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NORSK ENTOMOLOGISK FORENING
Cold storage tolerance and supercooling points of mummies of *Ephedrus cerasicola* Stary and *Aphidius colemani* Viereck (Hym. Aphidiidae)

TROND HOFSVANG & ELINE BENESTAD HÅGVAR


*Ephedrus cerasicola* Starý, parasitizing *Myzus persicae* Sulzer, is well suited for storage at 0 ± 1°C as -2 day-old mummies. Subsequent emergence at 21°C occurred from 60–90% of the mummies stored for 1, 2, 3, 4, and 6 weeks. Storage for 8, 10, 14, 18, and 22 weeks successively reduced the percentage emergence from 46% to 2%. The emerged females produced significant amounts of fertilized eggs at room temperature even after 14 weeks' cold storage of the mummies. When 4–5 day-old mummies were stored at 1°C, normal emergence occurred at 21°C from those stored for 1 and 2 weeks. However, emergence was reduced to 30% and 0% after 4 and 8 weeks' storage respectively. Mummies of *Aphidius colemani* Viereck are not suited for long-term cold storage because of too low emergence at 21°C after storage at 0°C, 4°C, and 7°C and too fast development during storage at 7°C and 10°C.

The average supercooling points of *E. cerasicola* and *A. colemani* were -26.1°C, SD = 1.3 and -25.4°C, SD = 0.9, respectively. Acclimation for 1 week at -5°C lowered the supercooling point in *E. cerasicola* mummies to -29.4°C, SD = 1.9.

Trond Hofsvang & Eline Benestad Hågvar, Agricultural University of Norway, Department of Zoology, P.O. Box 46, N-1432 As–NLH, Norway.

Successful storage of parasites at low temperatures has practical importance in biological control. It is a simple method to keep parasites alive when they are of no use, e.g. outside the greenhouse cultivating season. In this way they may also be more easily shipped, and the costs of transportation may be lowered because the time factor is less important. Furthermore, the synchronization of emergence for mass release programs is facilitated by such storage. It has been shown that low storage temperatures may increase the reproductive potentials in some parasitic Hymenoptera (Legner 1976). Even tropical species seem to have some advantages by such treatment (Legner 1967).

Aphidiid parasites are easy to handle as mummies, and mummies are well protected from external injuries. Probably the most common case of arrested development in aphidiids in cold winter areas is hibernal quiescens inside the cocoon of a mummified aphid (Starý 1970a). Archer et al. (1974) found that mummies of *Lysiphlebus testaceipes* (Cresson) tolerated storage of low temperatures better than adults.

In the experiments presented in this paper, mummies of the aphidiid parasites *Aphidius colemani* Viereck and *Ephedrus cerasicola* Starý were stored at low temperatures. Both species readily attack the green peach aphid *Myzus persicae* Sulzer in Norwegian greenhouses. Parts of the biology of these two species, such as longevity, developmental rate, fecundity and oviposition position, have previously been studied (Hofsvang & Hågvar 1975, a, b, c). In these papers *A. colemani* was named *Aphidius platensis* Brethés, but *A. platensis* is now considered as a synonym of *A. colemani* (Starý 1975, 1976).

The world distribution of *A. colemani* covers Mediterranean Europe, parts of Asia, Africa, Australia, and South America (Starý 1975). Its introduction into our laboratory stocks was accidental (Hofsvang & Hågvar 1975b). It is uncertain if this species can survive the winter outdoors in Norway. *E. cerasicola* is widely distributed in Europe...
(Mackauer & Starý 1967), most probably including Norway. It is assumed that this species hibernates in Norwegian areas inside a mummified aphid.

MATERIAL AND METHODS
The parasite species used in the experiments were taken from laboratory stocks at room temperature, in which they were parasitizing *M. persicae* on swedes (*Brassica napus napobrassica* (L.) Rehb.) or paprika (*Capsicum annuum* L.).

In the cold storage experiments, newly formed mummies from swedes, at most 1 day old, were placed in groups of ten in a dram vial plastic lid which was put on moistened filter paper in a petri dish (5.5 × 2.5 cm). Some mummies, kept in this way, were then put in cold storage conditions, some were acclimatized for two days prior to cold storage, and some were kept at 21°C, 16 hrs photoperiod, to obtain desired age at the start of cold storage. Acclimation temperatures were 10° and 4°C, and cold storage temperatures were 10°, 7°, 4°, 1°, and 0°C. At 0°C the temperature was not constant, fluctuating between +1° and -1°, but was on average about 0°C. Acclimation and cold storage were performed in darkness.

After storage, the mummies were transferred to an incubator at 21°C, 16 hrs photoperiod, for emergence. In order to check their reproduction ability after storage, some of the emerging females and males were transferred to a cage at room temperature, containing an aphid-infested swede or paprika. The sex of the progeny was also determined.

Tolerance to extreme low temperatures was tested by measuring supercooling points of the mummies, taken from swedes at room temperature, by placing them in contact with a copper-constantan thermocouple connected to a recording potentiometer (Sømme 1964). The cooling rate was about 1°C per minute. Supercooling points were first measured on 20 untreated mummies of each species. The age of the mummies was unknown.

The effect of acclimation at low tempera-

<table>
<thead>
<tr>
<th>Series</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acclimation</td>
<td>2 days at 4°C</td>
<td>2 days at 4°C</td>
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<td>No accl.</td>
<td>No accl.</td>
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<tr>
<td>Storage temp.</td>
<td>0°C</td>
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<td>1°C</td>
<td>1°C</td>
<td>1°C</td>
</tr>
<tr>
<td>Age of mummies at storage (days)</td>
<td>0-1</td>
<td>0-1</td>
<td>0-1</td>
<td>1-2</td>
<td>4-5</td>
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</tbody>
</table>

<table>
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<tr>
<th>Weeks stored</th>
<th>Series 1</th>
<th>Series 2</th>
<th>Series 3</th>
<th>Series 4</th>
<th>Series 5</th>
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<tr>
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<td>90</td>
<td>79</td>
<td>64</td>
<td>71</td>
<td>69</td>
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<td>2</td>
<td>79</td>
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<td>3</td>
<td>64</td>
<td>70</td>
<td>86</td>
<td>60</td>
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<td>4</td>
<td>71</td>
<td>48</td>
<td>42</td>
<td>40</td>
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<td>6</td>
<td>46</td>
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<td>34</td>
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<td>8</td>
<td>31</td>
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<td>10</td>
<td>16</td>
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<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no accl. or storage</td>
<td>62</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
tures on the supercooling point was tested for *E. cerasicola* only. Groups of 25 mummies, at most 2 days old, were kept at 0° for two weeks or at -5°C for one week before the supercooling points were measured. During acclimation, the mummies were kept in small glass tubes plugged with cotton, placed in tight glass jars with moist cotton in the bottom. To control survival after acclimation, 25 additional mummies were stored under the same conditions, but were then transferred to 21°C, 16 hrs photoperiod, for emergence. Several experiments on supercooling points with different acclimation conditions were excluded because of low emergence from control mummies. Differences in supercooling points were tested by the Student t-test.

Some of the emerged adults were released on paprika plants and their progeny was counted and the sex determined.

**RESULTS**

*Cold storage of mummies*

Table I shows for *E. cerasicola* the percentage emergence from mummies which had been cold stored at different conditions. The percentage emergence without any acclimiation and cold storage is also given. Obviously, *E. cerasicola* tolerates rather long storage at low temperatures. Compared with the control mummies, storage of 0–2 day-old mummies up to 4–6 weeks at 0–1°C had no clear negative effect on percentage emergence. Storage for 8 weeks or more had an increasingly detrimental effect on the emergence percentage.

Acclimation of mummies prior to the storage did not affect the emergence (series 1, 2, and 3 in Table I).

No effect of the age could be demonstrated for mummies stored up to 2 weeks. However, emergence was reduced with increasing age of mummies both after 4 and 8 weeks' storage (series 4 and 5).

Apparently, no development occurred at 0°C in *E. cerasicola* (series 1). After being brought to 21°C, the adults emerged after 8–10 days, which is about normal time of development for mummies at this temperature (Hofsvang & Hågvar 1975 a).

In series 1, which was most complete and based on most mummies, the ♀/♂ ratio of emerging adults after cold storage was well above 1 for mummies stored up to 10 weeks. Without cold storage, the sex ratio was 0.9.

For practical application, it is important to know whether cold storage of mummies interferes with the progeny production of the emerging adults. Table II gives such information for some of the series of *E. cerasicola*. It shows that females emerged from mummies cold stored up to 14 weeks were able to produce considerable number of offsprings. Apparently, plant species affected the progeny production.

*A. colemani* was obviously less tolerant to cold storage than *E. cerasicola* (Table III). Emergence was affected already after 1 week's exposure at 0°C (series 6), and after 2 weeks only 5% emerged. Therefore, 0°C

<table>
<thead>
<tr>
<th>Series</th>
<th>Storage temp.</th>
<th>Storage period for mummies (weeks)</th>
<th>Number emerged adults used for oviposition</th>
<th>Plant species</th>
<th>Progeny</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>♀♂</td>
<td></td>
<td>♀/♂</td>
</tr>
<tr>
<td>1</td>
<td>0°C</td>
<td>1</td>
<td>14 8</td>
<td>swedes</td>
<td>156</td>
</tr>
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<td></td>
<td>&quot;</td>
<td>6</td>
<td>11 13</td>
<td>&quot;</td>
<td>213</td>
</tr>
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<td>&quot;</td>
<td>&quot;</td>
<td>8</td>
<td>15 15</td>
<td>&quot;</td>
<td>89</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>10</td>
<td>13 11</td>
<td>&quot;</td>
<td>109</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>14</td>
<td>3 4</td>
<td>paprika</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>1°C</td>
<td>2</td>
<td>7 11</td>
<td>&quot;</td>
<td>53</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>4</td>
<td>14 15</td>
<td>&quot;</td>
<td>83</td>
</tr>
</tbody>
</table>
Table III. Percentage emergence at 21°C (series 10: at 10°C) from mummies of *A. colemani*, 0-1 days old when stored at low temperatures for different time periods. Percentage emergence during cold storage is given in bracket. At each time period, n=50, except series 6 where n=100.

<table>
<thead>
<tr>
<th>Series</th>
<th>Acclimation</th>
<th>Storage temp.</th>
<th>Weeks stored</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 days at 4°C</td>
<td>2 days at 10°C</td>
<td></td>
<td>No accl.</td>
<td>No accl.</td>
<td>No accl.</td>
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<tr>
<td>1</td>
<td>0°C</td>
<td>4°C</td>
<td>1</td>
<td>38</td>
<td>12</td>
<td>82(0)</td>
<td>74(0)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0°C</td>
<td>4°C</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>50(0)</td>
<td>82(0) (28)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0°C</td>
<td>4°C</td>
<td>4</td>
<td>0</td>
<td>4(0)</td>
<td>4(44) (56)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0°C</td>
<td>4°C</td>
<td>6</td>
<td>0</td>
<td>0(0)</td>
<td>0(46) (48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0°C</td>
<td>4°C</td>
<td>8</td>
<td>0(4)</td>
<td>0(52)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>0°C</td>
<td>4°C</td>
<td>10</td>
<td>0(0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>0°C</td>
<td>4°C</td>
<td>no accl. or storage</td>
<td>75</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

is too low a temperature to be of practical use. Storage at 4°C, after acclimation at 10°C for 2 days (series 7), resulted in very low emergence. Without any acclimation (series 8), the mummies kept at 4°C survived better than those stored at 0°C. However, mortality was high for the mummies kept at 4°C for 3 or more weeks. A few parasites completed their development and emerged at 4°C (Table III). Long-term storage at 7°C proved to be difficult because the parasites developed and emerged at this temperature after on average 23.5 days. Storage at 10°C was impossible, due to considerable emergence during storage. Average developmental time from mummification to emergence was 16.6 days at 10°C.

Progeny production by adult *A. colemani*, emerging from mummies cold stored for one week, was tested on paprika in series 6, 7, and 9. Mean numbers of offsprings per female and sex ratio (♀/♂) were 6.8 and 0.8, 21 and 0.8, and 48 and 0.8, respectively.

Supercooling points

The average supercooling points of the mummies taken from swedes at room temperature were -26.1°C for *E. cerasicola* (Table IV) and -25.4°C (n = 20, SD = 0.88) for *A. colemani*. This difference between the species was not significant (0.05<p<0.1).

The effect of acclimation on the supercooling point in *E. cerasicola* is shown in Table IV. Apparently, 2 weeks in 0°C was not sufficient to improve the cold-hardiness of *E. cerasicola*, whereas 1 week in -5°C significantly lowered the supercooling point (p<0.001).

Within each series, the supercooling points lay with very few exceptions within a 5°C interval.

Table IV. Effect of different cold storage conditions on the supercooling points of mummies of *E. cerasicola*. Emergence and sex ratio at 21°C from groups of 25 mummies stored under the same conditions, but not supercooled, are also shown.

<table>
<thead>
<tr>
<th>Cold storage of mummies</th>
<th>Supercooling point</th>
<th>Emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C weeks</td>
<td>°C</td>
<td>SD</td>
</tr>
<tr>
<td>0</td>
<td>-26.2</td>
<td>1.9</td>
</tr>
<tr>
<td>-5</td>
<td>-29.4</td>
<td>1.9</td>
</tr>
<tr>
<td>no storage</td>
<td>-26.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>

*taken from Table I.*
DISCUSSION

In Norway it is likely that aphidiids hibernate inside cocoons attached to plant material. Most species probably spend the winter on the ground at temperatures around 0°C because of an insulating snow cover. It is therefore reasonable that just this developmental stage is most resistant to and suitable for storage at 0°C.

Based on percentage emergences, it seems that *E. cerasicola* is well adapted to long-term storage at temperatures around zero compared with other aphidiid species (Starý 1970b, Archer et al. 1973, Scopes et al. 1973, Tyler & Jones 1974). The present results clearly demonstrate that 0–1 day-old mummies of *E. cerasicola* are very suitable for storage at 0°C for at least 6 weeks, without subsequent emergence and reproduction being seriously affected. Six weeks' storage increased the length of developmental period about 3 times, compared with normal development at 21°C (Hofsvang & Hågvar 1975a).

Differences in emergence percentage between 0–1 and 1–2 day-old mummies cooled up to 8 weeks, were insignificant. However, 4–5 day-old mummies had significantly lower emergence after 4 and 8 weeks' storage than 0–2 day-old mummies. Therefore, efforts should be made in practical application to use rather newly formed mummies for cold storage. Archer et al. (1973) found similarly that 3 day-old mummies of *L. testaceipes* tolerated storage at 1.7°C, 4.4°C, 7.2°C, and 10°C better than 6 day-old mummies.

Females of *E. cerasicola* apparently survived up to 10 weeks' cold storage better than males. Similar sex differences were observed in *L. testaceipes* (Archer et al. 1973). However, sex ratio is very dependent on external factors, so that general conclusions are difficult to make.

Oviposition by parasites emerged from the cold stored mummies resulted in about 100–200 offsprings per female on swede, and 30–80 on paprika. Corresponding values without cooling are 316 on swede and 51 on paprika. Thus, the reproduction is fairly good even after 14 weeks' cold storage of the mummies.

Whether the observed differences in progeny productions of parasites on the two plant species will also exist under other experimental conditions, has not been studied.

Mummies of *A. colemani* tolerated much shorter storage than *E. cerasicola*. Obviously, 0–1 day-old mummies of *A. colemani* are not suited for long-term cold storage. At temperatures higher than or equal to 7°C, too large a fraction of the mummies developed and emerged during storage. At 7°C and below, emergence after a few weeks' storage was too low to be of practical value.

The negative effect of acclimation at 10°C in *A. colemani*, illustrated by series 7 and 8 in Table III, is probably due to some development which occurred in series 7 before the transfer to 4°C. This suggests an age-dependent tolerance for cooling, as was positively found in *E. cerasicola*.

The difference between the species in tolerance to 0°C may be explained by the more northern distribution of *E. cerasicola*. In addition, dissections of 0–1 day-old mummies show that *E. cerasicola* at this age is still in 4th larval instar. *A. colemani*, however, has begun to appear as prepupae, which may be less tolerant to cooling.

According to Asahina (1969), supercooling points a few degrees below −20°C frequently occur in hibernating insects, even in those which possess no glycerol or other protective substances. It is also known that in this range of temperature, nucleation in bulk water in a vessel is most probably induced. Both *A. colemani* and *E. cerasicola* agree with this picture, with supercooling points around −25°C.

Thermal acclimation in insects may lower the supercooling point, whereby the insect becomes able to withstand temperatures that would otherwise cause it to freeze. The present results indicate an acclimation effect at −5°C.

Thermal acclimation in insects may lower the supercooling point, whereby the insect becomes able to withstand temperatures that would otherwise cause it to freeze. The present results indicate an acclimation effect at −5°C.

Dissections have shown that the digestive tracts are emptied about the second and third day after mummification at 21°C. The supercooling points were measured before this occurred. Possibly, lower supercooling points could have been obtained in animals with emptied digestive tracts (Asahina 1969).

ACKNOWLEDGEMENTS

We would like to thank Dr. Lauritz Sømme for valuable discussions and for lending us...
the apparatus to measure the supercooling points. We also thank Thore Bihaug for laboratory assistance.

REFERENCES


Received 6 December 1976
Funn av Coleoptera fra Nord-Norge

ARNE C. NÏLSEN & JOHAN ANDERSEN


The article reports 66 finds in northern Norway of species of Coleoptera which previously have not been recorded from the districts in question. Four species are reported for the first time from northern Norway. The new records are the northernmost in Norway for 14 species.

Arne C. Nilssen, Zoological department, Tromsø Museum-University of Tromsø, N-9000 Tromsø, Norway.

Johan Andersen, Institute of biology and geology, University of Tromsø, N-9000 Tromsø, Norway.

I listen er oppført arter som ikke er angitt fra vedkommende områder etter inndelingen i Coleoptera-katalogen (Lindroth 1960) eller ikke er oppført i senere korreksjonslister (Strand 1970a) eller i faunistiske notiser om Coleoptera fra Nord-Norge (Zackariassen 1972). En del av funnene gjort av Johan Andersen er allerede publisert (Strand 1970b), men uten nærmere angivelse av sted og funnforhold.

Listen er intet resultat av systematiske innsamlinger innen bestemte områder, men representerer mere tilfeldige funn. Unntak er til en viss grad arter samlet på elvebredder og under furubark.

De fleste funn fra Skjomen er gjort under feltkurs for studenter arrangert av Universitetet i Tromsø.


Dermestes lardarius L. Fø: Tromsø står oppført med spørsmålstegn i Strand (1946). Arten er imidlertid meget vanlig i hus i Tromsø og omegn.


Adalia bipunctata L. Ns: Bodø. Leg. H.
Andersen. Flere eksemplarer. Tidligere funnet nordligst i NTi.


REFERENCES


Mire invertebrate fauna at Eidskog, Norway. V. Auchenorrhyncha, Psylloidea, and Coccoidea (Hem.)

