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NORSK ENTOMOLOGISK FORENING

ser sin hovedoppgave i å fremme det entomologiske studium i Norge, og danne et bindeledd mellom de interesserte. Søknad om opptagelse i foreningen sendes formannen. Medlemskontingenten er for tiden kr 20,— pr. år. Medlemmer får tidsskriftet fritt tilsendt.

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Studies on Norwegian Aphids (Hom., Aphidoidea) II
THE SUBFAMILY MYZINAE (MORDVILKO) BÖRNER

HELENE TAMBS-LYCHE

Tambs-Lyche, Helene. 1970. Studies on Norwegian Aphids (Hom., Aphidoidea) II. The subfamily Myzinae (Mordvilko) Börner. *Norsk ent. Tidsskr. 17*, 1-16.

The present paper is the second of a series on Norwegian aphids, and comprises 88 species of the subfamily Myzinae, of which the following 34 are recorded for the first time from Norway: *Cryptosiphum artemisiae, Ceruraphis eriophori, Dysaphis aucupariae, D. pyri, Brachycaudus klugkisti, B. semisubterraneus*, Appelia prunicola, Holcaphis holci, Hyadaphis foeniculi, Staegeriella necopinata, Coloradoa rufomaculata, C. tanacetina, Longicaudus trirhodus, Ericaphis latifrons, Chaetosiphon fragaefolii*, C. potentilee, C. tetrarhodus, Liosomaphis berberidis, Cavariella konoi, Jacksonia papillata, Ovatus insitus, Myzus ornatus, Tubaphis ranunculinus, Galiobium langei, Vesiculaphis theobaldi, Aspidaphium escherichi, Capitoporus hippophaes, Impatientum balsamines, Nasonavia compositellae*, N. nigra, Rhopalosiphoninus calthae, R. heikinheimoi, R. ribesinus, R. staphyleae.* Three species (*) are new also to Scandinavia. Two species of Dactynotinae are listed as an addendum, of which *Microsiphum millefolii* is new to Norway.

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INTRODUCTION

The present paper is a continuation of a survey of Norwegian aphids, based upon the author's own finds, on trap catches from yellow trays (Moericke-traps) in 1954-56, and on a smaller collection of aphids from the Zoological Museum Bergen.

Part I (Tambs-Lyche 1968) dealt with the subfamily Dactynotinae. The present paper concerns the subfamily Myzinae, and two additional species of the Dactynotinae are listed in an addendum. In all, 88 species of Myzinae are listed, of which 34 are new to Norway. Most of the species are included in the Catalogus Insectorum Sueciae Homoptera Aphidoidea (Ossiannilsson 1969) in the column for Norway, which is partly based upon information in litt. from the present author.

The abbreviations in the locality list refer to the map in Fig. 1, Part I. Under each species the total distribution of the species is listed first, and specific information is added about the occurrence in the nearest countries (i.e. Sweden, Denmark, Finland, Iceland and Great Britain). The information is cited from the same publications as in Part I (Tambs-Lyche 1968), and in addition from Ossiannilsson (1969).

LIST OF SPECIES

**Cryptosiphum artemisiae* Buckton

Acaudinum scabiosae Hille Ris Lambers

**Ceruraphis eriophori* (Walker)

Dysaphis (Dysaphis) anthrisci Börner
D. (D.) crataegi (Kaltenbach)
D. (D.) ranunculi (Kaltenbach)
**D. (Pomaphis) aucupariae* (Buckton)
D. (P.) maritima Hille Ris Lambers
D. (P.) plantaginea (Passerini)

D. (P.) pyri (Boyer de Fonscolombe)
D. (P.) sorbi (Kaltenbach)

Anuraphis farfarae (Koch)
A. subterranea (Walker)

Brachycaudus cardui (Linné)
B. helichrysi (Kaltenbach)
**B. klugkisti* (Börner)
**B. lateralis* (Walker)
B. lychnidis (Linné)
B. napelli (Oestlund)
***B. semisubterraneus* Börner
B. spiraeae (Oestlund)

**Appelia prunicola* (Kaltenbach)

Thuleaphis rumexicolens (Patch)

Holcaphis frequens (Walker)
**H. holci* Hille Ris Lambers

Aspidaphis adjuvans (Walker)

Hayhurstia atriplicis (Linné)

Brevicoryne brassicae (Linné)

Lipaphis erysimi (Kaltenbach)

**Hyadaphis foeniculi* (Passerini)

**Staegeriella necopinata* (Börner)

Decorosiphon corynothrix Börner

Hyalopteroides humilis (Walker)

Coloradoa abrotani (Koch)
C. absinthii (Lichtenstein)
C. achilleae Hille Ris Lambers
C. artemisiae (del Guercio)
C. inodorella Ossiannilsson
**C. rufomaculata* (Wilson)
**C. tanacetina* (Walker)

**Longicaudus trirhodus* (Walker)

Ericaphis ericae (Börner)

**E. latifrons* (Börner)

Myzaphis rosarum (Kaltenbach)

***Chaetosiphon fragaefolii* (Cockerell)
**C. potentillae* (Walker)
**C. tetrarhodus* (Walker)

Elatobium abietinum (Walker)

**Liosomaphis berberidis* (Kaltenbach)

Cavariella aegopodii (Scopoli)
C. archangelicae (Scopoli)
**C. konoi* Takahashi
C. pastinacae (Linné)
C. theobaldi (Gilette & Bragg)

**Jacksonia papillata* Theobald

**Ovatus insitus* (Walker)

Phorodon humuli (Schrank)

Rhopalomyzus lonicerae (Siebold)
R. poae (Gillette)

Myzus ascalonius Doncaster
M. cerasi (Fabricius)
**M. ornatus* Laing
M. padellus Hille Ris Lambers & Rogerson
M. persicae (Sulzer)

**Tubaphis ranunculinus* (Walker)

**Galiobium langei* Börner

**Vesiculaphis theobaldi* Takahashi

**Aspidaphium escherichi* Börner

Cryptomyzus alboapicallis (Theobald)
C. galeopsidis (Kaltenbach)
C. ribis (Linné)
Capitophorus carduinus (Walker)
**C. hippophaes* (Walker)
C. horni Börner
C. similis van der Goot

**Impatientum balsamines* (Kaltenbach)

Pleotrichophorus glandolosus (Kaltenbach)

Nasonovia altaensis Stenseth
***N. compositellae* (Theobald)
N. nigra Hille Ris Lambers
N. ribisnigri (Mosley)
N. vannesi Stenseth

Hyperomyzus lactucae (Linné)
H. pallidus Hille Ris Lambers
H. (Hyperomyzella) rhinanthi (Schouteden)

**Rhopalosiphoninus calthae* (Koch)
**R. heikinheimoi* (Börner)
**R. ribesinus* (van der Goot)
**R. staphyleae* (Koch)

*New to Norway

**New to Scandinavia.

SUBFAMILY MYZINAE (MORDVILKO) BÖRNER

CRYPTOSIPHUM Buckton, 1879

Cryptosiphum artemisiae Buckton, 1879

Published here for the first time from Norway.

AK:Ås: Vollebekk, trapped in yellow trays. I have not found the species on its host plant *Artemisia vulgaris*.

Geographical distribution: Europe. The species is known from Sweden, Denmark, Finland and Great Britain.

ACAUDINUM Börner, 1930

Acaudinum scabiosae Hille Ris Lambers, 1959

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Centaurea jacea*.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

CERURAPHIS Börner, 1926

Ceruraphis eriophori (Walker, 1848)

Published here for the first time from Norway.

HOy: Stord: Stokksund on *Carex* sp. 17. VII 1953, Fana: Paradis on *Viburnum* sp. 2. VI 1944, Revhaug on *Carex* sp. 15. IX 1952, Biological Station on *Rubus idaeus* 13. IX 1952, on *Rosa* sp. and *Rubus idaeus* 10. X 1959, and on *Sorbus aucuparia* and *Rubus idaeus* 23. IX 1961, Bergen: Solheim on *Viburnum* sp. 18. VI 1944.

Trapped in yellow trays: AK:Ås: Vollebekk, Ry: Hetland: Forus, HOy: Fana: Stend and Biological Station.

The specimens taken on *Rosa, Rubus* and *Sorbus* were all alatae and probably accidentally found on these hosts.

Geographical distribution: Europe. It is known from Sweden, Denmark. Finland and Great Britain.

DYSAPHIS Börner, 1931

Subgenus *DYSAPHIS* s.str.

Dysaphis (Dysaphis) anthrisci Börner, 1950

Published from Norway by Fjelddalen (1964) on *Malus pumila*.

Geographical distribution: Europe. It is known from Sweden, Finland and Great Britain.

Dysaphis (Dysaphis) crataegi (Kaltenbach, 1843)

Published from Norway by Fjelddalen (1964) from AK: Asker and SFi: Stryn on *Crataegus* spp.

Geographical distribution: Europe, Central Asia, North America. The species is known from Sweden, Denmark and Great Britain.

Dysaphis (Dysaphis) ranunculi (Kaltenbach, 1843)

Löw (1888): *Aphis oxyacanthae* Koch

The galls produced by this species on *Crataegus oxyacantha* are reported by Löw (1888) from TRy: Tromsøysund: Tromsdalen. This record is mentioned by Leatherdale (1959). Ossiannilsson (1962) reported the species from AK: Oslo and Fjelddalen (1964) from AK: Asker and SFi: Stryn.

Geographical distribution: Europe, Central Asia. It is known from Sweden, Denmark, Finland and Great Britain.

Subgenus *POMAPHIS* Börner, 1936

Dysaphis (Pomaphis) aucupariae (Buckton, 1879)

Published here for the first time from Norway.

Nsy: Bodin: Vågönes on *Avena sativa* (1 alate, accidentally) 2. VIII 1950. The specimen from Bodin was kindly identified by Dr. H. L. G. Stroyan.

Trapped in yellow trays: AK:Ås: Vollebekk and HOy: Fana: Stend.

Geographical distribution: Great Britain, Germany, Sweden.

Dysaphis (Pomaphis) maritima Hille Ris Lambers, 1955

Published here for the first time from Norway.

AK:Ås: Vollebekk trapped in yellow tray. The specimen was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Netherlands, Great Britain, Sweden.

Dysaphis (Pomaphis) plantaginea (Passerini, 1860)

Published from Norway by Fjelddalen (1964) from Bö, TEy, AAy, AAi, VAy, HOi, SFi on *Malus pumila*.

AK:Ås: Vollebekk trapped in yellow trays.

Geographical distribution: Europe, Asia, North America. It is known from Sweden, Denmark, Finland and Great Britain.

Dysaphis (Pomaphis) pyri (Boyer de Fonscolombe, 1841)

Published here for the first time from Norway.

AK:Ås: Vollebekk, HOy; Fana: Stend, both places trapped in yellow trays.

Geographical distribution: Europe, Asia. It is known from Sweden, Denmark and Great Britain.

Dysaphis (Pomaphis) sorbi (Kaltenbach, 1843)

Siebke (1874): *Aphis sorbi* Kaltenbach

Published from Norway by Siebke (1874) from AK: Oslo. The species is reported in the annual reports of the Government Entomologist, Schöyen (1922-41) from Nsy: Rödöy and Nnv: Andenes. Fjelddalen (1964) reports the species from Bö: Lier.

Ö: Hvaler: Reff on *Sorbus aucuparia* 4. VII 1953. AK: Ås: Monsrud on *Sorbus aucuparia* 9. VII 1967. VAy: Spangereid: Våge on *Sorbus aucuparia* 25. VII 1963. Ri: Suldal: Bråtveit on *Sorbus aucuparia* 9. VIII 1943. HOy: Stord: Stokksund on *Sorbus aucuparia* 17. VII 1953. Fana: Stend on *Sorbus aucuparia* 26. V 1947. HOi: Kvinnherad: Mel by sweeping 15. VI 1943, Rosendal on *Sorbus aucuparia* 4. VI 1964, Ulvik: Hjeltnes on *Prunus padus* 15. VIII 1958 (1 alate). Nnv: Sortland: Sortland on *Sorbus aucuparia* 16. VII 1950.

Trapped in yellow trays: AK:Ås: Vollebekk, Ry: Hetland: Forus, HOy: Stend and Biological Station.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

ANURAPHIS del Guercio, 1907

Anuraphis farfarae (Koch, 1854)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Tussilago farfara*.

AK: Ås: Vollebekk trapped in yellow trays.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

Anuraphis subterranea (Walker, 1852)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Heracleum*.

AK: Ås: Vollebekk trapped in yellow trays.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

BRACHYCAUDUS van der Goot, 1913

Brachycaudus cardui (Linné, 1758)

Siebke (1874): *Aphis cardui* Linné.

Published from Norway by Siebke (1874) from AK: Oslo. Ossiannilsson (1962) published

records from Bö and Fjelddalen (1964) from VE. Fjelddalen also records attacks, probably by this species, from TEy, HOy, SFi, MRi and NTi.

Ö: Hvaler: Reff on *Cirsium* sp. 24. VII 1944, on *Cirsium palustre* and *Cirsium vulgare* 12. VII 1945; near Hvaler church on *Senecio vulgaris* 6. VIII 1947. AK: Oslo on *Senecio vulgaris* VIII 1949 (sample sent me from the Norwegian Plant Protection Institute).

Trapped in yellow trays: AK: Ås: Vollebekk, HOy: Fana: Biological Station.

Geographical distribution: Europe, Asia, North America. It is known from Sweden, Denmark, Finland and Great Britain.

Brachycaudus helichrysi (Kaltenbach, 1843)

Siebke (1874): *Aphis helichrysi* Kaltenbach.

First published from Norway by Siebke (1874) from AK: Oslo. Later records have been published by Tambs-Lyche (1961), Ossiannilsson (1962), Fjelddalen (1964), Heikinheimo (1966), and Stenseth (1967).

AK: Ås: Vollebekk on *Senecio vulgaris* 22. VIII 1958. HOy: Fana: Biological Station on *Achillea millefolium* 5. VIII 1952, on *Matricaria inodora* 5. VIII 1954, on *Senecio vulgaris* 13. VIII 1954, on *Ribes nigrum* (accidentally) 26. IX 1958, on *Bellis perennis* 21. IX 1959 (alate ♂♂), Nesttun on *Senecio cruentus,* pot flower indoor 25. II 1961.

Trapped in yellow trays: AK: Ås: Vollebekk, Ry: Hetland: Forus, Klepp: Öksnevad, HOy: Fana: Stend and Biological Station.

Geographical distribution: Worldwide. It is known from Sweden, Denmark, Finland, Iceland and Great Britain.

Brachycaudus klugkisti (Börner, 1942)

Published here for the first time from Norway.

AAi: Bygland: Bygland on *Silene cucubalus* 13. VII 1967. HOy: Fana: Skjoldbukta 18. VI 1944 and Skjold 24. VI 1949, both localities on *Melandrium rubrum.*

Trapped in yellow trays: AK: Ås: Vollebekk, Ry: Hetland: Forus.

Geographical distribution: North and Central Europe. It is known from Sweden, Denmark, Finland and Great Britain.

Brachycaudus lychnidis (Linné), 1758

Siebke (1874): *Aphis lychnidis* Linné.

Published from Norway by Siebke (1874) from AK: Oslo. Heikinheimo (1966) published the species from SFi: Aurland.

On: Vågå: Vågåmo on *Silene venosa* 11. VII 1953, Skjervå on *Silene venosa* 12. VII 1953 (leg.C. Lindroth). HOy: Ullensvang: Aga on *Silene maritima* 15. VIII 1958. SFi: Luster: Skjolden on *Melandrium rubrum* 13. VII 1953.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

Brachycaudus napelli (Schrank, 1801)

Tambs-Lyche (1961): *Brachycaudina napelli* (Schrank)

Published from Norway by Tambs-Lyche (1961) and Fjelddalen (1964) from HEs: Grue. (leg. Fjelddalen).

Geographical distribution: Europe. It is known from Sweden, Denmark and Finland.

Brachycaudus semisubterraneus Börner, 1951

Published here for the first time from Norway and from Scandinavia.

HOi: Kvinnherad: Rosendal, host unknown, 1. VI 1957 (leg. A. Löken).

Trapped in yellow trays: HOy: Fana: Biological Station.

Geographical distribution: Europe. It is known from Great Britain.

Brachycaudus spiraea (Oestlund, 1887)

Published from Norway by Fjelddalen (1964) from TEy: Herefoss. He also mentions the record listed here.

Ö: Hvaler: Reff on *Spiraea salicifolia* 8. VII 1945.

Trapped in yellow trays: AK:Ås: Vollebekk.

Geographical distribution: Holarctic. It is known from Sweden, Denmark, Finland and Great Britain.

APPELIA Börner, 1930

Appelia prunicola (Kaltenbach, 1843)

Published here for the first time from Norway.

Ö: Hvaler: Huser on *Prunus spinosa* 21. VII 1944.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

THULEAPHIS Hille Ris Lambers, 1960

Thuleaphis rumexicolens (Patch, 1917)

Ossiannilsson (1962): *Brachycaudus rumexicolens* (Patch)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Rumex acetocella* and *Rumex domesticus*.

Trapped in yellow trays in AK: Ås: Vollebekk, Ry: Hetland: Forus, HOy: Fana: Stend.

The species occurred quite frequently in the traps but I have not found it on its host plants.

Geographical distribution: Europe, North America. It is known from Sweden, Finland and Great Britain.

HOLCAPHIS Hille Ris Lambers, 1939

Holcaphis frequens (Walker, 1848)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Agropyron repens*.

AK: ÅS: Vollebekk 12. IX 1955 (oviparae). HOy: Fana: Kuholmen 7. VI 1954, Biological Station 6. VI 1957 and 23. IX 1961 (oviparae). In all localities on unidentified grasses. Dr. Hille Ris Lambers kindly identified the specimens from Vollebekk.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

Holcaphis holci Hille Ris Lambers, 1959

Published here for the first time from Norway.

HOy: Fana: Biological Station on *Holcus mollis* 17. VII 1957. Colonies of apterae were found inside the rolled leaves.

Geographical distribution: Great Britain, Netherlands, Germany, Austria, Poland, Sweden, Denmark.

ASPIDAPHIS Gillette, 1917

Aspidaphis adjuvanus (Walker, 1848)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Polygonum aviculare*.

AK: Ås: Vollebekk, trapped in yellow trays.

Geographical distribution: Europe. It is known from Sweden and Great Britain.

HAYHURSTIA del Guercio, 1917

Hayhurstia atriplicis (Linné, 1761)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen.

Os: Fåberg: Opland agricultural school on potato (accidentally) 6. IX 1945 (ovipara). Ry: Klepp: Öksnevad on potato (accidentally) 22. VIII 1956. HOy: Fana: Biologholmen on *Atriplex* sp. 1. VIII 1956. HOi: Strandebarm: Oma on *Atriplex latifolia* 14. VIII 1958. MRy: Bremsnes: Bremsnes on *Atriplex* sp. 1. VII 1969.

Trapped in yellow trays: Ås: Vollebekk. Frogn: Röd. On: Öystre Slidre: Rudi. Ry: Hetland: Forus, Klepp: Öksnevad. HOy: Fana: Stend and Biological Station. The specimens from Frogn and Öystre Slidre were trapped by Leif Sundheim. The species was very frequently caught in the traps.

Geographical distribution: Europe, Asia, North America. It is known from Sweden, Denmark, Finland and Great Britain.

BREVICORYNE van der Goot, 1915

Brevicoryne brassicae (Linné, 1758)

Attacks by this species are reported in the annual reports of the Government Entomologist, see Fjelddalen (1964) who also gives records from Ö: Öymark, AK: Ås, Bö: Modum, and AAy: Fjære.

Bö: Modum: Buskerud agricultural school on *Brassica napus* var. *napobrassica* 9. VIII 1945.

Geographical distribution: Cosmopolitan. It is known from Sweden, Denmark, Finland, Great Britain and Iceland.

LIPAPHIS Mordvilko, 1938

Lipaphis erisymi (Kaltenbach, 1843)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen.

AK: Ås: Vollebekk 12. IX 1955. On: Vågå: Vågåmo 11. VII 1953. HOy: Fana: Biological Station 27. VII 1953. All finds on *Capsella bursa pastoris*.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Klepp: Öksnevad.

Geographical distribution: Cosmopolitan. It is known from Sweden, Denmark, Finland and Great Britain.

HYADAPHIS Kirkaldy, 1904

Hyadaphis foeniculi (Passerini, 1860)

Published here for the first time from Norway.

Ö: Hvaler: Botne 7. VIII 1947, Reff 11. VIII 1947, both places on *Pimpinella saxifraga*.

Trapped in yellow trays: AK: Ås: Vollebekk.

Geographical distribution: Europe, Asia, North America, Australia. It is known from Sweden, Denmark, Finland and Great Britain.

STAEGERIELLA Hille Ris Lambers, 1947

Staegeriella necopinata (Börner, 1939)

Published here for the first time from Norway.

AK: Ås: Vollebekk, trapped in yellow trays.

I have not found the species on its host plants *Galium* spp. The single specimen caught in the yellow tray was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Switzerland, Germany, Great Britain, Sweden and Finland.

DECOROSIPHON Börner, 1939

Decorosiphon corynothrix Börner, 1939

Published from Norway by Tambs-Lyche (1955), without giving any localities.

HOy: Fana: Ospöya 28. VII 1952, Löningehamn 17. IX 1957, Biological Station 25. IX 1963. In all localities on *Polytrichum* sp.

The first specimen sampled on Ospöya was found by letting the moss dry in a vessel, the aphid was then found walking on the bottom. In the two other localities the aphids were collected on the plants. They were living on the lower parts of the stems, where the moss-leaves were brownish. No sexuales were found, even if the samples were taken in September.

Geographical distribution: Germany, Great Britain, Sweden, Denmark and Finland.

HYALOPTEROIDES Theobald, 1916

Hyalopteroides humulis (Walker, 1852)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Dactylis*.

HOy: Fana: Biological Station on *Dactylis glomerata* 11. VI 1956.

Trapped in yellow trays: HOy: Fana: Stend and Biological Station.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

COLORADOA Wilson, 1910

Coloradoa abrotani (Koch, 1954)

Published from Norway by Ossiannilsson (1962) from AK: Oslo on *Artemisia abrotanum*.

Geographical distribution: Germany and Sweden.

Coloradoa absinthii (Lichtenstein, 1885)

Published from Norway by Ossiannilsson (1962) from VE: Strömm on *Artemisia absinthium*.

Geographical distribution: Europe. It is known from Sweden and Great Britain.

Coloradoa achilleae Hille Ris Lambers, 1939

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Achillea millefolium*.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

Coloradoa artemisiae (del Guercio, 1913)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Artemisia vulgaris*.

Geographical distribution: Europe, Israel. It is known from Sweden, Denmark, Finland and Great Britain.

Coloradoa inodorella Ossiannilsson, 1959

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Matricaria inodora*.

Geographical distribution: Sweden.

Coloradoa rufomaculata (Wilson, 1908)

Published here for the first time from Norway.

AK: Asker: Volden and Stålenga 14. IV 1945, in both localities on *Chrysanthemum* spp. in greenhouses (leg. J. Teigland).

Geographical distribution: Cosmopolitan in greenhouses. It is known from Sweden, Finland and Great Britain.

Coloradoa tanacetina (Walker, 1850)

Published here for the first time from Norway.

AK: Ås: Vollebekk trapped in yellow tray. One single alate which was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

LONGICAUDUS van der Goot, 1913

Longicaudus trirhodus (Walker, 1849)

Published here for the first time from Norway.

HOy: Bergen 15. VI 1961. HOi: Ullensvang: Börve 11. V 1950 (fund.), Granvin: Granvin 27. VIII 1944. MRi: Rindal: Övre Rindal 5. VI 1948 (leg. Hans Tambs-Lyche). NTy: Otteröy: Otteröy 31. V 1948 (leg. Hans Tambs-Lyche). In all localities on *Rosa* spp.

Geographical distribution: Europe, North America. It is known from Sweden, Denmark and Great Britain.

ERICAPHIS Börner, 1939

Ericaphis ericae (Börner, 1933)

Published from Norway by Tambs-Lyche (1955) without giving any localities.

HOy: Austevoll: Store Karlsöy 31. VII 1957. Fana: Kuholmen 20. IX 1952 (oviparae), Nordre Eggholmen 11. VIII 1954, Spikaren 16. VIII 1961, Herdla: Turöy 9. VII 1954. HOi: Kvinnherad: Uppsangerneset 30. VII 1949. In all localities on *Erica tetralix*.

Geographical distribution: Germany, Netherlands, Great Britain, Sweden, Denmark and Finland.

Ericaphis latifrons (Börner, 1942)

Published here for the first time from Norway.

VAy: Mandal: Furulunden 24. VII 1963. Fn: Kistrand: Smörstad in Lakselv 6. VII 1955. Fö: Sör-Varanger: Örnevann 11. VII 1955. In all localities on *Empetrum* sp., probably *Empetrum niger*.

The distribution in Norway may seem peculiar, since two of the localities are in the northernmost part of the country and one locality in the most southern part. There is, however, a similarity between these localities. The plants grew in a dry sandy soil. I have examined *Empetrum* on several other localities, especially in the western parts of the country, but I have never succeeded in finding the spelies; *Empetrum* was always growing on other types of soil.

Geographical distribution: Germany, Austria, Great Britain, Sweden, Denmark and Iceland.

MYZAPHIS van der Goot, 1918

Myzaphis rosarum (Kaltenbach, 1843)

Siebke (1874): *Aphis rosarum* Kaltenbach.

Published from Norway by Siebke (1874) from AK: Oslo.

Os: Östre Toten: Valle agricultural school on *Rosa* sp. 30. VII 1945.

Trapped in yellow trays: AK: Ås: Vollebekk.

Geographical distribution: Europe, North America, Asia, South Africa, New Zealand. It

is known from Sweden, Denmark, Finland and Great Britain.

CHAETOSIPHON Mordvilko, 1914

Chaetosiphon fragaefolii (Cockerell, 1901)

Published here for the first time from Norway and from Scandinavia.

AK: Ås: Vollebekk trapped in yellow trays.

Geographical distribution: Europe, North America, Argentine, Eritrea, Palestine, New Zealand. It is known from Great Britain.

Chaetosiphon potentillae (Walker, 1850)

Published here for the first time from Norway.

HOy: Fana: Nordre Eggholmen 18. VIII 1961. HOi: Strandebarm: Oma 14. VIII 1958. In both localities on *Potentilla anserina.*

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

Chaetosiphon tetrarhodus (Walker, 1849)

Published here for the first time from Norway.

Bö: Kongsberg: Saggrenda 13. VIII 1945. HOy: Lindås: Lygra 14. VII 1948. In both localities on *Rosa* sp.

Geographical distribution: Europe, North America, Palestine, Egypt, India. It is known from Sweden, Denmark and Great Britain.

