Thrips reproduce thelytokously in some areas, whereas in some other areas the sex ratio values indicate arrenhotokous reproduction. This also applies to *T. vulgarissimus*, the sex ratio of which is 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 arrenhotokously, 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.

ACKNOWLEDGEMENTS

I am grateful to Dr. J.O. Solem, University of Trondheim, The Museum, for valuable advice under the preparation of the present paper, and to Dr. L.A. Mound, British Museum, for critical reading of the manuscript. I also thank P.A. Tal lentire who has improved the English.

REFERENCES


Received 15 Mar. 1984
The life cycle of *Halesus radiatus* (Curtis, 1834) (Trich., Limnephilidae) in a West Norwegian lowland stream.

TROND ANDERSEN AND ÅSMUND TYSSE


*Halesus radiatus* is frequently found in West Norwegian streams and rivers, and has a vertical range from sea level 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.


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 Østerøy, 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.

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

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 equipped 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 head 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.

<table>
<thead>
<tr>
<th>Instar</th>
<th>n</th>
<th>( \bar{x} )</th>
<th>S.D.</th>
<th>range</th>
<th>factor of increase</th>
<th>( \bar{x} )</th>
<th>S.D.</th>
<th>range</th>
<th>factor of increase</th>
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<td>31</td>
<td>0.371</td>
<td>0.011</td>
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<td>1.57</td>
<td>0.333</td>
<td>0.009</td>
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<tr>
<td>II</td>
<td>57</td>
<td>0.584</td>
<td>0.018</td>
<td>0.54–0.61</td>
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<td>0.524</td>
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<td>III</td>
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<tr>
<td>V</td>
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<td>1.76–2.09</td>
<td></td>
<td>1.799</td>
<td>0.065</td>
<td>1.63–1.94</td>
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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 12 μ, and of third, fourth and fifth instar larvae of 25 μ.

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 moultimg 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 fligth 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 flight 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 an 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 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 Scot-
land 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 Osterey 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, \textit{H. radiatus}, \textit{P. cingulatus} and \textit{C. villosa}, are all leaf eating shredders. There was a clear habitat segregation between the larvae. \textit{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 \textit{H. radiatus} and \textit{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 Osterey \textit{P. cingulatus} flies from late July until late October, \textit{H. radiatus} from late August to early November, and \textit{C. villosa} from late September to mid December (Andersen 1983). Of the two species that coexist in the same habitat, \textit{H. radiatus} has a rapid larval development during late autumn and winter with first instar modal in November and second instar modal in December. \textit{C. villosa}, which is the smaller species, has a much slower larval growth during the winter with first instar modal until March and secord 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.

**ACKNOWLEDGEMENTS**

We are indebted to A. Fjeldsa and Ø. Wiig for commenting on the manuscript, to M. Diaz for technical assistance, and to E. Pierce for improving the language.

**REFERENCES**


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

LITA GREVE, JOHN O. SOLEM AND ANDERS OLSEN


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.

John O. Solem and Anders Olsen, University of Trondheim, The Museum, Zoological Department, Erling Skakkesgt. 47A, N-7000 Trondheim, Norway.

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, Siebeke (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. Stropisjøen, 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 Rønning (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.

<table>
<thead>
<tr>
<th>Sites no.</th>
<th>Alpine belt</th>
<th>Sub-alpine belt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Bibio clavipes (Meigen)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B. fluvipes Zetterstedt</td>
<td>1</td>
<td>242</td>
</tr>
<tr>
<td>B. rufipes Zetterstedt</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>B. pomonae Fabricius</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Bibio spp.</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Dilophus femoratus Meigen</td>
<td>26</td>
<td>4</td>
</tr>
</tbody>
</table>

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 phytosaprophagic, 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. «Russefly», 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 Finnmark (Siebke, 1877) and has later been recorded from middle Europe (Pecina, 1965b). *B. rufipes* has been recorded from the Dovrefjell mountains and Kongsjoll (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

<table>
<thead>
<tr>
<th>Dato</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibio fulvipes Zetterstedt</td>
<td>5</td>
<td>99</td>
<td>112</td>
<td>34</td>
</tr>
<tr>
<td>B. rufipes Zetterstedt</td>
<td>11</td>
<td>20</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>B. pomonae (Fabricius)</td>
<td>1</td>
<td>11</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>B. clavipes (Meigen)</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td>Dilophus femoratus Meigen</td>
<td>3</td>
<td>3</td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

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 Bibio fulvipes. Highest number of individuals of Bibio 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 Dilophus 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 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 (1965a) 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.

