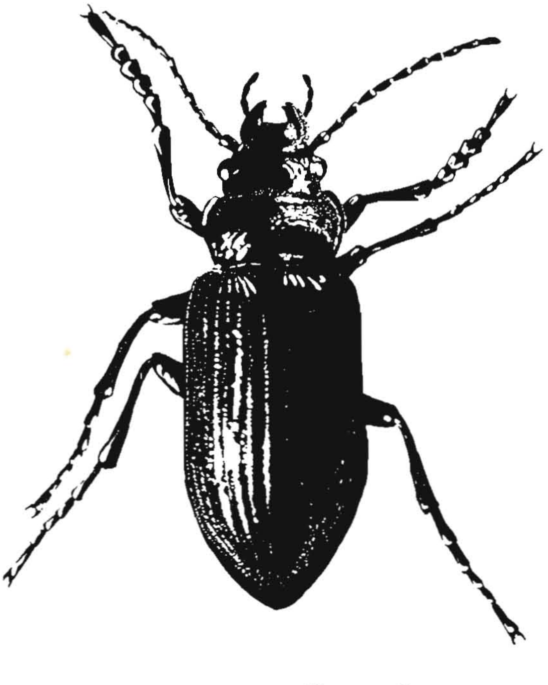
NORWEGIAN JOURNAL OF ENTOMOLOGY

Volume 23 · No. 2 · 1976



Universitetsforlaget

Norwegian Journal of Entomology
Norsk Entomologisk Tidsskrift

EDITOR

EDITORIAL COMMITTEE

PUBLISHER

Universitetsforlaget: P. O. Box 7508, Skillebekk, Oslo 2, Norway.
P. O. Box 142, Boston, Massachusetts 02113, U.S.A.

CONTRIBUTIONS

These should be sent to the Editor. Authors are requested to follow the instructions on page 3 of the cover.
Artikler som ønskes trykt i tidsskriftet sendes redaktøren. Bidragsytere må følge anvisningen på omslagets tredje side.

SUBSCRIPTIONS

Non-members of the Norwegian Entomological Society should send their orders to Universitetsforlaget. The subscription price per volume (two issues annually) is for 1976 U.S. $ 13.00 (N. kr. 65.–). U.S. $ price is subject to change without notice in case of devaluation/revaluation. Notice of change of adress should be accompanied by the old address. Back volumes should also be ordered from Universitetsforlaget.

NORSK ENTOMOLOGISK FORENING

ser sin hovedoppgave i å fremme det entomologiske studium i Norge, og danne et bindeledd mellom de interesserte. Medlemskontingenten er for tiden kr. 30,– pr. år. Medlemmer får tidsskriftet fritt tilsendt. Henvendelser om medlemskap sendes sekretæren: Cand. real. Trond Hofsvang, Zoologisk institutt, NLH, 1432 Ås-NLH.

E. SEM A/S, HALDEN

Contribution to the knowledge of the Norwegian fauna of Ichneumonidae (Hymenoptera parasitica)

REIJO JUSSILA

Jussila, R. 1976. Contribution to the knowledge of the Norwegian fauna of Ichneumonidae (Hymenoptera parasitica). *Norw. J. Ent. 23*, 97–120.

A total of 437 species of Ichneumonidae is listed with notes on their distribution in Norway. 173 species are new to Norway and 12 new combinations are described.

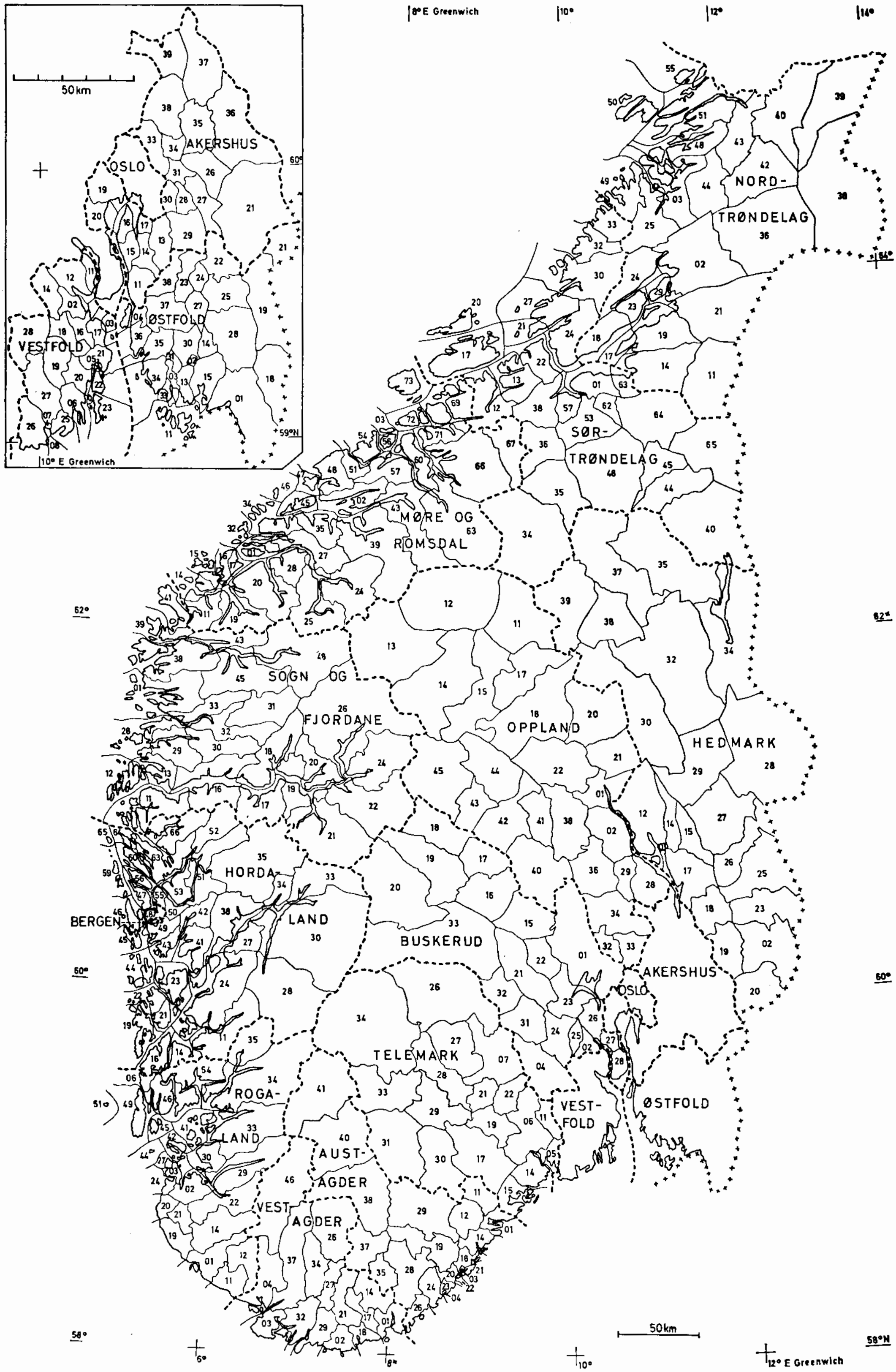
Reijo Jussila, Mullintie 6 B 63, SF–20300 Turku 30, Suomi–Finland.

The fauna of parasitic wasps in Norway is poorly known. The earliest information of Ichneumonidae to my knowledge refers to records from the northernmost Norway mentioned in *Insecta Lapponica descripta* (Zetterstedt 1838). A total of 234 species is presented in Enumeratio hymenopterorum norvegicorum (Strand 1898a), which, in addition to the author's personal observations, is based upon pioneer studies by mainly Holmgren (1855, 1876) and Siebke (1863, 1870). Further contributors to the knowledge of the Norwegian ichneumonids are particularly Strand (1898b, 1906, 1913) and Roman (1936, 1942). The only recent, fuller study refers to the fauna of the Hardangervidda mountainous plateau (Jussila 1973).

The present study is based upon approximately 1500 specimens belonging to the Zoological Museum, University of Bergen. The material comprises individuals from various parts of the country, but mainly from Western Norway. The records are casual, mostly collected by former and present members of the staff, and particularly by the late N. Knaben and during the last decades by L. Greve Jensen and A. Løken. With the exception of some single records, the specimens were collected by the late A. Brinkmann, S. Dommersnes, A. Fjeldså, A. Fjellberg & al., J. Gullaksen, Chr. Hysing-Dahl, the late S. Johnsen, K. E. Jørstad & al., P. G. Krüger, the late O. Meidell, B. Midttun, A. Nielsen, T. Nielsen, R. Rosendahl Knudsen, T. Solhøy, Hans Tambs-Lyche, Inger Tambs-Lyche, A. Tjønneland and students joining field courses and excursions.

In addition to the collection examined by me, the list below is completed with about 275 specimens identified by W. Hellén and 15 specimens identified by S. Johansson; all of these were recorded by the collectors mentioned above and belong to the same institution.

The taxonomy adopted follows principally that of Townes (1969–1971). Species new to Norway are marked with an asterisk. The localities are arranged by rural district ('herred') and municipalities within the different counties ('fylker'). The sequence fol-


50km
AKERSHUS
OSLO
ØSTFOLD
VESTFOLD
60°
59°N
10° E Greenwich
8° E Greenwich
10°
12°
14°
NORD-
TRØNDELAG
64°
SØR-
TRØNDELAG
MØRE OG
ROMSDAL
SOGN OG
FJORDANE
OPPLAND
HEDMARK
HORDA-
LAND
BERGEN
BUSKERUD
AKERSHUS
OSLO
TELEMARK
VEST-
FOLD
ØSTFOLD
ROGA-
LAND
AUST-
AGDER
VEST-
AGDER
62°
60°
58°
6°
8°
10°
12° E Greenwich
50km
58°N

RURAL DISTRICTS AND CITIES IN NORWAY

The numbers below refer to official index number of the rural districts and cities. The two first figures correspond to the index number of the county and the two last to the index of the rural district or the city. As the two first figures are common for all districts within a county, only the two last are used

01 Østfold county
0101 Halden
0102 Sarpsborg
0103 Fredrikstad
0104 Moss
0111 Hvaler
0113 Borge
0114 Varteig
0115 Skjeberg
0118 Aremark
0119 Marker
0121 Rømskog
0122 Trøgstad
0123 Spydeberg
0124 Askim
0125 Eidsberg
0127 Skiptvet
0128 Rakkestad
0130 Tune
0131 Rolvsøy
0133 Kråkerøy
0134 Onsøy
0135 Råde
0136 Rygge
0137 Våler
0138 Hobøl

02 Akershus county
0211 Vestby
0213 Ski
0214 Ås
0215 Frogn
0216 Nesodden
0217 Oppegård
0219 Bærum
0220 Asker
0221 Aurskog-Høland
0226 Sørum
0227 Fet
0228 Rælingen
0229 Enebakk
0230 Lørenskog
0231 Skedsmo
0233 Nittedal
0234 Gjerdrum
0235 Ullensaker
0236 Nes
0237 Eidsvoll
0238 Nannestad
0239 Hurdal

0301 Oslo

04 Hedmark county
0401 Hamar (s)
0402 Kongsvinger (s)
0412 Ringsaker (s)
0414 Vang (s)
0415 Løten (s)
0417 Stange (s)
0418 Nord-Odal (s)
0419 Sør-Odal (s)
0420 Eidskog (s)
0423 Grue (s)
0425 Åsnes (s)
0426 Våler (s)
0427 Elverum (s)
0428 Trysil (n)
0429 Åmot (n)
0430 Stor-Elvdal (n)
0432 Rendalen (n)
0434 Engerdal (n)
0435 Tolga-Os (n)
0437 Tynset (n)
0438 Alvdal (n)
0439 Folldal (n)

05 Oppland county
0501 Lillehammer (s)
0502 Gjøvik (s)
0511 Dovre (n)
0512 Lesja (n)
0513 Skjåk (n)
0514 Lom (n)
0515 Vågå (n)
0517 Sel (n)
0518 Fron (n)
0520 Ringebu (s)
0521 Øyer (s)
0522 Gausdal (s)
0528 Østre Toten (s)
0529 Vestre Toten (s)
0532 Jevnaker (s)
0533 Lunner (s)
0534 Gran (s)
0536 Søndre Land (s)
0538 Nordre Land (s)
0540 Sør-Aurdal (s)
0541 Etnedal (s)
0542 Nord-Aurdal (s)
0543 Vestre Slidre (n)
0544 Øystre Slidre (n)
0545 Vang (n)

06 Buskerud county
0601 Ringerike (ø)
0602 Drammen (ø)
0604 Kongsberg (ø)
0615 Flå (v)
0616 Nes (v)
0617 Gol (v)
0618 Hemsedal (v)
0619 Ål (v)
0620 Hol (v)
0621 Sigdal (v)
0622 Krødsherad (ø)
0623 Modum (ø)
0624 Øvre Eiker (ø)
0625 Nedre Eiker (ø)
0626 Lier (ø)
0627 Røyken (ø)
0628 Hurum (ø)
0631 Flesberg (ø)
0632 Rollag (v)
0633 Nore og Uvdal (v)

07 Vestfold county
0702 Holmestrand
0703 Horten
0705 Tønsberg
0706 Sandefjord
0707 Larvik
0708 Stavern
0711 Svelvik
0713 Sande
0714 Hof
0716 Våle
0717 Borre
0718 Ramnes
0719 Andebu
0720 Stokke
0721 Sem
0722 Nøtterøy
0723 Tjøme
0725 Tjølling
0726 Brunlanes
0727 Hedrum
0728 Lardal

08 Telemark county
0805 Porsgrunn (y)
0806 Skien (y)
0807 Notodden (i)
0811 Siljan (y)
0814 Bamble (y)
0815 Kragerø (y)
0817 Drangedal (y)
0819 Nome (y)
0821 Bø (i)
0822 Sauherad (i)
0826 Tinn (i)
0827 Hjartdal (i)
0828 Seljord (i)
0829 Kviteseid (i)
0830 Nissedal (i)
0831 Fyresdal (i)
0833 Tokke (i)
0834 Vinje (i)

09 Aust-Agder county
0901 Risør (y)
0903 Arendal (y)
0904 Grimstad (y)
0911 Gjerstad (y)
0912 Vegårshei (y)
0914 Tvedestrand (y)
0918 Moland (y)
0919 Froland (y)
0920 Øyestad (y)
0921 Tromøy (y)
0922 Hisøy (y)
0923 Fjære (y)
0924 Landvik (y)
0926 Lillesand (y)
0928 Birkenes (y)
0929 Åmli (i)
0935 Iveland (y)
0937 Evje og Hornnes (i)
0938 Bygland (i)
0940 Valle (i)
0941 Bykle (i)

10 Vest-Agder county
1001 Kristiansand (y)
1002 Mandal (y)
1003 Farsund (y)
1004 Flekkefjord (y)
1014 Vennesla (y)
1017 Songdalen (y)
1018 Søgne (y)
1021 Marnardal (y)
1026 Åseral (i)
1027 Audnedal (y)
1029 Lindesnes (y)
1032 Lyngdal (y)
1034 Hægebostad (i)
1037 Kvinesdal (i)
1046 Sirdal (i)

11 Rogaland county
1101 Eigersund (y)
1102 Sandnes (y)
1103 Stavanger (y)
1106 Haugesund (y)
1111 Sokndal (y)
1112 Lund (y)
1114 Bjerkreim (y)
1119 Hå (y)
1120 Klepp (y)
1121 Time (y)
1122 Gjesdal (y)
1124 Sola (y)
1127 Randaberg (y)
1129 Forsand (i)
1130 Strand (y)
1133 Hjelmeland (i)
1134 Suldal (i)
1135 Sauda (i)
1141 Finnøy (y)
1142 Rennesøy (y)
1144 Kvitsøy (y)
1145 Bokn (y)
1146 Tysvær
1149 Karmøy (y)
1151 Utsira (y)
1154 Vindafjord (y)

12 Hordaland county
1211 Etne (i)
1214 Ølen (y)
1216 Sveio (y)
1219 Bømlo (y)
1221 Stord
1222 Fitjar (y)
1223 Tysnes (y)
1224 Kvinnherad (i)
1227 Jondal (i)
1228 Odda (i)
1239 Ullensvang (i)
1233 Ulvik (i)
1234 Granvin (i)
1235 Voss (i)
1238 Kvam (i)
1241 Fusa (y)
1242 Samnanger (y)
1243 Os (y)
1244 Austevoll (y)
1245 Sund (y)
1246 Fjell (y)
1247 Askøy (y)
1248 Laksevåg (y)
1249 Fana (y)
1250 Arna (y)
1251 Vaksdal (y)
1252 Modalen (y)
1253 Osterøy (y)
1255 Åsane (y)
1256 Meland (y)
1259 Øygarden (y)
1260 Radøy (y)
1263 Lindås (y)
1264 Austrheim (y)
1265 Fedje (y)
1266 Masfjorden (y)

1301 Bergen (y)

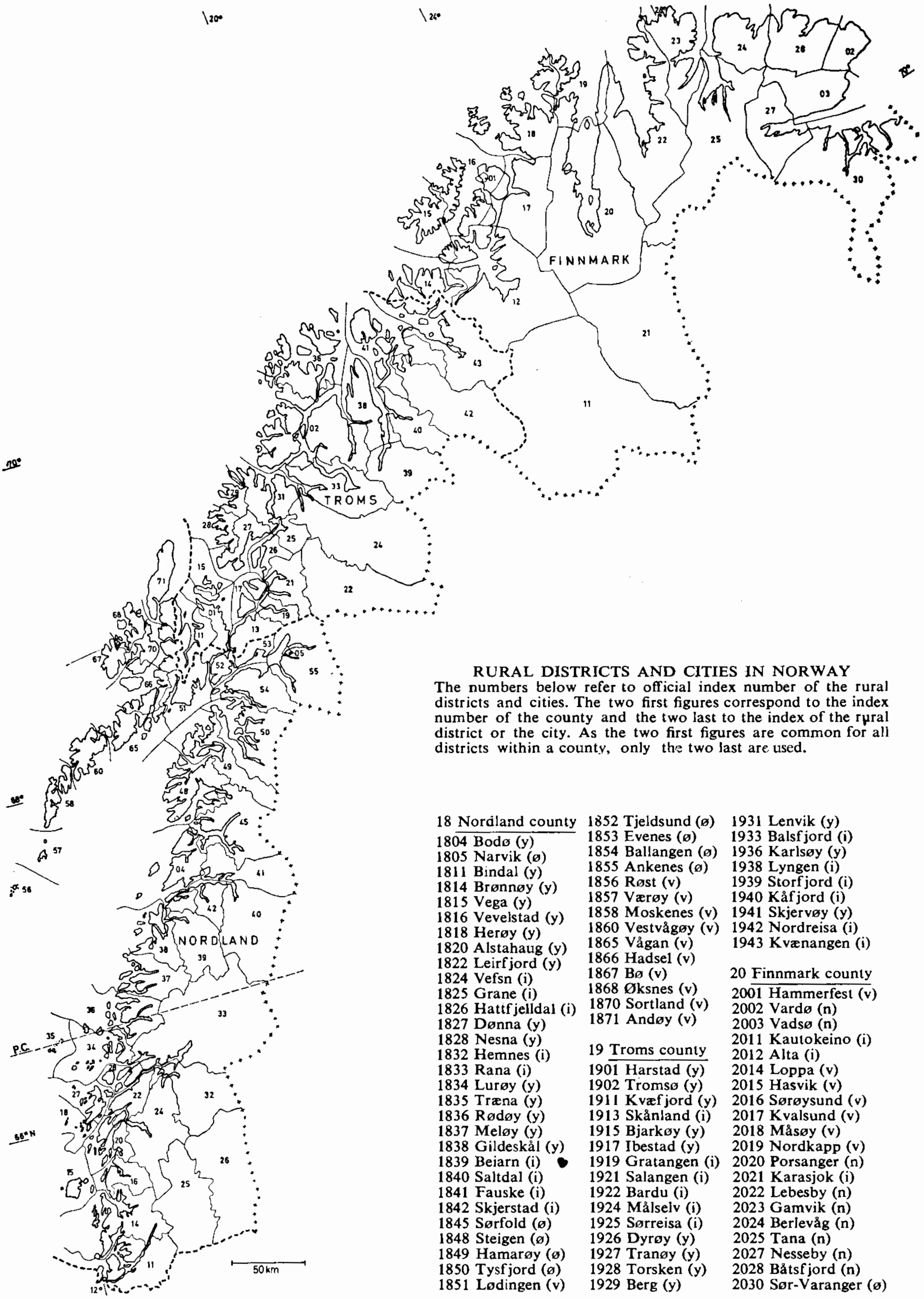
14 Sogn og Fjordane county
1401 Flora (y)
1411 Gulen (y)
1412 Solund (y)
1413 Hyllestad (y)
1416 Høyanger (y)
1417 Vik (i)
1418 Balestrand (i)
1419 Leikanger (i)
1420 Sogndal (i)
1421 Aurland (i)
1422 Lærdal (i)
1424 Årdal (i)
1426 Luster (i)
1428 Askvoll (y)
1429 Fjaler (y)
1430 Gaular (y)
1431 Jølster (y)
1432 Førde (y)
1433 Naustdal (y)
1438 Bremanger (y)
1439 Vågsøy (y)
1441 Selje (y)
1443 Eid (y)
1445 Gloppen (y)
1448 Stryn (i)

15 Møre og Romsdal county
1501 Ålesund (y)
1502 Molde (y)
1503 Kristiansund (y)
1511 Vanylven (y)
1514 Sande (y)
1515 Herøy (y)
1516 Ulstein (y)
1517 Hareid (y)
1519 Volda (y)
1520 Ørsta (i)
1524 Norddal (i)
1525 Stranda (i)
1527 Ørskog (y)
1528 Sykkylven (y)
1532 Giske (y)
1534 Haram (y)
1535 Vestnes (y)
1539 Rauma (i)
1543 Nesset (i)
1545 Midsund (y)
1546 Sandøy (y)
1547 Aukra (y)
1548 Fræna (y)
1551 Eide (y)
1554 Averøy (y)
1556 Frei (y)
1557 Gjemnes (y)
1560 Tingvoll (y)
1563 Sunndal (i)
1566 Surnadal (i)
1567 Rindal (i)
1569 Aure (y)
1571 Halsa (y)
1572 Tustna (y)
1573 Smøla (y)

16 Sør-Trøndelag county
1601 Trondheim (i)
1612 Hemne (y)
1613 Snillfjord (y)
1617 Hitra (y)
1620 Frøya (y)
1621 Ørland (y)
1622 Agdenes (y)
1624 Rissa (y)
1627 Bjugn (y)
1630 Åfjord (y)
1632 Roan (y)
1633 Osen (y)
1634 Oppdal (i)
1635 Rennebu (i)
1636 Meldal (i)
1638 Orkdal (i)
1640 Røros (i)
1644 Ålen (i)
1645 Haltdalen (i)
1648 Midtre Gauldal (i)
1653 Melhus (i)
1657 Skaun (i)
1662 Klæbu (i)
1663 Malvik (i)
1664 Selbu (i)
1665 Tydal (i)

17 Nord-Trøndelag county
1702 Steinkjer (i)
1703 Namsos (y)
1711 Meråker (i)
1714 Stjørdal (i)
1717 Frosta (i)
1718 Leksvik (i)
1719 Levanger (i)
1721 Verdal (i)
1723 Mosvik (i)
1724 Verran (i)
1725 Namdalseid (i)
1729 Inderøy (i)
1736 Snåsa (i)
1738 Lierne (i)
1739 Røyrvik (i)
1740 Namsskogan (i)
1742 Grong (i)
1743 Høylandet (i)
1744 Overhalla (i)
1748 Fosnes (y)
1749 Flatanger (y)
1750 Vikna (y)
1751 Nærøy (y)
1755 Leka (y)

Fig. 1. Division of Southern Norway. Names and limits dated to 1969. Ø = Ö.



RURAL DISTRICTS AND CITIES IN NORWAY

The numbers below refer to official index number of the rural districts and cities. The two first figures correspond to the index number of the county and the two last to the index of the rural district or the city. As the two first figures are common for all districts within a county, only the two last are used.

18 Nordland county
1804 Bodø (y)
1805 Narvik (ø)
1811 Bindal (y)
1814 Brønnøy (y)
1815 Vega (y)
1816 Vevelstad (y)
1818 Herøy (y)
1820 Alstahaug (y)
1822 Leirfjord (y)
1824 Vefsn (i)
1825 Grane (i)
1826 Hattfjelldal (i)
1827 Dønna (y)
1828 Nesna (y)
1832 Hemnes (i)
1833 Rana (i)
1834 Lurøy (y)
1835 Træna (y)
1836 Rødøy (y)
1837 Meløy (y)
1838 Gildeskål (y)
1839 Beiarn (i)
1840 Saltdal (i)
1841 Fauske (i)
1842 Skjerstad (i)
1845 Sørfold (ø)
1848 Steigen (ø)
1849 Hamarøy (ø)
1850 Tysfjord (ø)
1851 Lødingen (v)
1852 Tjeldsund (ø)
1853 Evenes (ø)
1854 Ballangen (ø)
1855 Ankenes (ø)
1856 Røst (v)
1857 Værøy (v)
1858 Moskenes (v)
1860 Vestvågøy (v)
1865 Vågan (v)
1866 Hadsel (v)
1867 Bø (v)
1868 Øksnes (v)
1870 Sortland (v)
1871 Andøy (v)

19 Troms county
1901 Harstad (y)
1902 Tromsø (y)
1911 Kvæfjord (y)
1913 Skånland (i)
1915 Bjarkøy (y)
1917 Ibestad (y)
1919 Gratangen (i)
1921 Salangen (i)
1922 Bardu (i)
1924 Målselv (i)
1925 Sørreisa (i)
1926 Dyrøy (y)
1927 Tranøy (y)
1928 Torsken (y)
1929 Berg (y)
1931 Lenvik (y)
1933 Balsfjord (i)
1936 Karlsøy (y)
1938 Lyngen (i)
1939 Storfjord (i)
1940 Kåfjord (i)
1941 Skjervøy (y)
1942 Nordreisa (i)
1943 Kvænangen (i)

20 Finnmark county
2001 Hammerfest (v)
2002 Vardø (n)
2003 Vadsø (n)
2011 Kautokeino (i)
2012 Alta (i)
2014 Loppa (v)
2015 Hasvik (v)
2016 Sørøysund (v)
2017 Kvalsund (v)
2018 Måsøy (v)
2019 Nordkapp (v)
2020 Porsanger (n)
2021 Karasjok (i)
2022 Lebesby (n)
2023 Gamvik (n)
2024 Berlevåg (n)
2025 Tana (n)
2027 Nesseby (n)
2028 Båtsfjord (n)
2030 Sør-Varanger (ø)

Fig. 2. Division of Northern Norway. Names and limits dated to 1969. Ø = Ö.

lows Strand (1943), except that names and limits on the whole have been dated to 1969 (Figs. 1–2). The abbreviations (H) and (J) have been added to the data noted for the individual specimens identified by Hellén and Johansson respectively. All specimens were otherwise determined by me.

Abbreviation of the name of the counties follows Strand (1943):

Ø = Østfold
AK = Akershus (incl. Oslo)
HE = Hedmark
O = Oppland
B = Buskerud
V = Vestfold
TE = Telemark
AA = Aust-Agder
VA = Vest-Agder
R = Rogaland
HO = Hordaland (incl. Bergen)
SF = Sogn & Fjordane
MR = Møre & Romsdal
ST = Sør-Trøndelag
NT = Nord-Trøndelag
N = Nordland
T = Troms
F = Finnmark

The suffixes (small letters) mean: i = indre (inner), y = ytre (outer), n = nordre (northern), s = søre (southern), v = vestre (western) and ø = østre (eastern).

SUBFAMILY *EPHIALTINAE*

**Scambus arundinator* (F.). HOy: Ølen: Vikebygd 1 ♀ 17 July 1967; Bergen 1 ♀ 17 August 1963.

**S. nucum* Ratzeburg. On: Vågå: Klones 1 ex 13 June 1948 (H). HOy: Bergen 1 ♀ 11 September 1952 (H).

S. sagax (Hartig). Ø: Halden 1 ♀ 5 June 1967. Ry: Klepp: Orre 1 ♀ 10 May 1967 e.p. *Evetria resinella* L. (Lep. Eucosmidae) and Vik 1 ♀ 1 August 1960. HOy: Bergen 1 ♂ 7 July 1934. Known from Hardangervidda and Northern Norway (Jussila 1973).

S. brevicornis (Grav.). Ø: Halden 1 ♀ 5 June 1967. Ry: Hå: Ogna 1 ♀ 4 August 1960 and 1 ♀ 6 August 1966. HOy: Tysnes: Ånuglo 1 ♀ 29 May 1969; Bergen 1 ♀ 5 June 1969; Askøy: Herdla 1 ♂ 29 July 1935, 1 ♂ 30 June 1936. STy: Agdenes: Lillevann 1 ♀ 10 September 1967. Occurring throughout Norway (Jussila 1973).

S. buolianae (Hartig). HOy: Bergen 1 ♀ 5 June 1969, 1 ♀ 24 September 1972. Also recorded from Hardangervidda (Jussila 1973).

S. v. vesicarius Ratzeburg. HOy: Askøy: Herdla 1 ♀ 19 July 1937 (H). HOi: Voss: Hauge 1 ♀ 4 June 1905 (H). Previously recorded from the southern coast and Hardangervidda (Jussila 1973).

**Liotryphon punctulatus* (Ratzeburg). Ri: Forsand 5 ♀♀ 5 July 1945 (H). Hoi: Ullensvang: Lofthus 1 ♀ 25 May 1950 (H). HOy: Vaksdal: Eidslandet 8 ♀♀ 14–17 June 1968. Earlier recorded in Northern Norway (Roman 1936).

Pimpla manifestator (L.). HEs: Stange 1 ♀ 28 June 1945 (H). Ri: Forsand 1 ♀ 5 July 1945 (H). Distributed throughout Norway (Strand 1898a, Roman 1942).

**Dolichomitus mesocentrus* (Grav.). SFi: Aurland: Otternes 1 ♀ 14 June 1939 (H).

**Paucdolichomitus imperator* (Kriechbaumer). SFi: Aurland: Otternes 1 ♀ 14 June 1939 (H); Stryn: Nedstryn 1 ♀ 14 July 1942 (H).

Tubercuephialtes t. tuberculatus (Fourcroy) (*Ephialtes parallelus* Thomson). HOy: Os: Flatøen 1 ♀ 28 July 1957; Askøy: Herdla 1 ♀ July 1939 (H). Recorded from Oppland (Strand 1898a).

**Paraperithous gnathaulax* (Thomson). Bv: Hol: Geilo 1 ♀ 25 June 1967.

Iseropus stercorator (F.). HOy: Askøy: Herdla 1 ♀ 19 July 1937 (H). Also found in VAy: Mandal (Roman 1942). Records from Hedmark (Strand 1898a) might be correct.

**Trematobia variabilis* (Hlmgr.). Ry: Klepp: Orre 1 ♂ 27 July 1960.

**Zaglyptus v. varipes* (Grav.). Ry: Sokndal 1 ♂ 3 August 1960.

Clistopyga incitator (F.). Ri: Forsand 1 ♀ 28 June 1945 (H). HOy: Ølen: Vikebygd 1 ♀ 17 July 1967. MRy: Ørsta: Viddal 2 ♀♀ 26 June 1946 (H). Moreover recorded from Hardangervidda (Jussila 1973).

Oxyrrhexis c. carbonator (Grav.). Ri: Forsand 3 ♀♀ 24 June and 5 July 1945 (H). HOy: Ølen: Vikebygd 1 ♀ 17 July 1967; Bergen 1 ex 6 July 1952 (H). HOi: Kvinnherad: Guddalsdalen 1 ♂ 9 June 1943 (H). SFy: Gulen: Indre Takle 1 ♀ 21 July 1944 (H). Recorded earlier from Southern and Northern Norway (Siebke 1863, Roman 1942).

**Schizopyga frigida* Cress. (*atra* Kriechbaumer). HOi: Granvin: Seim 1 ex 30 May 1936.

**Polysphincta rufipes* Grav. STi: Røros: Feragen 1 ♀ 17 July 1966.

**Itoplectis aterrima* Jussila. Ry: Klepp: Vik

1 ♀ 27 July 1960. HOy: Bergen 1 ♀ 17 September 1967.

**I. a. alternans* Grav. HOy: Bergen 1 ex 29 September 1934 (H).

**Ephialtes quadridentatus* (Thomson). HOi: Strandebarm: Eikenes 1 ♀ 1 July 1970.

Coccygomius arcticus Zetterstedt. Fn: Porsanger: Skoganvarre 1 ♀ 13 July 1941 (H). Distributed throughout Norway (Siebke 1868, Strand 1898a, Roman 1936, 1942).

C. t. turionellae (L.). AK: Oslo: Hovedøya 1 ♀ 20 August 1937. HOy: Os: Hagavik 1 ♂ 16 May 1937 (H); Lysekloster 1 ♀ 13 July 1965; Nordstrønen 1 ♀ 18 July 1963 and 3 ♀♀ August 1965; Bergen 1 ♀ e.l. Lepidoptera (on *Rosa* sp.) 4 July 1934 (H). 1 ♀ 7 June 1967, 1 ♀ 10 August 1967, 2 ♀♀ 1 June 1968 and 19 June 1971; Askøy: Turøy 1 ex 9 July 1954 (H); Lindås: Kolås 1 ♀ 6 June 1965. SFi: Luster: Fortun 1 ex 15 July 1938 (H). Distributed throughout Norway (Strand 1898a, Roman 1936, 1942).

C. aquilonius flavicoxis (Thomson). HEn: Kvikne: By the church 1 ♂ 22 June 1967. HOy: Stord: Leirvik 1 ♀ 11 July 1969; Austevoll: Hækjingen 1 ♀ 21 August 1953 (H); Fjell: Bjorøya 1 ex 15 August 1954 (H); Bergen 1 ex 12 September 1937 (H), 1 ex 29 June 1955 (H); Vaksdal: Eidslandet 1 ♀ 28 June 1969. HOi: Kvinnherad: Skeie 1 ex 17 July 1943 (H). SFi: Leikanger: Hermansverk 1 ♀ 19 September 1941 (H); Balestrand: Fjærland 1 ex 28 June (H). Distributed throughout Norway (Jussila 1973).

**C. melanacrias* (Perkins). Ry: Hå: Ogna 1 ♂ 4 August 1960. Fi: Alta: Arones 1 ♂ 28 July 1955.

C. spurius (Grav.). VE: Tjøme: Kjære 1 ♀ 11 August 1966. Ry: Sokndal: Rekefjord and Sokndal 2 ♂♂ 2 and 3 August 1960; Klepp: Vik 1 ♂ 8 August 1960. Also found in Vest-Agder (Roman 1942).

Perithous m. mediator (F.). VE: Skoger: Konnerud 1 ♀ 5 August 1922. HOy: Osterøy: Kleppe 1 ♀ 8 July 1952 (H). HOi: Voss 1 ♀ 30 June 1969. Recorded earlier from Oppland (Strand 1898a).

**P. divinator* (Rossi). Ry: Stavanger 5 ♀♀ April 1932 (H).

Delomerista texana (Cresson). HOy: Bergen 1 ♀ 6 July 1935, 1 ♂ 1 June 1954. HOi: Kvinnherad: Varaldsøy 1 ♂ 31 May 1969. Recorded also from Hardangervidda (Jussila 1973).

Rhyssa persuasoria (L.). HOy: Bergen 1 ♀ 27 April 1957 (H) and 1 ♀ 13 August 1959. HOi: Kvinnherad: Fjellberg 1 ♀ 20 July 1970. Also recorded from Hedmark (Strand 1898a).

Neoxorides collaris (Grav.). SFi: Leikanger: Hermansverk 1 ♀ 5 July 1939 (H). Previously found in Northern Norway (Roman 1936).

**Megarhyssa emarginatoria* (Thunberg). HOy: Bergen 1 ♀ June 1948 (H).

SUBFAMILY *TRYPHONINAE*

Netelia cristata (Thomson). HOy: Ølen: Vikebygd 1 ♀ 12 September 1971. Also recorded from Hardangervidda (Jussila 1973).

N. latungula (Thomson). VE: Tjøme: Mostranda 1 ♂ and 1 ♀ 1 June 1967. HOy: Vaksdal: Eidslandet 1 ♂ 30 August 1970; Meland: Brakstad 1 ♀ 8 September 1968. HOi: Kvinnherad: Rosendal 1 ♂ 5 June 1967. Moreover recorded from Hardangervidda (Jussila 1973).

**N. virgata* (Grav.). VAy: Kvinesdal: Gjemlestad 1 ♀ 7 August 1917. HOy: Os: Lysekloster 1 ♂ 23 August 1965 (J); Bergen 3 ♂♂ 15 August 1969; Vaksdal: Eidslandet 2 ♂♂ 19 August 1966 (J). SFi: Aurland: Vassbygda 1 ♂ and 4 ♀♀ 17 and 18 August 1940.

**Hercus fontinalis* (Hlmgr.). SFy: Gaular: Sande 1 ♂ 21 June 1942 (H). Earlier recorded from Northern Norway (Strand 1913).

**Thymaris contaminatus* (Grav.) (*pulchricornis* Brischke). SFi: Aurland: Vassbygda 2 ♀♀ 18 August 1940 and 14 August 1941 (H).

Polyblastus carbonator Kasparyan (*carbonarius* auctt.). Bv: Hol: Haugastøl 1 ♀ 16 July 1973. STi: Oppdal: Knutshø 1 ♀ 16–23 June 1967. Recorded earlier from Hardangervidda and Northern Norway (Jussila 1973).

P. palaemon Schiødte. SFi: Aurland: Otternes 1 ♂ 14 June 1939. Earlier found in Northern Norway (Strand 1913).

P. varitarsus (Grav.). HEn: Folldal: Borkhus 1 ♂ 22 July 1966. HOy: Os: Hagavik 1 ♀ 11 August 1945, Søfteland 1 ♀ 11 June 1967. NTi: Verdal: Stiklestad 1 ♂ 10 August 1959. Known from Oppland (Holmgren 1855) and Northern Norway (Roman 1942).

**P. wahlbergi* Hlmgr. (*wesmaeli* Hlmgr.). HOy: Tysnes: Ånuglo 1 ♂ 10 June 1965; Os: Heglandsdal 1 ♂ 29 May 1966. HOi: Kvinnherad: Rosendal 1 ♂ 2 July 1966. SFi: Lørdal 1 ♂ 28 June 1938.

Ctenochira pastoralis (Grav.). HOY: Bergen 1 ♀ 4 September 1936 (H). SFi: Aurland: Vassbygda 1 ♀ 18 August 1940 (H). Known from Hardangervidda and Northern Norway (Jussila 1973).

C. rufipes (Grav.). STi: Oppdal: Grosmyra 1 ♂ 18 June 1967. Also recorded from Hardangervidda and Northern Norway (Jussila 1973).

*_C. xanthopyga_ (Hlmgr.). HOi: Kinsarvik: Grøndalen (see Fjellberg 1972 p. 17 loc. 48) 1 ♀ 2 August 1968.

*_C. arcuata_ (Hlmgr.). SFy: Høyanger: Vadheim 1 ♂ 17 June 1942 (H).

Erromenus brunnicans (Grav.). Ø: Halden: Idd 1 ♀ July 1925. Ry: Klepp: Vik 1 ♂ 27 July 1960. Also found in Northern Norway (Strand 1913).

*_E. calcator_ (Müller). HOy: Ølen: Vikebygd 1 ♀ 31 May 1966.

E. punctulatus Hlmgr. HOy: Os: Søfteland 1 ♀ 11 June 1967. STi: Oppdal: Vårstigen 1 ♂ 17 June 1967. Known from Hardangervidda and Northern Norway (Jussila 1973).

E. punctulatus Woldstedt (_simplex_ Thomson). HOy: Bergen 1 ♂ 28 July 1953 (H). Recorded from Aust-Agder, Hardangervidda and Northern Norway (Strand 1913, Jussila 1973).

*_E. zonarius_ (Grav.). SFi: Aurland: Aurlandsvangen 1 ♂ 16 June 1939 (H).

*_Monoblastus brachycanthus_ (Grav.). SFi: Årland: Øvre Årdal 2 ♂♂ 1 July 1938 (H).

Cosmoconus elongator (F.). AAy: Lillesand: Høvåg 1 ♂ 22 July 1961. Ry: Klepp: Reve 1 ♀ 31 July 1963. HOy: Sund: Tyssøy 1 ♀ 24 July 1952 (H); Bergen 3 ♀♀ 30 July 1951 (H), 1 ♂ 8 August 1964, 1 ♂ 18 July 1965, 1 ♂ 25 August 1965, 1 ♂ 28 July 1966 and 1 ♂ 12 July 1972; Askøy: Herdla 1 ♂ 29 July 1935 (H), 1 ♂ July 1936, 1 ♂ 16 July 1964. HOi: Ullensvang: Lofthus 1 ♀ 16 July 1952 (H), Ringsøy 1 ♂ 16 July 1967. SFy: Askvoll: 1 ♂ 21 August 1954 (H); Vågsøy: Refvik 1 ♂ 18 July 1957. SFi: Aurland: Vassbygda 3 ♂♂ 17–18 August 1940 and 19 August 1941 (H). MRy: Vestnes: Vikabukt 1 ♀ 31 July 1957; Aukra 1 ♂ 13 August 1957. NTi: Frosta: Holmberget 1 ♂ 13 August 1969. Also found in Vest-Agder (Roman 1942).

*_C. ceratophorus_ (Thomson). HOy: Bergen 1 ♂ 28 August 1956. SFi: Stryn 1 ♀ 14 July 1957.

*_Tryphon abditor_ Kasparyan. Ø: Kråkerøy 1 ♂ 19 July 1958. AAy: Hisøy: Flødevigen 1 ♀ 12 July 1960. HOy: Bergen 3 ♀♀ 17 July 1966 and 12 July 1972. STy: Bjugn 1 ♀ 5 July 1959.

*_T. relator_ (Thunberg). Ry: Sokndal: Rekefjord 1 ♀ 3 August 1960. HOy: Bergen 1 ♂ 18 May 1958.

T. trochanteratus Hlmgr. HOy: Askøy: Io 2 ♀♀ 4 July 1964. Earlier found in Southern Norway (Strand 1913).

T. obtusator (Thunberg). Ø: Halden 2 ♀♀ 5 June 1967. AK: Nesodden 1 ♀ 17 June 1957. Bø: Krødsherad: Veikåker 2 ♂♂ 14 June 1963. VE: Tjøme: Hvasser 1 ♀ 2 June 1967. Ri: Suldal: Jelsa 1 ♂ 3 July 1969. HOy: Eide 1 ♂ 31 May 1963, Søfteland 1 ♀ and 3 ♂♂ 11 June 1967; Bergen 7 ♂♂ and 2 ♀♀ May–June 1935–1954 (H) and 2 ♂♂ 6 ♀♀ June–July 1962–1967; Vaksdal: Eidslandet 2 ♂♂ 16 and 17 June 1968; Askøy: Herdla 6 ♂♂ and 3 ♀♀ June–July 1935–37 (H); Meland: Brakstad 9 ♂♂ June 1965–68. HOi: Kvinnherad: Murabotten 1 ♀ 9 May 1965; Ullensvang: Fresvik 1 ♂ 3 June 1953 (H), Lofthus 1 ♂ 23 May 1950; Kinsarvik: Kvanndal 2 ♂♂ 12 June 1964 and 2 June 1968; Voss: Vossevangen 1 ♂ 10 June 1935 (H). SFy: Høyanger: Vadheim 1 ♂ 17 June 1942 (H). Ni: Saltdal: Vensmoen 1 ♀ 8 August 1955. Fi: Alta: Bossekop 1 ♀ 24 July 1955. Also recorded from Hedmark and Hardangervidda (Jussila 1973).

T. brunniventris Grav. HOy: Bergen 1 ♀ 21 August 1969. Fø: Sør-Varanger: Skogfoss 1 ♀ 21 July 1969. Recorded earlier from Hedmark, Hardangervidda and Northern Norway (Jussila 1973).

T. incestus Hlmgr. Ry: Sokndal: Rekefjord 1 ♂ 3 August 1960. HOy: Os: Søfteland 1 ♂ 11 June 1967; Bergen 1 ♀ 19 June 1957, 1 ♂ 12 June 1966; Lindås: Alversund 1 ♀ 6 June 1965. HOi: Granvin: Seim 1 ♂ 31 May 1936. SFi: Lærdal: Borgund 1 ♂ 25 July 1938, Bjørkum 1 ♂ 21 June 1939 (H); Hornindal 1 ♂ 15 July 1957. Occurring throughout Norway (Jussila 1973).

*_T. thomsoni_ Roman. HOy: Askøy: Herdla 2 ♂♂ July 1936 (H).

*_Kristotomus laetus_ (Grav.). SFi: Årdal: Øvre Årdal 2 ♂♂ 1 July 1938 (H).

Exenterus ictericus (Grav.). Ø: Hvaler: Asmaløy 1 ♂ 20 July 1958. HOy: Os: Bjørnefjorden 2 ♀♀ 5 July 1953 (H). Known from Akershus and Aust-Agder (Roman 1942).

*_E. abruptorius_ (Grav.). Bv: Hol: Iungdalen 1 ♂ 30 July 1944 (H).

**Exyston sponsorius* (F.) (*cinctulus* Grav.). Bø: Drammen: Hokksund 3 ♂♂ 5 May 1921 (H). Nnv: Hol: Storhelle 1 ♂ 17 July 1959.

Smicroplectrus j. jucundus (Hlmgr.). HOi: Kinsarvik: Stavali (cf. Fjellberg 1972 p. 14 loc. 13) 2 ♀♀ 27 July 1968. STi: Oppdal: Grosmyra 1 ♂ 18 June 1967. Earlier recorded from Hardangervidda (Jussila 1973).

Eridolius consobrinus (Hlmgr.). HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 2) 1 ♂ and 1 ♀ 27 July 1968. Earlier recorded from Northern Norway and Hardangervidda (Strand 1913, Jussila 1973).

**E. pictus* (Grav.). VE: Tjøme: Kjære 1 ♀ 21 May 1967. Ry: Klepp: Vik 2 ♀♀ 29 July and 1 August 1960; Stavanger 1 ♂ June 1929. HOy: Lindås: Alversund 1 ♀ 6 June 1965.

E. flavomaculatus (Grav.). SFi: Vik: Målset 1 ♂ 12 July 1941 and Vålahole 1 ♂ 11 July 1940 (H). Earlier found in Hardangervidda and Northern Norway (Jussila 1973).

SUBFAMILY *GELINAE*

**Thrybius tricolor* (Grav.), comb.n. (*Cryptus tricolor* Gravenhorst 1829b, p. 514; *Thrybius* Townes in Townes, Momoi & Townes 1965, p. 602). HOi: Eidfjord: Sysenvann (Fjelberg 1972, p. 39, loc. 337) 1 ♂ 5 August 1969.

**Pycnocryptus director* (Thunberg). HOy: Bergen 1 ♂ 2 June 1968. SFi: Aurland: Aurlandsvangen 1 ♂ 19 June 1938; Årdal: Øvre Årdal 1 ♂ 3 July 1938.

Buathra l. laborator (Thunberg). On: Vågå: Randsverk 1 ♂ 6 July 1961. HOy: Askøy: Herdla 1 ♀ 23 July 1937. SFi: Årdal: Øvre Årdal 1 ♀ 3 July 1938. Occurring throughout Norway (Jussila 1973).

Itamoplex viduatorius (F.). Ø: Onsøy: Dypeklo 1 ♂ 7 July 1958. HOy: Bergen 1 ♀ 23 May 1937. Known from Oppland (Strand 1898a, Vest-Agder and Hordaland (Roman 1942).

I. dianae obscuripes (Zetterstedt). HOy: Askøy: Herdla 1 ♀ 19 June 1936. Also recorded from Northern Norway (Strand 1898a, Roman 1936, 1942).

I. armator (F.). Ø: Halden 1 ♂ 5 June 1967. HEn: Kvikne: By the church 1 ♂ 22 June 1967. TEi: Hjartdal: From stomach of *Salmo trutta* L. taken in lake Vindsjå 3 ♀♀ August 1967. Ry: Hå: Brusand 1 ♂ 4 August 1960. HOi: Kvinnherad: Varaldsøy 1 ♂ 31 May 1969; Voss: Mjølfjell 1 ♀ 20 June 1966. STi: Oppdal: Kongsvoll 2 ♀♀ and 2 ♂♂ 12–14 July 1966; Rise 1 ♂ 22 June 1967. TRy: Skjervøy: Ravelseidet 1 ♀ and 1 ♂ 20 July 1955. TRi: Målselv: Aundhaug 1♀ 13 July 1955. Fi: Alta: Gargia 1 ♀ 25 July and Bossekop 1 ♀ 29 July 1955. Recorded from Hardangervidda and Northern Norway (Jussila 1973).

Meringopus titillator (L.). HOi: Kvinnherad: Branvikshorgi 1 ♂ 12 June 1969. Also recorded from Dovre (Siebke 1863).

Idiolispa a. analis (Grav.). HOy: Bergen 1 ♀ 15 August 1951. HOi: Ullensvang: Lofthus 1 ♂ 30 May 1951. Recorded in Northern Norway (Roman 1936).

Trychosis legator (Thunberg). Ri: Suldal: Saudasjøen 1 ♀ 22 May 1935. HOy: Askøy: Herdla 1 ♀ 25 June 1936. Moreover recorded from Aust-Agder and Vest-Agder (Roman 1942).

**Echthrus r. relucator* (L.). HOy: Bergen 1 ♀ 26 May 1957. HOi: Kvinnherad: Murabotn 1 ♀ 2 May 1965; Ullensvang: Djønno 1 ♀ 2 June 1941.

**Helcostizus r. restaurator* (F.). SFi: Aurland: Vassbygda 1 ♂ 18 August 1940.

Sphecaphaga v. vesparum (Curtis). HOy: Bergen 1 ♀ 30 June 1953. MRy: Kristiansund 1 ♂ 25 March 1963 from a wasp nest. Earlier recorded from Malangen in Troms (Roman 1942).

Parmortha p. parvula (Grav.). HOy: Bergen 1 ♀ 29 August 1937 and 1 ♂ 25 June 1964. HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 3) 1 ♂ 25 July 1968. SFi: Lærdal: Kvamma 1 ♀ 28 June 1938. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

Cubocephalus associator (Thunberg). HOy: Os: Heglandsdal 1 ♂ 29 May 1966. Earlier recorded as *Cratocryptus associator alpinus* Strobl from HOi: Granvin (Roman 1942).

**C. anatorius* (Grav.). Ri: Forsand 1 ♂ 10 July 1945. HOy: Bergen 1 ♂ 9 May 1937, 1 ♂ 11 June 1953. HOi: Kinsarvik: Stavali (cf. Fjellberg 1972 p. 13 loc. 2) 1 ♂ 25 July 1968; Eidfjord: Rjoto (Fjellberg 1972 p. 29 loc. 208) 1 ♂ 23 July 1968. SFi: Årdal: Øvre Årdal 1 ♂ 1 July 1938.

Oresbius septentrionalis (Thomson), comb.n. (*Microcryptus septentrionalis* Thomson 1883, p. 863; *Oresbius* Marshall 1867, p. 193). HOy: Bergenl ♂ 6 June 1968. HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 3 and p. 15, loc. 29) 2 ♂♂ 25 and 30 July 1968. Earlier recorded from TRy: Karlsøy: Hushattøy (Roman 1942).

O. nivalis (Zetterstedt). Ø: Halden: Berg 1 ♂ 6 June 1967. On: Vågå: Valdersflya 1 ♂ 10 July 1966. HOy: Bergen 1 ♂ 4 June 1969. TRi: Målselv 1 ♂ 10 July 1955. Known from Hardangervidda (Jussila 1973).

Polytribax gravenhorsti (Thomson), comb.n. (*Microcryptus Gravenhorsti* Thomson 1883, p. 854; *Polytribax* Förster 1868, p. 183). HOi: Kvinnherad: Berget 1 ♂ 11 June 1965. Earlier known from Northern Norway (Strand 1913).

Schenkia opacula (Thomson). VAy: Kvinesdal: Gjemlestad 1 ♂ 9 July 1945. SFy: Gaular: Sande 1 ♂ 21 June 1942. Earlier recorded from Nordland and Hardangervidda (Strand 1913, Jussila 1973).

Pleolophus micropterus (Grav.). HOi: Kvinnherad: Hatlestrand 1 ♀ 24 June 1974. SFi: Leikanger: 1 ♀ 2 July 1939. Known throughout Norway (Strand 1913, Roman 1936).