ELATOBIUM Mordvilko, 1914

Elatobium abietinum (Walker, 1849)

Theobald (1926): *Neomyzaphis abietina* (Walker). Tambs-Lyche 1957b: *Liosomaphis abietina* (Walker).

Published from Norway by Theobald (1926) from HOi: Odda. Tambs-Lyche (1957b) published finds from HOy: Fana and Bergen and from Hoi: Voss. Kloft et al. (1964) published finds from Rogaland, Hordaland, Sogn and Fjordane and Möre and Romsdal.

AK: Kråkstad: Kolstad on *Picea abies* 9. VIII 1967. HOy: Fana: Biological Station on *Picea abies* 26. VII 1957, 9. VIII 1957 and 5. VI 1961, Ramstad on *Picea engelmanni* 26. VIII 1957, Sele on *Picea sitchensis* 27. VII 1957, Espeland on *Picea abies* 30. VII 1957, Bergen: Botanical garden on young *Picea*-plants in greenhouse 28. IX 1945. HOi: Kvinnherad: Hatteberg on *Picea abies* 4. VI 1964, Voss: Björgum and Bavallen on *Picea abies* 4. VIII 1957.

Geographical distribution: Europe, North America, Japan, New Zealand. It is known from Sweden, Denmark, Finland, Great Britain and Iceland

LIOSOMAPHIS Walker, 1868

Liosomaphis berberidis (Kaltenbach, 1843)

Published here for the first time from Norway.

HOy: Fana: near Fana church on *Berberis thunbergi* 5. X 1963 (oviparae).

Geographical distribution: Europe, North America. It is known from Sweden, Denmark, Finland and Great Britain.

CAVARIELLA del Guercio, 1911

Cavariella aegopodii (Scopoli, 1763)

Published from Norway by Tambs-Lyche (1957a). More records were listed by Tambs-Lyche (1961), Ossiannilsson (1962) and Fjelddalen (1964).

VE: Brunlanes: Klever on *Salix* sp. 28. VII 1944. HOy: Fana: Stend on *Salix caprea* 4. VI 1947, Biological Station on *Angelica silvestris* 29. VII 1952 and on *Anthriscus silvestris* 8. VI 1954, Ådland on *Anthriscus* sp. 5. IX 1952, Festevik on *Geranium robertianum* (accidentally) 21. VI 1959, Spikaren on *Potentilla anserina* (accidentally) 16. VIII 1961, Bergen: Övregaten on *Salix* sp. 5. VI 1954 (leg. Hans Tambs-Lyche). HOi: Röldal: Svandalsflona on grasses (accidentally) 30. VIII 1959, Ullensvang: Aga on *Ligusticum scoticum* 15. VIII 1958. Nnö: Narvik: Narvik on *Anthriscus silvestris* 17. VII 1955 (leg. L. Cederholm). TRy: Tromsöysund: Storsteinnes on *Anthriscus silvestris* 26. VII 1955 (leg. L. Cederholm), Tromsö: Tromsöya on *Carum carvi* 21. VII 1955 (leg. L. Cederholm).

Trapped in yellow trays: AK: Ås: Vollebekk,

Ry: Hetland: Forus, HOy: Fana: Stend and Biological Station.

Geographical distribution: Worldwide. It is known from Sweden, Denmark, Finland, Great Britain and Iceland.

Cavariella archangelicae (Scopoli, 1763)

? Siebke (1874): *Aphis capreae* Fabricius

Siebke (1874) published *Aphis capreae* Fabricius from AK: Oslo, but since I have not seen his material it is impossible to say for certain if he meant this species or one of the other *Cavariella* species. Theobald (1926) published the species from HOy: Bergen. Tambs-Lyche (1957a) gave records from TRy: Tromsöysund and TRi: Sörreisa.

VE: Brunlanes: Klever on *Angelica silvestris* 28. VII 1944. HOy: Fana: Söndre Eggholmen on *Angelica silvestris* 7. IX 1952, Flesland by thrashing Umbelliferae 15. IX 1952. Nsy: Mosjöen: Nyrud on *Salix* sp. 4. VII 1950.

Trapped in yellow trays: AK: Ås: Vollebekk.

Geographical distribution: Europe, North America, Australia. It is known from Sweden, Denmark, Finland, Great Britain and Iceland.

Cavariella konoi Takahashi, 1939

Published here for the first time from Norway.

HOy: Fana: Söndre Eggholmen on *Angelica silvestris* 7. IX 1952. Nnö: Evenes: Liland on *Salix* sp. 18. VII 1950. TRy: Tromsöysund: Storsteinnes 30. VII 1950.

Trapped in yellow trays: AK: Ås: Vollebekk.

Geographical distribution: Japan, Europe, North America. It is known from Sweden, Finland, Great Britain and Iceland.

Cavariella pastinacae (Linné, 1758)

Published from Norway by Tambs-Lyche (1957a).

On: Vågå: Sandbu on *Salix* sp. 11. VII 1953. HOy: Bömlo: Langevågen on *Heracleum sphondyleum* 12. VIII 1958. Nsy: Tjötta: Tjötta on *Heracleum sibiricum* 3. VIII 1950. Nnö: Evenes: Liland on *Salix phylicifolia* 18. VIII 1950.

Trapped in yellow trays: AK: Ås: Vollebekk, HOy: Fana: Biological Station.

Geographical distribution: Europe, Asia. It is known from Sweden, Denmark, Finland and Great Britain.

Cavariella theobaldi (Gillette and Bragg, 1918)

Tambs-Lyche (1957a): *Cavariella umbellatarum* (Koch)

Published from Norway by Tambs-Lyche (1957a) from TRy: Kvæfjord and TRi: Målselv. Ossiannilsson (1962) recorded the species from AK: Oslo and Bö: Drammen.

Ö: Hvaler: Reff on *Salix* sp. 25. VII 1944, Botne on *Pastinaca sativa* 31. VII 1947. Ry: Klepp: Öksnevad on *Salix* sp. 29. VIII 1955. HOy: Fana: Rådal on *Salix* sp. 16. VII 1954, Festevik on *Salix* sp. 21. VI 1959, Bergen: Botanical garden on *Salix* sp. 6. VI 1944. HOi: Voss: Mjölfjell on *Salix* sp. 21. VII 1953. TRi: Bardu: Andselv on *Salix* sp. 21. VII 1950, Målselv: Moen on *Salix* sp. 21. VII 1950, Olsborg on *Salix nigricans* 21. VII 1950, Tromsöysund: Storsteinnes on *Salix* sp. 30. VII 1950.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus. HOy: Fana: Stend and Biological Station.

Geographical distribution: Europe, North America. It is known from Sweden, Denmark, Finland and Great Britain.

JACKSONIA Theobald, 1923

Jacksonia papillata Theobald, 1923

Published here for the first time from Norway.

HOy: Fana: Stend and Biological Station trapped in yellow trays.

Geographical distribution: Great Britain, Netherlands, Germany, Italy, Sweden and Iceland.

OVATUS van der Goot, 1913

Ovatus insitus (Walker, 1849)

Published here for the first time from Norway.

AK: Ås: Vollebekk trapped in yellow tray.

The single alate specimen was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Europe, Asia. It is known from Sweden, Denmark and Great Britain.

PHORODON Passerini, 1860

Phorodon humuli (Schrank, 1801)

Siebke (1874): *Aphis humuli* Schrank.

Published from Norway by Siebke (1874) **from AK**. Fjelddalen (1964) published records **from AK**, HEs and NTi.

HOi: Granvin: Granvin on *Prunus domestica* 27. VIII 1944. NTi: Skogn: Staup on *Prunus domestica* 10. VII 1950.

Trapped in yellow trays: AK: Ås: Vollebekk. **Ry**: Hetland: Forus. HOy: Fana: Stend and **Biological** Station.

Geographical distribution: Europe, Asia, **North** America. It is known from Sweden, **Denmark**, Finland and Great Britain.

RHOPALOMYZUS Mordvilko, 1921

Rhopalomyzus lonicerae (Siebold, 1839)

Published from Norway by Fjelddalen (1964) from AK: Ås: Oslo and Bærum, and from TEy: Holla on *Lonicera* spp.

VAy: Spangereid: Våge on *Galeopsis tetrahit* (accidentally) 25. VII 1963. HOi: Ulvik: Hjeltnes on *Phalaris arundinacea* 15. VIII 1958.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

Rhopalomyzus poae (Gillette, 1908)

Published from Norway by Fjelddalen (1964) from AK: Ås from *Lonicera alpigena*.

AK: Ås: Vollebekk, trapped in yellow trays. Apart from alate viviparae, 1 alate ♂ was trapped 5. IX 1956.

Geographical distribution: North America, Netherlands, Switzerland, Germany, Great Britain, Sweden and Finland.

MYZUS Passerini, 1860

Myzus ascalonius Doncaster, 1946

Published from Norway by Tambs-Lyche (1961), more detailed information is given below. Fjelddalen (1964) published records from Ö, VE, Ry and NTi.

Ry: Klepp: Öksnevad on *Cerastium tomentosum* 29. IV 1955. HOy: Fana: Biological Station on potato sprouts indoor 5. VIII 1952, on *Allium porrum* indoor 24. II 1954, on *Allium schoenoprasum* indoor IV 1954.

Trapped in yellow trays: Ry: Hetland: Forus. HOy: Fana: Stend.

Geographical distribution: Europe, North America. It is known from Sweden, Denmark, Finland, Great Britain and Iceland.

Myzus cerasi (Fabricius, 1775), sensu latiore

Siebke (1874): *Aphis cerasi* Fabricius, *Aphis apparines* Kaltenbach.

Published from Norway by Siebke (1874), later records by Tambs-Lyche (1961), Ossiannilsson (1962) and Fjelddalen (1964).

Ö: Hvaler: Reff on *Prunus avium* 9. VII 1944 and on *Prunus cerasus* 12. VII 1944. VE: Tjöme: Hulebak on *Prunus avium* 31. VII 1944, Larvik on *Prunus avium* 28. VII 1944. HOy: Fana: Biological Station on *Prunus avium* 1. X 1962. HOi: Kvinnherad: Skeie on *Prunus avium* 11. VIII 1944, Langgoto on *Prunus cerasus* 22.VIII 1944.Ullensvang: Århus on *Prunus avium* 23. V 1950, Aga on *Prunus avium* 15. VIII 1958.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus. HOy: Fana: Stend and Biological Station.

Geographical distribution: Nearly all over the world. It is known from Sweden, Denmark, Finland and Great Britain.

Myzus padellus Hille Ris Lambers & Rogerson, 1946

Published from Norway by Tambs-Lyche (1957a).

STi: Strinda: Voll on *Galeopsis* sp. 8. VII 1950, on *Prunus padus* 8. VII 1950, 30. VIII 1961, 6. IX 1961, 14. IX 1961 (oviparae), 19. IX 1961 (ovipara) and 27. IX 1961 (oviparae) (the last four records, leg. Vidar Jetne). NTi: Stjördal: Kvithamar on *Galeopsis tetrahit* 9. VII 1950. Nsy: Bodin: Nordland agricultural school on *Galeopsis tetrahit* 2. VII 1950.

Geographical distribution: Great Britain, Austria, Sweden, Finland. In Norway the most southern locality is Strinda just outside Trondheim. In Sweden it is not found south of Härjedalen — Medelpad, that is about the same latitude as the most southern locality in Norway. *Prunus padus* and *Galeopsis* spp. are common plants all over the country.

Myzus ornatus Laing, 1932

Published here for the first time from Norway.

AK: Ås: Vollebekk trapped in a yellow tray, 1 single alate.

Geographical distribution: Europe, U.S.A. It is known from Sweden, Denmark, Finland and Great Britain.

Myzus persicae (Sulzer, 1776)

First published from Norway by Tambs-Lyche (1950, 1957a), more records are given by Ossiannilsson (1962), Fjelddalen (1964), and Stenseth (1967). Additional records are listed below. The author intends to give a survey of the occurrence in the yellow traps in a separate paper.

AK: Ås: Vollebekk on *Fumaria officinalis, Senecio vulgaris* and potato 12. IX 1955, Ås on *Stachys palustris* 11. VIII 1965 (leg. Heikinheimo). Ry: Klepp: Öksnevad on potato 29. VIII 1955 and 22. VIII 1956. HOy: Fana: Skjold on *Chrysanthemum* sp. indoor 6. I 1962, Bergen on *Begonia* sp. indoor VI 1962.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus.

Geographical distribution: Cosmopolitan. It is known from Sweden, Denmark, Finland and Great Britain.

TUBAPHIS Hille Ris Lambers, 1947

Tubaphis ranunculinus (Walker, 1952)

Published here for the first time from Norway.

HOy: Fana: Biological Station on *Ranunculus acris* 11. VIII 1956.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus. HOy: Stend and Biological Station.

The species occurred quite frequently in the traps, but I have only found it once on its host plant. The aphids were quite numerous, but no colonies were built. The small yellow apterae were scattered on the leaves, mostly on the lower ones.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

GALIOBIUM Börner, 1933

Galiobium langei Börner, 1933

Published here for the first time from Norway.

HOy: Fana: Biological Station on *Galium* sp. 15. VIII 1961.

Geographical distribution: Europe. It is known from Great Britain and Sweden.

VESICULAPHIS del Guercio, 1911

Vesiculaphis theobaldi Takahashi, 1930

Published here for the first time from Norway.

AK: Ås: Vollebekk, trapped in yellow tray. The specimen was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Great Britain, Germany, Netherlands, Sweden.

ASPIDAPHIUM Börner, 1939

Aspidaphium escherichi Börner, 1939

Published here for the first time from Norway.

HOy: Stord: Storsöy 15. V, 20. VI and 10. VII 1966 (leg. B. Kvamme).

The aphids, which belong to the collection from the Zoological Museum, Bergen, were collected during an investigation of soil fauna carried out by Brynjulv Kvamme. The results are not yet published, but B. Kvamme has very kindly let me use the information given in litt. The vegetation consisted of *Vaccinium myrtillus, Deschampsia flexuosa* and mosses. After the *Vaccinium* had been cut away, samples from the bottom layer of the vegetation were placed in Tullgren funnels. The mosses

growing in the area were mainly the following: *Hylocomium splendens, Dicranum majus, Ptilium crista-castrensis* and *Plagiochila asplenioides*. One or more of these moss species must be the host of *Aspidaphium escherichi*. The samples contained several apterae and some larvae.

Geographical distribution: Germany, Great Britain and Sweden.

CRYPTOMYZUS Oestlund, 1922

Cryptomyzus alboapicallis (Theobald, 1916)

Tambs-Lyche (1950): *Rhopalosiphon alboapicallis* Theobald.

Published from Norway by Tambs-Lyche (1950) from Bö: Hurum.

AK: Ås: Vollebekk, trapped in yellow tray. The specimen from the trap was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Great Britain, Netherlands, Germany and Sweden.

Cryptomyzus galeopsidis (Kaltenbach, 1843)

Published from Norway by Tambs-Lyche (1957a). More records are given by Ossiannilsson (1962) and Heikinheimo (1966).

AK: Ås: Vollebekk on *Galeopsis tetrahit* 12. IX 1955 (Alate ♂). Os: Östre Toten: Valle agricultural school on *Ulmus* sp. (accidentally, alate ♂) 30. VII 1945. TE: Sauherad: Årnes on potato 17. VIII 1945. VAy: Spangereid: Våge on *Galeopsis tetrahit* 25. VII 1963. HOy: Fana: Biologholmen on *Galeopsis bifida* 8. VIII 1952, Stend on *Galeopsis* sp. 29. VI 1954. STi: Strinda: Vold on *Galeopsis* sp. 30. VIII 1961. Nsy: Tjötta: Tjötta on *Ribes rubrum* 3. VIII 1950, Bodin: Nordland agricultural school on *Galeopsis tetrahit* 2. VIII 1950. Nsi: Mo: Selfors on *Galeopsis tetrahit* 11. VII 1950. Nnv: Hadsel: Stokmarknes on *Ribes rubrum* 15. VII 1950, Sortland: Sortland on *Galeopsis tetrahit* 16. VII 1950. TRy: Kvæfjord: Voktor on *Galeopsis tetrahit* 17. VII 1950.

Trapped in yellow trays: AK: Ås: Vollebekk, Ry: Hetland: Forus, Klepp: Öksnevad, HOy: Fana: Stend and Biological Station.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland, Great Britain and Iceland.

Cryptomyzus ribis (Linné, 1778)

Siebke (1874): *Aphis ribis* Linné.

First published from Norway by Siebke (1874). The species is frequently mentioned in the annual reports of the Government Entomologist (Schöyen, W. M. 1893-1912, Schöyen T. H. 1914-1921, 1922-1941). Further records by Tambs-Lyche (1950), Leatherdale (1959), Ossiannilsson (1962) and Fjelddalen (1964).

Ö: Hvaler: Brenne, host unknown 10. VIII 1947. AK: Ås: Vollebekk on *Stachys palustris* 12. IX 1955. Os: Östre Toten: Hallingstad on *Ribes* sp. 29. VII 1945. Bö: Modum: Buskerud agricultural school on *Ribes rubrum* 9. VIII 1945. VAy: Mandal: Mandal on *Ribes rubrum* 25. VII 1963. HOy: Bömlo: Espevær on *Stachys palustris* 11. VIII 1958.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus. HOy: Fana: Stend and Biological Station.

Geographical distribution: Palaearctic, but transported to other parts of the world. It is known from Sweden, Denmark, Finland and Great Britain.

CAPITOPHORUS van der Goot, 1913

Capitophorus carduinus (Walker, 1850)

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Cirsium lanceolatum*.

Trapped in yellow trays: AK: Ås: Vollebekk. HOy: Fana: Stend, Biological Station and Nordre Eggholmen.

Geographical distribution: Great Britain, Netherlands, Germany, Poland, Sweden and Denmark.

Capitophorus hippophaes (Walker, 1852)

Published here for the first time from Norway.

Ry: Hetland: Forus on *Polygonum persicaria* 30. VIII 1955.

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus. HOy: Fana: Stend and Biological Station.

Geographical distribution: Probably hol-

arctic. It is known from Great Britain, Sweden, Denmark and Finland.

Capitophorus horni Börner, 1931

Published from Norway by Ossiannilsson (1962) from Bö: Drammen on *Cirsium palustre*.

AK: Ås: Vollebekk on *Cirsium arvense* 12. IX 1955 (oviparae and alate ♂).

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Klepp. Öksnevad.

Geographical distribution: Germany, Netherlands, Great Britain and Sweden.

IMPATIENTUM Mordvilko, 1914

Impatientum balsamines (Kaltenbach, 1862)

Published here for the first time from Norway.

AK: Ås: Vollebekk, trapped in yellow tray. The specimen was kindly identified by Dr. V. F. Eastop.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

PLEOTRICHOPHORUS Börner, 1930

Pleotrichophorus glandulosus (Kaltenbach, 1846)

First published from Norway by Ossiannilsson (1962) from Bö: Drammen. Heikinheimo (1966) published the species from SFi: Aurland.

VAy: Mandal: Mandal on *Artemisia vulgaris* 25. VII 1963.

Trapped in yellow trays: AK: Ås: Vollebekk.

Geographical distribution: Europe, Asia. It is known from Sweden, Denmark, Finland and Great Britain.

NASONOVIA Mordvilko, 1914

Nasonovia altaensis Stenseth, 1969

The species was described by Stenseth (1969) from Fi: Alta: Aronnes on *Thalictrum rariflorum*.

Nasonovia compositellae (Theobald, 1924)

Published here for the first time from Norway and from Scandinavia.

HOy: Fana: Rådal on *Hieracium* sp. 8. VI 1954, Kolavatn on *Hieracium* sp. 12. VI 1955.

Geographical distribution: Great Britain and Iceland.

Nasonovia nigra Hille Ris Lambers, 1931

Published here for the first time from Norway.

HOi: Kvinnherad: Sundevågen on *Hieracium* sp. 3. VIII 1949.

Geographical distribution: Europe. It is known from Sweden, Finland and Great Britain.

Nasonovia ribisnigri (Mosley, 1841)

First published from Norway by Tambs-Lyche (1961). Ossiannilsson (1962) and Fjelddalen (1964) have published records of the species. Siebke (1874) records *Aphis hieracii* Kaltenbach which may be this species, but there is also a possibility that it is one of the other *Hieracium*-infesting *Nasonovia* spp. I have not seen Siebkes material.

AK: Ås: Vollebekk on *Veronica agrestis* 22. VII 1958. Bö: Övre Eiker: Horgen on *Cichorium intybus* 8. VIII 1945. TEi: Vinje: Haukeligrend on *Hieracium* sp. 31. VII 1959. Ry: Klepp: Öksnevad on *Leontodon autumnale* 29. VIII 1955. HOy: Fana: Ådland on *Euphrasia* sp. 5. IX 1952. Biological Station on *Veronica chamaedrys* 9. VI 1953, caught flying 23. VIII 1953, on *Ribes grossularia* 28. V 1959, Rådal on *Hieracium* sp. 6. VII 1954, Stend on *Hieracium* sp. 9. VII 1954 and on *Leontodon autumnale* 26. VIII 1955, Milde on *Veronica officinalis* 13. VIII 1956, Espeland on *Ribes grossularia* 19. V 1959, Festevik on *Hieracium* sp. 21. VI 1959, Spikaren on *Veronica officinalis* 16. VIII 1961, Bergen: Botanical garden on *Picris hieracioides* and *Hieracium rubrum* 15. VI 1961. HOi: Kvinnherad: Veavik, host unknown, 10. VII 1943, Röldal: Svandalsflona on *Hieracium alpinum* 30. VII 1954.

Geographical distribution: Europe, North

America. It is known from Sweden, Denmark, Finland and Great Britain.

Nasonovia vannesi Stenseth, 1968

The species was described by Stenseth (1968) from Fa: Vadsö on *Ribes x cultorum*.

HYPEROMYZUS Börner, 1933

Hyperomyzus lactucae (Linné, 1758)

Siebke (1874): *Aphis lactucae* Linné.

First published from Norway by Siebke (1874) from AK: Oslo. Records given by Tambs-Lyche (1957a), Leatherdale (1959) and Fjelddalen (1964).

Ö: Hvaler: Botne on *Sonchus asper* 24. VII 1944. AK: Ås: Vollebekk on *Sonchus arvensis* 12. IX 1955. Os: Brandbu: Grinaker on *Sonchus arvensis* 3. VIII 1945. HOy: Austevoll: Bakkasund on *Sonchus asper* 29. VIII 1952, Fana: Östre Löholmen on *Sonchus oleraceus* 20. IX 1952, Stend on *Leontodon autumnale* 26. VIII 1955, Bergen: host unknown 17. VIII 1965 (leg. O. Heikinheimo).

Trapped in yellow trays: AK: Ås: Vollebekk. HOy: Fana: Stend and Biological Station.

Geographical distribution: Europe, North and South America. It is known from Sweden, Denmark, Finland and Great Britain.

Hyperomyzus pallidus Hille Ris Lambers, 1935

Published from Norway by Ossiannilsson (1962) from VE: Strömm on *Sonchus arvensis*.

HOy: Fana: Biological Station on *Ribes nigrum* 26. IX 1958. NTi: Skogn: Staup on *Ribes grossularia* 10. VII 1950.

Geographical distribution: Europe, U.S.A. It is known from Sweden, Denmark, Finland and Great Britain.

Hyperomyzus rhinanthi (Schouteden, 1903)

First published from Norway by Fjelddalen (1964) from TEy: Holla and SFi: Luster. Heikinheimo (1966) published the species from SFi: Aurland.

VAy: Spangereid: Våge by thrashing mixed vegetation 25. VII 1963. On: Vågå: Besstrondi on *Rhinanthus minor* 29. VIII 1968. SFi: Aurland: Nyheim, host unknown, 19. VII 1939 (leg. N. Knaben).

Trapped in yellow trays: AK: Ås: Vollebekk. Ry: Hetland: Forus. HOy: Fana: Stend and Biological Station.

Geographical distribution: Europe. It is known from Sweden, Denmark, Finland and Great Britain.

RHOPALOSIPHONINUS Baker, 1920

Rhopalosiphoninus calthae (Koch, 1854)

Published here for the first time from Norway.

HOy: Fana: Biological Station on *Caltha palustris* 11. V 1959.

Trapped in yellow trays: AK: Ås: Vollebekk. HOy: Fana: Stend.

Geographical distribution: Europe. It is known from Sweden, Denmark and Great Britain.

Rhopalosiphoninus heikinheimoi (Börner, 1952)

Published here for the first time from Norway.

AK: Ås: Vollebekk, trapped in yellow tray.

Geographical distribution: Germany, Netherlands, Great Britain and Sweden.

Rhopalosiphoninus ribesinus (van der Goot, 1912)

Published here for the first time from Norway.

Ry: Hetland: Forus. HOy: Fana: Biological Station, both places trapped in yellow trays.

Geographical distribution: Europe. It is known from Sweden and Great Britain.

Rhopalosiphoninus staphyleae (Koch, 1854)

Published here for the first time from Norway.

AK: Ås: Vollebekk. HOy: Fana: Biological Station, both places trapped in yellows trays.

Geographical distribution: Europe. It is known from Sweden and Great Britain.

ADDENDUM TO PART I

Two more species are here added to the list in Part I, Tambs-Lyche (1968), of the subfamily *Dactynotinae*. One of them was by a mistake omitted in Part I, the other is a species new to Norway.

ANTHRACOSIPHON Hille Ris Lambers, 1947

Anthracosiphon hertae Hille Ris Lambers, 1947

Published from Norway by Ossiannilsson (1962) from VE: Strömm on *Potentilla anserina*.

Geographical distribution: Netherlands, Sweden and Great Britain.

MICROSIPHUM Cholodkovsky, 1908

Microsiphum millefolii Wahlgren, 1940

Published here for the first time from Norway.

AAy: Tromöy: Sandum on *Achillea millefolium* 12. VII 1967.

The aphids were found very low on the stem, but they were not subterranean. They occurred as colonies of apterae attended by ants.

Geographical distribution: Sweden, Great Britain.

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Habitat Choice and Life History of Bembidiini (Col., Carabidae) on River Banks in Central and Northern Norway

JOHAN ANDERSEN

Andersen, J. 1969. Habitat choice and life history of Bembidiini (Col., Carabidae) on river banks in central and northern Norway. *Norsk ent. Tidsskr. 17,* 17–65.

Habitat preference and life history of Bembidiini on river banks in central and northern Norway were studied using quadrat-sampling and time-catch, and by examination of ovaries and rearing of eggs and larvae. Although usually found in more than one habitat, most species preferred and reproduced in one or a few of them. Habitat choice was largely independent of weather conditions, season, and geographical position of investigated areas. Most species mainly hibernated as adults, but several sometimes as larvae or pupae; *Bembidion lunatum* Dft. exclusively as larvae, *Asaphidion pallipes* Dft. as larvae and adults, and *Bembidion hasti* Sahlb. probably in any stage.