ACKNOWLEDGEMENTS

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Received 14 Feb. 1984.
Some recent records of Hybotidae and Microphoridae (Dipt. Empidoidea) from Norway

TERJE JONASSEN


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

Terje Jonassen, N-4115 Songesand, Norway.

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 Tachydromilinae

Platypalpus ciliaris (Fallén)

Platypalpus stigma (Zetterstedt)

Platypalpus pectoralis (Fallén)

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

Platypalpus unguiculatus (Zetterstedt)
— Rogaland, R1, Forsand: Røssdalen, EIS 7, 1 ♂ 27 June 1982; Sonesand, EIS 7, 1 ♂ 5 August 1982; 1 ♂ 2 August 1983; Helmykstøl, EIS 8, 1 ♂, 1 ♂ 5 August 1982.

Platypalpus longicornis (Meigen)

(!) Platypalpus difficilis (Frey)
— Rogaland, RY, Sandnes: Hana, EIS 7, 1 ♀ 18 May 1982; Rennesøy: Vikøvåg, 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)

Platypalpus minutus (Meigen)

Platypalpus maculipes (Meigen)

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

Platypalpus notatus (Meigen)
- Rogaland, RI, Forsand: Songsand, EIS 7, 2♂ 3 July 1981; 1♂ 24 August 1982; Songsandstolen, EIS 7, 1♂ 20 August 1982; Møen, EIS 7, 1♂ 27 June 1983; Røssdal, EIS 7, 1♂ 27 June 1982; Helmkstol, EIS 8, 2♂ 4♂ 5 August 1982; Daladalen, EIS 8, 1♂ 7 August 1983.

Platypalpus interstinctus (Collin)

Platypalpus ecalceatus (Zetterstedt)

Platypalpus longiseta (Zetterstedt)

Platypalpus major (Zetterstedt)

Platypalpus candidans (Fallén)

Platypalpus cursitans (Fabricius)

Platypalpus verralli (Collin)

Tachypeza nubila (Meigen)

(1) Tachypeza femnica Tuomikoski

Tachydromia umbrarum Haliday

Tachydromia aemula (Loew)

Chersodromia arenaria (Haliday)

Chersodromia cursitans (Zetterstedt)

Chersodromia arenaria (Haliday)
- Rogaland, RI, 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.)

(1) Hybos culiciformis (Fabricius)
- Rogaland, RI, Rennesøy: Vikevåg, EIS 14,

New to Norway.

*Hybos femoratus* (Müller)


**Subfamily Ocydromiinae**

(!) *Trichinomyia flavipes* (Meigen)


New to Norway.

(!) *Trichina clavipes* Meigen


New to Norway.

(!) *Trichina bilobata* Collin


New to Norway.

*Bicellaria pilosa* Lundbeck


*Bicellaria austriaca* Tuomikoski


*Bicellaria subpilosa* Collin


*Bicellaria sulcata* (Zetterstedt)


*Bicellaria intermedia* Lundbeck


*Bicellaria nigra* (Meigen)


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: Melshøi, EIS 7, 1 φ  4 June 1983; Rennesøy: Vikevåg, EIS 14, 1 φ  10 June 1982.

These are the northernmost records from Scandinavia. New to Norway.

*Euthyneura myrtilli* Macquart


(!) *Euthyneura gyllenhali* (Zetterstedt)


New to Norway.

*Ocydromia glabricula* (Fallén)


*Ocydromia melanopleura* Loew

— Rogaland, RY, Rennesøy: Sel, EIS 14, 1 φ  10 July 1983.

*Leptopeza flavipes* (Meigen)


*Leptopeza borealis* Zetterstedt


**Microphoridae**

*Microphorus holosericus* (Meigen)

ACKNOWLEDGEMENTS

I am greatly indebted to K. Rognes, Madla for the gifts of invaluable material, advice on genitalia preparation etc. I would also like to thank A. Lund and I.K. Sunde, both Sandnes, for their assistance in my fieldwork.