FREJ OSSIANNILSSON


Sixteen identified species of Auchenorrhyncha, one species of Psylloidea, and two species of Coccoidea were pit-fall trapped in thirteen different mire habitats at Eidskog, Hedmark county, south Norway. *Tyrphodelphax distinctus*, *Stroggylocephalus livens*, *Cosmotettix panzeri*, and *Sorhoanus xanthonellus* are bound to this kind of habitat. Three or four other species of Auchenorrhyncha are typical mire inhabitants, but without being restricted to mires. *Cosmotettix panzeri*, *Atrococcus paludinus*, and *Spinococcus calluneti* are new to the fauna of Norway. The catches were rather low in most of the habitats.

Frej Ossiannilsson, Källparksgatan 9, S-754 32 Uppsala, Sweden.

This paper is part of a study on the invertebrate fauna in thirteen mire habitats at Eidskog, south Norway. Locality, habitat description, and the aim of these investigations are given by Pedersen, Hågvar & Bakke (1976).

MATERIAL AND METHODS

The material was collected in pit-fall traps. Further details of the method and explanation of the symbols used in this paper for the different habitats are given by Pedersen, Hågvar & Bakke (1976).

201 specimens of Auchenorrhyncha, 15 Psylloidea, and 59 Coccoidea were collected. The method is not very suitable for Psylloidea and adult Auchenorrhyncha and obviously unsuitable for sedentary Coccoidea.

RESULTS AND DISCUSSION

Out of the Auchenorrhyncha material, 78 specimens are nymphs and their specific identity could not be established. This is also valid for three females of *Macrosteles*. The identified material of Auchenorrhyncha consists of 16 species. The Psylloidea are represented by one, the Coccoidea by two species.

All species of these groups are phytophagous, depending on living plants for their existence. Some are monophagous, others oligo- or polyphagous. These three categories are all represented in the present material. Clearly the first condition for the affinity of a mono-phytophagous insect to a certain site is the presence of its host plant in that site. Of course this does not mean that the distribution areas of a monophagous insect and its host plant are always identical. The resistance of the insect against extreme degrees of an ecological factor may be smaller than that of the plant, and then the insect may be rare or absent in a site even if its host plant is abundant there.

In Table I the species are listed together with total catches from each habitat. In Table II, the recorded species have been grouped...
### Table I. Pitfall catches of Auchenorrhyncha, Psylloidea and Coccoidea in thirteen mire habitats at Eidskog, South Norway.

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitats:</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Auchenorrhyncha:**

- Cixius sp. (*similis* Kbm.), juv. - - 1 1 - 2 - - - - 5
- *Tyrphodelphax distinctus* (Flor) 6 5 - - 1 - 1 - - - - 14
- *Onocelophus pululus* (Boh.) - - - - 1 - - - - - - 1
- *Neoberallus lineatus* (L.) 5 2 1 - 2 - 1 - - - - 12
- *Aphrophora alni* (Fall.) - - 1 - - 1 - - - - - 2
- *Ulopa reticulata* (F.) - - - - 2 1 - - - - 3
- *Agallia brachyptera* (Boh.) - - 11 - 5 - 2 1 2 - - 21
- *Agallia venosa* (Pouzcr.) - - 1 - - - - - - - - 1
- *Aphrodectes bipunctatus* (Schrank.) 2 6 1 - 4 1 5 - - 1 - - 20
- *Stenoglycophalus livens* (Zett.) - - 10 - 4 - 8 3 - - - - 25
- *Arboridia parvula* (Boh.) - - - - - - - - - - - - 1
- *Lindavia nigromaculata* (Spay.) - - - - - - - - - - - - 1
- *Acrostichus sp.* 3 - - - - - - - - - - - - 3
- *Idiodonus cruentus* (Pons.) - - 1 - - - - 1 - 1 - 3
- *Macustus grisescens* (Zett.) - - 2 - - - - 4 - - - - 6
- *Solerocosus ruscelus* (Fall.) - - 1 - 1 - 2 - - - - 5
- *Sorhoanus xanthoneurus* (Piez.) - - - - - 1 - 2 - - 4
- *Cosmotettix panzeri* (Flor) - - 1 - - - - - - - - 1
- Unidentified *Sphagellidae* nymphs 1 3 4 7 2 7 - - 1 9 27 15 73

**Sum Auchenorrhyncha**: 201

**Psylloidea:**

- *Strophosia ericeae* (Curt.) - - - 8 1 2 - - 1 3 - - 15

**Sum Psylloidea**: 15

**Coccoidea:**

- *Atrococcus paludinus* (Green) - - - - 24 7 - 4 - - - - 35
- *Spinoecoccus pallianeti* (Ldgr.) 3 2 - - 11 7 1 - - - - 24

**Sum Coccoidea**: 59

**Total no. of specimens per habitat**: 20 19 19 30 51 22 17 14 4 14 29 16 275

**Total no. of species identified per habitat**: 4 5 8 2 6 8 8 5 6 3 2 2 1 19

According to their affinity to mire habitats. *Tyrphodelphax distinctus* is associated with *Eriophorum*. The same plant is also stated to be the hostplant of *Cosmotettix panzeri* (Kuntze 1937). The latter is new to Norway. According to Nast (1972) its known distribution is: Czechoslovakia, Denmark, Finland, France, BRD., DDR., England, Scotland, Poland, Sweden, Estonia, Latvia, N. Russia. So far *C. panzeri* has been found in the following Swedish provinces: Sk., Hall., Sm., Ul., Ug., Dial, Upl, Vrm, Dr., Ang., Vb., As. Lpm., P. Lpm. *Stroiglycophalus livens* is associated with *Carex*, while *Sorhoanus xanthoneurus* belongs to the *Sphagnum-Eriophorum vaginatum* association (Wagner & Franz 1961).

The unidentified *Cixius* nymphs most probably belong to *similis* Kbm., which is typical of mire habitats. The nymphs are subterranean and their biology has not been studied. *Onocelophus pululus* and *Macustus grisescens* are also found on wet meadows. The Pseudococcid, *Atrococcus paludinus*, an addition to the Norwegian fauna, was originally described on material from Wicken Fen, England, *on the under surface of the foliage of Eupatorium cannabinum, Symphytum officinale, Urtica sp., Lysimachia sp., Convolvulus sp., and Spiraea sp.* (Williams...
1962). It has also been recorded from France, on Trifolium sp. (Goux 1933, 1941), and from Psamna arenaria in Holland (Reyne 1965). In Sweden, A. paludinus has been found in Ul., Gtl., Vg., Dsl., Upp., and Vb. The preferred host plant in Sweden seems to be Rubus chamaemorus, but the species has also been found on Filipendula ulmaria, Carex sp., and Sedum album (!) (Ossiannilsson, unpubl.). In the present material it is represented in sites 6, A, and C (Table I).

Ulopa reticulata and Strophingia ericae are monophagous on Calluna while Spinococcus calluneti feeds also on other Ericaceae and even on e.g. Fragaria vesca (Danzig 1959, 1960). These species occur also on Calluna growing in dry zootopes. S. calluneti is new to the fauna of Norway. It was described from Germany (Lindinger 1912) and has a wide distribution in Western Europe, present also in Latvia and the west of European Russia. In Sweden, S. calluneti has been found in Sk., Ug., Sdm., Upp., Vstm. (Ossiannilsson 1951, 1959, 1971) and Hls. Also Scleroracus russeolus is associated with Ericaceae, in both wet and dry sites. In Norway, this species has been recorded only from HOI (Ossiannilsson 1974).

Neophilaenus lineatus is abundant on Gramineae, Cyperaceae, and Juncaceae in both wet and fresh biotopes, while Aphro-

phora alni is polyphagous on herbaceous plants and almost ubiquitous. Also Aphrodes bicinctus is said to be polyphagous on herbs, but I was surprised to find that the species is here represented by f. diminuta Ribaut, a rare form with uncertain taxonomic status and unknown ecology. Agallia brachyptera prefers wet meadows and mires. Linnavuoriana sexmaculata is associated with Salix spp. Idiodonus cruentatus, a polyphagous species, is found in very different habitats. The present writer repeatedly found Arboridia parvula – here represented by one specimen in site 6 – on the leaves of Filipendula ulmaria. If this plant is absent in the area here investigated, Rubus chamaemorus probably serves as an alternative host plant. Finally, Agallia venosa normally inhabits dry biotopes and its presence in site 3 must be regarded as accidental.

Tyrphodelphax distinctus, Strogglococephalus livens, Cosmotettix panzeri, and Sorhoanus xanthoneurus can be used as indicator species to the habitats where they live.

ACKNOWLEDGEMENTS
I am indebted to Mr. Sigmund Hågvar for putting the material of the present paper at my disposal and for checking the manuscript.

REFERENCES


Received 9 December 1976
Ten species of adult Heteroptera were pit-fall trapped in thirteen different mire habitats at Eidskog, Hedmark county, south Norway. Six of the species are typical mire inhabitants: *Saldula opacula* (Zett.), *Myrmedobia exilis* (Fall.), *Hebrus ruficeps* Thorns., *Acalypta nigrina* (Fall.), *Ligyrocoris silvestris* (L.), and *Drymus brunneus* (F. Sahib.). The main material consisted of *A. nigrina* and *L. silvestris*, each of which were recorded from five different mire habitats.

This paper is part of a study on the invertebrate fauna in thirteen mire habitats at Eidskog, south Norway. Locality, habitat description, and the aim of these investigations are given by Pedersen, Hagvar & Bakke (1976).

**MATERIAL AND METHODS**

The present material was collected in pit-fall traps. Further information on the method, and explanation of the symbols used in this paper for the different habitats, are given by Pedersen, Hagvar & Bakke (1976).

The material of adult Heteroptera in the traps was rather small, consisting of only 24 specimens. However, ten species were represented, and most of these were typical mire inhabitants.

**RESULTS AND DISCUSSION**

Table I shows in which habitats the different species were recorded. No Heteroptera were caught in the following four habitats: 2, 3, 4, and III. Based upon literature data (Jensen-Haarup 1912, Wagner 1952, Southwood & Leston 1959, Wagner 1966 & 1967, and Gaun 1974), the species have been grouped according to their affinity to mire habitats (Table II). No species occur exclusively in mires, even though some of them are bound to wet habitats as such. Six species can be said to be typical of mire habitats. Three species are equally common in other types of habitats. One species probably prefers other habitats than mires. Below, a brief comment shall be given to each species.

*Saldula opacula*. Collected 7 September. According to Wagner (1966), the species occurs in two forms; a larger and more pale form, and a smaller and darker form. The collected specimen belongs to the last-mentioned form. In England, the species can be found in estuarine marshes (Southwood & Leston 1959).

*Coranus subapterus*. Collected 7 September. This is probably the species least bound to mires. It is often referred to as typical
Table I.  Pitfall catches of Heteroptera in mire habitats at Eldskog, south Norway

<table>
<thead>
<tr>
<th>Species:</th>
<th>Habitat:</th>
<th>No. per species</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Saldula opaula</em> (Zett.)</td>
<td>1 5 6 A B C D I II</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td><em>Coranus subapterus</em> (Deg.)</td>
<td></td>
<td>1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td><em>Myrmedobia exilis</em> (Fall.)</td>
<td></td>
<td>1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td><em>Haldolapus rufescens</em> (Burm.)</td>
<td></td>
<td>1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td><em>Gerris odontogaster</em> (Zett.)</td>
<td></td>
<td>1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td><em>Sebus ruficeps</em> Thoms.</td>
<td>1 1 1 1 1 1 1 1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><em>Acalypta nigrina</em> (Fall.)</td>
<td>1 1 1 1 1 1 1 1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><em>Ligyrocoris silvestrii</em> (L.)</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><em>Stygnocoris pedestrus</em> (Fall.)</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><em>Drymus brunneus</em> (F. Sahib.)</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
</tr>
</tbody>
</table>

Total no. of specimens per habitat: 1 2 6 3 1 5 1 4 24
Total no. of species per habitat: 1 2 2 1 1 5 1 3 10


*Myrmedobia exilis* (= *tenella* (Zett.)). Collected 24 July, macropter male. The larvae lives among moss (Southwood & Leston 1959).

*Haldolapus rufescens*. Collected 7 September. The species may also occur on dry habitats, often covered with *Erica* sp. (Gaun 1974).

*Gerris odontogaster*. Collected 7 September, and it was also taken by hand at the same locality 24 July. It often occurs on the surface of acid waters, as here, but also in weedy canals and lakesides (Southwood & Leston 1959).

*Hebrus ruficeps*. Collected 24 July in a very moist habitat with rich *Sphagnum* vegetation. The species is probably bound to such moist habitats near water, often with *Sphagnum* (Jensen-Haarup 1912, Southwood & Leston 1959). Thus, it may occur both in typical mire habitats and along the edge of lakes, ponds, and rivers.

*Kyllinga silvestrii*. Collected 24 July and 7 and 28 September. According to Wagner (1966), in northern Europe the species occurs on *Eriophorum* sp. In all the five habitats where it was collected, *E. vaginatum* was common. Two of the five habitats were open mire. However, in Denmark, it does not seem that the species is bound only to mires (Jensen-Haarup 1912).

*Stygnocoris pedestrus*. Collected 28 September. In England, the species often occurs on somewhat dry, sandy chalk or light soil, so it is not bound to moist habitats (Southwood & Leston 1959).

*Drymus brunneus*. Collected 28 September. The species feeds on mosses, and often occurs in habitats with *Sphagnum* (Southwood & Leston 1959, Wagner 1966).

In conclusion, the low catches of Heteroptera in the pit-fall traps indicate that the surface activity of this group in the actual mire habitats is rather small. This is to a large degree explained by the fact that many of the species are herbivorous. However, among the recorded species, many have their main distribution in this kind of habitats, and Heteroptera is a group which must be considered when defining typical mire invertebrate communities.

 ACKNOWLEDGEMENT
I am most grateful to Prof. Frej Ossiannilsson for help with the identification of the material.

REFERENCES


Received 17 December 1976
Females of the black-fly family (Simuliidae) can at times be exceedingly troublesome to man, cattle, and horses in several parts of Norway (Davies 1951, Carlsson 1962, Golini et al. 1976). One notorious species, Simulium truncatum (Lundström), is locally known as ‘Tuneflura’ (Raastad 1974, 1975). Another, Simulium ornatum Meigen, is often abundant in Norway (Golini & Davies 1975, Golini et al. 1976) and is a vector of the microfilarian Onchocerca gutturosa (Neumann) of cattle in England (Eichler and Nelson 1971, Eichler 1971). Other species have been shown to transmit avian haematozoa (Eide et al. 1969, Eide & Fallis 1972).

This paper describes experiments designed to determine whether various Norwegian simulid species are able (autogenous), or unable (anautogenous), to mature eggs without a blood meal. A knowledge of whether or not a simulid species is autogenous aids in understanding the seasonal attack of these flies and their success as vectors of haematozoa.

MATERIALS AND METHODS

In the summers of 1967 and 1968 black-fly material was collected from streams and rivers in the Rendalen region. The study area is described elsewhere (Davies et al. 1971, Golini & Davies 1975, Golini et al. 1976).

Black-fly pupae were either carefully removed from the substrate or brought to the laboratory attached to small bits of substrate. One species was also collected mating on the rocks at the edge of the Rena River, presumably after recent emergence from pupae.

The detached pupae were placed on moist cellucotton under individual cylinders (1 × 5 cm) plugged at the distal end with absorbent cotton so that adults associated with their exuviae could be reared (Wood & Davies 1966). This aided in the correct identification of species. For some of the species pupae were also group-reared on moist cellucotton or filter paper in petri dishes (9 cm
diam.) put below screen-topped cardboard cylinders (9 × 11 cm).

Freshly emerged females were transferred to cardboard cylinders as above and maintained with dry sucrose and water separately (Yang & Davies 1968). The flies were kept in subdued light in an unheated storeroom adjoining the laboratory. After 1-17 days flies died or were killed, and were then dissected to determine whether mature eggs were formed in the absence of a blood meal. Female mouthparts were also examined to reveal any relation between autogeny and reduced mouthparts.

The experiments ran from 29 June to 8 August in 1967 and 1968 during which time mean temperature in the test room was 15 ± 3°C in 1967 and 13 ± 2°C in 1968, except for 4-6 July 1968 when mean temperature reached 16.0-18.5°C.

RESULTS

Altogether 19 simuliid species (Table I) were reared from pupae, and 183 females were tested for egg development. In Table I the results are grouped according to length of test (days). Thirteen flies died or were killed after 1-4 days, 20 after 4-7 days, 45 after 7-10 days, 54 after 10-15 days, and 51 flies after 15-17 days.

This material is not large. Only four species were kept in reasonably high numbers, i.e. 14-71 individuals: Metacnephia fuscipes (Fries), Cnephia lapponica (Enderlein), Eusimulium vernum (Macquart) group, and Simulium truncatum (Lundström). For seven species 3-8 females were tested: Prosimulium ferrugineum (Wahlberg), P. ursinum (Edwards), P. hirtipes (Fries), Eusimulium bicorne (Dorogostajskij, Rubzov & Vlasenko), Simulium ornatum Meigen, S. rostratum (Lundström), and S. sublacustre Davies. Only 1-2 females of the remaining eight species were tested: Eusimulium crassum (Rubzov), E. curvans Rubzov & Carlsson, E. aureum (Fries), Schoenbaueria pusilla (Fries), Simulium monticola Friederichs, S. nitidifrons

Table I. Ovarian development in newly-emerged simuliid females given no blood meal but provided with dry sucrose and water separately.

<table>
<thead>
<tr>
<th>a) Species presumably anautogenous (no mature eggs formed)</th>
<th>Dates of Emergence</th>
<th>Numbers tested for different periods (days)</th>
<th>Total Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. ferrugineum</td>
<td>20-22 July 1967</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>P. hirtipes</td>
<td>29 June-1 July 1968</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>M. fuscipes</td>
<td>1-22 July 1967</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>E. vernum group</td>
<td>24-26 July 1968</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E. bicorne</td>
<td>22 July-8 Aug. 1968</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>E. meigeni</td>
<td>22 July 1968</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E. aureum</td>
<td>23 July 1968</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>S. rostratum</td>
<td>1-7 July 1967</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>S. nitidifrons</td>
<td>28 July 1968</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>S. ornatum</td>
<td>16 June 1967</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S. monticola</td>
<td>1-7 July 1967</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S. tumulosum</td>
<td>1-3 July 1967</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>S. truncatum</td>
<td>1-7 July 1967</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>S. sublacustre</td>
<td>6-9 July 1967</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b) Species autogenous (mature eggs formed)</th>
<th>Dates of Emergence</th>
<th>Numbers tested for different periods (days)</th>
<th>Total Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. ursinum</td>
<td>24 July 1968</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C. lapponica</td>
<td>10-11 July 1967</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>E. crassum</td>
<td>5 Aug. 1967</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>S. pusilla</td>
<td>20-21 July 1967</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S. argyreatum</td>
<td>14-18 July 1968</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

*collected mating at river's edge

Fourteen species, comprising 159 females, gave negative results as no mature eggs were developed (Table 1a). In E. aureum the data are too few to be conclusive as the single female lived only one day. In the other species females were kept alive for more than 7 days without forming mature eggs. These species are therefore presumed to be anautogenous, at least in their first ovarian cycle.