P. basizonius (Grav.). HOy: Os: Hagavik 2 ♂♂ 16 May 1937, Halgjem 1 ♂ 19 August 1962; Askøy: Herdla 1 ♀ 19 July 1937. HOy: Granvin: Seim 1 ♂ 31 May 1936. SFy: Jølster: Skei 1 ♂ 3 July 1942. SFi: Aurland: Berekvam 1 ♀ 8 July 1965; Leikanger: Njøs 1 ♂ 30 May 1948; Balestrand: Fjærland 1 ♂ 28 June 1939. Nnø: Tysfjord 1 ♀ 21 July 1947; Narvik 1 ♀ 21 July 1959. Earlier recorded from Southern Norway (Strand 1913, Roman 1942).

P. sperator (Müller). HOy: Os: Hagavik 2 ♂♂ 16 May 1937; Vaksdal: Eidslandet 1 ♂ 28 August 1970. SFi: Lærdal: Eggum 1 ♂ 21 June 1938. Earlier recorded from Akershus, Buskerud and Northern Norway (Strand 1906, 1913, Roman 1942).

Aptesis assimilis (Grav.). HOy: Bergen 1 ♂ 29 May 1967. Earlier recorded from Hardangervidda (Jussila 1973).

A. nigrocinctus (Grav.). Bv: Hol: Iungsdalen 1 ♂ 22 July 1944. HOy: Austevoll: Yttrøy 1 ♂ 25 August 1954; Bergen 1 ♂ 13 June 1937. SFi: Leikanger 2 ♂♂ 2 and 5 July 1939; Balestrand: Fjærland 1 ♂ 28 June 1939. STy: Agdenes: Storevann 1 ♂ 10 September 1967. Nnv: Buksnes 1 ♂ 17 July 1959. Found throughout Norway (Strand 1913, Jussila 1973).

Mesoleptus l. laevigatus (Grav.). SFi: Balestrand: Fjærland 2 ♂♂ 28 June 1939. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

M. filicornis (Thomson). Ri: Forsand 1 ♀ 10 July 1945. SFi: Lærdal: Seltun 1 ♂ 23 June 1939. Known from Hardangervidda (Jussila 1973).

Atractodes Grav. As a taxonomic and nomenlatural revision of this genus is in progress an enumeration of the many species belongig here have to be postponed.

Stilpnus gagates Grav. HOy: Bergen 1 ♀ 15 August 1935; Austrheim: Fedje 1 ♀ 25 July 1954. Earlier found in Tromsø (Roman 1942).

S. tenebricosus (Grav.). Ry: Klepp: Revtangen 1 ♀ 6 August 1966. HOi: Eidfjord: Isdalen (Fjellberg 1972, p. 38, loc. 321) 1 ♂ and 1 ♀ 30 June 1969. Occurring throughout Norway (Jussila 1973).

*_Endasys parviventris_ (Grav.). On: Nord-Aurland: W Damtjern 1 ♂ 9 August 1970.

*_E. erythrogaster_ (Grav.). Ri: Årdal: Valda 1 ♂ 8 August 1966.

*_E. minutulus_ (Thomson). HOy: Bergen 2 ♂♂ 25 May 1938, 12 June 1937 and 1 ♂ 14 June 1958. HOi: Granvin: Skjervet 1 ♂ 9 June 1935.

Glyphicnemis profligator (F.). VE: Sande 1 ♀ 25 July 1969. Ri: Sokndal: Rekefjord 1 ♂ 3 August 1960. Ri: Årdal: Valda 1 ♀ 8 August 1966. HOy: Os: Trollholmen 1 ♂ 14 July 1967. HOi: Kinsarvik: Ringøy 1 ♂ 16 July 1967. SFy: Hyllestad 1 ♂ 30 June 1963. Moreover recorded from Nsy: Sømnes (Roman 1942).

*_Medophron afflictor_ (Grav.). Bv: Hol: Haugastøl area 1 ♀ 26 July 1973. HOi: Ullensvang: Lofthus 2 ♂♂ 28 May 1951.

Phygadeuon rugulosus Thomson. Ry: Bjerkreim 1 ♂ 20 May 1936. HOy: Tysnes: Ånugla 1 ♂ 29 May 1969; Bergen 3 ♂♂ 5 August 1935 and 4 July 1937; Askøy: Herdla 1 ♀ 6 July 1964. HOi: Ullensvang: Lofthus 1 ♂ 28 May 1951. STi: Oppland: Vårstigen 1 ♂ 16 July 1966. Earlier recorded from Hardangervidda (Jussila 1973).

P. lapponicus Thomson. Ry: Sokndal: Rekefjord 2 ♂♂ 2–3 August 1960. HOi: Eidfjord: Øvre Eidfjord (Fjellberg 1972, p. 34, loc. 269) 1 ♂ 8 July 1967; Voss: Skjervet 1 ♀ 9 June 1935. SFi: Aurland: Vassbygda 1 ♂ 18 June 1939. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

P. brachyurus Thomson. HEn: Kvikne: Lillefossen 1 ♂ 22 June 1967. Bv: Hol: Haugastøl area 1 ♂ 26 July 1973. HOy: Bergen 2 ♂♂ 23

May and 11 September 1937, 1 ♂ 10 July 1943; Askøy: Herdla 4 ♂♂ 4–17 June 1936. HOi: Kvinnherad: Rosendal 1 ♂ 10 July 1943; Ullensvang: Kinsekvelv (Fjellberg 1972, p. 23, loc. 119) 1 ♂ 6 July 1968 and Lofthus 1 ♂ 28 May 1951; Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 5 and p. 17 loc. 48) 2 ♂♂ 26 July and 2 August 1968. Also earlier recorded from Hardangervidda (Jussila 1973).

P. laeviventris Thomson. HOy: Bergen 1 ♂ 23 May 1937. HOi: Kvinnherad: Rosendal 1 ♀ 10 July 1943. SFi: Lærdal: Maristova 1 ♂ 29 June 1938. Earlier recorded from Southern Norway (Strand 1913, Jussila 1973).

**P. exiguus* Grav. HOy: Bergen 1 ♀ 22 September 1937. HOi: Voss: Bordalen 1 ♂ 31 July 1942. SFi: Aurland: Vassbygda 1 ♂ 18 June 1939.

P. f. fumator (Grav.). HOy: Bergen 1 ♀ 22 September 1937; Askøy: Herdla 1 ♀ 15 June 1936. HOi: Voss: Bordalen 1 ♂ 31 July 1942; Granvin: Holven and Seim 2 ♂♂ 31 May 1936. SFi: Aurland: Vassbygda 1 ♀ 18 August 1940; Balestrand: Brekka 6 June 1935. STi: Oppdal: Rise 1 ♂ 24 June 1967. Known from Buskerud, Hardangervidda and Northern Norway (Strand 1916, Jussila 1973).

P. fumator nivalis Hlmgr. STi: Oppdal: Vårstigen 1 ♂ 16 July 1966. Earlier recorded from Hardangervidda (Jussila 1973).

P. punctipleuris Thomson. HOy: Bergen 1 ♂ 6 July 1935; Askøy: Herdla 1 ♀ 15 June 1936. SFi: Aurland: Aurlandsvangen 1 ♂ 19 June 1938. Recorded from Buskerud, Hardangervidda (Strand 1916, Jussila 1973).

P. trichops Thomson. HOy: Bergen 1 ♀ 30 June 1934 and 1 ♀ 1 September 1937; Meland: Brakstad 1 ♂ and 1 ♀ 28 May 1968. HOi: Kvinnherad: Rosendal 1 ♀ 23 August 1944. SFi: Vik: Målset 1 ♀ 10 July 1934. Moreover recorded from Hardangervidda and Northern Norway (Jussila 1973).

**Arotrephes parvipennis* (Thomson). HOy: Bergen: Milde 1 ♂ 23 May 1968; Osterøy: Borgå 1 ♂ 12 May 1935.

Charitopes similis (Gmelin). HOy: Bergen 1 ♂ 23 May 1937. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

C. melanogaster (Thomson). HOy: Os: Hagavik 1 ♀ 16 May 1935; Bergen: 1 ♂ 6 June 1935 and 1 ♀ 13 October. HOi: Voss: Skjervet 1 ♂ 9 June 1935. Moreover recorded from Hardangervidda (Jussila 1973).

Arctoudouon glacialis (Hlmgr.). HOi: Stavali (cf. Fjellberg 1972 p. 13 loc. 3) 1 ♂ 25 July 1968. Earlier recorded from Hardangervidda as well and additionally from Suldal in Rogaland (Jussila 1973).

**Acrolyta distincta* (Bridgman). HOi: Eidfjord: Måbødalen (Fjellberg 1972, p. 36. loc. 297) 1 ♂ 4 July 1969. STi: Oppdal: Drivstua 1 ♂ 17 June 1967.

Mastrus inimicus (Grav.). HOy: Bergen 1 ♂ 23 May 1937. SFi: Stryn: Innvik 1 ♀ 31 July 1942. Earlier recorded from Hardangervidda and Northern Norway (Strand 1913, Jussila 1973).

M. gallicola (Bridgman). Ry: Hå: Brusand 2 ♂♂ 4 August 1960. Ri: Forsand: Lerang 1 ♂ 15 June 1931. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

**Pygocryptus grandis* (Thomson). HOi: Kinsarvik: Djønno 1 ♀ 5 June 1938.

**Gnotus chionops* (Grav.). HOy: Bergen 1 ♂ 2 May 1937.

Sulcarius hellbachi (Schmiedeknecht). STi: Oppdal: Grosmyra 1 ♂ 18 June 1967. Recorded from Hardangervidda (Jussila 1973).

**Uchidella clavipes* (Thomson). HOi: Voss: Skjervet 1 ♂ 9 June 1935.

Rhadiurginus areator (Panzer). HOy: Bergen 1 ♂ 15 August 1936, 2 ♀♀ 3 and 7 June 1937. HOi: Kvinnherad: Rosendal 1 ♂ 6 June 1966 and 1 ♀ 3 June 1967. Distributed throughout Norway (Strand 1906, 1913, Roman 1936).

**Rh. pumbeus* (Thomson). Ry: Hå: Brusand 2 ♂♂ 4 August 1960.

**Hemiteles unicolor* Thomson. Ri: Forsand 1 ♂ 8 July 1945.

Aclastus minutus (Bridgman). HOi: Eidsfjord: Måbødalen (Fjellberg 1972, p. 36, loc. 292) 1 ♂ 7 August 1968. Earlier found in Northern Norway (Roman 1942).

A. gracilis (Thomson). Ry: Sokndal 4 ♂♂ 2 August 1960. Ri: Forsand: Lerang 1 ♂ 15 June 1935. HOy: Bergen 1 ♂ 19 May 1960. HOi: Kinsarvik: Sysenvann (see Fjellberg 1972 p. 39 loc. 338) 1 ♂ 5 August 1969; Eidfjord: Øvre Eidfjord (cf. Fjellberg 1972 p. 34 loc. 269) 1 ♀ 10 July 1967; Voss: Hjelle 2 ♂♂ 29 July 1942; Granvin: Skjervet 1 ♀ 9 June 1935. Distributed throughout Norway (Jussila 1973).

**Therescopus micator* (Grav.). HOi: Kvinnherad: Rosendal 1 ♀ 10 July 1943.

Gelis agilis (F.). HOy: Bergen 1 ♂ and 1 ♀

11 September 1937; Askøy: Herdla 1 ♂ 19 June 1936. HOi: Voss: Hjelle 1 ♀ 19 July 1942. SFi: Lærdal: Eggum 1 ♂ 24 June 1938. MRy: Volda 1 ♀ 22 September 1966. Recorded throughout Norway (Strand 1898a, 1906, 1913, Roman 1936).

G. instabilis (Förster). Ry: Sokndal 1 ♂ 2 August 1960. HOy: Bergen 1 ♂ 2 August 1936 and 5 ♀♀ 2–9 May 1937; Askøy: Herdla 1 ♂ 3 July 1935 and 3 ♀♀ July–August 1937. HOi: Voss: Hjelle 1 ♂ 27 July 1942; Granvin: Seim 2 ♂♂ 30–31 June 1936, Skjervet 1 ♂ 9 June 1935. SFi: Aurland: Flåm 1 ♂ 16 August 1965; Lærdal: Eggum 2 ♂♂ 24 June 1938 e.l. *Fumea casta* Pallas (Lep., Psychidae); Årdal: Øvre Årdal 1 ♀ 10 July 1939. Occurring throughout Norway (Jussila 1973).

G.acarorum (L.). HOy: Bergen 1 ♀ 18 September 1937. SFi: Lærdal: Eggum 1 ♀ 24 June 1938. Recorded throughout Norway (Strand 1913, Jussila 1973).

*_G. hortensis_ (Grav.). HOy: Bergen 1 ♀ July 1934.

G. tonsus (Förster). HOy: Askøy: Herdla 1 ♀ 29 July 1935. Recorded throughout Norway (Strand 1913, Jussila 1973).

*_G. attentus_ (Förster). HOy: Bergen 1 ♀ 2 May 1937.

G. analis (Förster). HOy: Bergen 4 ♀♀ 2 May and 22 September 1937. Earlier recorded from Northern Norway (Roman 1936).

*_Encrateola laevigata_ (Ratzeburg). HOy: Bergen 1 ♀ 25 June 1934 and 1 ♀ 15 August 1936. HOi: Kinsarvik: Djønno 1 ♀ 5 June 1938.

SUBFAMILY *BANCHINAE*

Glypta ceratites Grav. HOy: Askøy: Herdla 1 ♂ 5 June 1936 (H), 1 ♂ and 1 ♀ 23 July 1937 (H). SFi: Årdal: Utdalen 1 ♀ 10 July 1939 (H). Recorded throughout Norway (Strand 1913, Roman 1942).

*_G. extincta_ Ratzeburg. SFi: Vik: Valafjell 1 ♀ 16 July 1940 (H).

*_G. heterocera_ Thomson. Ry: Klepp: Orre 1 ♂ and 1 ♀ 27 July 1960. HOy: Bergen 1 ♂ 17 July 1966; Vaksdal: Eidslandet 1 ♀ 2 July 1966. SFi: Årdal: Øvre Årdal 1 ♂ 10 July 1966.

*_G. fronticornis_ Grav. HOy: Bergen 1 ♀ 14 August 1936 (H).

*_G. b. bicornis_ Boie. V: Tjøme: Kjære 1 ♀ 10 August 1966.

G. teres Grav. HOy: Bergen 1 ♂ 8 July 1934. Also found in Northern Norway (Roman 1936).

G. scalaris Grav. SFi: Aurland: Vassbygda 1 ♂ 18 August 1940. A female from Fi: Alta: Jotkajärvi may belong to this species (Roman 1936).

*_G. parvicaudata_ Bridgman. Ry: Klepp: Orre 1 ♀ 10 May 1957. HOy: Fjell: Solsvik 2 ♀♀ 8 August 1964; Bergen 1 ♀ 8 August 1964; Askøy: Herdla 2 ♂♂ and 1 ♀ July 1936 and 23 July 1937. SFi: Lærdal: Hegg 1 ♂ 24 July 1938.

G. bifoleata Grav. SFi: Aurland: Vassbygda 1 ♀ 17 August 1941 (H). Also found in Northern Norway (Strand 1913, Roman 1936).

Apophua bipunctoria (Thunberg). HOy: Bergen 1 ♀ 29 June 1934 (H). Also found from AAy: Hisøy (Roman 1942).

Lampronota catenator (Panzer). AAy: Høvåg 2 ♀♀ 22 July 1961 and 21 July 1966. HOy: Stord 1 ♀ 11 July 1969; Vaksdal: Eidslandet 1 ♀ 28 June 1969. HOi: Voss 1 ♀ 7 July 1969. Earlier recorded from Aust-Agder (Roman 1936).

*_L. impressor_ (Grav.). HOy: Bergen 1 ♂ 3 October 1941 (H).

Lissonota bellator Grav. On: Vestre Slidre: Einang 1 ♂ 5 July 1944 (H). Ry: Klepp: Vik 1 ♂ 1 August 1960. Ri: Forsand 1 ♂ August 1945 (H). HOy: Samnanger: Høyseter 1 ex 3–10 August 1947 (H); Bergen 6 ♀♀ 9–15 August 1935, 2 ♀♀ 2 August 1936 (H) and 2 ♀♀ 30 July 1951 (H); Askøy: Herdla 4 ♀♀ July 1936, 4 ♂♂ 23–28 July 1937 (H) and 1 ♂ 10 July 1937 (H), Io 2 ♀♀ 7 and 14 August 1964. HOi: Kvinnherad: Rosendal 1 ♀ 10 July 1943. SFi: Aurland: Vassbygda 1 ♂ 7 July 1939 and 3 ♂♂ 16–17 August 1941 (H); Stryn: Oppstryn 1 ♀ 21 July 1942 (H). MRy: Ørsta: Viddal 1 ♂ July 1946 (H). Earlier recorded from South-Eastern Norway and Hardangervidda. (Jussila 1973).

L. clypeator (Grav.). Ry: Hå: Brusand 2 ♂♂ 24 July 1960, Ogna 1 ♂ 4 August 1960; Klepp: Orre 1 ♂ 27 July 1960. HOy: Bergen 1 ♂ 19 May 1966 and 1 ♀ 27 August 1968; Askøy: Kleppestø 1 ♀ 30 September 1936 (H); Meland 1 ♀ 14 July 1966. HOi: Voss: Bordalen 2 ♀♀ 24 July 1942. Known from Hardangervidda (Jussila 1973).

L. segmentator (F.). STi: Oppdal: Drivstua 1 ♂ 17 June 1967. Earlier recorded from Northern Norway (Roman 1936).

*_L. errabunda_ Hlmgr. HOi: Kvinnherad: Rosendal 1 ♀ 25 July 1943 (H).

L. gracilenta Hlmgr. Ry: Hå: Nærbø 1 ♀ 6 August 1966; Klepp: Orre 1 ♀ 30 July 1960. Earlier recorded from Hardangervidda (Jussila 1973).

L. unicincta Hlmgr. STi: Ålen: Reitan 1 ♂ 13 August 1959. Recorded from Hardangervidda (Jussila 1973).

L. variabilis Hlmgr. Ry: Sokndal: Rekefjord 1 ♂ 3 August 1960. Earlier recorded from Buskerud (Roman 1942).

L. dubia Hlmgr. Bv: Hol: N of Halnefjorden (Fjellberg 1973, p. 41, loc. 356) 1 ♀ 29 August 1969. Ry: Klepp: Orre 1 ♀ 30 July 1960, Vik 2 ♀♀ 27 July 1960. SFi: Aurland: Frettheim 1 ♀ 12 June 1939 (H), Vangen 1 ♀ 19 June 1939 (H); Lærdal: Eggum 3 ♀♀ 24 June 1938 e.l. *Fumea casta* Pallas (Lep., Psychidae); Årdal: Øvre Årdal 1 ♀ 1 July 1938 (H). Previously recorded from Northern Norway (Strand 1913).

L. carbonaria Hlmgr. HOi: Voss: Hjelle 1 ♀ 20 July 1942 (H). Recorded from Northern Norway (Roman 1936).

L. cylindrator (Villers). HOy: Bergen 2 ♀♀ 2 August 1936 (H); Askøy: Herdla 3 ♂♂ 29 July 1935, July 1936 and 28 July 1937 (H). SFi: Vik: Framfjord 1 ♂ 31 July 1940 (H); Leikanger 1 ♂ 5 July 1939 (H). Known from AAy: Hisøy and Hardangervidda (Jussila 1973).

*_Anarthronota thuringiaca_ Schmiedeknecht. HOi: Kvinnherad: Ljosmyr 1 ♀ 23 May 1971.

Cryptopimpla anomala (Hlmgr.). HOy: Bergen 1 ♀ 26 May 1966. HOi: Kvinnherad: Berget 1 ♀ 30 June 1967. Moreover recorded from Hardangervidda (Jussila 1973).

C. errabunda (Grav.). SFi: Årdal: Øvre Årdal 1 ♂ 3 July 1938. Known from Hardangervidda (Jussila 1973).

Alloplasta piceator (Thunberg). HOy: Tysnes: Ånuglo 1 ♀ 10 June 1965; Os: Berge 1 ♀ 2 June 1963 and 1 ♂ 29 May 1966; Bergen 1 ♀ 18 May 1936 and 1 ♀ 31 May 1966; Lindås: Kolås 1 ♀ 27 May 1965. HOi: Kvinnherad: Staffvann 1 ♀ 18 May 1969; Granvin: Seim 1 ♀ 1 June 1936 (H); Skjervet 1 ♀ 9 June 1935 (H). MRi: Norddal: Valldal 1 ♀ 6 June 1948. STi: Støren: Budal 1 ♀ 21 June 1967. Earlier recorded from Hordaland (Roman 1942).

*_Arenetra pilosella_ (Grav.). Bv: Nore: Uvdal: Dagali 2 ♂♂ and 1 ♀ 14 June 1965.

Exetastes illusor Grav. SFi: Leikanger 1 ♀ 5 July 1939. Earlier recorded from TRy: Skjervøy (Roman 1936).

Banchus volutatorius (L.). Ry: Sokndal: Dalane 2 ♀♀ 12 July 1961; Klepp: Vik 4 ♂♂ and 1 ♀ 27 July 1960; Time 1 ♂ 2 July 1960; Stavanger 1 ♀ 5 August 1966. Ri: Forsand 3 ♂♂ 5–10 July 1945 (H). HOy: Tysnes: Ånuglo 2 ♀♀ 10 June 1965. HOi: Odda 5 ♂♂ 24 June 1951 (H). SFi: Sandane: Gloppen 4 ♂♂ 28 June and 3 July 1965. Earlier recorded from Southern Norway (Siebke 1870, Strand 1913).

B. falcatorius (F.). HOi: Odda 2 ♂♂ 24 June 1951 (H). SFi: Årdal: Øvre Årdal 1 ♂ 1 July 1938 (H). Previously found in Southern Norway (Strand 1898b, 1913).

SUBFAMILY *SCOLOBATINAE*

Xenoschesis resplendens (Hlmgr.). SFi: Stryn: Briksdal 1 ♀ 11 July 1957. Known from Aurland in Sogn and Fjordane (Løken 1965).

Lethades lapponicus (Hlmgr.). STi: Oppdal: Grosmyra, Gåvåli, Jerosbekken and Knutshø 1 ♂ and 3 ♀♀ 16–24 June 1967. Also recorded from Hardangervidda and Northern Norway (Jussila 1973).

L. facialis (Brischke). STi: Oppdal: Drivstua 1 ♂ 17 June 1967. Known from Hardangervidda and Northern Norway (Jussila 1973).

Trematopygus ruficornis (Hlmgr.). STi: Oppdal: Grosmyra and Vårstigen 1 ♂ and 1 ♀ 17 and 18 June 1967. Recorded from Northern Norway (Roman 1936).

*_Rhorus longicornis_ (Hlmgr.). Ø: Onsøy: Dypeklo 1 ♂ 7 Juli 1958. VAy: Mandal 1 ♀ 2 July 1960 SFy: Gloppen: Sandane 1 ♀ 2 July 1965. SFi: Leikanger 1 ♂ 5 July 1939.

R. longigena (Thomson). HOy: Bergen 1 ♀ 18 June 1966. Also recorded from Hardangervidda (Jussila 1973).

Pion fortipes (Grav.). Ry: Sandnes: Høyland 1 ♀ 22 June 1965. Hordaland (HOy): Bergen 6 ♂♂ and 2 ♀♀ 13 June 1937 (H) and 1 ♂ 15 June 1967 (G). HOi: Kinsarvik: Djønno 1 ♀ 5 June 1938 (H); Granvin 1 ♀ 15 June 1936. SFy: Gaular: Hetle 1 ♂ 24 June 1942 (H). Recorded earlier from Akershus and Hordaland (Jussila 1973).

Sympherta fuscicornis (Gmelin). Ri: Suldal: Håvardstøl 1 ♀ 12 July 1940. HOy: Bergen 1 ♀ 7 June 1937. Known from Oppland (Strand 1898a), inner districts of Hordaland and Troms (Jussila 1973).

**S. ambulator* (Thnbg.). HOi: Kvinnherad: Murabotten 1 ♂ 9 June 1965. SFi: Årdal: Årdalstangen 1 ♂ 3 July 1938 (H). STi: Støren: Budal 1 ♂ 21 June 1967.

**S. antilope* (Grav.). HOy: Bergen 1 ♀ 29 June 1962. STi: Støren: Budal 1 ♂ 22 June 1967.

**Syntactus delusor* (L.). HOy: Bergen: Nådalen 1 ♀ 30 May 1935.

**Rhaestus rufipes* (Hlmgr.). HOi: Kvinnherad: Rosendal 1 ♂ 14 June 1943.

Perilissus filicornis (Grav.). HOy: Beregn 1 ♀ 27 May 1954 (H), 1 ♂ and 1 ♀ 29 May 1967, 2 ♂♂ 29 May 1965; Meland 1 ♂ and 1 ♀ 3 and 6 June 1968. HOi: Granvin: Skjervet 1 ♂ 9 June 1935 (H). SFi: Høyanger: Vadheim 1 ♂ 17 June 1942 (H). Moreover recorded from Hardangervidda (Jussila 1973).

**P. orbitalis* (Grav.). HOy: Bergen 1 ♀ 7 July 1965.

P. pictilis Hlmgr. Ry: Ry: Klepp: Vik 1 ♀ 2 July 1960. Known from Hardangervidda (Jussila 1973).

**Oetophorus naevius* (Gmelin). HOy: Fusa: Øvre Hålandsdal 3 ♂♂ 7 June 1958. HOi: Kinsarvik: Kvanndal 1 ♀ 12 June 1964.

Opheltes g. glaucopterus (L.). On: Lom 1 ♀ 9 September 1957 and 1 ♂ 6 August 1960 (J). HOi: Kvinnherad: Rosendal 1 ♀ 26 July 1968, Seimsfoss 1 ♀ 20 August 1944 (H). SFi: Aurland: Vassbygda 1 ♀ 18 August 1941 (H). Earlier found in Buskerud and Northern Norway (Strand 1913, Roman 1936).

Lathrolestes clypeatus (Zetterstedt). STi: Oppdal: Vårstigen 1 ♀ 17 June 1967. Known from Hardangervidda and Northern Norway (Jussila 1973).

**L. macropygus* (Hlmgr.). HOy: Askøy: Herdla 1 ex 7 September 1934 (H).

Absyrtus vicinator (Thunberg). SFi: Aurland: Vassbygda 1 ♂ 17 August 1940 (H). Earlier found in Southern Norway (Strand 1913).

Lagarotis debitor (Thunberg). HOy: Bergen 1 ♂ and 1 ♀ 4 and 15 September 1936 (H). HOi: Kvinnherad: Rosendal 1 ♀ 3 July 1966. Earlier found in Northern Norway (Roman 1936).

Alexeter sectator (Thunberg). HEs: Stange 1 ♂ 20 July 1945 (H). HOy: Bergen 1 ♂ 4 September 1936 (H), 1 ♂ 29 August 1937 (H) and 1 ♂ 30 July 1951 (H); Meland: Brakstad 1 ♂ 2 August 1964. SFi: Aurland: Vassbygda 2 ♂♂ 18 June 1939 and 18 August 1940 (H). MRi: Stranda: Fivelstad 1 ♂ 26 July 1957. Known from Hardangervidda and Northern Norway (Jussila 1973).

A. fallax (Hlmgr.). SFi: Aurland: Berekvam 1 ♂ 8 July 1965. NTi: Frosta: Holmberget 1 ♂ 13 August 1967. Earlier recorded from Northern Norway (Roman 1936).

A. nebulator (Thunberg). HOy: Vaksdal: Eidslandet 1 ♀ 31 August 1970. HOi: Kvinnherad: Rosendal 2 ♀♀ 2 September 1966. Recorded from Northern Norway (Roman 1936, 1942).

Perispuda sulphurata (Grav.). On: Lom: Leirdalen 1 ♂ 24 July 1960. Earlier found in Northern Norway (Roman 1936).

**P. munda* (Grav.). HOy: Vaksdal: Eidslandet 1 ♀ 17 July 1965. NTi: Stjørdal: Hegra 1 ♂ 12 August 1959.

Scopesis bicolor (Grav.). MRi: Stranda: Fivesltad 1 ♀ 29 July 1957. Earlier recorded from Hardangervidda (Jussila 1973).

S. rufonotatus (Hlmgr.). SFy: Gloppen: Sandane 1 ♂ 29 June 1965. Known from Hardangervidda (Jussila 1973).

**Arbelus mandibularis* (Thomson), comb.n. (*Spudaea mandibularis* Thomson 1894, p. 2013; *Arbelus* Townes 1969c, p. 122). HOi: Granvin: Seim 1 ♀ 21 May 1936.

Hyperbatus segmentator (Hlmgr.). HOy: Vaksdal: Eidslandet 1 ♂ 2 July 1960. HOi: Eidfjord: Sysenvann (Fjellberg 1972, p. 39, loc. 338) 1 ♂ 5 August 1969. Earlier recorded from Hardangervidda, too (Jussila 1973).

Campodorus alticola (Hlmgr.), comb.n. (*Mesoleius alticola* Holmgren 1855, p. 150; *Campodorus* Förster 1868, p. 212). HOy: Tysnes: Ånuglo 1 ♂ 29 May 1969. Earlier recorded from Northern Norway and Hardangervidda (Strand 1913, Jussila 1973).

**C. amictus* (Hlmgr.). HOy: Vaksdal: Eidslandet 1 ♀ July 1966.

**C. rufonotatus* (Hlmgr.), comb.n. (*Mesoleius rufonotatus* Holmgren 1876, p. 31). HOi: Kinsarvik: Stavali (cf. Fjellberg 1972 p. 16 loc. 31) 1 ♀ 30 July 1968. STi: Oppdal: Kongsvoll 1 ♀ 29 July 1966.

**C. obtusus* (Hlmgr.), comb.n. (*Mesoleius obtusus* Holmgren 1855, p. 139). HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 14, loc. 9) 1 ♀ 26 July 1968.

C. juvenilis (Hlmgr.), comb.n. (*Mesoleius juvenilis* Holmgren 1855, p. 143). On: Fron: Eldåseter 1 ♀ 6 August 1965. HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 3) 1 ♂ 25 July 1968. Earlier recorded from Hardangervidda (Jussila 1973), and additionally a female from Finnmark might belong to this species (Roman 1936).

Anoncus stipator (Hlmgr.), comb.n. (*Mesoleius stipator* Holmgren 1855, p. 164; *Anoncus* Townes 1969c, p. 127). On: Vågå: Gjendesheim 1 ♂ 10 July 1966. Earlier recorded from Hardangervidda (Jussila 1973).

A. gracilicornis (Hlmgr.), comb.n. (*Mesoleius gracilicornis* Holmgren 1855, p. 155). HOi: Kvinnherad: Rosendal 1 ♀ 2 September 1966. Distributed throughout Norway (Jussila 1973).

A. axillaris (Stephens), comb.n. (*Tryphon axillaris* Stephens 1835, p. 256). HOy: Bergen 1 ♂ 28 June 1934 (H). HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 3 and p. 17, loc. 48) 1 ♂ 25 July and 1 ♀ 2 August 1968. STi: Oppdal: Kongsvoll 1 ♂ 13 July 1966. Earlier recorded from Hardangervidda (Jussila 1973).

Mesoleius molestus Hlmgr. SFy: Høyanger: Vadheim 1 ♂ 17 June 1942. Earlier recorded from Hardangervidda (Jussila 1973).

M. geniculatus Hlmgr. HOy: Ånuglo 1 ♂ 10 June 1965; Askøy: Herdla 1 ♀ 5 June 1936. Earlier recorded from Hardangervidda (Jussila 1973).

M. armillatorius (Grav.). Ry: Klepp: Vik 1 ♂ 27 July 1960. HOy: Bergen 1 ♂ 9 July; Meland 1 ♂ 28 May 1967. Earlier recorded from Northern Norway (Roman 1936).

M. viduus Hlmgr. HOi: Røldal: Valldalen 1 ♂ 10 August 1968; Kinsarvik: Stavali (Fjellberg 1972, p. 16, loc. 31) 1 ♂ 30 July 1968. Earlier recorded from Vest-Agder and Hardangervidda (Jussila 1973).

M. coriaceus Hlmgr. STi: Oppdal: Vårstigen 1 ♂ 16 July 1966. Known from Hardangervidda and Northern Norway (Jussila 1973).

Neostrobalia ruficollis (Hlmgr.). HOi: Ullensvang: Kinsekvelv 1 ♂ 6 July 1968; Kinsarvik: Stavali 2 ♀♀ 30 July and 3 August 1968; Eidfjord: Viveli 1 ♂ 13 July 1969. The specimens were all collected in biotopes described by Fjellberg (1972, p. 23, loc. 119, p. 14 loc. 13, p. 16 loc. 31 and p. 31 loc. 225 respectively). In Norway not yet observed outside Hardangervidda (Jussila 1973).

**Synomelix scutulata* (Hartig). HEn: Åmot: Øgle 1 ♀ July 1933. HOy: Bergen 1 ♂ 12 June 1937.

Pantorhaestes xanthostomus (Grav.). Ry: Klepp: Vik 1 ♀ 2 July 1960. HOy: Askøy: Herdla 1 ♀ 15 June 1936. Also recorded from Buskerud, Hardangervidda and Northern Norway (Strand 1906, Jussila 1973).

P. albipes (Grav.). Ry: Klepp: Orre 1 ♀ 27 August 1960. HOi: Ullensvang: Kinsekvelv (Fjellberg 1972, p. 23, loc. 119) 1 ♀ 26 July 1968. STi: Oppdal: Grosmyra 1 ♀ 18 June 1967. Earlier recorded from Hardangervidda, too, and also from Northern Norway (Jussila 1973).

Mesoleptidea prosoleucus (Grav.). Ry: Forsand 1 ♂ 23 June 1945. SFi: Aurland: Blomheller 1 ♂ 8 August 1965; Lærdal: Kvamma 1 ♂ 28 June 1938 (H). Known from Northern Norway (Roman 1936).

M. cingulata (Grav.). HOy: Bergen 1 ♀ 12 July 1937 (H). Known from Southern and Central Norway (Strand 1898a, 1913, Roman 1942).

Hadrodactylus faciator (Thunberg). HOy: Os: Søfteland 1 ♂ 11 June 1937. HOi: Kvinnherad: Murabotten 1 ♀ 9 May 1965. SFy: Gloppen: Sandane 1 ♀ 27 June 1965. STi: Støren: Rogstadøyen 1 ♀ 21 June 1967. Known from Southern and Northern Norway (Jussila 1973).

H. typhae (Fourcroy). Ry: Sandnes: Høyland 2 ♂♂ 13 June and 29 August 1963, 3 June 1965. HOy: Ølen: Vikebygd 1 ♂ 29 May 1966; Bergen 2 ♀♀ 13 and 23 June 1953 (H), 1 ♀ 21 June 1964, 1 ♀ 9 July 1965, 1 ♂ 12 June 1966, 1 ♀ 18 June 1967. SFi: Lærdal 1 ♀ 23 June 1939(H). MRy: Sunndal: Dalen 1 ♀ 5 August 1967. Previously recorded from Hardangervidda and Northern Norway (Jussila 1973).

**H. paludicola* (Hlmgr.). HOy: Meland 1 ♂ and 2 ♀♀ 25 July 1965 and 14 August 1966.

Syndipnus lateralis (Grav.). HOy: Bergen 1 ♂ 13 June 1937. Earlier recorded from Troms (Roman 1942).

**Euryproctus alpinus* Hlmgr. HOy: Os: Lysekloster 1 ♂ 26 July 1965.

Hypamblys albopictus (Grav.). SFi: Årdal: Øvre Årdal 1 ♀ 2 July 1938 (H). Earlier recorded from Hardangervidda (Jussila 1973).

SUBFAMILY *PORIZONTINAE*

Sinophorus crassifemur (Thomson). SFi: Vik: Høgeggji 1 ♂ 12 July 1940. TRy: Kvæfjord: Borkenes 1 ♀ 30 June 1955. Earlier recorded from Northern Norway (Roman 1942).

**S. costalis* (Thomson). HOy: Bergen 1 ex 25 August 1965.

*_Campoplex difformis_ (Gmelin). HOy: Bergen 1 ♀ September 1934 and 1 ♂ 15 August 1935. HOi: Granvin: Seim 1 ♀ 31 May 1936.

C. faunus Grav. SFi: Vik: Langedalen 2 ♀♀ 8 August 1940; Luster 1 ♀ 22 July 1945. Also recorded from Hardangervidda (Jussila 1973).

C. borealis (Zetterstedt). Ry: Hå: Brusand 1 ♀ 4 August 1960. HOy: Bergen 1 ♂ 18 July 1934; Askøy: Herdla 1 ♂ 29 July 1935. SFi: Vik: Framfjord 1 ♂ 9 August 1940. Known from Hardangervidda (Jussila 1973).

C. angulatus (Thomson). Ry: Sokndal: Rekefjord 1 ♀ 8 August 1960; Sandnes: Figgjo 1 ♀ 18 August 1966. HOi: Kvinnherad: Varaldsøy 1 ♀ 30 May 1969. Earlier recorded from Northern Norway (Roman 1936).

*_C. cingulatus_ (Brischke). HOy: Bergen 2 ♂♂ 13 September 1953. SFi: Aurland: Vassbygda 1 ♀ 16 August 1941; Stryn: Loen 1 ♂ 2 August 1942.

Bathyplectes exiguus (Grav.). Ry: Klepp: Orre and Vik 3 ♂♂ and 2 ♀♀ 27 July–1 August 1960. SFi: Årdal: Utdalen 1 ♂ 10 July 1939. Also recorded from Hardangervidda (Jussila 1973).

*_B. corvinus_ (Thomson). HOi: Kinsarvik: Kvanndal 1 ♂ 2 June 1968 and Stavali (cf. Fjellberg 1972 p. 15 loc. 17) 1 ♀ 28 July 1968. SFi: Leikanger: Suphamar 1 ♂ 18 July 1948.

*_B. anurus_ (Thomson). SFy: Eid: Nordfjordeid 1 ♀ 30 July 1942. SFi: Balestrand: Fjærland 1 ♀ 28 June 1938.

B. cingulatus (Brischke). HOi: Eidfjord: Øvre Eidfjord and Sysenvann (cf. Fjellberg 1972 p. 34 loc. 269 and p. 39 loc. 338) 1 ♂ 1 July 1967 and 4 ♀♀ 5 July 1969 respectively. So far recorded only from Hardangervidda (Jussila 1973).

Pyracmon fumipennis (Zetterstedt). HOy: Askøy: Herdla 1 ♀ 27 June 1936. SFi: Årdal: Øvre Årdal 1 ♂ 10 July 1939. Moreover recorded from inner district of Hordaland (Roman 1942).

*_P. sepiellum_ (Hlmgr.). HOy: Bergen: Skjold 1 ♀ 25 June 1937.

Campoletis crassicornis (Tschek). HOy: Bergen 1 ♂ 21 May 1935. Also recorded from Northern Norway (Roman 1936, 1942).

*_C. erythropus_ (Thomson). HOy: Bergen 1 ♀ 28 May 1968. SFi: Lærdal: Maristova 1 ♀ 29 June 1938.

*_C. thomsoni_ (Roman). HOy: Askøy: Herdla 1 ♂ 7 June 1936.

C. latrator (Grav.). Ry: Klepp: Orre 2 ♀♀ 27 July and Vik 1 ♀ 29 July 1960. HOy: Bergen 2 ♀♀ 9 and 23 May 1937. HOi: Kvam: Steine 1 ♀ 11 August 1964. SFi: Aurland: Vassbygda 1 ♂ 16 August 1941; Lærdal: Eggum 1 ♀ 21 June 1938. STi: Støren: Budal 2 ♀♀ 21 June 1967. Throughout Norway (Strand 1913, Roman 1936, 1942).

C. holmgreni (Tschek). Ry: Klepp: Orre 1 ♀ 27 July 1960. Also recorded from Hardangervidda (Jussila 1973).

C. varians (Thomson). HOy: Bergen 1 ♀ 11 June 1953 and 1 ♀ 3 August 1969; Meland: Brakstad 1 ♀ 24 July 1965. STi: Støren: Budal 1 ♀ 21 June 1967. Earlier recorded from Southern Norway (Strand 1913), Hardangervidda and Northern Norway (Jussila 1973).

C. femoralis (Grav.). HOy: Bergen 1 ♂ 9 May 1937. SFi: Vik: Målset 1♂ 6 Juli 1940. STi: Støren: Budal 1 ♂ 21 June 1967. Also recorded from Hardangervidda (Jussila 1973).

*_Dusona peregrina_ (Woll.). HOy: Bergen 1 ♂ 28 June 1968.

D. stragifex (Förster). AK: Nesodden 1 ♀ 14 June 1951. On: Vågå: Valdresflya 1 ♀ 10 July 1966. VE: Tjøme 1 ♂ 30 May 1967. HOy: Osterøy: Kleppe 1 ♀ 3 July 1957; Vaksdal: Eidslandet 1 ♀ 16 June 1968; Askøy: Herdla 2 ♀♀ 19 and 22 June 1936. STi: Trondheim 1 ♀ 13 June 1967. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

D. zonella (Förster). Ø: Hvaler: Kirkøy 1 ♂ 12 July 1940. HOy: Bergen 1 ♂ 9 July 1935. SFy: Vågsøy: Røysen 1 ♂ 18 July 1957. Fi: Alta: Arones 1 ♂ 28 July 1955. Earlier recorded from Tromsø (Roman 1936).

D. subaequalis (Förster). Os: Lillehammer 1 ♂ 9 August 1965. VE: Tjøme 1 ♂ 31 May 1967. SFi: Vik: Rivedal 1 ♂ 13 July 1940. Moreover recorded from Hardangervidda and Northern Norway (Strand 1913, Jussila 1973).

Meloboris collector (Thunberg). Ry: Klepp: Vik 1 ♀ 29 July 1960. HOy: Bergen 1 ♀ 27 September 1934 and 1 ♂ 23 May 1965. SFi: Vik: Målset 1 ♂ 19 July 1940. Moreover recorded from Hardangervidda (Jussila 1973).

Cymodusa antennator Hlmgr. SFi: Aurland: Vassbygda 1 ♀ 17 August 1941. Previously recorded from Southern Norway (Strand 1906, 1913, Jussila 1973).

*_C. petulans_ (Hlmgr.). Ry: Stavanger 1 ♀ 5 August 1966. Ri: Forsand 1 ♂ 8 July 1945. HOy: Bergen 1 ♂ 14 August 1953.

Phobocampe bicingulata (Grav.). HOy: Os:

Hagavik 1 ♀ 16 May 1937; Bergen 4 ♂♂ 28 June 1968. HOi: Ulvik 1 ♀ 28 May 1939. SFy: Gaular: Sande 1 ♀ 19 June 1942. Previously recorded from Southern Norway (Strand 1913).

Tranosema arenicola Thomson. HOy: Bergen 1 ♀ 25 June and 1 ♂ 18 July 1934. Also recorded from Hardangervidda (Jussila 1973).

Enytus exareolatus (Ratzeburg). AAy: Tromsøy 1 ♂ 22 March 1967. HOy: Bergen 1 ♂ 12 June 1937. STi: Oppdal: Grosmyra 1 ♀ 18 June 1967. Moreover recorded from Hardangervidda and Northern Norway (Jussila 1973).

Diadegma pusio (Hlmgr.). HOy: Askøy: Herdla 2 ♂♂ e.l. on _Lotus corniculatus_ L. 16 and 17 August 1936. SFi: Aurland: Vassbygda 2 ♂♂ 18 August 1940. Also recorded from Hardangervidda (Jussila 1973).

*_D. ischiocera_ (Thomson). Ry: Hå: Nærbø 1 ♀ 3 August 1963.

*_D. truncata_ (Thomson). Ry: Hå: Brusand 1 ♂ 4 August 1960. HOy: Askøy: Herdla 1 ♂ e.l. on _Lotus corniculatus_ L. 17 July 1936.

*_D. sordipes_ (Thomson). HOy: Bergen 1 ♀ 11 September 1937.

D. fenestralis (Hlmgr.). Ry: Hå: Brusand 1 ♂ and 1 ♀ 4 August 1960; Klepp: Orre 1 ♂ 27 July 1960; Haugesund 1 ♀ 18 September 1966. Ri: Forsand 1 ♀ 28 June 1946. HOy: Sund: Telavåg 1 ♂ 13 May 1951; Bergen 3 ♂♂ and 1 ♀ 13 July 1934, 6 August and 15 September 1936, 23 may 1937; Askøy: Herdla 5 ♂♂ and 3 ♀♀ 4 and 30 June 1936, 16 July 1937 and 18 August 1940. HOi: Kvinnherad: Seimfoss 1 ♀ 11 July 1943, Skeie 1 ♂ 5 June 1943; Granvin: Holven 1 ♂ 31 May 1936, Seim 2 ♂♂ 1 July 1936. SFy: Gulen: Brekke 1 ♂ 27 June 1944. SFi: Aurland: Frettheim 1 ♂ 11 June 1939, Vassbygda 1 ♂ and 1 ♀ 18 August 1940. Recorded earlier from inner districts of Rogaland and Hordaland, too (Jussila 1973).

D. chrysostincta (Gmelin). HOy: Bergen 1 ♂ 23 May 1937; Askøy: Herdla 1 ♀ July 1937. Earlier recorded from South-eastern Norway, e.g. Østfold and Akershus (Roman 1942).

D. tenuipes (Thomson). SFi: Lærdal: Moristova 1 ♂ 29 June 1938. Known from Hardangervidda (Jussila 1973).

D. armillata (Grav.). HOy: Bergen 1 ♂ 8 July 1935 and 1 ♂ 9 June 1967; Askøy: Herdla 1 ♀ 28 July 1937. Earlier recorded from Hardangervidda (Jussila 1973).

*_D. vestigalis_ (Ratzeburg). SFi: Aurland: Vassbygda 2 ♂♂ 18 August 1940; Balestrand: Fjærland 1 ♂ 28 June 1939.

Hyposoter notatus (Grav.). Ry: Hå: Brusand 1 ♀ 4 August 1960. Earlier recorded from South-eastern and Northern Norway (Strand 1906, Roman 1936, 1942).

*_H. caedator_ (Grav.). HOy: Askøy: Herdla 1 ♀ 15 July 1937.

H. didymator (Thunberg). HOy: Os: Hagavik 1 ♂ e.l. 20 June 1937; Bergen 1 ♀ 13 June 1937 and 1 ♂ 18 May 1947. Moreover recorded from Vest-Agder and Nordland (Roman 1942).

*_H. albicans_ (Brischke). HOi: Ullensvang: Lofthus 1 ♀ 2 June 1951.

H. inquinatus (Hlmgr.). HOy: Bergen 1 ♂ 29 May 1965 and 1 ♂ 18 May 1969. Earlier recorded from Hardangervidda (Jussila 1973).

H. brischkei (Bridgman). MRy: Sande 1 ♀ 20 July 1957. Moreover recorded from Hardangervidda (Jussila 1973).

*_Olesicampe patellana_ Thomson. VAy: Kvinesdal: Gjemlestad 1 ♀ 8 July 1945. SFi: Lærdal: Borgund 1 ♂ 25 June 1939.

*_O. sericea_ (Hlmgr.). STi: Oppdal: Grosmyra 1 ♂ 18 June 1967.

*_O. pagana_ (Hlmgr.). SFi: Stryn: Loen 1 ♂ 2 August 1942. STi: Støren: Budal 1 ♂ 21 June 1967.

O. proterva Brischke. Ry: Bjerkreim: Ivesdal 1 ♂ 5 July 1960. HOy: Bergen 3 ♂♂ 3 June 1937 and 1 ♂ 7 June 1965; Vaksdal: Eidslandet 1 ♂ 3 July 1966. SFi: Aurland: Frettheim 1 ♂ 13 June 1939; Årdal: Øvre Årdal 1 ♂ 1 July 1938; Stryn: Loen 1 ♂ 2 August 1942. Moreover recorded from Hardangervidda (Jussila 1973).

O. canaliculata (Grav.). STi: Oppdal: Grosmyra 1 ♀ 18 June 1967 and Gåvåli 1 ♂ 24 June 1967. Earlier recorded from Hardangervidda (Jussila 1973).

O. argentata (Grav.). HOy: Askøy: Herdla 1 ♀ 4 June 1936. Earlier recorded from Hardangervidda (Jussila 1973).

SUBFAMILY *CREMASTINAE*

*_Cremastus infirmus_ Grav. Ry: Klepp: Orre 1 ♀ 1 August 1960, Vik 1 ♀ 27 August 1960.

SUBFAMILY *TERSILOCHINAE*

Leptopygus harpurus (Schrank). SFi: Luster: Skjolden 1 ♂ 13 July 1938; Balestrand: Fjærland 1 ♂ 28 June 1939. Known from Hardangervidda and Northern Norway (Jussila 1973).

Barycnemis claviventris (Grav.). HOy: Bergen 1 ♂ 13 June 1937; Askøy: Herdla 1 ♂ July 1936 and 1 ♂ 7 July 1937. HOi: Kvinnherad: Rosendal 1 ♀ 10 July 1943, Seimsfoss 2 ♂♂ 11 July 1943. SFi: Luster: Solvorn 1 ♂ 6 July 1938; Balestrand: Fjærland 2 ♂♂ 28 June 1939. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

B. laeviceps (Thomson). HOi: Ulvik: Kongsnut by Finse 1 ♀ 8 September 1967. Earlier recorded from Hardangervidda and Northern Norway (Jussila 1973).

**Pectinolochus striola* (Thomson). HOy: Bergen 2 ♂♂ 25 April, 1 ♂ and 1 ♀ 30 June 1937.

**Allophroides striola* (Thomson). SFi: Luster: Skjolden 1 ♂ 25 April 1937.

**Microdiaparsis versutus* (Hlmgr.). HOi: Ulvik 1 ♂ 18 September 1967.

**Probles montanus* Horstmann. Bv: Uvdal 1 ♂ 24 August 1969. HOi: Eidfjord 1 ♂ 7 August 1969.

**P. exilis* (Hlmgr.). Bv: Hol: Haugastøl 1 ♀ 28 August 1968.

SUBFAMILY *OPHIONINAE*

Ophion luteus (L.). HEs: Stange 1 ♂ 1943 (H). HEn: Stor-Elvdal: Koppang 2 ♂♂ 1943 (H). VE: Tjøme 1 ♂ 1 June 1967. Ry: Sandnes: Dale 1 ♀ 13 April 1968. HOy: Ølen: Vikebygd 1 ♀ 3 August 1972; Os 1 ♀ 18 September 1949 (H); Bergen 1 ♀ 9 September 1956 (H), 1 ♀ 11 May 1968 and 1 ♀ 15 August 1969; Vaksdal: Eidslandet 2 ♀♀ 30 July 1972; Askøy: Kleppestø 1 ex 20 September 1936 (H). HOi: Kvinnherad: Rosendal 1 ♀ 3 September 1964 (J) and 5 ♀♀ 23–24 August 1971. SFi: Aurland: Vassbygda 1 ♂ 18 August 1940 (H) and 1 ♀ 15 August 1965 (J); Luster: Gaupne 1 ♂ 9 July 1938 (H). MRy: Ørsta: Viddal 1 ♂ 28 June 1946 (H). NTi: Levanger: Ekne 1 ♂ 15 September 1944 (H). Distributed throughout Norway (Jussila 1973).

**O. impressus* (Thunberg). Nsy: Gildeskål: Skaval 2 ♂♂ 31 July 1959 (J).

**O. obscuratus* (F.). HOy: Bergen 2 ♂♂ 24 May 1965 and 12 May 1966 (J).

**O. subarcticus* Hellén. VE: Tjøme: Hvasser 1 ♀ 2 June 1967. HOi: Kvam: Lillefosse 1 ♂ 1 July 1970.

O. scutellaris Thomson. SFi: Aurland: Flåm 1 ♀ 13–16 August 1965 (Løken 1966).

**O. pteridis* Kriechbaumer. Ry: Forsand 1 ♂ 5 July 1945 (H).

**Enicospilus ramidulus* (L.). Ry: Forsand 1 ♂ August 1945 (H). HOy: Lindås: Alversund 1 ♂ 18 August 1944 (H).

SUBFAMILY *MESOCHORINAE*

Mesochorus nigripes (Ratzeburg). Ry: Klepp: Vik 1 ♀ 2 July 1960. Recorded earlier from Hardangervidda (Jussila 1973).

M. fulvus Thomson. On: Sel: Rondavasshøgda on a snowfield 1 ♀ 5 August 1965. A female from Oslo might belong to this species (Roman 1942).

M. vitticollis Hlmgr. Ry: Hå: Ogna 1 ♂ 3 August 1963. Earlier found in Buskerud and Nordland (Strand 1906, 1913).

M. pectoralis (Ratzeburg). HOy: Osterøy: Kleppe 1 ♂ 11 July 1956. Also recorded from Southern and Northern Norway (Strand 1906, 1913, Roman 1936).