REFERENCES


Received 6 Feb. 1984.
Cluster analysis of milliped communities of different altitudes and distances from the coast in Setesdal, Southern Norway

ÅGE SIMONSEN


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.

Åge Simonsen, Museum of Zoology, University of Bergen, N-5000 Bergen, Norway.

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°15'—5°9'). The river run though four main vegetation zones: the boreoemoral 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

<table>
<thead>
<tr>
<th>Main areas</th>
<th>Mean annual temperature C</th>
<th>Mean temperature C</th>
<th>Annual temp. range</th>
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<table>
<thead>
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<th>Main areas</th>
<th>Number of days from t &gt; 9°C to t &lt; 9°C.</th>
<th>Mean yearly precipitation mm.</th>
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<td>1412</td>
</tr>
<tr>
<td>Hægeland</td>
<td>139</td>
<td>1349</td>
</tr>
<tr>
<td>Byglandsfjord</td>
<td>132</td>
<td>735</td>
</tr>
<tr>
<td>Austad</td>
<td>115</td>
<td>687</td>
</tr>
</tbody>
</table>

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). Kendall's 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). Kendall's 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 *Schiophyllum 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.

<table>
<thead>
<tr>
<th>Main Areas.</th>
<th>Loc. nr.</th>
<th>Grid Ref.</th>
<th>Vegetation association</th>
<th>Slope</th>
<th>Description of locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kristiansand 50 m.a.s.</td>
<td>1</td>
<td>32VMK379487</td>
<td>Populus-Quercetum</td>
<td>20 W</td>
<td>Oak dominated hardwood with sparse shrub layer. Stony.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>32VMK378489</td>
<td>Grassland</td>
<td>Open moist grassland.</td>
<td></td>
</tr>
<tr>
<td>Evje 64 km f.coast</td>
<td>4</td>
<td>32VMK368529</td>
<td>Populus-Quercetum</td>
<td>—</td>
<td>Open calcareous pine wood.</td>
</tr>
<tr>
<td>300 m.a.s.</td>
<td>5</td>
<td>32VMK293947</td>
<td>Vaccinio-Pinetum</td>
<td>20 E</td>
<td>Mixed wood of aspen, pine, birch and sloe.</td>
</tr>
<tr>
<td>6 32VMK283966</td>
<td>7</td>
<td>32VMK342973</td>
<td>Vaccinio-Pinetum</td>
<td>30 E</td>
<td>Relatively dense pine wood.</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>32VMK308987</td>
<td>Vaccinio-Pinetum</td>
<td>5 SE</td>
<td>Mixed wood of pine and birch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>Open pine wood with same birches. Rotten logs.</td>
</tr>
<tr>
<td>Bygland 100 km from coast</td>
<td>9</td>
<td>32VML30195</td>
<td>Eu-Piceetum</td>
<td>—</td>
<td>Dense spruce wood.</td>
</tr>
<tr>
<td>320 m.a.s.</td>
<td>10</td>
<td>32VML304198</td>
<td>Eu-Piceetum</td>
<td>20 W</td>
<td>Open pine wood, with birch, sloe and spruce. Stony.</td>
</tr>
<tr>
<td>11</td>
<td>32VML294226</td>
<td>Eu-Piceetum</td>
<td>5 W</td>
<td>Open pine wood, without shrub layer.</td>
<td></td>
</tr>
<tr>
<td>Valle 160 km from coast</td>
<td>13</td>
<td>32VML153521</td>
<td>Eu-Piceetum</td>
<td>20 E</td>
<td>Pine wood with sparse shrub layer.</td>
</tr>
<tr>
<td>400 m.a.s.</td>
<td>14</td>
<td>32VML156529</td>
<td>Melico-Piceetum</td>
<td>30 E</td>
<td>Hardwood of sloe, birch and mountain ash, same pines and spruce. Very rich field layer with 22 herbs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>Coniferous wood.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>Heterogenous site. Dry pine wood and more open moist areas with Sphagnum.</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>32VML151534</td>
<td>Eu-Piceetum</td>
<td>—</td>
<td>Like loc. 19</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>32VML149553</td>
<td>Eu-Piceetum</td>
<td>—</td>
<td>Shrub layer of Betula spp. Ground layer Cladonia dominated.</td>
</tr>
<tr>
<td>Bykle 190 km from coast</td>
<td>17</td>
<td>32VML058775</td>
<td>Eu-Piceetum</td>
<td>5 N</td>
<td>Dense pine wood</td>
</tr>
<tr>
<td>600 m.a.s.</td>
<td>18</td>
<td>32VML055783</td>
<td>Eu-Piceetum</td>
<td>20 SE</td>
<td>Mixed wood of birch and pines with many stones and sparse ground and field layer.</td>
</tr>
<tr>
<td>Hovden 220 km from coast</td>
<td>19</td>
<td>32VMM094058</td>
<td>Eu-Piceetum-Myrtilosum</td>
<td>—</td>
<td>Shrub layer of Betula spp. Ground layer Cladonia dominated.</td>
</tr>
<tr>
<td>900 m.a.s.</td>
<td>20</td>
<td>32VMM106086</td>
<td>Eu-Piceetum-Myrtilosum</td>
<td>—</td>
<td>Like loc. 19</td>
</tr>
</tbody>
</table>