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CONTENTS

INTRODUCTION

The aims of the present work were to investigate the habitat preference and life history of the tribe Bembidiini occurring on river banks in central and northern Norway.

Preliminary investigations showed that most species occurred in more than one habitat, and it was found necessary to estimate the relative or absolute abundance of the species in different habitats. The habitat choice of the species has been studied mainly by Lindroth (1945), but no quantitative methods were used.

Like Larsen (1936), my opinion is that even though a species occasionally occurs in several habitats, only those where it reproduces are to be regarded as its true habitats. Samples taken during or immediately after inundations were not considered, therefore, in evaluation of habitat choice.

The life histories were studied by Larsson (1939) and Lindroth (1945). For most of the species their conclusions were based on occurrence of fully hardened and teneral specimens. In the present study information was also obtained about occurrence of larvae and of the breeding season.

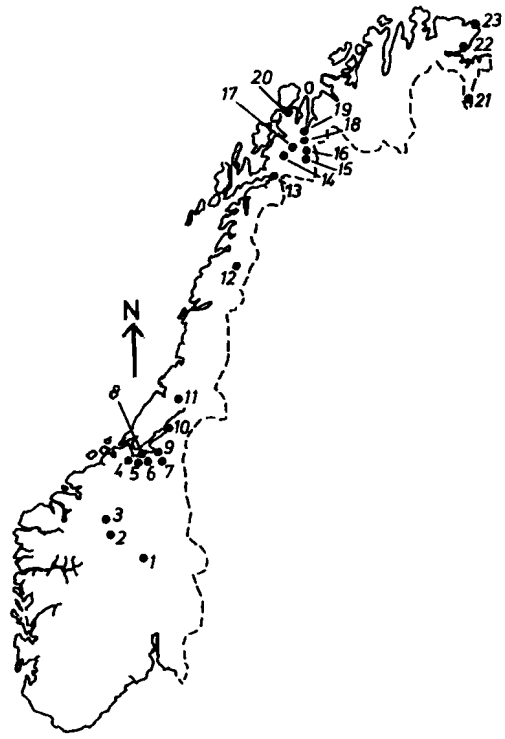


Fig. 1. Map of areas investigated. 1. Os: Ringebu, Gudbrandsdalslågen. 2. On: Vågåmo, the Otta. 3. On: Lesjaskog, Lesjaskogsvatnet. 4. STi: Orkdal, the Orkla. 5. STi: The Gaula, st. 1-7. 6. STi: Bröttemsnes, Nidelva. 7. STi: Selbu, Selbusjöen and the Nea. 8. STi: Trondheim. 9. NTi: Stjördalen, Tröyte. 10. NTi: Steinkjer. 11. NTi: Bergsmo. 12. Nsi: Bleiknesmo. 13. Nnö: Bjerkvik. 14. TRi: Setermoen. 15. TRi: Frihetsli, Dividalen. 16. TRi: Rostaelva. 17. TRi: Rundhaug. 18. TRi: Tamokdalen. 19. TRi: Balsfjordelva. 20. TRy-Tönsvikelva. 21. Fö: Vaggatem. 22. Fn: Jacobselva. 23. Fn: Vesterelva.

STUDY AREAS

The river banks studied comprise seven stations in STi: on the Gaula, between Melhus and Kuöra in Öysand (for positions see Andersen 1968); one station in NTi: Bergsmo, on the Namsen; one station in Nsi: Bleiknesmo (about 1 km N of the bridge) on Saltdalselva; one station in TRi: Rundhaug, on Målselva; one station in TRy: Tönsvikelva (50-300 m from the sea); and two in Fn: Jakobselva (500 m N of Vestre Jakobselv) and on Vesterelva in Persfjord (200-300 m from the sea). District abbreviations (STi, NTi, etc.) are according to Strand (1943). The position of the areas are shown in Fig. 1. Other localities (Fig. 1), including some outside river-plains, are mentioned when observations of interest connected with the problems being considered were made.

Data about the rivers and the stations are given in Table I. The terminology of the zones is according to Hämet-Ahti (1963). The Gaula, the Namsen, Saltdalselva and Målselva are quite large and typical flood rivers (Andersen 1968).

Although often varying from one place to another within the areas, the topography and vegetation types on the inside of the meanders of the four larger rivers are generally as in Fig. 2. The gravelly and sandy zones, which often alternate, usually lack vegetation, or *Myricaria germanica* grows sparingly. The upper parts of the sandy areas are dry and have a xerophilous vegetation. In the bush zone, open areas alternate with brush-wood of

Table I. Some data on the rivers and the investigated stations

River	Length of river (km)	Catchment areas (km²)	Height above sea level (m) of investigated station(s)	Station(s) situated in
The Gaula	140	3680	< 6	coniferous zone
The Namsen	210	6255	25	coniferous zone
Saltdalselva	75	1539	50–60	coniferous zone
Målselva	140	6000	40	coniferous zone
Tönsvikelva	15		< 5	birch zone
Jakobselva	50	564	< 5	birch zone
Vesterelva	13–15		< 5	arctic zone

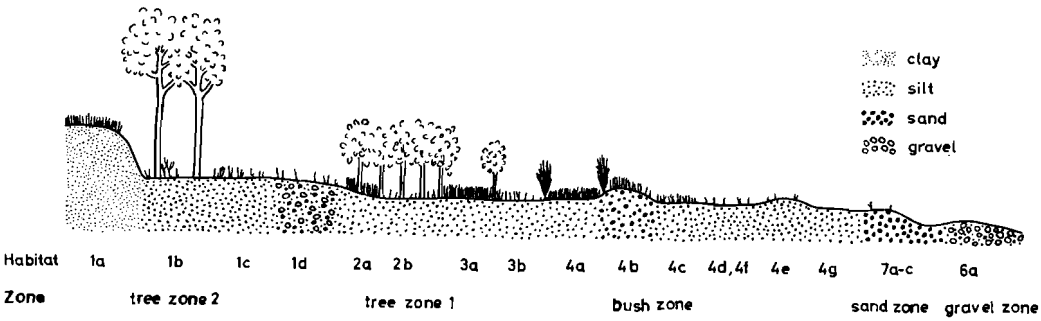


Fig. 2. Transverse section of a river bank with its habitats. Habitat 5 and 6b, which are weakly saline, are not drawn.

Myricaria germanica, Alnus incana or *Salix* sp. Tree zone 1 consists of low, dense-growing *Salix* sp. (on the Gaula *S. triandra)* and *Alnus incana*. Tree zone 2 usually consists of a tall wood of *Alnus incana*. At the highest levels are cultivated fields. At st. 1 on the Gaula, sandy areas without vegetation predominate followed by a dense, low, grassy mat which is succeeded by densely growing *Hippophäe rhamnoides* and *Alnus incana*.

Along the smaller rivers the plain is constructed more simply. A gravelly and silty zone exists at Tönsvikelva, and Jakobselva; the latter zone is sparsely vegetated, but at the first place shaded by *Alnus incana*. At Jakobselva a rather extensive sandy zone is also present. At Vesterelva a low-lying gravelly zone with steep acclivities is followed by elevated silty flats.

On the Gaula and probably the Namsen, all sections up to tree zone 2 are usually flooded each year (Andersen 1968). Sometimes even cultivated fields are submerged on the Gaula. On Målselva, tree zone 2 is flooded more infrequently.

The definitions or classifications of a river bank or flood plain given by Palm & Lindroth (1936), Palmén & Platonoff (1943), Shelford (1954, 1965) and Carpenter (1956) were not found quite satisfactory for the present rivers. For the river bank, zones were selected whose peculiarities seem conditioned by the river. The top of the river bank is at the beginning of tree zone 2 on the Gaula, the Namsen and Målselva, on the other rivers about the end of the silty zone. At st. 1 on the Gaula, the boundary is drawn where the dense grassy mat begins.

The mean monthly air temperatures at the meteorological stations in the neighbourhood of the investigated areas are shown in Table II. The date are taken from Bruun (1962) and the Norwegian Meteorological Institute (1949 and 1963-69).

Spring and summer in Trondheim were warm and relatively dry in 1963, but rather cold in 1962. Whereas May, July and August 1966 had temperatures below the mean, June was warm and dry in Tröndelag. The air temperatures at Bardufoss and Tromsö were higher than average in June 1966 and May 1967. The summer was extremely cold in Tromsö in 1968. Vardö had temperatures close to normal in May-August 1967.

MATERIAL AND METHODS

Identification of the larvae

Larvae of several species were reared and some (subg. *Chrysobracteon* spp. and *B. dentellum* Thbg.) have been described (Andersen 1966). Identifying the larvae is often difficult, but by means of size, colour, shape of nasale and proportion of joints, many of the specimens collected were identified with a high degree of probability. Several larvae collected in the field were identified by rearing to imagines.

Table II. Mean monthly air temperatures (T in °C) and precipitation sums (P in mm) at the meteorological stations nearest the investigated areas. The coldest month at Trondheim and Höylandet is January, at the other stations February

Met. station	Hs	Investigated area and d	Year	Lowest winter T	Apr.		May		June		July		Aug.		Sept.		Oct.		Jan.–Dec.
					T	P	T	P	T	P	T	P	T	P	T	P	T	P	P
Trondheim	127	The Gaula	1931–60	−3.4	3.2		7.9		11.3		14.4		13.3		9.5		5.1		767
		15–18	1962		2.7	37	6.9	30	9.0	124	11.7	55	11.7	113	8.9	126	6.1	113	
			1963		4.1	21	10.7	43	12.7	41	12.0	66	14.7	43	9.7	121	6.0	108	
			1964		4.7	23	9.0	65	9.8	136	12.3	80	11.5	68	7.6	105	5.7	60	
			1965		4.7	24	7.0	24	11.8	100	11.6	46	11.7	33	11.1	86	5.8	171	
			1966		0.3	15	7.4	74	14.4	24	12.3	70	12.2	50	7.7	197	4.3	59	
			1967		2.5	91	8.5	27	10.5	88	12.7	94	12.9	62	11.1	18	5.3	97	
			1968		3.7	39	6.5	26	12.7	35	12.9	12	12.9	9	10.9	29	3.4	144	
Höylandet	21	The Namsen	1955–60	−7.3	2.4		7.5		11.9		15.1		13.4		9.0		4.0		1100
		21	1966		−0.5	28	7.1	67	15.2	27	13.2	84	11.9	120	7.3	213	3.6	120	
Bardufoss	74	Målselva	1941–60	−9.0	−0.3		4.9		10.2		14.2		12.2		7.0		1.1		
		16	1966		−2.9	7	3.8	22	12.0	28	13.8	54	10.6	89	3.0	64	−1.5	61	
			1967		0.1	19	6.6	5	9.5	61	11.9	100	12.4	65	9.3	51	−0.1	43	
Tromsö	102	Tønsvikelva	1931–60	−4.0	0.3		4.1		8.8		12.4		11.0		7.2		3.0		1013
		12	1966		−1.5	25	2.5	78	10.2	42	12.4	82	10.0	163	3.5	170	0.3	74	
			1967		0.4	84	5.9	8	8.3	97	10.8	136	11.0	109	9.2	113	1.7	97	
			1968		−0.2	88	2.3	41	7.7	117	8.9	80	8.9	117	5.7	37	−1.6	88	
Vardö	13	Vesterelva	1931–60	−5.2	−0.8		2.6		6.2		9.1		9.7		6.8		2.5		573
		16	1967		−0.1	25	2.6	14	6.9	35	9.5	52	10.4	59	7.8	64	2.4	17	

Hs: height above sea level of meteorological station; d: distance in km between meteorological station and investigated area.

Collecting methods

Quadrat samples. Areas of 0.5 × 0.5 m were bounded by pressing a square metal frame partly into the earth. The beetles were collected by hand. All loose material (stones, twigs etc.) and vegetation were removed and the bare surface layer was closely observed.

The gravelly substratum was washed in water, while washing proved unnecessary on silty or sandy ground with sparse or no vegetation. On densely vegetated silty sites, washing gave some additional specimens of *Bembidion schueppeli* Deg. (four of a total of 42 specimens). The samples were taken randomly within each habitat. Quadrat samples were taken on the Gaula 10-12 May 1964, 15-21 June 1964, 15-24 July 1964, 13 Aug. 1966, on Målselva, 2,3 and 10 July 1966. During sampling there was sunny as well as poor weather. Greater parts of gravelly and bare silty zones were submerged in May and June 1964, otherwise the water level was low.

The confidence limits of the mean abundance were calculated, but it should be noted that it is not known whether the beetles are randomly distributed within the habitats.

Quadrat sampling was often difficult or impossible to carry out because habitats were distributed as mosaics or very narrow zones, bushes or high vegetation were in the way, or the ground was rather uneven. Furthermore, it was impossible to obtain material of the most active and least abundant species by quadrat sampling; thus time-catch was also used.

Time-catch. The time used in the investigation was noted. Places lacking vegetation were investigated by moving very slowly, observing continuously. Vegetation and loose material were systematically removed. In several samples on sparsely vegetated or bare ground it was noted whether specimens were in concealment, on open ground in the sun, or flying. Investigation time in different habitats, areas and months is shown in Table III.

On the Gaula and Målselva, all collecting in sparsely vegetated or bare habitats, and most in densely vegetated habitats was made during sunny weather except for some samples treated separately. It was cloudy weather during the investigations on Saltdalselva and the Namsen.

To estimate the approximate sizes of the areas investigated per unit of time by time-catch, some areas of known sizes in various habitats were investigated using the same procedure as in time-catch (Table IV). In areas with a more developed vegetation a quadrat frame was used, whereas those with sparse or no vegetation were measured and delimited by sticks stuck into the earth, and thereupon investigated.

The sizes of the areas investigated per unit of time varied greatly with the habitat (Table IV). Thus, catches per unit of time give a false expression of the relative abundance of a species in different habitats. By dividing the one-hour-catch by the size of the area investigated per hour, in a habitat (cf. Table IV), a more reliable estimate of the relative abundance is attained. Numerically these estimates give an expression of the number of specimens per m^2. In the following, the number of m^2 investigated per hour are referred to as correcting factors.

Although time-catch and quadrat sampling showed fairly similar abundance figures in the same habitats for the less active species, when the two methods were carried out under comparable circumstances (Fig. 3), the estimates are regarded as relative abundance estimates because of the inherent errors of the method.

The main sources of error are: (1) the subjective collecting error due to the varying efficiency of the collector; (2) the varying activity of the beetles depending upon weather conditions (Murdoch 1966) and the habitat (Greenslade 1964); and (3) the fact that more time is used on the collecting itself in proportion to the time used for searching when the abundance is high. In the present case these errors are reduced, as sampling was made during similar weather conditions and the extremes of the correcting factor on a habitat are used in the statistical treatment. Furthermore, the time needed to collect the beetles are included in the estimated time required to investigate one area unit.

A population size so large that not all beetles could be put in the glasses (Murdoch 1966)

Table III. Investigation time (mins) in the habitats by time-catch. It has not been differentiated between in 7a, 7b and 7c on Målselva. Collecting on the Gaula in 1965 was not made every day during the periods mentioned

	Habitat																			
	1a	1b	1c	1d	2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	5	6a	6b	7a	7b	7c
The Gaula 1.5–27.5 1965		30	10		50	60	33	30			40	105	180	25	25	185	65	140	65	
The Gaula 9.6–25.6 1965		30	40		40			40	30		65	40	15	65	20	15	60	304	144	17
The Gaula 5.7–12.7 1965					135		50	25	10	45	55	20	50	40		60		57	57	57
The Gaula 15.8–24.8 1965			40		80		20		45	20	90	65	55			110		127	90	
The Gaula 1.6–3.6 1966					110												40			
The Gaula 8.8–14.8 1966			15		24	30	140	75	80	35	95	30	35	52		125	35			
The Gaula 15.5–20.5 1967	20		30			15	55		35	85	115	75				85				
The Gaula 12.9, 13.9 1967					35		43				55	72						10		
The Gaula 20.6–26.6 1968		20			33			25	34	20	80	35	52		15		45	60	60	
The Gaula 2.9–4.9 1968					27			52	60		71	47					34			
The Namsen 4.8, 5.8 1966					20				15	100	123	102				50		195		
Saltdalselva 2.8 1966					20		60						25			90				

Table III. (Contd)

	Habitat																		
	1a	1b	1c	1d	2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	5	6a	6b	7a	7b	7c
Målselva 17.6, 18.6 1966				30	55	15	70		12	65	30			43		73			47	
Målselva 1.7–3.7, 10.7–11.7 1966				165	70		60					10		110		35			85	
Målselva 3.9, 4.9 1966					136		25			25	18			12		75			40	
Målselva 26.5–28.5 1967				25			48			40	19	15		10		60			150	
Målselva 4.9 1967					20		41		22	45	8	20		20		20			50	
Tönsvikelva 12.6 1966								65								20				
Tønsvikelva 3.9 1967																60				
Tönsvikelva 26.5 1968																30				
Tönsvikelva 2.6 1968																60	20			
Tönsvikelva 8.7 1968																150				
Tönsvikelva 15.9 1968																120				
Jakobselva 19.7 1967																60		30		
Vesterelva 21.7 1967																50				

Table IV. Estimation of the size of the areas investigated per unit of time by time-catch. Samples were taken in habitat 2a, 2b, 4c, 4d, 4g and 6 and the estimates for the other habitats were based on the figures for these habitats (see this page)

Habitat	a	n	t		N	
			M	E	M	E
1c					4.8–9.8	3.8, 15.0
1d					8.0	4.7, 10.0
2a	0.25	18	5.6	4.5–6.8	2.7	2.2, 3.4
2b	0.25	6	2.9	2–4	5.2	3.8, 7.5
3a					2.7	2.2, 3.4
3b					4.8–9.8	3.8, 15.0
4a					2.7	2.2, 3.4
4b					2.7–9.8	2.2, 15.0
4c	0.25	11	3.1	2–4	4.8	3.8, 7.5
4d	1.00	8	6.1	4–8	9.8	7.5, 15.0
4e					9.8–35.2	7.5, 80.0
4g	8.00	5	13.6	6–20	35.2	24.0, 80.0
5					4.8	3.8, 7.5
6a, 6b	1.00	4	7.5	6–13	8.0	4.7, 10.0
7a-c					35.2	24.0, 80.0

a: area of one sample (m^2); n: number of samples; t: time required to investigate one sample (mins.); N: number of m^2 investigated per hr.; M: mean; E: extremes

was only realized in habitats 3b and 4c in June 1968.

The areas investigated per unit of time seem largely to depend upon degree of vegetation and litter cover, and substratum.

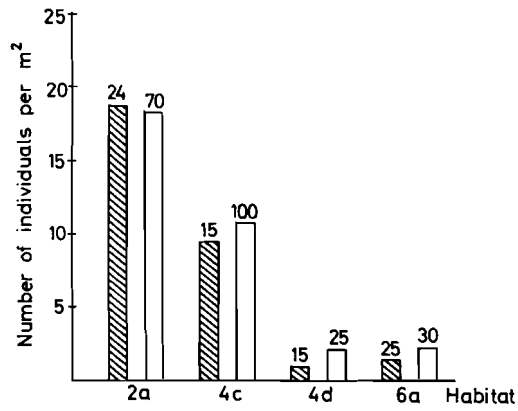


Fig. 3. Catches of the less active *Bembidion* spp. in some habitats according to time-catch (light blocks) and quadrat-sampling (hatched blocks). Methods were practised under comparable circumstances. Figures above the blocks give the collecting time (time-catch), or number of samples of 0.25 m^2 (quadrat-sampling). Concerning the abundance estimation by time-catch, see p. 21.

Different habitats with similar types of coverage and substratum have therefore been assumed to have the same correcting factors. On this assumption it is possible to estimate the relative abundance of species in a habitat with unknown correcting factor by applying the known correcting factor from a habitat with similar degree of coverage and substratum (Table IV). The same correcting factor was used both on silty and sandy sites without vegetation (habitat 4g and 7a-c), as the same collecting procedure was used in these habitats.

The correcting factor is more unreliable for habitat 1c than for the other habitats, as the vegetation type differs from that on the river bank. In the statistical treatment of the time-catch material a test for comparison of two Poisson trials (Sverdrup 1964) was used. The test is based on the assumption that the number of specimens of a species within a habitat is Poisson distributed and the test results must be taken with the reservation that this assumption is sufficiently fulfilled. When no beetles were taken in a habitat, no tests were made between this and other habitats. However, when dealing with life history, months with no occurrence of a species were used, the material

being sparse because only catches from one habitat could be used in each test.

Hand-collecting without time-notation (in the following referred to as hand-collecting) was carried out in all the places shown on Fig. 1 (on the Gaula this took place in 1962-1964 and 1966).

Methods for study of life history

A distinction was made between teneral (newly emerged) and fully hardened imagines. The pigmentation of the aedeagus was often used for differentiating between teneral and old males collected in 1966-68 (Murdoch 1966, Vlijm & van Dijk 1967).

Females collected in 1966-69 were dissected for examination of ovaries. The usual distinction between immature, mature and spent ovaries (Gilbert 1956, Schjötz-Christensen 1965, Murdoch 1966, Vlijm & van Dijk 1967) was generally followed, but often it was distinguished only between females with ripe eggs and those without eggs.

Observations of adults in the field and the laboratory gave information about copulation. Adults were kept on their natural substratum in glass jars. They were fed with bread and dead and living small invertebrates. Tenerals of *Bembidion petrosum* Gebl. collected in October 1964 were divided into two groups, one living at 20-22°C in naturally decreasing day length, and another kept at 1-3°C in darkness without food. After the exposure (1-3 months), the last group was kept at 20-22°C with food supply.

Hatching and rearing of larvae took place in the laboratory. Egg-laying or eggs were seldom observed and usually the time of egg-laying was estimated as being after or on the same date as when the imagines were put in the jars. Some further information about rearing of larvae is given by Andersen (1966). The temperature fluctuated during the rearing. Day temperatures were usually between 18°C and 24°C, in 1966 up to 26°C, whereas night temperatures were seldom below 13°C. Mean temperatures in the laboratory were high in June and August 1963 and June 1966.

Methods for classification of vegetation coverage and ground type

Coverage of herbaceous vegetation (in the following called vegetation) was judged according to the scale of Hult-Sernander (Nordhagen 1943):

Without vegetation. Figs. 8 and 9.
1-2. Sparse vegetation. Fig. 8.
3. More developed vegetation. Fig. 7.
4-5. More or less dense vegetation. Fig. 5.

Often a correlation exists between coverage and height of vegetation.

The substratum was sifted through either of two sets of sieves. For the finest fractions (grain size below 0.063 or 0.07 mm) the procedure of Schjötz-Christensen (1957) or Haarlöv (1960) was used. The scales were as follows:

	Particle diameter (mm)	
	Scale 1	Scale 2
Stones and gravel	>2	>2
Very coarse sand	2.0–1.0	2.0–0.8
Coarse sand	1.0–0.5	0.8–0.5
Medium sand	0.5–0.25	0.5–0.25
Fine sand	0.25–0.125	0.25–0.15
Very fine sand	0.125–0.063	0.15–0.07
Coarse silt	0.063–0.025	0.07–0.02
Fine silt and clay	<0.025	<0.02

The amount of oxidizable organic material was determined according to the method of Schjötz-Christensen (1957).

Substratum predominated by coarse silt is mixed with fine sand and small amounts of fine silt and clay in nature. If the mixture (in the results and discussion termed silt) is packed in a moist condition or is deposited in water, its compact consistency is still retained when the material becomes dry, in contrast to sand, although the mechanical strength needed to detach the particles is much less than in pure clay. The mixture except sometimes in the uppermost layer, in contrast to clay, does not crack when it dries up.

The moisture of the substratum was determined subjectively in a manner resembling that of Krogerus (1948). By controls in the labora-

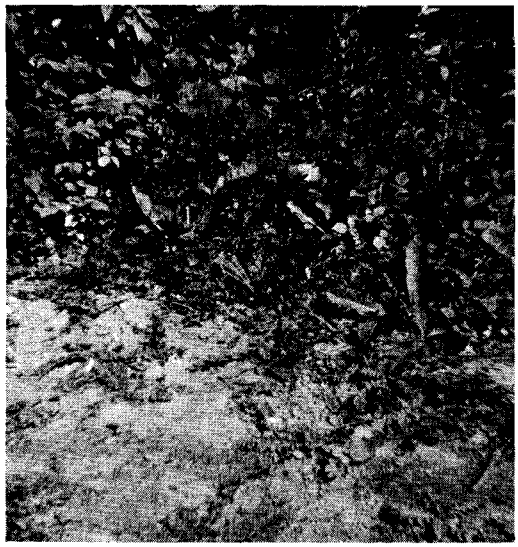


Fig. 4. The Gaula, st. 7. Habitat 1c.

tory the approximate water content of the substratum predominated by silt could be estimated. The categories were as follows (the weight of water as a percentage of the dry weight of the substratum is given in brackets):

0: Substratum seems quite dried up, light in colour (0-2).
1: Substratum rather light coloured, the finger is not moistened when pressed against the surface. When crumbled the particles do not hold together very well (4-8).
2: Substratum darker. The particles hold together well, the finger is moistened when pressed against the surface (15-25).
3: Substratum very wet, when the finger is pressed against the surface, water is pressed out (30).
4: Substratum muddy, and with a water membrane on the surface (≥ 35). The moisture was often judged to be between two of the neighbouring categories, and is then given with the decimal point 5, e.g. 1.5.

The water content in sand with grain size of 0.5-0.063 mm could not be judged. The categories were as follows:

a: Sand quite loose and dry on surface.
b: Sand moistened, but uppermost layer shows incipient drying up.
c: Sand more or less moistened, uppermost layer does not show incipient drying up.

DESCRIPTION OF HABITATS

The sites were grouped according to their elevation, exposure, vegetation coverage, substratum type and moisture. As the moisture often fluctuates violently within short periods and the vegetation grows denser during the summer, the same sites could not always be referred to the same group. Often the groups seem to correspond well with the concept of microhabitat as defined by Luff (1966), but as not all of them have the same degree of restriction the term habitat is preferred. This term has sometimes been used for larger environmental areas (river banks, clay and sand pits, cultivated fields), but when used in this way it should be obvious from the context. A survey of the characteristics of the habitats is given in Fig. 2.

Localities where the habitat collections were made, are given below the description of each habitat.

Habitat 1

Elevated zones seldom or never flooded and consequently could not have belonged to the river bank proper.

1a. More elevated than any other zone investigated on the Gaula, about 5-10 m higher than tree zone 2 and probably never flooded. Far from the river beside the end of a road. Very moist, clayish soil (grain size: < 0.025 mm). Well-developed vegetation of *Scirpus* sp. and *Tussilago farfara*. The Gaula, st. 7.