SUBFAMILY *METOPIINAE*

**Triclistus lativentris* Thomson. SFi: Lærdal: Maristova 1 ♀ 29 June 1938.

**Spudaeus s. scaber* (Grav.). HOy: Hagavik 1 ♂ 16 May 1937 (H); Bergen: Håkonshella 1 ♂ 15 June 1967; Askøy: Io 1 ♀ 16 July 1964. Fi: Kautokeino 1 ♂ 26 July 1955 (H).

**Hypsicera curvator* (F.). Ry: Klepp: Vik 1 ♀ 29 July 1960.

Exochus p. pictus Hlmgr. Fv: Nordkapp: Honningsvåg 1 ♂ 23–26 July 1947. Also recorded from Southern Norway and Hardangervidda (Strand 1906, 1913, Jussila 1973).

E. gravipes (Grav.). HOy: Bergen 2 ♂♂ 1 June 1954 (H). HOi: Granvin: Skjervet 1 ♂ 9 June 1935 (H). SFi: Aurland: Vassbygda 4 ♂♂ 17–18 August 1940 and 16 August 1941 (H). Earlier found in Northern Norway (Roman 1936).

**E. incidens* Thomson. Ry: Sokndal 1 ♂ 3 August 1960. SFi: Aurland: Vassbygda 1 ♂ 18 August 1940.

**E. flavomarginatus* Hlmgr. HOy: Vaksdal: Eidslandet 1 ♂ 28 June 1969.

**E. signifrons* Thomson. Ry: Klepp: Orre 1 ♂ 27 July 1960.

**E. notatus* Hlmgr. HOy: Bergen 1 ♂ 15 August 1935 and 1 ♂ 22 October 1967.

SUBFAMILY *ANOMALINAE*

*_Aphanistes bellicosus_ (Wesmael). HOy: Bergen 1 ex 19 August 1935.

Agrypon flaveolatum (Grav.). VE: Tjøme 1 ♀ 1 June 1967. Ry: Sandnes: Dale 1 ♂ 13 June 1962. HOy: Ølen: Vikebygd 1 ♂ and 1 ♀ 31 May 1966; Stord: Storsøy 1 ♂ and 1 ♀ 29 May 1967; Tysnes: Ånuglo 2 ♂♂ and 1 ♀ 26 May 1968; Os: Lepsøy 1 ♀ 25 May 1967; Bergen 1 ♂ June 1965 (J), 3 ♂♂ and 1 ♀ 19, 28 and 31 May 1966, 3 ♂♂ and 1 ♀ 29 May, 15 July 1967 and 12 June 1968; Meland: Brakstad 1 ♂ 22 May 1966 and Meland 2 ♀♀ 6 June 1967. HOi: Kvinnherad: Bergshei 1 ♀ 3 June 1967, Rosendal 1 ♂ 2 June 1966 (J), Staffvann 1 ♂ 28 May 1969 and Varaldsøy 1 ♀ 31 May 1969; Granvin: Skjervet 1 ♀ 9 June 1935. SFi: Balestrand: Brekka 1 ♂ 6 June 1935. STi: Støren: Aune 1 ♀ 21 June 1967. Distributed throughout Norway (Jussila 1973).

*_Trichionotus anxius_ (Wesmael). HOy: Vaksdal: Eikemo 1 ♀ 3 August 1968. HOi: Kvinnherad: Varaldsøy 1 ♂ 31 May 1969.

Therion circumflexum (L.). Ry: Eigersund: Lysevann 1 ♂ 30 July 1960 (J). HOy: Bergen 2 ♂♂ and 2 ♀♀ 2, 12 and 19 August 1969. Earlier recorded from the southern coast of Norway (Roman 1942).

*_Heteropelma amictum_ (F.). Ri: Forsand: Lerang 1 ♀ 14 July 1934 (J).

SUBFAMILY *MICROLEPTINAE*

Cylloceria melancholica (Grav.). HOi: Kinsarvik: Stavali (Fjellberg 1972, p. 13, loc. 1) 1 ♂ 25 July 1968. Distributed throughout Norway (Roman 1936, 1942).

C. fusciventris Hellén. HOy: Osterøy: Kleppe 1 ♀ 11 July 1965. Earlier recorded from Hardangervidda (Jussila 1973).

*_Eusterinx subdola_ Förster. HOi: Eidfjord: Sysenvann (Fjellberg 1972, p. 40, loc. 350) 1 ♂ 10 August 1969.

E. oligomera Förster. HOi: Eidfjord: Hallaskard (Fjellberg 1972, p. 27, loc. 181) 1 ♀ 19 July 1968. In Norway not yet recorded outside Hardangervidda (Jussila 1973).

Pantisarthrus inaequalis Förster. HOi: Eidfjord: Måbødalen (Fjellberg 1972, p. 36, loc. 297) 1 ♀ 4 July 1969. In Norway recorded only from Hardangervidda (Jussila 1973).

*_Proclitus autumnalis_ Förster. HOy: Bergen 1 ex 11 September 1937 (H). HOi: Kvinnherad: Seimfoss 1 ♂ 11 July 1943 (H); Eidfjord: Måbødalen (Fjellberg 1972, p. 36, loc. 296) 1 ♀ 4 July 1969; Granvin: Seim 1 ♀ 1 June 1936 (H).

P. mesoxanthus Förster. HOi: Eidfjord: NW Halnefjord (Fjellberg 1972, p. 41, loc. 357) 1 ♀ 29 August 1969. Earlier probably recorded from Northern Norway (Roman 1936).

Plectiscidea terebrator (Förster). HOi: Granvin: Seim 1 ♂ 1 June 1936. SFi: Lærdal: Borgud 1 ♂ 25 Jue 1939. TRi: Målselv: Olsborg 1 ♀ 10 July 1955. Moreover recorded from Hardangervidda (Jussila 1973).

SUBFAMILY *ORTHROCENTRINAE*

Orthrocentrus protervus Hlmgr. HOi: Granvin: Seim 2 ♀♀ 30 and 31 May 1936. Also recorded from Hardangervidda (Jussila 1973).

O. frontator (Zetterstedt). Bv: Hol: Ustaoset 1 ♀ August 1937. Recorded earlier from Hardangervidda and Northern Norway (Jussila 1973).

Stenomacrus silvaticus (Hlmgr.). SFi: Lærdal: Kvamma 1 ♂ 28 June 1938. Known from Hardangervidda (Jussila 1973) and Northern Norway (Roman 1936).

S. confinis (Hlmgr.). HOi: Kinsarvik: Stavali (cf. Fjellberg 1972 p. 15 loc. 17) 1 ♀ 28 July 1968; Eidfjord: Viveli (cf. Fjellberg 1972 p. 31 loc. 241) 1 ♀ 27 July 1968. A female from Akershus may belong to this species (Roman 1942).

S. nemoralis (Hlmgr.). HOi: Ullensvang: N Viveli (Fjellberg 1972, p. 31, loc. 236) 1 ♀ 22 July 1968. Recorded earlier from Hardangervidda, too, and also from Northern Norway (Jussila 1973).

*_S. minutus_ (Hlmgr.). HOi: Eidfjord: Stigstuv 1 ♀ 2 July 1969.

Plectiscus callidulus (Hlmgr.). VAy: Kvinesdal: Gjemlestad 1 ♀ 18 April 1936. HOi: Granvin: Seim 1 ♀ 31 May 1936. Recorded earlier from Hardangervidda (Jussila 1973).

Picrostigeus anomalus (Hlmgr.). HOi: Granvin: Skjervet 1 ♀ 9 June 1935. SFi: Lærdal: Kvamma 1 ♂ and 1 ♀ 28 June 1936. Recorded earlier from Hardangervidda (Jussila 1973).

SUBFAMILY *DIPLAZONTINAE*

Diplazon laetatorius (F.). Ry: Sokndal 2 ♀♀ 3 August 1960; Klepp: Vik 2 ♀♀ 1 August

1960 and 22 July 1962. HOy: Bergen 1 ♀ 20 July 1934. Recorded earlier from Østfold and Hardangervidda (Jussila 1973).

D. t. tetragonus (Thunberg). HOy: Bergen 1 ♂ 27 September 1958; Meland 1 ♀ 25 June 1966. HOi: Granvin: Seim 1 ♂ 1 June 1936. Observed throughout Norway (Jussila 1973).

D. varicoxa (Thomson). HOi: Kvinnherad: Guddalsdalen 1 ♂ 9 June 1943. Recorded earlier from Hardangervidda and Northern Norway (Jussila 1973).

D. annulatus (Grav.). On: Lom: Leirdalen 1 ♂ 13 July 1961. HOy: Bergen 1 ♂ 21 July 1952. SFi: Årdal: Øvre Årdal 1 ♂ 2 July 1938. STi: Oppdal: Vårstigen 1 ♂ 17 June 1967. Observed earlier from Hardangervidda and Northern Norway (Jussila 1973).

D. pectoratorius (Thunberg). HOi: Kvinnherad: Guddalsdalen 1 ♂ 10 June 1943, Varaldsøy 1 ♂ 31 May 1969. SFi: Aurland: Nalfarhøgdi 1 ♀ 14 August 1965. Distributed throughout Norway (Jussila 1973).

Syrphophilus bizonarius (Grav.). Ry: Strand: Vatne 3 ♂♂ 8 August 1966. HOy: Osterøy: Kleppe 1 ♂ 29 June 1951. STi: Oppdal 1 ♂ 17 June 1967; Støren: Rogstadøyen 1 ♂ 21 June 1967. Observed throughout Norway (Jussila 1973).

S. t. trinctorius (Thunberg). HOy: Stord: Storsøy 1 ♂ 29 May 1967; Tysnes: Ånuglo 1 ♀ 29 May 1969; Bergen 2 ♂♂ 21 May 1957; Meland 1 ♂ 25 June 1966. HOi: Kvinnherad: Løfallstrand 1 ♀ 6 June 1966. Known from Hardangervidda and Northern Norway (Jussila 1973).

Thymmophorus g. graculus (Grav.). HOy: Lindås: Vollom 1 ♂ 10 June 1966. HOi: Eidfjord: Sysenvann (Fjellberg 1972, p. 40, loc. 344) 1 ♂ 7 August 1969. STi: Oppdal: Grosmyra and Knutshø 2 ♀♀ 16–23 June 1967. Moreover recorded from Hardangervidda and Northern Norway (Jussila 1973).

Homotropus pictus (Grav.). HOy: Bergen 1 ♀ 31 May 1966. SFi: Aurland: Flåm 1 ♀ 16 August 1965. Also recorded from Stavanger and Northern Norway (Strand 1916, Roman 1936).

**H. crassicrus* Thomson. SFi: Aurland: Flåm 1 ♀ 16 August 1965.

H. elegans (Grav.). SFi: Leikanger: Njøs 1 ♂ 21 May 1949. Recorded earlier from Hardangervidda and Northern Norway (Jussila 1973).

H. n. nigritarsus (Grav.). Ry: Hå: Ogna 1 ♂ 6 August 1966. Observed earlier from Southern Norway (Jussila 1973).

H. signatus (Grav.). Ry: Klepp: Orre 1 ♂ 27 July 1960. Earlier found in Northern Norway (Roman 1936).

H. pallipes (Grav.). Ry: Stavanger 1 ♂ 16 June 1930. HOy: Bergen 2 ♂♂ 23 May and 13 June 1937; Vaksdal: Eidslandet 1 ♂ 28 June 1969. HOi: Kinsarvik: Kvanndal 1 ♂ 2 June 1968. Recorded earlier from Northern Norway and Hardangervidda (Strand 1913, Jussila 1973).

H. pulcher (Hlmgr.). SFi: Aurland: Vassbygda 1 ♂ 17 August 1941. Recorded from Hardangervidda (Jussila 1973).

Syrphoctonus f. flavolineatus (Grav.). HOi: Kvinnherad: Løfallstrand 1 ♀ 6 June 1966. Earlier recorded from Northern Norway (Strand 1913).

S. biguttatus (Grav.). VE: Brunlanes: Mølen 1 ♀ 5 August 1967. Earlier found in Northern Norway (Strand 1913).

Promethes nigriventris (Thomson). TEi: Kviteseid: Haugland 1 ♀ 4 July 1970. Known from Hardangervidda (Jussila 1973).

P. s. sulcator (Grav.). HOy: Bergen 1 ♂ 24 September 1972. Recorded throughout Norway (Jussila 1973).

Sussaba p. pulchella (Hlmgr.). Bv: Hol: NW Haugastøl 1 ♀ 26 July 1973. HOy: Vaksdal: Eidslandet 1 ♀ 27 May 1971. SFi: Leikanger 1 ♀ 5 July 1939. Recorded throughout Norway (Jussila 1973).

S. d. dorsalis (Hlmgr.). HOy: Bergen 1 ♀ 14 September 1952. Known from Hardangervidda (Jussila 1973).

S. c. cognata (Hlmgr.). HOi: Voss: Hjelle 1 ♂ 22 July 1942. Recorded earlier from Hardangervidda and Northern Norway (Jussila 1973).

SUBFAMILY *ALOMYINAE*

Alomya debellator (F.). Ø: Trøgstad 1 ♂ 6 July. On: Vågå 1 ♂ 7 July 1961. AAy: Grimstad 1 ♂ 30 June 1960. HOy: Fusa: Øvre Hålandsdal 2 ♂♂ 4 June 1958; Bergen 5 ♂♂ 30 July 1951, 31 May 1954 (H), 15 June 1968, 28 July 1966 and 18 June 1967; Vaksdal: Eidslandet 1 ♂ 16 June 1968. HOi: Kvinnherad: Guddalsdalen 1 ♂ 10 June 1943 (H), Løfallstrand 1 ♂ 13 June 1965, Murabotten 2 ♂♂ 9 May 1965, Skeie 1 ♂ 11 June 1943 (H); Kvam: Kaldestad 3 ♂♂ 1 July 1967; Granvin 2 ♂♂ 1 June 1936 (H) and 15 June 1936. SFy: Hyllestad 2 ♂♂ 30 June 1963; Høyanger: Vadheim 1 ♂ 18 June 1942 (H). SFi: Leikanger: Suphamar 1 ♂ 2 June 1949 (H); Stryn: Hjelledalen 2 ♂♂ 12 and 14 July 1957, Hornindal 4 ♂♂ 15 July 1957, Utvik 1 ♂ 7 July 1942 (H). MRy: Ulstein: Vonheim 1 ♂ 21 July 1957. STy: Bjugn 5 ♂♂ 5 July 1959. STi: Oppdal: Vårstigen 1 ♂ 16 July 1966. Ny: Bodø: Falkflaudalen 9 July 1970. Recorded from southern to central Norway.

**A. pygmaea* Heinrich. HOi: Kvinnherad: Skeiehavna 1 ♂ 19 June 1943 (H).

SUBFAMILY *ICHNEUMONINAE*

**Dirophanes fulvitarsis* (Wesmael). AAy: Arendal 1 ♀ 21 March 1964. HOy: Bergen 1 ♀ 11 September 1937.

**D. callopus* (Wesmael). HOy: Askøy: Herdla 1 ♂ 10 July 1937.

Phaeogenes planifrons Wesmael. HOi: Voss: Bordalen 1 ♂ 31 July 1947. Earlier found Southern Norway (Strand 1906, 1913).

P. heterogonus Hlmgr. HOy: Os: Hagavik 2 ♀♀ 16 May 1937; Bergen 1 ♂ 2 August 1936; Askøy: Herdla 1 ♂ July 1936. HOi: Kvinnherad: Hatlestrand 1 ♀ 27 November 1968, Rosendal 2 ♀♀ 15 and 16 May 1937 and 1 ♀ 2 June 1966. SFi: Balestrand: Horpedalen 1 ♂ 9 July 1957. Recorded earlier from Hardangervidda (Jussila 1973).

P. nigridens Wesmael. HOy: Askøy: Herdla 1 ♂ July 1936. Moreover recorded from Vest-Agder, Hardangervidda and Northern Norway (Strand 1913, Jussila 1973).

P. melanogonos (Gmelin). HOy: Bergen 1 ♂ 28 August 1956. Earlier found in Southern Norway (Strand 1906, 1913).

P. ophthalmicus Wesmael. HOy: Bergen 1 ♀ 2 August 1936; Askøy: Herdla 1 ♀ 26 August 1934. STi: Støren: Rogstadøyen 1 ♀ 21 June 1967. Recorded earlier from Southern and Northern Norway (Jussila 1973).

**P. maculicornis* (Stephens). HOy: Vaksdal: Eidslandet 1 ♀ 1 July 1969.

**P. clypearis* Wesmael. Ry: Sokndal 1 ♀ 3 August 1960.

**P. impiger* Wesmael. HOy: Bergen 1 ♀ 26 May 1969.

P. suspicax Wesmael. HOy: Os: Hagavik 1 ♀ 16 May 1934. Also recorded from Hardangervidda (Jussila 1973).

P. fulvitarsis Wesmael. HOy: Bergen 1 ♀ 11 June 1969. Earlier found in Northern Norway (Strand 1913).

**P invisor* Thunberg. HOi: Kvam: Nes 1 ♀ 20 July 1968.

Diadromus troglodytes (Grav.). HOy: Bergen 1 ♀ September 1939. Also recorded from Hardangervidda (Jussila 1973).

**Aethecerus porcellus* Hlmgr. HOy: Bergen 1 ♀ 2 May 1957.

Colpognathus divisus Thomson. HOy: Os: Rød 1 ♀ 21 July 1940; Bergen 1 ♀ 26 June 1935. HOi: Kvinnherad: Guddal 1 ♂ 11 July 1943. SFi: Stryn: Oppstryn 1 ♂ 18 July 1948.

**C. celerator* (Grav.). Ri: Forsand 1 ♀ 10 July 1945. SFi: Stryn: Nordstryn 2 ♀♀ 10 July 1942. Earlier found in Southern Norway (Strand 1913).

**Dicaelotus pusillator* (Grav.). HOy: Bergen 1 ♀ 3 May 1939. HOi: Voss: Tvildemoen 1 ♀ 10 June 1935.

**Ectopius rubellus* (Gmelin). SFi: Aurland: Vassbygda 3 ♂♂ 18 August 1940.

**Cyclolabus dubiosus* Perkins. Ry: Klepp: Øksnevad 1 ♂ 10 June 1955 e.p. *Eupithecia valerianata* Hb. (Lep., Geometridae).

**Platylabus odiosus* Perkins. Ry: Sokndal 1 ♀ 3 August 1960.

P. pedatorius (F.): Bergen 1 ♂ 16 July 1953 (H) and 1 ♀ 10 January 1971 (indoors). SFi: Vik: Målset 1 ♀ 15 July 1940 (H). Recorded earlier from Østfold (Strand 1898a).

**P. intermedius* Hlmgr. HOy: Bergen 1 ♂ 17 June 1970.

Cratichneumon rufifrons (Grav.). HOy: Osterøy: Kleppe 2 ♂♂ and 4 ♀♀ 11 July 1956; Vaksdal: Eidslandet 1 ♂ 28 June 1969; Meland 1 ♀ 10 July 1965. Known from Hardangervidda and Northern Norway (Jussila 1973).

**C. versator* (Thunberg). HOy: Bergen 1 ♂ and 1 ♀ 15 August 1935 (H).

C. v. viator (Scopoli). SFi: Lærdal: Eggum 1 ♂ 22 June 1938 (H). STi: Oppdal: Kongsvoll 1 ♂ 12 July 1966; Røros: Søndervika 1 ♂ 16 July 1966. TRi: Målselv: Olsborg 1 ♂ 19 July 1955. Recorded throughout Norway (Jussila 1973).

C. fabricator (F.). TEi: Hjartdal: Lake Vindsjå 3 ♀♀ August 1967 in the stomach of *Salmo trutta* L. Known from Northern Norway (Roman 1936).

C. culex (Müller). HOy: Bergen 1 ♂ 11 June 1956, 3 ♂♂ 11 August 1954 and 1 ♂ 11 June 1967; Osterøy: Kleppe 4 ♂♂ and 5 ♀♀ 11 July 1956. Observed throughout Norway (Jussila 1973).

*_C. clarigator_ (Wesmael). SFi: Gloppen: Breim 1 ♀ 7 August 1942 (H).

*_Crypteffigies albilarvatus_ (Grav.). Ry: Sandnes: Dale 1 ♂ 2 June 1967. HOy: Os: Lepsøy 1 ♂ 25 May 1967.

*_C. lanius_ (Grav.). HOy: Bergen 1 ♀ 14 June 1954 and 1 ♂ 2 June 1967; Meland: Brakstad 1 ♀ 8 July 1966 and 1 ♂ 28 May 1967.

Homotherus locutor (Thunberg). AAy: Tvedestrand: Askerøy 2 ♂♂ 24 July 1960. HOy: Bergen 1 ♀ 11 September 1937 (H) and 1 ♂ 18 June 1967. HOi: Kvinnherad: Rosendal 1 ♀ 5 September 1965. SFi: Aurland: Vassbygda 2 ♂♂ 18 August 1940 (H); Balestrand: Fjærland 1 ♂ 28 June 1939 (H). Recarded earlier from Northern Norway (Roman 1936).

*_Melanichneumon anator_ (F.). AAy: Grimstad 1 ♀ 16 June 1961.

*_M. praeceptor_ (Thunberg). On: Vestre Slidre: Neste 1 ♂ 8 July 1944 (H).

*_M. peregrinator_ (L.). HOy: Bergen 1 ♀ 15 September 1936 (H).

*_Stenobarichneumon basiglyptus_ (Kriechbaumer). HOi: Voss: Evanger 1 ♂ 7 August 1970.

*_Limerodes arctiventris_ (Boie). HOi: Askøy: Io 2 ♂♂ 16 July 1964.

*_Aoplus defraudator_ (Grav.). HOy: Vaksdal: Gullbrå 1 ♂ 9 August 1966.

A. c. castaneus (Grav.). HOy: Os: Hagavik 1 ♀ 16 May 1937 (H); Vaksdal: Eidslandet 1 ♀ 5 July 1966; Askøy: Herdla 1 ♀ 8 May 1969; Meland: Brakstad 1 ♀ 8 July 1966. HOi: Kvinnherad: Fossberg 1 ♂ 7 June 1964. STi: Røros: Søndervika 1 ♀ 16 July 1966. Recorded throughout Norway (Strand 1906, 1913, Jussila 1973).

*_A. r. ruficeps_ (Grav.). HOy: Bergen 1 ♀ September 1971; Meland: Brakstad 1 ♀ 16 September 1966.

A. o. ochropis (Gmelin). HOy: Os: Hatvik 1 ♂ 3 June 1968. Earlier found in Vest-Agder (Strand 1913).

*_A. pictus_ (Gmelin) (_Cryptus Ratzeburgi_ Hartig). HOi: Os: Hagavik 1 ♀ 16 May 1937 (H).

*_Stenichneumon ephippiatus_ (Dalla Torre). VAi: Sirdal: Ådneram 1 ♂ 14 August 1961.

*_Syspasis haesitator_ (Wesmael). HOy: Bergen 1 ♂ 13 June 1968.

*_Ichneumon alpicola_ Kriechbaumer. HOy: Askøy: Io 1 ♂ 16 July 1974. MRi: Norddal: Valldal 1 ♂ 30 July 1959.

I. sarcitorius L. Ø: Trøgstad: Mønster bru 1 ♂ 25 July 1958. HOy: Sund: Toft 1 ♀ 1 June 1968; Bergen 1 ♀ 15 July 1951 (H); Askøy: Herdla 2 ♀♀ 15 and 19 July 1937 (H), 1 ♀ August 1938 (H). SFy: Vågsøy: Degnepollen 1 ♀ 17 July 1957. Earlier recorded from Østfold, Hedmark and Rogaland (Strand 1898a).

*_I. divergens_ Hlmgr. HOy: Askøy: Io 1 ♂ 14 August 1964.

*_I. d. deliratorius_ Wesmael. AAy: Grimstad 1 ♀ 30 July 1961. HOy: Bergen 1 ♀ 25 June 1969.

I. molitorius Grav. HOy: Os: Lysekloster 1 ♀ 14 July 1965. Found earlier in Hedmark and Buskerud (Strand 1898a).

I. confusor Grav. VE: Tjøme 1 ♂ 11 August 1966. AAy: Landvik 1 ♂ 23 July 1961. Ry: Sandnes: Ganddal 1 ♂ 31 July 1963. HOy: Bergen 5 ♂♂ 14 August 1954, 20 August 1965, 17 July 1966 and 21 August 1969. Earlier recorded from Southern and Northern Norway (Løken 1965, Jussila 1973).

*_I. bucculentus_ Wesmael. Os: Lillehammer 1 ♂ 9 August 1965. HOy: Bergen 1 ♀ August 1950 (H), 2 ♂♂ 20 August 1965 and 19 August 1969; Askøy: Io 1 ♂ 14 August 1964. SFi: Aurland: Flåm 1 ♂ 16 August 1965, Vassbygda 1 ♂ 15 August.

*_I. tempestivus_ Hlmgr. Ø: Hvaler: Bølinghamn 1 ♂ 21 July 1958; Onsøy: Lervik 1 ♂ 18 July 1958. Bø: Hurum: Storsand 1 ♂ 15 July 1958. AAy: Tvedestrand: Askerøy 1 ♂ 24 July; Åmli 1 ♂ 22 July 1961; Landvik 1 ♂ 23 July 1961; Lillesand: Høvåg 1 ♂ 22 July 1961. Ry: Eigersund: Lysevann 1 ♂ 30 July 1960; Klepp: Reve 1 ♂ 31 July 1963; Sola: Tananger 1 ♂ 4 August 1968. HOy: Os: Lysekloster 1 ♂ 4 September 1965; Bergen 1 ♂ 19 August 1965; Askøy: Io 1 ♂ 7 August 1964.

I. s. septentrionalis Hlmgr. Ø: Onsøy: Lervik 1 ♂ 18 July 1958. Ry: Sandnes: Oslo 1 ♂ 29 August 1963. HOy: Os: Nordstrøno 1 ♂ 20 July 1963; Bergen 1 ♂ 15 August 1935, 1 ♀ 20 May 1935 and 1 ♂ 2 August 1936 (H), 3 ♂♂ 30 July 1951, 28 July and 19 August 1952 (H) and 1 ♂ 26 July 1969; Askøy: Herdla 1 ♂ 29 July 1935 (H). HOi: Ullensvang: Lofthus 2 ♂♂ 26 June 1953 (H). SFy: Eid: Nordfjordeid 1 ♂ 28 July 1942 (H). SFi: Aurland: Vassbygda 1 ♂ 18 August 1941 (H). Distributed throughout Norway (Jussila 1973).

I. extensorius L. VE: Ramnes 1 ♂ 30 July 1961. Bø: Øvre Eiker: Hokksund 1 ♀ 19 September 1921 (H). AAy: Tvedstrand: Askerøy 1 ♂ 24 July 1960; Moland 2 ♂♂ July 1960. Ri: Forsand: Lerang 1 ♀ 10 April 1935. HOy: Os: Storom 1 ♀ 25 May 1967, Lysekloster 1 ♂ 12 August 1965; Sund: Telavåg 1 ♂ 3 June 1954; Bergen 1 ♀ 6 July 1952 (H) and 1 ♂ 3 August 1966. HOi: Kvinnherad: Rosendal 1 ♀ 2 June 1966; Ullensvang: Lofthus 1 ♂ 26 June 1953 (H); Kinsarvik: Djønno 1 ♂ 2 September 1950 (H). Earlier recorded from the coast of Østfold, Aust-Agder, Vest-Agder and Rogaland (Strand 1916, Roman 1942).

I. suspiciosus Wesmael. AAy: Tvedestrand: Askerøy 2 ♂♂ 24 July 1960. HOy: Bergen: Bokken 1 ♂ 2 August 1954. Recorded earlier from Akershus (Roman 1942).

**I. melanobatus* Grav. HOy: Sund: Sotra 1 ♂ 26 July 1959. SFi: Lærdal: Borgsund 1 ♀ 25 June 1939 (H).

I. gracilentus Wesmael. On: Lom 1 ♂ 26 July 1959. HOy: Stord: Storsøy 1 ♂ 5 September 1965; Bergen 1 ♀ 2 May 1939 (H). Known from Southeastern Norway (Strand 1913, Roman 1942).

**I. caedator* Grav. HOy: Sund: Risøy 1 ♀ 31 May 1965.

**I. computatorius* Müller. HOy: Bergen 1 ♀ 27 September 1958. SFi: Stryn: Loen 1 ♀ 2 August 1942.

**I. lapponicus* Hellén. SFi: Vik: Målset 1 ♂ 12 July 1941 (H).

I. latrator F. HOy: Bergen 1 ♀ 21 July 1951 (H); Vaksdal: Eidslandet 1 ♂ 27 June 1969; Askøy: Herdla 1 ♀ 3 July 1935 (H). HOi: Kvinnherad: Rosendal 1 ♂ 10 July 1943 (H) and 1 ♂ 26 August 1968. Earlier recorded from Southern Norway (Strand 1906, 1913).

**I. incomptus* Hlmgr. HOi: Kinsarvik (cf. Fjellberg 1972 p. 14 loc. 13 1 ♀ 3 August 1968.

**I. p. primatorius* Förster. SFi: Aurland: Vassbygda 1 ♂ 18 August 1941 (H).

**I. quesitorius* L. HOy: Fjell: Landro 1 ♂ 8 August 1964; Bergen 1 ♂ 27 July 1963; Vaksdal: Eidslandet 1 ♂ 17 August 1965.

**I. formosus* Grav. (*haglundi* Hlmgr.). HOy: Bergen 1 ♀ 5 May 1935 (H).

**I. gracilicornis* Grav. TEi: Finn: Sneiseli 1 ♂ 4 August 1960.

**I. batis* Hlmgr. HOy: Askøy: Herdla 1 ♀ 5 June 1936 (H).

**I. croceipes* Wesmael. HOy: Ølen: Vikebygd 1 ♀ 31 May 1966; Os: Søfteland 1 ♀ 11 June 1967.

**I. nereni* Thomson. SFi: Årdal: Årdalstangen 1 ♀ 3 July 1938 (H). MRy: Ørsta: Viddal 1 ♀ July 1946 (H).

I. stigmatorius Zetterstedt. SFi: Vik: Rivedalseter 1 ♂ 13 July 1940 (H); Lærdal: Tønjum 2 ♂♂ 20 August 1949 (H). Earlier found in Oppland and Troms (Strand 1898a).

I. vulneratorius Zetterstedt. HOy: Vaksdal: Gullbrå 2 ♀♀ 9 October 1966. HOi: Kinsarvik: Stavali (cf. Fjellberg 1972 p. 13 loc. 1 and p. 14 loc 13) 2 ♂♂ 3 August 1968; Ulvik: Finse 1 ♂ 7 September 1964. Observed throughout Norway (Jussila 1973).

I. cessator Müller. Os: Sør-Aurland: Begndal 1 ♀ 21 June 1962. SFi: Lærdal: Bjørkum 1 ♀ 21 June 1939 (H); Stryn: Briksdal 1 ♀ 11 July 1959. TRi: Nordreisa: Bakkeby 1 ♂ 20 July 1955. Known from Hardangervidda (Jussila 1973).

**Chasmias motatorius* (F.). HOy: Bergen 1 ♀ 2 May and 1 ♂ 29 July 1937 (H), 1 ♂ 16 August 1967.

**Exephanes occupator* (Grav.). SFi: Lærdal: Kvamma 1 ♂ 28 June 1938 (H).

Spilichneumon occisor (F.). Ry: Rennesøy: Mosterøy 1 ex 6 May 1934 (H). Previously recorded from Østfold (Strand 1913).

**Diphyus raptorius* (L.). HOy: Vaksdal: Eidslandet 1 ♀ (no dates).

**D. septemguttatus* (Grav.). HOy: Bergen 2 ♂♂ 25 August 1955 and 19 August 1969. HOi: Kvinnherad: Ljosmyr 2 ♂♂ 3 August 1965. SFy: Flora: Nekkøyna 1 ♂ 21 August 1954.

D. alpestris (Hlmgr.). HOy: Bergen 1 ♂ September (H) and 2 ♂♂ 30 July 1954 (H); Askøy: Herdla 2 ♂♂ July 1936 and 1 ♂ 28 July 1937 (H). HOi: Kvinnherad: Rosendal 1 ♂ 1 August 1954. Earlier found in Finnmark (Strand 1898a).

D. luctatorius (L.). Ø: Halden: Idd 1 ♂ 23 July 1958. AAy: Lillesand: Høvåg 1 ♂ 22 July 1961. HOi: Fitjar: Agøy 1 ♀ 27 June 1954. SFy: Flora: Nekkøyna 1 ♂ 21 August 1954. Mentioned from Troms (Siebke 1963).

**D. margineguttatus* (Grav.). HOy: Bergen 1 ♂ 23 May 1943 (H).

Triptognathus amatorius (Müller). Ø: Moss: Jeløy 1 ♂ 25 June 1908 (H). Earlier found from Hedmark (Strand 1898a).

Achaius o. oratorius (F.). HOy: Stord: Storsøy 1 ♀ 29 May 1967; Bergen 1 ♂ May 1938 (H); Meland: Brakstad 1 ♂ 8 July 1966 and 1 ♂ 11–18 July 1967. HOi: Kvinnherad: Rosendal 1 ♂ 5 September 1964. Earlier recorded from Aurland in Sogn & Fjordane (Løken 1965).

**Eutanyacra repertina* (Grav.), comb.n. (*Ichneumon repertinus* Gravenhorst 1820, p. 334; *Eutanyacra* Cameron 1903, p. 227). TEi: Nissedal: Lauvviki 1 ♂ 24 July 1961. AAi: Valle: Kvaestad 2 ♂♂ 3 August 1960. HOy: Bergen 1 ♂ 20 July 1965.

**Ctenichneumon nitens* (Christ). Ø: Onsøy 1 ♂ 7 July 1958.

Probolus culpatorius (L.). HOy: Bergen 1 ♂ 29 August 1937 (H); Askøy: Herdla 1 ♂ 19 June 1936 (H). Earlier recorded from Buskerud, Møre og Romsdal (Strand 1898a) and Hardangervidda (Jussila 1973).

Coelichneumon fuscipes (Gmelin). HOy: Os: Lysekloster 1 ♀ 28 May 1965. HOi: Kvinnherad: Lio 1 ♂ 31 May 1969; Kvam: Ålvik 1 ♂ 26 May 1971. Recorded earlier from Aust-Agder (Roman 1942).

**C. leucocerus* (Grav.). HOy: Vaksdal: Flatekvål 1 ♂ 30 July 1972.

C. comitator (L.). HOy: Bergen 1 ♂ 15 July 1951 (H), 1 ♂ 3 August 1952 (H) and 1 ♂ 17 June 1966; Askøy: Herdla 1 ♂ July 1936 (H). MRy: Ørsta: Viddal 1 ♀ 2 ♂♂ July 1946 (H). Recorded earlier from Romsdal (Strand 1898a) and Hardangervidda (Jussila 1973).

Protichneumon coqueberti (Wesmael). SFi: Lærdal: Borgund 2 ♂♂ 25 June 1939 (H). Earlier recorded from VAy: Siredal (Strand 1913).

P. pisorius (L.). HOy: Bergen 1 ♀ 1958. Earlier found in Østfold (Roman 1942).

REFERENCES

Cameron, P. 1903. Eutanyacra gen. n. *Ent. Soc. London Trans. 1903,* 227.

Fjellberg, A. 1972. Coleoptera from Hardangervidda. *Fauna of the Hardangervidda 1, Zool. Mus., Univ. of Bergen,* 74 pp.

Förster, A. 1868. Synopsis der Familien und Gattungen der *Ichneumonen. Verh. zool.-bot. Ges. Wien 18,* 135–221.

Gravenhorst, J. L. C. 1820. Monographia ichneumonum Pedemontanae regionis. *Mém. Acad. Sci. Torino 24,* 275–388.

Gravenhorst, J. L. C. 1829a. *Ichneumonologia Europaea I.* XXXI & 830 pp. Vratislaviae.

Gravenhorst, J. L. C. 1829b. *Ichneumonologia Europaea II.* 989 pp. Vratislaviae.

Holmgren, A. E. 1855. Försök till upställning och bekrifning af de i Sverige funna tryphonider (Monographia Tryphonidum Sueciae). *K. Sv. Vetensk. Akad. Handl., N.F., 1, No. 1,* 93–246.

Holmgren, A. E. 1876. Dispositio synoptica Mesoleiorum Scandinaviae. *K. Sv. Vetensk. Akad. Handl., N.F., 13, No. 12,* 1–51.

Jussila, R. 1973. Ichneumonidae from Hardangervidda. *Fauna of the Hardangervidda 2,* 50 pp.

Løken, A. 1966. Ekskursjonsberetning. Insekter og arachnoider samlet under det 13. Nordiske Entomologmøtets ekskursjon til Flåm (SFi: Aurland) 13–16 August 1965. *Norsk ent. Tidsskr.* 13, 371–386.

Marshall, T. A. 1876. Description of a new genus and species of British Hymenoptera allied to Pezomachus. *Ent. mon. Mag. 3,* 193–194.

Roman, A. 1936. Die Ichneumoniden des Nördlichen Norwegens. *Tromsø Mus. Årsheft, Nat. Avd., 13 (54, 1931, Nr. 4),* 25 pp.

Roman, A. 1942. List of new finds of Ichneumonidae in Norway. *Tromsø Mus. Årsheft, Nat. Avd., 23 (60, 1937, Nr. 3),* 20 pp.

Siebke, H. 1863. Entomologisk reise i Norge sommeren 1861. *Nytt Mag. Naturv. 12,* 104–192.

Siebke, H. 1870. *Om en i sommeren 1869 foretagen entomologisk reise gjennem Ringerike, Hallingdal og Valdres.* 71 pp., Gundersen, Christiania (Oslo).

Stephens, J. F. 1835. *Illustrations of British Entomology. Mandibulata 7, Order VI. Hymenoptera.* 312 pp. London.

Strand, A. 1943. Inndeling av Norge til bruk ved faunistiske oppgaver. *Norsk ent. Tidsskr. 6,* 208–224.

Strand, E. 1898a. Enumeratio hymonopterorum norvegicorum. *Ent. Tidsskr. 19,* 71–112.

Strand, E. 1898b. Coleopterologische und hymenopterologische Untersuchungen in Hallingdal und Lyngør (Norwegen) 1897. *Ber. naturv. Ver. Regensburg 1896–1897 No 6,* 1–19.

Strand, E. 1906. Nye bidrag til Norges hymenopter- og dipterfauna. *Nytt Mag. Naturv. 44,* 95–104.

Strand, E. 1913. XX. Hymenoptera Parasitica. *Nytt Mag. Naturv. 51,* 337–361.

Teunissen, H. G. M. 1945. Ueber die Gattung Mesoleius. *Zool. Med. Leiden 25,* 200–238.

Thomson, C. G. 1883. Försök till gruppering och bekrifning af crypti (fortsättning), (Fasc. IX). *Opusc. ent. 31,* 850–872.

Thomson, C. G. 1894. Bidrag till kännedom om tryphonider, (Fasc. XIX). *Opusc. ent. 49,* 1971–2024.

Townes, H. K. 1969a. Genera if Ichneumonidae 1. Ephialtinae to Agriotypinae. *Mem. Amer. Ent. Inst. 11,* 300 pp.

Townes, H. K. 1969b. Genera of Ichneumonidae 2. Gelinae. *Mem. Amer. Ent. Inst. 12,* 537 pp.

Townes, H. K. 1969c. Genera of Ichneumonidae 3. Banchinae, Scolobatinae & Porizontinae. *Mem. Amer. Ent. Inst. 13,* 307 pp.

Townes, H. K. 1971. Genera of Ichneumonidae 4.

Cremastinae to Diplazontinae. *Mem. Amer. Ent. Inst. 17*, 372 pp.

Townes, H. K., Momoi, S. & Townes, M. 1965. A catalogue and reclassification of the Eastern Palearctic Ichneumonidae. *Mem. Amer. Ent. Inst. 5*, 661 pp.

Zetterstedt, J. W. 1838. *Insecta Lapponica descripta. Sectio secunda. Hymenoptera.* 317–476. Lipsiae (Leipzig).

Received 19 January 1976

Araneae from Finnmark, Norway

ERLING HAUGE

Hauge, E. 1976. Araneae from Finnmark, Norway. *Norw. J. Ent.* 23, 121–125.

Nineteen spider species are reported from Finnmark, Norway. Four species are new to Norway: *Eboria angulata* Holm, *Lepthyphantes decipiens* (L. Koch), *Dictyna terricola* Holm and *Gnaphosa intermedia* Holm. The remaining 15 species are relatively poorly known in Norway. Two doubtful specimens of *Thanatus arcticus* Thor are described and discussed.

Erling Hauge, Zoological Museum and Department of Morphology, Systematics and Animal Ecology, University of Bergen, N-5014 Bergen-Univ., Norway.

In the summer of 1955, Dr. Hans Tambs-Lyche collected some spiders during a stay in Finnmark. The material was deposited unidentified at the Zoological Museum of Bergen. Recently my examination of this collection resulted in a list of spiders, of which four turned out to be new to the Norwegian fauna. The rest of the list contains species whose distribution in Norway is still very little known, and these species have, together with the new ones, been selected for the present paper. A further species (*Oedothorax agrestis* (Blw.)) was collected in 1975 by cand. mag. Per Undheim.

To avoid too much repetition I have numbered the localities using Roman numbers (I–VII) which are put in brackets behind each record:

I. Finnmark-interior: Karasjokk, 7–8 July 1955
II. Finnmark-east: Sør-Varanger, 11 July 1955
III. Finnmark-north: Kistrand, 6–7 July 1955
IV. Finnmark-north: Tana, 9–10 July 1955
V. Finnmark-north: Lebesby. Ifjord, 13 July 1955
VI. Finnmark-west: Kvalsund, 2 July 1955
VII. Finnmark-west: Kvalsund, Skaidi, 1 July 1955

LIST OF SPECIES

Eboria angulata Holm (1963)
One ♀ (I) after sifting the river deposits on the banks of the river Karasjokka. The species is new to Norway.

Oedothorax agnestis (Blw.)
One ♂ was caught in a pitfall trap 29 July–11 August 1975 near a river bank at Repparfjord, Kvalsund, W. Finnmark (P. Undheim coll.). The specimen was found together with one male of *O. retusus* (Westr.). The only previously known record in Norway is from Suldal, W. Norway.

Thyreosthenius parasiticus (Westr.)

One ♀ (IV). Previously the most northern record in Norway has been Sør-Trøndelag (Hauge 1972).

Enidia bituberculata Wid

Seven ♂♂ + 4 ♀♀ (IV). First record from Finnmark. Strand (1900) and Jackson (1932) recorded the species from Troms.

Diplocentria bidentata Emert

One ♀ + 1 ♂ (VII) after sifting in litter and moss. This northern species is far from rare in Norway, but the only record published until now is from Ringsaker (Waaler 1972).

Tapinocyba pallens (Cbr.)

One ♀ (VII) together with *D. bidentata*. The first record from Finnmark for this typical northern species. Previously it has been recorded as far north as Nordland (Hauge 1968).

Minyrioloides trifons (Cbr.)

One ♂ (III) in Stokkadalen. Previously found only in Finnmark (Jackson 1932). Holm (1945): 'n Dänemark und Norwegen würden bisher nur ♀♀ angetroffen.'

Agyneta conigera (Cbr.)

One ♀ (VII). In moss and foerna. A further 3 ♂♂ were taken in pitfall traps 13–29 July 1975 at Repparfjord, Kvalsund, W. Finnmark (P. Undheim coll.). In Norway previously known from Nord-Møre (Hauge 1972), and from Kvinnherad, Hardanger: 2 ♀♀ 23 May 1971 (Hauge unpublished).

Lepthyphantes antroniensis Schenkel (= *L. exiguus* Holm)

Three ♀♀ (III) at Treviknes near Oldenfjorden. The previous record published in Norway was from Nordland (Hauge 1969), but we now also know the species from a spruce forest near Voss, W. Norway (1 ♂ + 4 ♀♀ 26 June 1974, E. Hauge coll.).

L. alacris (Blw.)

One ♀ (III) in Stokkadalen, a birch forest about 250 m above sea level. First record from Finnmark of this common species.

Lepthyphantes decipiens (L. Koch)

One ♀ (III) near Stabbursnes. The species is new to Norway, but probobly not too rare in the north (according to Koponen 1972).

Kaestneria pullata (Cbr.) (= *Lepthyphantes pullatus* (Cbr.))

One ♀ (II) near Bjørnevatn, and 1 ♀ (III) in a bog near Loustijokka river. Previously only one record in Norway: Hattfjelldal, Nordland (Strand 1902b).

Tiso aestivus (L. Koch)

One ♀ (III) at Jonsnes, Gårådek. Hitherto the most northern record in Norway has been Skarmodalen, Nordland (Strand 1902b). The species is locally quite common in some of the South Norwegian high mountain areas.

Dictyna terricola Holm 1945

One ♀ (II) near Bjørnevatn. The species is new to Norway.

Singa albovittata (Westr.)

One ♂ (I) in a humid, sloping terrain. The species was previously recorded only from S. Norway: Oslo and Valdres (Collett 1875) and Nes, Hallingdal (Strand 1899).

Robertus scoticus Jackson

Three ♀♀ + 1 ♂ (VII) after sifting in litter and moss. This common, northern species has been reported only twice (in S. Norway): Nordmarka near Oslo (Palmgren 1964) and Ringsaker (Waaler 1972).

Lithyphantes albomaculatus (Degeer)

Four ♀♀ + 1 subad. ♂ (III) at Smørdal. New in N. Norway. Previously known from Lærdalsøra, W. Norway (Strand 1902a, identified as *L. corollatus* (L.)) and from Ål, Hol, and Hemsedal (Strand 1899).

Gnaphosa intermedia Holm

One ♀ (III) near Stabburselv. The species is new to Norway. Further there exists an unpublished record from N. Nordland (Nnø: Ankenes, Skjomen, E. Hauge coll.).

Thanatus arcticus (?) Thor

One ♀ (III) at Sørdal, and 1 ♀ + 1 juv. (III) near Loustajokka river. The identification

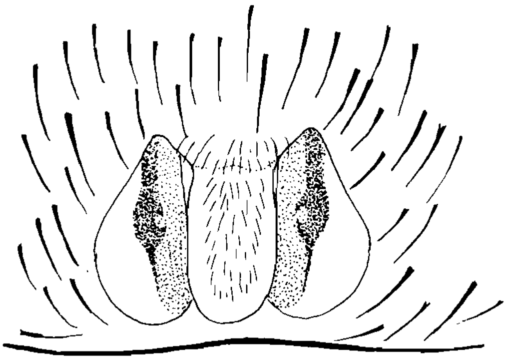


Fig. 1. *Thanatus arcticus* (?) Thor. Epigyne.

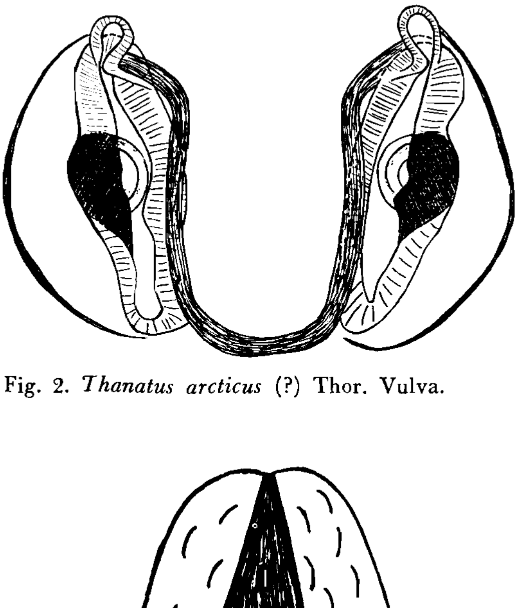


Fig. 2. *Thanatus arcticus* (?) Thor. Vulva.

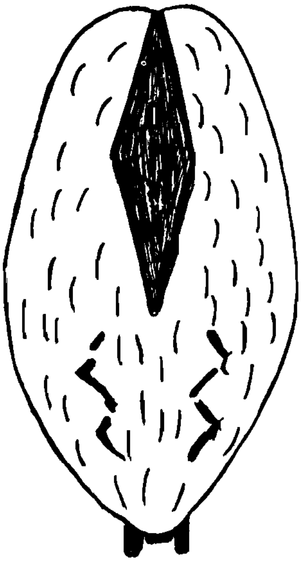


Fig. 3. *Thanatus arcticus* (?) Thor. Abdomen, dorsal view.

of these specimens has been somewhat uncertain. Personal communication with Dr. Pekka Lehtinen has led to the conclusion that it is probably *T. arcticus.* According to Dr. C. D. Dondale (pers. comm.), however, there is some doubt about the identification of the specimens. It therefore seems justified to give a more detailed description of my specimens.

The epigyne (Fig. 1) corresponds very much to that of *T. vulgaris borealis* as described by Tullgren (1944, Pls. XVIII, Fig. 237). This close relationship with *T. vulgaris* Sim. is also indicated by Dr. Dondale in his pers. comm. According to Dondale et al. (1964), however, the epigyne (i.e. the median plate) of *T. vulgaris* can be variable. The vulva of my specimens (Fig. 2) deviates from Tullgren's drawing of *T. vulgaris borealis* (Tullgren 1944, Fig. 45 B); for one thing, the uppermost small pockets of the vulva-complex of my two specimens are more oblique, in a way more similar to another drawing made by Tullgren (1942, Fig. 6b). Furthermore, the receptaculae of my specimens contain a circular, dark, and very obscure gland-like figure (Fig. 2), conspicuous to such a degree that they can be seen through the epigyne (Fig. 1). On the other hand, the general elongated shape of the vulva-complex corresponds to that of Tullgren's *T. vulgaris borealis* and to that of *T. vulgaris* drawn by Dondale et al. (1964, Fig. 42). The rest of Tullgren's species (Tullgren 1944, Figs. 45A, 46A+B) have receptaculae which are considerably broader compared to their length. This also seems to be true when comparing the remaining *Thanatus* species of Dondale et al. (1964, Figs. 46–59), including *T. arcticus.* According to Dondale et al. (1964, Fig. 59) the spermatecae of *T. arcticus* are touching each other at the midline, whereas in my specimens (Fig. 2) they are widely separated.

The length and breadth of the carapace of my two adult specimens are as follows: Spec. 1: 3.33 mm long and 2.75 mm broad, spec. 2: 2.78 mm long and 2.55 mm broad. This is considerably larger than the measurements of Tullgren's *T. vulgaris borealis,* and more in accordance with the data given for both *T. arcticus* and *T. vulgaris* by Dondale et al. (1964).

The length of the legs of my largest specimen (ta–Mt.–tib.–pat.–fem.):

I (1.37–1.65–1.92–1.17–2.66) = 8.77 mm,
II (1.49–1.76–2.27–1.29–2.55) = 9.36 mm,
III (1.29–1.76–2.39–1.18–2.86) = 9.48 mm,
IV (1.37–2.88–2.20–2.25–2.94) = 11.64 mm.

These lengths are considerably longer than those of Tullgren's *T. borealis.* Also a comparison with two specimens of *T. vulgaris* from France (one owned by Zoological Museum of Bergen and one most kindly lent to me by Dr. Dondale) makes clear that my specimens are larger and are much tougher in general appearance. Dondale et al. (1964) found femur II (*T. arcticus* ♀) to be approximately 2.71 mm.

Spinulation on the legs:

Femur I: 2 prolat. + 1 dors., 0 retrolat. Dondale et al. (1964) (*T. arcticus* ♀): 2–3 prolat., 1–2 dors. Tullgren (1944) (*T. vulgaris borealis*): 3 prolat.

Femur II–IV: 1 dorsal spine. Tullgren (1944) (*borealis*): Fem. III–IV 2 dors. spines.

Tibia I: 1 prolat., (2+2+2) ventr. spines. Dondale et al. (*T. arcticus*): 'Tibia I with 3 pairs of ventral spines'. Tullgren (1944) (*T. borealis*): 1 prolat., (2+2) ventr. spines.

Tibia II: (2+2+2) ventr. spines. Tullgren (1944) (*T. borealis*): (2+2) ventr. spines.

Tibia III: 1 prolat. + 1 retrolat. + (2+2+2) ventr. spines. Tullgren (1944) (*T. borealis*): 1 prolat., (2+2+2) ventr. spines.

Tibia IV: 2 prolat. + 3 retrolat. + (2+2+2) ventr. spines. Tullgren (1944) (*T. borealis*): 1 prolat., 1 retrolat., (2+2+2) ventr. spines.

Metat. I+II: (2+2) ventr. spines. Tullgren (1944) (*T. borealis*): (2+2) ventr. spines.