98
Fig. 2. Kite-diagram showing change in relative abundance with distance from the coast. The species are from left to right: Cylindroïdus londinensis, Glomeris marginata, Polyxenus lagurus, Schizophyllum sabulosum, Cylindroïdus punctatus, Proteroïlulcus fuscus, Polydesmus complanatus, Polydesmus denticulatus and Leptoïulus proximus.

Table 3. Species occurrences at the localities.

<table>
<thead>
<tr>
<th>loc.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyxenus lagurus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glomeris marginata</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polydesmus complanatus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. denticulatus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proteroïlulcus fuscus</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leptoïulus proximus</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylindroïdus londinensis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. punctatus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizophyllum sabulosum</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Spécies occurrences in the main areas.

<table>
<thead>
<tr>
<th>Kristiansand</th>
<th>Evje Bygland</th>
<th>Valle</th>
<th>Bykle</th>
<th>Hovden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylindroïdus londinensis</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leptoïulus proximus</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polydesmus denticulatus</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylindroïdus punctatus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Glomeris marginata</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Schizophyllum sabulosum</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Polydesmus complanatus</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyxenus lagurus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Proteroïlulcus fuscus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

99
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 seem probable that the decrease in precipitation may limit the distribution.

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 denti culatus, Cylindroiulus londinensis and Leptoii­lus 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.

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

Fig. 5. Trellis diagram showing similarities between the localities based on the Sørensen Index.
Vaccinio-Pinetum associations. Melico-Piceetum associations occur on relatively dry but mineral rich soil and some of the differences in the millipede fauna may be due to this. In the oakwoods (Populus-Quercetum) xerophilic and thermophilic species with an eastern distributional range (like Glomeris marginata, Leptoilulus 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.

ACKNOWLEDGEMENT

I am indebted to Torstein Solhøy and Svein Fosså, Museum of Zoology, University of Bergen, for critical reading of the manuscript, and to Bjarne A. Meidell, Museum of Zoology, U.I.B. for good advices during the field period. I wish to give a special thank to Cand.scient. Lars Tveit, Bergen, for help with the fieldwork.

REFERENCES


Received 10 Jan. 1984

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

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.

Gösta Hagenlund, Paal Bergsv. 50, N-1349 Rykkinn, Norway.

**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* (Gyllenhall), *Ilybius aenescens* Thomson, *I. fuliginosus* (Fabricius), *Rhanthus saturellus* (Harris) and *Graphoderus zonatus* (Hoppe).

**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 (Lenistea 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 & Gardenfors 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. unistratus* Schrank (Schaeffer 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.

**REFERENCES**


Holmen, M. 1979. Fire vandkalve nye for Danmark med oplysninger om deres udbredelse og levevis (Coleoptera: Dytiscidae) *Ent. meddr* 47, 89—95.