Twenty-four females, all that was tested of five species, proved to be autogenous (Table 1b). In P. ursinum the eggs were fully developed as soon as the flies emerged. In C. lapponica there were only two laboratory-reared specimens. These were examined after six days, and contained fully developed eggs. The field-caught females, tested at intervals up to 16 days, had all formed mature eggs. The single female of E. crassum had eggs only half developed at one day old. After six or more days the females of S. pusilla and S. argyreatum were found to contain mature eggs.

Reduced mandibles and lacinae were found in the following three of the nineteen species tested: P. ursinum, C. lapponica, and E. crassum. The mouthparts were normally developed in the other species.

DISCUSSION

There appear to be three distinct groups of simuliid species in relation to female bloodfeeding and ovarian development: 1) those in which females have reduced mouthparts and are unable to pierce the skin of vertebrates and feed on blood (often in these species females emerge with eggs mature or almost so), 2) those in which females have fully developed mouthparts and can develop the first batch of eggs without a blood meal, but require vertebrate blood for subsequent ovarian cycles, and 3) those in which females must feed on vertebrate blood for even the first ovarian cycle.

Autogenous species with reduced female mouthparts

Several authors have recognized one or more of these univoltine, fully autogenous simuliid species, in which females have reduced mandibles and lacinae. This study confirms that Norwegian populations of P. ursinum, C. lapponica, and E. crassum belong to this group.

Prosimulium ursinum was found previously in Norway and shown to be autogenous with eggs mature in newly emerged females (Davies 1954) and even in pharate pupae (Carlsson 1962). Peterson (1970) showed that this species was wholly parthenogenetic and described a new species, P. neomacropygum, to account for the bisexual population of the so-called P. ursinum in Alaska.

Rubzov (1956) referred to Russian populations of Prosimulium macropygum (Lundström) and C. lapponica as having reduced mouthparts unsuited for blood-sucking. P. macropygum is closely related to P. ursinum, and has now been found in Norway (Raastad & Davies 1977). Possibly P. macropygum belongs to this group of autogenous species. Rubzov (1960) described histological changes during ovarian development in C. lapponica, and he and Ussova (1961) found eggs mature at the end of the pupal stage.

The present study is the first to reveal reduced mouthparts and autogeny in E. crassum. Females of a closely related species, Eusimulium baffinense (Twinn), were reported to have reduced mouthparts in Canadian populations (Davies et al. 1962). Larvae of this species are now found in Norway (Raastad & Davies 1977). This is possibly a fifth Norwegian species in this group.

Downes (1971) argues persuasively that this reduction in female mouthparts is secondary and adaptive.

Autogenous species with well-developed female mouthparts

In this study two species, Schoenbaueria pusilla and Simulium argyreatum, were shown to be autogenous, at least for the first ovarian cycle, and to have normally developed mouthparts. Populations of S. pusilla actively bit humans and cows in the Rendalen area (Golini et al. 1976) and elsewhere in Norway (Carlsson 1962), and it was previously shown to be mainly autogenous for the first cycle (Shipitsina 1962b). Less is known about S. argyreatum apart from the fact that it can be a severe bloodsucker (Rubzov 1956 as nölleri, Carlsson 1962 as decorum).
Shipitsina (1962a, b) indicated that black-flies may be capable of varying autogeny for the first ovarian cycle. As an example of this she referred to Simulium reptans (L.) (as var. galeratum). This species is found in Norway (Raastad 1975) and is possibly a third Norwegian species in this group.

Simulium reptans is also known in certain regions as an aggressive bloodsucker (Rubzov 1956, Carlsson 1962). In fact Rubzov (1962) speaks of it as a facultative bloodsucker. Although Rubzov (1956) brings together an impressive amount of information to substantiate a case for facultative autogeny in simulids (i.e. autogeny and anautogeny in a single species depending on nutrition and temperature during the larval stage), it does not rule out the possibility of regular autogeny for a first ovarian cycle and anautogeny for subsequent cycles (cf. Davies 1961).

Anautogenous species
The majority of black-flies in Norway and most temperate and tropical regions appears to be in this category, i.e. females require a blood meal in order to develop any eggs. In this study there was evidence that the following species were in this group (Table Ia): Prosimulium farrugineum, P. hirtipes, Metacnephia fuscipes, Eusimulium vernum (group), E. bicorne, E. curvans, E. aurum, Simulium monticola, S. nitidifrons, S. ornatum, S. rostratum, S. truncatrum, S. sublacustrum, and S. tumulosum. They are all known to be bloodsuckers to a greater or lesser extent.

Davies (1951) netted females of P. hirtipes and S. monticola around cattle in Norway. Carlsson (1962) referred to the following species biting humans and cattle in Scandinavia: P. farrugineum, P. hirtipes, S. monticola, S. nitidifrons, S. ornatum, S. rostratum, (as forsi), S. truncatrum (as venustum, part) and S. tumulosum (as vulgare). In addition he found occasional single flies of E. vernum group (as latipes) biting man and cattle. All these species, except P. farrugineum, E. vernum and S. nitidifrons, and in addition S. sublacustrum, were collected around cattle in Rendalen (Golini et al. 1976). The other Rendalen species, except S. truncatrum, are known to be ornithophilic (Golini 1970): M. fuscipes (as palipes). E. aurum, E. bicorne, E. curvans, and E. vernum group (as latipes). Raastad (1974) considered S. truncatrum a major pest of humans and cattle in parts of Norway. This supports substantial evidence that these species are anautogenous and obligatory bloodsuckers in Norway.

In conclusion there are in Norway at least three (possibly five) species that are fully autogenous with reduced female mouthparts; at least two (possibly three) species are usually autogenous for the first ovarian cycle and require a blood meal for subsequent egg batches; and at least 14 species are anautogenous, requiring a blood meal to produce any eggs.

Acknowledgements
This study was part of a cooperative research project in 1967 and 1968 between the Zoological Laboratory, University of Bergen and the Department of Parasitology, University of Toronto, made possible by a NATO grant to Professor A. M. Fallis of the latter department. We appreciate being invited to share in this project. We are grateful to Mr. O. Kvaernes, Manager of Renåvangen Motel, for providing laboratory facilities and to Mr. V. I. Golini for technical assistance.

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Davies, L. 1951. Some field observations on Simuliidae (Diptera) at Holandsfjord, Norway. Oikos 3, 193–199.


Received 29 November 1976
Effects of glycerol in freeze-tolerant *Pytho depressus* L. (Col., Pythidae)

KARL ERIK ZACHARIASSEN


Adult *Pytho depressus* beetles are reported to be tolerant to freezing. During winter the beetles have high concentrations of glycerol in their body fluid. When the beetles have spent three days at room temperature, no glycerol is left, and the lower tolerated temperature is simultaneously elevated from about -27 to about -7.5°C. The beetles have remarkably high supercooling points, which are only slightly influenced when the glycerol concentration of the beetles changes. In the winter the hemolymph of the beetles contains nucleating agents which are probably responsible for the high supercooling points. Nucleating agents seem to be lacking in the hemolymph of summer beetles, which are sensitive to freezing. Glycerol can account for almost the whole decrease in osmolality of winter beetles transferred to room temperature.

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Since Miller (1969) reported the first example of tolerance to freezing in an adult insect, about 15 species of insects have been reported to tolerate freezing as adults (Ohyama & Asahina 1972, Somme 1974, Miller & Smith 1975, Zachariassen & Hammel 1976a). A general feature in these insects seems to be a low capacity to supercooling, which is probably caused by nucleating agents in their hemolymph (Zachariassen & Hammel 1976b). In the winter several of these species have accumulated glycerol or other polyols in their body fluid, but the concentration of polyols does not seem to affect significantly the supercooling points of the beetles. However, high concentrations of polyols are accompanied by a marked increase in the tolerance of the insects to low temperatures.

In this article, adult *Pytho depressus* beetles are reported to be tolerant to freezing. During winter the beetles have high concentrations of glycerol in their body fluid. Experiments were made to see how the solute concentration influences various other parameters, such as the supercooling point and the low temperature tolerance of the beetles, and how the glycerol concentration and osmolality change when the beetles are kept at room temperature. Finally, the osmotic contribution of glycerol and the presence of hemolymph nucleators were investigated.

**MATERIAL AND METHODS**

*Pytho depressus* L. (Col., Pythidae) is widely distributed in boreal forests in the palaearctic region, where the beetles develop under the bark of dead conifers. The adults emerge from their pupal state in the fall and spend the winter in the pupal chamber. Since the pupal chambers are frequently placed in those parts of the trees which are standing above the snow level in the winter, the beetles are probably regularly exposed to arctic winter temperatures.

The beetles used for the present investigation were collected in the middle of the winter at their overwintering sites in the vicinity of Oslo. They were kept without food in a refrigerator at 0° to +4°C for up to two weeks before they were used in the experiments.
Preliminary studies had shown that when winter beetles with high concentrations of glycerol in their body fluid were kept at room temperature for more than three days, no glycerol was left. In order to study the connection between the glycerol concentration and other parameters, a group of beetles was removed from the refrigerator and kept at room temperature (22°C). After the beetles had spent various periods of time at room temperature, they were taken out and used for the experiments, so that the experiments were performed on beetles with different concentrations of glycerol in their body fluid.

The freeze-tolerance of the beetles was established by investigating their ability to survive freezing at a temperature equal to their supercooling point, such as described by Zachariassen & Hammel (1976a). The beetles were cooled in a deep freezer at a rate of 20°C per hour until they froze spontaneously. The temperature was measured with a copper constantan thermocouple, with the junction kept in close contact with the surface of the beetle and connected to a Leeds & Northrup Speedomax recorder. The freezing was indicated by the sudden temperature increase due to the release of heat of fusion of water. The last temperature recorded before the initiation of the freezing was taken as the supercooling point.

The tolerance of the beetles to low temperatures was studied by allowing the frozen beetles to cool to various low temperatures. After each cooling experiment the beetles were heated slowly to room temperature, and the effect observed during 15 min. Cooling experiments were repeated to gradually lower temperatures until the first sign of injury was observed. Analyses of the osmolality and the glycerol concentration of the body fluid followed immediately, in order to obtain values representative for the beetle at the moment of the cooling experiment.

The glycerol concentration was measured on whole beetles, having removed a sample of hemolymph for osmolality determination. For determination of their water content, the beetles were weighed before and after drying to constant weight at 55°C. According to Somme (1964) no glycerol is lost by this treatment. The dried beetles were then ground in a mortar in a mixture of purified sea-sand and 80% ethanol. The mixture was centrifuged, the precipitate washed and centrifuged twice, and the combined supernatants dried at room temperature. The residue was dissolved in a known volume of distilled water, and stored frozen at -27°C for up to two weeks before the glycerol content was measured. The glycerol content was measured by using a paper chromatographic method, described by Metzenburg & Mitchell (1954). This method leaves glycerol as distinct white spots on the chromatograms. The areas of the spots are proportional to the amount of glycerol, and the unknown samples were run together with samples with a known glycerol content. The molal concentration of glycerol was calculated by relating the content of glycerol to the total water content of the beetles. Results obtained by Zachariassen (1973) indicate that glycerol is distributed in equal concentrations in intracellular and extracellular compartments in insects. Consequently, the glycerol concentrations found by means of this method should be representative for the intracellular as well as the extracellular glycerol concentration.

The osmolality of the body fluid was determined by measuring the melting point of small samples of hemolymph on a Clifton Nanoliter Osmometer. Hemolymph samples were obtained by making a small hole on the ventral side of the beetles and sucking the exuding hemolymph droplet into a thin glass capillary. To prevent evaporation of water from the sample, the hemolymph was isolated inside the capillary between two layers of immersion oil. The temperature at which the last ice crystal disappeared when a frozen hemolymph sample was heated, was taken as the melting point. The osmolality was calculated from the melting point by means of the osmolar melting point depression (-1.86°C per osmolar).

The presence of nucleating agents in the hemolymph of the beetles was investigated by using a method described by Zachariassen & Hammel (1976b) in which the supercooling point was measured on 5 μl samples of 0.9% NaCl, containing 5 vol% hemolymph. Samples of 5 μl 0.9% NaCl will supercool to the temperature range from -15 to -18°C, while samples mixed with 5 vol% hemolymph containing nucleating agents had their supercooling points elevated to above -7°C.
RESULTS

Table I shows that winter beetles with high concentrations of glycerol in their body fluid survived in a frozen state at temperatures down to about -27°C. Beetles which had been kept at room temperature for 3 days, so that all accumulated glycerol had disappeared from their body fluid, were tolerant to only about -7°C. Beetles collected in the month of May were not tolerant to freezing.

Fig. 1 shows how the supercooling points of beetles collected in the winter changed when their osmolality was reduced by keeping them at room temperature. The calculated regression line has the formula $y = -3.99 - 0.00116 x$, and the correlation coefficient is 0.82. The supercooling points of beetles collected when they were just about to leave their pupal chambers in the beginning of May were markedly lower than the supercooling points of winter beetles with the same osmolality.

Fig. 2 shows how the osmolality and the glycerol concentration changed in beetles which had been transferred from the refrigerator ($0-+4°C$) to room temperature ($22°C$). There is an exponential decline in both parameters, and the reduction in osmolality corresponds fairly well to the reduction in glycerol concentration. After three days at room temperature no glycerol was left, and the osmolality was concomitantly reduced to about 600 mOsm, where it was stabilized.

Fig. 3 shows the connection between osmolality and the osmotic contribution of gly-
cerol. The osmotic contribution of glycerol was calculated from its molal concentration by means of data found in a standard physical tables (Weast 1972). The calculated regression line has the formula \( y = -460 + 0.85x \).

This line deviates significantly on level \( p<0.05 \) from a line with a slope equal to 1.0 (Students t-test, \( t = -2.5, n = 2 = 10 \)). For osmolality values up to ca. 1500 mOsm glycerol seems to account for the whole increase in the osmolality, but at an osmolality of ca. 2000 mOsm there is a discrepancy of ca. 250 mOsm. The chromatograms showed no spots which could indicate the presence of other polyhydric alcohols in the beetles.

The mean supercooling point of 5 parallel samples of 0.9 NaCl containing 5 vol\% hemolymph from \( P. \) depressus collected in the winter was \(-8.9 \pm 1.2^\circ C \) (± S.D.). The corresponding supercooling point of NaCl-solution containing hemolymph from a beetle collected in the month of May was \(-15.5^\circ C \).

**DISCUSSION**

The high supercooling points of beetles collected in winter (Fig. 1) indicate that these beetles contain some kind of nucleating agents. Zachariassen & Hammel (1976b) found the hemolymph of several species of freeze-tolerant beetles to contain nucleating agents, which probably ensure a protective extracellular freezing in the beetles at high sub-zero temperatures. Similar nucleating agents are probably responsible for the high supercooling points of this species as well. The supercooling points of the samples of 0.9% solution of NaCl, containing hemolymph from \( P. \) depressus, reveal that \( P. \) depressus has nucleating agents in its hemolymph. However, the supercooling points were somewhat lower than should be expected from the high supercooling points of the intact beetles and from the values of corresponding tests with hemolymph from other freeze-tolerant species.

The slope of the regression line (\( = -0.00116 \)) corresponds to a depression of the supercooling points of 1.16°C per osmolal. Zachariassen & Hammel (1976b) found that the corresponding value for solutions of NaCl and glycerol containing nucleating agents was 1.95°C per osmol. This value agrees fairly well with the osmolar melting point depression (1.86°C per osmol), indicating that the agents initiate freezing at a constant level of supercooling. The slope of the present regression line deviates significantly on level \( p<0.05 \) from the osmolar melting point depression (Students t-test, \( t = 2.57, n=2=9 \)). This deviation might indicate that the osmolality at the nucleation site changes less than the hemolymph osmolality. Another explanation of the deviation might be that the nucleation takes place in more peripheral parts of the beetles, such as legs or antennae, so that the temperature at the nucleation site differs from the temperature of the body, where the temperature was measured.

The low supercooling points of 0.9% solution of NaCl containing hemolymph from a beetle collected in the summer indicate that summer beetles lack nucleating agents in their hemolymph. The lack of nucleating agents in the hemolymph of summer beetles might be the reason why summer beetles have lower supercooling points than beetles collected in the winter. The positive correlation between the presence of nucleating agents in the hemolymph and tolerance to freezing agrees with the observations of Zachariassen & Hammel (1976b), and gives further support to the view that extracellular nucleating agents are of physiological importance to freeze-tolerant insects.

The osmolality of \( P. \) depressus beetles lacking glycerol in their body fluid seems to be about 600 mOsm (Figs. 2 and 3). These results agree well with corresponding results obtained on other species of beetles. Cerambycid beetles of the species \textit{Rhagium inquisitor} L., in which the free glycerol had been eliminated, had a hemolymph osmolality of 600 mOsm (Zachariassen 1973), while a number of tenebrionid beetles were found to have values of hemolymph osmolality varying from about 430 to about 610 mOsm (Zachariassen & Hammel 1976a).

The discrepancy between the osmotic contribution of glycerol and the osmolality at the higher osmolality values might indicate that there is a contribution from other solutes as well. The results indicate no accumulation of other polyols, but it is difficult to imagine which non-polyol metabolites could be accumulated to give an osmotic contribution...
as high as 250 mOsm. In any case, of the solutes responsible for the osmolality increase beyond 600 mOsm, glycerol seems to be the quantitatively dominating one, even in those beetles which had the highest osmolality values.

The correlation between the glycerol concentration and the low temperature tolerance of *P. depressus* agrees with the results obtained by Miller (1969) and by Miller & Smith (1975). The increased tolerance to low temperatures might be explained by the colligative properties of glycerol. One theory of freeze injuries ascribes the injuries to the high concentrations of inorganic salts which occur at low temperatures, due to the freezing of solvent water. High concentrations of glycerol or other polyols will reduce the frozen fraction of the water at any subfreezing temperature. Consequently, the temperature at which the inorganic salts are becoming concentrated to the critical value will be lowered. More experiments should be performed to study the mechanisms of the cryoprotective effect of glycerol in freeze-tolerant insects.

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REFERENCES
On the distribution and habitat choice of *Agonum dorsale* Pont. (Col., Carabidae) in Norway

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*Agonum dorsale* Pont. is known from only four localities in Norway. The northernmost record is from Jeløya, Østfold County. All records are from dry habitats with sparsely ground vegetation. The soil varied from almost pure sand to clayey ground. The species may have been overlooked in Norway, but recent records may indicate that *A. dorsale* is increasing its distribution area.

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From literature, *Agonum dorsale* Pont. has been reported only twice in Norway. Contact with museums and private collectors did not give further information about records on the species. However, two new records have recently been made by the author.

The first record of *A. dorsale* in Norway was made by Fjellberg 8 July 1965 at Kjære in Tjøme, Vestfold County (Fjellberg 1966). In the middle of June 1975, the species was recovered from the same area. The habitat was a strawberry field with dry, clumpy and clayey soil (Fjellberg pers. comm.).