1b. Vegetation lacking, or if present, consisting of *Anemone nemorosa* or *Tussilago farfara, Ribes rubrum, Rubus idaeus* and *Arctium minus*. Organic matter: 6.5 per cent. Substratum porous, mainly very fine sand (32.4 per cent) and coarse silt (40.7 per cent). Litter on the surface. The Gaula, st. 3.

1c. Fig. 4. Exposed spots at the same level as tree zone 2. Coverage 1-3. Dominating plants are *Ranunculus repens, Taraxacum* sp. and *Carduus crispus*. Substratum often dusty, with 33 per cent fine sand and 66 per cent coarse silt. Organic matter: 3 per cent.

Fig. 5. Målselva. In the foreground habitat 4a, in the background 2a.

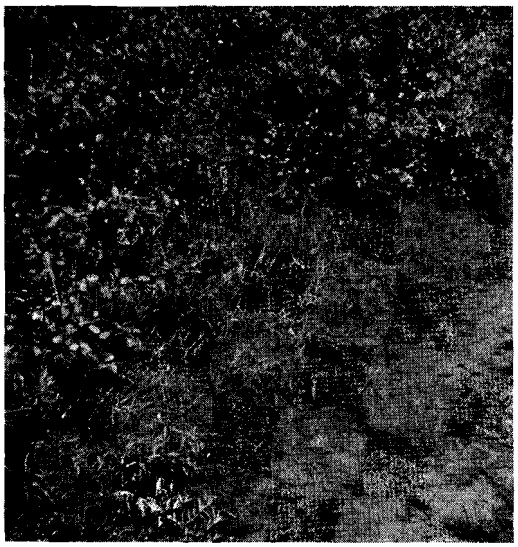


Fig. 6. The Gaula, st. 3. From right to left successively denser vegetation; from spares (habitat 4d) to dense vegetation with some shadow (habitat 3a).

Moisture: 0-1. Probably only flooded 31 Aug. 1964 in the whole period 1962-65. The Gaula, st. 7.

1d. Heterogeneous silty-sandy mixture, mostly covered by gravel on the surface. Substratum usually completely dried up. Vegetation sparse, consisting of *Festuca ovina, Agrostis tenuis, Poa* sp., *Astragalus alpinus* and mosses such as *Rhacomitrium* sp. Målselva.

Habitat 2

Shady places in tree zone 1, on Målselva often in the bush zone with densely growing *Salix* sp. Substratum mainly coarse silt (56-77 per cent) and very fine sand (21-33 per cent), also some medium and fine sand and clay. Moisture: 2-3.

2a. Fig. 5. Coverage 4-5, dominant plants are grasses, for instance: *Poa* sp., *Calamagrostis* sp., *Festuca ovina* (at Målselva) or *Hierochloë odorata* (at Målselva). Often very fine mosses. Organic matter: 4 per cent. The Gaula st. 3, 6 and 7, the Namsen, Saltdalselva, Målselva.

2b. As 2a, but vegetation is sparse. Much foliage at the time of investigation. The Gaula, st. 3 and 4, Målselva.

Habitat 3

Rather shady places under bushes, but the ground or the herbaceous vegetation is, at least for a short period of the day, illuminated, in contrast to that on habitat 2. Same substratum type as on habitats 2a and b. Moisture: 2-2.5. In spring greater or lesser amounts of foliage on the ground in hab. 3b.

3a. Fig. 6. Coverage 4-5, dominant plants are grasses *(Poa* sp. or *Agrostis tenuis)*. Mosses are sometimes prominent. In addition, *Chrysanthemum vulgare, Tussilago farfara* (both on the Gaula), *Astragalus alpinus, and Juncus* sp. often occur scattered. The Gaula, st. 2, 4, 6 and 7, Saltdalselva, Målselva.

3b. Coverage 1-3, vegetation consisting of grasses, *Juncus* sp. or *Equisetum arvense*. The Gaula, st. 2, 3, 6 and 7, Tönsvikelva.

Habitat 4

More or less exposed spots, usually in the bush zone. Substratum usually predominated by coarse silt, on the Gaula 77-84 per cent, on Målselva often with higher amounts of sand mixed with some gravel. Organic matter: 0.7

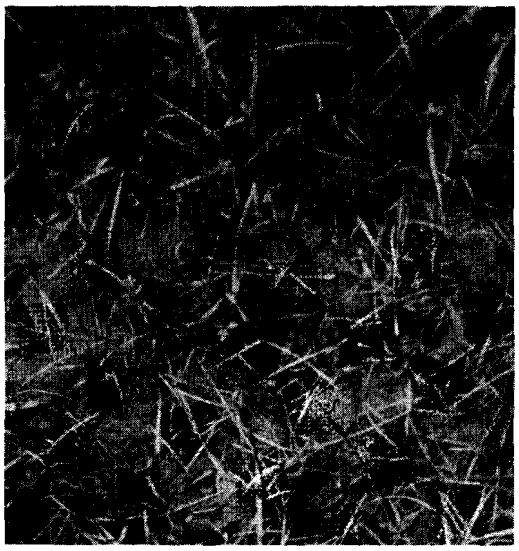


Fig. 7. The Gaula, st. 3. Close-up picture of habitat 4c.

per cent (hab. 4b): 1.8 per cent (hab. 4d): 2.1 per cent (hab. 4g).

4a. Fig. 5. Coverage 4-5, vegetation consisting of *Poa* sp., *Calamagrostis* sp., *Agrostis* sp., often together with *Juncus* sp. and *Scirpus* sp., on the most humid places even *Clycera fluitans* and *Equisetum fluviatile*, on elevated places *Astragalus alpinus, Chrysanthemum vulgare* (on the Gaula) and *Lotus corniculatus*. Moisture: 1.5-2.5. The Gaula, st. 3 and 6, the Namsen, Målselva.

4b. Often somewhat shaded by scattered bushes. Substratum often less compact and more sandy than on other spots on habitat 4. The uppermost and driest sections of the real river bank. Moisture: 0-1. Coverage usually 3-5 (correcting factors used: 2.7-4.8). Spots investigated on the Gaula in May 1967 had, however, a rather sparse vegetation (coverage 1-3, correcting factors used: 4.8-9.8). Vegetation consists of *Agrostis tenuis, Poa* sp., *Achillea millefolium, Chrysanthemum leucanthemum, Astragalus alpinus* and *Lotus corniculatus*, on the Namsen *Pimpinella saxifraga, Campanula rotundifolia*, and *Solidago virgaurea* also occur. The Gaula, st. 3 and 7, the Namsen, Målselva.

4c. Fig. 7. Often less exposed and more humid and low lying sites than 4d-4g. Often much foliage before the flood. Coverage 3, vegetation consisting of *Agrostis stolonifera* (on the Gaula and the Namsen) or *Calamagrostis* sp. and other grasses (on Målselva). Often very fine moss. Moisture: 2-3. The Gaula, st. 3, 6 and 7, the Namsen, Målselva.

4d. Fig. 6 and 8. Open, exposed spots. Coverage 1, vegetation consisting of grasses, for instance *Agrostis* sp., in addition often *Juncus* sp., and some *Chrysanthemum vulgare* (the Gaula), *Achillea millefolium* and *Lotus corniculatus*. Moisture: 2-2.5. The Gaula, st. 3, 4, 6 and 7, the Namsen, Målselva.

4e. Vegetation sparse or lacking. Dominant plants are *Poa irrigata, Festuca ovina, Astragalus alpinus* and *Chrysanthemum vulgare* (only on the Gaula). Drier and often more elevated sections than the previous, moisture: 1-2. The Gaula, st. 3, the Namsen.

4f. As the previous, but the silt completely dried up (moisture: 0). Only represented on the Gaula in June, July and August 1963, July and August 1964 and in May and June 1967 on Målselva (no collecting at the latter place), when greater parts of the river bank were dried up. The Gaula, st. 7.

4g. Fig. 8. Partly below the bush zone. Spots without vegetation. Moisture: 2-2.5. The Gaula, st. 3, Målselva.

Habitat 5

Near the mouth of the river. Below the tree and bush zones. Substratum type as on habitats 4a-g, weakly saline. Moisture: 2. Coverage 3, vegetation consisting of *Juncus gerardi, Cochlearia officinalis, Sagina nodosa, Stellaria crassifolia, Plantago maritima*, and others. The Gaula, st. 1.

Habitat 6

Exposed spots, usually below the tree and bush zones and without or with a very scattered vegetation. Substratum always with a layer of gravel or boulders on the surface, below this a mixture of gravel, sand, silt and some clay or a compact silty layer. Organic content obviously

very low and could not be detected by analysis.

Moisture varies considerably, in spring and early summer mostly not below 1.5 (on places with silt), later in the year often 0-1.

6a. Fig. 9. Substratum not saline. If a scattered vegetation exists, it may consist of *Poa* sp., *Lotus corniculatus, Astragalus alpinus, Myricaria germanica* and *Arenaria norvegica* (the last only on Målselva). The Gaula, st. 2, 3, 4, 5 and 6, the Namsen, Saltdalselva, Målselva, Tönsvikelva, Jakobselva, Vesterelva.

6a. Substratum weakly saline. Near the mouth of the rivers. The Gaula, st. 1, Tönsvikelva.

Habitat 7

Fig. 9. Exposed spots below the tree and bush zones. Substratum sandy, samples from the Gaula and Målselva with about 90 per cent coarse, medium and fine sand, some very coarse sand, little or no gravel and silt. Organic content could not be detected by analysis.

Substratum on st. 1 on the Gaula is weakly saline. Vegetation usually not present or very fine and scattered, consisting of, for instance, *Alopecurus geniculatus,* and *Potentilla anserina.* The Gaula, st. 1 and 6, the Namsen, Målselva, Jakobselva. Habitats 7a-c are defined according to the moisture (7a category a etc.).

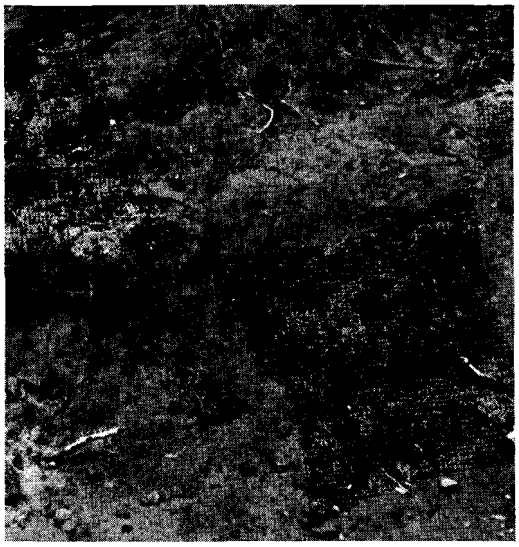


Fig. 8. Målselva. Silty site without vegetation (habitat 4g) in the foreground, with sparse vegetation (habitat 4d) in the background. Photo: O. A. Aune.

Fig. 9. Målselva. To the right habitat 7, to the left habitat 6a.

RESULTS

Asaphidion pallipes Dft.

Habitat. Most frequent in habitat 4b (Table VIII, Fig. 10). In May partly among sparse vegetation in habitats 4b, or 4e (Table IX) on the Gaula; in July and August among a more developed one on the Gaula and the Namsen. *A. pallipes* mostly shelters under leaves (Table V). The species occurs relatively abundantly on pure clay in a clay-pit in Trondheim; one specimen also taken in a sand-pit there. According to Lindroth (1945) *A. pallipes* occurs in spots with a very sparse vegetation; otherwise his data agree with the present.

Life history. Rather abundant from early May to August (Table IX). Tenerals were collected on the Gaula 22 Aug. 1965 (one specimen), and 8-13 Aug. 1966 (three of 36 specimens). One pair observed copulating 15 May 1967 on the Gaula, and one pair 15 June 1963 in captivity. Egg-laying occurs in May to August (Tables VI and VII). One third stage larva

Table V. Behaviour of species of the tribe Bembidiini during sunny weather (11.00 – 16.00 hrs.) on different habitats. The figures give the number of specimens observed. Data are from the Gaula and Målselva

Species		Habitat(s) 1c, 3b	4b	4c, 5	4d	4e, 4g, 7	6	Sum	%
A. pallipes	h		38	5	3	15		61	87.1
	e	1	4		3	1		9	12.9
	fl								
B. argenteolum	h					6		6	6.0
	e					66		66	66.0
	fl					28		28	28.0
B. bipunctatum	h		2	6	1	1	16	26	43.3
	e			20	1	2	11	34	56.7
	fl								
B. bruxellense	h	18		24	1	5	7	55	52.9
	e	13		19	11	5	1	49	47.1
	fl								
B. dentellum	h								
	e			8				8	100.0
	fl								
B. femoratum	h		4	2	2	10	33	51	67.1
	e			4	11	6	4	25	32.9
	fl								
B. hasti	h						64	64	100.0
	e								
	fl								
B. hyperboraeorum	h						41	41	100.0
	e								
	fl								
B. lapponicum	h					3		3	3.5
	e					66	1	67	77.0
	fl					17		17	19.5
B. litorale	h			2	5	6		13	7.3
	e	4		10	75	74		163	91.6
	fl					2		2	1.1
B. lunatum	h	9	6	25	4	5	7	56	56.6
	e	10		20	9	3	1	43	43.4
	fl								
B. petrosum	h			8	2	113	179	302	83.9
	e			3	2	36	17	58	16.1
	fl								
B. prasinum	h					4	42	46	100.0
	e								
	fl								
B. quadrimaculatum	h	17	6	11	2	10		46	54.1
	e	17	1	4		17		39	45.9
	fl								
B. saxatile	h				1		24	25	100.0
	e								
	fl								
B. schueppeli	h	1	6	65		10	2	84	62.7
	e	6		34	6	4		50	37.3
	fl								
B. semipunctatum	h	8	1	51		1		61	27.7
	e	10		130	4	14		158	71.8
	fl	1						1	0.5
B. virens	h					4	65	69	98.6
	e					1		1	1.4
	fl								

h; hiding under stones, leaves etc., e: running about on the substratum surface, fl: flying.

collected 25 June 1968 on the Gaula. Larvae were reared from August (Table VI).

Bembidion argenteolum Ahr.

Habitat. Only found on sandy sites usually lacking vegetation, both on sunny (Table X) and cold and rainy days. All the five larvae (Andersen 1966) on dry substratum. At Selbusjöen collected numerously on medium or fine sand without vegetation. The species seemed to occur at about the same frequency on dry and moist sand during sunny, warm weather (Table X), but on cold and mostly cloudy days (air temperature 8-12°C) nearly all of more than 70 individuals collected on the Gaula and at Selbusjöen were seen on dry sand, often far

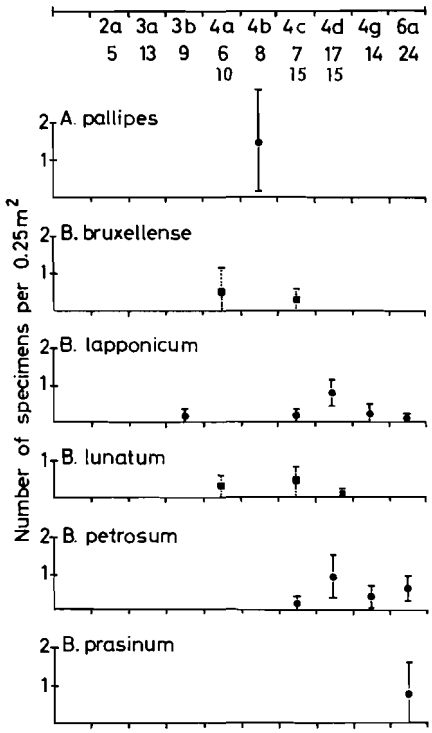


Fig. 10. Mean abundance (points or quadrats) with 95 % confidence interval (vertical lines; confidence limits marked as horizontal lines) of Bembidiini spp. in quadrat samples on the Gaula, June 1964, and in habitat 4b, July 1964 (points and solid vertical lines) and 13 August 1966 (quadrats and interrupted vertical lines). Lower part of confidence interval often negative.

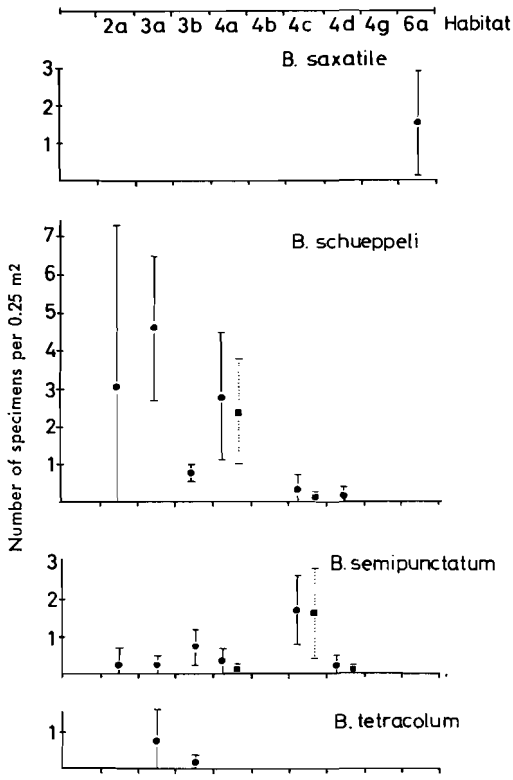


Fig. 11. Mean abundance with 95 % confidence interval of four *Bembidion* spp. in quadrat samples on the Gaula in 1964 and 1966. For symbols and further information see Fig. 10.

from moist sites. During sunny weather they occurred on the sand surface, running or flying away when disturbed (Table V).

The results are in agreement with Krogerus (1932), Palmén & Platonoff (1943) and Lindroth (1945).

Life history. In 1965 adults occurred from late May with highest frequency in June (Fig. 13). The relative abundance in August was significantly (95 per cent) lower than in June on habitat 7b. Some newly emerged specimens were collected in July and August 1963 and August 1964. One pair was observed in copulation 17 June 1965 on the Gaula and several in captivity 24 May- 29 June among animals kept 14 May-30 July or August-December. Egg-laying occurs from late May to mid-July (Tables VI and VII). Third stage larvae were col-

Table VI. Results of rearing of Bembidiini spp. The dates give the first recording of specimens in the respective stages. If more than one specimen was observed, the numbers are given in brackets. Parents were collected on the Gaula. In 1966 *B. lapponicum* and *B. petrosum* were collected on Målselva

Species	Year	Egg-laying	Larvae 1 st.	2 st.	3 st.	P	I	Development time from egg to 3 st..	Duration of: 3 larval st.	pupal st.
A. pallipes	1963		4.8	21.8	15.9			>43	> 64	
	1963			15.9						
B. argenteolum	1963	14.6(s)	≤24.6	28.6	7.7			24		
	1963	14.6	≤24.6	4.7						
	1964	26.6	13.7	29.7(4)	9.8(2)			44–46(2)		
	1965	30.5(s)	10.6(s)	17.6(8)	27.6(6)			29–31(6)		
	1965	30.5(s)	10.6(s)	20.6(14)	6.7(9)			38–40(9)		
	1965	14.6(s)	19.6(5)	30.6(5)						
	1965	14.6	24.6							
	1965	≥25.6, ≤8.7	10.7(7)							
B. bruxellense	1963	≥ 4.6	5.7							
	1963	≥25.6	5.7	16.7						
	1964		13.7(2)							
B. femoratum	1963	≥ 7.6	24.6	27.6	6.7			< 30		
	1963	≥ 7.6	2.7							
	1963	≥ 7.6	5.7							
B. lapponicum	1962	≥ 1.7		9.7(2)	18.7(2)			≤18		
	1962	≥ 1.7	9.7							
	1962	≥ 1.7	14.7							
	1962		2.8							
	1963		10.7(s)	21.7						
	1964		29.6(>5)	19.7(2)	28.7			>30		
	1966	≥20.6	28.6(>3)		2.7(3)			≤13(3)		
	1966		2.7							

Table VI (contd)

Species	Year	Egg-laying	Larvae 1 st.	Larvae 2 st.	Larvae 3 st.	P	I	Development time from egg to 3 st.	Duration of: 3 larval st.	Duration of: pupal st.
B. litorale	1965	10.5	28.5(≥ 2)	18.6(2)	29.6			≥ 51		
B. lunatum	1962		20.8(s)	7.9	10.10			> 51		
	1963	≥ 23.7	3.8(s)	17.8(13)	4.9			≥ 32, ≤ 55(10)	> 100D	
	1964				18.10(6)+				> 60D	
	1965			30.4+	3.5	17.5	5.6		15	20
	1966				1.6+	13.6	20.6			8
	1966	> 18.8	29.8	16.9						
	1966	> 18.8	6.9(3)							
B. petrosum	1962	≥ 1.7	14.7(s)	18.7	23.7			≥ 13, ≤ 23		
	1962	≥ 1.7	14.7(s)	18.7(s)	3.8			≥ 24, ≤ 34		
	1962	≥ 20.7	10.8	13.8						
	1963	≥ 4.6	16.6	25.6	2.7			≥ 17, ≤ 29		
	1963		10.7	20.7	3.8			> 25		
	1963			10.7	21.7	< 2.8	6.8		< 13	> 5
	1963		18.8(6)	26.8(6)	2.9(4)			> 16(4)		
	1963			21.8	7.9					
	1963				18.7+	24.7	2.8			10
	1964				?+	8.8	20.8			13
	1965	≥ 5.6	12.6	17.6	20.6			< 16		
B. schueppeli	1962	≥ 1.7, ≤ 10.7	23.7							
	1963	4.6	26.6(3)		1.8?			59		
	1965				10.7?					
	1966	7.6	15.6							
B. semipunctatum	1962		14.7							
	1966	> 1.6	12.6							
B. virens	1966	≥ 3.6	13.6(s)							

I: imago; P: pupa; s: several; st.: stage; in connection with dates: >: after; <: before; ≥: after or on the date given; ≤: before or on the date given.

Table VII. Results of dissection of females of the Bembidiini spp. In several cases no distinction was made between immature and spent ovaries

Locality	Species, Date	n	Ovaries		
			immature	mature	spent
	A. pallipes				
The Gaula	15.5-67	10	3	7	–
The Gaula	25.6-68	2	–	2	–
The Gaula	3.9-68	3	3	–	–
	B. argenteolum				
The Gaula	1.7–10.7-65	10	?	5	?
	B. bipunctatum				
The Gaula	20.6-68	4	–	4	–
Målselva	26.5-68	4	3	1	–
Målselva	10.7-66	9	–	9	–
Tönsvikelva	20.5;26.5-68	7	2	5	–
Tönsvikelva	2.6-68	7	1	6	–
Tönsvikelva	12.6-66	7	–	7	–
	B. bruxellense				
The Gaula	15.5-67	3	1	2	–
The Gaula	18.6-68	8	–	7	1
The Gaula	12.8-66	6	6	–	–
Tönsvikelva	20.5;26.5-68	4	4	–	–
Tönsvikelva	2.6-68	3	–	3	–
Tönsvikelva	12.6-66	3	–	3	–
	B. dentellum				
The Gaula	18.6;27.6-68	3	–	3	–
	B. difficile				
Målselva	2.6–3.6-67	10	?	7	?
Målselva	18.6-66	2	?	1	?
Målselva	10.7-66	2	?	1	?
	B. femoratum				
The Gaula	18.6-68	2	–	2	–
	B. hasti				
Jakobselva	19.7-67	3	–	3	–
Vesterelva	21.7-67	20	–	20	–
Tönsvikelva	3.9-67	2	–	2	–
Tönsvikelva	16.9-68	3	2	–	1
Tamokdalen	13.9-68	5	5	–	–
Balsfjordelva	13.9-68	9	3	2	4
Tönsvikelva	15.6-69	12	12	–	–
Balsfjordelva	10.7-69	5	1	4	–
	B. hyperboraeorum				
Tönsvikelva	2.6-68	17	16	1	–
Tönsvikelva	8.7-68	8	5	3	–
Tönsvikelva	3.9-67	1	1	–	–
Tönsvikelva	1.10-67	8	8	–	–
Jakobselva	19.7-67	3	2	–	1
Tamokdalen	13.9-68	1	1	–	–

Table VII (contd)

Locality	Species Date	n	Ovaries		
			immature	mature	spent
	B. lapponicum				
Målselva	28.5-67	5	5	–	–
Målselva	19.6-66	23	?	12	?
	B. litorale				
The Gaula	1.7–10.7-63, 1.7–10.7-65	40	?	–	?
	B. lunatum				
The Gaula	27.6-68	12	4	8	–
The Gaula	8.8–13.8-66	68	?	51	?
The Gaula	12.9-67	1	–	1	–
	B. petrosum				
Målselva	26.5–27.5-67	10	8	2	–
Målselva	17.6–19.6-66	12	?	10	?
Målselva	10.7-66	6	–	5	1
Målselva	3.9–5.8-66	11	6	–	5
	B. prasinum				
The Gaula	15.5–16.5-67	2	?	1	?
Nidelva	24.6-68	7	–	7	–
Målselva	26.5–27.5-67	8	?	2	?
Målselva	18.6–19.6-66	9	?	6	?
Målselva	3.9–5.9-66	2	?	–	?
	B. quadrimaculatum				
The Gaula	15.5–16.5-67	2	–	2	–
The Gaula	6.6-66	3	–	3	–
	B. saxatile				
The Gaula	15.5-67	3	?	2	?
Nidelva	24.6-68	9	?	7	?
	B. schueppeli				
The Gaula	15.5–16.5-67	30	6	24	–
The Gaula	4.6–6.6-66	22	–	22	–
The Gaula	18.6-68	4	–	2	2
The Gaula	9.8–11.8-66	40	39	–	1
Målselva	26.5–27.5-67	9	1	8	–
Målselva	17.6–19.6-66	17	2	14	1
Målselva	1.7–2.7-66	5	–	5	–
Målselva	10.7-66	32	2	8	20
Målselva	3.9–5.9-66	21	19	–	2
	B. semipunctatum				
The Gaula	15.5–16.5-67	4	3	1	–
The Gaula	18.6-68	9	–	5	4
The Gaula	9.8–11.8-66	14	14	–	–
	B. virens				
The Gaula	19.5-67	1	–	1	–
Nidelva	24.6-68	7	?	6	?
Målselva	19.6-66	1	–	1	–

Table VIII. Number of individuals collected (n) and estimated relative abundance (a) of *A. pallipes* in different habitats by time-catch. The lines, points and crosses below the figures symbolize that the relative abundance in the habitat only marked with a point (in this case 4b) is significantly different from that in habitats marked with points and x (significance level 95 %) or xx (s.l. 99 %). When no beetles were taken in a habitat no tests were made between this and other habitats. Figures are placed below each other, when given as intervals

		Habitat							
Material from		2a	3a	3b	4b	4c	4d	4e	4g
The Gaula,	n	2	2	3	21	7	4	0	1
July, August 1965,									
August 1966	a	0.2	0.2	≥ 0.2, ≤ 0.4	≥ 2.6, ≤ 4.7	0.4	0.2	0	< 0.1
		xx	xx	xx		xx	xx		xx
		●	●	●	●	●	●		●
The Gaula,									
May 1967	n	–	0	–	21	0	0	–	–
The Gaula,									
June 1968	n	0	–	0	7	0	0	0	0
The Namsen,									
August 1966	n	0	–	–	5	0	0	–	–
Saltdalselva,	n	0	2	–	–	–	–	8	–
August 1966	a	0	0.7	–	–	–	–	≥ 0.5, ≤ 2.0	–
Målselva,									
Sept. 1967	n	0	0	–	1	0	–	–	0

–: the habitat not investigated

0: the habitat investigated, but specimens not found

Table IX. Seasonal distribution of *A. pallipes* by time-catch on the Gaula

		May		June		July		August	
Habitat, year		H	T	H	T	H	T	H	T
4b, 1965	n	–	–	–	–	9	0	3	0
	a	–	–	–	–	≥ 2.5, ≤ 4.4	0	≥ 1.9, ≤ 3.3	0
2a, 4c, 4d, 1965	n	0	0	1	0	2	0	7	1
	a	0	0	< 0.1	0	0.1	0	0.2	< 0.1
4e, 1965	n	6	0	0	0	0	0	0	0
	a	≤ 0.2	0	0	0	0	0	0	0
4b, 1966 (Aug.), 1967 (May)	n	21	0	–	–	–	–	9	0
	a	≥ 1.5, ≤ 3.1	0	–	–	–	–	≥ 3.2, ≤ 5.7	0

a: estimated relative abundance; n: number of specimens; H: fully hardened specimens; T: teneral specimens; –: habitat not investigated; 0: habitat investigated, but no specimens found.

lected in July (Andersen 1966). Larvae were reared from June to August (Table VI).