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 parameters were the area of the water, 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.

Gösta Hagenlund, Paal Bergsv. 50, N-1349 Rykkinn.

INNLEDNING


FAM. DYSTISCIDAE


Bidessus grosspunctatus 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 Myrt­jørn UTM NP 5863. On, Vinstra, tjern nord for Musvoldkampen UTM NP 5563. Andre funn: Dominerende Dytiscidae i oligotrofe insjøer i AAy og VAy (Hagenlund upubl.).


Hydroporus lapponum (Gyllenhal). HEN, Stor-Elvdal, dam nær Atnsjøen UTM NP 6260 og Kamptjørn UTM NP 6064.


H. melanocoephalus (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 geclittoralsonen på Øyna i Dalsfjorden UTM LP 0309.

H. obsolerus 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 Gulaal, Hauke­dalsvann (leg. G. Raddum).


P. g. multilinearus (Falkenström). HEN, Stor-Elvdal, Kamptjørn UTM NP 6064 og Folldal, Reivtjørn UTM NP 5647.

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

Oreodytes sanmarksahlbergi (rivals 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. labiatus (Brahm). HEn, Stor-Elvdal, sammen med A. nigroaeneus.

Illybius fenestratus (Fabricius). AAy, Gjerstad, Heilandsvann, s. L. stroehmi og Lundvann UTM ML 9731, samme habitat-type som i Heilandsvann.

I. fuliginosus (Fabricius). SFy, Fjaler, habitat s. H. palustris.

I. guttiger (Gyllenhal). AAy, Gjerstad, Lille Finntjern UTM ML 9332. Tjern omtatt av Sphagnum spp.


Rhanthus saturellus (Harris). HEn, Stor-Elvdal, dam nær Atsjoen UTM NP 5260 og Myrtjørri UTM NP 5863 og Folidal, Reivtjørrni UTM NP 5467.

Colymbetes dolabratus (Paykull). HEn, Folidal, Reivtjørrni UTM NP 5467.

Graphodieres zonatus (Hoppe). AAy, Gjerstad, Østre Kalvann, Reproduserte neppe.


FAM. GYRINIDAE

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

FAM. ELMIDAE


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 før det samtidig var mye vegetasjon, vegetasjonsstruktur og bunnnforhold. Kjemske parametre var i de fleste tilfelle av liten betydning i lite forutsettede 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

Alle funn fra HEn og On var gjort av R. Heimholdt, lokaltetsbeskrivelser kan finnes i hans hovedopp

REFERANSER


Received 20 Feb. 1984.
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.

Nils Chr. Stenseth. Department of Biology, Division of Zoology, University of Oslo, P.O. Box 1050, Blindern, N-0316 Oslo 3, Norway.

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 IpslurR 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.

<table>
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<th>Date caught (hr. 0700-1900)</th>
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<th>Wind speed (m/sec)</th>
<th>Rain (mm)</th>
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| June 1—24                  |                  |                   |           |
| 25                         | 3.1              | 21.2              | 0         |
| 26                         | 5.7              | 14.6              | 0         |

REFERENCES


Received Mar. 22 1984.

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.

Preben S. Ottesen, Zoological institute, University of Oslo, P.O. Box 1050 Blindern, N-Oslo 3, Norway.

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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 Bo: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.

ACKNOWLEDGEMENT

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

REFERENCES


Received 9 Apr. 1984.

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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.

Helge Huru, Tromsø Museum, N-9000 Tromsø, Norway.

Lakselv is one of the largest rivers in Finnmark with a drainage area of 1500 km². The upper and middle part of the Lakselv river system consists of many small streams, one of which is the stream Cævre-sjåkka. 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 lutuleum* Müller, 1776), *Paraleptophlebidae*.  

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**Fig. 1. The known distribution of *Habrophlebia lauta* in Fennoscandia.**

▲ Present record in Lakselv, Finnmark.
○ Previous records in Finland.
bria sp. Heptagenia joernensis (Bengtsson, 1909), Ephemeria danica Mülller, 1764, Baetis vernus group (see Muller-Liebenau, 1969), Caenis horaria (L., 1758), Baetis muticus (L., 1758), Ephemerella ignita (Poda, 1761), Heptagenia fuscorosea Retzius, 1783, Ameletus inopinatus Eaton, 1887, Ephemerella aurivillii (Bengtson, 1908), Habropelbia sp. (lauta?), Siphlonurus aestivalis (Eaton, 1903).