Metat. III: 1 prolat. + (2+2+2) ventr. spines. Tullgren (1944) (*T. borealis*): 1 prolat., (2+2) ventr. spines.

Metat. IV: 3 prolat. + 2 retrolat. + (2+2+2) ventr. spines. Tullgren (1944) (*T. borealis*): 3 prolat. + 1 retrolat. + (2+2+2) ventr. spines.

Colours: The present specimens have been preserved in alcohol for a long time and the colours may not be quite representative: The carapace is practically unicolorous yellow-brown. The dark, langitudinal bands mentioned by Tullgren (1944) for *T. v. borealis* hardly visible, if at all. The abdomen is dorsally light yellow-brown, laterally and down towards the ventral side faint traces of longitudinal dark bands. Dorsally the abdomen also has a dark, very clear lanceolate stripe on the anterior half (Fig. 3), like that of *T. arcticus* (Holm 1967, Fig. 101) and also very like *T. formicinus* (Cl), and on the posterior half two zig-zag formed figures.

The descriptions given above indicate that my specimens have much in common with both *T. vulgaris* and *T. arcticus,* but that there are distinct differences from both species. They most probably belong to *T. arcticus,* perhaps a subspecies, but to decide this a larger material is necessary.

T. arcticus has previously been recorded once in Norway (Finnmark), according to Holm (1968) described as *T. lapponicus* by Jackson (1932).

ACKNOWLEDGEMENTS

I am much indebted to Dr. H. Tambs-Lyche for giving me permission to publish this list, to cand. mag. P. Undheim for contributing the *Oedothorax* species, and to Prof. H. Kauri for his criticism of this manuscript.

REFERENCES

Collett, R. 1875. Oversigt af Norges Araneider. I. *Forh. Vid. Selsk. Christian. 1875,* 225–259.

Dondale, C. D. et al. 1964. Revision of the nearctic species of *Thanatus* C. L. Kock (Araneae: Thomisidae) *Canad. entomol. 96,* 636–656.

Hauge, E. 1968. *Typhocraestus sylviae* sp. n. and *Panamomops mengei* Simon (Araneae) in Norway. *Norsk ent. Tidsskr. 15,* 65–69.

Hauge, E. 1969. Six species of Spiders (Araneae) new to Norway. *Norsk ent. Tidsskr. 16,* 1–8.

Hauge, E. 1972. Spiders and Harvestmen from Møre & Romsdal and Trøndelag, Norway. *Norsk ent. Tidsskr. 19,* 117–121.

Holm, Å. 1945. Zur Kenntnis der Spinnenfauna des Torneträskgebietes. *Ark. Zool. 36(A),* 1–80.

Holm, Å. 1963. Spiders of the Genus *Eboria* Falc. (Araneae: Erigonidae). *Ent. Tidsskr. 84,* 266–291.

Holm, Å. 1967. Spiders (Araneae) from West Greenland. *Meddel. om Grønland, 184 (Nr. 1),* 1–99.

Holm, Å. 1968. A contribution to the spider fauna of Sweden. *Zool. Bidr. Uppsala 37,* 183–209.

Jackson, A. R. 1932. Results of the Oxford University expedition to Lapland in 1930. Araneae and Opiliones. *Proc. Zool. Soc. 1932, I.,* 97–112.

Koponen, S. 1972. On the spiders of the ground layer of a pine forest in Finnish Lapland, with notes on their diurnal activity. *Rep. Kevo Subarctic Res. Stat. 9,* 32–34.

Palmgren, P. 1964. Några spindelprov från Nordmarka vid Oslo. *Norsk ent. Tidsskr. 12,* 176–177.

Strand, E. 1899. Araneae Hallingdaliae. *Arch. Math. Naturv. 21 (6),* 1–23.

Strand, E. 1900. Fortegnelse over en del af Sparre Schneider i det arktiske Norge samlede Araneider. *Tromsø Mus. Aarb. 23,* 9–12.

Strand, E. 1902a. Theridiiden aus dem westlichen Norwegen. *Bergens Mus. Aarb. 6,* 1–23.

Strand, E. 1902b. Theridiiden aus dem nördlichen Norwegen. *Arch. Math. Naturv. 24,* 1–66.

Strand, E. 1906. Die arktischen Araneae, Opiliones und Chernetes. pp. 431–478 in *Fauna Arctica,* 544 pp., Jena.

Tullgren, A. 1942. Bidrag till kännedomen om den svenska spindelfaunan I. *Entomol Tidsskr. 63,* 217–234.

Tullgren, A. 1944. Svensk spindelfauna. 3. Egentliga spindlar. Araneae. Fam. 1–4 Salticidae, Thomisidae, Philodromidae och Eusparrassidae. 132 pp., Stockholm.

Waaler, P. F. 1972. Spiders (Araneae) from Ringsaker, Norway. *Norsk ent. Tidsskr. 19,* 49–57.

Received 10 February 1976

Collembola from mountains in South Norway

ARNE FJELLBERG

Fjellberg, A. 1976. Collembola from mountains in South Norway. *Norw. J. Ent.* 23, 127–137.

A total of 64 species of Collembola are reported from different mountains in South Norway, ranging from 900 – 2300 m a.s.l. The characteristic High Alpine communities described by earlier authors from North Scandinavia are found to be present also in South Norway. Certain species were associated with calceophilous Middle Alpine meadows, among others *Folsomia dovrensis* n.sp., which is described. The dorsal chaetotaxy of *Anurida alpina* Agrell is figured.

A. Fjellberg, Zoological Museum, N-5014 Bergen-University, Norway.

The Collembola fauna of Norwegian mountains is insufficiently known. However, Linnaniemi (1911) listed some species from the Dovre area, and Wahlgren (1906) and Agrell (1941) reported some observations from mountains in North Norway. Fjellberg (1975b) gave a list of species from Hardangervidda, as part of an ecological study.

A unique element of High Alphine Collembola species has been reported from North Scandinavian mountains by Wahlgren (1919) and Agrell (1941). A corresponding fauna in South Norway has not been found, but might be expected, since such elements are well known among other insect groups (Lindroth 1945, 1949) and also from plant communities (Nordhagen 1936).

MATERIAL AND METHODS

The field work of the present study was done during the first half of July 1975. Some of the highest mountains in Jotunheimen, Dovrefjell, and Trollheimen were visited. A few samples were taken from the mountains of Hallingskarvet and Vikafjell (Fig. 1, Table I). A total of 61 samples were cut from different plant communities and transported in plastic bags to laboratory for extraction in Tullgren funnels. Specimens were also collected directly by hand or swept from vegetation with an insect net.

LIST OF SPECIES

Hypogastrura scotica (Carpenter & Evans)

Loc. 2, 3, 4, 5, 14, 16, 19, 21, 24, 25, 27, 35, 37, 38, 39, 42, 43, 45, 47, 50, 52, 53, 55, 56, 57. Found over most of the area, ascending to 2200 m in Jotunheimen. Especially abundant in High Alpine communities with wet moss and grass along melt-water brooks.

H. inermis (Tullberg)

Loc. 23. Only found in dry *Pinus silvestris* litter in Visdalen, 900 m a.s.l.

Xenylla maritima Tullberg

Loc. 6, 28, 32, 33. Dry meadows and *Dryas* heath in Jotunheimen and Trollheimen, up to 1400 m.

Willemia aspinata Stach

Loc. 3, 7, 12, 35, 45. Most abundant in litter of *Betula nana* and *Salix* in the Low Alpine region. Once in an High Alpine habitat (1600 m). Dovrefjell and Jotunheimen.

W. anophthalma Børner

Loc. 2, 5, 8, 11, 12, 14, 29, 31, 54. Dry meadows, *Dryas* heaths and *Betula nana* litter up to the Middle Alpine region. Once in a High Alpine habitat (1900 m). Jotunheimen and Trollheimen.

W. scandinavica Stach

Loc. 11. A few specimens in cushions of moss and *Festuca* on dry sand in a river bed at Spiterstulen in Jotunheimen (1100 m).

W. intermedia Mills

Loc. 29, 30, 31, 44. Only found in dry meadows with rich, calceophilous flora in the Middle Alpine region, 1300–1500 m. Dovrefjell and Jotunheimen.

Friesea mirabilis (Tullberg)

Loc. 3, 5, 12, 19, 25, 26, 37, 44, 52, 53, 54, 55, 56. Both dry and wet habitats (meadows, heaths, thickets, bogs) up to 1900 m. Jotunheimen, Dovrefjell, Trollheimen, Vikafjell.

Pseudachorutes subcrassus Tullberg

Loc. 54. Several specimens in Dryas litter in Sub Alpine birch forest at Bøvertun in Jotunheimen (960 m).

Anurida alpina Agrell

Loc. 21, 43. One specimen in High Alpine habitat with moss, grass and lichens near the summit of Styggehø in Jotunheimen (2200 m). Many specimens in a very wet meadow with calceophilous flora *(Draba, Saxifraga, Silene, Luzula, Carex,* etc.) beneath a large snow fen north of N. Knutshø at Dovrefjell (1550 m).

Agrell (1941) reported the species from mountains in Swedish Lappland and at Narvik in North Norway. Not reported outside Scandinavia. As there exist no illustrations of the dorsal chaetotaxy in the literature, it is shown in Fig. 2.

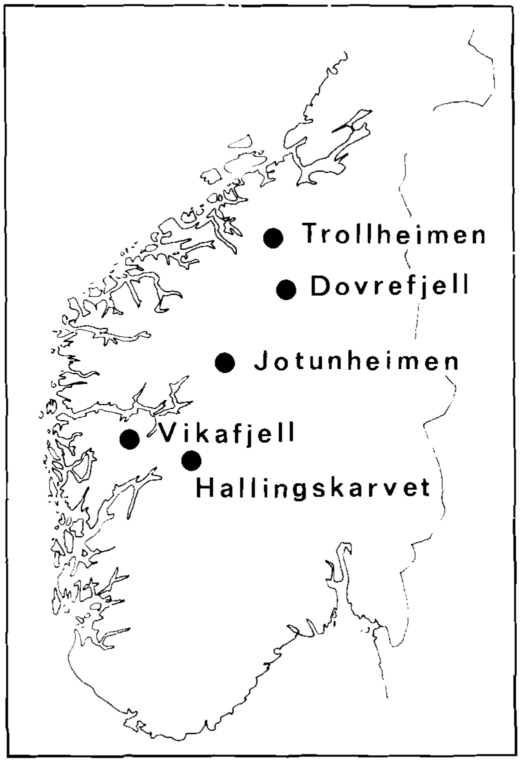


Fig. 1. Map of South Norway with the examined areas.

Anurida frigida Fjellberg

One specimen under moss on stone in a melt-water brook at N. Knutshø, Dovrefjell (1500 m).

The species was described by Fjellberg (1973) from a mountain at Abisko, Swedish Lappland. Later it was found to be common in Spitsbergen (Fjellberg, unpubl.).

A. forsslundi Gisin

Loc. 3, 10, 12, 25, 46, 54. Drier habitats up to the Low Alpine region (1320 m). Jotunheimen, Dovrefjell, Trollheimen.

A. pygmaea (Børner)

Loc. 7, 19, 43, 55. Both dry and wet meadows in Jotunheimen and Dovrefjell, up to 1900 m.

Neanura muscorum (Templeton)

Loc. 8, 12. Found twice in Jotunheimen in litter of *Betula nana* (1250 m) and heath with *Dryas, Silene acaulis,* and *Carex rupestris* (1350 m).

Onychiurus absoloni (Børner)

Loc. 3, 5, 12, 55. Dry meadows and thickets of *Betula nana* and *Salix* in Jotunheimen (1250–1400 m).

O. arcticus (Tullberg)

Loc. 1, 8, 28, 48, 50, 51. In moss and grass in the High Alpine zone, both dry and wet. Especially abundant at resting places of birds, where the droppings give a rich nitrophilous flora of moss, lichens, and algae. This was observed at the top of Nystuguhø (loc. 51), where the birds used the stone cairn as a resting and watching place. Jotunheimen (1400–2200 m).

The presence of this 'maritime' species (Agrell 1941, p. 46) in the high, continental mountains in South Norway is surprising. The species has a nearly holarctic, coastal distribution, but is also found inland in Siberia (Valpas 1967). Agrell (1941) did not observe it in North Swedish mountains, but found it in coastal mountains at Narvik in North Norway. In Norway it is probably distributed along the west coast; the southernmost record is from Stryn in Sogn og Fjordane (Lie-Pettersen 1898). Some new records are from the island of Runde at Ålesund and the Trolltindane mountains (700 m a.s.l.) at Molde, Møre og Romsdal (Fjellberg, unpubl.).

In comparison with specimens from Jan Mayen, the specimens from South Norway have shorter body hairs and usually lack the ventral pseudocelli on Abd. II. This may indicate that different subspecies are involved.

O. pseudovanderdrifti Gisin

Loc. 3, 5, 6, 7, 8, 10, 12, 25, 26, 27, 28, 29, 30, 32, 33, 35, 38, 40, 42, 44, 45, 46, 50, 51, 54, 55. This is an ubiquitous species found all over the area, most abundant in dry meadow sites. Ascends to 1750 m. Jotunheimen, Dovrefjell, Trollheimen.

Tullbergia arctica (Wahlgren)

Loc. 28, 29, 30, 31, 32, 44. Only found in dry meadows with calceophilous vegetation (1350–1450 m). Trollheimen, Dovrefjell.

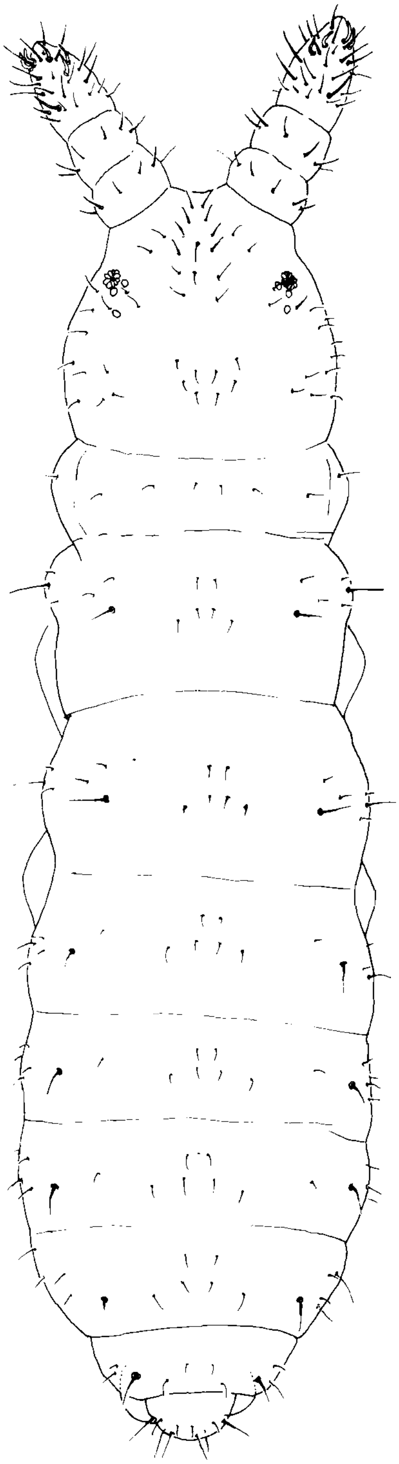


Fig. 2. Dorsol chaetotaxy of *Anurida alpina* Agrell.

Table I. Survey of examined localities. County abbreviations: On = North Oppland, STi = Inner South Trøndelag, SFi = Inner Sogn & Fjordane, HOi = Inner Hordaland, Bv = West Buskerud.

No.	Locality	Date 1975	District	UTM grid 32 V	Elevation m a.s.l.	Biotope
1.	Svellnosi	1 July	On: Lom	MP6533	2000	Moist moss & lichens on rock
2.	"	"	"	MP6633	1900	Wet Luzula, moss etc. on ground soaked by melt-water.
3.	Hellstuguhøgda	1 July	"	MP6830	1320	Luxuriant thicket with Salix and Juniperus. Rich undergrowth.
4.	"	"	"	MP6831	1300	Eutrophic, very wet meadow.
5.	"	"	"	MP6830	1320	Rich dry meadow among Salix.
6.	N of Skauthø	2 July	"	MP7034	1350	Dry, exposed heath with Carex rupestris, Dryas, Silene.
7.	"	"	"	MP7034	1300	Salix reticulata, Cladonia and Cetraria on dry, steep rock shelf.
8.	"	"	"	MP7034	1350	Dry meadow/heath with Carex rupestris, Dryas, Silene etc.
9.	S of Spiterstul	"	"	MP683326	1100	Stereocaulon cushions on dry sand in river bed.
10.	"	"	"	MP683326	1100	Thin moss layer on dry sand in river bed.
11.	"	"	"	MP683326	1100	Thick moss with Festuca tufts on dry sand in river bed.
12.	SW of Spiterstul	"	"	MP6732	1250	Dense thicket of Betula nana on exposed heath.
13.	Leirgrovi	3 July	"	MP94301	1600	Moist moss and grass cushions near brook in steep rockfall.
14.	Leirhø	"	"	MP699297	1850	Moss, lichens, Luzula and Ranunculus glacialis, rather dry.
15.	"	"	"	MP717289	2320	Wet moss at melt-water brooks.
16.	"	"	"	MP698298	1800	Thick moss on boulders.
17.	"	"	"	MP709291	2200	Wet moss at melt-water brooks.
18.	Styggehø	4 July	"	MP6529	2100	Moist moss & lichens.
19.	"	"	"	MP6529	1900	Moss, Luzula, Ranunculus glacialis on moist ground.
20.	"	"	"	MP6429	2210	Dry moss & grass in rock crevices.
21.	"	"	"	MP6429	2000	Grass, moss lichens etc. on rock shelves, rather moist.
22.	"	"	"	MP6529	1950	Wet snowfield with Ranunculus glacialis, grass moss etc.
23.	Visdalen	5 July	"	MP7038	900	Dry Pinus litter.
24.	Gjevilvatnet	"	STi: Oppdal	NQ209524	670	Meadows at lake shore.
25.	Heimre Gjevilvasskammen	6 July	"	NQ1554	1320	Damp meadow with Salix herbacea, Empetrum, moss, lichens etc.
26.	"	"	"	NQ1554	1320	Just melted snowfield with moss and lichens. Moist.
27.	"	"	"	NQ1556	1400	Wet Luzula, moss & lichens on ground soaked by melt-water.
28.	"	"	"	NQ152562	1420	Dry, calceophilous vegetation on rock shelves in precepice.
29.	"	"	"	NQ151564	1440	Large cushion of grass turf with bone and feather fragments.
30.	"	"	"	NQ151564	1440	Large cushion of grass turf with bone and feather fragments

Table I. Continued

31.	"	6 July	"	NQ151564	1440	Thick Dryas turf in dry meadow.
32.	"	"	"	NQ151564	1440	Thick grass cushion with Sedum, Potentilla, Thalictrum, etc.
33.	"	"	"	NQ151564	1450	Dry meadow with grass, Dryas, Silene etc.
34	Vårstigen	7 July	"	NQ3212	900	Rich undergrowth in Sub Alpine Betula forest.
35.	"	"	"	NQ3212	900	Under bark scales of Betula.
36.	S. Knutshø	"	"	NQ3508	1600	Wet moss, Saxifraga, Draba, etc. on ground soaked by melt-water.
37.	"	"	"	NQ357087	1680	Wet moss and grass on ground soaked by melt-water.
38.	"	"	"	NQ356087	1690	Dry ground with Luzula, moss and lichens.
39.	"	"	"	NQ357087	1680	Moist moss and lichens on stones in snowfield.
40.	"	"	"	NQ3408	1550	Wet ground with grass, moss, Saxifraga, Ranunculus etc.
41.	"	"	"	NQ342087	1400	Wet moss close to edge of snowfen.
42.	N of N. Knutshø	8 July	"	NQ3411	1550	Moss, grass, Saxifraga etc. on ground soaked by melt-water.
43.	"	"	"	NQ3411	1550	Rich, very wet meadow with Silene, Saxifraga, Luzula, Carex etc.
44.	N. Knutshø	"	"	NQ3310	1300	Rich dry meadow with calceophilous vegetation.
45.	"	"	"	NQ3310	1450	Dry Dryas heath on slopes against Drivdalen.
46.	S of Vårstigåa	"	"	NQ3413	1155	Dry lichen heath with Empetrum and Betula nana.
47.	Gl. Reinheim	9 July	On: Dovre	NQ1608	1620	Wet moss and Luzula on ground soaked by melt-water.
48.	Snøhetta	"	"	NQ158095	1750	Thick, moist moss on rock.
49.	"	"	"	NQ145102	2150	Wet moss
50.	Nystughø	10 July	STi: Oppdal	NQ2812	1630	Wet moss and grass at brook.
51.	"	"	"	NQ289133	1754	Dry grass, moss, lichens and algae with bird droppings.
52.	Fokstumyra	11 July	On: Dovre	NP1892	920	Carex bog with moss.
53.	"	"	"	NP1892	920	Moist moss in thicket of Betula nana and Salix spp.
54.	N of Bøvertun	"	On: Lom	MP5035	960	Luxuriant Dryas tufts in Sub Alpine Betula forest.
55.	Sognefjell at Fannaråken	"	SFi: Luster	MP3923	1400	Dry meadows etc. near the road.
56.	Vikafjell at Vossadal	12 July	HOi: Voss	LN5562	900	Oligotrophic bog (Eriophorum, Sphagnum, etc.).
57.	Hallingskarvet N of Lengjedalsvann	29 July	Bv: Hol	MN2720	1650	Wet moss at melt-water brook.
58.	Hallingskarvet at Hellevassfonn	"	"	MN2820	1800	Wet moss at melt-water brook.
59.	"	"	"	MN2820	1750	Wet moss on rock.
60.	Hallingskarvet at Kyrkjedørsnut	"	"	MN2522	1750	Wet moss.
61.	"	"	"	MN2522	1750	Moss, rather dry.

The species is reported from Jan Mayen (Gisin 1960) and Spitsbergen (Valpas 1967). I have collected specimens from Kopparåsen at Abisko (Swedish Lappland) and Rauhellerskorane at Hardangervidda (South Norway), all in calceophilous communities (Fjellberg, unpubl.).

T. affinis (Børner)

Loc. 54. One specimen in *Dryas* tufts in birch forest at Breiseterdalen, Jotunheimen (960 m).

T. krausbaueri (Børner) s. lat.

Loc. 5, 7, 8, 10, 11, 12, 25, 27, 28, 29, 30, 31, 33, 44, 46, 54, 55. Mostly in dry meadows up to 1450 m. Jotunheimen, Dovrefjell, Trollheimen.

Tetracanthella britannica Cassagnau

Loc. 3, 4, 5, 8, 21, 25, 26, 35, 37, 39, 42, 43, 44, 45, 48, 52, 56, 57. A common species in different vegetation types, mostly wet moss and wet meadows up to 2200 m. Jotunheimen, Dovrefjell, Trollheimen, Vikafjell, Hallingskarvet.

T. wahlgreni Linnaniemi

Loc. 5, 7, 10, 11, 12, 19, 25, 26, 27, 28, 29, 33, 38, 45, 46, 51, 53, 55. A common species, preferring drier biotopes than *T. britannica* (dry meadows, dry moss, lichen heaths, etc. Up to 1900 m). Jotunheimen, Dovrefjell, Trollheimen.

Anurophorus septentrionalis Palissa

Loc. 23. One specimen in *Pinus* litter in Visdalen, Jotunheimen (900 m).

Pseudanurophorus binoculatus Kseneman

Loc. 3, 5, 7, 8, 11, 28, 29, 32, 46, 54. Rather common in dry meadows, lichen heaths, *Dryas* heath, *Salix* thicket. Up to 1440 m. Jotunheimen, Dovrefjell, Trollheimen.

P. inoculatus Bødvarsson

Loc. 43, 45. Only found at N. Knutshø at Dovrefjell, once in a very wet meadow with calceophilous flora and once in a dry *Dryas* heath (1450–1550 m).

The species was redescribed by Fjellberg (1975a) and reported from Iceland, Greenland, North Norway and North Sweden. Recently it was found in Spitsbergen (Fjellberg, unpubl.).

Isotomodella pusilla Martynova

Loc. 30, 31. Only found at the mountain Gjevilvasskammen in Trollheimen, in dry meadows with calceophilous flora (1440 m).

The species was described from mountains in central Asia, and was reported by Fjellberg (1975a) from Hardangervidda in S. Norway and Abisko in Swedish Lappland.

Folsomia brevicauda Agrell

Loc. 4, 7, 8, 25, 26, 28, 29, 31, 33, 57. Both in wet and dry meadows, *Dryas* heath and moss. Up to 1650 m. Jotunheimen, Dovrefjell, Trollheimen, Hallingskarvet.

F. quadrioculata (Tullberg)

Loc. 2, 3, 5, 6, 7, 8, 10, 11, 12, 14, 15, 16, 19, 21, 22, 25, 28, 29, 30, 31, 33, 35, 37, 38, 40, 42, 43, 44, 45, 46, 47, 48, 51, 54, 55. The most euryecious and abundant species in the material. A preference for certain biotopes could not be demonstrated. Ascends to 2320 m. Jotunheimen, Dovrefjell, Trollheimen.

F. diplophthalma (Axelson)

Loc. 3, 5, 7, 8, 22, 29, 30, 31, 32, 33, 44, 45. Apart from one record in wet moss in the High Alpine zone (1900 m), this species apparently prefers drier biotopes in the Middle and Low alpine zones. Most abundant in dry meadows with calceophilous vegetation. Jotunheimen, Dovrefjell, Trollheimen.

F. agrelli Gisin

Loc. 1, 2, 15, 16, 17, 18, 19, 20, 21, 22, 49, 50, 57, 58, 59, 61. A High Alpine species that prefers the barren ground with abundant melt-water and only patches of vegetation (moss, lichens, *Luzula, Phippsia, Ranunculus glacialis,* etc.) between the boulders. Not seen below 1630 m. Jotunheimen, Dovrefjell, Hallingskarvet.

The species is reported from North Scandinavia and Iceland (Gisin 1960).

F. sensibilis Kseneman

Loc. 3. Only found once at Hellstuguhøgda in Jotunheimen, in litter in luxuriant *Salix* scrub (1320 m).

Folsomia dovrensis n. sp.

Loc. 11, 28, 29, 31, 32, 44, 54. Dry moss, *Dryas* heath and dry meadows with calceophilous flora (960–1440 m). Jotunheimen, Dovrefjell, Trollheimen.

Type material

Holotype: Female, 0.48 mm, labelled: 'Norway, S. Trøndelag: Oppdal, 8. VII 1975. N. Knutshø, 1300 m. Dry calceophilous meadow. A. Fjellberg leg.' Deposited in alcohol at Zoological Museum, Dept. of Entomology, Bergen, Norway.

Paratypes: The following are deposited with the holotype: 4 specimens (alcohol) with the same data as holotype. 101 specimens (99 in alcohol, 2 on slides) from Norway, S. Trøndelag: Oppdal. 6 July 1975. Heimre Gjevilvasskammen, 1420–1440 m. Dry, calceophilous meadow, calceophilous vegetation on rock shelves, grass cushions with *Sedum, Thalictrum, Potentilla,* etc., thick *Dryas* tuft. 14 specimens (6 in alcohol, 8 on slides) from Norway, Oppland: Lom. 2 July 1975. South of Spiterstulen, 1100 m. Moss with *Festuca* on dry sand in river bed. 1 specimen (slide) from Sweden, Torne Lappmark: Nissunkårsa, Abisko. 16 June 1973. In *Dryas* on boulder of limestone. A. Fjellberg leg. The following are deposited at British Museum (Nat. Hist.), Department of Entomology, London: 4 specimens (slide) from the sample at Spiterstulen and 10 specimens (alcohol) from the locality at Gjevilvasskammen.

Derivatio nominis: After the district of Dovre.

Description

Total body length up to 0.50 mm. Colour white, no pigment. Eyes absent. PAO narrow elliptical, not as high as thickness of Ant. I. Head with 3 + 3 setae along ventral line. Antennae I with two ventrolateral sensillae, the lateral one largest. Antennal organ III with two club-shaped sensillae, flanked by two long, sensorial hairs (Fig. 3c). No hairs along ventral line of thorax. Claws and empodia simple, without teeth. No spur hairs. Ventral tube with 4 + 4 (occasionally 3 + 3) lateral and 6 (5) caudal hairs. Tenaculum with 4 + 4 teeth and one seta. Manubrium 1.2–1.3 as long as dens, with 1 + 1 (sometimes 1 + 2) ventral setae. Dens 3.0–3.3 as long as mucro, with 2 (3) dorsal setae and 8 ventral setae (Fig. 3 d, e, f). Mucro with two teeth. The longest macrochaetae of Abd. IV–VI about 2.7 as long as mucro. Dorsal chaetotaxy as in Fig. 3a. Irregularities are frequent, but number of setae along dorsal median line of Th. II – Abd. III appears to be constant: 64/333. Sensorial hairs of Abd. IV–VI slightly differentiated.

Affinities

F. dovrensis comes close to the description of *F. brevifurca* (Bagnall 1949) from Scotland and *F. monosetosa* Rusek, 1966 from Czechoslovakia. According to Lawrence (1973), *F. brevifurca* is a species dubia, described from one juvenile specimen of uncertain position. It differs from *F. dovrensis* by longer abdominal macrochaetae (ca. 4.0 as long as mucro, not 0.4 as Rusek (1966) reports). The single type specimen of Bagnall measures 0.6 mm and is juvenile. Probably it belongs to a species which is larger than *F. dovrensis.* Also *F. monosetosa* is bigger than *F. dovrensis.* The single type specimen measures 1.05 mm. Adult specimens of *F. dovrensis,* with well-developed genital organs, measure only 0.45–0.50 mm. Apart from the difference in body size, it is difficult to find good morphological characters separating *monosetosa* and *dovrensis.* To judge from the original drawings, *monosetosa* has more slender antennae and furca than *dovrensis.*

The present records of *dovrensis* indicate an arctic/alpine distribution, whereas *monosetosa* was found in forest in Mähren. It is very unlikely that the two forms are conspecific.

Ecology, distribution

F. dovrensis has been found in dry meadows with calceophilous vegetation and in *Dryas* tufts from the Sub Alpine to the Middle Alpine region (960–1440 m) in Jotunheimen, Dovrefjell, and Trollheimen. One specimen was found in *Dryas* at Abisko in Swedish Lappland.

The species is probably parthenogenetic as only females have been seen.

Isotomiella minor Schäffer

Loc. 3, 5, 7, 8, 12, 26, 32, 33, 46, 55. *Dryas* heath, lichen heath, dry meadow and thickets of *Betula nana* and *Salix.* Ascends to 1450 m. Jotunheimen, Dovrefjell, Trollheimen.

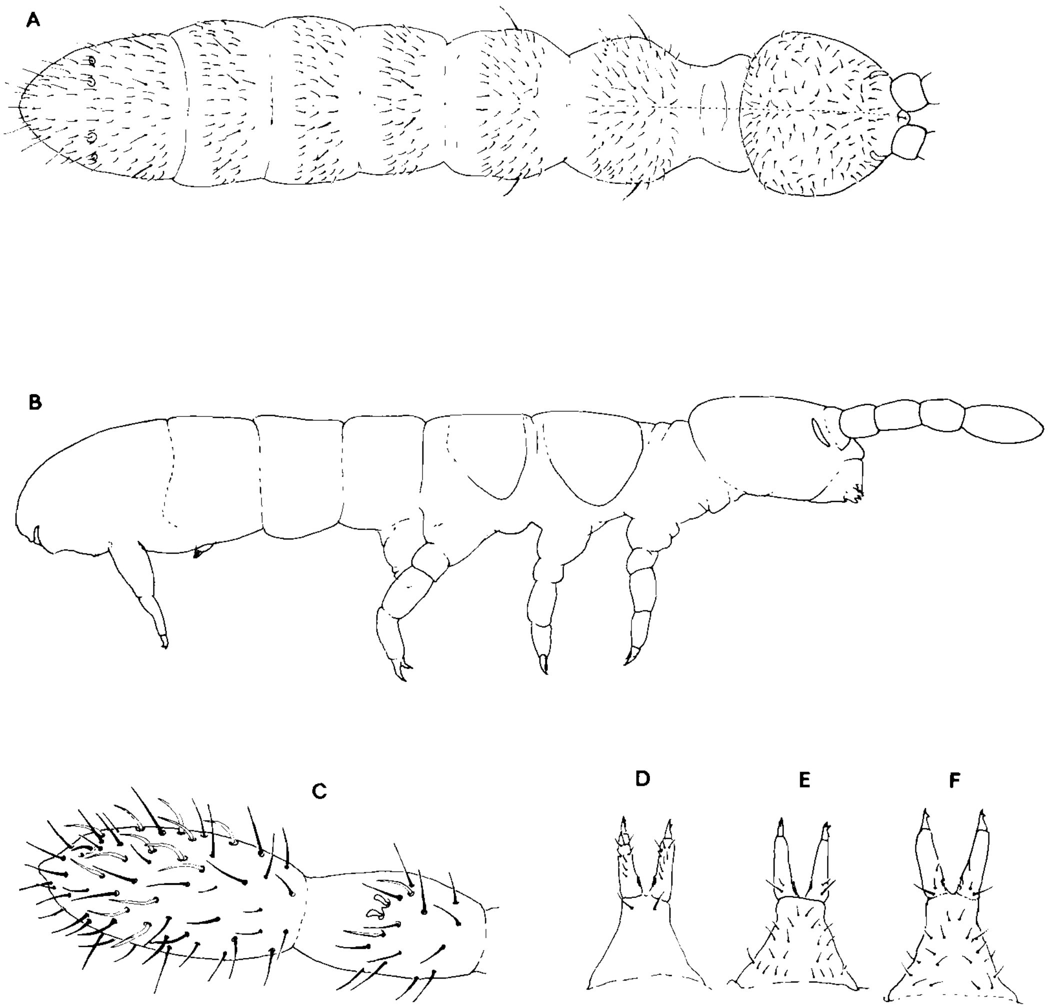


Fig. 3. *Folsomia dovrensis* n.sp. A: Dorsal chaetotaxy, sensillae of Abd. IV–VI encircled. B: Lateral view of the animal. C: Segments III–IV of right antanna. D: Ventral view of furca. E, F: Dorsal view of furca, two different specimens.

Proisotoma subarctica Gisin

Loc. 1, 2, 4, 7, 15, 26, 27, 35, 37, 40, 43, 47, 50, 57, 60, 61. A typical high alpine species in moss, lichens, and other vegetation. The species is abundant along melt-water brooks and is sometimes found down to the Middle Alpine zone (1300–2320 m). Jotunheimen, Dovrefjell, Trollheimen, Hallingskarvet.

Until now the species has only been reported from Swedish Lappland and North Norway (Agrell 1941, Fjellberg 1975a).

Agrenia bidenticulata (Tullberg)

Loc. 13, 17, 41, 49, 57, 59. At snow fields and melt-water brooks in the High Alpine zone. Sometimes at lower levels (1400–2200 m). Jotunheimen, Dovrefjell, Hallingskarvet.

Pseudisotoma sensibilis (Tullberg)

Loc. 33. A few specimens in a dry meadow at Gjevilvasskammen (1450 m) in Trollheimen.

Vertagopus westerlundi (Reuter)

Loc. 35. Under bark scales on stems of *Betula pubescens* at Vårstigen, Dovrefjell (900 m).

V. sarekensis (Wahlgren)

Loc. 1, 7, 10, 11, 15, 16, 17, 19, 20, 21, 28, 31, 33, 35, 37, 39, 45, 49, 50, 51. Common in the High Alpine zone, most abundant in dry biotopes (in cushions of moss and lichens on stones). Some records in the Low Alpine zone. Ascends to 2320 m. Jotunheimen, Dovrefjell, Trollheimen.

The species was redescribed by Fjellberg (1975a) and reported from North Norway and Swedish Lappland. In South Norway it has also been found at Grunke in V. Slidre, Oppland (1400–1500 m, H. P. Leinaas in lit.) and at Trolltindane in Fræna, Møre og Romsdal (Fjellberg, unpubl.). This last locality is near the coast, only 700 m a.s.l., but above the forest limit. The species was not seen at Hallingskarvet, in spite of careful examination at suitable habitats.

V. arcticus Martynova

Loc. 49. Several specimens in moist moss near the summit of Snøhetta, Dovrefjell (2150 m).

The species was described by Martynova (1969) from the Vrangel Island in the East Siberian Ocean, and redescribed by Fjellberg (1975a) who found the species in High Alpine communities at Abisko, Swedish Lappland.

Isotoma notabilis Schäffer

Loc. 3, 5, 7, 8, 11, 12, 22, 28, 29, 31, 33, 42, 44, 54, 55. *Dryas* heath, dry meadows and thickets of *Betula nana* and *Salix*. Ascends to 1950 m, but most abundant in lower regions. Jotunheimen, Dovrefjell, Trollheimen.

I. pallida Agrell

Loc. 32, 45. Dry, calceophilous meadow at Gjevilvasskammen in Trollheimen (1440 m) and *Dryas* heath at N. Knutshø, Dovrefjell (1450 m).

I. viridis Bourlet

Loc. 2, 3, 4, 5, 6, 7, 8, 19, 27, 28, 29, 31, 33, 35, 40, 42, 43, 44, 45, 50, 52, 53, 54, 55, 56. Common in a variety of both dry and moist habitats up to 1900 m. Jotunheimen, Dovrefjell, Trollheimen, Vikafjell.

I. violacea Tullberg

Loc. 1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 27, 29, 30, 35, 37, 38, 40, 42, 44, 45, 47, 48, 50, 51, 57, 58, 59, 60, 61. Common in both wet and dry habitats. Most frequent in the High Alpine zone, where it ascends to the highest peaks examined (2320 m). Jotunheimen, Dovrefjell, Trollheimen, Hallingskarvet.

I. hiemalis Schøtt f. *mucronata* Axelson

Loc. 3, 55. In dry meadow at Sognefjell in Jotunheimen (4100 m) and in litter of *Salix* scrub at Spiterstulen, Jotunheimen (1320 m).

I. olivacea Tullberg

Loc. 2, 3, 4, 13, 25, 26, 27, 35, 39, 40, 42, 47, 48, 55, 56, 57. Common in wet meadows and in moss at melt-water brooks up to 1900 m. Jotunheimen, Dovrefjell, Trollheimen, Vikafjell, Hallingskarvet.

I. neglecta Schäffer

Loc. 3, 4, 7, 8, 21, 25, 42, 43, 50. Most frequent in waterlogged moss along brooks and in wet meadows, up to 2200 m. Jotunheimen, Dovrefjell, Trollheimen.

I. sp.

Loc. 57, 59. Some specimens in wet moss near snow fens at Hallingskarvet, 1650–1750 m.

Entomobrya nivalis (Linné)

Loc. 6, 7, 8, 33, 46. A few specimens in dry meadow, *Dryas* heath, lichen heath and pine litter (950–1450 m). Jotunheimen, Dovrefjell, Trollheimen.

E. multifasciata (Tullberg)

Loc. 54. Several specimens in *Dryas* tufts in birch forest at Bøvertun, Jotunheimen (960 m).

Willowsia buski (Lubbock)

Running in sunshine on warm slates in garden near the railway station at Kongsvoll, Dovrefjell (1000 m).

Lepidocyrtus lignorum Fabricius

Loc. 2, 3, 4, 5, 6, 7, 8, 12, 14, 16, 21, 27, 28, 29, 30, 31, 32, 33, 35, 42, 44, 45, 46, 52, 54, 55. Common in both dry and moist biotopes up to 2200 m. Jotunheimen, Dovrefjell, Trollheimen.

L. violaceus Lubbock

Loc. 54, 56. Subalpine marsh and birch forest (900–960 m), Jotunheimen, Vikafjell.

Tomocerus minutus Tullberg

Loc. 8. One specimen in *Dryas* heath N of Skauthø, Jotunheimen (1350 m).

Sminthurides pumilis (Krausbauer)

Loc. 3. One specimen in litter in *Salix* scrub at Hellstuguhøgda, Jotunheimen (1320 m).

S. malmgreni (Tullberg)

Loc. 4, 8, 40, 42, 50, 52. Subalpine bog, wet meadow in the Middle Alpine zone and different moist habitats up to 1630 m in the High Alpine zone. Jotunheimen, Dovrefjell.

S. schoetti (Axelson)

Loc. 8, 19, 25, 35, 52, 53, 56. Marshes and wet meadows up to 1900 m. Jotunheimen, Dovrefjell, Trollheimen, Vikafjell.

S. parvulus (Krausbauer)

Loc. 3, 43, 53. Wet habitats up to 1550 m. Jotunheimen, Dovrefjell.

Arrhopalites principalis Stach

Loc. 25, 53. In bog and wet moss (920–1320 m). Dovrefjell, Trollheimen.

Sminthurinus aureus (Lubbock)

Loc. 3, 4, 5, 8, 25, 42, 43, 44, 53, 55. Both dry and wet biotopes, but most abundant in wet meadows, up to 1550 m. Jotunheimen, Dovrefjell, Trollheimen.

S. concolor (Meinert)

Loc. 20, 28, 51. Only found at dry sites (moss, lichens, grass tufts) at the mountains Styggehø in Jotunheimen (2210 m), Nystugu hø in Dovrefjell (1754 m), and Gjevilvasskammen in Trollheimen (1420 m).

According to Gisin (1963) this is an arctic/subarctic species that is found in Greenland, Jan Mayen, and England. Stach (1962) reports the species from Spitsbergen.

Bourletiella insignis (Reuter)

Loc. 24, 34. Among vegetation in subalpine birch forest, up to 900 m. Dovrefjell, Trollheimen.

B. clavigera Gisin

Loc. 3, 34, 56. Marsh, birch forest and meadow up to 1320 m. Jotunheimen, Dovrefjell, Vikafjell.

B. pistillum Gisin

Loc. 2, 5, 9, 10, 14, 19, 28, 55. Dry meadows and heaths, sometimes in wetter habitats, up to 1900 m. Jotunheimen, Trollheimen.

B. repanda (Ågren)

Loc. 34. On vegetation in Sub Alpine birch forest at Vårstigen, Dovrefjell (900 m).

DISCUSSION

Vertical distribution

As most of the examined localities are above the forest limit (1000–1100 m), only a few lowland species were found: *Hypogastrura inermis*, *Pseudachorutes subcrassus*, *Tullbergia affinis*, *Anurophorus septentrionalis*, *Vertagopus westerlundi*, *Entomobrya multifasciata*, *Lepidocyrtus violaceaus* and *Bourletiella repanda.*

Most of the species in the Lower and Middle Alpine zones (1100–1500 m) are also known from lowland sites in other places, but some are possibly confined to plant communities in these zones: *Tullbergia arctica*, *Pseudanurophorus inoculatus*, *Isotomodella pusilla*, and *Folsomia dovrensis*. It is noteworthy that all these four species were most abundant in the luxuriant dry meadows with calceophilous flora in the Middle Alpine zone.

The most characteristic fauna is found above 1500 m, in the High Alpine zone. The following species were not found at lower levels: *Anurida alpina*, *A. frigida*, *Onychiurus arcticus*, *Folsomia agrelli*, *Vertagopus arcticus*, *Sminthurinus concolor*. The three species *Proisotoma subarctica*, *Agrenia bidenticulata*, and *Vertagopus sarekensis* are most frequent in the High Alpine zone, but were occasionally found at lower levels.

Frequent in all altitudinal zones were: *Hypogastrura scotica*, *Onychiurus pseudovanderdrifti*, *Tetracanthella britannica*, *Folsomia quadrioculata*, *Isotoma viridis*, *I. olivacea*, *I neglecta*, *Lepidocyrtus lignorum*, and *Sminthurides malmgreni.*

Geographical distribution

A rich alpine collembole fauna was described by Wahlgren (1919), Agrell (1941), and Fjellberg (1973, 1975a) in North Scandinavia. The present survey demonstrates that most of these species also occur in mountains in South Norway. Of special interest are the following species with a predominately arctic distribution (details given in the species list): *Anurida alpina, A. frigida, Onychiurus arcticus, Tullbergia arctica, Pseudanurophorus inoculatus, Isotomodella pusilla, Folsomia agrelli, Proisotoma subarctica, Vertagopus sakenis, V. arcticus,* and *Sminthurinus concolor.*

In the high arctic (Greenland, Spitsbergen, etc.) several of these species are found down to sea level.

ACKNOWLEDGEMENTS

This study was made possible by a grant from the Nansen Foundation, Oslo. For various practical arrangements in the field, I am indebted to Bjarne Kristiansen and his wife at Kongsvoll, and the University in Trondheim. I am most grateful to Hans Petter Leinaas, Oslo, for permission to publish his record of *Vertagopus sarekensis*, and to Dr. John Breen, Bergen, for improving the language.

REFERENCES

Agrell, I. 1941. Zur Ökologie der Collembolen. Untersuchungen in Schwedischen Lappland. *Opusc. ent. Suppl. 3,* 1–236.

Bagnall, R. S. 1949. Notes on British Collembola. *Ent. mon. Mag. 85,* 61.

Fjellberg, A. 1973. *Anurida frigida.* A new species of Collembola (Hypogastruridae) from Swedish Lappland. *Norsk ent. Tidsskr. 20,* 285–287.

Fjellberg, A. 1975a. Redescriptions of some little known Collembola from Scandinavia (Insecta: Collembola). *Ent. scand. 6,* 81–88.

Fjellberg, A. 1975b. Organization and dynamics of Collembola populations on Hardangervidda. pp. 73–79 in Wielgolaski, F. E. (ed.) *Fennoscandian Tundra Ecosystems, part 2.* Springer-Verlag, Berlin, Heidelberg, New York.

Gisin, H. 1960. *Collembolenfauna Europas.* 312 pp. Geneve.

Gisin, H. 1963. Collemboles d'Europe. V. *Rev. suisse Zool. 70,* 77–101.

Lawrence, P. N. 1973. The species of *Folsomia* Willem, 1902 (Collembola) described by Bagnall. *Ent. gazette 24,* 349–361.

Lie-Pettersen, O. J. 1898. Apterygogenea in Sogn und Nordfjord 1897–98 eingesammelt. *Bergens Mus. Aarb. 1898 (6),* 1–17.

Lindroth, C. H. 1945, 1949. Die Fennoscandischen Carabidae, I–III. *K. Vet. Vitt. Samh. Handl. (6) B 4 (1–3),* 1–711, 1–279, 1–911.

Linnaniemi, W. M. 1911. Zur Kenntnis der Apterygotenfauna Norwegens. *Bergens Mus. Aarb. 1911 (1),* 1–28.

Martynova, E. F. 1969. New species of the family Isotomidae (Collembola) from the Asiatic part of the USSR. *Zool. žurnal 48,* 1342–1348.

Nordhagen, R. 1936. Skandinavias fjellflora og dens relasjoner til den siste istid. *Nordiska naturforskarmöte i Helsingfors 1936,* 93–124.

Rusek, J. 1966. Einige Collembolen-Arten aus der Tschechoslowakei. *Acta soc. zool. Bohemoslov. 30,* 54–64.

Stach, J. 1962. On the fauna of Collembola from Spitsbergen. *Acta zool. Cracov. 7,* 1–20.

Valpas, A. 1967. Collemboles of Spitsbergen. *Ann. ent. Fenn. 33,* 28–40.

Wahlgren, E. 1906. Collembola från Torne Lappmark och angränsande trakter. *Ent. tidskr. 27,* 219–230.

Wahlgren, E. 1919. Über die alpine und subalpine Collembolenfauna Schwedens. *Naturw. Unters. d. Sarekgeb. 4,* 743–762.

Received 14 June 1976

Predation of *Anthocoris sibiricus* Reuter (Het., Anthocoridae) on *Myzus persicae* (Sulzer) at constant and fluctuating temperatures

LISE HOFSVANG

Hofsvang, L. 1976. Predation of *Anthocoris sibiricus* Reuter (Het., Anthocoridae) on *Myzus persicae* (Sulzer) at constant and fluctuating temperatures. *Norw. J. Ent. 23,* 139–142.

Aphid predation of *Anthocoris sibiricus* Reuter was studied at a temperature fluctuating between 8° and 28° and at a constant temperature of 18°C. The green peach aphid *Myzus persicae* (Sulzer) was used as prey. Total predation of the nymphs was significantly greater at fluctuating temperature. There was no difference between the daily predation of male and female nymphs. Of the imagines, the daily predation of the females was significantly greater than that of the males.

Lise Hofsvang, Department of Zoology, Agricultural University of Norway, N-1432 Ås-NLH, Norway.

Species of Anthocoridae are, together with species of Chrysopidae, Syrphidae, and Coccinellidae, important predators on the green peach aphid *Myzus persicae* (Sulzer) on potato (Barbagallo et al. 1972) and on tobacco (Mardzhanyan & Ust'yan 1965). Börner & Heinze (1957) report *Anthocoris sibiricus* Reuter as an enemy of *M. persicae* and that the species is also known to prey on the aphids *Semiaphis dauci* F., *Aphidula pomi* DeC., *Aphidula nasturtii* (Kalt.), and *Aphis fabae* Scop.

In the present paper, *A. sibiricus* is reported as predator on *M. persicae* reared on swedes (*Brassica napus napobrassica* (L.) Rchb.) at a constant temperature of 18° and a temperature fluctuating between 8° and 28°C. Times of development, hatching per cent, and mortality with the same prey species are published in a previous paper (Hofsvang 1976).

MATERIAL AND METHODS

The method of rearing *A. sibiricus* is published elsewhere (Hofsvang 1976). The specimens were supplied with fresh aphids once a day and always in excess. Winged aphids and the smallest aphid stages were avoided.

At the daily control, aphids alive from the previous day were counted. In vials with aphids only, the natural aphid mortality, z, was found at all temperatures. When a nymph, i, was supplied with N aphids, and x_i was the total number of dead aphids, two equations were used to find the number of aphids, x_i, killed by predation of one specimen of *A. sibiricus*. If z per cent of the aphids die, and y_i aphids are then preyed upon, we have:

$$\text{I} \qquad x_i = y_i + \frac{z}{100} N_i$$

If y_i aphids are preyed upon, and then z per cent of the aphids die of other reasons, we have:

$$\text{II} \qquad x_i = y_i + \frac{z}{100} (N_i - y_i)$$

Aphid predation by males and females of imagines was studied. The adult specimens

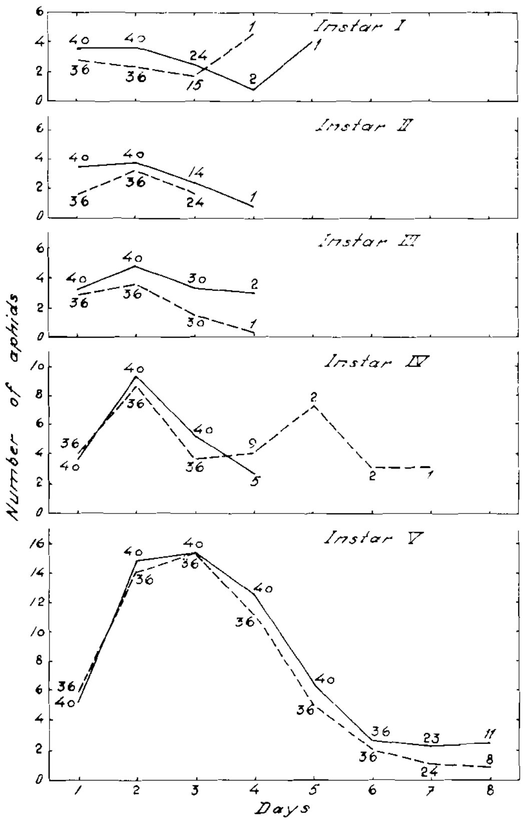


Fig. 1. Daily average number of aphids killed by predation in instar I–V of *A. sibiricus* at 8°–28° and 18°C. The numbers at the curve points show the number of nymphs left in each instar on that particular day. —— 8°-28°C. – – – 18°C.

were treated as the nymphs (Hofsvang 1976). The observations were made from the fifth to the 18th day of imaginal life.

RESULTS

The aphid mortality during 24 hours was 12.0 per cent at fluctuating temperature and 7.2 per cent at 18°C. The results are based on feeding of 40 nymphs at 8°–28° and 36 nymphs at 18°C. Close to and at moulting there was no predation by the nymphs. As the period of no predation prior to moulting lasted longer than the period from the moulting was accomplished to the nymphs again started to feed, predation at the day of moulting was included in the following stage. Fig. 1 shows the average daily predation of the different instars at 18° and at 8°–28°C. Especially at the end of instar V the lower aphid predation can clearly be seen.