Strand (1970) published a record from Grimstad, Aust-Agder County. Also this record was made in a strawberry field with soil consisting of sand mixed with clay. Pitfall traps were used (Stenseth leg., pers. comm.).

NEW RECORDS

At Svinevika in Tjølling, Vestfold County the author caught about forty specimens during a few hours, 23 March 1975. The beetles were found under stones, partly in areas between deciduous forests and grain fields, and partly in open meadows. The neighbouring forests were dominated by *Quercus robur* L., mixed with *Corylus avellana* L., and others. All sites had only a sparse cover of grass, were in a sun-exposed position, and the soil had a low water content. The soil varied from almost pure sand to soil with clayey character.

The main number of the collected specimens were found aggregated, and in hibernating position. Very often, *Badister bipustulatus* Fbr. and *Calathus melanocephalus* L. were found under the same stones as *A. dorsale*.

At Jeløya, Østfold County, a record of seven alive and six dead specimens was made by the author 10 April 1976. The aggregation with dead beetles was overgrown with a fungus mycelium, and *C. melanocéphalus* was also represented with dead specimens. The record was made under stones in a border zone between grain fields and deciduous
forest with Q. robur, T. cordata, B. pubescens and others. Also here the beetles were found in hibernating position. C. melanocéphalus was found to be a common species in this habitat. B. bipustulatus also occurred, but less frequently.

DISCUSSION

All the records are from nearly similar habitats considering ground vegetation, relationship to water, type of soil, and sun exposition.

Several authors claim that the species has an affinity to soils with a high content of lime (Westhoff 1881, Dahl 1928, Horion 1941). This characteristic holds very well for the Jeløya habitat, but the three other habitats are less specific.

The northern distribution limit of the species is probably determined by temperature. The two new records mentioned were made near forest types, which need a high mean summer temperature.

In Sweden, the species has only been found in five new localities after 1945 (Lindroth pers. comm.). These records lie within the earlier known distribution area of the species. The Norwegian records, which are all from 1965 or later, lie within the most intensely studied areas in the country concerning Coleoptera. It is, therefore, possible that the species recently may have increased its distribution area westwards.

In southernmost Sweden, A. dorsale typically occurs together with Brachinus crepitanus L. and Harpalus azureus F. (Lindroth 1945, 1949). None of these species have been recorded in Norway. B. crepitanus, however, is known from middle Sweden, and it would therefore be reasonable to seek for this species in Norwegian localities for A. dorsale.

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Black flies (Dipt., Simuliidae) new to Norway

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Since 1967-68 when a NATO project, acknowledged elsewhere in this journal, was conducted in Rendalen, 14 black-fly species new to Norway have been published (Rubzov 1971, Golini 1975, Raastad 1975). Two of these species were described as new.

This paper reports 9 additional black-fly species new to Norway, of which four are previously unknown outside USSR. A fuller account of the Fennoscandian species will be given elsewhere (Raastad 1977).

Prosimulium macropygum (Lundström, 1911)
Synonym: Hellichia latifrons Enderlein, 1925

H. latifrons is described on Norwegian material. Since then, P. macropygum has not been recognized in Norway until the present report. It is known from Sweden and Finland (Carlsson 1962, Kuusela 1971), as well as from USSR (Ussova 1961, Rubzov & Carlsson 1965).

Cnephia lapponica (Enderlein, 1921)
Material: Akershus, Oppegård, Klemetsrud, 14 June 1970, 14 larvae, 9 pupae. Leg. J. E. R. Hedmark, Y. Rendal, Åkre, 31 July 1968, 5 larvae, 28 pupae. Leg. D. M. D. & J. E. R. Ussova (1961) and Raastad (1971) briefly indicated the presence of this species in Norway, but this was not verified until recently (Davies et al. 1977). This report is the first to give exact location of the material. C. lapponica is also known from Sweden, Finland, and USSR (Rubzov 1956, Ussova 1961, Carlsson 1962, Kuusela & Itämies 1976).

Cnephia freyi (Enderlein, 1929)
Synonym: Stegopterna richteri Enderlein, 1930
This is a first report of this species from Norway. It is known as St. richteri from Sweden, Finland and USSR (Rubzov 1956, Ussova 1961, Carlsson 1962, Rubzov & Carlsson 1965, Kuusela 1971).
Cnephia dogieli (Ussova, 1958)
This is a first report of this species from Norway. A species close to C. dogieli is mentioned by Eide & Fallis (1972) and described by Golini (1975). C. dogieli is known from Finland and USSR (Rubzov 1956 sic, Ussova 1961, Kuusela 1971).

Eusimulium olonicum Ussova, 1961
This is a first record outside USSR. As far as we can trace it is known only from Murmansk–Karelia (Ussova 1961).

Eusimulium crassum (Rubzov, 1956)
This species was unknown outside USSR until recently (Davies et al. 1977). This report is the first to give exact location of the material.

Eusimulium baffinense (Twinn, 1936)
This species is known from Sweden (Carlsson 1962). The present record is the first from Norway. Otherwise it is unknown outside USSR.

Eusimulium beltukovae Rubzov, 1956
This is a first record of this species outside USSR.

Simulium rotundatum (Rubzov, 1956)
Material: Hordaland, Ølen, Bjordalen, 7 July 1965, 2 larvae. Leg. A. Lillehammer.
This species is previously unknown outside USSR.

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Communication by sound between desert tenebrionids

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East African desert beetles of the species *Phryanocolus somalicus* Wilke (Col., Tenebrionidae) have been found to produce sound by tapping their abdomen against the substrate. The sound production probably serves the purpose of attraction between beetles of opposite sexes. The beetles are sensitive to the sound, not only to mechanical vibrations in the substrate. They also seem to be able to distinguish between sounds from different directions.

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Ability to produce and to respond to sound is known from a number of insect orders. Sound production usually serves the purpose of frightening predators or is used for intraspecific communication. Some insects produce sound by the impact of a part of their body against the substrate, while others use special sound-producing organs. The detection of sound is obtained by the use of tympanic membranes or by using specialized sensory hairs. From the coleoptera, only sensory hairs have been reported (Rockstein 1974).

OBSERVATIONS AND DISCUSSION

In the laboratory, the beetles were found to produce sound by tapping their abdomen against the substrate. The sound was made by a series of 7 to 12 tapping with a frequency of about 2 tappings per second.

Observations in the laboratory strongly suggest that the sound production serves the purpose of sexual attraction. A series of tapping sounds produced by a male was immediately followed by a similar series produced by a female, whereafter the male moved in the direction of the answer. The female was standing still. After a short while, the male stopped and made another series of tapping sounds, which was answered by the female. The male then continued in the direction of the answer. This was repeated until the male ran into the female and copulation took place.

Response from the beetles in the form of

MATERIAL

The species *Phryanocolus somalicus* Wilke (Col., Tenebrionidae) inhabits arid thorn shrub and semi desert areas in Eastern Africa. The beetles spend the day under stones and fallen branches of trees and are probably active at night.

Beetles of this species were collected near Isiolo in the northern part of Kenya. They were brought alive to Oslo and kept in the laboratory at room temperature. They were fed by pieces of apple and carrot.
abdominal tapping was also obtained by artificially made sounds, for example by tapping a pencil against the plastic box in which the beetles were kept. The beetles even responded to tapping sounds produced in the air above the box. In this case there were probably no mechanical vibrations in the substrate under the beetles. This indicates that they are sensitive to sound, and not only to mechanical vibrations in the substrate. Consequently, the beetles probably have sound-sensitive receptor organs, such as tympanic membranes or sensory hairs. The beetles have hairs on the antennae and on the pronotum, and these hairs might serve as sound-sensitive receptor organs.

The observations also indicate that the beetles (at least the males) have the capability to discriminate between sounds of different directions.

The ground is very hard at the locality where the beetles were found. Thus, the natural substrate should allow the production of rather loud tapping sounds, which might be heard many metres away, depending on the sensitivity of the receptor organs of the beetles.

Because of the dense darkness of tropical nights, it is probably a great advantage to night-active insects in these regions to communicate by means of sound.

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REFERENCES

Ectoparasites (Mallophaga, Siphonaptera, Acarina) from Birds of Jan Mayen Island, Norway

NIELS HAARLØV


Mallophaga, Siphonaptera, and ectoparasitic mites from birds of Jan Mayen have been registered and discussed.

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Klaus Vestergaard stayed on the Norwegian island of Jan Mayen during the period 11 June to 20 July 1972 as a member of the Danish Jan Mayen Expedition 1972. His main task was to collect mites, collemboles, and other microarthropods from moss and soil, but besides this work he shot several birds for the Zoological Museum of Copenhagen. From these birds he sampled as many ectoparasites as he could collect in the given time, and these parasites form the material for the study described in the following.

The following birds were examined: *Fulmarus glacialis* (L.), *Alle alle* (L.), *Uria lomvia* (L.), *Fratercula arctica* (L.), *Rissa tridactyla* (L.), *Charadrius hiaticulae* L., and *Calidris alpina* (L.).

Following the methods of Mehl (1967), the birds were put into plastic bags immediately after they had been shot. After return to the laboratory, each bag was opened and a wad of cotton with chloroform put into it. After about 30 minutes the birds were taken out and the inside of the bag examined for the possible presence of parasites. Then the bird was placed on a piece of white paper and its plumage brushed, beaten, and thoroughly ransacked for ectoparasites; when found they were put in 70%/o alcohol. In some cases dead Mallophaga could be taken directly from the feathers. The kittiwake and the dunlin were the only birds that were not chloroformed before being examined for ectoparasites.

According to Becher (1865) and Zunker (1932), the following species of Mallophaga have been found in Jan Mayen:

- **Menopon albofasciatum** Piaget 1880 (≡ *Holomenopon albofasciatum* (Piaget) 1880) from *Uria lomvia*.
- **Menopon lutescens** Burmeister 1838 (≡ *Austromenopon lutescens* (Burmeister) 1838) from *Tringa* sp.
- **Philoterus gonothorax** Giebel 1874 (≡ *Saemundssonia gonothorax* (Giebel) 1874) from *Uria lomvia*.
- **Degeeriella brachythorax** Giebel 1876 (≡ *Brüelia brachythorax* (Giebel) 1876) from *Plectrophenax nivalis*. 
Esthiopterum nigrolimbatum Giebel 1874 (= Perineus nigrolimbatis (Giebel) 1874) from Fulmarus glacialis.

No records for Siphonaptera (Jordan 1933) seem to exist from Jan Mayen nor for the two species of ectoparasitic species of mites (Frisstrup 1942, MacFadyen 1954, Krezal 1959, Arthur 1963, Doss et al. 1974, Rack 1975). The material is kept at The Zoological Museum, Copenhagen, Denmark.

MALLOPHAGA

Austromenopon nigropleurum (Denny) 1842
Kap Muyen, 27 June 1972, 19 and 1 juv., taken together with Saemundssonia calva from an Uria lomvia which was rather exhausted and not able to fly. According to Clay (1959) the specimens belong to the nigropleurum group. She made no distinction between subspecific varieties in this group; these, however, may certainly be found when comparing, for instance, this specimen from Uria lomvia with Austromenopon nigropleurum from an Alca torda (Overgaard 1942).

Among other things, it is evident that the outer hair but one along the posterior side of the head is well developed in the specimen from Alca torda, but rudimentary in that from Uria lomvia.

Carduiceps meinertzhageni (Timmermann) 1952
Stasjonsbukta, 16 June 1972, 23 adults and juvenes were collected nine days after the bird had been shot together with Lunaceps sp. of a Calidris alpina. Identified according to Timmermann (1957).

Chadraceps hiatriculae (O. Fabr.) 1780

From a Charadrius hiatriculae, Stasjonsbukta, 25 June 1972, 16 adults and juvenes were collected together with Quadraceps fissus. This species can be identified according to Clay and Hopkins (1954) and Zlotarzycka (1967).

Lunaceps sp.

Stasjonsbukta, 16 June 1972, 2 adults found together with Carduiceps meinertzhageni from Calidris alpina. As the material contained no males, identification of species could not be made (Timmermann 1954b, 1957).

Mjöberginirmus klatti (Tim.) 1954
Stasjonsbukta, 10 July 1972, 2 adults (♂, ♀) from Alle alle. Timmermann (1954a) originally referred this species to the genus Quadraceps. Zlotorzycka (1967), however, in her revision of the Quadraceps group, distinguished between species with one or with two long temporal hairs, and in that connection the original Quadraceps klatti distinctly belongs to the former group including the genus Mjöberginirmus.

Quadraceps fissus (Burm.) 1838
Stasjonsbukta, 25 June 1972, about 55 specimens (adults, juvenes) were collected together with Chadraceps hiatriculae from Charadrius hiatriculae. Identified according to Timmermann (1953, 1957) and Zlotorzycka (1967).

Perineus nigrolimbatis (Giebel) 1874
Båtvika, 19 July 1972, about 50 specimens, taken together with Saemundssonia occidentalis (?) from two specimens of Fulmarus glacialis. This relatively big species is with certainty referred to genus (Séguy 1944, Timmermann 1965). At species level, however, there may be some difficulties, especially in relation to P. circumfasciatus v. Kéler, 1957. Yet the structure of clypeus seems sufficiently characteristic to make a correct identification.

Saemundssonia calva (Kellogg) 1896
Kap Muyen, 27 June 1972, 3♀ and 1♂ were collected from Uria lomvia together with specimens of Austromenopon nigropleurum. Identification was according to Timmermann (1957).

Saemundssonia merguli (Denny) 1842
Stasjonsbukta, 14 June and 10 July 1972, 3 adults (1♀, 2♂) and 4 juveniles from 3 specimens of Alle alle. Evidently the structure of the male genitalia of this species is closely related to those of S. grylle (O. Fabr.) 1780 (Clay & Hopkins 1954). Yet the dimensions of its head and relative lengths of telomeres and endomeres should make it clearly distinguishable from S. grylle.
**Saemundssonia lari** (O. Fabr.) 1780  
Stasjonsbukta, 20 June 1972, 14 adults and juveniles taken from the neck of a *Rissa tridactyla*. Male genitalia correspond fairly well with Timmermann's depictions (1957) of an individual taken from *Larus hyperboreus*, but deviate somewhat and especially to the form of the telomeres depicted by Hopkins and Clay (1954) probably from the same host. As there may be some sub-specific variations, the specimens found are nevertheless referred to *S. lari*.

**Saemundssonia tringae** (O. Fabr.) 1780  
Stasjonsbukta, 16 June 1972, 13 and 1 juvenis from *Calidris alpina*. The identification is based on high similarity with the figures of Timmermann (1957) and Hopkins & Clay (1954).

**Saemundssonia occidentalis** (Kellogg) 1896 (?)  
Båtvika, 19 July 1972, 2♀♀ taken on the same specimen of *Fulmarus glacialis* from which *Perineus nigrolimbatus* were found. Based on Timmermann (1965), the identification seems reasonable, but as the material has no males, the species cannot be determined with certainty.

**SIPHONAPTERA**

*Mioctenopsylla arctica* Rotschild 1922  
June 1972, 3♀♀ and 2♂♂ collected from the nest of *Rissa tridactyla*. The identification agrees closely with Rotschild's original description.

**ACARINA**

*Pygmephorus spinosus* Kramer 1877  
Fishburndalen, 15 July 1972, collected from feathers of *Fratercula arctica*. According to the description by Krzal (1959) and Rack (1975), the only individual found can with certainty be identified as *P. spinosus*.

*Ceratixodes uriae* (White) 1852  
Jamesonbukta, 13 June 1972. Three larvae were collected from *Uria lomvia*. Identification according to Filipova (1958).

**DISCUSSION**

In order to outline the hosts of the ectoparasites collected at Jan Mayen, and to summarize the occurrence of these species from neighbouring areas, Table I has been compiled from Trägårdh (1904, 1931), Henrikсен (1928, 1939a, b), Thor (1930), Jordan (1933), Overgaard (1942), Fristrup (1942), Arthur (1963), Hackman & Nyholm (1968), Kaisala (1973), and Lindroth et al. (1973), with reference to Jan Mayen (M), Svalbard (S), Iceland (I), Greenland (G) and Faroes (F). Those which are new to the fauna of Jan Mayen are marked with an asterisk.

As stressed by Clay (1949), host and geographical distribution must be equated in work with highly specialized ectoparasites like Mallophaga. Considering the distribution of the hosts from Jan Mayen, the geographical distribution of the Mallophaga outside the island is therefore quite reasonable. It should be understood, however, that non-occurrence of the mallophagan species in most cases is due to non-systematic collections. In this investigation no species have been found on abnormal hosts.

With the larval stages of the fleas living off their hosts, the distribution of *Mioctenopsylla arctica* may depend equally on the ecology of the nests of their hosts as on the hosts themselves. At any rate it has till now only been found in nests and specimens of *Rissa tridactyla*. Yet it is astonishing that in colonies of *Rissa tridactyla* on the cliffs of, for instance, Røst at Lofoten, no *Mioctenopsylla arctica* were found despite special search (Mehl 1968).

Regarding host and geographical distribution, the most astonishing find at Jan Mayen is *Pygmephorus spinosus*, which strictly speaking seems to have been found neither in arctic regions nor on a bird, but only on small mammals (Krzal 1959, Rack 1975). Yet Rack (by letter) reports 'besitze 2 Exemplare von *Turdus merula* aus den Niederlanden', which may indicate that the species is not as host-dependent as generally supposed. Furthermore, it is worthwhile mentioning that Vitzthum (1943) points out that even if *Pygmephorus spinosus* and other species of the same genus are found on moles and mice, they may be more parasitic on insects found in the subterranean nests of these mammals. If so, the
### Table I. The presence of ectoparasites at Jan Mayen, and their occurrence in neighbouring areas. Jan Mayen (M), Svalbard (S), Iceland (I), Greenland (G) and Faroes (F). Species new to the fauna of Jan Mayen are marked with an asterisk.

<table>
<thead>
<tr>
<th>Mallophaga</th>
<th>Siphonaptera</th>
<th>Acarina</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Fulmarus glacialis</em></td>
<td><em>Scaemundssonia occidentalis</em> (?) (M, F)</td>
<td>-</td>
</tr>
<tr>
<td>Alle alle</td>
<td><em>Müllerinimus katti</em> (M, S)</td>
<td><em>Scaemundssonia mergui</em> (M, G)</td>
</tr>
<tr>
<td><em>Uria lomvia</em></td>
<td><em>Holomenopon albofasciatum</em> (M)</td>
<td>-</td>
</tr>
<tr>
<td><em>Rissa tridactyla</em></td>
<td><em>Austromenopon nigropleurum</em> (M, S)</td>
<td><em>Saemundssonia gonothorax</em> (M)</td>
</tr>
<tr>
<td><em>Plectrophenax nivalis</em></td>
<td><em>Briielia brachythorax</em> (M, G)</td>
<td>-</td>
</tr>
</tbody>
</table>

Presence of *Pygnemephorus spinosus* on *Fratercula arctica* may seem more understandable inasmuch as this species also has its nest in tunnels in the soil, and is thus in close contact with the insects living there. Except for the arctic fox (*Alopex lagopus*), no mammals live permanently at Jan Mayen.