Only two Plecoptera species were found at this station, while 18 species were recorded in the whole river system. Although not recorded from Norway (Dahly 1973), Habropelbia lauta has been found in Finland and the Soviet Union, but not in Sweden (Saaristo 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 Ephemeropera 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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Received 12 Jan. 1984.

THE DISTRIBUTION OF TIPULA (ARCTOTIPIULA) 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.

Trond Hofsvang, Agriculture Entomology, Agriculture University of Norway, P.O. Box 70, N-1432 Ås-NLH, Norway.

The subgenus Arctotipula Alexander, 1933 of the genus Tipula L., 1758 is Holarctic in distribution (Savshenko 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 Trøms 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 Övre 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).

ACKNOWLEDGEMENTS

I am grateful to John O. Solem, Trondheim, for making available larval material from Sør-Trøndelag, Nord-Trøndelag and Nordland.

REFERENCES


Received 16 Mar. 1984.

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.

Øyvind Håland, Heyjord, 3120 Andebu, Norway.

During a preliminary investigation of the Norwegian Dixidae, I found 4 larvae (third instar) of the species Dixella 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 Diixa 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 interspircular 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.

REFERENCES


Received 27 Feb. 1984.

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

RUDOLF ROZKOSNÝ & LITA GREVE

Ilione (= Knutsonia) lineata (Fallén, 1820) is reported new to Norway. Four specimens were netted at Moutmarka, Tjome county E19, province of Vestfold, near a small lake, on 8. July 1983. This is the first record of the species in Norway.

Rudolf Rozkošný, Natural Science Faculty, J. E. Purkyné University, Kotlárška 2, 611 37 Brno, Czechoslovakia.

Lita Greve, Museum of Zoology, University of Bergen, N-5000 Bergen, Norway.

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 R1 (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 Transcaucassus, 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 (Leso, Jutland, Als, Zealand). Generally it represents a Euroasian element ranging from Scotland, Lapland and the vicinity of Arkhangelsk in the USSR to France and Yugoslavia, 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 602483 in Tjome county, Vestfold province, four specimens of Ilione lineata were found. Moutmarka is situated at the southernmost tip of Tjome at Helgeland. 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. Tetracera 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 an 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 Siberia to Yakutia. The Norwegian specimens are deposited in the Zoological Museum, University of Bergen.

ACKNOWLEDGEMENTS

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

REFERENCES


Received 17 Feb. 1984.
NEOPACHYGASTER MEROMAELEAENA
(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.

Arild Fjeldså and Lita Greve, Museum of Zoology, University of Bergen N-5000, Norway.
Alf-Jacob Nilsen, Kirkehamn, 4432 Hidrasund.

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 Fennoscandian and later the European Stratiomyidae have recently been surveyed by Rozkosný (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 thoroughly 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)

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 deciduous 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)

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 Rozkosný (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.

ACKNOWLEDGEMENTS
We are indebted to Dr. R. Rozkošný, Natural Science Faculty, J. E. Purkyne University, 61137 BRNO, Kotlárská 2, Czechoslovakia for verifying the determinations.

REFERENCES

Received 27 Apr. 1984.

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.

Lita Greve, University of Bergen, Museum of Zoology, Museplass 3, N-5000 Bergen, Norway.

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 32VNL3207. 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 32VNL266117, 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

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**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.

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**Table 1**

[112]

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

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

The male from Hegglandsdalen was determined to
\textit{X. competitus} by T. Soot-Ryen, but this material has
never been published. The list follows \textit{Okland} (1981).

The female collected at Vollane was found in a col-
cluding-trap operated throughout the summer 1978.
No more specimens were caught. Where dates have
been noted, all specimens of \textit{X. competitus} 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 com-
pared 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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mission to study the material in Zoological Museum,
University of Oslo and to Kaj Berggren for loan of
material in his private collection.

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Received 25 Jan. 1984.