The average numbers of aphids killed by predation of each nymph at 18° and 8°–28°C are given in Table I. At fluctuating temperature, 26.3 per cent of the total aphid predation occurred during the three first instars, 17.8 per cent in the fourth, and 56.1 per cent in the fifth. At 18°C, these values were 21.3, 19.4, and 59.2 per cent, respectively. The total nymphal time of development was significantly shorter at fluctuating temperature

Table I. Aphid predation per nymph of A. sibiricus at 18° and at temperatures fluctuating from 8° to 28°C. $n_{8°-28°C} = 40$. $n_{18°C} = 36$.

	Temp. °C	Instar					Total nymphal stage
		I	II	III	IV	V	
Mean no. aphids per instar ±SE	8-28	8.9 ± 0.62	8.1 ± 0.41	10.6 ± 0.46	18.7 ± 0.62	59.0 ± 1.66	105.2 ± 2.07
	18	5.8 ± 0.26	6.0 ± 0.34	7.8 ± 0.35	17.8 ± 0.75	54.4 ± 1.58	91.9 ± 1.93
t-test		P ≤ 0.001	P ≤ 0.001	P ≤ 0.001	not sign.	not sign.	P ≤ 0.001
Mean no. aphids per instar as per cent of total	8-28	8.5	7.7	10.1	17.8	56.1	100.0
	18	6.3	6.5	8.5	19.4	59.2	100.0
Mean no. aphids per day ± SE	8-28	3.3 ± 0.20	3.4 ± 0.20	3.9 ± 0.18	6.0 ± 0.31	8.7 ± 0.41	5.9 ± 0.13
	18	2.4 ± 0.14	2.2 ± 0.17	2.7 ± 0.17	5.3 ± 0.32	7.3 ± 0.40	5.1 ± 0.19
t-test		P ≤ 0.001	P ≤ 0.001	P ≤ 0.001	not sign.	not sign.	P ≤ 0.002

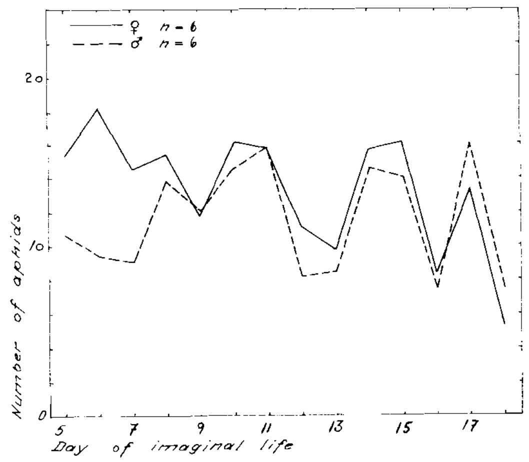


Fig. 2. Daily aphid predation of male and female imagines of *A. sibiricus* at 18°C from the fifth to the 18th day of imaginal life.

than at 18°C (Hofsvang 1976) but more nymphs were killed at fluctuating temperature. This was significant for the total predation of instar I, II, III, and for the five instars together.

It appears from Fig. 1 and Table I that the number of aphids killed by *A. sibiricus* in these investigations was nearly always higher at fluctuating temperature, though not significant at instar IV and V. The aphid predation had a maximum in the beginning of each instar. Except for instar I at 18°C, where the top was reached on the first day, the numbers of aphids killed by *A. sibiricus* in the first four instars reached a top the second day. For the fifth instar the maximum was reached on the third day (Fig. 1).

There was a significant difference between the average predation of the total nymphal stage for males and females of *A. sibiricus* (Table II). The female had a significantly longer average time of development: 19.6 days for females and 17.3 days for males at fluctuating temperature, 20.0 days for females and 18.1 days for males at 18°C (Hofsvang 1976). However, the mean number of aphids killed per day in a stage was similar in the two sexes at both temperatures (Table II).

Table II. Aphid predation of males and females of A. sibiricus at constant and fluctuating temperature. $n_{♂} = 6$, $n_{♀} = 6$.

	Sex	8°–28°C	18°C
No. aphids killed per total nymphal stage	♀	111.6 ± 2.40	96.3 ± 2.16
	♂	98.1 ± 2.67	87.0 ± 2.91
t-test		P ≤ 0.001	P ≤ 0.02
No. aphids killed per day	♀	5.7	4.8
	♂	5.7	4.8

Fig. 2 shows the daily number of aphids preyed upon by 6 males and 6 females through a period of 14 days. The females of the imagines of *A. sibiricus had* a significantly greater daily predation than the males ($P \leqq 0.02$); the average number of aphids killed in a day was 12.6 for females and 11.6 for males.

DISCUSSION

Predation and aphid consumption of *Anthocoris nemorum* L., an anthocorid species of about the same size as *A. sibiricus*, has been investigated with other prey species besides *M. persicae*, and in different ways (Hill 1957, Krämer 1961, Asgari 1965, Russel 1970). It is difficult to compare these investigations with the results of this paper. The one where the methods seem to be most comparable is the investigation done by Asgari (1965). He found that the daily average amounts of the aphid *Aphidula pomi* DeG. preyed upon by *A. nemorum* through instar I–V at 20°C were 9.8, 11.0, 16.9, 15.5, and 12.9 aphids respectively. *A. pomi* is approximately the same size as *M. persicae*. It seems that *A. sibiricus* needs a lesser amount of food to accomplish development than *A. nemorum*, but this difference might also be due to different nutrial value of the different prey species.

As fluctuating temperature had a significant effect on aphid voracity of *A. sibiricus*, it also shortened the time of development of the same species significantly (Hofsvang 1976). The small increase in heat summation at fluctuating temperature is probably the reason (Hofsvang 1976). When the instars are treated individually, both voracity (Table I) and time of development (Hofsvang 1976) are significantly different at constant and fluctuating temperature only in the second instar. The first and third instar did not have a significantly shorter time of development at fluctuating temperature (Hofsvang 1976), but voracity was significantly greater. The contrary was the case in the fourth instar. In the fifth instar no significant difference was present. The instars seem to have different lower temperature limits for time of development (Hofsvang 1976). Then the heat summation that influences the individual nymphal instars at the two temperatures will differ a little from one instar to the other. Because of this and also the fact that the increase in heat summation when changing from constant to fluctuating temperature is small, it is reasonable that the strength of the response of the temperature on the individual instars should differ.

Perhaps, then, the females of imagines of *A. sibiricus* have a higher aphid consumption to obtain energy for egg production.

ACKNOWLEDGEMENTS

I am indebted to cand. real. Else Sandved for suggesting the method to calculate aphid mortality.

Received 16 February 1976

REFERENCES

Asgari, A. 1966. Untersuchungen über die im Raum Stuttgart–Hohenheim als wichtigste Prädatoren der grünen Apfelblattlaus (*Aphidula pomi* DeG.) auftretenden Arthropoden. *Z. angew. Zool. 53*, 35–93.

Barbagallo, S., Inserra, R. & Foster, G. N. 1972. Population dynamics of *Myzus persicae* (Sulzer) on potato in Sicily. *Entomologica 8*, 21–33.

Börner, C. & Heinze, K. 1957. In Sorauer, P.: *Handbuch der Pflanzenkrankheiten,* 5th ed. 577 pp. Paul Parey, Berlin & Hamburg.

Hill, A. R. 1957. The biology of *Anthocoris nemorum* (L.) in Scotland (Hemiptera: Anthocoridae). *Trans. R. ent. Soc. Lond. 109*, 379–394.

Hofsvang, L. 1976. Development of *Anthocoris sibiricus* Reuter (Het., Anthocoridae) at constant and fluctuating temperatures with the green peach aphid *Myzus persicae* (Sulzer) as prey. *Norw. J. Ent. 23*, 29–34.

Krämer, P. 1961. Untersuchungen über den Einfluss einiger Arthropoden auf Raubmilben (Acari). *Z. angew. Zool. 48*, 257–311.

Mardzhanyan, G. M. & Ust'yan, A. K. 1965. A test on the application of integrated control of the peach aphid. *Myzodes persicae* Sulz. on tobacco. *Ent. Rev. 44*, 441–448.

Russel, R. J. 1970. The effectiveness of *Anthocoris nemorum* and *A. confusus* (Hemiptera: Anthocoridae) as predators of the sycamore aphid, *Drepanosiphum platanoides*. I. The number of aphids consumed during development. *Entomologia exp. appl. 13*, 194–207.

Notes on the Collembola communities in some major plant-sociological associations at Spitsbergen, Svalbard

ERLING SENDSTAD

Sendstad, E. 1976. Notes on the Collembola communities in some major plant-sociological associations at Spitsbergen, Svalbard. *Norw. J. Ent. 23,* 143–148.

The Collembola communities were studied in four different areas at Spitsbergen, Svalbard. The sites of investigation were picked out according to a plant-sociological analysis.

Mean data for the abundance of the different species are given. It is also shown that the Collembola are grouped characteristically according to the broad lines in plant sociology.

Data for diversity and biomass are also given. It is shown that the two dominant Collembola species in a specific area have a biomass of live weight estimated to 340 mg/m^2.

Erling Sendstad, University of Trondheim, Royal Norwegian Society of Sciences and Letters, The Museum, Erling Skakkes gt. 47 B, N–7000 Trondheim, Norway.

Human activity in different parts of the Arctic has many times resulted in biological backlashes. This has more or less dramatically demonstrated the need for increased ecological understanding of the arctic tundra.

Spitsbergen, the main island in the archipelago of Svalbard (Fig. 1), is still little influenced by the activity of man. On the other hand, this island is probably among the areas in the Norwegian Arctic where human activity will increase in the future. It is an important and interesting task for biologists to follow this process and its impact on the fragile biological systems in this area. For this purpose, it is important to get reference data from the arctic tundra while it is still found in its natural state.

AREA

These investigations were carried out during the summer seasons of 1973 and 1974, in the period from primo July to ultimo August. In 1973 the field work took place at Kapp Wijk, Isfjorden. Summerhays & Elton (1928) divided Svalbard into four ecological zones. In this system Kapp Wijk belongs to the biologically richest zone, called 'Innerfjord zone'. Three investigation sites were picked out in three different plant-sociological associations:

Site A: Tetragono-Dryadetum (Rønning 1965)

Site B: Polari-Dryadetum (Rønning (1965)

Site C: Caricetum ursinae (Hadac 1946)

In 1974 the field work was concentrated at Ny Ålesund. This area belongs to the 'Outer fjord zone' according to Summerhays & Elton (1928). The area as such is characterized by more severe macroclimatic conditions than the Kapp Wijk area. At Ny Ålesund one site was picked out as investigation area:

Site D: Tetragono-Dryadetum (Rønning 1965).

Fom a plant-sociological viewpoint, site C is unique among the sites. Site C is a shore meadow dominated by sedges, as *Carex ursinae.* Seaweeds deposited on land by the sea are also typical for this site.

The other three sites, A, B, and D, all be-

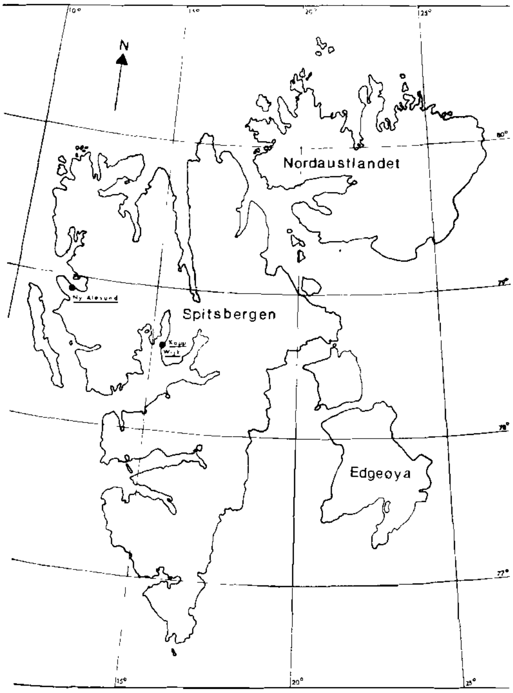


Fig. 1. Map of Spitsbergen and neighbouring islands. The two areas of investigation, Kapp Wijk and Ny Ålesund, are marked.

long to the plant-sociological unit Dryadion (Rønning 1965). Typical plants at these sites are therefore *Dryas octopetala* and other woody species. Consequently the litter produced at these three sites is totally different from that of site C. The edaphic data of the four sites are given elsewhere (Sendstad 1976).

METHODS

The Collembola were extracted from soil cores, each with a diameter of 5.5 cm. The soil cores were 3 cm deep; consequently these investigations describe the fauna in the upper 3 cm of the soil profile.

The extraction process was carried out by a high-gradient extractor, following Macfadyen's principles (Macfadyen 1961). The data given are calculated as mean data for the summer season, based on ten samples during the summer, each with two replicates for the sites A, B, and C. The data from site D are based on nine samples, each with twelve replicates.

QUANTITATIVE ASPECTS OF THE FAUNA

The Collembola fauna in the four sites were treated qualitatively and quantitatively. This forms the basis for a comparison between the different sites (Table I).

A coincidence table (Table II) was calculated based on Renkonen's number (Renkonen 1938). Renkonen's number is calculated from Table I by adding the smallest relative abundance for each species present in both of the two sites compared. This is an index of similarity. The estimated figures for Renkonen's number were arranged in a coincidence table.

To show the relations in Table II more clearly, a classification system based on Mountfort (1962) was constructed. This is done by arranging the two most similar sites together. The similarity between these two sites and the rest of the sites are then calculated. As can be seen from Table II, sites A and B show the greatest degree of similarity. The relation to the other sites was calculated as shown in Fig. 2.

Table II and Fig. 2, based on the Collembola communities in the different sites, show the same main picture as the plant-sociological analysis. There is one site among the four which is unique, site C. The Collembola fauna in the sites belonging to the plant-sociological unit Dryadion, that is A, B, and D, do not show striking differences. It is, however, interesting to note that the difference between the inner and outer fjord zone seems to have a greater influence on the Collembola communities than on the plant communities in which the Collembola live. This can be seen by examining sites A and D (Table II). Site A is situated in the inner fjord zone, while site D belongs to the outer fjord zone; nevertheless both of these sites belong to the same plant-sociological association. The Collembola fauna in these two sites is, however less similar than in the sites A and B. These two sites both belong to the inner fjord zone, but they are plant-sociologically different.

Table I. Mean number per m^2 of the different species of Collembola and their relative abundance. The species marked with * is not recorded from Spitzbergen before

	A		B		C		D	
	No./m^2	R.ab.	No./m^2	R.ab.	No./m^2	R.ab.	No./m^2	R.ab.
Poduridae								
Hypogastrura viatica	-	-	-	-	380	2.0	-	-
Hypogastrura tullbergi	1290	30.6	2150	28.1	-	-	6580	33.9
Hypogastrura hirsuta	40	1.0	400	5.3	1730	9.2	-	-
Xenylla humicola	-	-	-	-	2930	15.6	-	-
Willemia anophtalma	-	-	-	-	250	1.4	-	-
Anurida frigida	110	2.5	590	7.5	740	3.9	440	2.3
Anurida pygmaea	-	-	-	-	-	-	20	0.1
Onichiuridae								
Onichiurus groenlandicus	-	-	-	-	5500	29.4	60	0.3
Onichiurus arcticus	320	7.5	480	6.4	130	0.7	50	0.3
Isotomidae								
Folsomia quadrioculata	1900	45.2	3280	43.1	6420	34.1	8690	44.8
Folsomia bisetosa	130	3.2	130	1.7	440	2.4	2560	13.2
Proisotoma schoetti	50	1.0	-	-	-	-	-	-
Agrenia bidenticulata	50	1.0	20	0.3	-	-	20	0.1
Isotoma viridis	20	0.5	20	0.3	20	0.1	10	0.1
Isotoma angelicana	50	1.0	20	0.3	20	0.1	60	0.6
Isotoma olivacea	20	0.5	400	5.3	110	0.6	720	3.7
Isotoma neglecta	230	5.5	130	1.7	40	0.2	-	-
Sminthuridae								
Sminthurides sp.	-	-	-	-	40	0.2	-	-
Sminthurinus niger	-	-	-	-	-	-	170	0.9
*Megalothorax minimus**	20	0.5	-	-	20	0.1	-	-
Σ Collembola	4230	100	7620	100	18770	100	19380	100

QUALITATIVE ASPECTS OF THE FAUNA

The qualitative background for the data given in Table II and Fig. 2 was investigated by testing the tendency of the different species to occur together in the soil. In this analysis only those species which have a relative abundance of 5% or more were treated. This choice leaves ten species to be considered.

The degree of interspecific association is calculated and tested by a method used by Davis (1963). The significance of association is given by the following equation, with one degree of freedom:

$$x^2 = \frac{N\,(|\,ad - bc\,| - \tfrac{1}{2}N)^2}{(a+b)\,(b+d)\,(c+d)\,(a+b)}$$

where N = the number of soil cores investigated, a = the number of times both species are present, b and c = the number of times only one species is present, and d = the number of times none of the species is present.

From a x^2 table, one degree of freedom, one gets that $x^2 > 6.63$ is significant at 1% level. A positive or negative value is given by (ad – bc). This test was done for data from 168 soil cores.

The degree of interspecific association is shown in Fig. 3, where it can be seen that

Table II. Coincidence table, based on Renkonen's number

	D	A	B	C
C	40.3	41.7	46.7	100
B	79.7	85.9	100	
A	82.2	100		
D	100			

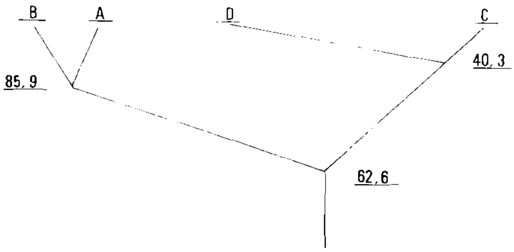


Fig. 2. Final classification of the four sites, based on the Collembola communities.

the Collembola form two groups. There is one which contains the Collembola of the shore meadow, site C. This group consists of: *Xenylla humicola, Hypogastrura hirsuta, Onichiurus groenlandicus, Anurida frigida.* The other group belongs to the sites A, B, and D and comprises: *Hypogastrura tullbergi, Folsomia bisetosa, Isotoma olivacea.*

It should also be mentioned in this connection that the Collembola fauna of site C also includes some epigeous species which are not trapped in the soil cores in representative numbers. Of these, both *Sminthurides malmgreni* and *Archisotoma besselsi* were found to be common.

Among the soil-living species characterizing the shore meadow (site C), only *X. humicola* seems to be typical of this habitat. The other species seem to be attracted by humid grassland areas or other humid habitats rich in easily decomposable organic matter. They are all common in other similar habitats on Svalbard, for instance in areas dominated by *Deschampsia alpina.* Among the species which belong to sites A, B, and D, only *H. tullbergi* seems to be a really characteristic species of a habitat that plant-sociologically can be described as Dryadion.

It should also be noted that all the sites are dominated and kept together by *Folsomia quadrioculata.* This species seems to be the most widely distributed and ecologically most important Collembola species on Svalbard, both as a consequence of its distribution and because it seems to prefer to feed directly on litter (Whittaker 1974). A taxonomical remark must, however, be attached to this species. In wet habitats on Svalbard it may be mixed with *Folsomia nana.* These 'species' can only be separated through relative characters. These characters seem, however, to be self-contradictory. At the present state of taxonomy, I therefore prefer to keep the two 'forms' together and treat them as *F. quadrioculata.*

THE COLLEMBOLA COMMUNITY AT SITE D

As a specific example, the Collembola community at site D will now be treated more thoroughly, with regard to biomass and diversity.

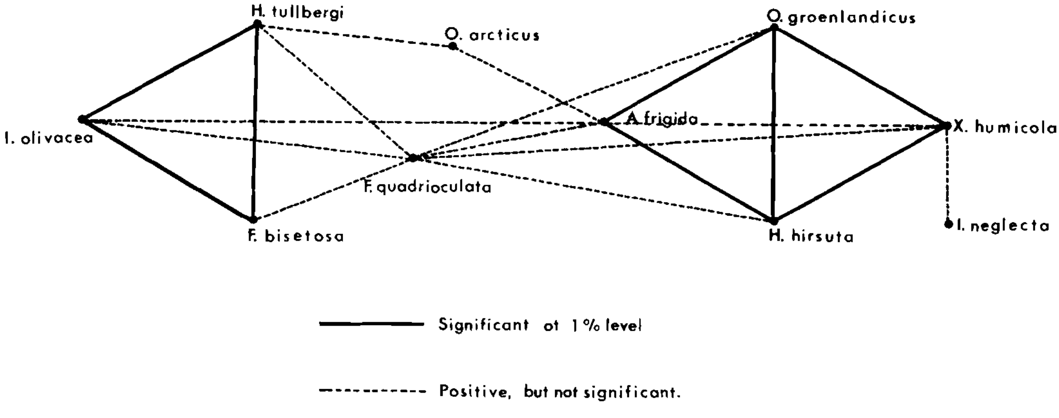


Fig. 3. Interspecific association of ten Collembola species as it appeared in 168 soil cores. The lines between the species indicate the significance of association.

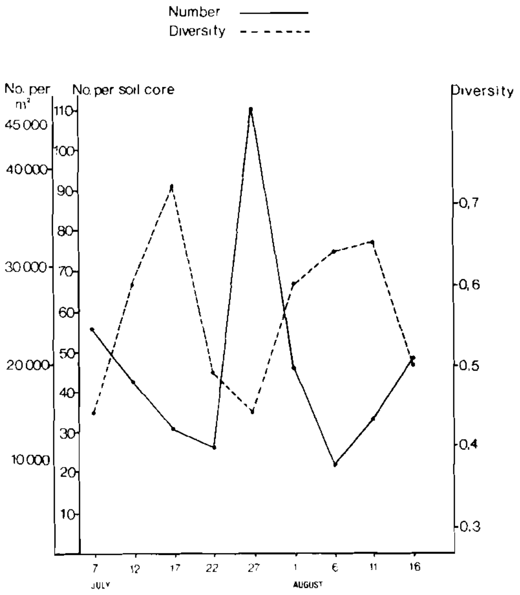


Fig. 4. Fluctuations in the total abundance and the diversity of the Collembola community at site D.

The diversity in this community is presented in Fig. 4, calculated as Shannon's index:

$$H = - \sum \frac{N_i}{N} \log \frac{N_i}{N}$$

where $\frac{N_i}{N}$ = the No. per m² of a specific species relative to the No. per m² of all species.

As can be seen (also from Table I) this community consists of a few, dominating species. When these species increase their abundance, the diversity consequently goes down (Fig. 4). The mean estimate of diversity during the season was $H = 0.57$.

In this community there are two species which are of prime importance in the transfer of organic matter, *F. quadrioculata* and *H. tullbergi*. They count for about 80% of the total Collembola abundance. However, this statement does not mean that the other ten species in the community are uninteresting ecologically. They constitute the 'diversity' in the community, and as such they provide the system with a greater ability to meet the challenge of a changing environment. To know the diversity of a community is, in fact, of major interest in an arctic habitat, because a reduced diversity is one of the most characteristic features in arctic ecology.

The biomass of *H. tullbergi* and *F. quadrioculata* was estimated by weighing the species alive.

The populations were divided into growth classes by measuring the body length, from the base of antennae to the end of the abdomen.

The weighing was done with a microscale, with an accuracy of 0.5 µg. The specimens were, however, kept on a water film for about three hours so that their guts were emptied to a certain degree. The weight of the different growth classes are presented in Table III.

To calculate the biomass for these two species, the fluctuations in abundance during the summer had to be considered. A new estimate of biomass was calculated for each period between the dates of sampling (Fig. 4). Then a mean estimate for the summer was calculated. This gives:

F. quadrioculata	165 mg/m²
H. tullbergi	175 mg/m²

If compensated for the total abundance of Collembola, the biomass of this Collembola community may be estimated to approximately 425 mg/m² live weight.

Table III. Mean weight of the different growth classes in live weight for *Hypogastrura tullbergi* and *Folsomia quadrioculata*

Growth classes	I			II			III			IV			V		
Mean length (mm)	0.39			0.64			0.89			1.14			1.28		
	n	$\bar{x}$ µg	Sx	n	$\bar{x}$ µg	Sx	n	$\bar{x}$ µg	Sx	n	$\bar{x}$ µg	Sx	n	$\bar{x}$ µg	Sx
Hypogastrura tullbergi	10	5.00	–	5	17.60	5.37	5	38.80	4.60	6	42.83	4.96	5	55.00	5.70
Folsomia quadrioculata	3	2.33	0.58	5	11.80	4.15	8	33.38	6.00	8	39.13	8.44	5	52.67	7.51

ACKNOWLEDGEMENTS

I wish to thank Professor O. I. Rønning for arranging the expeditions to Spitsbergen. I am also indebted to The Norwegian Polar Institute, The Ministry of Environment, and the Norwegian Research Coucil for Science and the Humanities, which have supported the expeditions technically and financially.

REFERENCES

Davis, B. N. K. 1963. Arthropods of mineral soils. *J. anim. Ecol. 32,* 49–71.

Hadac, E. 1946. The plant communities of Sassen Quarter, Vestspitsbergen. *Studia Bot. Cechoslovaca 7,* 124–164.

Macfadyen, A. 1961. Improved funnel-type extractors for soil arthropods. *Ecol. 30,* 171–184.

Mountford, M. D. 1962. An index of similarity and its application to classificatory problems. pp. 43–50 in Murphy, P. W. (ed.) *Progress in Soil Zoology.* Butterworths, London.

Renkonen, O. 1938. Statistisch-ökologische Untersuchungen über die terrestrische Käferwelt der finnischen Bruchmoore. *Suomal, eläin-ja kasvit. Seur. Van Julk 6,* 1–226.

Rønning, O. I. 1965. Studies in Dryadion of Svalbard. *Norsk Polarinstitutts Skrifter,* 134.

Sendstad, E. 1976. Trekk fra Svalbards jordbunnsfauna sett i relasjon til dens abiotiske miljø. *Fauna 29,* 41–44.

Summerhays, V. S. & Elton, C. S. 1928. Further contribution to the ecology of Spitsbergen. *J. Ecol. 16,* 193–268.

Whittaker, J. B. 1974. Interactions between Fauna and Microflora at Tundra sites. pp. 183–195 in Holding, A. J. et al. (eds.) *Soil Organisms and Decomposition in Tundra.* Tundra Biome Steering Committee, Stockholm.

Received 10 May 1976

Cold-hardiness of winter-active Collembola

LAURITZ SØMME

Sømme, L. 1976. Cold-hardiness of winter-active Collembola. *Norw. J. Ent. 23*, 149–153.

Winter-active collembolans were collected on the snow surface in the vicinity of Oslo. The mean chill-coma temperatures of three species, *Isotoma hiemalis* Schött, *Entomobrya nivalis* (L.), and *Hypogastrura socialis* (Uzel) were –7.1°, –3.4° and –8.6°C respectively. All species had supercooling points in the range of –25° to –6°C. In *I. hiemalis*, the ability to supercool increased during starvation, indicating a relationship between supercooling and the presence of food in the gut. No specimens survived freezing at temperatures corresponding to their supercooling points. It is concluded that the collembolans avoid freezing during cold spells in winter by escaping from the snow surface to the warmer surroundings under the snow.

Lauritz Sømme, Zoological Institute, University of Oslo, P. O. B. 1050, Blindern. Oslo 3, Norway.

Winter-active insects have been observed by a number of authors, and a review of older literature has been compiled by Strübing (1958). Several species of collembolans may occur in enormous numbers on snow and glaciers. Among the most common are species of *Isotoma, Hypogastrura,* and *Onychiurus,* as well as *Podura quatica* L. and *Entomobrya nivalis* (L.). From Norway, Hågvar (1973) reported that *Isotoma hiemalis* Schött appears on the snow surface in mild weather from January to April, and is the main source of food for the winter-active spider *Bolyphantes index* (Thorell).

Although numerous observations of winter-active collembolans have been made, their cold-hardiness is poorly investigated. Steinböck (1939), however, found that most specimens of *Isotoma saltans* (Nicolet) had chill-coma temperatures between –9° and –7°, and some specimens as low as –12° or even –15°C.

Other species of collembolans may also be active at low temperatures. The chill-coma temperatures of 24 species studied by Agrell (1941) varied from –10° to 4°C. The species included the winter-active *Entomobrya nivalis*, which had chill-coma temperatures in the range of –7° to –4°C. These results were obtained with summer animals, but in four species a lowering of the chill-coma temperatures with about 4°C was observed during August and September.

Information about the survival of winter-active collembolans at low temperatures is also scarce. According to Steinböck (1939) some specimens of *Isotoma saltans* survived exposure to –19°, while Strübing (1958) found that all specimens of *I. hiemalis* and *I. fennica* Axels. perished at –9° to –7°C.

Other insects besides collembolans are also known to be active on the snow surface during winter (Strübing 1958). Among these are two species of *Boreus* (Mecoptera), which, according to Sømme & Østbye (1969), are not able to survive temperatures below –6° to –5°C. Although these insects may be observed on the snow at a few degrees below zero, their survival apparently depends on their ability to seek protection under the snow cover when lower air temperatures set in.

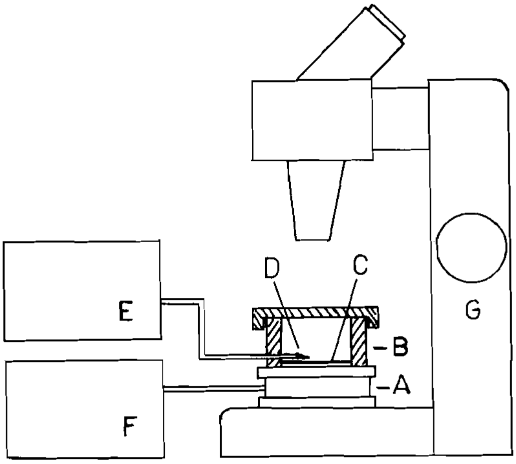


Fig. 1. Apparatus for studies of chill-coma temperatures of collembolans. A: Freezing stage, B: Observation chamber, C: Cardboard floor, D: Thermocouple, E: Recording potentiometer, F: Freezing stage power unit, G: Binocular microscope.

The purpose of the present study was to obtain more information about the cold-hardiness of winter-active collembolans. Unless these animals are frost-resistant, as defined by Asahina (1966), their survival on the snow surface may depend on their ability to avoid freezing by supercooling. It may also depend on their ability to escape from the snow surface, thus avoiding the risk of freezing when the temperature drops. To determine the ecological significance of these factors, activity at low temperatures, chill-coma, and supercooling were studied in the laboratory. The ability of the different species to survive freezing was judged from the revival of specimens used in the experiments.

MATERIAL AND METHODS

Collembolans used in the present study were collected on snow in coniferous forests. Samples were taken at various localities in the vicinity of Oslo from December to March during the winters of 1971/72 and 1973/74. The localities are situated in Enebakk (UTM: 32VPM165248), Bærum (UTM: 32VNM 850440), Oslo at Sognsvann (UTM: 32VNM 964501), and Frogn (UTM: 32VNM931191). The most common species was *Isotoma hiemalis* Schött, but on some occasions *Entomobrya nivalis* (L.) and *Hypogastrura socialis* (Uzel) were also found in high numbers. The collembolans were brought to the laboratory in glass tubes, and stored at 2°C until experiments were performed the same or following day.

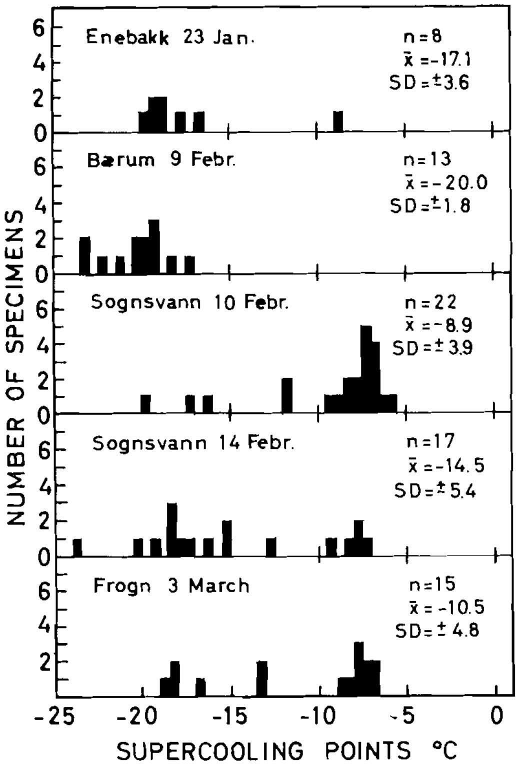


Fig. 2. Supercooling points of *Isotoma hiemalis* collected on snow at different localities from January to March 1972.

Supercooling points were measured with a copper-constantan thermocouple, connected to a recording potentiometer. The collembolans were attached to the thermocouple by a thin layer of Vaseline. The supercooling points of five or six collembolans could be measured simultaneously by attaching them to the thermocouple at the same time. To slow the rate of cooling, the thermocouple was placed inside two glass tubes, closed by rubber stoppers through which the connecting cords were run. The thermocouple with surrounding

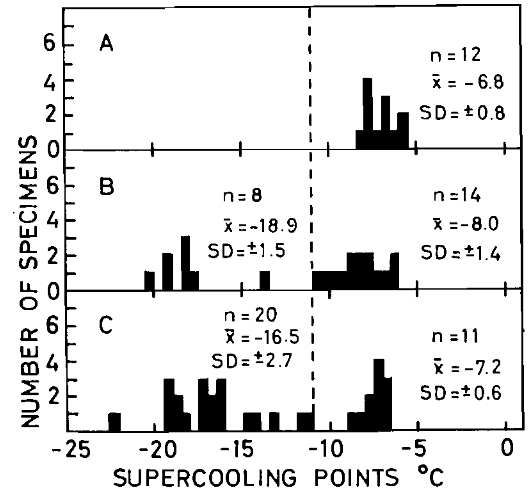


Fig. 3. Supercooling points of *Isotoma hiemalis* collected in Frogn 27 February 1972 (A) and stored without food at 3°C for one (B) and two (C) weeks in the laboratory. Means and SD are calculated separately from data on the right and left sides of the dotted line.

glass tubes was then lowered into a glass cylinder placed in the cooling bath of a cryostat. Under these conditions the insects were cooled at a rate of 1 to 2°C per minute.

Chill-coma and chill-stupor temperatures were studied by observing the collembolans under a binocular microscope during gradual cooling. A 'Pelcool' microtome freezing stage connected to a power unit was placed on the microscope stage (Fig. 1). The freezing stage itself consisted of a Peltier chamber which could be cooled to temperatures of about -20°C. An observation chamber, made from a thick-walled plastic cylinder, was placed on the freezing stage. The chamber was 3 cm high and had an inner diameter of 4 cm. It was covered by a clear plastic lid, through which the animals could be observed. The bottom of the observation chamber was made from a cardboard plate, to the upper side of which a small copper-constantan thermocouple was fastened. The thermocouple was connected to a recording potentiometer from which the temperature of the observation chamber floor could be read continuously. The cooling rate could also be observed from the potentiometer, and regulated by adjustments of the freezing stage power unit. In the chill-coma temperature range of the collembolans, the cooling rate was approximately 0.5° to 1.0° per minute.

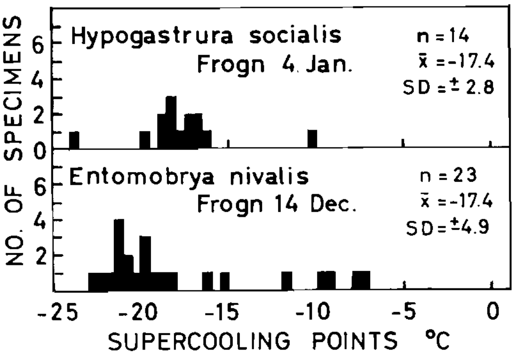


Fig. 4. Supercooling points of *Hypogastrura socialis* and *Entomobrya nivalis* collected on snow during the winter of 1973/74.

One or two collembolans were placed in the observation chamber and their activity observed as the temperature was gradually lowered. The chill-coma temperature was defined as the temperature at which the insects lost their ability to walk or jump, often falling on their sides. The chill-stupor temperature was reached when all small movements of legs and antennae ceased.

RESULTS AND DISCUSSION

Supercooling

The ability of field-collected specimens of *I. hiemalis* to supercool was quite variable. The dispersal of the supercooling points is presented as bar charts in Fig. 2, where the supercooling point of each specimen is plotted.

Specimens collected in Enebakk 23 January and in Bærum 9 February all had relatively low supercooling points, while the supercooling points of those from Sognsvann 10 February were mostly higher than -10°C. A few specimens of the last sample, however, had lower supercooling points, and the proportion of specimens with low supercooling points was larger in collembolans collected 4 days later at the same locality. In specimens collected in Frogn 3 March the results also appear to fall into two groups.

The high supercooling points of some of the

Table I. Chill-coma and chill-stupor temperatures of winter-active collembolans collected on snow during the winter of 1973/74

Species	Date of collection	n	Chill-coma °C mean	Chill-coma °C range	Chill-stupor °C mean	Chill-stupor °C range
Hypogastrura socialis	4 Jan.	8	-8.6	-10.0/-7.5	-11.8	-12.5/-11.0
Entomobrya nivalis	14 Dec.	11	-3.4	-5.0/-2.0	-9.3	-12.5/-7.0
Isotoma hiemalis	7 Jan.	12	-7.1	-9.0/-5.0	-11.9	-15.0/-7.0

specimens may be related to the amount of food in their gut lumen. It has been suggested by Salt (1967) that the food of many insects may contain nucleating agents, which cause freezing to start in the gut. From the gut lumen the ice rapidly spreads through the rest of the body.

To investigate a possible relationship between feeding condition and supercooling in *I. hiemalis,* some specimens were starved for one or two weeks in the laboratory. The specimens belonged to a sample collected in Frogn 27 February 1972, and at the time of collection all of them had supercooling points higher than –11°C (Fig. 3A). After one weeks storage at 2°C in clean, empty glass containers, the supercooling points clearly fell into two groups, and were greatly lowered in more than one-third of the collembolans (Fig. 3B). After two weeks storage, two-thirds of the specimens had supercooling points below –11°C, and only one-third above this temperature (Fig. 3C).

The supercooling points of *H. socialis* and *E. nivalis* collected during the winter of 1973/74 are presented in Fig. 4. In *E. nivalis* the supercooling points fell into two groups, while most specimens of *H. socialis* had low supercooling points. As in *I. hiemalis* most of the supercooling points in the lower group lie between –22° and –15°C.

Chill-coma and chill-stupor temperatures

Chill-coma and chill-stupor temperatures of all three species are presented in Table I. The ability to move actively at sub-zero temperatures was most pronounced in *H. socialis* and *I. hiemalis,* whose average chill-coma temperatures were –8.6° and –7.1°C respectively. Specimens of *E. nivalis* were immobilized by cold at an average temperature of –3.4°C. The chill-stupor temperatures of all species were still lower, and small movements of antennae were observed even in the range of –15° to –12°C. The chill-stupor temperatures, as defined in the present study, are of no ecological significance, but show that some muscle work may be performed at surprisingly low temperatures.

Death by freezing

While most insects are killed by freezing, some species may tolerate the actual formation of ice in their tissues (Asahina 1966). Following supercooling, freezing, and removal from the cryostat at temperatures in the range of their supercooling points, no specimens of any of the three species used in the present study showed signs of revival. During cooling for studies of chill-coma and chill-stupor temperatures, a sudden jerk or crumpling up appeared in some specimens. Following this behaviour, no specimens survived, although other specimens that were cooled to the same temperatures returned to an active state when reheated. It was assumed that the observed jerk was due to instantaneous freezing, corresponding to the supercooling point, and causing the immediate death of the animal. Of the collembolans used for chill-coma studies, two specimens of *H. socialis* died in this way at –15°, four specimens of *E. nivalis* died at temperatures from –12.5° to –7.5°, and five specimens of *I. hiemalis* died with a sudden jerk at temperatures from –15.0° to –7°C. It is concluded that all species are killed by freezing at temperatures corresponding to their supercooling points, and may thus be regarded as freezing-susceptible species.

Conclusions

In general the supercooling points of the three species of collembolans were relatively high regardless of feeding condition. Supercooling points of insects that overwinter above the snow cover, e.g. on trunks or branches of trees, are normally much lower. To survive the winter, the supercooling points of freezing-susceptible species must be lower than the extreme winter temperatures of the area in which they live. In the surroundings of Oslo, where the collembolans of the present study were collected, winter air temperatures may drop below -20° and -25°C. Since the collembolans of the present study are not freezing tolerant, even specimens with the lowest supercooling points would be killed during such cold spells. The means of survival for winter-active collembolans is to escape low temperatures by migration from the snow surface to the warmer surroundings under the snow. Their ability to move actively makes it possible for all species used in the present studies to disappear from the snow surface when low temperatures set in.

Received 15 June 1976

ACKNOWLEDGEMENTS

The collembolans used in the present study were partly collected by Mr. S. Hågvar, and their identity confirmed by Mr. H. P. Leinaas. Some of the chill-coma measurements were performed by Mrs. E.-M. Conradi-Larsen, who also suggested improvements to the apparatus. I am most grateful for this kind assistance, as well as for valuable discussions during the preparation of the present study.

REFERENCES

Agrell, I. 1941. Zur Ökologie der Collembolen. *Opusc. Ent. Suppl. 3,* 236 pp.

Asahina, E. 1966. Freezing and frost resistance in insects. pp. 451–486 in Meryman, T. H. (ed.) *Cryobiology,* Academic Press, London.

Hågvar, S. 1973. Ecological studies on a winter-active spider *Bolyphantes index* (Thorell) (Araneida, Linyphiidae). *Norsk ent. Tidsskr. 20,* 309–314.

Salt, R. W. 1967. Location and quantitative aspects of ice nucleators in insects. *Can. J. Zool. 46,* 329–333.

Sømme, L. & Østbye, E. 1969. Cold-hardiness in some winter-active insects. *Norsk ent. Tidsskr. 16,* 45–48.

Steinböck, O. 1939. Der Gletscherfloh. *Z. Dtsch. Alpenver. 70,* 138–147.

Strübing, H. 1958. *Schneeinsekten* 47 pp. Ziemsen Verlag, Wittenberg.

The specific heat of insects as a function of their relative water content

K. E. ZACHARIASSEN, H. T. HAMMEL & W. SCHMIDEK

Zachariassen, K. E., Hammel, H. T. & Schmidek, W. 1976. The specific heat of insects as a function of their relative water content. *Norw. J. Ent. 23,* 155–157.

The specific heat of adult *Eleodes blanchardi* Blaisd. (Col., Tenebrionidae) was measured as a function of their relative water content. The specific heat was found to be about 0.37 cal/g.°C for dry beetles, increasing linearly with the relative water content.

Karl Erik Zachariassen, Institute of Zoophysiology, University of Oslo, Blindern, Oslo 3, Norway.

Harold T. Hammel, Physiological Research Laboratory, Scripps Institution of Oceanography, San Diego, California 92037.

Werner Schmidek, Department of Physiology, Institute of Biomedical Science, University of São Paulo, São Paulo, Brazil.

The specific heat of whole animals and tissues under various conditions is a frequently used quantity in thermal biology. In spite of the importance of this parameter, only few data as to its exact value are found in literature (Mayer 1964, Luecke et al. 1975). The influence of the relative water content does not seem to be given much attention.

In the present study the specific heat of whole beetles was measured and related to their relative water content.

MATERIAL AND METHODS

The measurements were performed on adult tenebrionid beetles of the species *Eleodes blanchardi* Blaisd., which were collected in the mountains of southern California.

The specific heat of the beetles was determined with a gradient layer calorimeter. The calorimeter consists of a box, the walls of which contain a double layer of copper-constantan thermocouples, arranged in series and alternating between the inner and the outer layer. Arranged in this way, the thermocouples give rise to an electrical potential proportional to the mean temperature difference between the two layers, which furthermore is proportional to the heat flux through the calorimeter walls. A detailed description of the calorimeter is given by Caldwell & al. (1966).

The beetles were kept at 0°C and then rapidly transferred to the calorimeter, which was previously equilibrated to room temperature (21°–22.5°C). Inside the calorimeter the beetles were allowed to heat to room temperature, and the heat needed for this would have to pass through the calorimeter walls, where it would be registered by the gradient layer.

The relative water content of the beetles was determined by weighing the beetles before and after drying to constant weight at 70°C. The relative water content was reduced by keeping the beetles without food and water at room temperature for up to three weeks. In one case, the specific heat was measured on a beetle after drying to constant weight at 70°C.

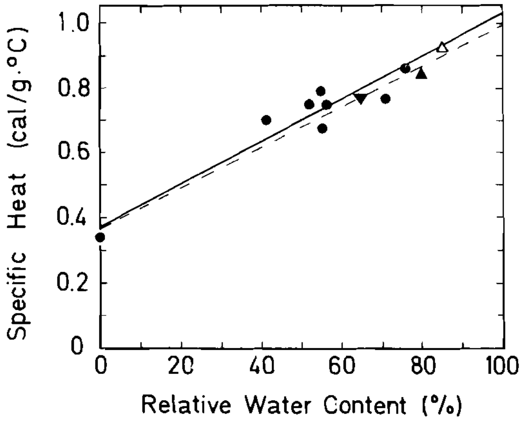


Fig. 1. Specific heat of adult *E. blanchardi* as a function of their relative water content (●). The solid line represents the calculated regression line of the observed values, while the dashed line represents a corrected course, taking into consideration that the specific heat of pure water actually is 1.00 cal/g.°C. Values taken from the literature are also included in the diagram. From Luecke & al. (1975) are taken values for specific heat of 'tissues' (▲) (assuming a relative water content of 80%) and of blood (△) (assuming a relative water content of 85%). From Altman & Dittmer (1971) is taken a corresponding value for erythrocytes (▼) (assuming a relative water content of 65%).

RESULTS AND DISCUSSION

Corresponding values of specific heat and relative water content are plotted in Fig. 1. The calculated regression line has the formula

$$y = 0.37 + 0.00656\ x,$$

and the correlation coefficient is 0.95.

At an abscissa value of 100% (pure water) the corresponding ordinate value of the regression line is 1.03 cal/g.°C. This value agrees well with the ideal value of the specific heat of pure water in this temperature range, which is about 1.00 cal/g.°C. The good correspondence between these two values and the high correlation coefficient confirm the reliability of the present measurements.

Since the specific heat of pure water has actually a value of about 1.00 cal/g.°C, a corrected line, describing the relation between specific heat and relative water content of the beetles, has been drawn (the dashed line in Fig. 1). This line is in good agreement with data given by Luecke et al. (1975) and Altman & Dittmer (1971) (plotted as triangles in Fig. 1).

As should be expected, the specific heat changes considerably with the relative water content of the beetles, and the relative water content should consequently be taken into consideration when the specific heat of tissues or whole animals is to be estimated.

Particularly interesting is the specific heat of the dry substances of the animals. A determination of this value should make it possible, on the basis of the relative water content, to estimate the specific heat of animals by interpolation, assuming that the specific heat increases linearly with the relative water content.

The ordinate intersection point of the regression line, corresponding to the specific heat of dry beetles, has a value of 0.37 cal/g.°C. This value is in fairly good agreement with values given by Hodgman (1947) for solid organic substances such as dextrose (0.275 cal/g.°C), maltose (0.32 cal/g.°C), and urea (0.32 cal/g.°C). The discrepancy might be caused by an incomplete water loss in the betles dried at 70°C, and by the fact that beetles here stated to have a relative water content of zero, thus contain some water. However, control measurements showed no further loss of weight when beetles, previously dried to constant weight at 70°C, were kept at 100°C for 12 hours. This indicates a practically complete water loss at 70°C. On this basis, the discrepancy between the present results and the values given by Hodgman is more likely to be due to the contribution from other substances, with a higher specific heat than those given by Hodgman.

As to the applicability of the present results on animals of other phyla, it must be kept in mind that the beetles used in the present studies have a thick chitinous exoskeleton peculiar to arthropods. The exoskeleton might give insects a specific heat different from that of animals of most other phyla. The difference, if any, should be most pronounced in dry animals and approach zero as the relative water content approaches 100%. However, since the specific heat of erythrocytes, which have a relative water content as low as 65%, fits perfectly with the corrected line on Fig. 1, it seems that this difference is insignificant, and consequently, that the present results can be applied on a wide biological material.

ACKNOWLEDGEMENTS

This work was generously supported by Thanks to Scandinavia Inc., New York, and by the United States Educational Foundation in Norway, which supplied the fund for K. E. Zachariassen's visit to the United States. We wish to express our gratitude to these organizations. We also wish to thank the Norway–America Association for its most kind assistance.

Received 31 July 1976

REFERENCES

Altman, P. L. & Dittmer, D. S. (Ed.) 1971. Resuiration and circulation. *Biological Handbooks.* Federation of American Societies for Experimental Biology. Bethesda, Maryland.

Caldwell, F. T., Hammel, H. T. & Dolan, F. 1966. A calorimeter for simultaneous determination of heat production and heat loss in the rat. *J. Appl. Physiol. 21,* 1665–1671.

Hodgman, C. D. (Ed.) 1947. *Handbook of Chemistry and Physics. 30th ed.* Chemical Rubber Publishing Co., Cleveland.

Luecke, R. H., Natarajan, V. & South, F. E. 1975. A mathematical biothermal model of the Californian sea lion. *J. Thermal Biology 1,* 35–45.

Mayer, W. V. 1964. Hibernation. *BSCS Pamphlets 19.* 40 pp. D. C. Heath & Co., Boston.

Homoptera Auchenorrhyncha from Norway

CARL AUGUST SCHULZ

Schulz, C. A. 1976. Homoptera Auchenorrhyncha from Norway. *Norw. J. Ent. 23,* 159–160.

Fifty-two species of cicadas are reported from different parts of Norway. The following species are new to this country: *Macropsis glandacea* Fieber, *Psammotettix albomarginatus* **Wagner,** ***Scleroracus decumanus*** Kontkanen and *S. russeolus* Fall.

C. A. Schulz, Fazantenlaan 60, St.-Pancras-Z, Holland.

Localities for 52 species of cicadas from several Norwegian counties are reported, based on material collected during the summers of 1972 and 1973. Species marked with an asterisk are new to Norway. Previous records of cicadas from Norway have, among others, been published by Holgersen (1944a, b, 1945, 1946, 1953) and Ossiannilsson (1943), but a complete list of the species and their distribution does not exist.

The material of the present study is kept in the author's collection.

CIXIIDAE

Cixius cunicularius L. Kongsberg 5 July 1972 1 ♂.

DELPHACIDAE

Stiroma affinis Fieber. Morgedal 5 July 1972 1 ♂ 1 ♀, Gjøvik 27 July 1973 1 ♂ 3 ♀. *Dicranotropis hamata* Boheman. Langesund 30 June 1972 2 ♀ 1 ♂, Morgedal 5 July 1972 2 ♀, Kongsberg 5 July 1972 2 ♂, Hvittingfoss 8 July 1972 1 ♀, Larvik 11 July 1972 2 ♀. *Criomorphus albomarginatus* Curt. Gjøvik 27 July 1973 1 ♀. *Javesella forcipata* Boheman. Gjøvik 27 July 1973 2 ♂ 1 ♀. *J. obscurella* Boheman. Evje 3 July 1972 1 ♀. *J. pellucida* Fabr. Langesund 30 June 1972 1 ♂.

CERCOPIDAE

Neophilaenus exclamationis Thunb. Langesund 30 June 1972 8 ♂ 4 ♀, Hvittingfoss 8 July 1972 2 ♂ 2 ♀, Lalm 27 July 1973 3 ♂ 2 ♀. *N. lineatus* L. Hvittingfoss 8 July 1972 1 ♂, Gjøvik 27 July 1973 3 ♂ 2 ♀, Slinde 24 July 1973 1 ♂ 2 ♀, Lalm 27 July 1973 1 ♂ 2 ♀. *Aphrophora alni* Fall. Hvittingfoss 8 July 1972 2 ♂. *Philaenus spumarius* L. Larvik 11 July 1972 2 ♀, Kongsberg 5 July 1972 1 ♂, Ulvik 22 July 1973 4 ♂ 7 ♀, Gjøvik 27 July 1973 4 ♂ 1 ♀, Lalm 27 July 1973 2 ♂ 1 ♀, Hvittingfoss 8 July 1972 1 ♂.