**Acknowledgement**
My sincere thanks are due to Dr. Bengt Nilsson, The University of Lund, Sweden, for very informative discussions as to identification of the Mallophaga. I am most grateful to Dr. Klaus Vestergaard, The Royal Veterinary and Agricultural University, for his kindness in giving me the opportunity of utilizing the material he had collected.

**References**


The *Eupithecia* group (Lep., Geometridae) in Norway

NILS KNABEN

Compiled by Magne Opheim


A faunistic and taxonomic study of the genera *Eupithecia* Curtis, *Gymnoscelis* Mabille, and *Chloroclystis* Hübner in Norway, based on the notes of the late Nils Knaben, is presented. The synopsis comprises 50 species, of which two, *Eupithecia irriguata* (Hübner) and *E. cauchita*, (Duponchel), have been added by M. Opheim.

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PREFACE

The *Eupithecia* group in Norway comprises three genera, *Eupithecia* Curtis, 1825, *Gymnoscelis* Mabille, 1868 and *Chloroclystis* Hübner, 1825, containing in all 50 species.

The species are rather small geometrid moths, and as many of them are superficially similar, many mistakes have been made by collectors and students when trying to identify the different species.

A revision of the Norwegian material of the group seemed highly necessary, and my deceased friend, Nils Knaben, head curator at the Zoological Museum, Oslo, undertook this great task, starting as far back as the middle of the 1930s. He studied the collections in all of the Norwegian zoological museums and had also access to several large private collections of the group. In addition, he brought together a large material from many districts in Norway, in particular from the western part of the country.

In order to get a reliable determination, many specimens had to be dissected. In all 1750 dissections were made by him.

Knaben’s untimely death in January 1969 prevented him from putting his work on the *Eupithecia* group into print, and he did not leave a complete MS, though he had typescript for most species, regarding lists of localities and of literature of Norwegian records, up to 1953. Between this year and 1968 there were many notes on loose sheets. His comprehensive journal listing dissected specimens was very helpful to me. Knaben had also handwritten commentaries to many of the species.

Maps of distribution of the species were brought up to about 1953 by Knaben and to 1975 by Opheim. Excellent photographs of the species numbered 48.

Knaben’s typescript had to be rewritten because of the addition of many new localities and new Norwegian records. In this the following arrangement of the text was used: Norwegian records – Localities – Not verified records – Doubtful and erroneous records.
- Distribution (incl. vertical) – First capture
- Food-plant – Flight – Remarks. Dates and sex are given for scarce species only. The sequence of the countries and that of rural districts follows Strand (1943).

CONTRIBUTORS

Aa = Aarvik, L.
AB = Bakke, A.
AF = Fjeldså, A.
AN = Nielsen, A.
AU = Ulla, A.
B&L = Brattegard, T. & Lindén, L.
CFL = Lühr, C. F.
EB = Barca, E.
ES = Strand, E.
Es = Esmark, L.
FJ = Jensen, F.
FS = Smedstad, F.
Fu = Fugelli, E.
GN = Grude-Nielsen, M. A.
Gr = Grimsgaard
Haw = Hawkshaw, J. C.
He = Henrichsen, H.
HG = Høegh-Guldberg, O.
Ih = Ihlebæk, R.
IS = Svenssson, I.
JF = Fjeldalen, J.
JG = Grønvall, J.
JH = Heiland, J.
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KB = Berggren, K.
KG = Gjertsen, K.
KH = Haanshus, K.
KK = Krog, K.
LP = Lie-Pettersen, O. J.
Lu = Lundetrae, O. B.
MO = Opheim, M.
Moe = Moe, A.
Mu = Munster, T.
NG = Grønnli, N.
NK = Knaben, N.
OK = Kvalheim, O.
Pe = Peltonen, O.
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THS = Schøyen, T. H.
Th = Thorstensen, T. D.
Tj = Tønneeland, A.
To = Torpe, L. H.
Ull = Ullmann, A. C.
WC = Christie, W.
Wck = Wocke, M. F.
We = Wessel, A.
WH = Hackman, W.
WMS = Schøyen, W. M.
ZMO = Zoologisk Museum, Oslo
ZMT = Zoologisk Museum, Trondheim
Øw = Øwre

SYNOPSIS OF THE SPECIES

The nomenclature used here is in the main part that applied by Opheim (1972).

EUPITHECIA Curtis, 1825

Eupithecia tenuiata (Hübner, 1809–12) (Figs. 1A, 11E)

Norwegian records: Eupithecia tenuiata;
Schøyen 1882, 1893; Lampa 1885, Sparre Schneider 1893; Henrichsen 1907; Nielsen 1956; Berggren 1970; Opheim 1972. Tephroclysia tenuiata; Barca 1910.

Localities: Østfold: Jeløy (EB, AN, GN);

Not verified record: The record of Schøyen (1882) refers to information received from J. Schilde, who bred E. tenuiata from larvae.

Found on the catkins of *Salix* at Nsy: Bodo May 1879. Although the locality is the northernmost in Norway, the record should be considered reliable.

Doubtful and erroneous records: *Tephroclystia tenuiata*, Hawkshaw (1919) VAy: Vigel and 2 Aug. 1905 (= *E. inturbata* Hb.). *Tephroclystia tenuiata*, Torpe 1926: 77 (HOi:
Viveli 11 July 1909 (EB)). The record is considered unreliable, as Viveli is situated at 900 m.

**Distribution**: Main area from 58° to 62° N.L., northern localities at 64° and 67° N.L.


**Remarks**: Mostly found singly, but 38 firsts were captured 23 July 1942 at SF: Fannemel, and also bred in numbers at Oslo: Tåsen.

**Eupithecia subciliata** (Hübner, 1814–17) (Figs 1B, 10A)


**Locality**: Østfold: Sarpsborg (EB); Jeløy (EB, GN); Rauer (AB). Akershus: Oslo: Frogner, Thoresens Løkke (Es), Tøyen (Si, Moe, WMS), Tåsen (KK); Bærum: Sandvik (EB), Slependen (AU); Asker (CFL). Østfold: Sem: Narverød (CFL). Aust-Agder (AAY): Risør (Th); Nes Verk (SS). Vest-Agder (UAY): Vennesla: Vigeland (Haw).

**Doubtful record**: Tephroclystia interrata, Grønlien 1921: 78 (HO: Voss). No specimen from Voss has been found in any of the studied collections, and furthermore there is no record from western Norway.

**Distribution**: Along the southeast coast from Oslo to Vest-Agder. Vertical distribution: E. interrata is a lowland species, not found above 100 m. First capture: Oslo, Frogner 15 July 1845 (Es). Recorded food-plant: Acer campestris, flowers. Flight: 21 July–1 Sept.

**Eupithecia immundata** (Zeller, 1846) (Figs 1C, 1B)

**Norwegian records**: Eupithecia immundata; Schøyen 1885, 1893; Lampa 1885; Opheim 1951, 1972; Lühr 1973.


**Remarks**: Not found between 1849 and 1952.

**Eupithecia plumbeolata** (Haworth, 1809) (Figs 1D, 7B, 12A)

**Norwegian records**: Eupithecia plumbeolata; Schøyen 1882, 1883, 1893; Lampa 1885; Sprarre Schneider 1893; Strand 1901; Haanshus 1921; Opheim 1938, 1972; Werner 1940; Nielsen 1956; Lühr 1960; Berggren 1970. Tephroclystia pygmaeata; Strand 1902. Tephroclystia plumbeolata; Strand 1904; Grønlien 1921; Barca 1923.


**Not verified record**: The record of Hawkshaw (1919), UAY: Vennesla: Vigeland is probably correct. Besides, E. plumbeolata has been captured in 5 other localities in the same district.

**Distribution**: Generally distributed north to Nnv: Lødingen, except the outer coastal strip from Bergen to MRy: Skodje. North of the area of distribution: Fi: Alta. Vertical
Fig. 11. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia pulchellata*, B. *E. icterata*, C. *E. nanata*, D. *Gymnoscelis fumilata*, E. *E. tenuiata*, F. *E. pini*. 
Eupithecia pini (Retzius, 1783) (Figs 1E, 7E, IIF)

Norwegian records: Eupithecia togata; Sparre Schneider (1876a, 1878, 1882), Schoyen (1893).

Distribution:

Eupithecia pini; Pratense. Flight: 1 June–18 July.

Eupithecia bilunulata (Zetterstedt, 1839) (Figs IF, 13B)

Norwegian records: Eupithecia abietaria; Schoyen 1880, 1882, 1893; Lampa 1885; Werner 1917; Haanshus 1921. Tephroclystia abietaria; Barca 1910; Grønlien 1921. Eupithecia bilunulata; Bakke 1955; Lühr 1960; Feichtenberger 1965; Opheim 1972.

Localities: Østfold: Sarpsborg (EB); Jeløy (GN). Akershus: As (He); Nesodden: Spro (KH); Askor (KH, CFL); Bærum: Stabekk (Es), Sandvik (EB); Oslo: Slemdal (SS), Nordmarka (WMS), Tøyen (Si), Nordstrand (EB).

Heimark (He): Sør-Odal (WMS): Ringsaker: Furnesåsen (AB), Oppland (Os); Sør-Fron: Harpefoss (MO), On: V. Sildre: Vollen (NK); Vang (THS), Buskerud (Ba); Vikersund (SS); Røyken: Hovik (MO). Aust-Agder (AAy): Nes Verk (SS); Riser: Laget (NK); Tromøya (AB), Vest-Agder (UAy); Kristiansand (KB); Sogne (CFL).


Not verified records: Sparre Schneider (1876a), AK: Bekkenstein. Hawkshaw (1919), VAY: Vigel. Feichtenberger (1965): 110 (Ns: Mo i Rana and Selfors 18 June–13 July, forewing 9.5 to 11.5 mm).


Remarks: In Scandinavian literature there has previously been some confusion regarding the nomenclature of E. pini and E. bilunulata; for example, Aurivillius (1893) uses the name E. togata Hb. for E. pini, and E. abietaria Goeze for E. bilunulata Zett., respectively, and in older Norwegian literature up to the 1920s the same is the case regarding the last-mentioned species. Haanshus (1933) lists E. pini only as he probably refers to Prout (1915), who considers E. abietaria Goeze and E. togata Hb. as synonyms to E. pini Retz.

The ventral plate in E. pini differs from that of E. bilunulata, in having concave outer edges which converge strongly proximally. In E. bilunulata the edges run more parallel, slightly converging at the outer end.

E. bilunulata prefers Chermes galls according to Juul (1948), but seldom cones. On the other hand, Bakke (1955) obtained a large material of E. bilunulata from spruce cones. The Chermes galls he evidently did not pay any attention to.

Eupithecia linariata (Denis & Schiffermüller, 1775) (Figs 1G, 9A)
Eupithecia linariata
Schøyen 1883, 1893; Lampa 1885; Haanshus 1921; Werner 1940; Nielsen 1956; Luhr 1962; Berggren 1970; Opheim 1972. Tephroclystia lineariata; Barca 1923.

Localities: Østfold: Rauer (EB); Varteig (EB); Moss (EB), Jeløy (GN). Akershus: Nesodden; Spro (KH); Oslo; Rosenberg (Es).

Oppland (Os): Gjøvik (Aa); Sør-Fron; Harpefoss (WH). On: V. Slidre; Vollen ex larvae (NK); Lom; Fossberg, Røysheim (CFL).


Remarks: In Norway the larva has been found a few times in the flowers of Digitalis as mentioned above. Most of them were infested with parasites so only a few reached the adult state after hibernation. In one case a δ needed two winters for complete development, though the wings were reduced.

Eupithecia irriguata (Hübner, 1809–13) (Fig. 10C)


Eupithecia exiguata (Hubner, 1809–13) (Figs 2A, 10K)
Norwegian records: Eupithecia exiguata; Schøyen 1875, 1893; Sparre Schneider 1876a; Lampa 1885; Huitfeldt-Kaas 1892; Haanshus 1928; Berggren 1970; Opheim 1972. Tephroclystia exiguata; Barca 1910.

Localities: Østfold: Hvaler δ 28 May 1889 (WMS); Sarpsborg φ 12 June 1922 (EB); Jeløy δ 30 May, φ 3 June 1908 (EB); Refsnes 2 δ 20 June 1955 (GN). Akershus: Nesodden: Spro δ 26 May 1919, φ 20 June 1924 (KH); Oslo: Tøyen δ 1 June 1849, φ 2 June 1850 (Si), φ no date (ZMT). V. Aker δ 13 June 1885 (WMS); Nordstrandshøyden δ 17 June 1924 (EB); Ask φ 9 June 1964, δ 5 June 1965 (CFL). Hedmark (Hes): Sør-Odal φ 23 June 1885 (WMS). Oppland (OS): Lunner: Roa φ June 1939 (MO). Aust-Agder (AAy): Riser 1 specimen (Th). Vest-Agder (UAy): Kristiansand fairly common on light June–July (KB); Sogne δ 29 May 1966 (CFL). Horda-
Fig. 13. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia plumbeolata*, B. *E. bilunulata*, C. *E. valerianata*, D. *E. palustraria*. 

Distribution: A few scattered localities from Kirstiansand to Bardu along the west coast (58° to 68°40” N.L.). E. valerianata is a scarce species in the adult state because of heavy parasitism (Hoffmeyer 1966), and will probably be discovered in many more localities if collectors would also search for the larva. Vertical distribution: Only found in the lowland. First capture: NNV: Svolvær 27 July 1951 (MO). Food-plant: Valeriana officinalis. Flight: 22 June–27 July.

Eupithecia palustraria Doubleday, 1850 (Figs 2B, 13D)

Norwegian records: Eupithecia pygmaeata; Staudinger 1861; Sparre Schneider 1876a, 1888, 1893, 1895; Schøyen 1880, 1882, 1893; Lampa 1885. Eupithecia scriptaria; Schøyen 1885. Tephroclystia pygmaeata; Sparre Schneider 1921. Eupithecia palustraria; Opheim 1972; Lühr 1973.


Doubtful and erroneous records: Tephroclystia pygmaeata, Strand (1902), Os: Land, Odnes one ø in the ZMO collection (= E. plumbeolata (Haw.)). Eupithecia pygmaeata, Christie (1909), Hes: Vang ø June 1906, not present in any of the studied collections. Tephroclystia pygmaeata, Barca (1923), Ø: Sarpsborg 12 June 1922, no specimens present in Barca’s collection.


Eupithecia undata (Freyer, 1840) ssp. fennoscandica Knaben, 1949 (Figs 2C, 9H)


Locality: Finnmark (FI): Alta: Jotkajavre ø 9 July 1924 (EB).

Doubtful and erroneous records: Eupithecia scriptaria, Schøyen 1885, Nsi: Saltdal ø and ø 6 July 1881; originally described as E. pygmaeata (Hb.) (= E. palustraria Dbl.) by Schøyen (1882b), but he came later to the conclusion after having seen specimens of E. scriptaria (Hs.) (= E. undata (Frr.)) from Tyrol, that the Saltdal pair indeed were the latter species. By dissection of the pair (in copula) Knaben found that belonged to E. palustraria, Eupithecia scriptaria, Lampa (1885) refers to Schøyen (1885). Eupithecia undata, Haanshus (1921), Buskerud: Br: Hol ø 8 July 1912 in the ZMO collection (= Chloroclystis chloroleta Mab.). Eupithecia undata, Feichtenberger (1965), Nsi: Rana, Tver­ånes ø 18 June 1944, Selfors ø 24 June 1944, 150 m). I (MO) consider this determination very doubtful as the localities are far from the species’ northern area of distribution. Probably the specimens belong to E. palustraria Dbl. which Feichtenberger did not mention from Nordland.


Eupithecia venosata (Fabricius, 1787) (Figs 2D, 71, 14A)

Norwegian records: Eupithecia venosata; Wocke 1864; Sparre Schneider 1876a, 1888, 1893; Schøyen 1879, 1880, 1893; Lampa 1885; Chapman 1899; Strand 1899, 1900; Christie 1909; Haanshus 1921; Opheim 1950, 1972; Nielsen 1956; Lühr 1960; Berggren 1970; Mehl 1971. Tephroclystia venosata; Sparre Schneider 1903, 1914; Strand 1904; Gronlien 1921; Barca 1923.

Locality: Østfold: Moss (EB), Jeløy (GN). Akershus: Oslo: Rosenberg (Es), Tøyen (Si,
Fig. 14. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia venosata*, B. *E. actaeata*, C. *E. intricata*, D. *E. satyrata*. 

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*Eupithecia*
Norwegian records: Eupithecia actaeata; Eupithecia trisignaria; Eupithecia bergunensis; Tephroclystia oblongata; Barca 1910.

Localities: Østfold: Sarpsborg (EB); Rygge: Dilling (EB); Moss (EB); Jeløy (EB, GN).

Akershus: Nesodden: Spro (KH); As (He); Bærum: Sandvika (EB); Oslo: Tøyen (Si, WMS, NK), Tobiesens lokke (Es), Malmøya (Es), Oscarshall (Es), Kristiania (SS), Hegdehaugen (SS), V. Aker (SS), Slemdal (JF), Frogner (MO). Hedmark (HEs): Sør-Odal (WMS). Buskerud, Bo: Lier: S. Linnæus (NK).

E. bergunensis; Tephroclystia oblongata; Barca 1910.


**Eupithecia**


**Erroneous records:** *Tephroclystia trisignaria*, Grønlien (1921), Hoi: Voss 3 22 June 1916 (= *goosensiata* Mab.). *Eupithecia trisignaria*, Haanshus (1921), AK: Spro 3 3 Sept. 1915 (= *absinthiata* Cl.). Recorded food-plants: Different umbelliferous plants.

**Eupithecia intricata** (Zetterstedt, 1839) (Figs 2G, 7P, 8Ae, 14C)

**Norwegian records:** *Larentia intricata*; Zetterstedt 1839. *Eupithecia helveticaria*; Staudinger 1861; Wocke 1864; Sparre Schneider 1876a, 1893; Schoyen 1880, 1898; Lampa 1885; Strand 1900; Henrichsen 1907; Haanshus 1921; Lundetrœ 1938. *Tephroclystia helveticaria*; Strand 1904; Sparre Schneider 1913. *Eupithecia intricata*; Opheim 1950, 1972; Nielsen 1956; Liihr 1960; Feichtenberger 1956.