\textbf{MEGASELIA RUFLIPES MEIGEN (DIPT.,
PHORIDAE) AS A PREPUPAE PARASITE OF
THE WINTER MOTH AND ALLIED SPECIES
IN DECIDUOUS FORESTS IN WESTERN
NORWAY}

\textbf{KÅRE HESJEDAL}

Records of a previously unknown parasite, \textit{Megase-
ilia ruflipes} Meigen, of the Geometridae larvae of \textit{Op-
heroptera brumata} L., \textit{Agriopis aurantaria} Hubner and \textit{Erannis defoliaria} Clerck is reported. Laboratory
experiments shows that the second generation of
these scuttle fly was able to parasitize Noctuidae lar-
vae. In this investigation \textit{M. ruflipes} showed to be a
facultative parasite.

Kåre Hesjedal, Ullensvang Research Station, N-5774

\textbf{INTRODUCTION}

The geometrids \textit{Opheroptera brumata} L. \textit{O. fagata}
Scharfenberg, \textit{Agriopis aurantaria} Hubner, and \textit{Er-
nasis defoliaria} Clerck, have regular outbreak peri-
ods at 12–15 years interval in the deciduous forests and
orchards in the Hardanger area, Western Nor-
way.

Among these the winter moth, \textit{O. brumata}, is the
most abundant species often causing complete defoli-
ation of the host trees (Edland 1981).

The ichneumonid, \textit{Agrypon flaveolatum} Graven-
horst, and the tachinids, \textit{Lypha dubia} Fallen and \textit{Cy-
zensis albicans} Fallen, were during the outbreak
period of 1960's found to parasitize \textit{O. brumata} while
very few of the \textit{A. aurantaria} and \textit{E. defoliaria} lar-
vae 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 Ta-
chinidae species (Edland 1981).

This investigation reports the finding of a Phoridae
species, \textit{Megaselia ruflipes} Meigen, previously unk-
nown as a parasite of this important group of Geo-
metridae pests (Clausen 1978, Edland 1981, Varley &

\textbf{MATERIAL AND METHODS}

Last instar larvae of \textit{O. brumata}, \textit{A. aurantaria}, and
\textit{E. defoliaria}, were collected on 12 June, 1981, from
heavily infested food plants by use of a Stainer's ba-
ting funnel. The collection were done at two locali-
ties, Kinsarvik and Lofthus, in Ullensvang, Horde-
land 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 m². 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 plants grown in a habitat of about 500 m². The larvae and fed with detached leaves from their respective food plants. Compared with O. brumata, the larvae of E. defoliaria and A. aurantia 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 parasitization 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 emerged 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 by the last instar larvae of the geometrids while they still were on the food plants. After the geometrid larvae were burried in the peat moss, they were killed and totally 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 inhabited 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 Stilpnottia 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 characterized 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.

ACKNOWLEDGEMENTS

I wish to thank Dr. R. H. L. Disney, Malham Tarn Field Centre, Yorkshire, for identification of the phorid species. The investigation was supported by The Agricultural Research Council of Norway.

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Bokanmeldelser


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 naturvemets overordnede mål, som er å bevare biologisk mangfold for ettertiden. Langt over 95% av alle verdens dyar er virvelløse dyr, og insektene alene utgjør vel 70% av artsrådken. I mange land er insektfaunaen blitt sterkst forarmet. Bl.a. er mange sommerfuglartruet i Europa. I en særstilling står de tropiske regnskogene, der bare få prosent av insektarten e 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 inneholder.

På denne bakgrunn viser 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 trute 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 vennemotiver for disse dyregruppene. Deretter omtales et stort antall trute arter (eller dyresamfunn, som f.eks. koralrev) 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 iverksette vernetiltak og forslag til videre vernetiltak.

Det sies klart fra i boka at antallet trute 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 pressingende, og som alle lands naturvernmyndigheter må ta alvorlig.

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

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


Det er viktig nok at fagzoologene på denne måten blir minnet om å bidra med opplysninger om trute arter og samfunn, og å komme med forslag til vernområder. 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


LARS TVEIT & ERLING HAUKE.

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

![Correct Figure 7](image-url)
**Announcements**

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