Bembidion bipunctatum L.

Habitat. Habitat choice probably varies from one place to another (Table XI and Fig. 12). On Målselva, habitat only found on silty ground; on the Gaula, at Bröttemsnes on Selbusjöen and on Tönsvikelva both on silty and gravelly sites (larvae only found among gravel), at Lesjaskogsvatnet only on gravelly ground (silt not present there). On Tönsvikelva, Jakobselva, at Setermoen and Vaggatem, on cultivated, slightly moistened, silty places far from open water. On the Gaula the species occurs regularly only on st. 1. On exposed, silty sites some vegetation seems to be required (Table XI), but the beetle is mostly found running about (Table V). According to Lindroth (1945) present on various types of ground, but with highest abundance on boulders (also stated by Palmén & Platonoff 1943).

Life history. Imagines were about equally frequent in May (present from 2 May) and June 1965 on the Gaula (no collecting was done in habitats 5 and 6b in July and August 1965) and in June 1966 and May 1967 on Målselva. Tenerals were collected in July and August 1963 on the Gaula and in September on Måls-

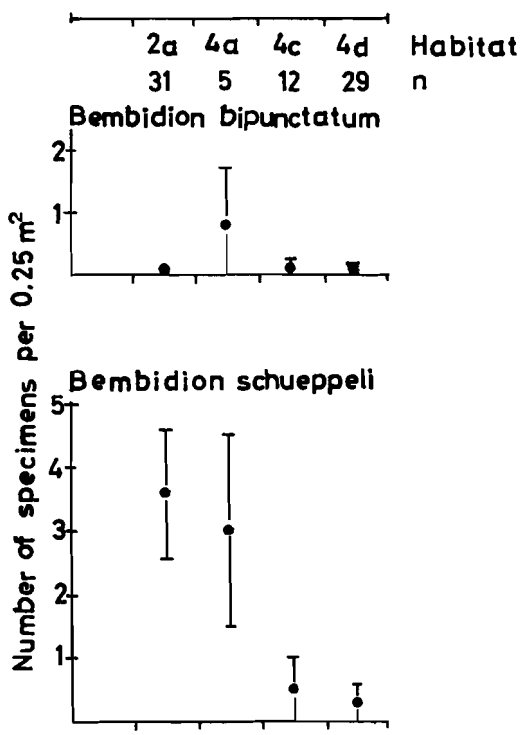


Fig. 12. Mean abundance (points) with 95 % confidence interval (vertical lines, confidence limits marked as horizontal lines) of two *Bembidion* spp. in quadrat samples at Målselva 3 and 10 July 1966. Lower part of confidence interval often negative.

Table X. Number of individuals collected (n) and estimated relative abundance (a) of *B. argenteolum* and *B. lapponicum* in different habitats by time-catch. For the material from Målselva there has been no differentiation made between habitat 7a and 7b

Species	Material from		Habitat 4d	4g	6a	6b	7a	7b	7c
B. argenteolum	The Gaula, June, July 1965	n	0	0	0	0	44	30	2
		a	0	0	0	0	0.21	0.25	0.05
	The Gaula, June 1968	n	0	–	–	0	4	7	–
		a	0	–	–	0	0.11	0.20	–
B. lapponicum	The Gaula, May-July 1965	n	0	2	0	1	4	5	0
		a	0	0.03	0	0.06	0.01	0.03	0
	The Gaula, June 1968	n	0	–	–	0	5	6	–
		a	0	–	–	0	0.14	0.17	–
	The Namsen, Aug. 1966	n	0	–	1	–	14	–	–
		a	0	–	0.15	–	0.12	–	–
	Målselva, June, July 1966, May 1967	n	0	22	0	–	31		–
		a	0	0.23	0	–	0.19		–
	Målselva, Sept. 1967	n	3	–	0	–	1		–

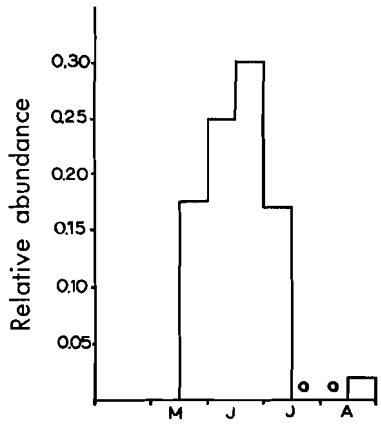


Fig. 13. Seasonal distribution of *Bembidion argenteolum* Ahr. by time-catch in habitat 7a and 7b on the Gaula in 1965. Catches are divided in half-monthly intervals. o: No collecting.

elva and Tönsvikelva. Copulation observed in captivity 7-28 June 1963, i.e. the whole period the animals were kept. Egg-laying occurs from May-July, at least (Table VII). Several third stage larvae were collected 3-5 Aug. 1964 on the Gaula and 2 July 1966 on Målselva.

Bembidion bruxellense Wesm.

Habitat. The eurytopic character, reported by Palmén & Platonoff (1943) and Lindroth (1945, 1963) was demonstrated by the present investigation, the species being found on almost every habitat (even in 1a) on the Gaula. However, on river banks silty spots with at least a somewhat developed vegetation, or some shadow, are probably preferred (Table XII and Fig. 10). On sparsely covered habitats, it is frequently found in the sun (Table V). The species occurs in sparse vegetation, according to Mrozek-Dahl (1928), whereas the observations of Palmén & Platonoff (1943) and Lindroth (1945) are more in accordance with the present ones.

Life history. In 1965 adults were collected in May, June and August on the Gaula, in August only tenerals were found. Tenerals were collected on the Gaula from July — September (in 1963 from 13 July), on Tönsvikelva 26 May 1968 (two of ten specimens) and in September in 1967 and 1968. One of sixteen adults found on the Gaula August 1966 was teneral. Copulation observed 19 May 1967 on the Gaula and

Table XI. Number of individuals collected (n) and estimated relative abundance (a) of *B. bipunctatum* indifferent habitats by time-catch. For further explanation, see Table VIII

		Habitat								
Material from		3a	3b	4b	4c	4d	4g	5	6a	6b
The Gaula, May, June 1965	n	0	–	0	0	0	0	10	0	24
	a	0	–	0	0	0	0	2.8	0	1.4
The Gaula, June 1968	n	0	–	0	0	0	0	5	0	0
The Namsen, Aug. 1966	n	–	–	0	1	0	–	–	0	–
Målselva, June 1966,	n	1	–	2	16	1	1	–	0	–
May 1967	a	0.2	–	≥ 0.2, ≤ 0.4	4.1	0.4	< 0.1	–	0	–
		xx		x			xx			
Tönsvikelva, June 1966	n	–	8	–	–	–	–	–	0	–
Tönsvikelva, June 1968	n								3	17
	a	–	–	–	–	–	–	–	0.4	6.4
									xx	

Table XII. Number of individuals (n) and estimated relative abundance (a) of *B. bruxellense* in different habitats by time-catch. For further explanation see Table VIII.

Material from		Habitat 1c	2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	5	6a
The Gaula, May-July 1965, Aug. 1966	n	11	2	4	10	32	21	1	37	12	4	6	1	5
	a	≥1.0, ≤2.1	0.2	0.5	1.0	≥1.2, ≤2.4	3.9	≥0.2, ≤0.3	1.8	0.4	≤0.1	<0.1	0.3	0.1
The Gaula, May 1967	n	2	–	0	0	–	0	0	12	0	–	–	–	0
	a	≥0.4, ≤0.8	–	0	0	–	0	0	1.3	0	–	–	–	0
The Gaula, Sept. 1967	n	–	–	–	3	–	–	–	20	4	–	–	–	–
	a	–	–	–	1.6	–	–	–	4.5	0.3	–	–	–	–
The Gaula, June 1968	n	–	2	–	–	–	3	0	18	1	0	0	0	–
	a	–	1.3	–	–	–	2.0	0	2.8	0.2	0	0	0	–
The Namsen, Aug. 1966	n	–	0	–	–	–	2	0	0	1	–	–	–	3
	a	–	0	–	–	–	3.0	0	0	0.1	–	–	–	0.5
Målselva, June–July 1966, May 1967	n	–	0	0	0	–	1	0	1	1	–	0	–	0
Tönsvikelva, June 1966	n	–	–	–	–	5	–	–	–	–	–	–	–	0

Table XIII. Number of individuals collected (n) and estimated relative abundance (a) of *B. dentellum* and *B. difficile* in different habitats by time-catch.

Species	Material from		Habitat 2a	2b	3b	4c
B. dentellum	The Gaula, June, July 1956	n	1	0	0	13
		a	0.1	0	0	1.4
	The Gaula, June 1968	n	0	–	>10	>5
B. difficile	Målselva, June, July 1966, May 1967	n	0	2	–	1
	Tönsvikelva, June 1966	n	–	–	7	–

Table XIV. Number of individuals collected (n) and estimated relative abundance (a) of *B. femoratum* in different habitats by time-catch. For further explanation see Table VIII

		Habitat										
Material from		1d	3a	4b	4c	4d	4e	4g	6a	6b	7a	7b
The Gaula, May, June	n	–	2	1	5	13	2	19	13	9	0	1
1965, Aug. 1966	a	–	0.3	≥0.4, ≤0.6	0.3	0.5	< 0.1	0.2	0.3	0.4	0	<0.1
												xx
												xx
												xx
							x					xx
The Gaula, May 1967	n	–	0	1	0	1	–	–	4	0	–	–
	a	–	0	≤0.1	0	≤0.1	–	–	0.4	0	–	–
The Gaula, Sept. 1967	n	–	0	–	1	3	–	–	–	–	–	–
	a	–	0	–	0.2	0.3	–	–	–	–	–	–
The Namsen, Aug.	n	–	–	0	0	25	–	–	9	–	10	–
1966	a	–	–	0	0	1.5	–	–	1.4	–	0.1	–
											xx	
											xx	
Målselva, June-July 1966, May 1967	n	8	0	0	0	0	0	0	0	–	0	0

4 June — 5 July 1963 in captivity. Egg-laying occurs in May, June and perhaps July (Tables VI and VII). Larvae were reared in July (Table VI). Some probable third stage larvae were found on the Gaula in August 1962.

Bembidion dentellum Thbg.

Habitat. Almost exclusively found in habitats 4c or 3b (Table XIII), always in very damp sites (moisture 3). Mostly observed running about (Table V). These and other results (Mrozek-Dahl 1928, Palmén & Platonoff 1943, Lindroth 1945) indicate a preference for very moist, silty or clayish soils with somewhat developed vegetation or with a sparse one, but at least in the latter instance, in shady positions.

Life history. Imagines were collected from late May to August, in 1965 in June and July. Tenerals present in August 1964 and 1966 and 20 May 1967 (one of two specimens). Eggs are laid at least in June (Table VII). Two third stage larvae, of which one was reared to imago (Andersen 1966), found 8 Aug. 1964 in Trondheim.

Bembidion difficile Mtsch.

Habitat. On Tönsvikelva and Målselva in silty, more or less shady habitats (Table XIII), frequent on the latter place during the flood in 1967 (Andersen 1968), whereas only one specimen was found by quadrat-sampling. Most specimens were found under leaves. Very rare on the Gaula and only taken by hand-collecting in habitat 6. Platonoff (1942, 1943) found the species abundantly on gravelly or stony ground in North Finland. Lindroth (1945) men-

Table XV. Number of individuals collected (n) and estimated relative abundance (a) of *B. hasti* and *B.hyperboraeorum* in different habitats by time-catch. For further explanation see Table VIII

Species	Material from		Habitat 6a	Habitat 7
B. hasti	Tönsvikelva, Sept. 1967	n	3	–
	Tönsvikelva, June, July, Sept. 1968	n	22	–
	Jakobselva, July 1967	n	8	1
		a	1.0	0.1 x
	Vesterelva, July 1967	n	63	–
B. hyperboraeorum	Målselva, June, July 1966,	n	2	1
	May 1967	a	0.1	< 0.1
	Tönsvikelva, June 1966	n	12	–
	Tönsvikelva, Sept. 1967	n	10	–
	Tönsvikelva, June, July, Sept. 1968	n	36	–
	Jakobselva, July 1967	n	4	0

tions that the species requires shadow and a substratum containing mud, otherwise it is little dependent on substratum type. The habitat choice perhaps varies from one place to another.

Life history. Seven of nine specimens collected on Målselva in September 1966 and 1967 were teneral. Egg-laying occurs at least in June and July (Table VII).

Bembidion femoratum Sturm

Habitat. Gravelly and silty sites seem about equally preferred (Table XIV). No specimens were found in densely vegetated habitats by hand collecting on the Gaula, and such habitats are probably less preferred than more sparsely covered ones. In August 1966 rather abundant in spots without vegetation both during sunny and cloudy weather (Table XIX). Often observed in the sun in silty sites (Table V). Frequently found on the drier parts of the bank or above it (Table XIV). In Trondheim, Dividalen and at Tönsvikelva in fairly dry spots with sparse vegetation in sand-pits and at roadsides. Lindroth (1945) also emphasizes the independence of moisture and a preference for sparsely vegetated or bare sites.

Life history. By time-catch on the Gaula in 1965 about equally frequent in May to July, in August only tenerals were collected. Generally, tenerals were present from late July - September. In August 1966, 14 of 15 specimens collected on the Gaula were teneral. Adults often copulated in captivity from 7 June - 18 July 1963, i.e. the period the adults were kept. Egg-laying occurs at least in June (Tables VI and VII). Larvae, probably belonging to *B. femoratum* were taken 18 August 1962, 11 July 1963 and 27 June - 16 July 1964 on the Gaula. One larva from habitat 1d on Målselva 2 July 1966 was definitely *B. femoratum*. According to this and Table VI the larval time for *B. femoratum* is June - August.

Bembidion hasti Sahlb.

Habitat. Gravelly or stony sites seem to be preferred (Table XV). On Balsfjordelva and in Tamokdalen, only collected in such habitats.

All specimens were found under stones or among gravel. According to Lindroth (1945) occurring on sandy, stony and gravelly ground, whereas the results of Brundin (1934) and Lindroth (1963) are in accordance with the present.

Life history. Fully hardened specimens were found from mid-June to mid September. One teneral collected 10 July 1969 on Balsfjordelva. In the collections at Tromsö Museum there are tenerals from 3 July (Moen in Målselvdalen, Leg. Schneider) and September (Kåfjord, Leg. Munster). Breeding period is from July to September (Table VII).

Two third stage larvae were collected at Vesterelva July 1967. On Balsfjordelva, four third stage larvae were collected 25 June 1969 and several third stage larvae and pupae 15 September (the identification proved by rearing to imagines). Several second stage larvae from Tönsvikelva 15 June 1969 are either *Bembidion hyperboraeorum* Munst. or *B. hasti*.

Bembidion hyperboraeorum Munst.

Habitat. Mostly collected on gravelly or stony ground (Table XV), near the water's edge. All specimens were found in concealment. According to Brundin (1934) the species occurs on sandy shores, whereas the observations of Lindroth (1945, 1963) and Brinck & Wingstrand (1951) correspond with the present ones.

Life history. Present from late May on Målselva and Tönsvikelva. On Tönsvikelva rather common in June 1966, 1968 and 1969, July 1968 and September 1967. In 1968 only one specimen was found in September. Tenerals were collected in September. Three pairs were observed copulating 15 June 1969 on Tönsvikelva. Egg-laying occurs at least in June and July (Table VII). Some third and second stage larvae from Jakobselva 19 July 1967 and one third stage larva from Dividalen 5 Sept. 1967 and one from Tamokdalen 13 Sept. 1968 are either *B. hyperboraeorum* or *B. hasti*.

Bembidion lampros Hbst.

Exclusively found in habitat 1c on the Gaula and consequently it does not belong to the fauna of the real river bank. The specimens, most of them tenerals, were found in August.

Bembidion lapponicum Zett.

Habitat. Except on the Gaula in 1964 found exclusively in sparsely vegetated or barren sites (Table X). The reasons for its presence in more shady or vegetated spots in 1964 (Fig. 10) are probably the high water level and perhaps the weather conditions (showery weather) which may partly have forced the beetles out of spots with sparse or no vegetation. The species should prefer sandy or gravelly spots (Lindroth 1945, 1963), but according to the present study it is frequent also on silt. However, all the larvae were found on sandy sites, and the species may prefer to reproduce here. Very few specimens were found on gravelly ground, and such habitats are perhaps less favoured. Very active during sunny weather, often flying away when disturbed (Table V).

Life history. Adults occurred on the Gaula from late May to July in 1965. Absent in quadrat samples from the Gaula in May 1964, but rather frequent in June (Table XXI). The water level in the river in May was even higher than in June and differences in water level cannot account for the result. The frequency dropped markedly from June to July

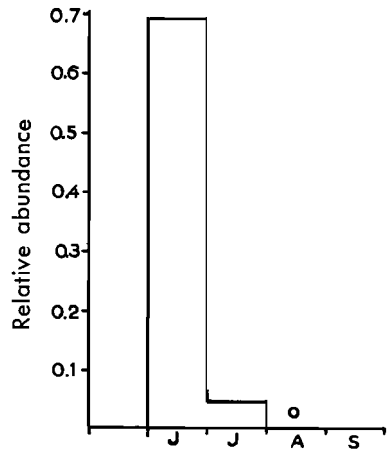


Fig. 14. Seasonal distribution of *Bembidion lapponicum* Zett. by time-catch in habitat 4g and 7 on Målselva. o: No collecting.

Table XVI. Dates of collection of larvae of *B. lapponicum* on the Gaula. Figures in brackets give number of individuals

Stage	Year			
	1962	1963		1964
1.	29.7 (2)			
2.	29.7 (2)	25.6 (4)	7.8 (1)	21.6 26.6 (3)
3.	14.8 (1)	7.7 (1)		

1966 on Målselva (Fig. 14). No beetles were observed 27 May 1967 on Målselva, but several 28 May, and it is likely that the latter date marked the onset of the activity that year. Tenerals were found in August (the Gaula and the Namsen, seven specimens on the latter river) and September (Målselva, all of four specimens). Copulation observed on Målselva 18 June 1966 and in captivity between 4 June and 13 Aug. among specimens kept 24 May to 20 Aug. Egg-laying occurs in June and July (Tables VI and VII). Larval time is from June to August (Tables VI and XVI).

Bembidion litorale Ol.

Habitat. Time-catch results may imply a preference for exposed, sparsely vegetated silty spots (Table XVII) and the following observations support this: spots on st. 3 and 7 on the Gaula were exposed and sparsely vegetated in 1962-1965 (habitats 4d, 4e). In 1966-1968 they were more shady with considerably more developed vegetation (habitats 3b, 4c). *B. litorale* was abundant here in 1963-1965, but absent in 1966-1968, whereas *B. semipunctatum*, *B. schueppeli* and *B. lunatum* were present in 1966-1968, but absent in 1963-1965.

B. litorale is less hygrophilous than many

Table XVII. Number of individuals collected (n) and estimated relative abundance (a) of *B. litorale* in different habitats by time-catch. For further explanation, see Table VIII

Material from		Habitat				
		3b	4c	4d	4e	4g
The Gaula, May-July 1965, Aug. 1966	n	4	17	62	48	31
	a	≥ 0.1, ≤ 0.3	0.8	2.0	≥ 0.3, ≤ 1.0	0.3
		xx				xx
The Gaula, Aug. 1965	n	–	0	3	0	–
The Gaula, May 1967	n	–	2	12	–	–
	a	–	0.2	1.0	–	–
The Gaula, Sept. 1967	n	–	2	4	–	–
	a	–	0.5	0.3	–	–
The Gaula, June 1968	n	0	0	5	15	–
	a	0	0	0.9	≥ 0.5, ≤ 1.8	–
The Gaula, Sept. 1968	n	0	0	7	–	–
The Namsen, Aug. 1966	n	–	1	10	–	–
	a	–	0.1	0.6	–	–

Table XVIII. Seasonal distribution of *B. litorale* by time-catch on the Gaula in 1965. The line, points and crosses below the figures symbolize that the relative abundance for the month only marked with a point is significantly different from that for the month marked with points and x (significance level 95 %) or xx (s.l. 99 %)

Habitat		May		June		July		August	
		H	T	H	T	H	T	H	T
4c	n	3	0	11	0	1	0	0	0
	a	0.9	0	2.1	0	0.2	0	0	0
				●———				xx ●———	
4d	n	20	0	19	0	7	0	1	2
	a	1.2	0	2.9	0	2.1	0	0.1	0.2
				●———				xx ●———	
						●———		x ●———	
4e	n	28	0	3	0	14	0	0	1
	a	≥ 0.3, ≤ 1.0	0	≥ 0.3, ≤ 1.2	0	≥ 0.5, ≤ 1.7	0	0	≤ 0.1
4g	n	11	0	13	0	0	0	–	–
	a	0.8	0	0.3	0	0	0	–	–
		●———				x ●———			

a: estimated relative abundance; n: number of specimens collected; H: fully hardened specimens; T: teneral specimens; –: habitat not investigated; 0: habitat investigated, but no specimens found.

Table XIX. Distribution of four *Bembidion* spp. in different habitats in relation to weather by time-catch on the Gaula in August 1966

Date	Weather	Habitat		*B. femoratum*	*B. litorale*	*B. petrosum*	*B. semi-punctatum*
10.8; 12.8	Sunny	4c	n	3	2	0	56
			a	0.4	0.3	0	7.4
		4d	n	1	16	4	2
			a	0.2	3.3	0.8	0.4
		4g	n	17	7	8	1
			a	0.6	0.2	0.3	< 0.1
12.8	Cloudy, partly rainy	4c	n	1	4	0	15
			a	0.4	1.4	0	5.4
		4d	n	1	5	2	2
			a	0.4	2.0	0.8	0.8
		4g	n	8	0	4	0
			a	1.4	0	0.7	0

n: number of individuals collected; a: estimated relative abundance

other *Bembidion* species, often occurring in habitat 4e. Several newly emerged specimens and four of five larvae were found on completely dry, compact, silty ground (habitat 4f) in July and August 1963 and 1964 on the Gaula, when the bank had largely dried up. The fifth larva was found in habitat 4e.

The species was not completely absent on sandy areas in 1963 and 1964, but perhaps the beetles had wandered from adjacent silty spots. The species is anyway essentially more frequent in silty sites in the study area. The completely barren ground is perhaps abandoned during less favourable weather (Table XIX). The species is mostly active in the sun, but flying was seldom observed (Table V), contrary to the experiences of Lindroth (1945), but in accordance with observations of Krogerus (1923) and Palmén & Platonoff (1943).

According to Mrozek-Dahl (1928), Gersdorf (1937), Palmén & Platonoff (1943) and Lindroth (1945) on open, sparsely vegetated ground. A preference for fine substratum is stated by Burmeister (1939) and Lindroth (1945), but according to Palmén & Platonoff (1943) also present on sand in Finland; on the river Elbe on sandy sites together with *B. argenteolum* and *B. velox* L. (Gersdorf 1937).

Life history. Collected from 1 May (1965) to mid-September (1967). Old adults occurred frequently until July, in 1963 to June (Tables XVIII and XXVI). Newly emerged specimens were present from late July or August, in 1963 already from 13 July. In August 1966, 21 of 45 specimens from the Gaula and six of 11 specimens from the Namsen were newly emerged. Copulation observed in captivity between 9 May and 27 June among specimens kept from 1 May to 15 Aug. Copulation was not observed among specimens taken newly emerged in July and August and kept at 20-22°C until December. Egg-laying occurs in May, perhaps also in June, but hardly in July (Tables VI and VII). Second and third stage larvae were collected between 25 June (1968) and August (Andersen 1966). This and Table VI shows larval time to be from May to August.

Bembidion lunatum Dft.

Among a material of 120 specimens of *B. lunatum* from the Gaula August 1966, one female deviates from normal *B. lunatum* by having dark legs. Prof. C.H. Lindroth (in lit.) who examined the specimen states that it deviates from normal *B. lunatum* also by having shorter middle joints of the antennae, less rounded prothorax and weaker 7th elytral striae. The systematic position of this form is still doubtful as no male is present.

Habitat. Time-catch indicates that densely vegetated habitats are preferred (Table XX). The confidence limits of the mean abundance in habitats 4a and 4c by quadrat-sampling in August 1966 overlapped (Fig. 10). Rather abundant in quadrat samples in habitats 2a, 3a and 3b in July 1964 (Table XXI), but no samples were taken in most other habitats for comparison. Larvae (partly reared to imagines) were collected on the Gaula in habitats 2a, 3a, 4a, 4e and 4g, mostly in the first three habitats. At Bröttemsnes on Nidelva, on Gudbrandsdalslågen and on the Otta found on silty, vegetated ground. At Trondheim *B. lunatum* is common in a clay pit (Andersen 1962) where it was significantly (99 per cent) more abundant in dense vegetation (coverage 4-5) than in sparse vegetation (coverage 1-2) by time-catch in June 1968. At Steinkjer abundant at the mouth of a river. *B. lunatum* is often observed in the sun in spots with sparse vegetation (Table V). The description of the habitat given by Lindroth (1945) agrees with the present.