**Localities:** Østfold: Onsoy: Rauer (EB); Jeløy (GN). Akershus: Ås (He); Nesodden: Spro (KH); Høland: Bjerkelangen (MO); Oslo: Tøyen (ST). Abildø (ST), Nordstrandshøyden (EB), Maridalen (NK, CFL), Nordmarka (WMS); Bærum: Stelepan (AU); Asker (CFL). Hedmark (HEs): Sor-Odal (WMS). Oppland (Os): Ringebu (WMS). On: Vang: Helinstrand (NK); Ø. Slidre: Beito (NK, MO), Nord-Fron: Vinstra (MO); Vågå: Vågåmo (MO). Hindseter (CFL); Lom: Boberdalen (WMS), Fossberg (CFL); Dovre: Dombås (WMS). Buskerud (Bo): Modum (WMS); Lier: S. Linnes (NK). Østfold: Tjome (NK, MO). Telemark (TEy): Kragerø (UlI?), Fossing (AU). Aust-Agder (AAy): Risør (JH), Laget (NK), Tromøy (AB). Vest-Agder (UAy): Vennesla: Vigeland (Haw); Sogne (CFL); Kvinesdal: Gjømlastad (NK); Sire­osen (ES). UAI: Sirdal (ES). Rogaland (Ry): Sandnes: Gaulsholm (AN, Fu), Dale (AN). Ri: Forsand (NK); Suldal: Lægeden (Fu), Nesse­t (Fu). Nordland (HOy): Fjellberg: Eidsvik (MO), Halsnøy kloster (MO), Borgundøy (MO); Tynnes: Angulsoy (BoL); Austvoll: Naushellar (MO); Os: Nordstrøm (AN); Fana: Fjelllytvatn (NK), Grimsøy (NK), Minde (EB); Bergen: Kalfaret (MO), Stare­foss (NK), Knatten (NK); Osterøy: Kleppe (MO), Njåstad (MO), Øvre Boltnvatn (MO); Herdla (NK). HOI: Kinsarvik: Dønno (Lu). Sogn og Fjordane (SFy): Gaula: Sande (NK), Viken (NK). SFi: Vik: Høgeggji (NK); Aurdal: Fretheim (NK), Aurlandsvangen (NK), Nyheim (NK), Vassbygd (AF); Borgund: Eggum (NK), Kvamna (NK), Maristova (NK); Stryn: Videseter (MO). Møre og Romsdal (MRI): Sunndal: Vangshaugen (MO), Storfale (MO). Sor-Trøndelag (STy): Åfjord: By (MO). STI: Oppdal (MO), Kongsvoll (NK). Nord-Trøndelag (NTi): Inderøy (WMS); Snåsa (WMS). Nordland (NSy): Bindal: Lande (MO); Herøy: Dønna (ES); Meløy: Svart­sen (SR). NSI: Grane: Majavatn (MO); Nord­Rana: Svertisdal (SR); Fauske (CFL). NnO: Skjomen (MO), Elvegård (MO), Fjellbu (MO); Hamarøy (ES); Tysfjord (ES). Nnv: Ladingen (ES). Troms (TR): Malangen: Skjåvik (SR); Kvænangen (SS); Nordreisa: Javreaoi­vek (NK), Finnmark (Fi): Alta (Wck). FN: Kistrand (OW). FO: Sør-Varanger: Kirkenes (We), Svannvatn (We).
Eupithecia helveticaria, Strand (1901), NV: Langøy and Haalø. ?Eupithecia helveticaria, Sparre Schneider (1901), HO: Bergen 'common', Lie-Pettersen.
Teophroclystia helveticaria, Gmnlien (1921), HO: Voss, Vossevangen 1 specimen ultimo May 1909.
Not verified records: Larentia intricata, Zetterstedt (1839), NV: Ankenes, Bjerkvik; FN: Talvik.
Eupithecia helveticaria, Wocke (1864), HVs: Loten 3 May 1862.
Eupithecia intricata, Feichtenberger (1965), NSi: Nord-Rana, Tveranes and Mofjell (350 m) 4-12 June-2 July.

Remarks: Two from AAy: Laget are of a greater size than average, and have distinct discal mark. The genitalia were fairly close to those of E. expallidata Dbl., in regard to the shape of the bursa and the placement of its thorns. In a large specimen from HO: Voss, Haugevoen the distal mark is absent.
Individual variation is considerable, especially in regard to outer appearances and the shape of the female genitalia.

Eupithecia cauchiata (Duponchel, 1831) Norwegian record: Eupithecia cauchiata; Opheim (1972).
Locality: Akershus: Oslo: V. Aker 13 June 1885 (WMS).
Remarks by M.O.: Knaben did not leave any written notes about this species except what was registered in his genitalia journal. 3 from AAy: Segne 22 June 1960 (CF) and AK: Bærum, Slependen 16 June 1963 (AU).

E. cauchiata is quite similar to the common E. satyrata (Hb.), but differs superficially from the latter, in having a darker outer margin. Unfortunately I had no success in locating the Norwegian specimens of E. cauchiata in the collections of ZMO. I am afraid they might be destroyed. But as their genitalia are intact, we can get some idea of the correctness of Knaben's determination.

Three characters relating to bursa copulatrix I found fairly useful in separating the two species, viz., 1) the chitinized stripes, 2) row of thorns near ductus bursa and 3) extension of thorns dorsally. E. satyrata has usually many chitinized stripes, while E. cauchiata has very few. In two specimens of the former only few stripes were found, so some variation might be expected. In E. cauchiata we find many strong thorns near ductus bursa, while E. satyrata has fewer and weaker thorns. The dorsal thorns cover a greater area in E. cauchiata than they do in E. satyrata. In the former species the thorns are extended one half of the length of bursa (incl. ductus bursa), measured at the middle of bursa; in E. satyrata the extension is between 1/3 and 2/5.
The specimen from V. Aker is in good agreement with the characters relating to E. cauchiata. The specimen from Sogne has some chitinized stripes, the row of thorns consists of fewer and weaker pieces, and the dorsal extension of thorns is about 5/6 of the length of bursa + ductus. The specimen from Slependen has few chitinized stripes, but is otherwise similar to the Sogne specimen. We can consider the last two specimens as transitional forms between E. cauchiata and E. satyrata, but more related to the latter.

Of foreign material of E. cauchiata I have examined a from Schneeberg, Austria inf. (Wagner coll.) and a from Usedom, East Germany (Urbahn leg. Holst coll.).

Eupithecia satyrata (Hübner, 1809-13) (Figs 3A, 7L, 14D)
Norwegian records: Eupithecia satyrata; Staudinger 1861; Wocke 1864; Sparre Schneider 1876, 1876a, 1878, 1880, 1882, 1884, 1885, 1890, 1893, 1998, 1901; Schoyen 1879, 1880, 1882, 1883, 1893; Lampa 1885; Lie-Petterlsen 1897, 1898; Strand 1899, 1900, 1901; Henrichsen 1907; Christie 1909; Buxton 1914; Haanshus 1921; Lundetra 1938; Werner 1940;
Eupithecia


**Tephroclystia satyrata:** Strand 1902, 1904; Sparre Schneider 1907, 1914, 1921; Barca 1910; Hawkshaw 1919; Gnmlien 1921.

**Localities:** Østfold: Sarpsborg (EB); Onsey: Rauer (EB); Jeley (GN, AN, MO).

**Akershus:** As: Tirudmosan (SP); Frogn: Håøya (MO, CFL); Nesodden: Spro (KH); Linderud (Si).

**Oppegard:** Kolbotn (MO); Oslo: Kristiania (Si, Tøyen (Si), Ekeberg (Si), Rosenberg (Es), Linderud (Si), V. Aker (WMS), Sognsvann (NK), Mari dalen (NK), Nordmarka (WMS), Appelsin haugen (MO), Bogstad (JR, CFL); Bærum: Lysaker (WMS), Stabekk (AU), Ask (CFL), Nesøya (NK), Gulhella (JH, MO); Ullensaker (WMS).

**Hurdal:** Tømte (AB); Hedmark (HEs): Solør (WMS);

**Henn:** Kvikne: Sverja (MO).

**Oppland:** Lunner: Roa (MO), Ytre (MO), Mylla (MO), S. Land: Odnes (MO), Sulandmarka (WMS), Houseby (MO), Upper Aust-Aurdal: Heidal (MO), Ytre (MO), Sandal (MO), Nisahus: Ornes (ES), Nord-Aurdal: Fagernes (MO), Lillehammer (WMS), Ringebu (MO). On: V. Slidre: Høyheim (NK), Grønsevann (NK), Ø. Slidre: Beito (NK, MO), Nord-Fron: Vinstra (MO), Øvre (MO), Mylla (MO), S. Land: Odnes (ES), Nord-Aurdal: Fagernes (MO), Lillehammer (WMS), Ringebu (MO).

**Telemark:** Porsgrunn (ES), Nome: Ulefoss (ES); Kragem (WMS).

**Teipi:** Finnsund (MO).

**Aust-Agder:** Riser: Laget (NK), Tromøy: Ballesvik (CFL), Østfold (HOi): Rødal (CFL), Horda (Lu); Ullensvang (NG); Kinsarvik: Djønno (Lu); Voss (EB), Voasveggen (NG), Haugamoen (NG), Sogn og Fjordane (SFy): Livik (ES), Gular: Viken (NK). Østfold (NK), SFi: Vik: Högii (NK); Aurland: Fretheim (NK); Lærdal: Stuvane (MO); Borgund: Eggom (NK), Hegg (NK), Galdestolen (NK); Luster: Turtagørøe (SS, SR), Skjolden (NK), Stryn: Hammerstadli (NK), Videseter (MO).

**More og Romsdal (MY):** Ørsta (JW), Ålesund (JR), Ørskog (WMS), MI: Rauma: Romsdal (WMS), Trolldindene (MO), Flatmark (MO), Sunndal: Jenstadlia (MO), Mid dagshjellen (MO), Gikling (MO), Inderdalen (MO), Sunndal: Kvanne (RM), Sør-Trøndelag (NTy): Bjugn: Søtter (MO), Melhus: Bønn (NK), Orkland: Svatn (RD), Nord-Trøndelag (NTy): Namsos: Alhusvatt (SR).

**Inderøy (WMS), Beittsdal (WMS), Steinjer (WMS), Snåsa (WMS), Gron: Fiskum (CFL), Sørlid: Ueland (MO), Lennervann (MO), Gupsiggen (MO), Nordli: Gasterfjell (MO), Finhusfjorden (MO), Nordland (Nli): Bindal: Todsalen (MO), Søna: Sandvåg (SR), Bodø: Överva (MO), Mejvatn (MO), Holmvassdalen (MO), Fjellstuen (MO), Østmark (MO), Skjøne (MO), Beittsdal (WMS), Beittsdalen (WMS), Oppland (Os): Unnar: Roa (MO), Mylla (MO), S. Land: Odnes (MO), Nord-Aurdal: Fagernes (MO), Lillehammer (WMS), Ringebu (MO). On: V. Slidre: Høyheim (NK), Grønsevann (NK), Ø. Slidre: Beito (NK, MO), Nord-Fron: Vinstra (MO), Øvre (MO), Mylla (MO), S. Land: Odnes (ES), Nord-Aurdal: Fagernes (MO), Lillehammer (WMS), Ringebu (MO).

**Saltal: Storjord (MS, JR), Junkerdalssaura (SS), Svolvaerg (CFL), Nyede: Tysfjord (ES), Skjomen: Melne elv (MO), Elvegår (MO), Oldsholmen (MO), Fjellbu (MO), Norddalen (MO), Narvik (MO), Kvitsand (MO), Sør-Trøndelag: Bonnassel (CFL).**

**Not verified records:** The record of Sparre Schneider (1876) refers to HOi: Kvaam, Tangeraas, and that of (1878) to Be: Drammen, Gilsken. Schøyen (1879), On: Sel, Laurgd, Sparre Schneider (1880), Nsi: Berann, Tollå. Schøyen (1882), Nsy: Bode (Schilde), and Nsi: Saltdal, Rognan (Schilde). Sparre

Doubtful or erroneous records: Eupithecia satyrata, Strand. Doubtful or erroneous records: Eupithecia satyrata, Schøyen (1881), Fø: Kirkenes. Eupithecia tripunctaria, Schneider (1882), AAy: Tvedestrand, Nes


Remarks: Variation is considerable, many forms have been named (Hoffmeyer 1966, Juul 1948).

Eupithecia tripunctaria Herrich-Schäffer, 1852 (Figs 3B, 8F, 9B)


Remarks: E. absinthiata and the next species, E. goossensis, are very closely related. There are no reliable characters by which to separate the two species. Juul's (1946) claim that the number of hairs on papillae should distinguish the two species, could not be sustained by the examination of a great amount of material.

Eupithecia absinhtiata (Clerck, 1759) (Figs 3C, 70, 8B, 15A)

Norwegian records: Eupithecia absinhtiata; Sparre Schneider 1881, 1893, 1901; Schøyen 1882, 1893; Lampa 1885; Huifeldt-Kaa 1892; Haanshus 1921; Opheim 1938, 1950, 1972; Nielsen 1956; Lühr 1960; Feichtenberger 1965. Tephroclystia absinhtiata; Barca 1910; Hawkshaw 1919, Grønlien 1921.

Localities: Østfold: Sarpsborg (Grimsaard, EB); Moss (EB); Jeley (EB, GN). Akershus: Ås (He); Frogn: Asponn (PS); Nesodden: Spro (KH); Oslo: Wratz løkke (Es), Tobisens løkke (Es), Rosenberg (Es), Frogner (Es), Tøyen (Si, WMS), Bygdøy (Munster); Åske (JH, CFL). Hedmark, HES: Kvikne: Sverja (MO). Oppland (On): Lom (CFL). ?Buskerud (Bo): Ådal: Maribo (JR) ex larvae. Østfold: Sem: Skallevoll (OK), Jarlsberg hovedgård (OK), Narverød (CFL); Tjøme: Ormelet (KH). Telemark (TEi): Seljord: Flatdal (MO). Aust-Agder (AAy): Risør (Th), Laget (NK); Tromsøya (MO); Grimstad (CFL). Østfold (OAy): Vennesla: Vigeland (Haw); Segne (CFL); Kvinesdal: Gjemestad (NK, Ro). Rogaland (Ry): Klepp: Vig (AN); Sandnes (AN), Gausel (AN(Fu). Ri: Sauda (FJ). Hordaland (HOy): Fjelberg: Søbø (MO); Os: Nordstrøna (AN); Bergen: Munkebotn (SS), Fløyen (EB). HOi: Voss (NG). Sogn og Fjordane (SFi): Aurland (NK). More og Romsdal (MRi): Sunndal: Jenstad (MO). Østfold (STi): Østfold (NTi): Snåsa (SS); Grong (WMS); Nordli (MO). Nordland (Nsy): Bindal: Tosebotn (MO). Nsi: Grane: Klovemoen (ES); Hattfjelldal (ES); Pantdalslien (ES); Saltdal (WMS); eBiarn: Tolla (SS). Ñno: Tysfjord (ES). Nnv: Svolvær (MO). Troms (TRy): Senja (NK). TRi: Bardu: Altevatn (CFL); Målselv: Dividal (CFL); Balsfjord: Skjåvik (SR); Nordreisa: Sappen (NK).
Fig. 15. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia absinthisata*, B. *E. vulgata*, C. *E. castigata*, D. *E. indigata*.
Eupithecia goossensiata (Mabille 1869) (Fig. 3D)
Norwegian records: Eupithecia goossensiata; Opheim (1972).
Localities: Akershus: Nesodden; Spro (KH).
Aust-Agder (AAy): Risør; Laget (NK).
Nordland (HoI): Voss (as 'T. trisignaria' NG).
Nordland (Ni): Hattfjelldal (ES).
Remarks: The specimens of E. goossensiata are all determined from outer appearances only. Knaben was not convinced that E. goossensiata was a good species.

Eupithecia assimilata Doubleday, 1856 (Figs 3E, 7Q, 8Ad, 12A)
Localities: Østfold: Jeløy (EB); Akershus: Nesodden; Spro (KH); Bærum: Slependen (AU).
Hedmark (HEs): Sør-Odal (WMS).
Oppland (Os): Ringebu (EB). On: Lom (CFL).
Telemark (TEi): Kviteseid: Vrådal (JR). Øst-Agder (UAy): Kristiansand (WMS, KB); Segne (CFL); Kvinesdal: Gjemlestad (NK).
Rogaland (Ry): Ogna (WMS); Sandnes: Gausel (AN, Fu); Klepp: Øksnevad (AN). Hordaland (HOy): Os: Lekven (EB), Hagavik (NK). HoI: Voss (NG, Torpe).
Nord-Trøndelag (NTi): Grong (WMS).
Doubtful and erroneous records: Eupithecia minulata; Sparre Schneider (1890), AK: Oslo; St. Hanshaugen, a few specimens.
Remarks: E. assimilata is not easy to distinguish from E. absinthiata superficially, but the male can be separated by its ventral plate. Eupithecia vulgata (Haworth, 1809) (Figs 3F, 7K, 8Ab, 15B)
Norwegian records: Eupithecia vulgata; Sparre Schneider 1876a, 1890, 1901. Schøyen 1879, 1893; Lampa 1885; Haanshus 1921; Opheim 1933, 1970; Lundetøe 1935; Werner 1940; Nielsen 1956; Lühr 1960; Berggren 1970; Mehl 1971. Tephroclystia vulgata; Strand 1904; Barca 1910; Grenli 1921.
Localities: Østfold: Hvaler (ES); Ønsøy: Rauier (EB); Sarpsborg (EB); Moss (EB); Jeløy (EB, GN, MO). Akershus: As (He); Frogn: Haøy (CFL); Asponn (PS); Nesodden: Spro (KH); Oslo: Rosenberg (Es), Vettkollen (MO); Bærum: Sandvika (EB), Slependen (AU), Kjåglidalen (CFL); Askar (CFL), Gullhella (MO), Eidsvoll (WMS). Hedmark (HeS): Sør-Ødal (WMS); Leten (JJW); Vang: Hjellum (WC); Hamar (CFL). Oppland (Os): S. Land: Odnes (ES); Lillemarker (WMS), Nansenskolen (AN); Ringebu (EB). On: V. Slidre: Einang (NK); Vågå: Hindseter (CFL); Lom: Fossberg (CFL), Solell (CFL); Dovre: Dombås (WMS), Buskerud (Bo); Røyken: Håvik (MO); Kongserg: Raje (MO), Skrim (MO). Bu: Gol (NK). Østfold: Holmestrand (NK); Tjøme: Rød (MO), Brunlæs: Nevungav (EB). Telemark (TEy): Skien (WMS); Kragere (ACU). Øst-Agder (AAy): Risør (Th), Laget (NK). Øst-Agder (UAy): Kristiansand (KB); Venesla: Vigel (as 'Chloroclystis rectungulata'). Hordaland (HOy): Fjellberg; Halsnøy kloster (MO); Tysnes: Onarheim (MO), iFjord (MO); Vennesla: Vigel (as 'Chloroclystis rectungulata'). Østfold: Voss (NG); Segne (CFL); Kvinesdal: Gjerdal (NK).
Rogaland (Ry): Ogna (WMS); Sandnes: Gausel (AN, Fu); Klepp: Øksnevad (AN). Hordaland (HOy): Os: Lekven (EB), Hagavik (NK). HoI: Voss (NG, Torpe).
Nord-Trøndelag (NTi): Grong (WMS).
Doubtful and erroneous records: Eupithecia minulata; Sparre Schneider (1890), AK: Oslo; St. Hanshaugen, a few specimens.
Eupithecia castigata (Hübner, 1809-13) (Figs 3H, 7C, 8D, 13B)

Norwegian records: Eupithecia castigata; Knaben 1879; Schøyen 1879, 1883, 1893; Lampa 1885; Strand 1899, 1900; Haanshus 1921; Lundete 1938; Werner 1940; Opheim 1950, 1959, 1972; Nielsen 1956; Lühr 1960; Berggren 1970. Localities: Østfold: Nesodden: Eupithecia castigata; Knaben (1944), NTi: Snåsa 9 Oct 1884 (WMS). This locality which is the northernmost in Norway does not figure in Knaben’s list.