CICADELLIDAE

Oncopsis alni Schrank. Slinde 24 July 1973 1 ♀, Hvittingfoss 8 July 1972 1 ♂, Horten 9 July 1972 1 ♀. *O. flavicollis* L. Morgedal 5 July 1972 1 ♂, Horten 9 July 1973 1 ♂, Slinde 24 July 1973 2 ♀. *O. tristis* Zett. Hvittingfoss 8 July 1972 1 ♂, Slinde 24 July 1973 1 ♂ 6 ♀, Kongsberg 5 July 1972 1 ♂. **Macropsis glandacea* Fieber. Larvik 11 July 1972 1 ♂. *M. fuscula* Zett. Lalm 27 July 1973 2 ♂. *M. cerea* Germar. Hvittingfoss 8 July 1972 2 ♀. *Aphrodes bifasciatus* L. Hvittingfoss 8 July 1972 4 ♂. *Evacanthus interruptus* L. Ulvik 22 July 1973 1 ♂ 2 ♀, Gjøvik 27 July 1973 7 ♂ 9 ♀. *Erythria aureola* Fall. Amli 30 July 1973 5 ♂ 5 ♀, Hella 20 July 1973 1 ♀. *Forcipata forcipata* Flor. Gjøvik 27 July 1973 3 ♂, Hella 20 July 1973 2 ♀. *Kybos smaragdulus* Fall. Horten 9 July 1972 1 ♂. *Eupteryx signatipennis* Boheman. Langesund 30 June 1972 1 ♂. *Balclutha punctata* Fabr. Evje 3 July 1972 2 ♂, Morgedal 5 July 1972 1 ♀. *Macrosteles alpinus* Zett. Sogndal 23 July 1973 1 ♂. *M. horvathi* Wagner. Sogndal 23 July 1973 1 ♂. *M. variatus* Fall. Gjøvik 27 July 1973 1 ♂, Ulvik 22 July 1973 2 ♂. *M. sexnotatus* Fall. Seljestad 21 July 1973 1 ♀. *Doratura stylata* Boheman. Lalm 27 July 1973 1 ♂ 1 ♀. *Allygus commutatus* Fieber. Larvik 11 July 1972 1 ♂. *Graphocraerus ventralis* Fall. Hvittingfoss 8 July 1972 2 ♀. *Paluda flaveola* Boheman. Hvittingfoss 8 July 1972 1 ♂, Ulvik 22 July 1973 1 ♂, Lalm 27 July 1973 3 ♂ 1 ♀. *Elymana sulphurella* Zett. Lalm 27 July 1973 1 ♂. *Speudotettix subfusculus* Fall. Morgedal 5 July 1972 1 ♂, Gjøvik 27 July 1973 1 ♀. *Hesium domino* Reut. Slinde 24 July 1973 1 ♂. *Thamnotettix confinis* Zett. Seljestad 21 July 1973 1 ♂, Ulvik 22 July 1973 1 ♂ 1 ♀, Morgedal 5 July 1972 1 ♀, Evje 3 July 1972 1 ♀. *Macustus grisescens* Zett. Evje 3 July 1972 1 ♂ 3 ♀.. *Doliotettix lunulatus* Zett. Lalm 27 July 1973 1 ♀. **Scleroracus decumanus* Kontkanen. Ulvik 22 July 1973 2 ♀. **S. russeolus* Fall. Hella 20 July 1973 1 ♀. *Streptanus sordidus* Zett. Gjøvik 27 July 1973 1 ♂. *S. confinis* Reut. Hvittingfoss 8 July 1972 1 ♀. *S. marginatus* Kirschbaum. Gjøvik 27 July 1973 1 ♂. *Psammotettix confinis* Dahlbom. Hvittingfoss 8 July 1972 1 ♂. *P. nodosus* Ribaut. Hvittingfoss 8 July 1972 2 ♀. *P. frigidus* Boheman. Seljestad 21 July 1973 2 ♂, Turtagrø 26 July 1973 1 ♀. *P. cephalotes* Herrich-Schäffer. Langesund 30 June 1972 2 ♂. *P. alienus* Dahlbom. Langesund 30 June 1972 1 ♀, Seljestad 21 July 1973 1 ♀. **P. albomarginatus* Wagner. Lalm 27 July 1973 1 ♀. *Jassargus flori* Fieber. Gjøvik 27 July 1973 4 ♂ 1 ♀. *Diplocolenus abdominalis* Fabr. Kongsberg 5 July 1972 2 ♂, Langesund 30 June 1972 2 ♂ 1 ♀, Hvittingfoss 8 July 1972 1 ♀, Ulvik 22 July 1973 4 ♂ 2 ♀, Gjøvik 27 July 1973 3 ♀, Lalm 27 July 1973 1 ♀. *D. limbatellus* Zett. Turtagrø 25 July 1973 1 ♂ 1 ♀.

Received 14 April 1976

ACKNOWLEDGEMENTS

I would like to thank Mr. W. Gravenstein for identifying and checking most of the species.

REFERENCES

Holgersen, H. 1944a. Norske sikader I. *Nyt Mag. Naturvid. 84,* 205–218.

Holgersen, H. 1944b. Norske sikader II. *Bergens Mus. Årbok. Nat. vit. rekke nr. 9,* 37 pp.

Holgersen, H. 1945. Norske sikader (Homoptera cicadina) III. De norske arter av slekten *Thamnotettix* Z ett. 1839. *Norsk ent. Tidsskr. 7,* 107–114.

Holgersen, H. 1946. Om en del norske fulgorider (Norske sikader, Homoptera cicadina IV). *Norsk ent. Tidsskr. 7,* 149–155.

Holgersen, H. 1953. Norwegian leaf-hoppers of the genera *Macrosteles, Erotettix* and *Balclutha* (Hom. cicadina). *Norsk ent. Tidsskr. 9,* 18–24.

Ossiannilsson, F. 1943. The Hemiptera (Heteroptera, Cicadina, Psyllina) of the Tromsø Museum. *Tromsø Mus. Årsh. 65,* nr. 1.

Norwegian stoneflies. V. Variations in morphological characters compared to differences in ecological factors

ALBERT LILLEHAMMER

Lillehammer, A. 1976. Norwegian stoneflies. V. Variations in morphological charatcers compared to differences in ecological factors. *Norw. J. Ent.* 23, 161–172.

In some stonefly species, environmental factors have produced differences in the time of emergence of local populations, thus partly isolating them from other populations of the same species. One such example is *Leuctra hippopus* at Isternfoss in northern Hedmark. There also exist ecological differences between populations which are often associated with differences in morphological characters such as genital appendages, body length, wing length, and wing venation. Wing length and body length seem greatly influenced by temperature and nutrition, and some local populations consist of specimens with short wings at high altitudes. At these localities there are small amounts of food and low temperatures. In species which occur in biotopes above the Low-Alpine (*Salix*) vegetation belt, such as *Diura bicaudata* (L.), *Capnia atra* Morton, and *Amphinemura standfussi* (Ris), wing length is often reduced more than body length, giving a small wing area together with a relatively large body. This seems to make them less able to fly, and, together with low temperatures, isolates local population to some degree. Such populations may also be distinct in the other morphological characters such as genital appendages and wing venation.

A. Lillehammer, Zoological Museum, University of Oslo, Sars gt. 1, Oslo 5, Norway.

Stoneflies show marked intraspecific variations in the morphological characters used in taxonomy (Lilelhammer 1974a). In several species, a larger part of the variants are found within local populations, but the incidence of each variant nearly always varies from population to population. In addition, there is intraspecific variation in habitat preference and emergence in several species (Lillehammer 1974b, 1975a).

It has been demonstrated that certain environmental factors effect the life cycle of some species (Lillehammer 1975b). In Norway a great number of streams run directly into the sea or into lakes without being conected to other streams. During the egg and nymphal periods the populations of such streams are completely isolated and thus susceptible to the differing impact of environmental factors such as food, temperature, pH, water hardness, stream flow, and predation. In a country rich in streams such as Norway there are thus thousands of isolated nymphal stonefly populations which are influenced in different ways. It is far more difficult to ascertain if they are also isolated as adults. Most stoneflies, however, normally seem to fly – if not well, well enough to colonise suitable water courses when temperatures are high enough not to inhibit flying activity.

Ulfstrand (1969) believed that isolation among local populations arose from different flight periods rather than from habitat distribution. However, populations in different streams might have different habitat distributions and environmental factors which produce different flight periods. For instance, differences in the effect of temperature on egg and nymphal development appear to produce emergence at different times in different populations of the same species (Lillehammer 1975a), and in this way isolate populations.

There is also evidence that climatic factors such as low temperature, wind, and snow can in certain circumstances lead to isolation of imagos by preventing flying and thus interchange between populations.

Wing length may be important for the

spread of species, and short wingedness in stoneflies has been discussed by several authors, including Hynes (1941), Tjeder (1945), Brinck (1949), and Nebeker & Gaufin (1967).

Lillehammer (1974a) mentioned that the environmental factors influenced body length and wing length, and Swensson (1975) came to the conclusion that food supply during late winter and spring was important in determining body size of the adult caddis fly, *Potamophylax cingulatus* (Stephens), and that environmental factors influenced the morphometric characters of subpopulations.

The influence of certain environmental factors on populations of Plecopteran species will therefore be further discussed in this paper.

SOME ENVIRONMENTAL FACTORS INFLUENCING LIFE CYCLE OF LOCAL POPULATIONS

Egg

Among the Norwegian species of Plecoptera there are large differences in egg incubation period. *Capnia bifrons* seems to have no incubation period, *C. atra* eggs take 8–24 days, *Amphinemura standfussi*, 70–128 days (Lillehammer 1975b), and *Diura bicaudata, D. nanseni*, and *Arcynopteryx compacta* 8 to 10 months with a diapause during the winter (Table I).

The effect of temperature on the length of the incubation period and the hatching period has been shown for Ephemeroptera by Elliot (1972) and for *Nemoura avicularis* by Brittain (1973). Saltveit (1976) and Lillehammer (in prep.) have investigated the effect of different temperatures on the incubation periods of eggs from *Leuctra nigra, Amphinemura borealis, A. sulcicollis*, and *A. standfussi* (Table II). From these studies it can be seen that the length of the egg incubation period can be greatly altered, and that different species react differently to the same stimuli.

Table I. Eggs from three females of Diura bicaudata, two of D. nanseni and one of Arcynopteryx compacta, reared during a 16 month period in the laboratory.
The temperature varied from 2.5°C to 8.9°C. Eggs of D. nanseni were kept frozen at -10°C for five days from 6. to 10. April.

	Egg batch	Date of ovipos.	No. hatching the next year Mar.	Apr.	May	June	July	Aug.
D. bicaudata	1	4 July	15	2	7	0	0	0
"	2	28 May	4	10	0	0	0	0
"	3	28 June	1	7	11	0	0	0
D. nanseni	1	16 June	2	0	53	2	0	0
"	2	16 June	1	0	26	0	0	0
A. compacta	1	1 July	2	0	0	6	4	2

Table II. The influence of different temperatures on the incubation period of four species taken from Saltveit (1976), Lillehammer (in prep.).

Species and temperatures	Incubation period (days)
Leuctra nigra	
14 days at 12°C and then 4°C	28
4°C	90
Amphinemura borealis	
4°C	41
8°C	22
Amphinemura sulcicollis	
4°C	25
8°C	20
24°C	12
Amphinemura standfussi	
4°C	70 - 130
8°C	"
16°C	no hatching
20°C	"
24°C	"

Nymph

Growth and emergence is affected both by differences in temperature and food. The species have an upper and lower temperature limit (Whitney 1939, Kjellberg 1972).

Table III. The range in body length attained by newly hatched nymphs of Leuctra fusca and L. nigra given excess of food and insufficient food. Newly hatched nymphs were on average 0.60 mm long. There were 10 nymphs in each of the four aquaria.

	Period reared	Excess of food	Insufficient food
L. fusca	8½ months	2.9-4.2 mm	2.2-2.6 mm
L. nigra	12 "	6.7-8.3 "	2.0-2.5 "

The influence of increased temperature and the resulting shortening of the development period of some stoneflies was shown by Lillehammer (1975a and b). The influence of differing amounts of food available to the nymphs was considered by Lillehammer (1975b), and Table III shows that food shortage slows down growth. In some species this probably results in a two-year instead of a one-year life cycle.

Imago

Emergence. The beginning of the reproductive stage is critical because the insect changes from the aquatic to the terrestrial environment. Emergence is usually associated with relatively high temperatures, photoperiod, good weather, hiding places, food, and suitable places to lay eggs (Corbet 1964).

Emergence which seemed dependent solely on temperature was noted by Jackson (Nebeker 1971) from artificially heated streams, where emergence took place throughout the year. Temperature-dependent emergence was also shown by Lillehammer (1975, a and b).

Flight period. Winged insects aggregate temporarily to rest, eat, copulate, and oviposite (Johnson 1966). Johnson also believed that in this way a local population mixes to a greater degree than it spreads within an area. Such movements he calls migration. The duration of the imaginal instar varies in Plecoptera. Some live only for a short time and do not need food, although copulating and ovipositing. Those stoneflies whose nymphs live on leaves or detritus often seem to need food as imagos (Hynes (1941), Brinck (1949)). This they find either near the water or at some distance away. When these functions are fulfilled, they have to return for oviposition or to find other suitable places for the eggs and nymphs. During this period they are influenced both by abiotic factors such as weather and temperature and biotic ones such as food and predation. The ability to find a mating partner is also density dependent according to Solomon (1957).

Among aquatic insects living in running waters some species seem to be bound to a distributional drift of immature stages and an upstream movement of the winged adults. However, certain species such as the stonefly *Capnia atra* have a more clumped distribution in streams, and undergo behavioural drift as nymphs and no upstream movement as imagos (Müller 1973). However, *C. atra* seems to walk quite a long distance on snow to reach wooded areas (Müller 1973) and above the three line they have been observed to move towards the nearest dark point (Daan & Gustavsson 1973).

Other observations made by the author in Øvre Heimdalen showed that imagos sought piles of stones in or near the stream and aggregated there. This was most marked among short-winged populations of *Amphinemura standfussi* at between 1100 and 1500 m a.s.l. in Øvre Heimdalen. The same was also noted for short-winged populations of *C. atra* and *D. bicaudata.* They were not observed to fly, but at 1400 m the surroundings are sub-arctic, and in such climates the insects appear to prefer to walk rather than fly (Downes 1965). Under such conditions reproductive isolation of populations may occur.

Isolation between imagos of different populations caused by differences in egg and nymphal development can also arise in the middle of the distribution area, while isolation caused by climatic impact upon the imagos is believed to be strongest at the limits of the species distribution. For many of the Norwegian species this occurs at high altitudes (Lillehammer 1974b). As a result of this the isolated population might be monomorphic as mentioned by Mayr (1970).

ENVIRONMENTAL FACTORS AND THE MORPHOLOGICAL DIFFERENCES BETWEEN LOCAL POPULATIONS

Certain environmental factors appear to produce isolation in local populations of *Diura bicaudata, Capnia atra, Nemoura arctica,* and *Amphinemura standfussi* at high altitudes and in sub-arctic conditions. Isolation of at least one *Leuctra hippopus* population seems to occur in the centre of its distribution area. The special lake outlet temperatures during the egg and nymphal stages produce emergence much earlier in the Isternfoss stream than in the surrounding streams (Lillehammer 1975a). In this connection, the influence of different temperatures on emergence in areas having the same photoperiod was demonstrated by Lillehammer (1975a).

Table IV. The wing length and body length (mean and standard deviation) of newly emerged female Nemoura avicularis taken on the first day of emergence, and after the emergence had taken place for at least three weeks. The material was collected from Øvre Heimdalsvatn during 1971.

Date	n	Wing length $\bar{X}$	Wing length SD	Body length $\bar{X}$	Body length SD
12 June	30	10.50 mm	0.58	7.60 mm	0.53
4-18 July	21	9.49 "	0.56	7.40 "	0.85

In all the above-mentioned species, marked differences occur in the morphology of the specimens from different populations (Lillehammer 1974a). This is visible in the genital appendages, wing venetation, body length, and the wing factor (wing length/body length).

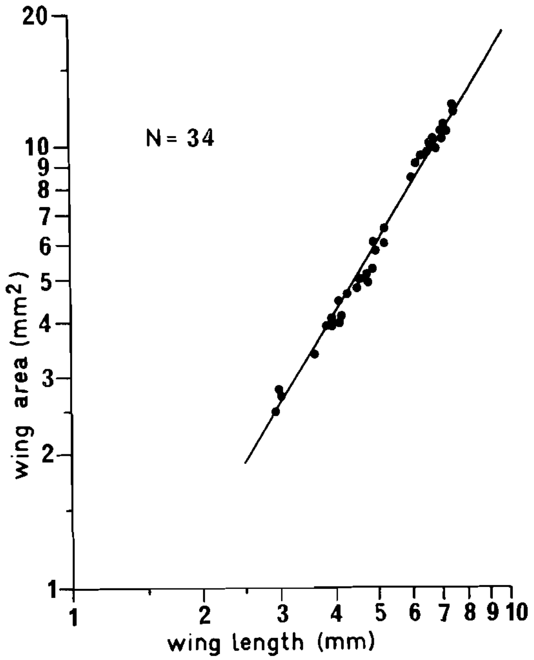


Fig. 2. The relationship between wing length and wing area in *Amphinemura standfussi* (Ris). $Y = 0.393X^{1.687}$, r=0.995, N=34.

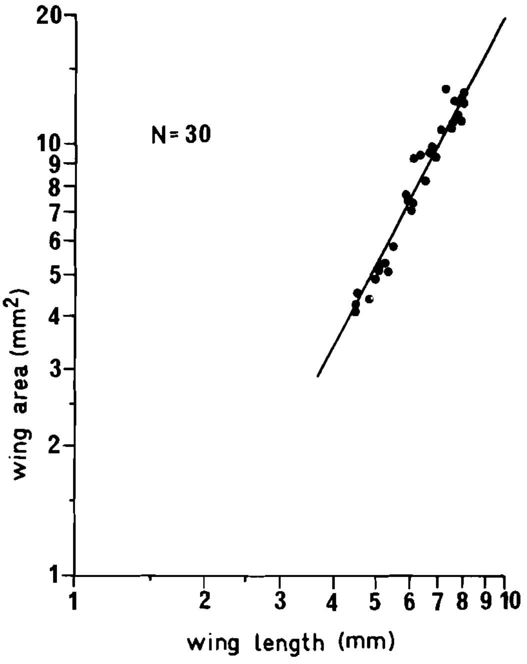


Fig. 1. The relationship between wing length and wing area in *Capnia atra* Morton. $Y=0.996X^{2.011}$, r=0.983, N=30.

Seasonal variation in wing length

Body length, wing length, and wing factor in Plecoptera were assumed to be affected by the environment (Lillehammer 1974a). Svensson (1975) demonstrated that specimens of the caddisfly *Potamophylax cingulatus* (Sheph.) showed seasonal differences in wing length and body weight, and that this was assumed to be connected to environmental factors.

In order to evaluate seasonal differences in wing length and body length in stoneflies, the wing lengths of 51 *Nemoura avicularis* females were measured. They emerged from Øvre Heimdalsvatn during 1971 and were captured in emergence traps which were emptied daily. The specimens were therefore not more than one day old when they were killed.

The results (Table IV) showed that wing length was greater at the peak in the emergence, that is about the 12 June (30 specimens). About three weeks later (21 specimens) the wing length was reduced by 9.5%, while the body length was only reduced by 2.6%.

N. avicularis is not one of the species occurring with short wings and will therefore not be considered further. However, the re-

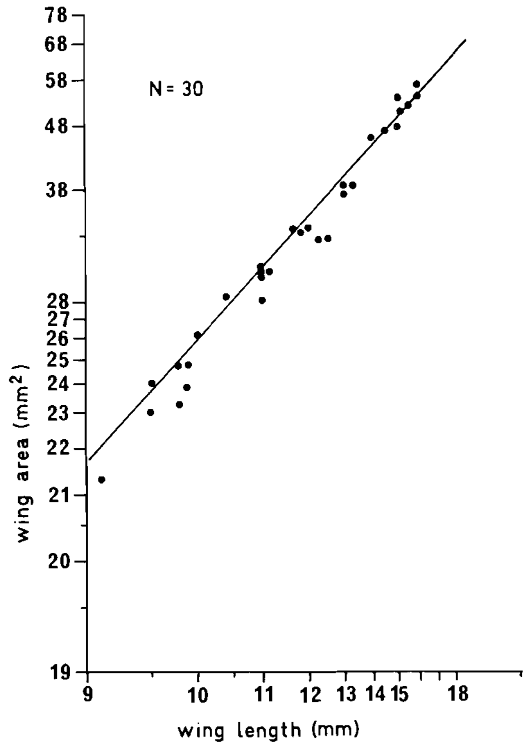


Fig. 3. The relationship between wing length and wing area in *Diura bicaudata* (L.). $Y = 0.548X^{1.661}$, $r = 0.989$, $N = 30$.

sults from these measurements of *N. avicularis* meant that only samples taken as near the peak of emergence as possible were used in comparing specimens from different populations.

Wing length and wing area

The flying ability of insects depends greatly upon the wing area, the strength of the wings, and the body weight.

Great interest is therefore associated with data concerning wing area and the wing veins of short-winged specimens having relatively long bodies (a low w/b index).

In Figs. 1, 2, and 3 the relationship between wing length and wing area in *Capnia atra, Amphinemura standfussi,* and *Diura bicaudata* is plotted.

It can be seen that while wing length is doubled, the wing area is increased threefold. Data concerning the body length and weight in mature nymphs (Brittain, pers. comm.) show that the body length and the body weight have a similar relationship. Any change in wing length, while body length remains constant, will therefore greatly influence flying ability if the wings themselves or their associated musculature are not strengthened. Information about the wing veins will be given below with the description of each species.

Diura bicaudata

This species occurs in a range of habitats in northern Norway, in small streams, rivers, and in lakes and their outlets (Lillehammer 1974b). In southern Norway the species has mainly been taken in lakes and lake outlets. Parallel with this, the local populations show differences in morphological characters. There are especially great differences in wing length between specimens from low- and high-altitude populations (Fig. 4). Specimens from populations in the highest altitudes situated in the sub-alpine vegetation belt in Pasvik, Finnmark, have mainly shorter wings than the low-altitude populations. In the low-altitude populations there is also less difference between wing length and body length. This renders the highest-altitude populations mostly short winged. The same differences betwen high- and low-altitude populations are also present around Mo i Rana, Nordland. In southern Norway all the investigated populations have much shorter wings than body length, making them all short winged.

Among the females in populations from Finnmark all forms of sub-genital plates were present (Lillehammer 1975a) (Fig. 4). In Nordland, at low altitude, the relatively long-winged females mainly have sub-genital forms 1 and 2, while at high altitudes the short-winged females mainly have the forms 3 and 4. Females from all the populations from southern Norway have forms 3 and 4. A high percentage of the southern specimens also have a high degree of irregularity in wing veins (Lillehammer 1974a, Fig. 5).

Thus there are morphological differences between southern and northern specimens of *D. bicaudata* which are paralleled by differences in habitat. This is seen in the narower variation in the form of female genitalia and a narrower ecological valence of the southern populations. A possible explanation of this is that they are ecologically at the limits of their distribution.

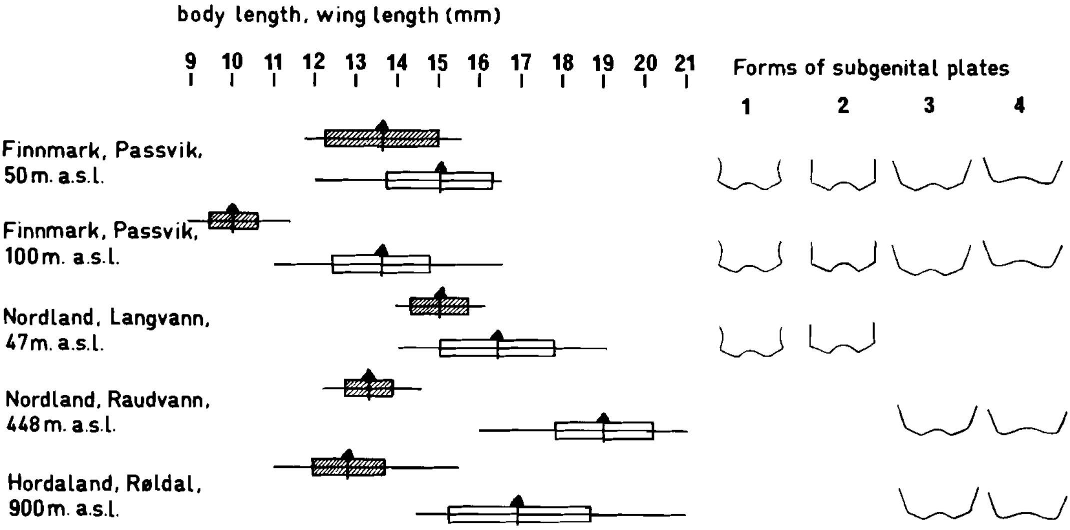


Fig. 4. Wing length, body length, and forms of sub-genital plates present in female *Diura bicaudata* specimens from different localities. Samples were taken in different parts of Norway and at different altitudes. Horizontal lines indicate the total variation, arrows the mean of the samples. Rectangles indicate ± standard deviation, hatched rectangles for wing length and white rectangles for body length.

Another explanation is that two main forms have invaded Norway, one from the south, which when reaching Finnmark hybridized with a form of north-eastern origin which reached at least to Rana in Nordland where the two forms usually occur in different kinds of lakes. However, further studies must be carried out to evaluate these theories.

Nemoura arctica

In this species differences also exist between local populations, in the form of the genital appendages, wing length, body length, and wing venation. Differences in the genital appendages are best seen in the form of the male sub-anal plates and the cerci. The populations of the lower areas (Kautokeino) in the sub-alpine vegetation belt show wide variation (Lillehammer 1974, Fig. 25 A–F), while the population in the Middle-Alpine belt (Biggjovagge) is monomorphic in certain characters (Lillehammer 1974, Fig. 25A). The same population from Biggjovagge is also more short winged than the lower-altitude populations. The wing venation is also highly irregular and the specimens from high altitude are more pigmentated.

Amphinemura standfussi

The form of genital appendages varies considerably in this species (Lillehammer 1974a). However, there do not seem to be clear morphological differences in genital appendages between local populations. There are, however, considerable differences in body length, wing length, short-wingedness, wing venation, and in pigmentation. Specimens from populations at higher altitudes have shorter wings than those from low altitudes (Figs. 5, 6). The species seems to be more affected by the low temperatures and shorter growing season in high altitudes than the amount of available detritus for food during the nymphal period.

In the low-altitude locality Tosketjønn the available food is the same as, or less than at the high altitude localities of Botnavatn (700 m a.s.l.) and Øvre Heimdalsvatn (1090 m a.s.l.).

In spite of this, the wings are much shorter in specimens from the two high-altitude localities. The climate of the three localities are, however, quite different. The Tosketjønn locality has an atlantic climate, while the two other localities are situated in a climate which is sub-arctic. This fits well with results

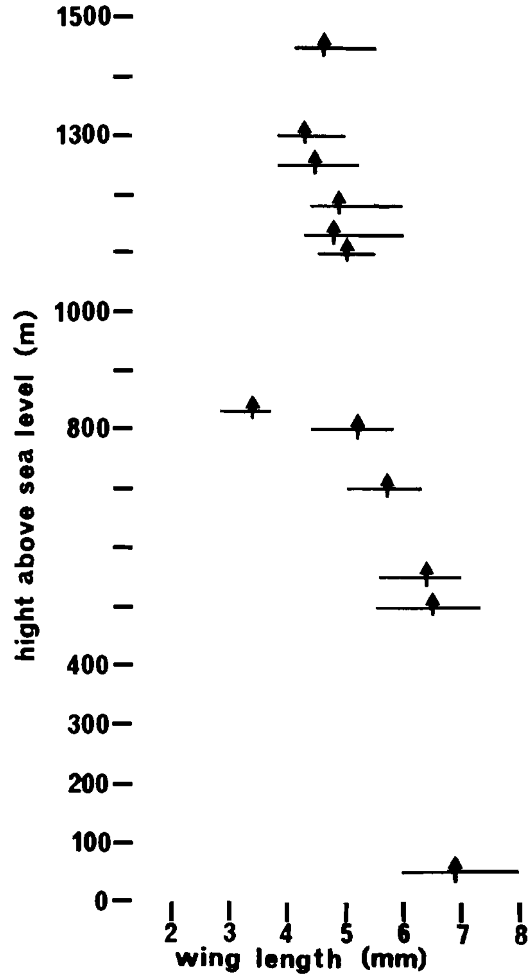


Fig. 5. Wing lengths of female *Amphinemura standfussi*. Samples were taken at different altitudes. Horizontal lines indicate the total variation, arrows the mean of the samples. There were usually 30 specimens in each sample.

from life-cycle studies made in laboratory. The development of nymphs of *A. standfussi* has been shown to be much more affected by differences in temperature than differences in food (Saltveit 1976).

The body length, however, is not reduced to the same degree as the wings. This is best seen in the wing factor (w/b, wing length/body length). A low wing factor means that the wings are relatively short and the body relatively large, indicating less flying ability (see also Fig. 2). Locally there is also a higher percentage of specimens with irregular wing venation in the higher altitude localities. In addition the ribs have a tendency to be reduced (Fig. 7). The separate individuals are also darker pigmentated at high altitude localities.

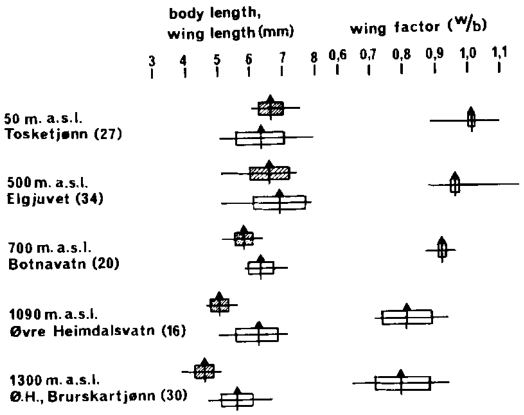


Fig. 6. Wing length, body length, and wing factor (wing length/body length) of female *Amphinemura standfussi* specimens. Samples were taken at different altitudes. The number of specimens is given in parentheses. Horizontal lines indicate the total variation, arrows the mean. The rectangles indicate ± standard deviation: hatched rectangles for wing length, and white rectangles for body length.

Capnia atra

Marked differences in the shape of genital appendages are present in this species (Lillehammer 1974a), and in females there are dif-

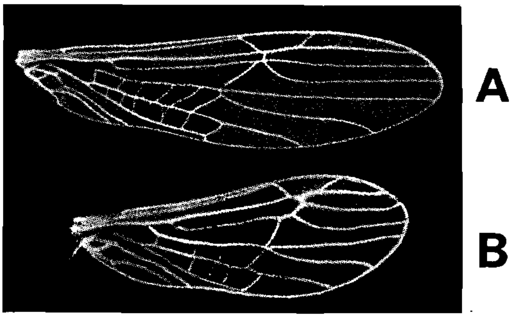


Fig. 7. Wings of *Amphinemura standfussi* specimens. A = normal veins. B = irregular veins with reduced number of cross veins in the cubital area. Type B is often seen in specimens from high altitudes.

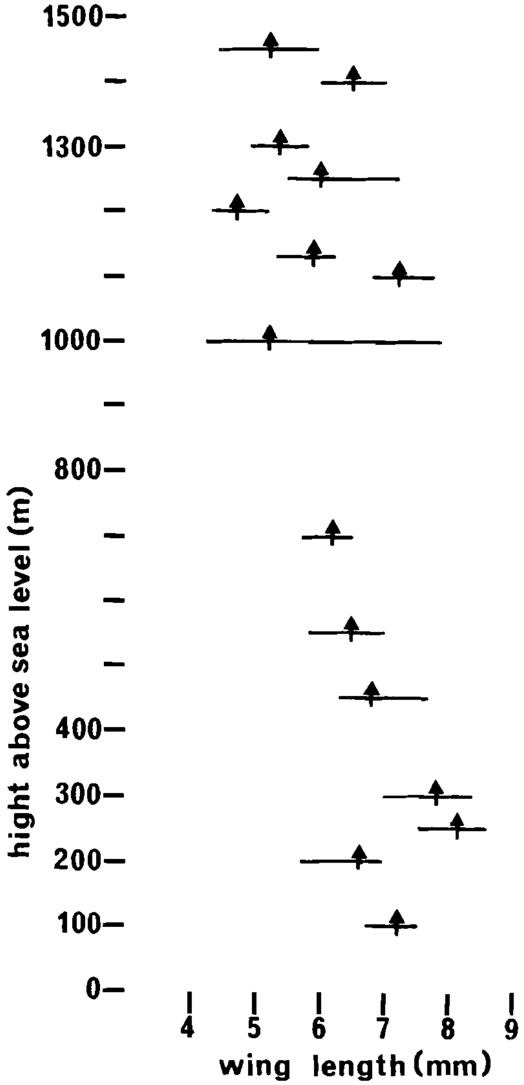


Fig. 8. Wing lengths of female *Capnia atra*. Samples were taken at different altitudes. Horizontal line indicates the total variation, arrows the mean of the samples. There were usually 30 specimens in each sample.

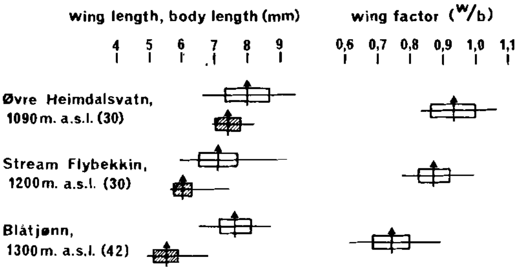


Fig. 9. Wing length, body length, and wing factor (w/b) of female *Capnia atra* specimens. Samples were taken at different altitudes. Horizontal line indicates the total variation, arrows the mean of the samples, and rectangles ± standard deviation. Hatched rectangles for the wing length, white rectangles for body length.

ferences in the form of the sub-genital plate between local populations.

There are also differences in wing length between local populations at low and at high altitudes. The high-altitude populations generally have shorter wings (Fig. 8), but there are exceptions, such as the population of the lake, Øvre Heimdalsvatn (1090 m a.s.l.) and the lake, Sandalsvatn, Finse (1400 m a.s.l.) which have fairly long wings. Locally, however, there is a decrease in wing length with increasing altitude (Fig. 9). The body length does not decrease to the same degree as wing length and therefore the high-altitude populations are those most short winged (low-wing factor), indicating less ability to fly (see also Fig. 1).

Increased irregularity of wing venation showed no relation with increasing height, but occurred scattered in local populations at all altitudes. Pigmentation was, however, stronger at high altitudes.

Leuctra hippopus

This species is one of the most widely distributed in Norway (Lillehammer 1974b). Marked variations exist in the morphological characters used in taxonomy (Lillehammer 1974a). The variation is visible in the genital appendages of both sexes, and in Table V the variation in male genital appendages from 9 local populations is shown. Drawings of the different forms A–L are shown in Lillehammer (1974a, Fig. 48). The Isternfoss population is markedly different from the rest, with its narrow variation.

In the investigated areas of south-western Norway there were differences in both body length and wing length between *L. hippopus* specimens from local populations both in lowland and at high-altitude localities. Body length and wing length were reduced at high altitude but body length was reduced more than wing length (Fig. 10). The wing factor

Table V. The percentage of each variant in the shape of: the 7th tergite, the sclerotized plate of the 9th tergite and the sub-anal plate in males of Leuctra hippopus from different local populations. The number of specimens is indicated in parentheses.

	7th tergite												8th tergite				9th tergite					Sub-anal plate		
	A	B	C	D	E	F	G	H	I	J	K	L	A	B	C	D	A	B	C	D	E	A	B	C
Etne i Hordaland (40)	9	9	40	18	18					3		3		4	21	75		54	46			42	33	25
Botnavatn Rogaland (45)	10	29	29	4	4			20		4					5	95		64	18	9	9	23	23	54
Elgjuvet Rogaland (30)		35	12	6	6			41								100		60	30		10	47		53
Nordelva Rogaland (31)		35	14					35	8	8					17	83		48	26	26		12	14	74
Sveio Hordaland (25)	9	32	14					36					10		[illegible]	[illegible]	[illegible]	64	14	14		36	32	32
Time Rogaland (11)	11		11	11				67								100			35	30		100		
Torsketjørn Rogaland (34)	[illegible]	10	35	[illegible]	[illegible]							[illegible]				[illegible]				5	5	90	10	
Øvre Heimdal Oppland (30)	35	10	20													[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	45	45	15
Isternfoss Hedmark (27)								[illegible]	[illegible]	77			[illegible]		[illegible]				100					100

(w/b) was therefore greater at high-altitude localities, indicating better flying ability. This trend is oposite to that of *C. atra, A. standfussi, N. arctica* and *D. bicaudata.*

Parallel to the decrease in wing length and body length with increasing altitude there is also an increase in the frequency of irregular wing venation (Fig. 12).

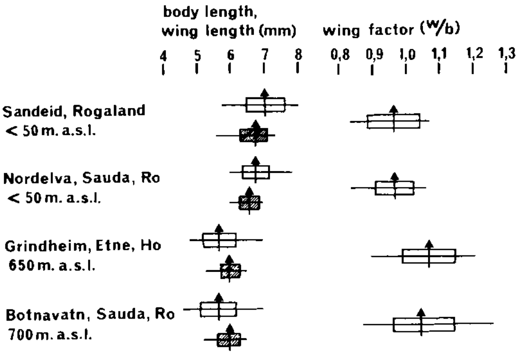


Fig. 10. Wing length, body length, and wing factor (w/b) of female *Leuctra hippopus* specimens. Samples were taken in two low-altitude and two high-altitude localities in Rogaland, West Norway. Horizontal lines indicate the total variation, arrows the mean of the samples. Rectangles indicate ± standard deviation: hatched rectangles for wing length, white rectangles for body length.

Although there was a clear trend towards reduction of wing length with increasing altitude in *L. hippopus* from south-western Norway, there was only a slight trend for the country as a whole (Fig. 11). There are populations from low altitudes which have short wings, and there are populations from localities at high altitudes which have fairly long wings. The variation present within a local population seems to be greatly dependent on local environment factors. In such situations body length seems to be more affected by local conditions than wing length. Different amounts of food, principally allochthonous matter, seem to be important in this connection. In south-western Norway the populations at Sveio, Sandeid, and Nordelva (Fig. 12, A, B, and C) are situated at low altitudes. The streams are bordered by a dense fringe of deciduous trees and thus contain considerable amounts of allochthonous matter (Lillehammer 1974b) and the specimens of *L. hippopus* have a fairly long body and long wings. At high altitudes such as Botnavatn, Sauda, and Grindheim, Etne, where there are only small amounts of deciduous trees and bushes, and where there is little allochthonous matter in the streams, the specimens have a fairly short body and short wings (Figs. 12, D and E). The same is also

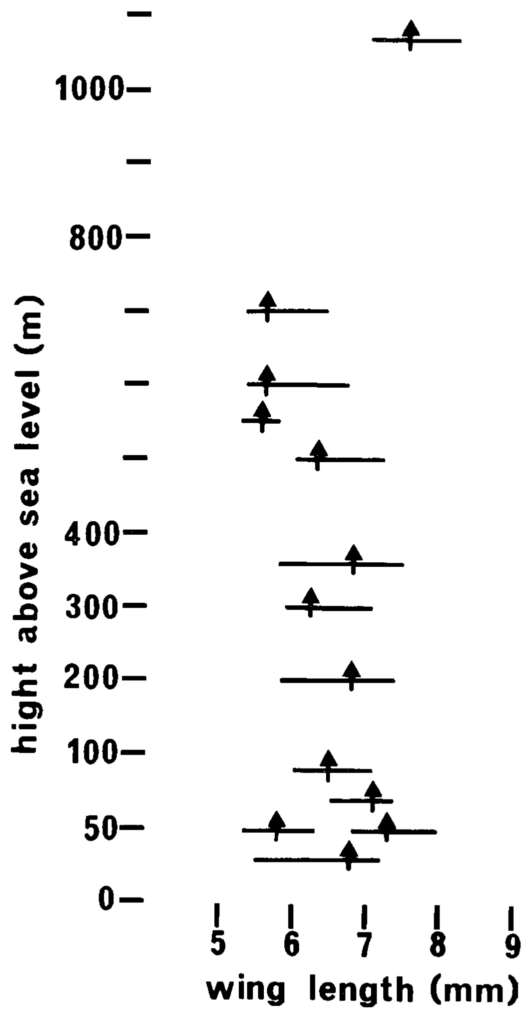


Fig. 11. Wing length of female *Leuctra hippopus* specimens. Samples are taken at different altitudes. Horizontal lines indicate the total variation, arrows the mean of the samples. There were usually 30 specimens in each sample.

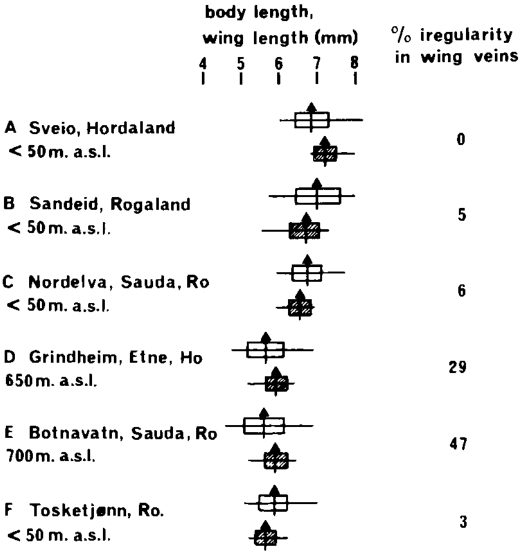


Fig. 12. Wing length and body length of female *Leuctra hippopus* specimens. Samples were taken in Rogaland and Hordaland from coastal, middle, and inner areas in lowland and in high-altitude localities situated in the lower part of the Low-Alpine vegetation belt. Horizontal lines indicate total variation, arrows the mean of the samples. Rectangles indicate ± standard deviation: hatched rectangles for the wing length, white for body length.

true of samples taken at Tosketjønn, Haugesund, a low-altitude locality (Fig. 12, F). However, the vegetation in this locality can be compared to that of high altitudes in that there are no deciduous trees and only scattered small bushes of *Salix*, resulting in only small amounts of allochthonous matter in the streams. This indicates that the amount of food during the nymphal period is an important factor determining both body and wing length in the adult insects. However, as there are both low temperatures and a short growing season at higher altitudes, it is often difficult to evaluate the relative importance of food and temperature in determining wing length and body length.

In *L. hippopus* the specimens taken in the lowlands of Rogaland and Hordaland show certain differences in wing length and body length. There is a decrease in wing length from the coast towards the inner fjord areas (Fig. 12, A, B, and C). Parallel to this trend there is a decrease in winter temperature and in the period during which growth is possible, while the food situation seems to be similar, as allochthonous matter is abundant in all the investigated streams (Lillehammer 1974b). It seems therefore possible that different temperatures at least affect the wing length more than body length in this species.

The most interesting local *L. hippopus* population investigated is the Isternfoss population, which seems to be isolated in a short stream between two lakes, Galten and Istern in Hedmark. *L. hippopus* does not normally occur in lakes. The specimens of this population have the shortest wings of the investigated local populations (Lillehammer 1974a, Fig. 52). The body length is fairly long, thus making the Isternfoss population the most short-winged population of *L. hippopus.* The population of Isternfoss has also a very high degree of irregularity in the wing veins. This was also maintained in specimens reared in laboratory for two generations. Only one of the 15 specimens did not show irregularity. The same population also consists of specimens which have a heavier pigmentation than most other populations.

CONCLUSIONS

During the nymphal stage local populations are influenced by differences in environmental factors which in turn produce differences in emergence period. Marked morphological differences also exist between many of these populations. In *Diura bicaudata, Nemoura arctica, Capnia atra,* and *Amphinemura standfussi* the differences seem to be greatest in the populations which are near their ecological or geographical limits. Such populations often contain specimens with a decreased wing length. Decreases in wing length with increasing altitude also occur locally. This reduction in wing length is often not followed by an equivalent reduction in body length, thus producing short-winged specimens which probably have less ability to fly. Together with low temperatures this indicates a considerable degree of isolation between populations of streams and of lakes which are widely separated. This is the case in *C. atra, A. standfussi,* and *D. bicaudata* which occur high up in the Middle-Alpine belt where the climate is subarctic.

In *Leuctra hippopus* the greatest divergence occurs in the population from Isternfoss stream which has a much earlier emergence than other populations in the surroundings (Lillehammer 1975a) and where the nymphs seem isolated in a stream between two lakes. In this Isternfoss population *L. hippopus* is also short winged.

Normally there is a reduction in body length and wing length in *L. hippopus* at high altitudes, but the reduction in body length is greater than the wing length with increasing altitude producing long-winged specimens at high altitudes. However, *L. hippopus* does not go above the low-Alpine belt such as the other species do.

The cause of the differences in the length of wings and body seems to be differences in temperature, growing season, and the amount of food available during the nymphal stage.

The differences in emergence and the low temperatures during the imaginal stage, together with a reduced flying ability, appear to isolate the local population of Isternfoss, despite it being in the middle of its distribution area. This can be seen in the narrow variation in the morphology of genitalia appendages of *L. hippopus* in this population.

Most populations normally consist of both long-winged and short-winged specimens which also vary in other morphological characters. The environmental factors seem to have selected specimens with a certain genetic load, and in some cases the isolation has stabilized the population into a genotypic unit such as in the Isternfoss population of *L. hippopus.*

ACKNOWLEDGEMENTS

The present paper is the last in a series of five considering certain morphological and ecological aspects of Norwegian stoneflies. Four of them were used during the defence of the degree of Doctor philosophiae at the University of Oslo on 30 May 1975. During the defence, most valuable advice for this fifth paper was given by Professor Per Brinck and Professor Hans Kauri.

During the whole work with Norwegian stoneflies I have had most valuable discussions with Professor Rolf Vik. I am also indebted to Dr. John E. Brittain for correcting the language and Dr. L. Sømme for advice with the manuscript. Valuable technical assistance was given by Ingrid Lund and Erik Vastaberg.

REFERENCES

Brinck, P. 1949. Studies on Swedish stoneflies (Plecoptera). *Opusc. ent. Suppl 11,* 1–250.

Brittain, J. E. 1973. The biology and life cycle of *Nemoura avicularis* Morton (Plecoptera) (Nemouridae). *Freshwat. Biol. 3,* 199–210.

Corbet, P. S. 1964. Temporal patterns of emergence in aquatic insects. *Can. Entom. 96,* 264–279.

Daan, S. & Gustafsson, K. 1973. Midsummer night emergence of stoneflies (Plecoptera) in a Lappland mountain lake. *Aquilo Ser. Zool. 14,* 29–33.

Downes, J. A. 1965. Adaptations of insects in the Arctic. *Ann. Rev. Ent. 10,* 257–274.

Elliott, J. M. 1972. Effect of temperature on the time of hatching in *Baëtis rhodani* (Ephemeroptera: Baëtidae). *Oecologia 9,* 47–52.

Hynes, H. B. N. 1941. The taxonomy and ecology of the nymphs of British Plecoptera with notes on the adults and eggs. *Trans. R. ent. Soc. Lond. 91,* 459–557.

Johnson, C. G. 1966. A functional system of adaptive dispersal by flight. *Ann. Rev. Ent.* 11, 233–260.

Kjellberg, G. 1972. Autekologiska studier över *Leptophlebia vespertina* (Ephemeroptera) i en mindre skogstjärn 1966–1968. *Ent. Tidskr. 93,* 1–29.

Lillehammer, A. 1974a. Norwegian stoneflies. I. Analysis of the variations in morphological and structural characters used in taxonomy. *Norsk ent. Tidsskr. 21,* 59–107.

Lillehammer, A. 1974b. Norwegian stoneflies. II. Distribution and relationship to the environment. *Norsk ent. Tidsskr. 21,* 195–250.

Lillehammer, A. 1975a. Norwegian stoneflies. III. Field studies on ecological factors influencing distribution. *Norw. J. Ent. 22,* 71–80.

Lillehammer, A. 1975b. Norwegian stoneflies. IV. Laboratory studies on ecological factors influencing distribution. *Norw. J. Ent. 22,* 99–108.

Lillehammer, A. (in prep.). Laboratory studies on oviposition, incubation period and hatching in the species *Diura bicaudata* (L.), *Diura nanseni* (Kempny) and *Arcynopteryx compacta* (McLachland).

Mayr, E. 1970. *Populations, Species and Evolution.* 453 pp. The Belknap Press of Harvard University Press, Cambridge, Massachusetts.

Müller, K. 1973. Life cycles of stream insects. *Aquilo Ser. Zool. 14,* 105–112.

Nebeker, A. V. 1971. Effect of temperature at different altitudes on the emergence of aquatic insects from a single stream. *J. Kans. ent. Soc. 44,* 26–35.

Nebeker, A. V. & Gaufin, A. R. 1967. Factors affecting wing length and emergence in the winter stonefly *Capnia nana. Ent. News 78,* 85–92.

Saltveit, S. J. 1976. *Felt- og laboratoriestudier på steinfluer (Plecoptera) i Sørkedalselven, Oslo, med spesiell vekt på slekten* Amphinemura. Unpubl. thesis, University of Oslo.

Solomon, M. E. 1957. Dynamics of insect populations. *Ann. Rev. Ent. 2,* 121–142.

Svensson, B. W. 1975. Morphometric variation of adult *Potamophylax cingulatus* (Trichoptera) reflecting environmental heterogeneity in a South Swedish stream. *Oikos 26,* 365–377.

Tjeder, B. 1945. *Capnia atra* Mort. vid Vättern. *Opusc. Ent. 10,* 139–140.

Whittney, R. J. 1939. The thermal resistance of Mayfly nymphs from ponds and streams. *J. exper. Biol. 16,* 374–385.

Received 10 February 1975; in revised edition 16 July 1976.

Mire invertebrate fauna at Eidskog, Norway. I. Aim, methods, and habitat descriptions

ARNE PEDERSEN, SIGMUND HÅGVAR & ALF BAKKE

Pedersen, A., Hågvar, S. & Bakke, A. 1976. Mire invertebrate fauna at Eidskog, Norway. I. Aim, methods, and habitat description. *Norw. J. Ent.* 23, 173–180.

The invertebrate fauna in mire habitats in Norway is poorly known. To an increasing degree, the quantity and diversity of untouched mire habitats are becoming reduced. There is therefore a need for a closer investigation of the mire invertebrate fauna in general, and also for more intensive studies which can result in concrete proposals on mire areas which should be protected, due to their invertebrate fauna. The present investigation was initiated by the Norwegian Entomological Society and concerns the invertebrate fauna in thirteen different mire habitats at Eidskog, Hedmark county, South Norway. In this first paper, aims and methods are presented, together with descriptions of the habitats.

Arne Pedersen, Botanical Laboratory, P.O. Box 1045, University of Oslo, Blindern, Oslo 3, Norway.

Sigmund Hågvar & Alf Bakke, Norwegian Forest Research Institute, N-1432 Ås-NLH, Norway.

This investigation was initiated by the Norwegian Entomological Society and has its basis in the following question: What is the need for protection of invertebrates in Norway? The question arises from the recognition that the diversity of invertebrate species and communities should, as far as possible, be conserved for the future. The main problem in this connection is our lack of knowledge on which habitat types contain the most specific fauna, and also which habitat types are most threatened.

It was, however, decided to arrange a study on the invertebrate fauna in mire habitats. This fauna is only poorly known in Norway, but our knowledge indicates that mires may contain a rather special and interesting invertebrate fauna. Originally, Norway contained about 30,000 km^2 of mires, of which two thirds were situated below the timber line. Today, about one fifth of the mire areas below the timber line has been cultivated. Each year, between 50 and 100 km^2 of mires are cultivated. From a zoological point of view, this means that the diversity of species bound to mire habitats may be reduced. Very often, the cultivated mires belong to the most eutrophic ones, which contain the largest number of plant and animal species.

Thirteen different habitats were chosen on two mires at Eidskog, Hedmark county, South Norway. Ten were situated at Momyra bog (UTM 33VUG353454), and three at Orremyra fen (UTM 33VUG362463). The description of the habitats is given by Arne Pedersen.

The intention of this investigation was to iluminate the following questions: How specific is the mire invertebrate fauna? How does the fauna respond to differences in plant communities? Are special groups or species so stenotopic that they might be used as 'indicators' on certain invertebrate communities on mire?

The different invertebrate groups will be treated in separate papers in this journal.

METHODS

The main part of the material was collected by pit-fall traps, 6.5 cm in diameter, and containing 4% formaldehyde. Such traps are selective, collecting the surface-active invertebrate fauna. However, since the same method was applied in all habitats, differences in catches must be due to faunal differences between habitats. It was also of interest to see to what extent this simple method might be useful for more extensive studies of the Norwegian invertebrate fauna on mires.

Ten pit-fall traps were placed in each habitat. They were arranged in two parallel rows, with 5 m between rows and traps. At each emptying of the traps, all material from each habitat was pooled. All traps were set out 2 June. They were emptied at the following dates: 25 June, 9–11 July, 24 July, 5–6 August, 7 September, and 28 September. Unfortunately, the material from the first sampling at habitat 3 and A could not be used due to wrong labelling.