Life history. The first adults occur in June, 4 June in 1963, 12 June in 1965 and 18 June in 1964. Tenerals were common in June and July (in 1965, 26 of 101 specimens), but only a single one was found in August (14 Aug. 1964). In 1965 seemingly most frequent in July (Fig. 15), but there was no significant difference in the abundance between the months in any habitat. In 1964 more abundant in July than in June (Table XXI).

Copulation was observed on the Gaula in one pair 12 Aug. 1963 and in three pairs out of 110 specimens August 1966; in captivity between 25 June and 30 Aug. among animals kept

Table XX. Number of individuals collected (n) and estimated relative abundance (a) of *B. lunatum* in different habitats by time-catch. For further explanation, see Table VIII

		Habitat											
Material from		2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	6a	7b
The Gaula,	n	28	2	15	24	39	6	34	14	4	2	5	1
June-Aug. 1965	a	2.2	0.8	1.6	≥1.0, ≤2.1	5.3	≥0.8, ≤1.3	1.4	0.6	≤0.3	< 0.1	0.1	< 0.1
Aug. 1966													
									xx	xx	xx	xx	xx
										x	xx	x	xx
			x	x			x	xx	xx	xx	xx	xx	xx
The Gaula,	n	0	–	2	0	–	–	2	0	–	–	–	–
Sept. 1967	a	0	–	1.0	0	–	–	0.5	0	–	–	–	–
The Gaula,	n	3	–	–	0	7	2	1	0	0	–	–	0
June 1968	a	2.0	–	–	0	4.6	≥1.3, ≤2.2	0.2	0	0	–	–	0
								xx					
The Gaula,	n	0	–	–	2	7	–	10	0	–	0	–	–
Sept. 1968	a	0	–	–	≥0.2, ≤0.5	2.6	–	1.8	0	–	0	–	–
The Namsen,	n	0	–	–	–	8	7	34	17	–	–	2	–
Aug. 1966	a	0	–	–	–	11.9	≥0.9, ≤1.6	3.5	1.0	–	–	0.3	–
							xx		xx			xx	
												x	
Saltdalselva,	n	0	–	5	–	–	–	–	–	1	–	4	–
Aug. 1966	a	0	–	1.9	–	–	–	–	–	≤0.2	–	0.3	–

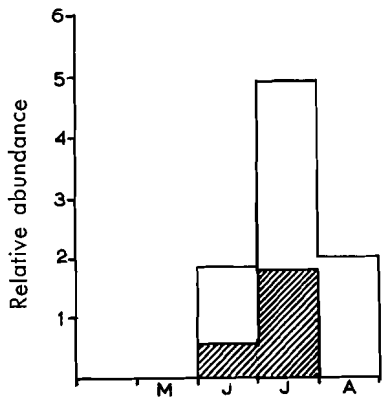


Fig. 15. Seasonal distribution of *Bembidion lunatum* Dft. by time-catch in habitat 2a, 4a and 4c on the Gaula in 1965. Hatched blocks symbolize teneral specimens.

from 11 June until they died in August — September. Egg-laying occurs in July to September (Tables VI and VII). One second and 14 third stage larvae were collected between 30 Apr. and 14 June, in September 1967 one second stage larvae and 17-20 Oct. 1964 six third stage larvae were found. At 20-22°C and

Table XXI. Abundance (number of specimens per 0.25 m²) of three *Bembidion* spp. in quadrat samples on the Gaula. Number of samples in brackets

Species	Habitat	Month		
		May	June	July
B. lapponicum	4d	0(7)	0.80(17)	–
B. lunatum	2a, 3a, 3b	0(12)	0.04(27)	0.75(21)
B. schueppeli	2a, 3a, 3b	3.70(12)	3.00(27)	0.10(21)
B. semipunctatum	2a, 3a, 3b	0.67(12)	1.33(27)	0.17(21)

Table XXII. Number of individuals collected (n) and estimated relative abundance (a) of *B. petrosum* in different habitats by time-catch. No differentation between 7a and b on Målselva. For further explanation, see Table VIII

Material from		Habitat											
		2a	3a	4a	4c	4d	4e	4g	6a	6b	7a	7b	7c
The Gaula, May, June	n	1	0	1	6	9	1	16	70	33	1	14	1
1965, Aug. 1966	a	0.2	0	0.2	0.4	0.3	< 0.1	0.2	1.6	1.5	< 0.1	0.1	0.1
					x	xx	xx	xx			xx	xx	xx
					x	xx	xx	xx			xx	xx	xx
The Gaula,	n	0	0	0	1	0	1	–	20	–	0	0	–
Aug. 1965	a	0	0	0	0.1	0	≤0.1	–	1.4	–	0	0	–
							x						
The Gaula, May 1967	n	–	0	0	0	0	–	–	7	–	–	–	–
The Gaula, Sept. 1968	n	0	–	0	0	0	–	–	6	2	–	–	–
The Namsen,	n	0	–	0	0	0	–	–	3	–	3	–	–
Aug. 1966	a	0	–	0	0	0	–	–	0.5	–	<0.1	–	–
											x		
Saltdalselva, Aug. 1966	n	0	0	–	–	–	0	–	16	–	–	–	–
Målselva, June-July	n	2	4	0	2	4	–	37	51	–		66	–
1966, May 1967	a	0.4	0.5	0	0.5	1.0	–	0.4	2.3	–		0.4	–
		x	x					xx				xx	–
Målselva,	n	0	0	–	0	–	–	0	23	–		12	–
Sept. 1966	a	0	0	–	0	–	–	0	2.3	–		0.5	–
												xx	
Målselva,	n	0	0	0	0	9	–	–	31	–		8	–
Sept. 1967	a	0	0	0	0	2.8	–	–	11.6	–		0.3	–
						x						xx	

Table XXIII. Seasonal distribution of *B. petrosum* by time-catch. For explanation of symbols see Table XVIII

Material from	Habitat		May H	May T	June H	June T	July H	July T	August H	August T	September H	September T
The Gaula 1965	6a	n	61	0	1	0	4	0	0	20		
		a	2.5	0	0.5	0	0.5	0	0	1.4	–	–
									xx			
				xx								
The Gaula 1965	6b	n	4	0	29	0	–	–	–	–	–	–
		a	0.5	0	3.6	0	–	–	–	–	–	–
			xx									
Målselva 1966	6a	n	–	–	28	0	6	0	–	–	6	17
		a	–	–	2.9	0	1.3	0	–	–	0.6	1.7
						xx						
Målselva 1966	4g	n	–	–	15	0	22	0	–	–	0	0
		a	–	–	0.6	0	0.3	0	–	–	0	0
Målselva 1966	7	n	–	–	4	0	26	0	–	–	4	8
		a	–	–	0.1	0	0.5	0	–	–	0.2	0.3
								x				

with food supply, eight larvae collected in October remained in the third stage for a long time, whereas two larvae collected in spring soon finished their development (Table VI).

Bembidion nitidulum Mrsh.

Habitat. Five specimens were caught 16 May 1967 in habitat 1a, i.e. on clayish soil far from the Gaula. Common in a claypit in Trondheim. Less dependent on a vegetation than *B. lunatum*, often hiding in crevices in barren clay. The demand for clayish soils is stated, among others, by Mrozek-Dahl (1928), Palmén & Platonoff (1943) and Lindroth (1945).

Life history. One specimen from the Gaula in May was quite pale. In Trondheim tenerals are frequent in late July and in August (11 of 19 specimens collected 18 July 1963 were teneral). Two of 58 specimens collected 4 May 1967 were also teneral. Third stage larvae, some of which were reared to imagines, were collected July and August and one 17 October 1964.

Bembidion petrosum Gebl.

Habitat. According to time-catch, most frequent in habitats 6a and b (Table XXII). The exceptionally high relative abundance in habitat 6a on Målselva in September 1967 can probably be explained by incipient aggregation in connection with hibernation (cf. Andersen 1968). No preference for gravelly ground could be shown by quadrat sampling (Fig. 10), but the high water level may partly have forced the beetles out of such sites. Only found on gravelly sites on the Otta, the Orkla, Nidelva (one specimen) and Rostaelva. On the Nea one specimen was found on silty ground.

Frequently collected on gravelly ground with underlying silt. Even in habitats with very

Table XXIV. Mating of *B. petrosum* observed in the field during the season. Data from the Gaula 1963-67, from Målselva 1966 and 1967

	The Gaula			Målselva		
Period	N	n	n(%)	N	n	n(%)
1–15 May	80	2	2.5			
16–31 May	57	4	7.0	78	6	7.7
1–15 June	104	16	15.4			
16–30 June	97	14	14.4	42	2	4.8
1–15 July	30	4	13.3	68	8	11.8
16–31 July	24	0	0			
1–31 Aug.	164	0	0			
1–15 Sept.	11	0	0	85	0	0
1–31 Oct.	110	4	3.6	154	0	0

N: number of individuals collected, n: number of individuals copulating

little protection (4e, 4g and 7a-c) most specimens were found under stones, branches or twigs (Table V). *B. petrosum* was never collected in the most elevated zones of the bank, and obviously it is more hygrophilous than *B. femoratum*. The species was not collected in denser vegetation in silty sites during less favourable weather (Table XIX). Many larvae collected in habitats 4d, 4g, 6a and 7 probably belong to *B. petrosum* (in some cases proved by rearing to adults).

The present study indicates at least some preference for gravelly or stony ground, often with underlying silt. According to Lindroth (1945) and Strand (1946) the species occurs on sparsely vegetated, fine sand, usually mixed with mud, whereas the habitat described for the form in North America (Lindroth 1963) is more in accordance with the present.

Life history. Fully hardened adults are frequent in late May, June and partly in July (Tables XXIII and XXVI). The low abundance in habitat 6a in June and July 1965 on the Gaula, is probably partly due to the spots investigated being ones where the species even in May was less abundant. In 1965 the first specimens were taken 1 May on the Gaula.

Tenerals were present from late July (the Gaula 1963, 1964) to September. Four of 78 specimens from Målselva 26-27 May 1967 were also teneral. On the Gaula, *B. petrosum* copulated from early May to early July, on Målselva from late May to July (Table XXIV). Specimens collected in May and June and kept in captivity to 15 September, copulated between 9 May and 12 August. More than a hundred adults, collected as tenerals in July and August, were kept at 20-24°C for up to five months without any mating being observed. 123 tenerals kept at 1-3°C in darkness for 1-5 months, copulated several times after a period at 20-22°C. Egg-laying occurs in June, July

Table XXV. Number of larvae of *Bembidion*, subgenus *Peryphus*, collected in half monthly periods on the Gaula

	Year			
Period	1962	1963	1964	1965
1–15 June	–	0	0	0
16–30 June	–	8	0	0
1–15 July	0	55	0	1
16–31 July	4	6	2	0
1–15 Aug.	14	6	5	0
16–31 Aug.	6	–	7	17
22 Oct.	–	–	1	–

Table XXVI. Seasonal distribution of four *Bembidion* spp. in 1962-64 on the Gaula. The figures give the ratio between teneral and total number of adults collected

	1962				1963						1964			
	July		August		June		July		August		May	June	July	Aug.
Species	I	II	I	II	I	II	I	II	I	II				
B. litorale	0/19	0/0	7/7	30/30	0/17	0/5	6/8	8/9	1/1	5/6	0/5	0/30	1/6	23/23
B. petrosum	0/16	0/8	1/4	7/7	0/46	0/18	0/15	3/6	33/33		0/20	0/35	0/17	13/13
B. semipunctatum	0/30	0/9	0/2		0/22	0/20	1/28	1/4	11/11		0/11	0/27	0/15	1/1
B. schueppeli					0/38		0/39	0/12	1/5					

I: first half of the month, II: second half of the month

Table XXVII. Number of individuals collected (n) and estimated relative abundance (a) of *B. prasinum* and *B. saxatile* in different habitats by time-catch. For further explanation, see Table VIII

			Habitat			
Species	Material from		4d	4g	6a	7
B. prasinum	The Gaula, May, June 1965 Aug. 1966	n	0	0	28	0
	The Gaula, May 1967	n	0	0	6	0
	The Namsen, Aug. 1966	n	0	0	1	0
	Målselva, June, July 1966, May 1967	n	0	4	7	3
		a	0	< 0.1	0.3	< 0.1
				x		xx
B. saxatile	The Gaula, May 1965, Aug. 1966	n	1	0	21	0
		a	< 0.1	0	0.5	0
			x			
	The Gaula, May 1967	n	0	0	7	0
	The Namsen, Aug. 1966	n	0	–	2	0

Table XXVIII. Number of individuals collected (n) and estimated relative abundance (a) of *B. quadrimaculatum* in different habitats by time-catch. For further explanation see Table VIII

		Habitat									
Material from		1c	3a	3b	4a	4b	4c	4d	4e	4g	6a
The Gaula,	n	30	4	4	0	5	2	3	27	9	1
May-Aug. 1965,	a	≥1.7, ≤3.6	0.4	≥0.1, ≤0.3	0	≥0.6, ≤1.1	0.1	0.1	≥0.1, ≤0.5	0.1	<0.1
Aug. 1966				x			xx	xx		xx	xx
											xx
The Gaula, May 1967	n	16	0	–	4	7	7	0	–	–	0
	a	≥3.3, ≤6.7	0	–	2.5	≥0.5, ≤1.0	0.8	0	–	–	0
The Gaula, Sept. 1967	n	–	1	–	0	–	2	9	–	–	–
	a	–	0.5	–	0	–	0.5	0.8	–	–	–
The Namsen, Aug. 1966	n	–	–	–	0	0	1	0	–	–	0

and probably early August (Tables VI and VII), in central Norway certainly also in May. Most larvae of subgenus *Peryphus* in Table XXV probably belong to *B. petrosum*. Larvae seemed to occur earlier in 1963 than in the other years. On Målselva one third stage larva was found 1 July 1966. Results of rearing are shown in Table VI.

Bembidion prasinum Dft.

Habitat. Table XXVII, Fig. 10 and hand-collecting at Selbusjöen and Nidelva show that *B. prasinum* prefers gravelly and stony ground which is in accordance with Lindroth (1945). Individuals were found on silty ground during hand-collecting on the Gaula, but then the gravelly and stony zones were submerged. Several larvae, some reared to imagines, were collected in habitats 6a and 4g on the Gaula. *B. prasinum* was exclusively observed under stones and among gravel (Table V).

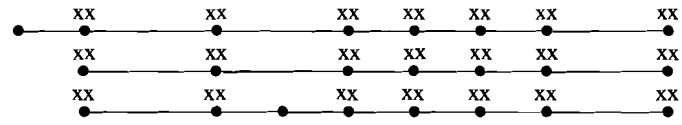
Life history. On the Gaula, imagines were found in May and August in 1965, in 1964 common in June. On Målselva taken in May, June and September. Four of 16 specimens

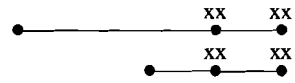
Table XXIX. Seasonal distribution of *B. quadrimaculatum* by time-catch on the Gaula in 1965. For explanation of symbols see Table XVIII

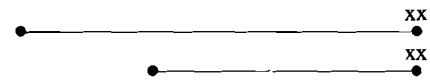
		May		June		July		August	
Habitat		H	T	H	T	H	T	H	T
1c	n	2	0	12	0	–	–	2	4
	a	≥1.2, ≤2.5	0	≥1.8, ≤3.8	0	–	–	≥0.3, ≤0.6	≥0.6, ≤1.3
4e	n	18	0	5	0	1	0	0	0
	a	≥0.2, ≤0.6	0	≥0.6, ≤2.0	0	≤0.1	0	0	0

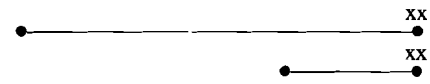
Table XXX. Number of individuals collected (n) and estimated relative abundance (a) of *B. schueppeli* in different habitats by time-catch. For further explanation see Table VIII

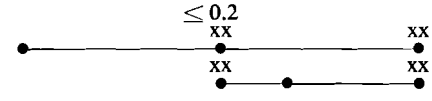
Material from		Habitat											
		2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	6a	7
The Gaula, May-July	n	146	27	134	31	97	1	67	7	6	0	1	0
1965, Aug. 1966	a	13.0	3.5	13.4	≥1.1, ≤2.3	18.0	≥0.2, ≤0.3	3.3	0.2	≤0.1	1	< 0.1	0
The Gaula, Aug. 1965	n	14	–	0	–	0	0	0	0	0	–	0	0
The Gaula, May 1967	n	–	0	52	–	28	1	37	0	–	–	0	–
	a	–	0	21.0	–	17.8	≥0.1, ≤0.2	4.0	0	–	–	0	–
The Gaula, Sept. 1967	n	14	–	18	–	–	–	6	0	–	–	–	–
	a	8.9	–	9.3	–	–	–	1.4	0	–	–	–	–
The Gaula, June 1968	n	30	–	–	0	21	0	17	0	0	–	–	0
	a	20.2	–	–	0	13.7	0	2.7	0	0	–	–	0
The Gaula, Sept. 1968	n	21	–	–	1	32	–	5	0	–	–	–	–
	a	17.3	–	–	≥0.1, ≤0.2	11.9	–	0.9	0	–	–	–	–
Målselva, June, July 1966	n	114	6	83	–	9	4	5	0	—	5	2	1
	a	20.3	4.6	14.2	–	16.7	≥0.8, ≤1.4	2.1	0	–	0.1	0.1	< 0.1
Målselva, Sept. 1966	n	70	–	8	–	–	1	4	–	–	0	0	0
	a	11.4	–	7.1	–	–	≥0.5, ≤0.9	2.8	–	–	0	0	
Målselva, Sept. 1967	n	10	–	18	–	9	–	0	0	–	–	0	0
	a	11.1	–	9.8	–	9.1	–	0	0	–	–	0	0

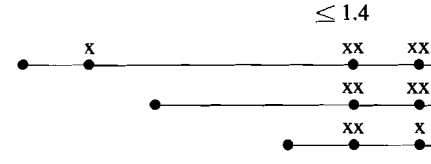


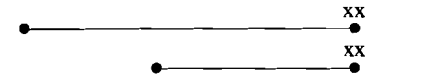












collected in August 1966 and one in September 1967 on the Gaula were pale. Egg-laying occurs in May, June, and probably later (Table VII). On the Gaula one third stage larva was seen 30 June 1963, in the other years in July and August.

Bembidion quadrimaculatum L.

Habitat. Commonly occurs on the bank (Table XXVIII), but perhaps most frequent on rather dry, silty sites above the bank (habitat 1c). The reason for its presence in habitat 4a in May 1967 is perhaps that not all the beetles had left their hibernation sites then. *B. quadrimaculatum* is frequently active in the sun (Table V). The results are in agreement with those of Lindroth (1945) as he states that this rather eurytopic species prefers drier parts of shores and banks.

Life history. Imagines are frequent in May and June, in August tenerals are present (Table XXIX). Egg-laying occurs at least in May and June (Table VII).

Bembidion saxatile Gyll.

Habitat. Gravelly and stony ground is preferred on all places investigated (Trondheim, Selbusjöen, Nidelva, the Nea and Stjördalen, besides those in Table XXVII and Fig. 11). The species is found in concealment during sunny weather (Table V). The observations of Schneider (1910), Burmeister (1939), Palmén & Platonoff (1943), Lindroth (1945, 1949) and Strand (1946) agree with the present. In Denmark and North Germany on clayish seamargins (Gersdorf 1937, Hansen 1964).

Life history. Adults collected only in May on the Gaula in 1965. The absence in June and July was perhaps due to different sites being investigated then than in May (cf.p. 49). Abundant in Trondheim in May - July, on Nidelva and the Nea frequent during the investigation in June 1968. Copulation was observed in captivity between 8 June and 22 July, which is nearly the whole period the beetles were kept. Egg-laying occurs in May, June and probably later (Table VII). Four probable third stage larvae collected 1 July 1963 in Trondheim.

Bembidion schueppeli Dej.

Habitat. A preference for silty, densely covered, often shady sites seems obvious (Table XXX and Figs. 11 and 12). Habitats on the bank are preferred, but two specimens were caught in habitat 1a at the Gaula. Often observed in the sun in sparsely vegetated habitats (Table V). The habitat choice is not influenced by weather conditions. Thus, during cold, rainy weather on the Gaula, the species occurred in large numbers in shady and densely vegetated spots, none being taken in sites with sparser vegetation (habitat 4c). The results agree quite well with observations of Palmén & Platonoff (1943) and Lindroth (1945), but occurs in sparse vegetation according to Strand (1946). At sea-margins *B. schueppeli* has been found under stones (Strand 1946), but it is uncertain whether this is the optimal habitat there.

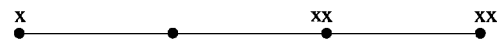
Life history. Imagines are abundant from early (the Gaula) or late (Målselva) May to July (Tables XXXI and XXVI). The low abundance in August 1965 on the Gaula is more likely due to a later emergence of the new generation than to extinction of it, the species being abundant in June 1966. On the Gaula tenerals were frequent in August 1966 (33 out of 48 specimens) and September 1967, on Målselva in September (Table XXXI). Two of 140 specimens from the Gaula 16 May 1967 were also teneral. No tenerals were found in August 1962 and 1964 on the Gaula. Copulation was observed 4 June 1963 in captivity. Egg-laying occurs in May - July (Tables VI and VII). Larvae occur at least from early June to August (Table VI).

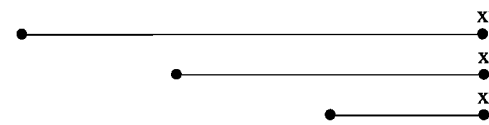
Bembidion semipunctatum Don.

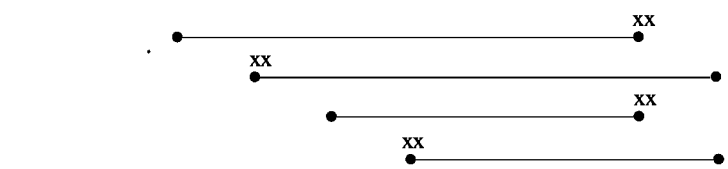
Habitat. Silty sites with at least a somewhat developed vegetation or more or less shady spots seem to be preferred to exposed sites with little or no vegetation (Table XXXII and Fig. 11). The species occurred seldom or was absent in densely covered, or very shady habitats in May (1965), June and July, whilst it was common in such habitats (2a, 2b, 3a, 4a) in May (1967), August and September (Table XXXII). Mostly running about on sunny days

Table XXXI. Seasonal distribution of *B. schueppeli* by time-catch. For explanation of symbols see Table XVIII. No distinction was made between H and T in habitat 2a on the Gaula in August 1966 and on Målselva in September 1967

			May		June		July		August		September	
Material from	Habitat		H	T	H	T	H	T	H	T	H	T
The Gaula	2a	n	23	0	51	0	61	0	14	0	–	–
1965		a	10.2	0	28.3	0	10.0	0	3.9	0	–	–
The Gaula	3a	n	38	0	–	–	59	0	0	0	–	–
1965		a	25.6	0	–	–	26.2	0	0	0	–	–
The Gaula	4a	n	–	–	46	0	11	0	0	0	–	–
1965		a	–	–	34.1	0	24.4	0	0	0	–	–
The Gaula	4c	n	16	0	23	0	22	0	0	0	–	–
1965		a	5.0	0	4.4	0	5.0	0	0	0	–	–
The Gaula	2a	n	–	–	83	0	–	–	11		–	–
1966		a	–	–	16.8	0	–	–	10.2		–	–
Målselva	2a	n	–	–	52	0	62	0	–	–	40	30
1966		a	–	–	21.0	0	19.7	0	–	–	6.5	4.9
Målselva	3a	n	–	–	33	0	50	0	–	–	4	4
1966		a	–	–	10.5	0	18.5	0	–	–	3.6	3.6
Målselva	3a	n	42	0	–	–	–	–	–	–	18	
1967		a	19.4	0	–	–	–	–	–	–	9.8	







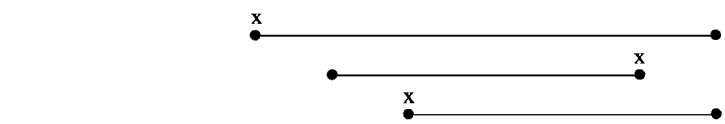


Table XXXII. Number of individuals collected (n) and estimated relative abundance (a) of *B. semipunctatum* in different habitats by time-catch. For further explanation, see Table VIII

		Habitat										
Material from		2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	7a
The Gaula,	n	11	1	3	23	3	0	121	7	2	7	0
May-July 1965	a	1.1	0.2	0.8	≥ 1.5, ≤ 3.0	1.7	0	9.5	0.3	< 0.1	< 0.1	0
		xx	xx	xx					xx	xx	xx	
									xx	xx	xx	
The Gaula,	n	0	–	0	–	4	0	13	0	2	–	0
Aug. 1965	a	0	–	0	–	2.0	0	1.8	0	≤ 0.2	–	0
The Gaula,	n	5	3	1	11	12	1	56	2	1	1	0
Aug. 1966	a	4.6	1.1	0.2	≥ 0.9, ≤ 1.8	3.3	≥ 0.4, ≤ 0.6	7.4	0.4	≤ 0.2	< 0.1	0
				xx					x	xx	xx	
				xx					x	xx	xx	
				xx	x		x		xx	xx	xx	
The Gaula,	n	–	10	3	–	1	0	24	6	–	–	–
May 1967	a	–	7.7	1.2	–	0.6	0	2.6	0.5	–	–	–
									xx			
									x			
The Gaula,	n	4	–	5	–	–	–	27	7	–	–	–
Sept. 1967	a	2.5	–	2.6	–	–	–	6.1	0.6	–	–	–
									xx			
The Gaula,	n	0	–	–	41	0	0	76	3	0	–	0
June 1968	a	0	–	–	≥ 10.0, ≤ 21.0	0	0	11.9	0.5	0	–	0
									xx			
									xx			
The Gaula,	n	0	–	–	29	7	–	22	11	–	–	–
Sept. 1968	a	0	–	–	≥ 3.4, ≤ 7.0	2.6	–	3.9	1.4	–	–	–
The Namsen,	n	0	–	–	–	0	0	9	0	–	–	1
Aug. 1966	a	0	–	–	–	0	0	0.9	0	–	–	0.1
												xx

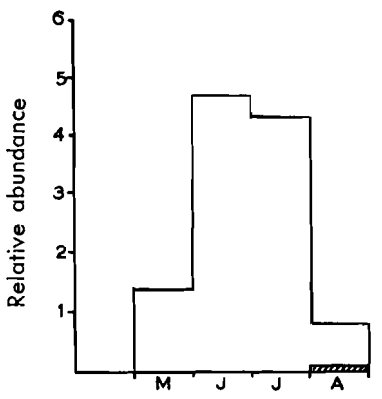


Fig. 16. Seasonal distribution of *Bembidion semipunctatum* Don. by time-catch in habitat 2a, 4c and 4d on the Gaula in 1965. Hatched blocks symbolize teneral specimens.