Remarks: The species has been mixed up with other species like E. castigata, E. intricata and E. immundata.

The dark form atraria H.S. was found at a few localities in SFy and SFi: Nordfjord, and at MRi: Sunndal.

Not verified record: Løken (1966), SFi: Flåm (Peltonen).

Eupithecia denotata (Hübner, 1809-13) (Figs 3G, 8E, 12B)

Eupithecia castigata (Linnaeus, 1758) (Figs 4B, 7T, 12C)

Localities: Østfold: Sarpsborg (EB); Moss (EB); Jeløy (GN). Akershus: Østfold: Rauer (EB); Moss (EB); Vansjø: Dalen (EB); Jeløy: Rosnes (EB), Orkerød (EB), Refsnes (GN, AN).
Akershus: Østfold: Rauer (EB); Moss (EB); Vansjø: Dalen (EB); Jeløy: Rosnes (EB), Orkerød (EB), Refsnes (GN, AN). Akershus: Østfold: Rauer (EB); Moss (EB); Vansjø: Dalen (EB); Jeløy: Rosnes (EB), Orkerød (EB), Refsnes (GN, AN).
**Eupithecia subnotata** (Hubner, 1822) (Figs 4D, 10F)

**Norwegian records:** Eupithecia subnotata; Schøyen 1882, 1893; Lampa 1885; Haanshus 1921; Opheim 1943, 1972. **Tephroclystia substituta**; Barca 1922. **Tephroclystia subnotata**; Barca 1922; Haanshus 1923. **Tephroclystia sinuosaria**; Eversmann, 1848 (Figs 4C, 10F)


**Distribution:** Eastern part of the Oslofjord district, and then inland to HEs: Sør-Ødal (60°14' N.L.). **Vertical distribution:** Lowland species, below 150 m. **First capture:** HEs: Sør-Ødal 4 June 1882 (WMS). **Recorded food-plants:** Umbelliferae, Compositae. **Flight:** 4-25 June.

**Eupithecia subnotata** (Hübner, 1809, 13) (Figs 4D, 10G)

**Norwegian records:** Eupithecia subnotata; Schøyen 1885, 1893; Lampa 1885; Haanshus 1921; Opheim 1943, 1972. **Tephroclystia subnotata**; Barca 1922; Haanshus 1923. **Tephroclystia sinuosaria**; Eversmann, 1848 (Figs 4C, 10F)


**Distribution:** Eastern part of the Oslofjord district, and then inland to HEs: Sør-Ødal (60°14' N.L.). **Vertical distribution:** Lowland species, below 150 m. **First capture:** HEs: Sør-Ødal 4 June 1882 (WMS). **Recorded food-plants:** Umbelliferae, Compositae. **Flight:** 4-25 June.

**Eupithecia subnotata** (Hübner, 1809, 13) (Figs 4D, 10G)

**Norwegian records:** Eupithecia subnotata; Schøyen 1885, 1893; Lampa 1885; Haanshus 1921; Opheim 1943, 1972. **Tephroclystia subnotata**; Barca 1922; Haanshus 1923. **Tephroclystia sinuosaria**; Eversmann, 1848 (Figs 4C, 10F)


**Distribution:** Eastern part of the Oslofjord district, and then inland to HEs: Sør-Ødal (60°14' N.L.). **Vertical distribution:** Lowland species, below 150 m. **First capture:** HEs: Sør-Ødal 4 June 1882 (WMS). **Recorded food-plants:** Umbelliferae, Compositae. **Flight:** 4-25 June.

Not verified records: Grønløien (1921): HOi: Voss one specimen June 1910.

Doubtful and erroneous records: Eupithecia indicata, Schayen 1880, Nsi: Saltdal: Sundby and Storjord several specimens primo June 1879 (= E. virgaureata altenaria Stgr.). Schayen (1882), Nsi: Saltdal 1881. Only one δ correctly determined, all the others are E. virgaureata altenaria Stgr. Record from HES: Sør-Odal is correct. Strand (1900), Nsi: Grane, Klovimoen a couple of specimens 1899. Not present in the museum collections. Strand (1901), Nno: Tysfjord 1900. Doubtful record. ?Tephroclystia indicata, Strand (1902), Os: Odnes, specimens not present in the museum collections.

Distribution: Scattered localities from 58° to 62° N.L. In northern Norway only one locality at 67° N.L. Vertical distribution: From sea level to 500 m (On: Lom). First capture: MRi: Geiranger 9 medio July 1880 (WMS). Recorded food-plants: Pimpinella and also other Umbelliferae, and Compositae.


Eupithecia gelidata Möschler, 1860 (Figs 4H, 7J, 16A)

Norwegian records: Eupithecia hyperboreata; Staudinger1861; Wocke 1864; Sparre Schneider 1876a, 1881, 1883, 1889, 1893, 1895a; Schøyen 1879, 1880, 1881, 1883, 1893; Sandberg 1883, 1885; Lampa 1885; Strand 1900, 1901; Werner 1940; Opheim 1950. Tephroclystia hyperboreata; Strand 1902; Sparre Schneider 1921. Eupithecia gelidata hyperboreata; Feichtenberger 1965, Opheim 1972.

Fig. 16. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia gelidata*, B. *E. virgaureata*, C. *E. sobrinata*, D. *Chloroclystis chloerata*.
Polmak: Aleknjarg (SS); Sør-Varanger: Neiden (CFL), Strand (SS, We), Kirkenes, Svanvik, Svanvatn, Melkefoss, Mennika and Jacobsev (We), Elvenes (OK), Vaggetem (CFL).

Doubtful and erroneous records: Eupithecia hyperboreata, Schøyen (1892), and Tephroclystia hyperboreata, Sparre Schneider (1907), Nsi: Saltidal. There are no specimens from this locality in the Norwegian Zoological Museums. ?Eupithecia hyperboreata, Strand (1899), Bv: = E. denotata (Hb.). Eupithecia gelidata, Lühr (1973), VE: Narverød 24 Aug. 1968.


Distribution: From 60° to 70° N. L. In western Norway mostly in inner districts, at 63°30′ N.L. it reaches the sea. Not found in Nord-Trøndelag and no reliable records between about 66° and 68° N.L. It is only 30 km. First capture: Oslo: Rosenberg 6 July 1848 (Es). Recorded food-plant: Calluna vulgaris. Flight: 5 May–8 Aug.

Eupithecia innotata (Hufnagel, 1767) (Figs 5B, 10H)


Eupithecia virgaureata Doubleday, 1861

ssp. alternaria Staudinger, 1861 (Figs 5C, 16B)

Norwegian records: Eupithecia nanata; Staudinger 1861; Sparre Schneider 1876a, 1893, 1895a; Schøyen 1880, 1895; Lamp 1885. Eupithecia indigata (part.); Schøyen 1882. Eupithecia indigata; Strand 1900, 1902. Tephroclystia lariciata (part.); Hawkshaw


Distribution: Scarce in South Norway between 58° and 70°30” N.L. Fairly common in North Norway between 65°30” and 70° N.L. Vertical distribution: From sea level to 400 m in South Norway, lowland species in the north. First capture: Fi: Alta 1 July 1860 (Stgr). Recorded food-plants: Sparre Schneider (1897) was sceptical about Solidago and Senecio as food-plants for E. v. alternaria, as none of these were found near the locality. Lhomme (1923–35) mentions quite a few food-plants for E. v. virgaureata. Among them Lysimachia and Cirsium might be considered as food-plants for E. v. alternaria. Flight: 2 June–12 July.

Remarks: Everyone of the examined specimens belonged to ssp. alternaria. Markings on the wings are more indistinct than found in the Central Europeans, with a tendency to become obsolete. In Scandinavia E. v. virgaureata has only been found in the south-eastern part of Sweden: Småland, Uland and Gotland. The southern limit of distribution of E. v. alternaria goes from Dalecarlia to Angermanland (Nordström 1943, 1953).

Eupithecia dodoneata Guenee, 1857 (Figs 5D, 9E)


Eupithecia sobrinata (Hübner, 1814–17) (Figs 5E, 7F, 8Aa, c, 16C)

Norwegian records: Eupithecia sobrinata; Staudinger 1861; Sparre Schneider 1876a, 1893, 1901; Scheyen 1880, 1893; Lampa 1885; Strand 1901; Haanshus 1921; Lundetrae 1938; Nielsen 1956; Opheim 1959, 1972; Lühr 1960; Feichtenberger 1965; Berggren 1970; Mehl 1971. Tephroclystia sobrinata; Strand 1902; Sparre Schneider 1904; Barca 1910; Hawkshaw 1919; Grønlien 1921.

Localities: Østfold: Sarpsborg (EB): Onsøy: Rauer (CFL); Moss (EB); Jeløy (EB, Gn). Akershus: Nesodden: Spro (KH); Oppegård: S. Oppegård (NK); Oslo (FJ): Bygdøy (JR, Mu), Nordstrandshøjden (EB), Tøyen (WMS, NK); Bærum: Sandvika (EB), Slependen (AU); Askvoll (CFL). Hedmark (HEs): Sør-Odal (WMS); Ringsaker: Helgøya (Es). Oppland (Os): Lunner: Roa (MO); Sør-Aurdal: aogn (KH, CFL); Nord-Aurdal: Aurdal (MO); Gausdal: Skeikampen (Rui). On: Ø. Siddle: Beito (NK, MO); Vang (THS); Vågå: Bukkehaug (Hackman); Lom: Beverdalen (WMS), Fossberg (KN, CFL); Skjåk: Jœingsli (CFL). Buskerud (Ba): Modum (WMS). Bu:
Al (ES). Vestfold: Sem (CFL). Telemark (Tei): Kviteseid (MO), Aust-Agder (AAy): Risør (Th), Laget (NK); Amli: Nelaug (MO), AAi: Bygland: Langerak (NK), Lenggjei (NK); Valle (NK); Bykle (NK). Uest-Agder (UAy): Kristiansand (KB); Vennesla: Vige­land (Haw); Sogn (CFL); Kvinesdal: Gjem­lestad (NK, Ro). UAI: Fjotland: Njarvastad (NK), Åseral (HG). Rogaland (Ry): Bjerk­reim (AN), Malmin (AN), Vaule (AN); Klepp: Veg (AN), Reive (FK); Sandnes (AN), Bråstein (AN), Figgjo (AN), Forus (AN), Gaul (AN), Dale (Fu), Hole (FJ); Finn­øy: Hilde (FJ); Imsland: Fjotland (FK), Eidsvagnes (NK); Borgund: Vindhella (NK); Luster: Hodnadn sr. (NK), SO. Klepp: Vig (AN), Reve (FJ); Sandnes (AN), Risa (Th), Laget (NK); Amli: Nelaug (MO).


Remarks: The species also occurs in North America as ssp. luteata Packar, 1867. Females from Nova Scotia (leg. A. Moe) in the Oslo Museum are identical with those from Norway in regard to the genitalia. Krogerus (1954) came to the same conclusion concerning specimens from Newfoundland and those from Finland.

Eupithecia tantillaria (Boisduval, 1840) (Figs 5G, 7D, 12D)

ssp. piceata Prout, 1914

Norwegian records: Eupithecia pusillata; Sparre Schneider 1876a, 1878; Schøven 1879, 1893; Lampa 1885; Strand 1900, 1901; Haanhus 1921. Tephroclystia pusillata; Strand 1902, 1904; Barca 1910; Hawkshaw 1919. Eupithecia tantillaria; Mehl 1971; Lühr 1973.
Eupithecia tantillaria piceata; Opheim 1972. 
Localities: Østfold: Hvaler (WMS, ES); Onsøy: Rauer (EB); Sarpsborg (EB); Jeløy (EB, GN, AN, MO). Akerhus: As (He); Frogn: Håøy (MO); Oppegård (WMS); Nesodden: Spro (KH); Oslo: Kristiania (ES), Tøyen (WMS), Ryenberg (Si), Grefsen (WMS), V. Aker (WMS), Bygdøy (ES), Skøyen (Si), Berg (NK), Nordmarka (WMS). Appelsinhausten (MO); Bærum: Lysaker (WMS, JR), Sandvika (EB), Haslum (MO), Østøya (NK), Slependen (AU), Kolsås (MO), Bjørnum ság (NK), Kjágdal (CFL); Asker (MO, CFL, TE); Nittedal: Movatn (MO); Ullensaker (WMS). Hedmark (HEs): Sør-Odal (WMS); Vang: Hjellum (WC). Oppland (Os): Lillehammer. Moss: Klovimoen (JR). Localities: Østfold: Frogn: Lillehammer (JR); Lysaker (EB), Sandvika (EB), Oslo: Hvaler 9 U 17 May-7 June 1902 (= E. indigata Hb.). Barca (1910): 19 (Ø: Moss several specimens June 1908). 

Eupithecia lanceata (Hübner, 1826) (Figs 6A, 7N, 101)
Norwegian records: Eupithecia lanceata; Schøyen 1893; Henrichsen 1907; Opheim 1972. Teproclystia lanceata; Strand 1902; Barca 1910, 1923.
Localities: Østfold: Sarpsborg (EB); Rygge: Larkollen (ES); Jeløy (GN, MO). Akerhus: As (He); Oppegård (NK); Oslo: Nordstrand (EB), Ekeberg (WMS), V. Aker (WMS), Holmenkollen (JR), Bygdøy (JR); Barum: Lysaker (JR), Sandvika (EB); Asker (CFL), Nesøy (JR). Hedmark (HEs): Sør-Odal (WMS). Oppland (Os): Gjovik (AA); Buskerud (Bo); Humu: Filtvedt (ES). By: Torpo (CFL), Telemark (TEi): Rjukan (CFL). Aust-Agder (AAy): Riser: Laget (NK). 
Doubtful and erroneous records: Eupithecia lanceata, Sparre Schneider (1876a), and Lampa (1885), Oslo: Tøyen (Si). Teproclystia lanceata, Grønlien (1921), HO: Voss 25 May 1910. Only two specimens of E. lanceata (Hb.) were present in Grønlien's collection, both without locality label. There are no new records from western Norway? Eupithecia lanceata, Werner (1940), (Møre og Roms-
78 N. Knaben
dal). Probably due to a printing error in the Haanshus' list (1933).

GYMNOSCELIS Mabille, 1868
Gymnoscelis pumilata (Hübner, 1809–13) (Figs 6B, 7H, 9Ac, 11D)
Norwegian records: Eupithecia pumilata; Schøyen 1883, 1893; Lampa 1885; Strand 1901; Haanshus 1921. Tephroclystia pumilata; Strand 1902; Barca 1910; Grønlien 1921. Gymnoscelis pumilata; Opheim 1938, 1972; Lundetnæs 1938; Werner 1940; Nielsen 1956; Berggren 1970.
Localities: Østfold: Vise (Ih); Hvaler (WMS); Halden (EB); Onsey (ES); Rygge: Larkollen (ES); Sarpsborg (EB); Moss (EB); Jeley (EB, GN, AN). Akershus: Nesodden: Spro (KH); Oslo: Teyen (Si). Oppland (On): Ø Slidre: Beito (NK); Vågå: Vågåmo (MO, AN); Lom (CFL). Buskerud (Bo): Hol (KH). Øst-Agder (UAy): Sogne (MO). Nordland (NS): Saltdal; Storjord (SS). Nø: Tysfjord (ES).
Remarks: The first 3 Chloroclystis Hb. species have to a large degree been confused with each other. Only misidentification mentioned in the literature will be noted specially here.

CHLOROCLYSTIS Hübner, 1825
Chloroclystis chloërata (Mabille, 1870) (Figs 6C, 16D)
Norwegian records: Eupithecia rectangulata ab. cydoniata; Strand 1901. Chloroclystis chloërata v. hadenata; Strand 1902, 1904. Chloroclystis rectangulata ab. cydoniata; Sparre Schneider 1907. Chloroclystis chloërata; Barca 1922, 1923; Opheim 1950, 1972; Lühr 1960; Feichtenberger 1965.
Remarks: The first 3 Chloroclystis Hb. species have to a large degree been confused with each other. Only misidentification mentioned in the literature will be noted specially here.

Chloroclystis rectangulata (Linnaeus, 1758) (Figs 6D, E, 12F)
Norwegian records: Eupithecia rectangulata; Sparre Schneider 1875, 1876a, 1901; Lampa 1885; Huitfeldt-Kaas 1892; Schøyen 1893; Strand 1901; Henrichsen 1907; Haanshus 1921. Chloroclystis rectangulata ab. nigro-sericeata; Strand 1904. Chloroclystis rectangulata; Barca 1910; Grønlien 1921; Opheim 1950, 1972; Nielsen 1956; Berggren 1970.
Localities: Østfold: Halden (Si); Sarpsborg (Gr, EB); Tune: Glomvik (Ih); Komm: Stovig (Ih); Utlesvang (JR, NG); Kinsarvik: Djenno (Ih); Granvin (NG). Sogn og Fjordane (SF): Sognsland (AM); Stryn (CFL); Møre og Romsdal (MR): Molde (WMS).

CHLOROCLYSTIS Hübner, 1825
Chloroclystis chloërata (Mabille, 1870) (Figs 6C, 16D)
Eupithecia 79

(Bø): Hurum: Hermansbråten (Ta); Lier (JF).


Vestfold: Sem (CFL).

Telemark (TEi): Kviteseid (MO), Vradal (JF).

Aust-Agder (AAy): Riser (Tb), Laget (NK); Nes Verk (SS).

Vest-Agder (VAy): Kristiansand (MO); Segne (CFL); Kvinesdal: Gjemlestad (Ro).

VAi: Sirdal (ES).

Rogaland (Ry): Sandnes: Gausel (AN), Li (Fu).

Hordaland (HOy): Bergen: Skjold (NK), Flesland (MO). HOi: Kinsarvik: Djenno (Lu); Voss (NG). Sogn og Fjordane (SFy): Førde (NK); Eid: Nordfjordeid (NK).

SFi: Gloppen: Olden (NK); Hornindal: Fanemel (NK).

Doubtful record: Chloroclystis debiliata, Feichtenberger (1965), Ns: Storjord worn δ 7 Aug. 1944 on Vaccinium.


Chloroclystis coronata (Hübner, 1809–13) (Figs 6G, 7H, 10)

Norwegian records: Chloroclystis coronata; Barca 1922; Haanshus 1924; Juul 1948. Dyserga coronata; Opheim 1972.