At the point marked with x on Momyra (Fig. 1) a light trap – model of Robinson, with baffles and a HPL 125 W mercury-vapour bulb – and a rotary trap (Bakke 1968, p. 486) were operated periodically during the summer. Some material was also collected by hand-collecting on the two mires.

HABITAT DESCRIPTIONS

The location of the ten habitats on Momyra is indicated on Fig. 1. They are named 1–6 (either on open mire, or within forest areas on the mire), and A–D (transition zones betwen open mire and forest). Fig. 2 shows the three sites on Orremyra, named I–III, which are all situated on open fen areas.

The botanical field work was carried out on 14 September 1974. By a combination of floristic notes and local ecological gradients the different plant communities were classified into the associations proposed by Fransson (1972). pH and specific conductivity were measured in mire water sampled on 24 September 1975. According to Sjörs (1952), the recorded values of specific conductivity are corrected by subtracting the contribution of the H+ ions (κ). This corrected value is representative for the total mineral content in the mire water.

Fig. 1. Air photo of Momyra bog, with the ten sampling sites indicated.

Vegetation around the traps at Momyra

Momyra (Fig. 1) is an ombrotrophic mire complex which consists mainly of two large bog elements – an eastern and a western.

Fig. 2. Air photo of Orremyra fen, with the three sampling sites indicated.

These areas are separated partly by pine bog forest and narrow soaks with dominance of *Carex rostrata.* The eastern bog element slopes mainly against east, and its surface features are arranged slightly excentrically.

Site 1. The traps were placed in wet lawns on the transition between *Scheuchzeria palustris/Sphagnum cuspidatum* mud-bottom and hummocks rich in *Calluna.* The lawns mainly consist of *Sphagnum fallax, S. flexuosum, S. rubellum,* and *S. magellanicum.* Frequent species in the field layer are *Andromeda, Oxycoccus quadripetalus, Rubus chamaemorus,* and *Scirpus caespitosus.* Fransson (1972, p. 39) has referred such lawns to the poor mire expanse fen association Trichophoro-papillosetum. Recorded parameters in mire water of the *Scheuchzeria* hollow: pH = 3.8, κ = 32.

Site 2. This is a typical ombrotrophic mire expanse community belonging to the association Rubello-tenelletum sensu Fransson (1972, p. 33). *Scirpus caespitosus* is the most dominant species in the field layer (Fig. 3). The moss cover is composed of *Sphagnum magellanicum, S. rubellum,* and *S. balticum.* pH = 4.0 and κ = 49.

Fig. 3. Fragment of site 2. The photo shows an ombrotrophic mire expanse community with dominance of *Scirpus caespitosus.*

Fig. 4. Fragment of site 3 with pine bog forest. Apart from the pine and birch, there is a great quantity of the shrub *Vaccinium uliginosum.*

Site 3. The biotope (Fig. 4) consists of a tree-covered mire margin community where *Pinus silvestris* and *Betula pubescens* form the tree layer. The field layer is dominated by the shrub *Vaccinium uliginosum,* but species like *V. myrtillus, V. vitis-idaea, Andromeda,* and *Eriophorum vaginatum* are frequently present. Varying quantities of *Sphagnum magellanicum, S. fuscum, Pleurozium schreberi, Polytrichum strictum,* and *Aulacomnium palustre* constitute the bottom layer upon the hummocks, whereas *Dicranum polysetum* and *Sphagnum flexuosum* occupy lower parts between the hummocks. According to Kielland-Lund (1973), this community is sociologically identical with the ombrotrophic mire margin association Vaccino uliginosi-Pinetum (abbreviated VUP in Table 1). The peat is dark, well humificated and rich in minerals; pH = 3.5 and κ = 167.

Fig. 5. Fragment of site 4. *Carex rostrata* dominates the soak vegetation of this poor fen community.

Fig. 6. Fragment of site 5. Homogenous mire expanse with hummock vegetation dominated by *Calluna* and *Eriophorum vaginatum.*

Site 4. As shown in Fig. 5, this station lies in a narrow soak dominated by homogenous *Carex rostrata* lawns with pH = 4.1 and κ = 84. Besides *Andromeda, Oxycoccus quadripetalus,* and *Eriophorum vaginatum*, there are scattered individuals of the two fen indicators *Carex nigra* and *Menyanthes trifoliata. Sphagnum flexuosum,* also a typical fen indicator, dominates the bottom layer. *S. fallax* and *S. majus* are sparsely found in the wettest parts of the soak. At Momyra, *Carex rostrata* mats appear to belong to a mire expanse/mire margin transitional community, but are closely related to the poor mire margin fen association Rostrato-parvifolietum in Fransson (1972, p. 42).

Site 5. The mire expanse community in this biotope may be characterized as a typical Calluno-fuscetum in the sense of Fransson (1972, p. 34). *Calluna vulgaris, Eriophorum vaginatum, Sphagnum fuscum,* and *S. rubellum* are the quantitatively most important species of the hummock vegetation (Fig. 6). Other species like *Andromeda, Rubus chamaemorus, Drosera rotundifolia,* and the liverwort *Mylia anomala* are constantly present. *Vaccinium uliginosum* grows exclusively on the highest hummock levels. The mire water hold pH = 3.85 and κ = 64.

Site 6. This is a pine bog forest, almost identical with site 3. The most important floristic difference is that *Calluna vulgaris* has replaced *Vaccinium* species in the field layer. There are also a few scattered individuals of the subalpine shrub *Betula nana.* pH = 3.5 and κ = 62.

Site A. The row of traps goes from scattered pine-covered mire margin association Vaccinio uliginosi-Pinetum and almost to the ombrotrophic lawn association Rubello-tenelletum. Mire water from Rubello-tenelletum holds pH = 3.7 and κ = 45.

Site B. Most of the traps were placed in a mire margin fen community which sociologically is closely related to the bilberry spruce forest (Eu-Piceetum subass. myrtilletosum).

Fig. 7. Fragment of site B with the poor lagg association Caricetum globularis in the background. In front, open *Carex rostrata* lawns and small hummocks with *Vaccinium uliginosum* and *Polytrichum commune.*

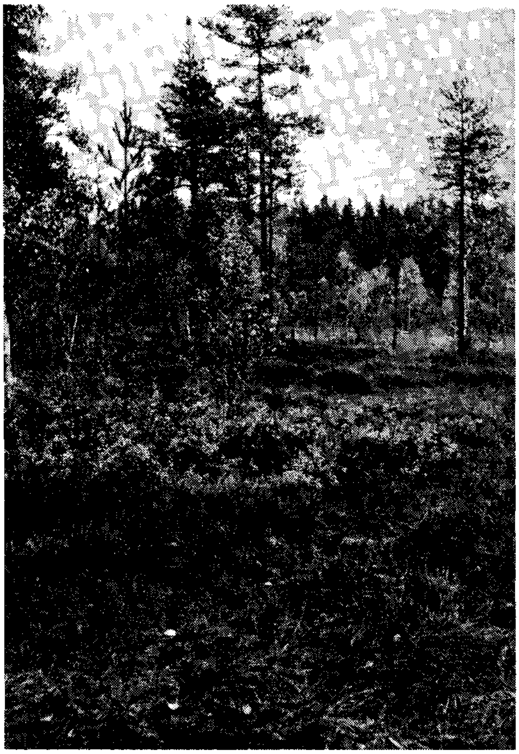


Fig. 8. View of site C. The boundary line between the pine bog forest (on the left) and poor fen association Paucifloro-parvifolietum (to the right) is evident from the picture.

Dominants were in the tree layer: *Picea abies* and *Betula pubescens,* in the field layer: *Vaccinium myrtillus* and *V. vitis-idaea,* and in the bottom layer: *Polytrichum commune* and *Sphagnum girgensohnii.* The frequent occurrence of species like *Equisetum silvaticum, Carex globularis,* and *Hylocomium splendens* indicates that this is a typical lagg community which belongs to the poor fen hummock association *Caricetum globularis* (Fransson 1972, p. 33). Just outside this community towards the mire expanse, there is a more open *Carex rostrata/Spagnum flexuosum* lagg, divided by small, but characteristic hummocks with dominance of *Vaccinium uliginosum* and *Polytrichum commune* (Fig. 7). Mire water from the *Carex rostrata* lawns holds pH = 4.8 and κ = 120.

Site C. Two different mire communities are represented in this biotope (Fig. 8). The traps were placed partly in the association Vaccinio uliginosi-Pinetum and partly in an exposed poor lawn community, where *Andromeda, Oxycoccus quadripetalus, Eriophorum vaginatum, Carex pauciflora, C. rostrata,* and *Sphagnum flexuosum* occur very frequently. The latter community is considered to be closely related to the mire margin fen association Paucifloro-parvifolietum after Fransson (1972, p. 43). pH = 3.85 and κ = 54.

Site D. The vegetation here represents a part of a larger, continuous hummock element, and the traps were placed both in the pine bog forest association Vaccinio uliginosi-Pinetum and in the treeless Calluno-fuscetum bog. pH = 3.8 and κ = 41.

Vegetation around the traps at Orremyra

Orremyra (Fig. 2), a topogenous mire complex, is mostly occupied by large, homogenous elements with poor minerotrophic lawn communities. It has few well-defined surface features, and may belong to a hydrotopographic mire type termed 'flat fens' (see e.g. Moen 1973, p. 190). The only feature of importance is represented by an intermediate water track running in a south-westerly direction, which divides the complex into approximately two equal parts.

Site I. This habitat consists of floating, intermediate lawns located close to the larger water pools in Orremyra. In the field layer, *Carex rostrata* and *Eriopharum vaginatum* are the most dominating species, whilst three *Sphagnum* species compete in the bottom layer, viz. *S. papillosum, S. flexuosum,* and *S. fallax. Carex livida, C. pauciflora, Menyanthes, Andromeda, Oxycoccus quadripetalus,* and *Calliergon stramineum* are also common species. This community corresponds both floristically and ecologically with the intermediate mire expanse association Subfulvetum in Fransson (1972, p 45).

Site II. This sampling area was located on wet lawns in the lower parts of the water track, and shows clear similarities with site I, both with regard to mire flora and trophic levels. However, there are a few differences in the floristic composition of the two sites. In site II, *Eriophorum vaginatum* dominates in the field layer at the expanse of *Carex rostrata.* In addition, *Rhynchospora alba* is common and *Scheuchzeria palustris* grows in small quantities. A couple of traps are also placed in an adjacent dense stand of *Myrica gale,* about 1 m high (Fig. 9). Apart from the bog myrtle, this community is composed of several hummock indicators, e.g. *Rubus chamaemorus, Andromeda, Sphagnum magrellanicum,* and a few lawn species, e.g. *S. papillosum* and *Calliergon stramineum.*

Site III. The location of site III is in the south-easterly section of Orremyra. Here, there are large, homogenous lawns with high subsoil water table. The mire vegetation is

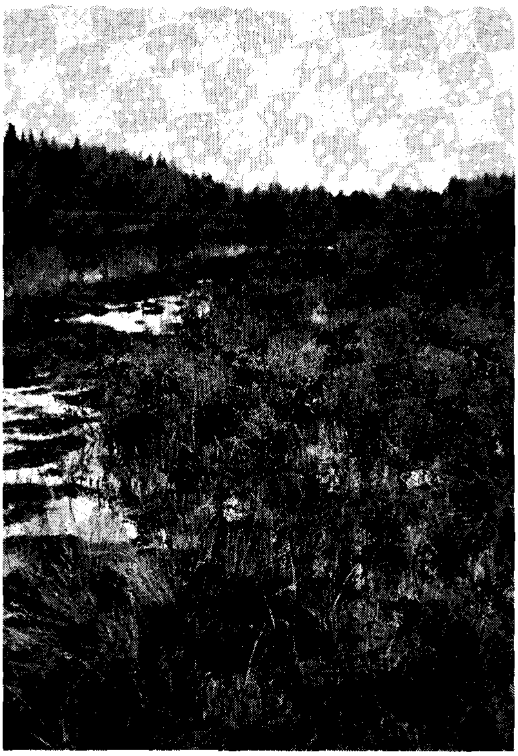


Fig. 9. Site II, inundated after a heavy rainfall. Close to the water track on the left lies a narrow dark area with the lawn association Subfulvetum. To the right, a dense stand of *Myrica gale.*

Fig. 10. From site III, showing a homogenous mire expanse occupied by the extremely poor fen association Trichophoro-papillosetum.

Table I. Species and types of community from 13 selected mire sites at Momyra and Orremyra, arranged in an ecological system (d: dominant, c: common, +: sparse).

(The botanical nomenclatur follows Lid (1963) for vascular plants, Arnell (1956) for liverworts, Nyholm (1954-1965) for mosses and Isoviita (1966) for Sphagnum).

	TRANSITION MIRE MARGIN MIRE EXPANSE			MIRE MARGIN					MIRE EXPANSE				
	Pine bog forest and treless												
Mire feature and trophic level	fen lawns	bog lawns	bog hummocks	Pine bog forest		Poor fen hummocks	Poor fen lawns	Bog hummocks	Bog lawns	Poor fen lawns		Intermed. lawns	
Associations	VUP-Pauc.-parv.	VUP-Rub.-t.	VUP-Call.-fu.	VUP		Cari.-glob.	Rost.-parv.	Call.-fu.	Rub.-t.	Tricho-papill.		Sub-fulv.	
Sites	C	A	D	3	6	B	4	5	2	1	III	I	II
Vascular plants:													
Betula pubescens	+			+	+	+							
Picea abies						+							
Pinus silvestris	+	+	+	+	+								
Andromeda polifolia	c	c	c	c			+	c	c	c	c	c	c
Calluna vulgaris	+	+	+		d			d		+		+	
Empetrum nigrum	c	c											
Myrica gale												+	d
Oxycoccus quadripet	c	c	c	c	c	+	c	c	c	c	c	c	c
Vaccinium myrtillus				c		d							
V. uliginosus	d	c	d	d	c	c		c		+			
V. vitis-idaea				c		d							
Drosera rotundifolia			+					+	c				
Equisetum silvaticum						c							
Menyanthes trifoliata							+				+	c	
Rubus chamemorus	d	d	c		c	c		c	c	c			c
Carex globularis						c							
C. livida												c	c
C. pauciflora	c									c	+	c	+
C. rostrata	c					c	d					d	c
Eriophorum vaginatum	c	d	c	c	c		c	c	c	c	c	d	d
Rhynchospora alba											+	c	c
Scheuchzeria palust										+	+		+
Scirpus caespitosus			c					c	d	c	d		
Mosses:													
Calliergon stramineum							+					+	+
Dicranum bergeri								+		+			
D. polysetum				c									
Hylocomium splendens						+							
Pleurozium schreberi			c	c		+							
Polytrichum commune						d							
P. strictum	+			c								+	
Sphagnum balticum		+						+	c		+	+	+
S. fallax							+			c		c	+
S. flexuosum	c	+		+	+	c	d			c		c	
S. fuscum	d	d	d	d	d			d		+		+	
S. girgensohnii						d							
S. magellanicum	c			c	c		c		d	c	d	c	d
S. papillosum											d	d	d
S. rubellum		+	+		c			c	c	c	+	c	+
Liverworts:													
Cladopodiella fluitans										c	+		+
Lepidozia setacea			+					+					
Mylia anomala			+					+		+			

Additional species (with sparse occurences): Betula nana 6, Equisetum fluviatile B,I, Carex magellanica C, nigra 4, Aulacomnium palustre 3, Drepanocladus fluitans II, Sphagnum angustifolium D, S. annulatum var. porosum II, S. cuspidatum 1, S. imbricatum I, S. majus 4, Cladonia arbuscula D,5, C. rangiferina D,5, C. stellaris D,5.

dominated by typical bog indicators. In the field layer, *Scirpus caespitosus, Eriophorum vaginatum, Andromeda,* and *Oxycoccus quadripetalus* grow in large numbers (Fig. 10). A mixture of *Sphagnum papillosum* and *S. magellanicum* constitutes most of the bottom layer. Occurrence of scattered and barren individuals of the fen indicator *Menyanthes trifoliata* indicates that these lawns must be included in the poor fen association Trichoporo-papillosetum. pH = 3.95 and κ = 59.

CONCLUSIONS

Table I gives a survey of the flora and types of community at the 13 mire sites described above. Along the wet-dry vegetation gradient, all the traps were placed either in lawns or in typical hummock communities. The selected mire sites represent a considerable variation in trophic levels, from mire margins with pine bog forest at Momyra (sites 3 and 6) to mire expanses with intermediate lawns rich in minerals at Orremyra (sites I and II). None of the complexes have areas with rich mire vegetation.

Ecologically and phyto-sociologically, the following sites can be considered as approximately identical: sites 1/III and sites 3/6. Almost identical are also sites I/II, only differing by an absence of a *Myrica gale* stand in the former. Site 4 represents a specific soak community, whilst a typical *Carex globularis* lagg community is well-developed in site B. The sites A, C, and D reflect two different trophic levels. Site A and D are purely ombrotrophic, while site C consists of one ombrotrophic and one poor fen mire margin community. Each of the remaining sites (2 and 5) represents its own mire margin bog community.

ACKNOWLEDGEMENTS

We are most grateful to Cand. real. Elmer Marker for selecting the habitats, Cand. real. Hans Chr. Gjerlaug for statistical information on mire areas in Norway, and the Ministry of Environment for financial support. We would also like to thank all those who have participated in the field work and in the sorting of the material. The sorting was mainly performed by Mr. Torstein Kvamme, who is also acknowledged for help in various other respects.

Received 15 July 1976

REFERENCES

Arnell, S. 1956. *Illustrated Moss Flora of Fennoscandia. I. Hepaticae.* 308 pp. Lund.

Bakke, A. 1968. Ecological studies on bark beetles (Coleotera: Scolytidae) associated with Scots pine (*Pinus sylvestris* L.) in Norway, with particular references to the influence of temperature. *Meddr norske SkogforsVes. 21,* 441–602.

Fransson, S. 1972. Myrvegetationen i sydvästra Värmland. *Acta Phytogeogr. Suecica 57,* 1–133.

Isoviita, P. 1966. Studies on *Sphagnum* L. I. Nomenclatural revision of the European taxa. *Ann. bot. fenn. 3,* 199–264.

Kielland-Lund, J. 1973. A classification of Scandinavian forest vegetation for mapping purposes. *IBP i Norden 11,* 173–206.

Lid, J. 1963. *Norsk og svensk flora.* 800 pp. Oslo.

Moen, A. 1973. Landsplan for myrreservater i Norge. *Norsk geogr. Tidsskr. 27,* 173–193.

Nyholm, E. 1954–1965. *Illustrated Moss Flora of Fennoscandia, II. Musci. Fasc. 1–5.* 647 pp. Lund.

Mire invertebrate fauna at Eidskog, Norway. II. Surface-active Collembola

ARNE FJELLBERG

Fjellberg, A. 1976. Mire invertebrate fauna at Eidskog, Norway. II. Surface-active Collembola. *Norw. J. Ent.* 23, 181–183.

35 species of surface-active Collembola were found on thirteen mire habitats near Lake Helgesjøen in Hedmark county. *Isotoma tenuicornis* Axels., *Arrhopalites cochlearifer* Gisin and *Sminthurides pseudassimilis* Stach are reported new to Norway. The following species recorded are typical mire inhabitants: *I. tenuicornis, I. neglecta* Schäffer, *I. olivacea* Tullberg, *Isotomurus plumosus* Bagnall, *Sminthurides aquaticus* (Bourlet), *Arrhopalites principalis* Stach, and *Bourletiella novemlineata* (Tullberg). The highest number of species was found in habitats in the transition zone between mire and forest.

Arne Fjellberg, Zoological Museum, N-5014 Bergen–Univ., Norway.

The present material was sampled as part of an analysis of the invertebrate fauna in mire habitats near Eidskog, Hedmark, South Norway. Frome earlier, little is known of the Collembola fauna occurring on Norwegian mires.

MATERIAL AND METHODS

All Colembola were taken in pit-fall traps during a period of four months. Only species which are active in litter or vegetation are represented. However, the material gives information on the occurrence of a rather large number of species in thirteen different mire habitats. The habitats are named 1–6, A–D, and I–III. Description of the habitats and more information on the method is given by Pedersen, Hågvar & Bakke (1976).

RESULTS AND DISCUSSION

Table I shows the species recorded in each habitat, together with a subjective evaluation of dominance. A total of 35 species was found. On the basis of the present data, and in light of earlier knowledge on the biology of each species (e.g. Gisin 1960), it is possible to make a rough ecological grouping of most species.

1. Eurytopic species: *Hypogastrura denticulata, Isotoma viridis, Lepidocyrtus cyaneus, Lepidocyrtus lignorum, Bourletiella clavigera.*
2. Species occurring on mires: *Isotoma neglecta, I. olivacea, I. tenuicornis, Isotomurus plumosus, Sminthurides aquaticus, Arrhopalites principalis, Bouletiella novemlineata.*
3. Species occurring in forests and on rather dry ground: *Neanura muscorum, Anurophorus laricis, Isotoma hiemalis, Entomobrya corticalis, E. nivalis, Orchesella cincta, Orhchesella flavescens, Tomocerus flavescens, Sphyrotheca lubbocki, Sminthurus fuscus, Dicyrtoma fusca, D. minuta.*

The following habitats have the most 'pure' mire communities of Collembola species: 1, 2, I, II and III. The number of recorded species in these habitats is relatively low. The highest number of species is found in the transition zones between forest and mire,

Table I. Collembola from mire habitats. (+): Sporadic occurrence. +: Constant. but low dominance. ++: High dominance. +++: Very high dominance.

	Habitat												
	1	2	3	4	5	6	A	B	C	D	I	II	III
Hypogastrura denticulata (Bagnall)	+			+	++	+	(+)	(+)	+	+	+	++	+
H. inermis (Tullberg)						+							
Xenylla maritima Tullberg				(+)			+						
Friesea mirabilis (Tullberg)	(+)	(+)					(+)						
Pseudachorutes dubius Krausbauer			(+)	+		(+)		+		+			
Neanura muscorum (Templeton)						+	(+)	+		+			
Anurophorus laricis Nicolet	+					+	(+)			+			
Isotoma hiemalis Schøtt						+		+	+	+			
I. neglecta Schäffer	+	+				+	(+)			+		+	+
I.notabilis Schäffer			(+)			+	(+)			(+)			
I. olivacea Tullberg	(+)	+				(+)	+			+			
I. tenuicornis Axelson													+
I. viridis Bourlet	+	+	+	+	+	+	+	(+)	+	+	+	+	+
Isotomurus plumosus Bagnall											+		+
Entomobrya corticalis (Nicolet)										+			
E. nivalis (L.)					+	+	+	(+)	+	(+)			
Orchesella bifasciata Nicolet			+			+		+		+			
O. cincta (L.)			+	+	+	+			+	+			
O. flavescens (Bourlet)	(+)		++					+	+	+			
Lepidocyrtus lignorum Fabricius	(+)		++	++	++	++	++	+++	++	++	+	++	++
L. cyaneus Tullberg	+	++		+	+	+	++	+	+	+	+	+	+
Tomocerus flavescens (Tullberg)		(+)	+	+	++	+	++	++	+	+	+		
Neelus minutus Folsom				+									
Sminthurides aquaticus (Bourlet)	+					(+)					+		
S. pseudassimilis Stach				+							+		
S. schoetti (Axelson)	+			+	+	(+)	(+)		+	+	+	+	+
Arrhopalites cochlearifer Gisin								+					
A. principalis Stach	+	+				+				+	+	+	+
Sminthurinus niger (Lubbock)								(+)					
Bourletiella clavigera Gisin	++	+++	+	+	++	++	++	+	+	++	++	+	++
B. novemlineata (Tullberg)	++	+++					(+)				++	+	+
Sphyrotheca lubbocki (Tullberg)			+					+		+			
Sminthurus fuscus (L.)								++	+				
Dicyrtoma fusca (Lucas)			++	+		++	(+)	+	+	+			
D. minuta (O. Fabricius)			+			+		+	+	+			
Number of species: 35	14	9	12	13	9	22	17	18	14	23	12	9	12

viz. A, B, C, and D, and also in habitat no. 6, which represent a small forest zone on the mire. In these habitats, the Collembola fauna is a mixture of mire species and forest species.

The listed species are mostly common with a wide distribution in Norway. Of some interest are *Isotoma tenuicornis* and *Sminthurides pseudassimilis* which probably belong to a boreal element, and *Arrhopalites cochlearifer* described from Switzerland and Austria (Gisin 1960). These three species are new to Norway.

Received 15 June 1976

REFERENCES

Gisin, H. 1960. Collembolenfauna Europas. 312 pp. Geneva.

Pedersen, A., Hågvar, S. & Bakke, A. 1976. Mire invertebrate fauna at Eidskog, Norway. I. Aim, methods, and habitat descriptions. *Norw. J. Ent.* *23,* 173–180.

Mire invertebrate fauna at Eidskog, Norway. III. Formicidae (Hymenoptera Aculeata)

CEDRIC A. COLLINGWOOD

Collingwood, C. A. 1976. Mire invertebrate fauna at Eidskog, Norway. III. Formicidae (Hypenoptera Aculeata). *Norw. J. Ent. 23,* 185–187.

Formicidae were collected with pit-fall traps in thirteen different mire habitats at Eidskog, Hedmark county. Eighteen species were recognised including three species that are very local in Norway, *Formica pressilabris* Nyl., *F. forsslundi* Lohmander and *F. transkaucasica* Nassonow. The two last ones are true characteristic mire species. One rare European parasite species, *Sifolinia karavajevi* (Arnoldi), is new to Norway. The most abundant species trapped included *Myrmica scabrinodis* Nyl., *M. ruginodis* Nyl., *F. transkaucasica* and *Leptothorax acervorum* Fab.

Cedric A. Collingwood, Agricultural Development and Advisory Service, Lawnswood, Leeds, UK.

The lowland forest mire areas of south Norway have not hitherto been intensively studied for ants. Three mire species are locally common in such situations in parts of Sweden, Finland, and Denmark, and the Eidskog faunal survey has provided an opportunity for detecting the presence of such species among others in a comparable Norwegian site. Two of these species, *Formica forsslundi* Lohmander and *F. transkaucasica* Nassonow, were already recorded from a small area of mire near Elverum by Collingwood (1963) and the comment was then made that further searching in this general area of southeast Hedmark should reveal more localities. The nomenclature used in this paper follows that of Collingwood (1974).

MATERIAL AND METHODS

Pit-fall traps were placed for four months in thirteen different mire habitats, named 1–6, A–D and I–III. Description of the habitats and more information on the method is given by Pedersen, Hågvar & Bakke (1976).

RESULTS AND DISCUSSION

Species recorded are listed in Table I in order of abundance as given by an index given by the number of sites (s) where the species occurred divided by the total sites (13) multiplied by the number of times (n) trapped divided by the total number of trap samples (86 × 100, i.e. $\frac{s}{13} \times \frac{n}{86} \times 100$

The species can be categorised as regards their distribution in Norway as follows: *Formica lugubris, F. exsecta, F. sanguinea* and *Camponotus herculeanus* are common forest species found throughout the country including mountain areas up to the tree line. *Myrmica scabrinodis, M. ruginodis, Leptothorax acervorum,* and *Formica lemani* are generally distributed throughout the country over a wide range of habitats These form the major component of the loose association of ant species found throughout the moorlands of Britain (Brian & Brian 1951). *Myrmica rubra, Lasius niger* and *Formica fusca* have a more restricted distribution in Norway from the

Table I. Occurrence of Formicidae in pitfall traps from thirteen mire communities. "Index of abundance" is explained in the text.

Species	No. of sites	No. of times trapped	Index of abundance	Note on collection areas
Myrmica scabrinodis Nylander	13	62	72.09	All sites
Myrmica ruginodis Nylander	12	42	45.08	All sites except no. 2
Formica transkaucasica Nassonow	10	27	24.15	All sites except I, II, III
Leptothorax acervorum (Fabricius)	10	25	22.36	All sites except nos. 2, II, III
Camponotus herculeanus (L.)	10	19	17.00	All sites except 1, 5, I
Myrmica rubra L.	6	14	7.51	Sites 1,4,5,6,B,C
Formica lugubris Zetterstedt	7	11	6.89	Sites 2,3,5,II, B,C,D
Formica lemani Bondroit	5	11	4.92	Sites 2,5,6,A,D
Lasius niger (L.)	3	7	1.88	Sites 6,C,D
Formica fusca L.	3	6	1.61	Sites 6,C,D
Formica exsecta Nylander	1	6	0.54	Site D
Formica forsslundi Lohmander	2	2	0.36	Site 1,2
[x]Formica pressilabris Nylander	1	3	0.27	Site A
Formica sanguinea Latreille	1	2	0.18	Site 6
Lasius fuliginosus (Latreille)	1	2	0.18	Site 6
[xx]Sifolinia karavajevi (Arnoldi)	1	2	0.18	Site 6
[x]Lasius umbratus (Nylander)	1	1	0.09	Site A
[x]Lasius mixtus (Nylander)	1	1	0.09	Site 5

[x] new record for Hedmark

[xx] new record for Norway

south to the centre of the country in lowland and sheltered areas. *Lasius umbratus, L. mixtus,* and *L. fuliginosus* were each taken as isolated dealate queens and are comparatively local in the south of the country. *Formica pressilabris* is very local in Norway; it has so far only been collected in two other localities (Akershus, Holgerson 1944, and Vestfold, leg. A. Fjellberg), although more widely distributed in Sweden, where for example a colony was seen near the border at Eda in Värmland 3 km to the east of the Eidskog site. Typical mire species are *Formica transkaucasica* (*picea* Auctt.) and *F. forsslundi,* both of which occurred in a mire near Elverum in 1963, the only other recorded Norwegian locality. *F. transkaucasica* has a wide distribution in Sweden, Finland, and Denmark and also occurs in Alpine meadows in Central Europe as far south as the Apennines and Eastern Pyrenees. It is usually abundant where it occurs as at Eidskog, where it was one of the commonest species. *F. forsslundi* is much less common and only occurs sparsely in the Alps, Poland, and northwest USSR outside the Scandinavian countries including Finland and Denmark. A third characteristic mire species in North Europe, *F. uralensis* Ruzsky, which is not uncommon in Finland, Sweden, and Jutland in Denmark, could well occur in the Eidskog environment, but has only been collected once in Norway – in the far north at Sør-Varanger (Fjellberg 1975).

Sifolinia karavajevi is of considerable interest. Two single dealate females were taken in the present collections. The species is parasitic on *Myrmica* species and has no workers. So far it has been taken only in widely separated localities in the Ukraine, Poland, southern England, and Belgium. The late K. H. Forsslund also took it once in Ristiina, Finland, according to information kindly supplied by Heikki Wuorenrinne. Little is known of its habits, but the capture of two separate dealate females suggests that the fecundated females wander out of the host nest to seek adoption by other *Myrmica* colonies. According to Brian (1972), the queen of the host species is not destroyed as may happen with other parasites, notaby *Anergates. Sifolinia* is not a characteristic mire species and has previously been recorded from lowland heath.

In conclusion, site 6 had the largest number of species, probably because of the greater variety of vegetation and range of nesting areas where the bog merged into open forest. Sites I, II, and III, being nearly submerged, supported fewest ants, being even too wet for *F. transkaucasica,* which was abundant at all other stations. This and *F. forsslundi* are true characteristic mire species and their occurrence in a restricted area of Norway would give support for the preservation of Eidskog mire as a typial habitat for these species.

REFERENCES

Brian, M. V. & Brian, A. D. 1951. Insolation and ant population in the west of Scotland. *Trans. R. ent. Soc. Lond. 102,* 303–330.

Brian, M. V. 1972. Population turnover in wild colonies of the ant *Myrmica. Ekologia Polska 20,* 43–53.

Collingwood, C. A. 1963. Three ant species new to Norway. *Ent. Rec. J. Var. 75,* 225–228.

Collingwood, C. A. 1974. A revised list of Norwegian ants (Hymenoptera, Formicidae). *Norsk ent. Tidsskr. 21,* 31–35.

Fjellberg, A. 1975. Occurrence of *Formica uralensis* Ruzsky (Hymenoptera, Formicidae) in Pasvik, northern Norway. *Norw. J. Ent. 22,* 83.

Holgersen, H. 1944. Ants of Norway (Hymenoptera, Formicidae). *Nytt. Mag. Naturv. 84,* 163–203.

Received 29 June 1976

Pedersen, A., Hågvar, S. & Bakke, A. 1976. Mire invertebrate fauna at Eidskog, Norway. I. Aim, methods, and habitat descriptions. *Norw. J. Ent. 23,* 173–180.

Mire invertebrate fauna at Eidskog, Norway. IV. Carabidae and Curculionidae (Col.)

TORSTEIN KVAMME

Kvamme, T. 1976. Mire invertebrate fauna at Eidskog, Norway. IV. Carabidae and Curculionidae (Col.). *Norw. J. Ent. 23,* 189–191.

Eighteen species of Carabidae and four species of Curculionidae were pit-fall trapped in thirteen different mire habitats at Eidskog, Hedmark county, south Norway. *Agonum ericeti Panz.* is bound to this kind of habitat. This species is new to HEs. Six other species of Carabidae are typical mire inhabitants, but without being restricted to mires. The catches of Carabidae and Curculionidae were rather low in most of the habitats. The highest number of species and specimens were recorded in transition zones between forest and mire.

Torstein Kvamme, NISK, Section of Forest Protection, N-1432 Ås – NLH, Norway.

This paper is part of a study on the invertebrate fauna in thirteen mire habitats at Eidskog, south Norway. Locality, habitat description, and the aim of these investigations are given by Pedersen, Hågvar & Bakke (1976).

MATERIAL AND METHODS

The materia was collected in pit-fall traps. Further details of the method, and explanation of the symbols used in this paper for the different habitats, are given by Pedersen, Hågvar & Bakke (1976).

199 Carabidae and 35 Curculionidae were collected. The method is less suitable for Curculionidae than for Carabidae.

RESULTS AND DISCUSSION

Eighteen species of Carabidae and four species of Curculionidae were recorded. The species are listed in Table I, together with total catches from each habitat. Habitat B, which is a transition zone between very wet sedge grass area (*Carex rostrata* Stokes) and blueberry–spruce forest, gave the largest number of species, as well as the largest total number of specimens. Also habitat D gave relatively high catches of species and specimens, compared to most other sites. Habitat D is in the transition zone between birch–pine forest – where lingonberry (*Vaccinium vitis-idaea* L.) is typical, but without heather (*Calluna vulgaris* (L.) Hull.) – and an open mire dominated by heather vegetation.

In Table II, the recorded species have been grouped according to their affinity to mire habitats. *Agonum ericeti* Panz. was the only species with absolute affinity to peat-moss mires, occurring not only in wet, pure *Sphagnum* areas but also in dryer *Sphagnum* areas mixed with *Calluna* and other *Ericaceae* sp. (Lindroth 1945). Krogerus (1939) found that the species was heliophilous and had a preference temperature from 20 to 28°C. He also found that the species demanded pH<4.6. Also in the present investigation pH in soil

Table I. Pitfall catches of Carabidae and Curculionidae in thirteen mire habitats at Eidskog, South Norway.

Species:							Habitat:							No. per	
	1	2	3	4	5	6	A	B	C	D	I	II	III	species	
Carabidae:															
Carabus glabratus Payk.	-	-	-	-	-	1	-	6	1	2	-	-	-	10	
C. hortensis L.	-	-	-	-	-	2	1	30	-	5	-	-	-	38	
C. problematicus Hbst.	-	-	1	-	-	1	-	1	-	3	-	-	-	6	
C. violaceus L.	-	1	4	1	-	2	1	11	1	4	-	-	-	25	
Cychrus caraboides L.	-	-	2	-	-	-	-	-	-	-	1	-	-	3	
Notiophilus biguttatus Fbr.	-	-	-	-	-	-	-	1	-	-	-	-	-	1	
Bembidion dentellum Thunb.	-	-	-	-	-	-	-	-	-	-	-	1	-	1	
Trechus secalis Payk.	-	-	-	-	1	-	-	5	-	-	-	-	-	6	
Patrobus atrorufus Chaud.	-	-	1	-	-	-	-	11	-	1	-	-	-	13	
Trichocellus cognatus Gyll.	-	-	-	-	1	-	-	-	-	-	-	-	-	1	
Pterostichus diligens Sturm	6	2	1	1	-	7	-	3	2	7	5	8	4	46	
Pt. melanarius Illig.	-	-	-	-	-	-	-	1	-	-	-	-	-	1	
Pt. niger Schall.	-	-	-	-	-	-	-	-	-	1	-	-	-	1	
Pt. nigrita Fbr.	2	-	1	2	-	2	1	2	3	-	-	4	1	18	
Pt. oblongopunctatus Fbr.	-	-	-	-	-	1	-	1	-	2	-	-	-	4	
Calathus micropterus Dft.	-	-	1	1	-	-	-	3	-	1	-	-	-	6	
Agonum ericeti Panz	1	2	-	-	4	1	-	-	-	6	-	2	1	17	
A. fuliginosum Panz	-	-	-	-	-	-	-	2	-	-	-	-	-	2	
Sum Carabidae															199
Curculionidae:															
Otiorrhynchus scaber L.	1	-	-	13	3	2	-	5	4	4	-	-	-	32	
O. dubius Strøm	-	-	-	-	-	-	-	-	-	1	-	-	-	1	
Hylobius abietis L.	-	1	-	-	-	-	-	-	-	-	-	-	-	1	
Rhyncolus ater L.	-	-	-	-	-	-	-	1	-	-	-	-	-	1	
Sum Curculionidae															35
Total no. of specimen per habitat:	10	6	11	18	9	19	3	83	11	37	6	15	6		234
Total no. of species per habitat:	4	4	7	5	4	9	3	15	5	12	2	4	3		22

water was below 4.6 in all habitats where this species occurred (Pedersen, Hågvar & Bakke 1976). The species was recorded from seven habitats (Table I).

Pterostichus diligens, P. nigrita, and *Agonum fuligonosum* are all typical species in mire fauna. However, their affinity is not absolute, even if they often occur in *Sphagnum* vegetation. *A. fuliginosum* prefers mires with alder trees (*Alnus* sp.), and *Trechus secalis* commonly occurs together with it. *P. diligens* is one of the euryoecious species among those Carabidae beetles that prefer humid habitats. These species demand about the same degree of soil humidity and humus (Lindroth 1945).

Trichocellus cognatus occurs in two different types of habitats: A. Typical *Miscodera* sites are preferred in the northern parts of the distribution area. B. The demand for humidity increases southwards, and in south Sweden the species is considered as a mire inhabitant (Lindroth 1945).

Bembidion dentellum is dependent on swampy, wet, and muddy ground, with or without moss vegetation, but it never occurs in *Sphagnum* (Lindroth 1945). The species demands open water, either stationary or running (Hansen 1968, Lindroth 1945). Areas with *Salix* or other shrubs are preferred.

Carabus glabratus, C. hortensis, Patrobus atrorufus, Pterostichus oblongopunctatus and *Calathus micropterus* are all typical members of the forest fauna. They all demand humid soil. In particular, *C. micropterus* and *P. oblongopunctatus* are bound to shady places, with humus mixed up in the soil (Hansen 1968, Lindroth 1945). All these species prefer places with moss vegetation.

Nothiophilus biguttatus is not bound to humid areas, but lives in a wide range of habitats (Hansen 1968). *P. oblongopunctatus* and *N. biguttatus* very often occur together with *C. micropterus* (Lindroth 1945).

Cychrus caraboides, Carabus problematicus, C. violaceus, Pterostichus melanarius and *P. niger* are species which have no special affinity to mires, and which occur mainly in other kinds of habitats. *C. caraboides* demands moistly soil with humus and moss vegetation and a high degree of shading, preferring deciduous forests or mixed forest. The other species in this group have a very wide range of habitats (Hansen 1968, Lindroth 1945).

Table II: Affinity of the recorded species to mire habitats

Species found only in mire habitats	*Agonum ericeti*
Species typical to mire habitats, but not absolutely bound to these sites	*Bembidion dentellum* *Trechus secalis* *Trichocellus cognatus* *Pterostichus diligens* *Pt. nigrita* *Agonum fuliginosum*
Species common in mires, but equally common in other types of habitats	*Carabus glabratus* *C. hortensis* *Notiophilus biguttatus* *Patrobus atrorufus* *Pterostichus oblongopunctatus* *Calathus micropterus* *Otiorrhynchus scaber*
Species occasionally found in mire sites, but more common in other habitats	*Cychrus caraboides* *Carabus problematicus* *C. violaceus* *Pterostichus melanarius* *Pt. niger* *Rhyncolus ater* *Otiorrhynchus dubius* *Hylobius abietis*

Otiorrhynchus scaber was the most commonly recorded species among the Curculionidae. This species can be recorded on dry hills with pine forest (*Pinus syvestris* L.), as well as on mires. The species are most common on spruce (*Picea abies* L.) (Hansen 1965). *Otiorrhynchus dubius* is common also in the alpine areas. Here the species eats *Rubus chamaemorus* L., *Salix herbacea* L. and *Oxyria digyna* (L.) Hill. (Hågvar, pers. comm.) *Hylobius abietis* and *Rhyncolus ater* typically occur on coniferous trees (Hansen 1965).

It must be concluded that none of the recorded Curculionidae species are bound to mire habitats.

Agonum ericeti and *Bembidion dentellum* can perhaps be used as indicator species to the habitats where they live.

A. ericeti may also be used as an indicator in relation to pH-values.

Received 15 July 1976

The catches indicate that the density of Carabidae in most of the habitats is rather low. However, we can conclude that some of the recorded Carabidae contribute to that group of invertebrate species which prefer mires as habitat.

ACKNOWLEDGEMENTS

I am indebted to Mr. Sigmund Hågvar for his valuable advice and help. I also wish to thank Mr. Stefan Murak for checking the determination of *Bembidion dentellum*.

REFERENCES

Hansen, V. 1965. Biller XXI. Snudebiller. *Danm. Fauna 69,* 1 – 524.

Hansen, V. 1968. Biller XXIV. Sandspringere og Løbebiller. *Danm. Fauna 76,* 1 – 451.

Krogerus, R. 1939. Zur Ökologie nordischer Moortiere. *VII Internat. Kongr. f. Ent. (1938),* 1213.

Krogerus, R. 1947. Nogot om torvmarksdjurens ekologi. *Sv. Faunistisk Revy 9,* 36–47.

Lindroth, C. H. 1942. Skalbaggar (Col.): Sandjägare och jordlöpare. *Sv. Insektfauna 9,* 1–260.

Lindroth, C. H. 1945. Die Fennoskandischen Carabidae. I. *Göteborgs K. Vetensk. o. Vitterh.-Samh. Handl. Ser. B4,* 709 pp.

Lindroth, C. H. (Ed.) 1960. *Catalogus coleopterorum Fennoscandia et Dania.* 476 pp. Entomologiska Sällskapet, Lund.

Strand, A. 1943. Inndeling av Norge til bruk ved faunistiske oppgaver. *Norsk Ent. Tidsskr.* 6, 208–224.

Strand, A. 1970. Addition and corrections to the Norwegian part of Catalogus coleopterorum fennoscandia et Dania. *Norsk Ent. Tidsskr. 17,* 125–145.

Pedersen, A., Hågvar, S. & Bakke, A. 1976. Mire invertebrate fauna at Eidskog, Norway. I. Aim methods, and habitat descriptions. *Norw. J. Ent. 23,* 173–180.

Phenology of egg development and egg-laying in a winter-active insect, *Chionea araneoides* Dalm. (Dipt., Tipulidae)

SIGMUND HÅGVAR

Hågvar, S. 1976. Phenology of egg development and egg-laying in a winter-active insect, *Chionea arneoides* Dalm. (Dipt., Tipulidae). *Norw. J. Ent. 23,* 193–195.

Chionea araneoides Dalm. (Dipt., Tipulidae) is a wingless insect which reproduces during winter, when snow covers the ground. In spruce forests near Oslo, the species has been recorded on snow from October to March. Females hatch in the autumn, at which time eggs are not visible in the ovaries. Eggs become developed in November and December. Each female produces about one hundred eggs. The eggs are laid mainly during December and January, but some also in February and March. Only a few are deposited at a time, probably on soil in the subnivean air space. The ovaries are not refilled. Reproduction in *C. araneoides* is performed at very low temperatures, around 0°C or lower. Although several terrestrial invertebrates may be found active during winter, both on snow and in the subnivean air space, very little is known about the function of this winter activity. Clearly, *C. araneoides* belongs to those whose reproduction period falls within winter.

Sigmund Hågvar, Norwegian Forest Research Institute, N-1432, ÅS–NLH, Norway.

Chionea araneoides Dalm. is a wingless, winter-active insect, which can be found on snow on windless days at temperatures between 0° and -6°C (Svensson 1966, Hågvar 1971). Copulation occurs on the snow surface. Since larvae develop in soil (Strübing 1958), it is commonly assumed that eggs are laid on the soil in the subnivean air space, where the animals evidently stay during unfavourable temperatures. Wiger (pers. comm.) has collected the species in pit-fall traps under the snow. Migration between the snow surface and the subnivean air space occurs along stems, branches, stones, etc., which penetrate the snow layers.

The species has been recorded in the imaginal stage from September to April (Sømme & Østbye 1969). Most of the imaginal life time is spent at temperatures below or around 0°C – either on snow, or in the subnivean air space, where temperature stays close to 0°C (Coulianos & Johnels 1962). Obviously, reproduction is performed under quite extreme temperature conditions. The present study gives information on the egg production capacity per female, together with phenology of egg development and egg-laying.

MATERIAL AND METHODS

Animals were collected on snow during several winters (1967–76), mainly in spruce forests in the neighbourhood of Oslo. 121 females, collected between 22 October and 28 March, were dissected. The animals could be grouped into three categories: 1. Eggs not visible. 2. Eggs visible, but only partly developed. 3. Eggs fully developed. In the latter case, the number of eggs was counted.

RESULTS

The results are presented in Fig. 1. The occurrence of females in the two first categories is indicated in the bottom of the figure. The number of developed eggs per female is plotted, and monthly mean values are given as horizontal, broken lines.

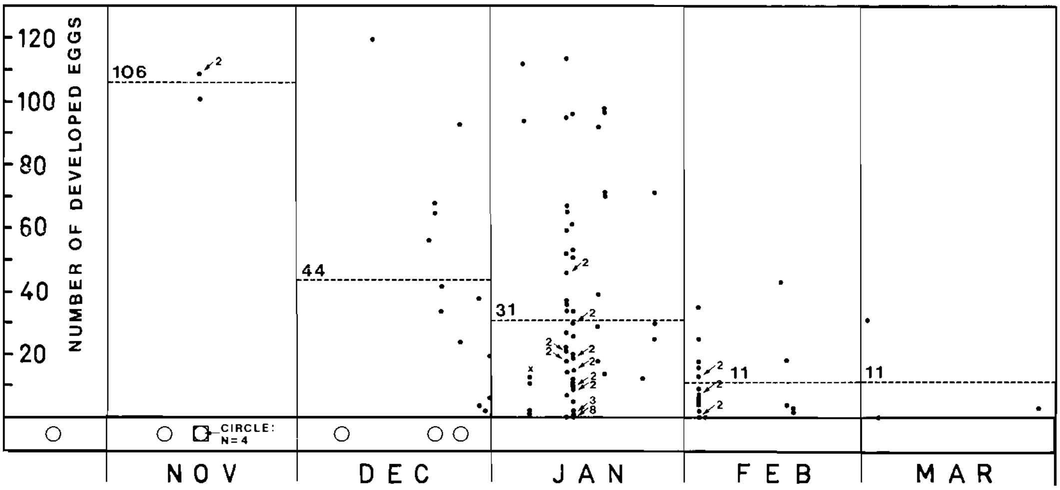


Fig. 1. Phenology of egg development and egg-laying in *Chionea araneoides*. Small dots denote the number of eggs in females where all eggs are developed. Figures and arrows indicate that two or more females had the same number of eggs. Small dots on the zero line indicate females which had emptied their ovaries. Horizontal broken lines give the monthly mean number of developed eggs per female. Bottom of figure: Circles indicate single females with partially developed eggs. One circle in mid-November represents four females. The square indicates a female, probably newly hatched, where eggs were not yet visible in the ovaries.

The following can be read from the figure: Female imagines of *C. araneoides* hatch with undifferentiated ovaries. In November, eggs are fully developed in some animals, and in January in all animals. The monthly decrease in the mean number of developed eggs from November to March, together with an absence of eggs under development after December, shows that the ovaries are not refilled. Evidently, the number of eggs produced per female is around 100. Since animals with every number of eggs from the maximum down to zero have been recorded, only a few eggs, or perhaps only one egg, is laid at a time. Furthermore, Fig. 1 indicates that the egg-laying period of a single female covers several weeks.

Obviously, there are great individual differences as to which phase of egg-laying different females are in at a given time. This is especially evident in January. In the middle of this month, some animals had laid all their eggs, while others were just beginning. However, in February, the main part of the population's egg production has been laid, and the numbers recorded were all relatively low. Specimens with some eggs can also be found in March. Clearly, most eggs are laid during December and January.

DISCUSSION

The occurrence of nearly any number of eggs in specimens taken on snow indicates that animals seek the snow surface at any stage of their egg-laying period, if only weather conditions are acceptable. Since only a few eggs are laid at a time, and since specimens on snow are always moving (Hågvar 1971), the eggs from each female may be spread over a rather large area.

It is not known whether imagines feed during winter. However, the full number of eggs fills up the abdomen almost completely, leaving practically no space for fat or the other organs. When most or all eggs have been laid, most of the abdominal cavity appears empty.

In some animals, especially at the end of the egg-laying, a few smaller eggs could be noted, mostly with distorted shape. These have been regarded as resorbed or undeveloped eggs, rather than as new eggs under development.

The concentration of observations from January is typical. For some reason, this species is most often found on snow during this month. It may perhaps be explained by a peak in copulation activity. Whether the same female copulates more than once, is not known.

The rather large spread in egg number at a given point of time in Fig. 1 may partly be due to differences in phenology in different years.

Imagines probably hatch before the soil becomes frozen, i.e. at the latest during October in the actual area. Still, in most females, the eggs are not developed until two months later or more. Even in February, four months or more after hatching, most of the recorded females had still some eggs left to be laid. Evidently, egg development, copulation and egg-laying activity altogether cover a period of at least five months. This is of course a much longer time than what insects reproducing in summer would need for the same processes. The remarkable point here is that these activities are really performed by *C. araneoides* during full winter conditions, and that the necessary physiological processes are working adequately at temperatures around or below 0°C.

A lot of invertebrate species can be found active during winter, both in the subnivean air space (Näsmark 1964) and on snow (e.g. Frey 1913). However, little is known about the purpose of winter activity in most of these species. Even in typical, winter-active species like *Scoliocentra nigrinervis* Wahlgr. (Dipt., Helomyzidae), and *Boreus* sp. (Mecoptera) (e.g. Svensson 1966, Sømme & Østbye 1969, Hågvar 1971), we have no exact information on when egg-laying occurs. There is clearly a need for a kind of grouping of terrestrial winter-active invertebrate species according to the function of their winter activity. First among these categories should be those species whose reproductive activity falls within that period when the ground is covered by snow. *C. araneoides* would be a typical species in this group.

Received 15 July 1976

ACKNOWLEDGEMENTS

I wish to thank all who helped in collecting specimens, especially Cand. mag. Ole Jakob Sørensen. Dr. Wieslaw Krzeminski, Warzaw, is heartily thanked for confirming the identification of the species. Mr. William N. Thompson kindly improved the English.

REFERENCES

Coulianos, C.-C. & Johnels, A. G. 1962. Note on the subnivean environment of small mammals. *Ark. Zool. Ser. 2, 15*, 363–370.

Frey, R. 1913. Beitrag zur Kenntnis der Arthropoden-Fauna im Winter. *Med. Soc. Fauna Flora Fennica 39*, 106–121.

Hågvar, S. 1971. Field observations on the ecology of a snow insect, *Chionea araneoides* Dalm. (Dipt., Tipulidae). *Norsk ent. Tidsskr. 18*, 33–37.

Näsmark, O. 1964. Vinteraktivitet under snön hos landlevande evertebrater. *Zool. Revy 1*, 5–15.

Sømme, L. & Østbye, E. 1969. Cold-hardiness in some winter active insects. *Norsk ent. Tidsskr. 16*, 45–48.

Strübing, H. 1958. *Schneeinsekten.* 47 pp., A. Ziemsen Verlag, Wittenberg Lutherstadt.

Svensson, S. 1966. Studier över vissa vinteraktiva insekters biologi. *Norsk ent. Tidsskr. 13*, 335–338.