(Table V). The habitat choice seems uninfluenced by weather conditions (Table XIX). During cold weather on the Gaula, June 1966, collected in habitat 4c only.

There is general agreement about preference for fine substratum (Gersdorf 1937, Burmeister 1939, Palmén & Platonoff 1943, Lindroth 1945, 1949, 1963 and Jeanell 1967). According to Lindroth (1945, 1963) on sparsely vegetated or barren ground, frequently together with *B. litorale*. Palmén & Platonoff (1943) states that *B. semipunctatum* occurs on moderately vegetated ground, but without preferring such sites. The present investigations indicate preference for more vegetated or shady, and often moister, sites than *B. litorale*. *B. semipunctatum* should occur more in shady habitats in central than in North Europe, even together with *B. dentellum* (Lindroth 1945, 1949), but as these species, on the Gaula, are abundant in rather shady habitats, the above-mentioned difference hardly exists.

Life history. Adults are frequent from May to July (Fig. 16 and Tables XXI and XXVI). In 1965 fully hardened specimens were significantly (99 per cent) more abundant in May, June and July than in August in habitat 4c. In 1965 a single specimen was taken in early May, but it was first common from the end of that month. Tenerals are frequent in August (31 of 44 specimens from the Gaula August 1966 were tenerals) and September. In 1963 tenerals occurred as early as 14 July. Mating observed in captivity 4 June 1963 and 30 July 1962. Egg-laying occurs from late May to July

Table XXXIII. Number of individuals collected (n) and estimated relative abundance (a) of *B. virens* in different habitats by time-catch. For further explanation see Table VIII

Material from		Habitat			
		3b	6a	6b	7
The Gaula, May, June 1965,	n	1	4	65	1
Aug. 1966	a	≤ 0.1	≤ 0.1	3.0	< 0.1
		xx	xx		xx
The Gaula, May 1967	n	–	30	–	–
	a	–	2.6	–	–
The Gaula, June 1968	n	0	–	18	0
The Gaula, Sept. 1968	n	0	–	48	–
The Namsen, Aug. 1966	n	–	0	–	1
Målselva, June, July 1966,	n	–	3	–	4
May 1967	a	–	0.1	–	< 0.1

Table XXXIV. Seasonal distribution of *B. virens* by time-catch in habitat 6b on the Gaula. For explanation of symbols see Table XVIII

Year		May		June		July	
		H	T	H	T	H	T
1965	n	40	0	2	0	–	–
	a	4.6	0	0.3	0	–	–
		●———		xx ———●			
1966	n	–	–	60	0	8	15
	a	–	–	11.3	0	1.7	3.2
				●———		xx ———●	

(Tables VI and VII). A few larvae were reared (Table VI).

Bembidion tetracolum Say.

Habitat. A few specimens were collected by time-catch in habitats 4a, 4c and 6a on the Gaula. By hand-collecting in 1962 and 1963 and quadrat-sampling (Fig. 11), it was found rather often in densely vegetated or shady habitats (2a, 3a, 3b, 4a), a few specimens on gravelly ground. According to Lindroth (1945) it occurs on clayish soil on vegetated, often shady ground. A few tenerals were collected in August.

Table XXXV. The probable optimal habitats of the Bembidiini species according to present investigations. Brackets mark less preferred habitats

Species	Habitats																		
	1a	1b	1c	1d	2a	2b	3a	3b	4a	4b	4c	4d	4e	4g	5	6a	6b	7a	7b	7c
A. pallipes										+										
B. argenteolum																		+	+	(+)
B. bipunctatum								+			+				+		+			
B. bruxellense			+					+	+		+									
B. dentellum								+			+									
B. femoratum				+						(+)	(+)	+				+	+			
B. hasti																+				
B. hyperboraeorum																+				
B. lampros			+																	
B. lapponicum														+		(+)		+	+	
B. litorale											(+)	+	+							
B. lunatum									+											
B. nitidulum	+																			
B. petrosum																+	+			
B. prasinum																+				
B. quadrimaculatum			+																	
B. saxatile																+				
B. schueppeli					+		+		+											
B. semipunctatum								+	(+)		+									
B. tetracolum					+		+	+	+											
B. virens																+	+			

Bembidion virens Gyll.

Habitat. The species was mostly found on gravelly or stony ground (Table XXXIII). At Lesjaskogsvatnet, Selbusjöen, Bjerkvik and on the Otta, Nidelva and Rostaelva only collected in such habitats. On the Gaula almost exclusively found on st. 1 and 2. The reason for the marked difference in the abundance in habitat 6a in 1965 and May 1967 is that collecting was made on st. 2 in 1967, in 1965 mostly on st. 3, 4 and 6. On the Gaula most specimens were found among boulders with underlying heterogenous substratum, few on gravelly ground with underlying silt. This may explain the low abundance in June 1965 as only silty spots underlying gravel were investigated. Many larvae, some reared to imagines, were collected in habitat 6b. Nearly all specimens were found in concealment (Table V). The description of the habitat given by Lindroth (1945) is consistent with the present.

Life history. In 1965 common on the Gaula as early as 2 May. The probable reason for the abundance being higher in May than in June 1965 (Table XXXIV) is given above. On the Gaula tenerals were common in July and August, in 1963 from 11 July. Copulation observed 2 May 1965 on the Gaula, in captivity in June. Egg-laying occurs in May, June and probably later (Tables VI and VII). Several third stage larvae taken 10 June 1963 and 5 Aug. 1964. Some larvae were reared (Table VI).

DISCUSSION AND CONCLUSION

Habitat

Most Bembidiini species (except *B. lampros* and *B. nitidulum)* were found in more than one habitat, but one or a few are usually preferred by the adults (Table XXXV). In all the investigated habitats, except habitat 1b, at least one species occurs regularly. As indicated by findings of larvae and quite pale adults the species obviously only develop in certain habitats. Thus the species must be regarded as confined to certain zones and habitats on the river bank, in contrast to the view of Wirén (1954). During inundations the species choose spots most resembling their usual habitats. Thus *B. schueppeli* and *B. difficile* are mostly found in dense vegetation or on protected sites during flooding, *B. lapponicum* and *B. petrosum* in spots with sparse or no vegetation, the last one mostly among gravel (Andersen 1968, Table II-IV). *B. petrosum* leaves such spots and seeks shelter in vegetation only when the water level becomes very high.

The present investigation in part indicates preference for other habitats than those mentioned in previous literature. This is probably mostly because of insufficient investigation of habitats and no estimation of the density of the species in earlier work, and perhaps because there is a different understanding of some terms e.g. substratum type and vegetation coverage. Reasonably, the term clay (in German: Lehm or Ton, in Swedish: lera) or mud (in German: Schlamm) used by Palmén & Platonoff (1943) and Lindroth (1945, 1949) are often almost identical with the term silt as used here. The choice of habitat for most species does not seem to vary with the locality within the areas investigated, although the species composition varies very much from one place to another. This is an indication that abiotic requirements largely determine the distribution of the species. The habitats of *B. bipunctatum* and perhaps *B. difficile* change from one area to another within Fennoscandia. *B. saxatile* shows a habitat change within its distributional area. It is confined to gravelly or stony ground in the whole of Fennoscandia, but occurs on clayish seamargins in Denmark and North Germany.

The habitat choice of Coleoptera living on river banks should be influenced by weather conditions (Wirén 1954). The present investigation may indicate that *B. litorale* and perhaps *B. lapponicum* to a higher degree shelter in denser vegetation and *B. argenteolum* prefers drier ground during less favourable weather, but for several other species no alteration was evident.

An increase in vegetation coverage in the course of the summer was often distinct. *B. semipunctatum* and perhaps *A. pallipes* occur more in dense vegetation late in summer, but

Table XXXVI. The occurrence of Bembidiini species on river banks in Tröndelag (STi, NTi), Northern Norway Troms and Finnmark counties) and entire Fennoscandia, and their regional distribution in Fennoscandia

Species	Degree of dependence on river banks in:			Occurrence in:		
	STi; NTi	Northern Norway	Entire Fennoscand.	coniferous zone	birch zone	arctic or alpine zone
A. pallipes	o	o	o	r	r	–
B. argenteolum	o?		o	r	–	–
B. bipunctatum	n	n	n	r	r	r
B. bruxellense	n	n	n	r	r	–
B. dentellum	n		n	r	–	–
B. difficile	n	n	n	r	r	r
B. fellmanni	n	n	n	+	r	r
B. femoratum	n	n	n	r	r	–
B. hasti		n	n	r	r	r
B. hyperboraeorum		n	n	r	r	r
B. lampros	n		n	r	–	–
B. lapponicum	s	n	n	r	r	–
B. litorale	s		s	r	a	–
B. lunatum	o		o	r	–	–
B. nitidulum	n		n	r	r	–
B. obliquum	n		n	r	–	–
B. petrosum	s	o	o	r	r	–
B. prasinum	o	o	o	r	r	–
B. quadrimaculatum	n		n	r	–	–
B. saxatile	n	n	n	r	+	–
B. schueppeli	o	n	n	r	r	–
B. semipunctatum	s		o	r	–	–
B. tetracolum	n		n	r	–	–
B. velox	n	n	n	r	r	–
B. virens	o?	n	n	r	r	–

r: regular occurrence; a: accidental; +: only found on a few localities; –: absent or probably so; s: probably stenotopic; o: probably oligotopic; n: no preference for river banks

no alteration in habitat was evident for the other species and thus they appeared to partly change their sites during the season. The rather common occurrence of *B. semipunctatum* and *B. quadrimaculatum* in densely vegetated or shady habitats in May 1967, is perhaps due to several specimens not having left their hibernation sites.

The larvae of *B. lapponicum* perhaps has a more restricted habitat choice than the very active adults. A similar feature is present among cicindelids (Shelford 1911).

Table XXXVI is based on the author's own investigations and on Schneider (1910), Strand & Hanssen (1935), Lysholm (1937), Lindroth (1945) and Strand (1946). The term stenotopic is used as by Palm & Lindroth (1936): *only* present in one habitat (river banks) within an area; and oligotopic correspondingly as: *mostly* occurring in one habitat (river banks) within an area. Tröndelag (STi, NTi) has four stenotopic bank species, but Målselvdalen none. Four or six species are oligotopic in the former area, three in the latter. *B. litorale* is stenotopic in the whole of Fennoscandia, perhaps in its entire distributional area (Lindroth 1945). Many oligotopic or eurytopic species (*A. pallipes, B. argenteolum, B. dentellum, B. hasti, B. hyperboraeorum, B. lapponicum, B. lunatum, B. prasinum, B. saxatile, B. virens* and perhaps *B. petrosum* and *B. schueppeli)* occurring on lake- or sea-shores or in clay pits, live there in habi-

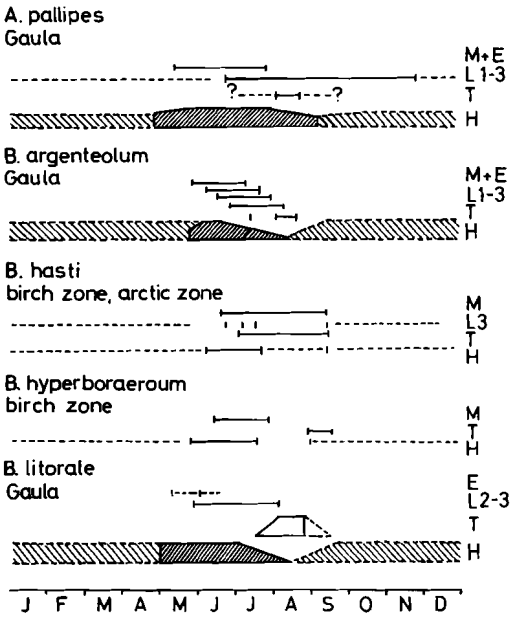


Fig. 17. Life history of Bembidiini spp. Separate observations are marked as vertical lines, and periods for observations as horizontal lines limited by vertical lines. Seasonal distribution of imagines often shown as densely hatched areas (fully hardened specimens) or light areas (tenerals). Expected periods or events are marked as broken lines (limited by vertical lines for *B. litorale* and *B. schueppeli* (Fig. 18) for the imagines as less-densely hatched areas. The height of the areas gives an impression of the relative abundance during the season. E: egg-laying; H: fully hardened specimens; L 1-3: larvae, 1-3 stage; M: females with mature ovaries; T: tenerals.

tats much resembling those on river banks as regards moisture, substratum type (some difference for *A. pallipes* and *B. lunatum)*, vegetation coverage and exposure. The clay and sand pits are obviously secondary habitats for *A. pallipes* and *B. lunatum*. They seem to be examples of species attaining a renaissance in their distributional possibilities due to human change of the environment. According to Brinck (1966) this feature is well known; as examples he mentions *Bembidion dauricum* Motsch., *Bembidion aeneum* Germ. and *B. femoratum*. The most eurytopic species *(B. bruxellense, B. lampros* and *B. quadrimaculatum)* occur in several types of habitats away from river banks (Lindroth 1945).

Some species (*A. pallipes, B. saxatile* and *B. lunatum)* occurring commonly on, or with a preference for river banks in central and North Fennoscandia, do not occur on river banks in Denmark and parts of South Scandinavia, or are more common in other habitats such as seashores and gravel or clay pits (Lindroth 1945, Hansen 1964).

The number of regularly occurring Bembidiini spp. declines markedly from the coniferous zone (24 species) to the arctic or alpine zone (5) (Table XXXVI). Nine species occur only or mostly in the coniferous zone whereas one species, *B. fellmanni,* is most common in the birch zone or the arctic or alpine zone.

Life history. Larsson (1939) divides carabid beetles into two life history categories: spring and autumn breeders. Members of the first group hibernate as imagines, breed in spring and early summer and their development is completed in the course of the summer. The autumn breeders propagate in summer and autumn and the larvae hibernate. Lindroth (1945) prefers the terms imaginal and larval hibernators instead of spring and autumn breeders, and according to him some species hibernate both as adults and as larvae. Studies made by, among others, Schjötz-Christensen (1965) reveal that the life history of Carabidae may be more varied than previously believed. The same must be concluded from the present work.

A graphical summary of data about the life history of *A. pallipes* and several *Bembidion* spp. is given in Figs. 17 and 18. The other *Bembidion* spp. showed a similar pattern of events to species represented in these figures. For the onset of activity on the Gaula, data are mostly based on investigations in 1965. The results for *B. argenteolum, B. lapponicum, B. lampros, B. litorale, B. prasinum, B. quadrimaculatum, B. saxatile, B. semipunctatum, B. tetracolum* and *B. virens,* in accordance with Larsson (1939), Lindroth (1945), Mitchell (1963) or Murdoch (1967), indicate exclusively imaginal hibernation. Populations, consisting of fully

hardened, breeding specimens are highest in May-July for most of these species. The abundance of such adults often declines markedly from June or July to August, but newly emerged imagines are abundant in August and September, sometimes already in July. Larvae occur in May to August, mostly third stage larvae being present in August.

In 1963 third stage larvae of *B. virens* occurred as early as 10 June. However, they probably originated from eggs laid the same year as the period previous to this was warm (Table II), and breeding starts early in spring.

As stated by Larsson (1939) and Lindroth (1945, 1963) *B. bruxellense, B. dentellum, B. nitidulum, B. petrosum* and *B. schueppeli* hibernate as imagines. However, as tenerals of the five species were collected in May even the larvae or most probably the pupae, hibernate. Thus tenerals of other species hibernating as larvae on the Gaula, such as *B. lunatum* (cf. below), *Trechus secalis* Payk. and *Nebria gyllenhali* Schnh., never occur before June. For *B. bruxellense,* which was found in a bare spot surrounded by snow, the possibility of hibernation as quite pale adults cannot be overlooked as observations in captivity reveal that the cuticula hardens slowly at low temperatures. The finding of larvae of *B. nitidulum* and *B. petrosum* in late October may suggest larval hibernation, but it is not known whether the larvae survive the winter.

Most of the populations of *B. femoratum, B. bipunctatum* and *B. difficile* no doubt hibernate as adults. One third stage larva each of *B. femoratum* and *B. bipunctatum* was taken as early as 2 July 1966 on Målselva, but as June was warm (Table II) the larvae may have originated from eggs laid the same year. However, some individuals of *B. bipunctatum* probably hibernate as larvae in North Fennoscandia, because teneral adults were collected rather early here (Lindroth 1945).

Perhaps no sharp boundary exists between those species supposed to be exclusively imaginal hibernators and those hibernating now and then as larvae or pupae.

Most of the population of the imaginal hibernators obviously live one year only, as indicated by the scarcity or absence of fully hardened specimens on the Gaula in late July or early August, but maybe a minority breed two or more years.

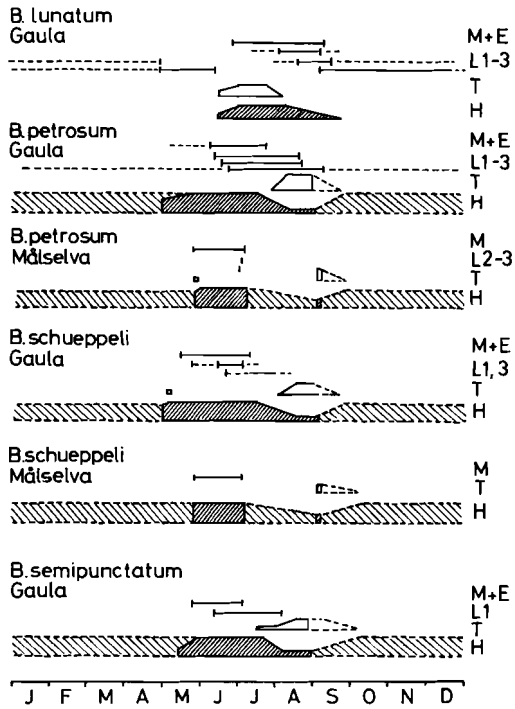


Fig. 18. Life history of Bembidiini spp.. For explanation see Fig. 17.

Rearing results show that the development time varies considerably within the same species and it is hardly legitimate to make comparisons of this for different species. However, *B. petrosum* and *B. lapponicum* develop rapidly, at least at high temperatures; the time required from egg-laying to emergence of adult *B. petrosum* is estimated to be about thirty to sixty days (Table VI). During natural circumstances the interval may be greater. The rearing results and the findings of larvae mostly in summer indicates that the life-cycle of the spring-breeders usually takes only one year.

The data for *B. lunatum* (Fig. 18) reveal exclusively larval hibernation as supposed by Larsson (1939) and Lindroth (1945). The first adults occur in June, tenerals constituting an essential part of the population. The adults

breed from July to September and all of them are probably extinct before winter. Second and third stage larvae occur in two separate periods, in late summer and autumn and in spring and early summer. Thus, larvae hibernate in more than one of the three stages. Considering the late emergence of imagines in 1964 (end of June) and the rather long development time, even during warm periods, the teneral specimens found in late July and mid-August 1964 obviously originated from eggs deposited the previous year.

Evidently *B. hyperboraeorum* mostly hibernates as imago, breeding occurring in the following spring and summer. However, as several had immature ovaries in June and July and females with ripe eggs were found 19 July on Jakobselva, larval hibernation perhaps also occurs.

In the arctic zone a large proportion of the eggs of *B. hasti* are laid in late July and probably in August. It is likely that many of the larvae originating from these eggs hibernate. In the birch zone larvae, pupae, pregnant females and females with immature ovaries are found in mid-September, larvae and females with only immature ovaries in June, and pregnant females and tenerals in July, suggesting hibernation both for larvae and adults. Perhaps also eggs and pupae hibernate, but it is not known whether the two last-mentioned stages are able to survive the winter. It is not unlikely that the life-cycle in part takes more than one year.

Previously little was known about the life history of *B. hasti* and *B. hyperboraeorum,* but they were at least regarded as, in part, imaginal hibernators (Lindroth 1945).

A. pallipes should hibernate as larva (Larsson 1939, Lindroth 1945). The present investigation supports this, but as fully hardened, pregnant females are abundant on the Gaula in May, a large proportion of the adults hibernate and breed in spring. Adults hibernate in northern Norway too, as a female from Målselva had immature ovaries in September and many specimens were found in May in Saltdalen (Schneider 1910). The population may thus consist of two groups: hibernating adults which breed in spring (May, June, perhaps also July), the offspring of which mostly hibernates as imagines but perhaps also as larvae, and another made up of adults which have hibernated as larvae, breeding in July and August, the offspring of which again hibernates as larvae. This life history applies to Central and North Fennoscandia, and as the species is present in Denmark in March (Larsson 1939), at least some imagines of *A. pallipes* in South Scandinavia hibernate, and probably breed, in spring.

Even within the same areas there are some differences in the phenology of those species mostly or entirely hibernating as adults. Thus, *B. argenteolum, B. dentellum, B. lapponicum,* and, to a lesser extent *B. semipunctatum* emerge and breed later in spring than most other species (Figs. 17 and 18). Some species have a long breeding period, e.g. *B. petrosum* (probably May to August), whereas others have a shorter one, e.g. *B. litorale* (May-June).

The times for the events differed from one year to another on the Gaula, but corresponded rather closely with the weather. Tenerals emerged two or three weeks earlier in the warm summer of 1963 than in the colder summers of 1962, 1964 and 1965. Tenerals probably also emerged early in 1966, which had a warm June, the percentage of fully hardened females with immature ovaries of some species being high in August. Furthermore teneral *B. schueppeli* were abundant in August 1966 whereas only a few were collected in this month the other years.

Pregnant females rarely lay eggs during exposure to cold water (Andersen 1968). Thus, spring floods of long duration are likely to have a delaying effect upon breeding and development. Sparse occurrence of teneral adults in August 1965 is no doubt partly explained in this way as there was a long inundation period in June. That the new generation was not appreciably decimated is evident at least for *B. schueppeli* as the species was abundant in June 1966.

Beetles collected as newly emerged in July and August of imaginal hibernators never copulated or laid eggs in captivity when kept at

20-22°C, which is understandable as imaginal hibernators of Carabidae have an ovarial diapause (Thiele 1966). Mating for *B. petrosum* was induced by exposure to cold in combination with darkness, but it is uncertain whether the treatment really broke the diapause as no eggs were laid and mating is not necessarily evidence of developed gonads and the insects being in breeding phase (Wigglesworth 1965). Experiments with two carabid beetles show that the diapause may be broken by short-day, followed by long-day treatment *(Pterostichus nigrita* F.) or mainly by cold treatment *(Agonum assimile* Payk.) (Thiele 1966).

Although data is scanty, there are indications of a larval diapause for *B. lunatum*.

The great value of obligatory diapauses for timing of life-cycles of monocyclic species (Andrewartha & Birch 1954, Danilewski 1965) is evident from the present investigation. Thus, tenerals of an imaginal hibernator, such as *B. litorale,* may emerge earlier in a warm year than *B. lunatum,* which is a larval hibernator, does in a cold one. Despite this, the characteristic life-cycles are maintained, because the species have a diapause at different, genetically determined, stages.

The spring is later in northern parts of the coniferous zone (Målselva) and development consequently starts later than far to the South. Nevertheless the *Bembidion* spp. living there mostly maintain the same life-cycle as in more southern areas.

Because of a short and variable summer, carabid beetles occurring in the alpine zone in Himalaya must be able to hibernate in any developmental stage (Mani 1962). The same is likely in Fennoscandia, as suggested by the life history of *B. hasti.*

SUMMARY

Habitat preference and life history of Bembidiini spp. occurring on river banks in central and northern Norway were studied, using, among other methods, quadrat sampling and time-catch. By the latter the relative abundance was estimated by means of a correcting factor (the approximate area investigated per hour) varying with the habitat. The disadvantages of the method are discussed. Dissection of ovaries and rearing of eggs and larvae in the laboratory were undertaken.

The species prefer, and only develop in, certain habitats on the bank. The present investigation in part reveals that the species prefer other habitats than those mentioned in earlier literature. During inundations the species choose sites most resembling their usual habitats. The habitat choice of the species (except *B. bipunctatum* and perhaps *B. difficile)* does not change within the areas investigated, although the species composition varies very much from one place to another, indicating that abiotic requirements largely determine the distribution of the species. A change in habitat selection due to weather conditions was likely only for *B. argenteolum, B. litorale* and perhaps *B. lapponicum.* Unripe specimens of some species may occur in dense vegetation late in summer and autumn more than the old generation earlier in the year, due to a development of the vegetation in the course of the season. The fauna on the banks comprises species which are stenotopic, oligotopic or eurytopic on river banks within the investigated areas.

In Tröndelag county *A. pallipes* and *B. lunatum* occur secondarily outside river banks in clay or sand pits, but are absent on other human influenced habitats.

The life history within the genera is less stable than previously supposed. *B. lunatum* is the only species hibernating exclusively as larvae. Larvae, as well as adults, of *A. pallipes* hibernate, breeding occurring from early spring to late summer. *B. hyperboraeorum* to a great extent hibernates as imago, but perhaps also as larvae, whereas *B. hasti* perhaps hibernates in any stage. The remaining species are imaginal hibernators, but several *(B. bruxellense, B. dentellum, B. nitidulum, B. petrosum* and *B. schueppeli)* now and then hibernate also as larvae or pupae. *B. argenteolum, B. dentellum* and *B. lapponicum* start breeding later than most of the other species.

Most of the population of the imaginal hibernators live one year only. Floods of long dura-

tion probably have a delaying effect upon breeding and development.

The imaginal hibernators have an imaginal diapause. Mating is induced by cold exposure in combination with darkness, but it is uncertain whether this treatment breaks the diapause. The *Bembidion* spp. living in northern parts of the coniferous zone mostly maintain the same life-cycle as in more southern areas.

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Notes on Nine Species of Neuroptera from Southern Norway

LITA GREVE

Greve, Lita, 1970. Notes on nine species of Neutroptera from Southern Norway. *Norsk ent. Tidsskr. 17*, 67-70.

New localities are given for nine species of Neuroptera. *Drepanopteryx phalaenoides* L. is reported for the second time since 1887. Records of the following are of special interest since they must be considered rare in Southern Norway: *Megalomus hirtus* L., *Chrysopa phyllochroma* Wesm. and *Chrysopa septempunctata* Wesm. Notes on the behaviour of *Eumicromus paganus* L. and a mass swarming of *Chrysopa chrysops* L. are given.