Species wrongly recorded from Norway

Eupithecia abbreviata Stephens, 1831

Norwegian records: Eupithecia abbreviata; Schøyen 1875; Haanshus 1930. Schøyen reported the species to occur commonly in HEs: Sør-Odal, but he deleted it in his list of 1893, so we might take it for granted that his original determination was erroneous. The record of Haanshus was based on δ from AK: Spro 25 March 1920. By dissection it was found to be an E. sobrinata.

Eupithecia veratraria Herrich-Schäffer, 1848 Norwegian records: Eupithecia veratraria; Sparre Schneider 1893; Schøyen 1893; Juul 1948. Remarks: The species was recorded from TRi: Målselvdalen by Sparre Schneider (1893), but deleted in his lepidopter-fauna from Målselv (1921). No E. veratraria specimen from this district could be found in the museum’s collections.
A ♀ from Fi: Alta, Romsdal caught 6 July 1924 (EB) (Fig 2H), was first supposed to be *E. veratraria*, but later determined as *E. intricata*. The specimen which was quite small had a bursa copulatrix with an aberrant distribution of thorns.

ACKNOWLEDGEMENTS

I am greatly indebted to Dr. Gunvor Knaben, University of Oslo, for all her help in bringing forth the vast material of notes and illustrations concerning the *Eupithecia* group, left by her late husband, Nils Knaben. Through the courtesy of Dr. Albert Lillehammer, Head Curator at the Zoological Museum, Oslo, I was allowed to study the collections of the *Eupithecia* group there. My thanks are due to Mr. Preben Holst, Harboer, Denmark, for the gift of a ♀ of *Eupithecia cauchia* (Du-ponchel) from Usedom, East Germany. Financial support from the Norwegian Research Council for Science and the Humanities (NAVF) is gratefully acknowledged.

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Short Communications

Further information on the distribution of *Anthocaris cardamines* L. (Lep.) in northern Norway

ERLING HAUGE

One male of *Anthocaris cardamines* L. (Lep.) was observed in July 1966 at Slettjord, Skjomen in Nordland county.

E. Hauge, Zoological Museum, University of Bergen, N-5014, Bergen-Univ, Norway.

Andersen (1975) reports the species *Anthocaris cardamines* L. from Dividalen, Troms. He also (citing Nordström (1955)) mentions a N to NW expansion of this species in Sweden during the last century, and presumes that the occurrence of the species in Dividalen is of quite recent origin. With this background I feel justified in giving information that may help to fill the gap between the last-mentioned locality and that previously most northern locality in Norway, Inderøya in N-Trøndelag. In early July 1966 I observed one male of this very easily recognizable species at Slettjord, Skjomen (Nnø: Ankenes). The specimen was sitting in the short grass besides a narrow road with birch forest intermingled with some pines on the upper side and cultivated land on the other side.

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*Lamprochernes nodosus* (Schrank 1761) (Pseudoscorpionida, Chernetidae) new to Norway

FINN ERIK KLAUSEN

*Lamprochernes nodosus* (Schrank) is recorded for the first time in Norway. A total of 26 specimens is reported from two localities in the southeastern parts of the country. All specimens were females attached to the appendages of houseflies.

Finn Erik Klausen, Zoological Museum, University of Bergen, N-5014 Bergen-Univ., Norway.

In a collection of pseudoscorpions kindly given to me by cand.real. Reidar Mehl, I have identified several specimens of *Lamprochernes nodosus* (Schrank). They come from two localities in the southeastern parts of Norway as follows: 5 specimens dated 19 Aug. 1973 from Ottestad south of Hamar, county of Hedmark. 21 specimens dated 19 Aug. 1975 from Skogsbygda, Togstad, county of Akershus.

All specimens from the two localities were females. The specimens from Ottestad were
all found clinging to the hairs of a housefly (*Musca domestica*): those from Skogsbygda were caught on several flies in a pigsty. This habit of letting themselves be transported by other animals, known as phoresy, is observed frequently in certain pseudoscorpion groups. *L. nodosus* is one of the species in which phoresy has been most often observed, particularly in the females (Beier 1948, 1963, Lohmander 1939).

According to Beier (1963) the species is widespread in Europe.

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Received 10 February 1977

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**Survival of Odonata larvae in a dried-up pond in western Norway**

BJØRN MIDTTUN

Four aeshnid larvae were found under a stone in a dried-up pond near Bergen, Norway. The pond had not contained any free water for at least one week.

**Bjørn Midttun, Zoological laboratory, N-5014 University of Bergen, Norway.**

Although most Odonata larvae are aquatic, a few such as *Megalagrion oahuense* inhabit humid terrestrial environments (Williams 1936). Reports on the ability of normally aquatic dragonfly larvae to survive for longer periods in air are rather sparse, and the following observation from the west coast of Norway, an area which usually receives abundant precipitation, deserves mention.

During the exceptionally dry spring of 1974, four aeshnid larvae were found under a stone on the bottom of a dried-up pond on 19 May at Lysekluster near Bergen, Norway. The pond is small, measuring 4.5 m across at its widest, and the maximum depth is approximately 20 cm. It is situated 60 m above sea level on rocky ground and receives practically all water by direct precipitation. The mud layer covering the bottom is only 10-12 cm deep at the most, and the vegetation is very sparse as a result of human activity in previous years. The larvae were all found in cracks in the dried mud under a stone. They were very sluggish, only moved slowly when touched, and their bodies were covered with a layer of slightly moist mud. They measured 10, 12, 17, and 21 mm respectively, but they were all too early instars to enable their identity to be firmly established (Gardner 1954). The pond had not contained any free water for at least one week, and probably not for two weeks or more. The larvae had chosen the moistest part of the ground and also one of the few places offering protection from direct sunlight.

Aeshnid larvae which experience low oxygen concentrations in the water, will move to the surface and in the case of final instar larvae, expose their thoracic spiracles, while young larvae will take in air through the cloaca (Wallengren 1914). The pre-emergence exposure of thoracic spiracles has been recorded in several aeshnid genera (Calvert 1929, Lucas 1930) and larvae of *Aeschna cyanea* and *Tanypterynx hageni* Selys have been kept alive for weeks in jars containing moist weed or mud (East 1900, Svhila 1959).

Fischer (1961) reports that larvae of *Goenagrion hastulatum* evidently survived one month of drought, whereas larvae of *Anax papuensis* (Burm.) Brauer were unable to withstand drought and died within a few days although the water-weed in the pond was damp (Tillyard 1916).
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New record of Apatania zonella Zett. (Trichoptera, Limnephilidae) from Svalbard

J. O. SOLEM, E. SENDSTAD, T. BERGVIK & A. HEGSTAD

One female of Apatania zonella Zett., was captured in a pitfall trap southwest of Innvikhøgda on Nordaustlandet, Svalbard in July 1976.

J. O. Solem, E. Sendstad, T. Bergvik & A. Hegstad, University of Trondheim, Royal Norwegian Society of Sciences and Letters, the Museum, N-7000 Trondheim, Norway.

In July 1976 an expedition from the Norwegian Polar Institute collected invertebrates for the Norwegian MAB group at Nordaustlandet, Svalbard. Among the species captured was a female of Apatania zonella taken in a pitfall trap, southwest of Innvikhøgda on Nordaustlandet, Svalbard. Collectors were Otha and Halvorsrud. The find was at the latitude between 80 and 81°N. Earlier records from Svalbard are those of Decamps & Voisin (1971) and Boheman (1866) from the bottom of Woodfjorden and Dirkses Bay, Wijdefjorden, respectively. All these three finds have been on the northern coast of the archipelago, but as Decamps & Voisin (1971) also mentioned, it is likely that the species occurs in other regions further south, where the climate is not as harsh as on the northern coast.

Two finds, Decamps & Voisin (1971) and the present, were females and only one individual each time. Boheman (1866) did not make any comments on the sex of the Trichoptera species he examined, as he did for other species.

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Bokanmeldelser


Boken omhandler sopp, insekter og pattedyr, som gjør skade i skogen, med omtrent halvparten av sidetallet på sopp og halvparten på dyr. Den er beregnet som lærrebok i skogskoler, og til andre undervisningsformål hvor den måtte passe. Ifølge forordet har man også tenkt på alle som er interesseret i skogen og dens biologi, og som vil gjøre seg kjent med grunnprinsippene for skade­gjørernes levevis og betydning.

Den delen av boken som omhandler insektene inneledes med et kapittel på tyve sider om dyr i skogen i sin alminnelighet. Dette omfatter bl. a. opplysninger om insektenes bygning, utvikling, systematikk, spredning og utbredelse, samt kje­misk og biologisk bekjempelse. Men når så mye skal sies på så lite plass, må det nødvendigvis bli så kortfattet at det nesten blir uinteressant lesning. Skal man først ta opp disse emnene, burde de fått en bredere plass.

De følgende kapitler, som omhandler forskjell­ige skadelige insekter og midd, går mer i detalj. Stoffet er tradisjonelt indrettet etter hvilke deler av planten skadedyrene angriper. Således får vi først et kapittel om skadedyr på unge planter, hvor seriel gransnutebilen får en grundig omtale.

Senere kapitler tar for seg insekter på nåler og blad, sugerende insekter på grenere og nåler, insekter som angriper knopper og skudd, insekter i kongler og fro, og insekter som lever under bårken og i veden. Barkbillene har imidlertid fått et kapittel for seg, som rimelig kan være for denne gruppen, som har så stor økonomisk betydning. Dette er et av de mer utførlege kapitler med gode strektesninger av barkbillenes gangsystem, og Paul Spessvittseffs kjente tegninger av billenes bakkropper.

Til slutt i boken fins et kapittel om virveldyr i skogen, i dette tilfelle begrenset til pattedyrene. De regnes ikke som spesielt viktige skadedyr, selv om forfatteren fremhever at både smågagere, hjort og elg kan ha stor økonomisk betydning. De enkelte artene får heller ingen bred omtale; kanin, hare, bever og ekorn må f. eks. klare seg med 7–8 linjer hver.

Boken har endel gode fargeplansjer, som viser soppangrep og skade-insekter. I teksten fins strek­tegnings og en rekke fotografier i sort og hvitt. Noen av fotografierne er lite tydelige, og det er vanskelig å se hva de egentlig forestiller.

Man sitter igjen med et inntrykk av at boken kan være en grei oppslagsbok, og at den inneholder mange nyttige opplysninger om skadegjørere i skogen. Noen stor utbredelse i Norge vil den allikevel neppe få, bl. a. fordi det fins tilsvarende bøker av norske forfattere. For mange vil sproget også by på problemer, da de fleste artene har forskjellige navn på svensk og norsk. Og en norsk leser vil kanskje savne noe om artenes forekomst på vår side av grensen – den grensen som setter et skille for innholder i bøker, men ikke for dy­renes utbredelse.

Lauritz Sømme


I denne boken har Sir Vincent B. Wigglesworth samlet en rekke forord og essay forfattet i år­enes løp. Mange av dem er høyest interessante både som historiske dokumenter og populærvitenskap av høy kvalitet.

Selv om han ikke regner seg selv som anvendt entomolog, har Wigglesworth hatt en rekke tilknytningspunkter til den anvendte entomologi. Han oppleved selv den store malaria-epidemien på Ceylon i 1934, og beskriver også hvilken betyd­ning denne sykdommen har i krig, særlig under den første verdenskrig.

Wigglesworth var meget opptatt av DDT, og allerede i 1945 skrev han en artikkel om «DDT og balansen i naturen». Han gir klart uttrykk for at DDT ikke bare vil drepe skadeinsekter, men også mange nyttige insekter. Han forutså at mange andre dyr også ville kunne skades ved uforværet bruk av DDT, og muligheten for at det kunne ut­vikles insekter som er resistente mot dette stoffet. Det er interessant at motrestillingene mot DDT kom frem på et så tidlig tidspunkt, selv om det gikk mange år før bruken av dette insektmidlet ble begrenset.

«Insekter fysiologi gjennom femti år» hadde Wigglesworth kalt sitt innledningsforedrag til den 12te Internasjonale entomologikongress i London i 1964. Her gir han en historisk oversikt over de viktigste oppdagelser innen området, og påpeker de viktigste bidrag insekt-fysiologi har gitt til biologien i sin helhet. Som historiker er Wigglesworth spesielt interessant i artikkelen om Sir John Lub­bock's bidrag til insekt-fysiologi. Lubbock var bankmann og politiker, men dertil interessert i alle naturvitenskaper, entomologi inkludert. Til tross for at han bare ofret en brøkdel av sin tid på dette området, gjorde han en betydelig innsats i sine studier av adferd hos bjer og maur. Som bokens tittel sier har Wigglesworth vært meget

Dette er en rent popularvitenskapelig artikkel, som på en fengseldige måte beskriver epidermiscellenes mange funksjoner. Som han sier til slutt, illustrerer disse cellene hvorledes tilsynelatende enkle strukturer bærer de mest komplekse idéer i seg.

Selv om noen av artikkene kan synes gamle og litt uaktuelle, er det i alt en fascinerende bok, med mange spennende og velutviklede kapitler. Direkte forteller den også meget om forfatterens selv og hans mange aktiviteter, som har gitt slike betydelige bidrag til studiet av insektenes fysiologi.


(iii) Beklagelig er det også at forfatterne er for mye opprett av sine egne arbeider. Det er, til tross for hva de selv sier, også andre som innen entomologien har gjort bra og relevante studier som burde være trukket inn. Derfor kan boka ikke sies å gi en god oversikt over stimulerende innen sektorforskningen. Den gir derimot en bra beskrivelse av noen slike studier. Så de positive sidene, som (bokstavelig talt) er i overvekt:

(i) Forfatterne påpeker nødvendigheten av samarbeid mellom bl. a. matematikere og tradisjonelle entomologer for å studere insektenes populasjons dynamikk. Dog mener de at hovedvekten må legges på biologien. Som riktig er, sier de at det er mest ønskelig om en og samme person behersker begge deler, noe som er mulig da den matematikken man trenger som populasjons-økologik ikke er særlig avansert. På en overbevisende måte viser de også nødvendigheten av at alle i et team deltar i de aller fleste forskningsfasene; f. eks. at matematikken også deltar i felt. Dermed advarer de mot den dessverre vanlige form for datainnsamling ut ført av feltbiologer som går til statistikkens spør: hva kan du finne ut av disse dataene?

(ii) Forfatterne er, som økologer, problemorienterte og ikke artsoorienterte. Derfor stiller de hele tida spørsmål som «hvilen dyregruppe kan mest effektivt brukes til å besvare spørsmålet?» Deres vare er insekter, og når det gjelder feltstudier, er nok dette riktig: insekter er vanlige og derfor oftest relativt lette og økonomisk mulig å gjennomføre. For det rimelige samplingprogram på.

(iii) Et vanlig argument brukt av forskere som utvikler simuleringmodeller, er at disse modellene direkte vil kunne brukes i skadedyrbekjempelse ved f. eks. å forutsi når og hvor utbrudd vil finne sted og hvor stort det da vil bli. Forfatterne av den foreliggende bok er meget reservert overfor slike påstander. De framhever imidlertid at simuleringmodeller vil kunne føre til bedre økologisk forståelse som i annen omgang vil kunne brukes i skadedyrbekjempelsen. Denne vurdering tror jeg er helt korrekt.

(iv) Det mest positive ved boka er at den er en god lærebok i hvordan simuleringmodeller konstrueres. Dette er den fordi også de versjonene av modellen som ble forkastet er rapportert og diskutert i boka. Og ved å se disse suksessive modellversjonene, lærer man økologi; dette fordi man, i det en versjon forkastes, lærer at ens tidligere antagelser var feilaktige. Oftest er det bare den gruppen som utvikler modellen som får denne forståelsen (som kommer i tillegg til den endelige analysen). Dette er forårsaket av at den vitenskapelige laglitteratur bare publiserer den mer fullstendige versjonen.

Som konklusjon vil jeg anbefale denne boka, lest sammen med annen litteratur, slik at motforstillinger mot en del av uttalelsene i boka kan dannes. Boka vil kunne egne seg som lærebok i et universitets- eller høgskole-kurs om simulering i populasjonsøkologi.

Nils Chr. Stenseth

A. Bakke. *Skadedyr i hus og hytte*, 224 pp. NKS forlaget, Oslo. Pris kr. 76.-.

I bolighus og andre bygninger, i næringsmiddel-fabrikkene og forretninger kan en rekke dyrerarter opptre som skadedyr eller sjenerende gjester. Flertallet av artene hører hjemme blant insektene og dyrkeroppdyrene, men også blant fugler og padder er det arter som vi ikke ønsker å ha for nært inn på livet. De fleste mennesker ser med skепsis på småkryp som dukker opp innenfor husvæggene, og vil ofte ha undersøkt om disse gjør skade på en eller annen måte, og hvordan det er mulig å bli kvitt dem. En del av disse «husdyrene» er etablerte arter og hører med til vår fauna, men mange kan ha fullt med importerte matvarer, tekstiler, gjester av tre o.a.

To medarbeidere ved Statens Skadedyrlaboratorium i Danmark, Henri Mourier og Ove Windig, er ansvarlig for de fleste fotografier.


I bolighus og andre bygninger, i næringsmiddel-fabrikkene og forretninger kan en rekke dyrerarter opptre som skadedyr eller sjenerende gjester. Flertallet av artene hører hjemme blant insektene og dyrkeroppdyrene, men også blant fugler og padder er det arter som vi ikke ønsker å ha for nært inn på livet. De fleste mennesker ser med skепsis på småkryp som dukker opp innenfor husvæggene, og vil ofte ha undersøkt om disse gjør skade på en eller annen måte, og hvordan det er mulig å bli kvitt dem. En del av disse «husdyrene» er etablerte arter og hører med til vår fauna, men mange kan ha fullt med importerte matvarer, tekstiler, gjester av tre o.a.
som angriper tekstiler, papir, lær, kunststoffer og trevirke. I disse gruppene opptrer de fleste av de mere alvorlige skadedyrne. Men murvegger, isoleringsmaterialer og metall blir også hjemsokt av forskjellige arter. Forøvrig omtales dyr som enten benytter hus som fast bosted, for overvintring eller for tilfeldig opphold. Mindre kapitler behandler ekskrementer, eksempler på fotspor, lukt og lyd. Fordommerne ser ut til å ha fått med det alt ve­sentligste av dyr som kan påtreffes i hus av for­skjellig slag.


Hvem kan så ha nytte av en slik bok? Tidligere er det utgitt flere håndbøker som behandler forskjellige dyregrupper og biotoper. Denne boka behandler en biotop som på en måte er spesiell, men samtidig svært aktuell for mange mennesker, og den må anses som et nyttig supplement til de øvrige zoologiske håndbøkene. Illustrasjonene er av en slik karakter at det skulle være mulig å identifisere en rekke av de artene som opptrer i vår umiddelbare nærhet uten å ha nærmere kjenn­skap til dem. Etter å ha besvart en rekke henven­delser fra privatpersoner og offentlige tjenestemenn om dyr som opptrer i hus, vil det være nær­liggende å anta at ansatte i næringsmiddelkontroll, i helsetråd, ved museer og i desinfeksjons­byråer kan ha stor nytte av denne boka. Prisen vil muligens være en årsak til at relativt få hus- og hytteeiere vil anskaffe den.

Per Knudsen
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