Contribution from the Norwegian IBT/PT-UM sections

Studies on the ecology of *Zygaena exulans* Hochw. (Lep., Zygaenidae) in an alpine habitat at Finse, south Norway

SIGMUND HÅGVAR

Hågvar, S. 1976. Studies on the ecology of *Zygaena exulans* Hochw. (Lep., Zygaenidae) in an alpine habitat at Finse, south Norway. *Norw. J. Ent. 23,* 197–202.

Zygaena exulans Hochw., a common species on the Hardangervidda mountain plateau, prefers habitats with rather high soil moisture. A main food plant is *Salix herbacea* L. However, the species is absent from *S. herbacea* snowbeds, which have a rather short snow-free period. Larval development seems to take two years or more. The slow growth is partly due to a considerable weight loss at each ecdysis. Up to 77 larvae and 7.7 pupae have been recorded per m^2. During pupation, almost a fourth of the adult larva's dry weight is lost in exuviae and silk. Pupation usually starts about 1 July, with the main swarming period about one month later. Imagines have a short life time and swarm only on very warm, calm days. Mass hatching on favourable days, which in some years are few, is probably triggered by a certain minimum temperature in the top litter layer, above which the cocoons are spun. In small-rodent peak years, the habitat is strongly disrupted by their grazing, runways, etc. This activity must certainly kill a part of the larval population. Pupal density was higher before a peak rodent year (1970) than during the two next years.

Sigmund Hågvar, Norwegian Forest Research Institute, N–1432 Ås–NLH, Norway.

Zygaena exulans Hochw. is a common species on the Hardangervidda mountain plateau. The larval density may be rather high, and in the favoured habitats this species is probably one of the main herbivores. Respiration rates, caloric content and water percentage have been presented by Hågvar & Østbye (1974). The present study was performed in a habitat at Finse, 1220 m a.s.l. (60°36′N–7°30′E). In the same habitat, the main saprovore invertebrate group, larvae of Tipulidae (Dipt.), has been studied by Hofsvang (1972, 1973).

MATERIAL, METHODS AND HABITAT DESCRIPTION

The study covers a period of three years (1970–72). It is mainly based upon field observations, but animals have also been kept in cultures at room temperature to study weights, egg-laying, food preference, growth etc. Some larvae were kept in cultures under field conditions in cages 50 × 50 cm wide and 10 cm high, covered by insect screen.

The actual habitat had high soil moisture, a eutrophic vegetation and well-developed tussocks. Common plants are *Carex bigelowii* Torr., mosses, *Salix herbacea* L., *Anthoxanthum odoratum* L., and *Deschampsia flexuosa* (L.). More details are given by Hågvar & Østbye (1972).

RESULTS

Eggs

Most females collected in the field weighed much less than newly hatched females (see chapter on imagines). This indicates that emptied ovaries are not refilled. The eggs are probably ready for fertilization immediately after the hatching of imago, and are deposited during a rather short period. Eggs could be found in the field in the beginning of August: 3 August 1970 and 5 August 1972.

The eggs are laid in clusters on vegetation near the ground, but not all at the same time. In cultures at room temperature, time intervals of up to 2–3 days were recorded between different egg batches from the same animal.

Five females, collected 4 August 1970 and kept in cultures at room temperature, deposited from 31 to 60 eggs each. Each batch contained from 9 to 51 eggs.

Eggs collected in the field 3 August 1970 hatched after eight days at room temperature. Probably the eggs hatch before winter in the field.

The mean weight of 250 rather newly laid eggs was 0.29 mg.

Larvae

Growth and larval period

Larvae were recorded throughout the snow-free period. Weight distributions at different collection times are given in Fig. 1. The figure also includes larvae collected at Møsvann, 950 m a.s.l., 95 km SE of Finse, just after the spring thaw in the start of June.

Obviously hibernation occurs in the larval stage. Pupae have never been recorded immediately upon the spring thaw.

Larval weights vary greatly just after hibernation. Some larvae are already heavier than mean pupal weights and should need little or no food before pupation. The question arises whether larvae achieve such high weights during their first autumn, or whether the larval period covers two or more years.

Several observations on larval growth make a one-year life cycle improbable. First, about twenty newly hatched larvae kept in a culture at room temperature for about one month in August/September 1970, grew insignificantly. They were fed leaves of *Salix* sp., which should be among the preferred food items (see below). Secondly, three larger larvae, at least one year old, did not change their weight much after 11 days in a culture at room temperature. One larva increased from 22.0 to 22.9 mg, one from 39.6 to 42.2 mg, and one dropped from 37.3 to 34.0 mg. They were fed leaves of *Salix herbacea,* which is probably their main food. All larvae performed an ecdysis during this period. Before ecdysis, the larvae did not eat for 5–6 days, losing from 11 to 25% of their weight. The rather large weight reductions during ecdysis, and lack of significant growth during a period of 11 days in the culture, indicate that a rather long time is needed in the field for complete larval development. Thirdly, cultures in the field revealed that not all larvae present at the spring thaw reached maturity during the snow-free season. Four larvae which had overwintered weighed from 17 to 44 mg in the first half of August, at the end of the swarming period. The total range of larval weights recorded in August was from 15 to 71 mg (Fig 1). Before winter, this population is supplemented with additional, newly hatched larvae.

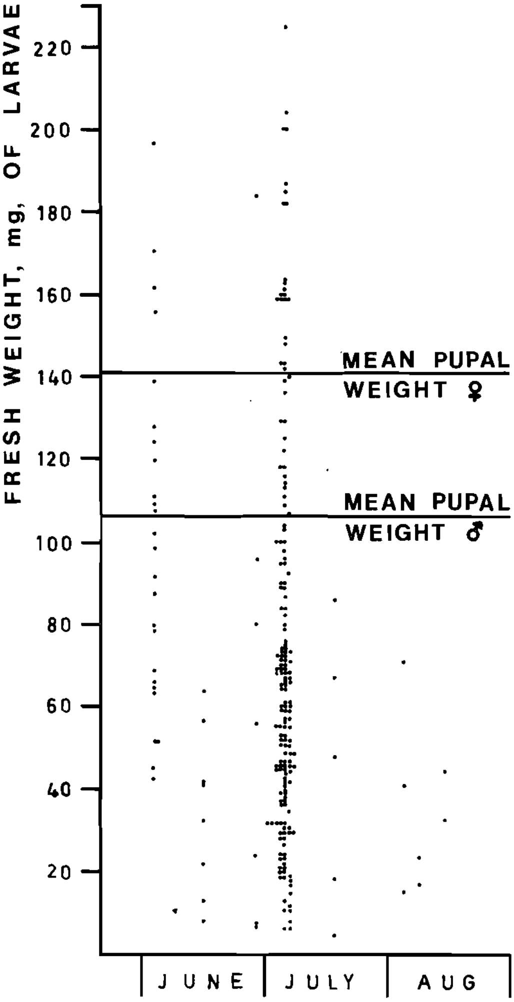


Fig. 1. Fresh weight distribution of *Zygaena exulans* larvae during the main snow-free period. Data from early June from Møsvann, just after snow melt. At that collection, the smallest larvae have probably been overlooked. Some dots from 5 July have been displaced to the left, and from 6 July to the right. Mean pupal weights are indicated.

The very large variations in larval weight in June and July must be due to a mixture of different age groups. However, the weights do not fall into two or three distinct year classes, as might be expected if larval development lasts two or three years. This might be explained by large variations in weights among larvae of the same age. As seen in Fig. 1, female pupal weights are considerably higher than male pupal weights. There are also large variations in pupal weights within each sex.

The use of the head capsule breadth in order to separate the larval stages was tried, but abandoned. This was partly because the capsule was often hidden and difficult to measure, and partly because some preliminary measurings did not indicate clear groups.

Density of larvae

Larval density was measured 5 July 1972. Within a typical habitat, measuring 20 × 10 m, the number of larvae were counted within 48 squares of 15 × 15 cm on the top of tussocks, and within 19 such squares between tussocks. Up to eight larvae were found per square. The mean density on top of tussocks was 48 per m^2, and between tussocks 37 per m^2. The squares contained a total of 158 animals. Twelve newly pupated larvae were included in this figure.

In a more moist habitat, with smaller tussocks, 30 squares on the top of tussocks had 49 larvae per m^2, and 33 squares between tussocks had 77 per m^2.

Food preference

Salix herbacea is probably the favoured food plant. Together with leaves of other *Salix* species, this plant was strongly favoured in a preference test conducted 28–29 June 1971. *S. herbacea* is, however, the only *Salix* species in the actual habitat. Leaves of *Polygonum viviparum* L. were slightly eaten, while other

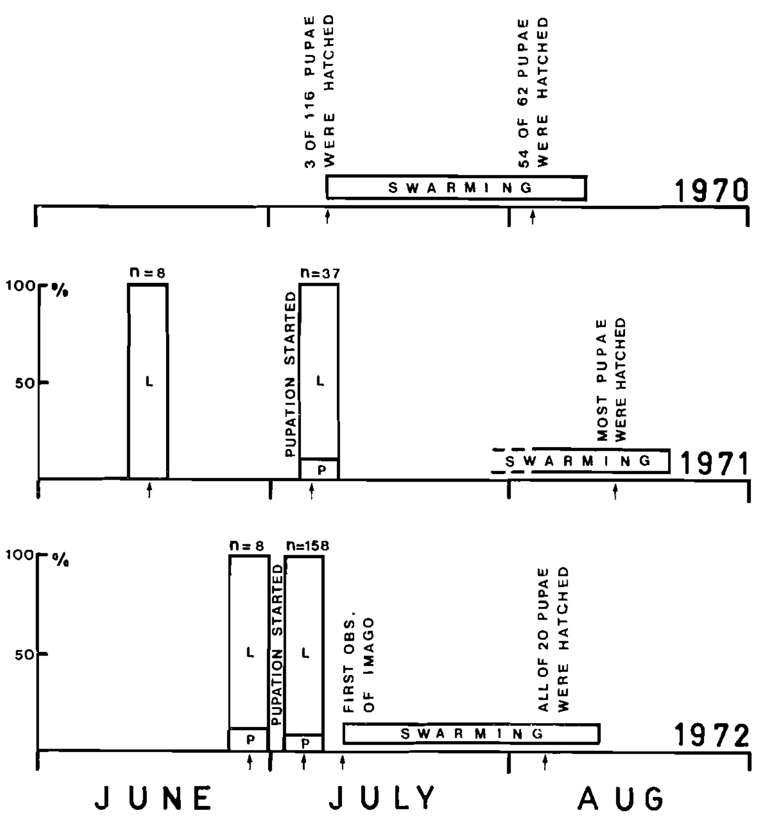


Fig. 2. Pupation, hatching, and swarming period in *Zygaena exulans* during three years. Scale to the left shows percentage larvae and pupae. Arrows indicate observation dates to which columns or vertical text refer.

common plants in the habitat were not touched: *Rubus chamaemorus* L., *Oxyria digyna* (L.), and some grasses.

Pupae

Pupation time and pupal period

Fig. 2 shows the percentage of larvae which had pupated, and how large a part of the pupae were hatched at different times in 1970, 1971 and 1972. In the last two years, pupation obviously started about 1 July. One month later, most of the pupae were hatched. Pupation occurred somewhat earlier in 1970.

Site of pupation

The location of the pupa is very characteristic. The larva makes a cocoon attached to a plant stem just at the soil surface. Most often the plant is *Carex bigelowii*. Due to the white cocoon, the pupae can be found rather easily. Two or more cocoons may be attached to each other. Of 157 cocoons, 84 occurred singly, 44 ocurred in groups of two, 24 in groups of three, and one group of five was found.

Density

The cocoons remain attached to the plants even after the pupae have hatched. Cocoon density was measured all three years in August, within the same area where the larval density was measured. Table 1 presents the results, based upon 25 squares of 0.5 × 0.5 m on the top of tussocks and the same number between tussocks. While the density in 1970 was largest between tussocks, the situation was the opposite the next two years. All cocoon densities were much lower than the larval densities measured before the pupation of 1972.

In another part of the habitat, with less-developed tussocks, a mean density of 5.4 cocoons per m^2 was measured on 35 randomly placed squares of 0.5 × 0.5 m in 1970. This corresponded to the mean density within the main plot. The highest number recorded in one square was 18.

Table 1. Density of Zygaena exulans pupae during three years, measured on the top of tussocks and between tussocks. Each mean number is based on 25 squares at 0.5 x 0.5 m.

	1970	1971	1972
Number per m^2 on top of tussocks	3.4	1.6	3.9
Number per m^2 between tussocks	7.7	0.32	0.64

Weights

The mean weight of the female pupae (142.8 mg, SD = 24.4, n = 14) was considerably higher than that of the male pupae (107.7 mg, SD = 7.3, n = 6); $p<0.005$, t-test. However, very large variations in female pupal weights (93.5–193.5 mg) produce a complete overlap of the range of male pupae (98–119.5 mg). All weights refer to pupae just before hatching.

The dry weight of an exuvium of a male pupa which weighed 109 mg was 2.5 mg. The mean dry weight of eleven cocoons together with the last larval exuvium was 3.5 mg. Altogether, the fully grown larva leaves 6 mg dry weight of larval exuvium, pupal exuvium, and cocoon. The mean fresh weight of an adult larva can be estimated at about 130 mg. Using a body water percentage of about 78 (Hågvar & Østbye 1974), this gives a dry weight of 28.6 mg. Evidently, almost a fourth of the larval dry weight is lost to exuviae and silk.

Tolerance against submergence in water

During heavy rain falls, the area between tussocks is filled with water. This, however, does not seem to harm the pupae. The tolerance is due to the cocoon, which keeps water out and maintains an air space around the pupa. Four pupae in their cocoons, submerged for 1.5 days at room temperature, hatched normally.

Imagines

Hatching time and swarming activitv

The first hatching of imagines usually occurs in the first half of July, and the total period over which imagines occur lasts about one month (Fig. 2). However, the main part of the population may hatch and swarm within a few days of this period. Mass hatching occurs only on warm, sunny and calm days. Imagines need such favourable weather conditions in order to achieve successful swarming, copulation and egg-laying.

If unfavourable weather conditions, e.g. rain and strong winds, follow a day with intense hatching activity, a large part of the adult population will die. During heavy rain fall many animals drown in water accumulating between the tussocks.

Most imagines probably swarm within a relatively small area, but some specimens can also be found in habitats far from the hatching point.

Weights

The mean fresh weight of ten newly hatched females was 133.9 mg, SD = 22.6. The values varied between 102 and 183 mg. The mean loss of weight during hatching of these animals was 12.9 mg, SD = 5.0. Three newly hatched males weighed 69.5, 83.5 and 103 mg. Based upon male pupal weights and given the same percentage loss during hatching as for females, an estimated mean weight of newly hatched males is 98.2 mg.

Most imagines recorded in the field weighed considerably less than newly hatched animals. Twenty-four females collected 2–8 August, 1972, weighed from 36 to 95 mg. The mean value was 54.6 mg, and SD = 12.3. Nine males collected during the same period weighed from 31 to 50 mg, with a mean value of 42.0 mg and SD = 6.3.

DISCUSSION

A life cycle lasting for more than one year represents a typical adaptation to alpine habitats with a short snow-free season (Downes 1962, Mani 1968). The present data cannot exclude the possibility of a life cycle lasting for more than two years. Nordstrøm et al. (1941) gives no definite information about the larval period in Sweden, but they assume that larvae hibernate twice.

In the mountain area studied, the favourable weather conditions necessary for successful swarming may be realized only on a few days during the potential swarming period. The mechanism which ensures mass hatching on favourable days evidently lies in the pupation site. The cocoon is spun quite near the litter surface, i.e., in just that layer of the habitat which is most strongly warmed on a sunny day. This layer is also relatively rapidly heated, so that hatching may occur early enough to allow copulation and some egg-laying during the same day. Temperatures above 40°C have been measured in the upper litter layer in a *Salix herbacea* community nearby (Hågvar 1975a). There probably exists a minimum temperature, above which fully developed pupae react with hatching activity.

A life cycle covering more than one year implies that only a part of the larval population pupates and hatches in a given year. If swarming activity and egg-laying is unsuccessful due to bad weather, the species has a 'population reserve' in the younger larvae. The prolonged life cycle thus 'buffers' extreme fluctuations in the total population of the species. However, an unsuccessful egg-laying one year will, of course, result in a low density of imagines the year when these larvae would be adults.

From Table I it evident that pupal density may vary markedly from one year to another. Here it is interesting to note that the drop in density from 1970 to 1971 corresponds with a peak in small rodent populations during early 1971. At snow melt this year, the habitat was markedly influenced by rodent grazing, rodent runways, etc. This activity must have killed a part of the hibernating larvae. Most probably, populations of *Z. exulans* larvae are regularly reduced in peak years for small rodents.

The shift in the site of highest larval density, from between tussocks in 1970 to the top of tussocks in the next two years (Table I) may also be due to the rodent activity, which was most intense between tussocks.

The great differences between larval and pupal densities in 1972 cannot be satisfactorily explained solely by assuming a mixed population of one and two-year-old larvae. The larval population may have contained more than two age classes, and/or there may have been a high larval mortality before pupation.

An interesting feature is that the only conspicuous flowering plant in the habitat, a *Hieracium* sp., blooms just during the swarming period. Both sexes often seek these flowers, and copulation sometimes occurs here.

S. herbacea, which is a suitable food plant for the larvae, also occurs in several other types of habitats, forming almost a monoculture in the *S. herbacea* snowbeds (Hågvar 1975a). However, in the Finse area, *Z. exulans* larvae occur only in rather moist habitats with a long vegetation period. Their absence in *S. herbacea* snowbeds may partly be due to the short snow-free season (Hågvar 1975a). However, it is difficult to explain the absence from several other habitats containing *S. herbacea* by factors other than unfavourable microclimate. Also, the *Z. exulans* habitat at Møsvann mentioned earlier as having a high larval density, was very moist.

Melasoma collaris L. (Col., Chrysomelidae), which also feeds on *S. herbacea*, although in other habitats, has an annual life cycle at Finse (Hågvar 1975a). This is possibly due to a very high assimilation efficiency and growth rate in larvae (Hågvar 1975b). For *Z. exulans*, the critical factor in the life cycle is not the growth rate, but to accomplish hatching on just the few suitable days. Thus, these two species illustrate two different ways of adapting to alpine conditions.

ACKNOWLEDGEMENTS

I would like to thank Cand. real. Eivind Østbye for focusing my interest on the study of this species, and for valuable advice. Mr. William N. Thompson kindly improved the English.

Received 15 July 1976

REFERENCES

Downes, J. A. 1962. What is an arctic insect? *Can. Ent. 94,* 143–162.

Hofsvang, T. 1972. *Tipula excisa* Schum. (Diptera, Tipulidae), life cycle and population dynamics. *Norsk ent. Tidsskr. 19,* 43–48.

Hofsvang, T. 1973. Energy flow in *Tipula excisa* Schum. (Diptera, Tipulidae) in a high mountain area, Finse, South Norway. *Norw. J. Zool. 21,* 7–16.

Hågvar, S. & Østbye, E. 1972. Quantitative and qualitative investigations of the invertebrate fauna under stones (the hypolithion) in some alpine habitats at Finse, South Norway. *Norsk ent. Tidsskr. 19,* 1–10.

Hågvar, S. & Østbye, E. 1974. Oxygen consumption, caloric values, water and ash content of some dominant terrestrial arthropods from alpine habitats at Finse, south Norway. *Norsk ent. Tidsskr. 21,* 117–126.

Hågvar, S. 1975 a. Studies on the ecology of *Melasoma collaris* L. (Col., Chrysomelidae) in alpine habitats at Finse, south Norway. *Norw. J. Ent. 22,* 31–47.

Hågvar, S. 1975 b. Energy budget and growth during the development of *Melasoma collaris* (Coleoptera). *Oikos 26,* 140–146.

Mani, M. S. 1968. *Ecology and biography of high altitude insects.* 527 pp. W. Junk, The Hague.

Nordström, F., Wahlgren, E. & Tullgren, A. 1941. *Svenska fjärilar.* 354 pp. Nordisk Familjeboks Förlags Aktiebolag, Stockholm.

Short Communications

Haliplus obliquus Fabricius (Col., Haliplidae) ny for Norge

DAG DOLMEN & JAN IVAR KOKSVIK

Three males of *Haliplus obliquus* Fabricius have been collected from the tarn Bjortjørna (UTM: VN546664) in Susendalen, Nordland County. The species has not previously been reported from Norway. The tarn is a relatively small one with a dense water vegetation. Values for total hardness and electrolytic conductivity were high, as the tarn and its drainage area lie in a belt of calcareous rocks.

D. Dolmen & J. I. Koksvik, University of Trondheim, Royal Norwegian Society of Sciences and Letters, The Museum, Erling Skakkes gt. 47 b, N–7000 Trondheim, Norway.

Under undersøkelsene i Vefsnavassdraget sommeren 1974 i forbindelse med Statskraftverkenes utbyggingsplaner i området ble det den 16. juli i Bjortjørna (UTM; VN546664) i Susendalen funnet tre hanner av *Halipus obliquus* Fabricius. Arten er tidligere ikke oppgitt å være funnet i Norge.

H. obliquus er utbredt i de sentrale deler av Europa, på De Britiske øyer, i Danmark og Sør-Finland, og er i Sverige registrert nord til Uppland (Balfour-Browne 1940, Lindroth 1960).

Sammen med *H. obliquus* fant en også *H. confinis*, en art hvis utbredelse stort sett faller sammen med utbredelsen av *H. obliquus*, men som går noe lengre mot nord, og er i Norge funnet spredt nord til Troms.

I Storbritannia er både *H. obliquus* og *H. confinis* funnet i et vidt spekter av vanntyper, og de forekommer ofte i samme lokalitet; i Danmark er *H. obliquus* også funnet i saltvann (Balfour-Browne 1940, Hansen 1964).

Både *H. obliquus* og *H. confinis* ble i Vefsnavassdraget funnet kun i denne ene tjørna, som skiller seg klart ut fra de andre undersøkte vatna m.h.t. beliggenhet, berggrunn og vegetasjon. Bjortjørna ligger ca. 200 m o.h., arealet er 1.5 ha og største dyp ca. 3 m. Tjørna er omgitt av blandingsskog og ligger lunt til i terrenget. Vanngjennomstrømningen er liten. Et kraftig *Carex*-belte strekker seg rundt storparten av tjørna, og mot slutten av sommeren er det forholdsvis tette forekomster av *Potamogeton* spp. i større partier. I vegetasjonsprøver tatt utenfor *Carex*-beltet ble det forøvrig funnet *Utricularia* sp., *Myriophyllum* sp. og *Scorpidium* sp., dels i meget tette bestander.

Tabell I. Hydrografiske data fra målinger utført på en meters dyp ved normal sommervannstand 24.aug.1974

pH	K_{18}	Tot. hard. °dH	Cl mg/l	$KMnO_4$-forbruk mg/l
7.6	210	7.6	5.0	17.4

Hydrografiske data er vist i tabell I. Etter norske forhold er elektrolyttverdiene for vannet meget høye. Dette har sin naturlige forklaring i at nedslagsfeltet og selve tjørna ligger i det kraftige kalksteinsbeltet som strekker seg nordover mot Røssvatn på østsida av Susendalen. $KMnO_4$-forbruke indikerer at humuspåvirkningen er liten.

I hele den undersøkte delen av Vefsnavassdraget ble det ellers av Halipidae bare funnet *Halipus fulvus*, en euryøk art med utbredelse over hele Norge.

REFERENCES

Balfour-Browne, F. 1940. *British Water Beetles 1.* 375 pp., Ray Society, London.

Hansen, V. 1964. Fortegnelse over Danmarks biller (Coleoptera). *Ent. Meddr. 33,* 1–507.

Lindroth, C. H. 1960 (red.). *Catalogus Coleopterorum Fennoscandiae et Daniae.* 476 pp. Entom. sällsk., Lund.

Mottatt 23. februar 1976.

Winter-active insects enclosed by ice from supercooled rain

SIGMUND HÅGVAR

Thirty specimens of the winter-active, wingless insect *Chionea araneoides* Dalm. (Dipt., Tipulidae) were found completely enclosed by ice from supercooled rain on snow. Evidently, supercooled rain may act as a strong decimating factor for several winter-active invertebrates, trapping that part of the population which is present on the snow surface.

S. Hågvar, Norwegian Forest Research Institute, 1432 Ås–NLH, Norway.

Chionea araneoides Dalm. is a typical winter-active insect which can be found walking on snow at temperatures between 0° and –6°C (Hågvar 1971). At Krokskogen near Oslo 13 January 1974, 15 ♂♂ and 15 ♀♀ were found enclosed in a thin ice layer on the snow in spruce forest. The ice layer had been established the preceding day as a result of supercooled rain at temperatures just below 0°C, and covered several hundred square kms. All animals were completely enclosed, and the ice cover, which partly followed the shape of the animals, was up to 3 mm thick. At that time, the insects must have been enclosed in ice for at least twelve hours.

When the ice cover was melted in the hand, all animals immediately started to move and behaved quite normally.

According to Sømme & Østbye (1969), the haemolymph freezing point of *C. araneoides* varies between –0.42° and –1.00°C, with mean value –0.71°. Animals frozen at their supercooling points (mean value –7.5°C) did not survive. Sømme & Østbye (1969) concluded that the species cannot survive freezing.

The animals mentioned had spent the night enclosed in ice at temperatures just below 0°C. If the haemolymph really was frozen, freezing had occurred at temperatures considerably above the supercooling point. It is a well-known fact that insects may freeze at temperatures above their supercooling point when they are in direct contact with water, and that insects in some cases may survive freezing when this occurs just below 0°C (Sømme 1974). However, as the animals behaved normally as soon as the ice cover melted, it seems reasonable to assume that the haemolymph had not been frozen. If this is the case, the ice cover would act only as a mechanical limitation, until freezing, or death caused by oxygen deficiency occurs.

Obviously, supercooled rain on snow may act as an important decimating factor on populations of *C. araneoides,* as well as on other winter-active invertebrates which periodically occur on the snow surface (Svensson 1966, Hågvar 1973).

Received 8 June 1976

REFERENCES

Hågvar, S. 1971. Field observations on the ecology of a snow insect, *Chionea araneoides* Dalm. (Dipt., Tipulidae). *Norsk ent. Tidsskr. 18,* 33–37.

Hågvar, S. 1973. Ecological studies on a winter-active spider *Bolyphantes index* (Thorell) (Araneida, Linyphiidae). *Norsk ent. Tidsskr. 20,* 309–314.

Sømme, L. 1974. The overwintering of *Pelophila borealis* Payk. III. Freezing tolerance. *Norsk ent. Tidsskr. 21,* 131–134.

Sømme, L. & Østbye, E. 1969. Cold-hardiness in some winteractive insects. *Norsk ent. Tidsskr. 16,* 45–48,

Svensson, S. 1966. Studier över vissa vinteraktiva insekters biologi. *Norsk ent. Tidsskr. 13,* 335–338.

Nye funn av Lepidoptera

C. F. LÜHR

New localities from various parts of Norway are reported for nineteen species of Lepidoptera.

C. F. Lühr, N-2680 Vågåmo, Norway.

Ved gjennomgåelse av de siste års innsamlete Lepidoptera kan nye lokaliteter angis for følgende arter. Samtlige arter er fanget med lysfelle.

Endromis versicolora L. On: Vågåmo 18. mai 1976. *Ammoconia caecimacula* Schiff., On: Vågåmo 20. sept. 1975. *Cosmia gilvago* Esp., On: Vågåmo 27. aug. 1975. *Crymodes rubrirena* Tr., TEi: Treungen, Nissedal 13. juli 1975. *Scopula immutata* L., VAy: Repstad, Søgne 16. juli 1957. *Sterrha bisetata* Hufn., AAy: Groos, Grimstad 18 aug. 1974. *Acasis viretata* Hb., AAy: Groos, Grimstad 2. mai 1974. *Hydrelia testaceata* Don., On: Lom 29. juni 1963. *Eupithecia palustraria* Dbl., STi: Storlidalen, Oppdal 28. juni 1975. *E. actaeata* Walderd. ssp. *bergunensis* Dietze, On: Vågåmo 9. juni 1976. *E. assimilata* Dbl., AAy: Groos, Grimstad 13. aug. 1974. *E. vulgata* Haw., TEi: Tjønnefoss, Nissedal 5. juli 1974. *E. nanata* Hb., HEs: Helgesjøen, Eidskog 17. juni 1974, TEi: Tjønnefoss, Nissedal 5. juli 1974, On: Vågåmo 19. juni 1975, *E. dodoneata* Gn., AK: Asker 2. juni 1961, *Chloroclystis chloreata* Mab., AAy: Tromøy 15. juli 1975, TEi: Treungen, Nissedal 5. juli 1974. *C. debiliata* Hb., VE: Sem, Narverød 7. aug. 1974. *Arichanna melanaria* L., TEi: Tjønnefoss, Nissedal 14. juli 1975. *Ectropis consonaria* Hb., AAy: Groos, Grimstad 2. mai 1974. *Pachycnemia hippocastanaria* Hb., AAy: Groos, Grimstad 10. mai 1976.

ACKNOWLEDGEMENT

Cand. mag. Hans Hegvik, Det kongelige norske videnskabers selskab, Trondheim har velvilligst gjennomgått og bestemt de omtalte *Eupithecia* og *Chloroclystis* artene.

Mottatt 14. juni 1976

New records of *Rhamphomyia marginata* Fabr. (Dipt., Empididae) from East and West Norway

TROND ANDERSEN & ARNE FJELLBERG

Rhamphomyia marginata Fabr., (Dipt., Empididae) is recorded from Østfold, Vestfold, and Hordaland.

Trond Andersen & Arne Fjellberg, Zoological Museum, University of Bergen, N-5014 Bergen-Univ., Norway.

The female of *Rhamphomyia marginata* Fabr. (syn.: *platyptera* Panz.) is easily recognized by her large wings with a broad dark brown margin. The species was first published from Norway by Opheim (1973), who caught a specimen at Holmsbu in Hurum, Buskerud county.

In the collection of the Zoological Museum in Bergen there are several specimens from various localities in East and West Norway.

Østfold: Strupe at Halden, 5 June 1967 1 ♀, pine and spruce, L. Greve leg. Hordaland: Steinestø in Kvam, 26 May 1971 1 ♀, hardwood, A. Fjeldså leg. Løfallstrand in Kvinnherad, 6 June 1966 1 ♀, Student excursion leg. Storsøy in Stord, 27 May 1968 4 ♀♀ and 29 May 1969 1 ♀, Student excursion leg. Lii in Os, 22–25 May 1976 1 ♀, light-trap, T. Andersen leg. The species has also been collected in Vestfold: Rød in Tjøme 23 May 1965 1 ♀, pine and spruce, by A. Fjellberg.

The species is distributed in Central Europe and southern Sweden (Frey 1956).

Received 24 June 1976

ACKNOWLEDGEMENT

We are indebted to Dr. A. Løken for permission to publish the material in Zoological Museum, Bergen.

REFERENCES

Frey, R. 1956. Empididae. pp. 400–639 in Lindner, E. (ed.) *Die Fliegen der Palaearktischen Region 4,4.* E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

Opheim, M. 1973. *Rhamphomyia platyptera* Panz. (Dipt., Empididae) ny for Norge. *Norw. J. Ent. 20,* 334.

Schizonotus sieboldi Ratzenburg 1852 (Hym., Pteromalidae) reared from *Melasoma populi* (L.) (Col., Chrysomelidae)

HENRIK PETTERSEN

Altogether 20 ♀♀ and 11 ♂♂ of *Schizonotus sieboldi* Ratz. were reared from *Melasoma populi* (L.) larvae found on *Populus tremula* L. at Veum, eastern Norway (UTM: 32VPL107695).

Henrik Pettersen, Norwegian Forest Research Institute, N-1432 Ås-NLH, Norway.

In September 1972 Dr. Alf Bakke collected some parasitized beetle larvae of *Melasoma populi* (L.) from leaves on root shoots of *Populus tremula* L. The location was Veum close to Fredrikstad in south-eastern Norway (UTM: 32VPL107695).

During February 1973 twenty females and eleven males of *Schizonotus sieboldi* Ratz. emerged. The specimens correspond with the descriptions given by Bouček (1958) and Graham (1969).

M. populi is a widely distributed and common species in Scandinavia; it has one generation each year and overwinters as imago.

Further south in the distribution range, i.e. Middle and Southern Europe, the *M. populi* may have two or three generations each year (Günther 1950, Mellini 1962). *M. populi* is named as a chief host to this parasite, and *S. sieboldi* has been reported from Germany, Czechoslovakia, Poland, and the Soviet Union (Bouček 1958, Szujecki 1966, Nicolskaya 1952). *S. sieboldi* is also known from North America, where it sometimes heavily parasitizes the introduced beetle pest *Plagiodera versicolor* Laich. (Bouček 1958). The species therefore seems to have a holarctic distribution, but no other Scandinavian records are previously known to the author.

REFERENCES

Boucek, Z. 1958. To the taxonomy of the European species of *Schizonotus* and *Caenoerepis*-parasites of economic importance – with notes and some new synonymy in Pteromalidae and Eurytomidae (Hym.). *Sb. ent. Odd. nár. Mus. Praze 32,* 395.

Graham, M. W. R. de V. 1969. The Pteromalidae of North-Western Europe (Hymenoptera: Chalcidoidea). *Bull. Brit. Mus. (Nat. Hist.) Ent. Suppl. 16,* 1–908.

Günther, F. 1950. Poppelschädlinge und ihre Bekämpfung. *Forstw. Holzw. 13,* 195–200.

Mellini, E. 1962. *Steiniella callida* Meiz. zu *Melasoma populi* L. (Coleoptera Chrysomelidae). *Univ. Bologna. Lst. Entom. Bull. 26,* 131–159.

Nikolskaya, M. N. 1962. The Chalcid fauna of the USSR (Chalcidoidea) 574 pp. Moscow and Leningrad (In Eng. transl. Jerusalem 1963).

Szujecki, A. 1966. About the biology of Chrysomelids (Coleoptera, Chrysomelidae) occurring on forest trees and shrubs in Poland, their predators and parasites. (Eng. summary.) *Lesnictwo 9,* 113–132.

Received 9 July 1976

Colydium elongatum Fabr. (Col., Colydiidae) new to Norway

ARVID PÅSCHE & KARL ERIK ZACHARIASSEN

Colydium elongatum Fabr. is reported new to Norway. One specimen was found under loose bark of a standing ring-barked aspen near Risør, Aust Agder county, on 5 June 1976.

A. Påsche & K. E. Zachariassen, Institute of Zoophysiology, University of Oslo, Blindern, Oslo 3, Norway.

The clavicorn beetle *Colydium elongatum* Fabr. lives under the bark of dead deciduous trees, particularly of beech and oak, where it feeds on xylophagous insects (Hansen 1951). In Northern Europe the species has been found in scattered localities in Southern Sweden and in Jylland in Denmark (Lindroth 1960). According to Hansen (1951), the Danish finding was made as long ago as in 1887.

On 5 June 1976 one specimen of *Colydium elongatum* was taken by the authors under loose bark of a standing ring-barked aspen near Risør in the outer part of Aust-Agder county. The aspen was standing sun-exposed in an open area, which seemed to have been clear-felled a couple of years ago. The length of the specimen was 6.5 mm.

ACKNOWLEDGEMENT

We would like to thank Dr. philos. h.c. A. Strand for checking the identification of the beetle.

REFERENCES

Hansen, V. 1951. Clavicornia 2. Biller Vol. XIV. *Danm. Fauna 56,* 253 pp.

Lindroth, C. H. (Ed.) 1960. *Catalogus Coleopterorum Fennoscandiae et Daniae.* 478 pp. Entom. sällsk., Lund.

Received 31 July 1976

Bokanmeldelser

M. Chvála. 1975. The Tachydromiinae (Dipt. Empididae) of Fennoscandia and Denmark. *Fauna ent. Scand. 3,* 336 pp., 790 figs. Scandinavian Science Press, Klampenborg, Denmark. Pris d. kr. 98.– (abonnement d. kr. 68.–).

Underfamilien Tachydromiinae hører til dansefluene (Empididae) og omfatter arter av størrelse mellom 0.7 og 5.5 mm. De hører således ikke til de mest iøynefallende artene. Kjennskapet til deres levevis og økologi er også relativt begrenset, selv om mange arter utvilsomt har en høyst spesialisert og interessant biologi. Så vidt man vet er alle rovinsekter, som særlig lever av andre Diptera. Noen av dem kan ha økonomisk betydning ved at de fanger skadeinsekter på korn og andre kulturplanter.

Det er meget gledelig at vi nå får en monografi om denne insektgruppen i Fauna Entomologica Scandinavica. Som tidligere bøker i serien inneholder også dette bindet bestemmelsestabeller og beskrivelse om de enkelte artene. Ialt er 128 arter omtalt, og forfatteren regner med at dette er de aller fleste som fins i Danmark og Fennoscandia. Teksten er meget rikelig illustrert med nærmere 800 figurer. De aller fleste av dem er usedvanlig klare strektegninger, som med stor dyktighet er utført av Grete Lyneborg. Uten å ha prøvd selv, må det være god grunn til å tro at den utførlige teksten og de detaljerte tegningene gir den beste mulighet for en vellykket identifikasjon.

Det ligger et omfattende arbeid bak en bok som denne. Forfatteren, som er tsjekkisk har tilbragt et år i København for å bearbeide nordisk materiale. Han har selv gjort en rekke innsamlinger i Danmark. Mer enn 18 000 eksemplarer av Tachydromiinae fra museene i Danmark og Fennoscandia har blitt undersøkt. Både i Finland og Sverige fins gode samlinger, men dessverre er det norske materialet relativt begrenset. Det gir seg også utslag i utbredelsesoversiktene bakerst i boken. Forholdsvis få arter er kjent fra Norge, og man vet lite om deres utbredelse i de forskjellige deler av landet.

Dette sørgelige faktum gjør boken spesiell verdifull for norske entomologer. Her har man iallfall førsteklasses bestemmelseslitteratur, med ajourført utbredelse for alle kjente arter i Norden. Ikke minst ville det vært av stor interesse å vite mer om mange arters forekomst på Vestlandet og i Nord-Norge.

Forfatteren fortjener ros for det store arbeid han har nedlagt i denne boken. Det fortjener også seriens redaktør, Leif Lyneborg, som har funnet frem til en klar og oversiktlig lay-out av bindene i Fauna Ent. Scand. Serien har allerede blitt en suksess, og har fått en rekke abonnenter i og utenfor de nordiske land.

Lauritz Sømme

B. Ohnesorge. 1976. *Tiere als Pflanzenschädlinge.* 288 pp. G. Thieme, Stuttgart. Pris DM 19.80.

Boken er utgitt i Thieme-forlagets serie av «Flexible Taschenbücher», som vanligvis er av meget god kvalitet.

Professor B. Ohnesorge gir her en innføring i skadedyrenes levevis, med særlig vekt på de økologiske forutsetninger for deres opptreden og skade. Bokens format begrenser tildels innholdets omfang, og det har heller ikke vært forfatterens mening å gi en helt uttømmende fremstilling av emnet. Bokens innhold må sees som en introduksjon til og en oversikt over dette fagområde. Den er i første rekke beregnet på studenter i landbruksfag, men vil utvilsomt også være av interesse for biologistudenter ved andre læresteder.

Den første delen av boken er en systematisk oversikt over de dyregrupper hvor skadedyr på kulturplanter hører hjemme. For det meste dreier dette seg om insekter. Under omtalen av hver insektorden presenteres de viktigste skadedyr med en kort beskrivelse av deres biologi og form for skade. Nyttige insekter, dvs. rovinsekter og parasitter behandles i et senere kapittel.

Det neste hovedavsnitt er en redegjørelse for de økologiske forutsetninger for skadedyrenes opptreden. Her behandles både abiotiske og biotiske faktorer som kan være av betydning for skadedyrenes biologi. Avsnittet avsluttes med en innføring i populasjonsdynamikk. Mye av dette stoffet er av generell karakter og berører bare kortfattet. Det meste kan man finne, og ofte mer utførlig, i en generell lærebok i økologi. Allikevel må det sees som en fordel at problemenes bredde her er presentert mellom to permer, slik at leseren får et inntrykk av hvor kompliserte forholdene egentlig er. Den som vil fordype seg i deler av problemene kan gå til andre kilder som det også er rikelig referert til.

I det siste hovedavsnitt av boken diskuteres de økologiske forutsetninger for at skaden skal inntreffe. Her blir man presentert for problemstillinger angående vekselvirkningen mellom skadedyr og kulturplanter, bl. a. med omtale av frastøtende substanser og næringskvalitet hos plantene, og hvorledes dette kan utnyttes i utviklingen resistente kulturplanter. Avsnittet tar også for seg insektenes rolle som vektorer for plantesykdommer og plantenes reaksjon på skadedyrenes angrep.

Boken har i det hele en meget stor spennvidde. Om alle emner ikke er like utførlig behandlet, burde den inspirere til videre lesning av mer spesiell litteratur. Den kan anbefales for alle som vil ha en innføring i skadedyrenes økologi med hele den bredde området omfatter. Boken er illustrert med tydelige strektegninger.

Lauritz Sømme

P. J. Mill (ed.) 1976. *Structure and Function of Proprioceptors in the Invertebrates.* 686 pp. Chapman & Hall Ltd., London. Pris £19.50.

Samtidig som flommen av faglitteratur øker, ser vi en stigende tendens til at bøkene blir mer og mer spesialiserte. Dette henger naturligvis sammen med den stadige tilførsel av nye kunnskaper gjennom fagtidsskriftene, og skal de bli tilgjengelige for andre enn spesialister på de enkelte områder, må de samles i oversiktlige review-artikler og bøker. Man skal ikke så mange årene tilbake før det neppe var mulig å skrive en egen bok om evertebratenes proprioceptorer, eller selvoppfattende sanseorganer.

Basert på bl. a. elektronmikroskopi og elektrofysiologiske målinger har det foregått en voldsom utvikling på sansefysiologiens område. Det er derfor med stor interesse man tar for seg den foreliggende boken, selv om den bare dekker en del av dette feltet. Proprioceptorer er her definert som de sanseorganer som er i stand til å registrere strekninger, trykk og andre deformasjoner i kroppen, som kan skyldes dyrets egne bevegelser, eller har sammenheng med dets vekt eller andre ytre mekaniske krefter. I boken benyttes denne definisjonen i videste forstand, og bare de mekanoreseptorer som utelukkende reagerer på berøring eller lyd er utelatt. Som det fremgår av tittelen dreier boken seg om virvelløse dyr i sin helhet. På den måten gir boken en rekke komparative aspekter, særlig mellom insekter og krepsdyr, hvor de fleste undersøkelser på dette området er utført.

I tillegg til bokens redaktør, J. P. Mill, har femten forfattere bidratt med artikler innen sitt spesialfelt. Det er ikke mulig i en anmeldelse som denne, å gi en kritisk vurdering av de enkelte bidrag mellom bokens permer, som ialt rommer nærmere 700 sider. Jeg må her nøye meg med en kort omtale av deres innhold.

Bokens første kapittel er en oversikt over ytre mekanoreseptorer, som gir dyret proprioceptiv informasjon. Dette omfatter en lang rekke organer, hvis morfologi er grundig beskrevet og illustrert. I de neste ni kapitler behandles indre proprioceptive organer hos arthropoder. De forskjellige kroppsavsnitts og ekstremitetenes organer omtales hver for seg. Mange av de indre proprioceptive organene er strengformete eller chordotonale, og viser en stor grad av variasjon og kompleksitet i sin oppbygning. Så meget er nå kjent om deres ultrastruktur, at et eget kapittel er viet dette tema. Likevektsanser hos arthropoder og mollusker blir omtalt i kapittel 12 og 13. På dette området har det samlet seg store kunnskapsmengder, som her blir oversiktlig oppsummert. Boken avsluttes med egne kapitler om de proprioceptive organers rolle i læringsprosesser hos evertebrater, om metoder til kvantitativ analyse av den informasjon de gir, og hvorledes impulser fra proprioceptive organer oppfattes i det sentrale nervesystem.

Det er ingen tvil om at dette er en meget avansert og àjourført bok innen sitt område. Den vil være en nødvendighet for alle som driver forskning på dette feltet, men også for forskere på beslektete fagområder. Boken vil ha stor betydning til undervisningsformål ved universiteter og høyskoler, hvor forelesere kan finne rikelig med stoff fra dette interessante felt. Boken inneholder en rekke ypperlige illustrasjoner av de enkelte sanseorganenes morfologi. Det dreier seg tildels om elektronmikroskopiske fotografier, men også usedvanlig klare tegninger av stor pedagogisk verdi.

Lauritz Sømme

IN MEMORIAM

Leif Reinhardt Natvig

Førstekonservator, dr. philos Leif Reinhardt Natvig døde 14. november 1975. Med ham er en sentral skikkelse i norsk entomologi gått bort. Natvig var født i 1894, og allerede året etter artium i 1913 begynte han å arbeide ved Zoologisk museum, Universitetet i Oslo. Han var senere knyttet til dette institutt helt til han nådde aldersgrensen. Hans hovedinteresse var parasittiske og blodsugende insekter, og hans viktigste publikasjon var hans store doktorarbeid 'Contribution to the knowledge of the Danish and Fennoscandian Mosquitos, Culicini' fra 1949.

I årenes løp har Natvig innehatt en rekke tillitsverv i Norsk entomologisk forening. Han var med i redaksjonen av Norsk entomologisk tidsskrift fra starten av. og senere dets redaktør i årene 1952–1955. Ved hans 70 års dag i 1964 var hefte 5–8. bind 12 av Norsk entomomologisk tidsskrift tilegnet ham. I samme hefte skrev førstekonservator Astrid Løken en hyldest og utførlig omtale av Natvigs karriere og innsats. Vi vil minnes ham for det arbeid han nedla for entomologien i Norge, både som forsker, foreleser og gjennom Norsk entomologisk forening.

Lauritz Sømme

Arne Nielsen

Den 18. februar 1976 mistet vi vår gode venn, lege og entomolog-kollega Arne Nielsen. For hans familie og nærmeste venner var det ikke så overraskende, da han i mange år hadde slitt med dårlig helse. Allikevel ble det en tung stund for oss alle, som hadde lært ham å kjenne som det stille og fine menneske han var.

Arne Nielsen var født 5. juli 1907, og tok sin medisinske embedseksamen i 1932. Først var han lege i Sandnes, senere i Elverum, men som den rogalending han var, dro han i 1938 tilbake til Stavanger, hvor han ble assistentlege ved Rogalad sjukehus. Bortsett fra et års fangeopphold på Grini 1944–45 praktiserte han resten av sitt liv på Sandnes som bedriftslege hos Jonas Øglænd, og fra 1964 til 1974 som lege ved Rogaland psykiatriske sjukehus.

Det var som entomolog vi kjente Arne Nielsen best. Hans store interesse var Lepidoptera, både macros og micros. Han var en fast deltager ved de Nordiske Entomologmøter, hvor han med sitt varme sinn og store viten om sommerfugler, vant seg mange venner. I Norsk entomologisk Tidsskrift har han skrevet flere artikler om sine funn av Lepidoptera. Til hans viktigste arbeider hører en undersøkelse av Rogalands macrodlepidopterfauna, og nye arter av noctuider for Norge. Spesielt vakte hans funn av ***Stilbia anomala*** Hw. stor oppmerksomhet som ny nordisk art.

Norsk entomoloigsk forening er ham meget takknemlig for hans mange nye funn. Som venn, kollega og forsker vil vi alltid minnes ham i kjærlighet.

Carl Fredrik Lühr

Instructions to Authors

The *Norwegian Journal of Entomology* publishes papers in English, occasionally in Norwegian and German. When preparing manuscripts for publication, authors should consult current copies of the journal and follow the style as closely as possible.

MANUSCRIPTS

Manuscripts must be typewritten on one side of the paper only, with double spacing throughout, and with a wide margin. Authors should submit the original manuscript (preferably with two copies) to the Editor whose address is on page 2 of the cover.

Separate sheets should be used for the following: (1) Title page, with the author's name; (2) Abstract not exceeding 11 lines (770 letters and spaces) with the name and full postal address of the author underneath; (3) References; (4) Tables with their headings; (5) Legends to Figures.

In the case of articles submitted in a language other than English, the Abstract. Table headings and Figure legends must be accompanied with an English translation.

Brief *Acknowledgements* of grants and other assistance, if any, will be printed at the end of the text.

FIGURES AND TABLES

All illustrations will be considered as Figures. Each graph, drawing or photograph should be numbered in sequence with arabic numerals, and should be identified lightly on the back with the name of the journal, the author's name, and the Figure number. The top should be indicated. The Figures should be the original drawings and should be constructed in proportion to either the entire width of the type area (14 cm) or to the column width (6.7 cm). Lines must be thick enough to allow for reduction. Letters and numbers must not be less than 2 mm in the printed illustration. Photographs should be submitted as unmounted glossy enlargements showing good detail.

Tables should be numbered in Roman numerals, each having a descriptive heading and typed on a separate sheet. Since Tables, as well as Figures, are reproduced photographically, they should be constructed in the same proportion as for Figures. Very large Tables should be typewritten on separate sheets to be printed on facing pages. They must be typewritten on good quality paper with all rules drawn in with a fine pen.

All Figures and Tables should be referred to in the text by their number, and their approximate position indicated in the margin of the manuscript.

All drawings and microphotographs should have a scale giving the appropriate metric unit (m, cm, mm, μm, or nm).

REFERENCES TO LITERATURE

In the text. Brown (1957), Brown & White (1961). If more than two authors, Brown et al. (1963). Multiple references: 'As several authors have reported (Brown 1957, Brown & White 1961, Green et al. 1963)', i.e. chronological order, no commas between names and year.

The list of *References* should be in alphabetical order and not numbered. The international alphabetical order of Scandinavian and German vowels should be observed: Å = AA, Æ and Ä = AE, Ø and Ö = OE, Ü = UE. Indicate 1st, 2nd, 3rd, etc. works by the same author in the same year by a, b, c, etc. e.g. (White 1966a). *Ditto marks, et al. and ibid.* should not be used. Generally, titles of journals should be abbreviated according to the *World List of Scientific Periodicals.*

Examples:

Løken, A. 1964. Social wasps in Norway (Hymenoptera, Vespidae). *Norsk ent. Tidsskr. 12,* 191–218.

Schwarts, R. J. 1955. *The Complete Dictionary of Abbreviations.* 211 pp., T. Y. Cromwell Co., New York.

Whitman, L. 1951. The arthropod vectors of yellow fever. pp. 229–298 in Strode, K. (ed.) *Yellow Fever.* McGraw-Hill, New York and London.

PROOFS

Authors will receive two copies of the first proof (page proof). One copy should be returned duly corrected without delay. All technical sections of the article, including references, names, figures (numbers, formulae), illustrations and so on, are the responsibility of the author. Authors will be required to pay for any alterations they make against the manuscript.

OFFPRINTS

Seventy-five offprints of each article without covers will be supplied free of charge. Additional offprints may be ordered at the author's own expense.

NORWEGIAN JOURNAL OF ENTOMOLOGY

EDITOR
LAURITZ SØMME

VOLUME 23, 1976

UNIVERSITETSFORLAGET

Norwegian Journal of Entomology

Norsk Entomologisk Tidsskrift

EDITOR

EDITORIAL COMMITTEE

PUBLISHER

Universitetsforlaget: P. O. Box 7508, Skillebekk, Oslo 2, Norway.
P. O. Box 142, Boston, Massachusetts 02113, U.S.A.

CONTRIBUTIONS

These should be sent to the Editor. Authors are requested to follow the instructions on page 3 of the cover.
Artikler som ønskes trykt i tidsskriftet sendes redaktøren. Bidragsytere må følge anvisningen på omslagets tredje side.

SUBSCRIPTIONS

Non-members of the Norwegian Entomological Society should send their orders to Universitetsforlaget. The subscription price per volume (two issues annually) is for 1976 U.S. $ 13.00 (N. kr. 65.–). U.S. $ price is subject to change without notice in case of devaluation/revaluation. Notice of change of adress should be accompanied by the old address. Back volumes should also be ordered from Universitetsforlaget.

NORSK ENTOMOLOGISK FORENING

ser sin hovedoppgave i å fremme det entomologiske studium i Norge, og danne et bindeledd mellom de interesserte. Medlemskontingenten er for tiden kr. 30,– pr. år. Medlemmer får tidsskriftet fritt tilsendt. Henvendelser om medlemskap sendes sekretæren: Cand. real. Trond Hofsvang, Zoologisk institutt, NLH, 1432 Ås-NLH.

E. SEM A/S, HALDEN

NORWEGIAN JOURNAL OF ENTOMOLOGY

Volume 23, No. 2, 1976

INNHOLD/CONTENTS

SHORT COMMUNICATIONS

In Memoriam

CONTENTS

Short communications

In Memoriam

NO ISSN 0029-1897