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The distribution of Neuroptera in Norway is still incompletely known. The purpose of this paper is to add further knowledge to the distribution and biology of nine species belonging to the genera *Chrysopa, Drepanopteryx, Eumicromus* and *Megalomus*. The material consists of 154 specimens.

Abbreviations used in the text:

Z. M. O. Zoological Museum, University of Oslo. Z. M. B. Zoological Museum, University of Bergen. Tr. Mus. Tromsö Museum. T. Mus. The Royal Norwegian Society of Science, Trondheim. St. pl. The Norwegian Plant Protection Institute, Vollebekk.

Unless otherwise stated, all specimens have been collected and determined by the author. In cases where the individual could not be determined to either sex, the word 'specimen' is used. The geographical divisions follow Strand (1943).

FAM. HEMEROBIDAE

Eumicromus angulatus Steph. 1836

New records. Northern Hedmark (HEn): Sollia, Degerud, 1 Oct. 1926 1 ♀ (Tr. Mus.). Vestfold (VE): Tjöme 27 June 1968 1 ♀ coll. A. Fjellberg. Southern Oppland (Os): Fåberg 1 June 1961 1 ♀ coll. G. Taksdal (St. pl.). Outer Austagder (AAy): Tromöy, Bjellandsvann 22 March 1967 1 ♀ coll. T. Solhöy (Z. M. B.). Arendal, Ingeborgdalen 26 July 1966 1, ♂ coll. T. Solhöy (Z. M. B.).

E. angulatus is new to HEn, VE and AAy. This species has a wide, but scattered distribution in Norway (Tjeder 1945). The low number of observations since 1945 seems to confirm Tjeder's (1944) view that *E. angulatus* is comparatively rarer than *E. micromus* (see below) in Norway. *E. angulatus* is known from most parts of Sweden (Tjeder 1940), and Meinander (1962) reports it to be common in all eastern Fenno-Scandia.

Eumicromus paganus L. 1767

New records. Östfold (Ö): Moss, Jelöya 26 June 1966 one specimen coll. G. Taksdal (St. pl.). HEn: Ytre Rendal, Solbakken 1 ♀ coll. L. R. Natvig (Z. M. O.). Os: Jörstadmo, July 1951 1 ♀ coll. R. P. det. B. Tjeder (T. Mus.). VE: Tjöme, 10 Aug 1969 1 ♀ attracted to Mercury Vapour Lamp coll. A. Fjellberg. AAy: Tvedestrand, Sandöy, 24 Aug. 1968 1 ♂ coll. A. Fjeldså. Outer and Inner Hordaland (HOy and HOi): Meland, Brakstad 19 June 1965 1♀, 25 June 1966 1 ♂ 2 ♀♀ on decidious trees; 18 June 1967 1 ♀ on *Corylus avellana;* 7 July 1968

2 ♂♂ (Z. M. B.) Åsane, Åstveit 18 June 1966 1 ♂ coll. et det. A. Fjellberg. Bruvik, Eidslandet 1 July 1966 1 ♀; 5 July 1966 1 ♂ on *Corylus avellana;* 6 July 1 ♂ 1966; 26 June - 1 July 1969 33 ♂♂ 12 ♀♀ (Z. M. B.). Bruvik, Flatekvål 29 June 1969 1 ♂ 1 ♀ on *Picea abies* (Z. M. B.). Eidfjord, Viveli 25 July 1968 1 ♂ 1 ♀ on planted *Ribes sp.* at 870 m above sea level (Z. M. B.). Stord, Hovenes 10 July 1969 1 ♂ on *Corylus avellana* (Z. M. B.). Fana, Myravann 5 June 1969 1 ♂ (Z. M. B.). Inner and Outer Möre and Romsdal (MR i and MRy): Stangvik, Kvanne ca. 1 Aug. 1963 1 ♀; 2 Aug. 1965 1 ♂ coll. R. Mehl (Z. M. O.). Bremnes, Langöylandet 16 July 1967 1 ♀ coll. R. Larsen (Z. M. B.). Nordal, Kaldhusdal 8 July 1966 1 ♀ coll. M. Opheim. Outer and Inner Southern Tröndelag (STy and STi): Örland 23 June 1950 1 ♂ coll. M. Opheim det. B. Tjeder (T. Mus.). Åfjord, Monstad 28 June 1950 1 ♂ coll. M. Opheim, det B. Tjeder (T. Mus.). Bjugn, Mebostad 26 June 1950 1 ♂ coll. M. Opheim, det. B. Tjeder (T. Mus.). Strinda, Valene 10 Aug. 1951 1 ♀ coll. R. D., det. B. Tjeder (T. Mus.). Strinda, Vaadan 22 July 1951 1 ♂ coll. R. D., det. B. Tjeder (T. Mus.). Örland 22 June 1950 1 ♂ coll. M Opheim, det. B. Tjeder (T. Mus.) Oppdal, Drivdalen 3 km North of Kongsvoll 13 July 1966 3 ♂♂ 800 m above sea level coll. T. Nielsen (Z. M. B.). Trondheim, Fagerheimskogen 2 Aug. 1968 1 ♀ coll. A. Pettersen (Z. M. B.). Inner Northern Tröndelag (NTi): Verran, Fines 3 July 1950 1 ♂ coll. M. Opheim det. B. Tjeder (T. Mus.). Nordli, Kveli 18 July 1950 1 ♀ coll. M. Opheim det. B. Tjeder (T. Mus.).

E. paganus is new to Ö, HEn, Os, VE, AAy, MRi, MRy and NTi. It is a common species all over Norway. In Sweden the species is known north to Åsele Lappmark (Tjeder, 1940), in Finland all over the country except North Lapland.

Note should be made of the specimens caught at high altitudes viz. at Viveli and Drivdalen at 870 m and 800 m above sea level respectively.

At Eidslandet, Bruvik from 26 June – 1 July 1969 a total of 32 ♂♂ and 12 ♀♀ were obtained in the evenings from a small area 1/1.5 m × 0.3 m close to a housewall. The area was covered with grass, and some *Rumex* sp. *E. paganus* appeared at dusk at about 10 p. m. and was seen as long as light permitted – at least 1 hour. The specimens were climbing the grass-straws or leaves of *Rumex* and jumping short distances to the next straw or leaf. They would sit quiet for some time in between. When disturbed, the specimens let themselves fall to the ground. After approximately ten minutes they reappeared on the leaves. The habit of letting themselves fall, and lying motionless afterwards, is a well known escape mechanism in many Neuroptera. The specimens were easy to catch. One specimen flew up to a 60 W afterwards, is a well known escape mechanism in many Neuroptera. The specimens were easy to catch. One specimen flew up to a 60 W light bulb on a neighbouring verandah, where earlier, 1 July and 6 July 1966, specimens were obtained. However this specimen left shortly afterwards. During daytime no specimens could be found in this small area. On 27 June 1969 one specimen, a male, was found on a *Betula* sp. nearby. Some evenings during rain-showers the animals disappeared. No mating was observed. *E. paganus* has been reported as occasionally attracted to light (Williams & Killington 1935).

Megalomus hirtus L. 1761

New records. VE: Tjöme, Kjære 20 June 1969 1 ♀ attracted to Mercury Vapour lamp, coll. et det. A. Fjellberg. Outer Vest-Agder (VAy): Lyngdal, Aug. 1928 1 specimen coll. F. Jensen det. B. Tjeder (Z. M. O.). HOy: Meland, Brakstad 6 June 1965 2 ♂♂; 25 June 1966 4 ♂♂; 7 July 1968 1 ♂ (Z. M. B.).

M. hirtus is new to VE, VAy and HOy. The species is mentioned by Tjeder (1944, 1945), Jensen (1950) and Löken (1966) from Norway. There are only 16 specimens from 6 localities in Zoological Museum, University of Bergen and 9 specimens from 6 localities in Zoological Museum, University of Oslo. The species must be considered rare in Norway. It is known from southern Sweden (Tjeder 1938) and southern Finland (Meinander 1962). It is not recorded from Denmark.

Drepanopteryx phalaenoides L. 1758

New record. Outer Telemark (TEy): Kragerö, Jomfruland 8 Aug. 1968 1 ♀ coll. et det. M. Opheim.

D. phalaenoides is new to TEy. Only 10 specimens of this species have been found in Norway. Eight have been found at Töien, Oslo, two are labelled Kristiania (Oslo). Nine of these specimens were published in 1887 by Schöyen (1887). The species must be considered rare in Norway.

It is known as scattered from all over Europe and northern Asia (Aspöck & Aspöck 1964).

FAM. CHRYSOPIDAE

Chrysopa carnea Steph. 1839

New records. HEn: Sollia, Degerud 26 Sept. 1926 1 ♀ (Tr. Mus.). Outer Sogn and Fjordane (SFy): Florö 25 Aug. 1953 1 ♀ det. B. Tjeder (Z. M. B.) MRy: Volda, Folkestad 18 April 1966 1 ♀ coll. A. O. Folkestad (T. Mus.). STi and STy: Strinda, Valene 25 Sept. 1950 1 ♀ coll. R. D. det. B. Tjeder. (T. Mus.). Örland, Rönne 21 June 1968 1 ♀ coll. R. Dahlby (T. Mus.). Trondheim, Ringve Gård 27 July 1968 1 ♂ coll. A. Pettersen (Z. M. B.). Trondheim, Fagerheimskogen 29 July 1968 ♂ coll. A. Pettersen. Inner Northern Tröndelag (NTi): Egge, Vold 25 May 1937 2 specimens coll. T. T. det. B. Tjeder (T. Mus.), Frosta, Holmberget 31 Aug. 1968 1 ♂ coll. A. Pettersen (Z. M. B.).

C. carnea is new to HEn, SFy, MRy, STy and NTi. NTi represents the hitherto known northern border in Norway. There are also several new records not included here, from many places in southern Norway where the species has been recorded before. *C. carnea* is judging from the many new records, probably one of our commonest species of Neuroptera.

Chrysopa chrysops L. 1743

New records. Ö: Moss, Jelöya 26 June 1966 1 ♂ on *malus domestica* coll. G. Taksdal (St. pl.). Halden, Strupe 5 June 1967 1 ♀ caught flying (Z. M. B.). VE: Tjöme, Mostranda 12 June 1967 2 ♂♂ coll. A. Fjellberg. Tjöme, Sandö 13 June 1967 1 ♂ 1 ♀ coll. A. Fjellberg. Tjöme, Kjærelia 12 June 1967 1 ♂ on herbage coll. A. Fjellberg. Tjöme 27 June 1968 2 ♂♂ coll. A. Fjellberg. Tjöme, Kjære 16 June 1969 1 ♀ coll. A. Fjellberg. Sem, Akersvannet 14 July 1968 1 ♂; 16 July 1968 1 ♂ coll. T. Andersen (Z. M. B.). MRi: Kvanne, Stangvik 26 July 1959 1 ♀ 4-7 June 1960 1 ♀ coll. R. Mehl (Z. M. O.). Kvanne 6 Aug. 1961 1 ♀ coll. R. Mehl (Z. M. O.).

C. chrysops is new to Ö and MRi. Parasited by *Forcipomyia eques,* the specimens taken at Akersvannet have been published earlier from VE (Greve 1969). There are also several new records from many places in southern Norway not included here, where the species has been recorded before. *C. chrysops* seems to be a very common species in southern Norway.

On one occasion I have seen a mass swarming of this species at Eidslandet, Bruvik on 17 June 1968. I only collected a number of approximately 40 specimens, but I could have taken many more. The specimens were seen flying in short flights and in some places the vegetation shimmered blue-green with lace-wings. The vegetation consisted of *Juniperus communis,* single trees of *Pinus silvestris* and *Calluna vulgaris.* The weather was warm and sunny. The locality was visited in August the same year, but not a single specimen was found. This particular locality has been visited by me in several years and single specimens of *C. chrysops* have been found from June to August.

Chrysopa phyllochroma Wesm. 1841

New records. Akershus (AK): Ås, Börsumrud 30 June 1966 1 ♀ on leaves of *Brassica napis oleifera* coll. G. Taksdal (St. pl.). Inner Telemark (TEi): Rauland 14 July 1937 1 ♂ 1 ♀ coll. F. Jensen det. B. Tjeder (Z. M. O.). VE: Sandar, Ö. Nes 29 June 1969 1 ♂ 6 ♀♀ 1 specimen coll. et det. A. Fjellberg. Tjöme, Kjære 10 Aug. 1969 1 ♂ on Mercury Vapour lamp; 19 Aug. 1969 1 ♀ coll. on Mercury Vapour lamp coll. et det. A. Fjellberg. Borre, Bastö

3 July 1969 1 ♀ coll. A Fjellberg. HOi: Eidfjord 8 July 1948 1 ♀ coll. F. Jensen (Z. M. O.).

C. phyllochroma is new to VE, TEi and HOi. The species is rare in Finland (Meinander 1962), recorded only from the southern part. It is known from Sweden up to Dalarna (Tjeder 1940, 1953).

Chrysopa septempunctata Wesm. 1841

New records. VE: Tjöme, Kjære 29 June 1968 2 ♀♀ coll. et det. A. Fjellberg. Tjöme 19 Aug. 1969 1 ♀ coll. et det. A. Fjellberg. Sandar 29 June 1969 1 ♀ coll. et det. A. Fjellberg. Tönsberg 14 Aug. 1969 1 ♀ coll. A Fjellberg. TEi: Rauland 14 July 1937 1 ♂; 20 Aug. 1947 1 ♂ coll. F. Jensen, det. B. Tjeder (Z. M. O.). AAy: Tvedestrand, Sandöy 22 July 1968 1 ♀ coll. A. Fjeldså. Tvedestrand, Boröy 27 July 1968 1 ♀ coll. A. Fjeldså. Outer Rogaland (Ry): Austrumsdal 28 Aug. 1948 1 ♂ leg. F. Jensen (Z. M. O.). HOi: Eidfjord 8 July 1948 3 ♀♀ coll. F. Jensen (Z. M. O.).

C. septempunctata is new to VE, TEi, AAy, Ry and Hoi. This species is known earlier from Ak, Os and VAy (Tjeder 1943, 1945). *C. septempunctata* is known from southern Sweden (Tjeder 1940 and 1953) and southern Finland (Meinander 1962). This species has a wide distribution and is known from whole Europe, Northern Africa and many parts of Asia (Aspöck & Aspöck, 1964). The northern border in Europe is southern Fenno-Scandia.

Nineta vittata Wesm. 1841

New records. Ö: Tune, Sollia 18 June 1966 1 ♀ on *Alnus sp*. coll. G. Taksdal (St. pl.). VE: Tjöme, Sandbekk 27 June 1969 1 ♂ coll. A. Fjellberg. MRi: Kvanne, Stangvik 3 June 1963 1 ♂ coll. R. Mehl (Z. M. O.). MRy: Vulvik 8 July 1951 1 ♂ coll. R. D. det. B. Tjeder (T. Mus.).

N. vittata is new to Ö, VE, MRi, and MRy. The species is known from southern Finland (Meinander 1962) and Sweden to Dalarna (Tjeder 1940).

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On a New Genus of Machilidae (Thysanura) from Alaska

J. PACLT

Paclt, J. 1970. On a new genus of Machilidae (Thysanura) from Alaska. *Norsk ent. Tidsskr. 17*, 71-74.

Two type specimens of *Machilis arctica* Folsom from Popoff Island, Alaska, were examined with the following results: 1. Lectotype is identical with the paratypoid, both specimens being males of a species which does not belong to any of the known genera, and for which a new genus, *Petridiobius*, type-species *M. arctica* — now *P. arcticus* — is established. 2. The new genus is a member of the newly emended subfamily *Petrobiinae*, this including at present 8 genera to which a key is added.

J. Paclt, Slovak Academy of Sciences, Institute of Experimental Phytopathology and Entomology, Ivanka pri Dunaji, Czechoslovakia

The only Machilid species reported so far from Alaska has been described as *Machilis arctica* by J. W. Folsom (1902, p. 103) who discovered it in the Apterygota series of the materials collected in June and July 1899, by Professor Trevor Kincaid, of the Harriman Expedition. Folsom (1902) based his description of *M. arctica* on nine types (= syntypes) of which three specimens were stated to come from Muir Glacier (Harriman Expedition sample No. 68), five from Popoff Island (Nos. 59, 66), and one from Sitka (No. 61). The type material was deposited in the U.S. National Museum, Washington, under the Cat. No. 5433.

Folsom (1902), in his early description of *M. arctica,* failed to characterize some structures of fundamental importance for identification and classification in the modern taxonomy of the suborder *Machiloidea*. Thus one finds therein no mention of the number and disposition of exsertile coxal vesicles, the relative size of the sternites, the structure of the mandible, the distribution of scales on the antenna, and the genital armature. Based on such an imperfect original diagnosis alone, nobody could fix the true generic position of *M. arctica* Folsom.

MATERIAL AND METHODS

From a reply to my letter addressed to the U.S. National Museum I learned that the Curator of Insects was unable to find any specimen of the type series. He suggested, however, that I asked the Illinois Natural History Survey, Urbana, Illinois to look in the Folsom collection for the type material.

Indeed, two type specimens (syntypes) from Popoff Island (Harriman Expedition sample No. 66) could be located which represented at the same time the only specimens of *M arctica* present in the Survey collection. Through the courtesy of the Illinois Natural History Survey I have been able to examine these two alcohol specimens.

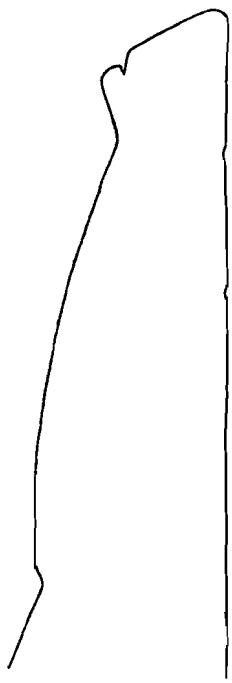

Fig. 1. Unidentate molar area of the distal piece of mandible in *Petridiobius arcticus*.

Of the two specimens, both of which proved to be males of the same species, I designed one to be the lectotype. This lectotype now includes the head and thorax in one vial, and the abdomen in another vial. In addition, the legs of the 1st, 2nd, and 3rd pair were mounted on three slides respectively.

The other specimen, now designed as a paratypoid, has been dissected and mounted on four slides.

Polyvinylalcohol, water, lactic acid and glycerine were used for preparing the mounting medium.

RESULTS AND DISCUSSION

Of the examined characters, particularly the following ones do not permit one to classify Folsom's species as a member of the genus *Machilis*: 1. Unscaled flagellum of the antenna. 2. Structure of the distal place of mandible (Fig. 1). 3. Position and shape of the paired ocelli. 4. Absence of parameres on the abdominal segment VIII.

The relative size of the sternites, and the number and disposition of exsertile coxal vesicles in Folsom's species (Fig. 2, 3) indicate that it belongs to the family *Machilidae*. Although the apical spine of the stylus IX is not preserved in either of the two males examined (compare also Fig. 4), certain characters like the lack of scales on the antenna flagellum, and the position and shape of the paired ocelli, place Folsom's species closer to the Nearctic halophile genus *Neomachilis* Silvestri 1911. However, the Alaskan species *Machilis arctica* Folsom does not correspond to the definition of any of the known genera, so a new genus is established to include this species.

PETRIDIOBIUS, nov. gen.

Diagnosis. Mandibles unidentate in adult insect. Antennae with unscaled flagellum. Paired ocelli transverse, subelliptical, situated sublaterally before the eyes, twice or three times as long as broad (broad in the sense of the longitudinal body axis). Eyes normal. Middle and hind legs with coxal stylets. Tarsus without scopulae. Metanotum normal. Abdominal sternites characteristic of *Machilidae*. Segments I and VI-VII with 1+1, II-V with 2+2 coxal vesicles. Segments II-IX with stylets.

♂ with parameres on abdominal segment IX.

Type-species. *Machilis arctica* Folsom.

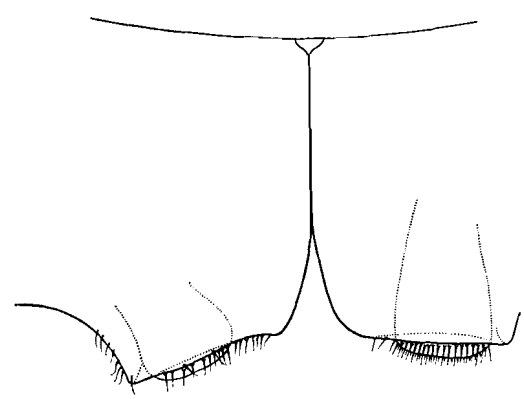

Fig. 2. Ventral aspect of the abdominal segment I of *Petridiobius arcticus*.

Derivatio nominis. ex vocis πετριον, saxulum, et βιος, vita.

Relationship. To separate the new genus from all those which have an important character in common – the lack of scales on the flagellum – I give the following key to all of the known genera of *Petrobiinae* Börner 1932 (= *Haloma-chilinae* Verh. 1910), sensu emendato.

1. Abdominal segments II-V with only one pair of coxal vesicles 2
– Abdominal segments II-V with two pairs of coxal vesicles 3
2. Ocelli transverse, sole-shaped, reaching the frontal anteocular region; parameres of male only present on abdominal segment IX ..... *Pedetontinus* Silv.
– Ocelli transverse, subelliptical, extending only as far as the tip of the sublateral anteocular region; parameres of male on abdominal segments VIII and IX .... *Neomachilis* Silv.
3. Ocelli transverse, subelliptical, extending only as far as the tip of the sublateral anteocular region; parameres of male only present on abdominal segment IX ..... *Petridiobius*, nov. gen.
– Ocelli transverse, sole-shaped, reaching the frontal anteocular region 4
4. Parameres of male present on abdominal segments VIII and IX 5
– Parameres of male only present on abdominal segment IX 6
5. Molar area of the distal piece of mandible nearly untoothed in adult insect; galea basally subdivided; parameres of the abdominal segment IX entire .... *Petromachilis* Reilly
– Molar area of the distal piece of mandible quadridentate; galea?; parameres of the abdominal segment IX annulated ..... *Meximachilis* Wygods.
6. Antenna, including scape and pedicel, without scales .... *Petrobiellus* Silv.
– Scales absent only from the flagellum .. 7
7. Molar area of the distal piece of mandible in adult insect either nearly untoothed, or uni-, or bidentate; parameres entire ..... *Petrobius* Leach
– Distal piece of mandible with a quadridentate molar area; parameres either annulated, or entire .... *Pedetontus* Silv.

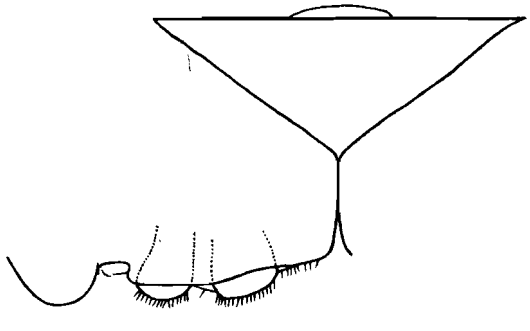

Fig. 3. Coxosternite IV (stylet not preserved) of *Petridiobius arcticus.*

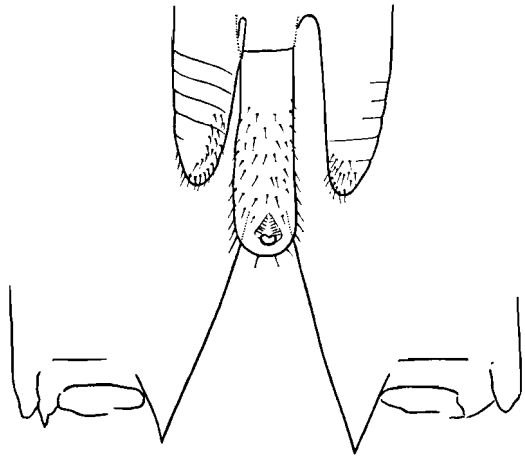

Fig. 4. Penis and parameres (stylets not preserved) of *Petridiobius arcticus.*

To the specific diagnosis given by Folsom (1902) I may add that the male of *Petridiobius arcticus* Folsom, nov. comb. is characterized by a penis which, like in *Neomachilis halophilus* Silv., does not reach the bases of stylets IX. Parameres annulated, attaining, unlike to *N. halophilus*, only to two third of the apical portion of penis. Fig. 4 showing the male genital armature has been drawn from the paratypoid specimen.

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Bokanmeldelse

Freude, H., Harde, K. W. und Lohse, G. A. 1969. Teredilia, Heteromera, Lamellicornia. Die Käfer Mitteleuropas. Bind 8. (388 p.) Goecke und Evers Verlag, Krefeld.

Arbeidet med dette bind er fordelt på S. Cymorek for Lyctidae og Bostrychidae, G. A. Lohse for Anobiidae, H. Freude for Ptinidae, K. Ermisch for Mordellidae, Z Kaszab for resten av Heteromera og J. W. Machatschke for Lamellicornia.

Under Heteromera er tatt med Stylopidae (Strepsiptera) bearbeidet av R. K. Kinzelbach, som gjør oppmerksom på at de ikke har noe med Heteromera å gjøre og med største sannsynlighet heller ikke med billene overhodet. I innledningen er det gjort oppmerksom på at når de er tatt med, skyldes det planleggingen i bind 1. Strepsipteradelen omfatter 21 sider med rikelig illustrerte tabeller over de enkelte artene.

Det som vel har vært imøtesett med størst forventning er Ermischs behandling av Mordellidae. Særlig i slekten Mordellistena er det i den siste tid kommet en lang rekke nye arter, deriblant flere med forekomst i Norden. Som Ermisch nevner, er penis på grunn av at forskjellen ofte er subtil, og at den har en tilbøyelighet til deformering ved skrumping, lite egnet til artsbestemmelse. Derimot er de sterkt kritiniserte, eiendommelige paramerer bedre egnet, og de er i stor utstrekning avbildet.

Det vil nok volde adskillige vanskeligheter å bestemme Mordellistenaartene. Forskjellen mellom artene er ofte liten og karakterene ikke alltid konstante, tabellene er knappe, særlig savner en for de enkelte artene en sammenlikning med nærstående arter med presisering av forskjellen.

Denne serien avløser Reitters «Fauna Germanica» fra 1908—1916 med Horions tilleggsbind fra 1935. Reitters fargetegninger, som gjorde hans arbeid så populært, vil nok bli savnet, men til gjengjeld er det, foruten omrisstegninger i sorthvitt for en representant for de enkelte slekter også rikelig med detaljtegninger, deriblant i stor utstrekning genitaltegninger. *Andreas Strand*

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Whitman, L. 1951. The arthropod vectors of yellow fewer, pp. 229-298 in Strode, K. (ed.). *Yellow Fever*. McGraw-Hill, New York and London.

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