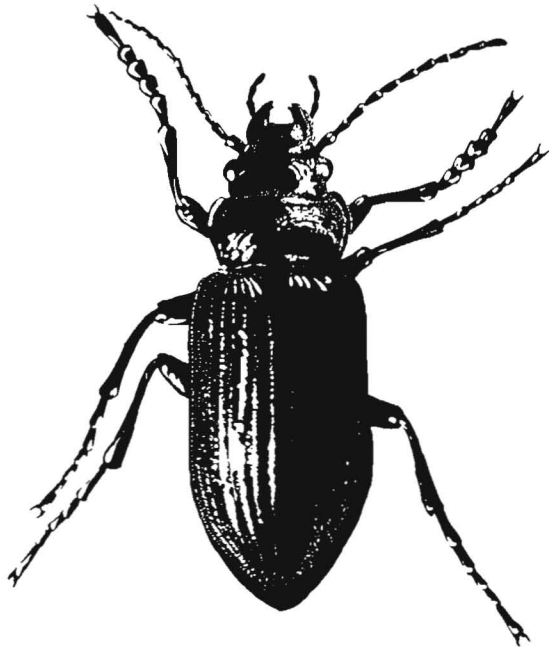


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NORSK ENTOMOLOGISK FORENING

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Cold storage tolerance and supercooling points of mummies of *Ephedrus cerasicola* Starý and *Aphidius colemani* Viereck (Hym. Aphidiidae)

TROND HOFVANG & ELINE BENESTAD HÅGVAR

Hofsvang, T. & Hågvar, E. B. 1977. Cold storage tolerance and supercooling points of mummies of *Ephedrus cerasicola* Starý and *Aphidius colemani* Viereck (Hym., Aphidiidae). *Norw. J. Ent.* 24, 1-6.

Ephedrus cerasicola Starý, parasitizing *Myzus persicae* Sulzer, is well suited for storage at $0 \pm 1^\circ\text{C}$ as 0-2 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 , $\text{SD} = 1.3$ and -25.4°C , $\text{SD} = 0.9$, respectively. Acclimation for 1 week at -5°C lowered the supercooling point in *E. cerasicola* mummies to -29.4°C , $\text{SD} = 1.9$.

Trond Hofsvang & Eline Benestad Hågvar, Agricultural University of Norway, Department of Zoology, P.O. Box 46, N-1432 Ås-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 testa-*

ceipes (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 pattern, 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 1975 b). 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.) Rchb.) 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 tempera-

tures 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 I. Percentage emergence at 21°C from mummies of *E.cerasicola*, taken from swedes and stored at low temperatures for different time periods. At each time period, n=50, except in series 1 where n=100.

Series	1	2	3	4	5
Acclimation	2 days at 4°C	2 days at 4°C	No accl.	No accl.	No accl.
Storage temp.	0°C	1°C	1°C	1°C	1°C
Age of mummies at storage (days)	0-1	0-1	0-1	1-2	4-5
Weeks stored					
1	90			82	82
2	79	60	76	82	80
3	64				
4	71	70	86	60	30
6	69				
8	46	48	42	40	0
10	31	46	34		
14	16	38	30		
18	3				
22	2				
no accl. or storage	62				

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 acclimation 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 II. Number of progeny produced at room temperature by *E. cerasicola* which had emerged at 21°C from mummies previously stored at 0°C or 1°C for different periods. Aphid: *M. persicae*.

Series	Storage temp.	Storage period for mummies (weeks)	Number emerged adults used for oviposition		Plant species	Progeny	
			♀♀	♂♂		pr.♀	♀/♂
1	0°C	1	14	8	swedes	156	-
"	"	6	11	13	"	213	0.9
"	"	8	15	15	"	89	0.9
"	"	10	13	11	"	109	0.9
"	"	14	3	4	paprika	33	0.4
3	1°C	2	7	11	"	53	0.9
"	"	4	14	15	"	83	1.0

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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.

Series	6	7	8	9	10
Acclimation	2 days at 4°C	2 days at 10°C	No accl.	No accl.	No accl.
Storage temp.	0°C	4°C	4°C	7°C	10°C
Weeks stored					
1	38	12	82 (0)	74 (0)	
2	5	3	50 (0)	82 (0)	(28)
3	2		16 (4)	48 (14)	
4	0		4 (0)	4 (44)	(56)
5	0			0 (72)	
6	0		0 (0)	0 (46)	(48)
7	0				
8			0 (4)	0 (52)	
14			0 (0)		
18			0 (6)		
no accl. or storage	75				

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.

Cold storage of mummies	Supercooling point	Emergence		
		°C	SD	n
°C weeks	°C			% ♀/♂
0 2	-26.2 1.9	25	56	1.0
-5 1	-29.4 1.9	25	64	1.8
no storage	-26.1 1.3	20	62 ⁺	0.9

⁺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 (Stary 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 1975 a).

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°, 4.4°, 7.2°, 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.

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).

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Funn av Coleoptera fra Nord-Norge

ARNE C. NILSSEN & JOHAN ANDERSEN

Nilssen, A. & Andersen, J. 1977. Finds of Coleoptera from northern Norway. *Norw. J. Ent.* 24, 7-9.

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.

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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.

Trachypachys zetterstedti Gyll. Fø: Fiskevatn, noen km fra Ødevatn i Øvre Pasvik, 15. juni 1966 (leg. R. Mehl). Ett eksemplar.

Dyschirius septentrionum Munst. TRY: Tønsvikelv. Nnø: Elvestrand i Skjomen, 15. juli 1972. På silt ved utløpet av Skjoma.

Dyschirius globosus Hbst. Nnø: Elvestrand, 15. juli 1972.

Tachyta nana Gyll. Fø: Lyngmo i Øvre Pasvik, juli 1966 og 1967. To eksemplarer under løs bark på liggende morkne furustammer. Fra Nord-Norge ellers bare kjent fra TRi: Rundhaug.

Harpalus fuliginosus Duft. Fø: Lyngmo, juli 1966 og 1967. Tre eksemplarer under krekling eller planker på tørr sand. Ellers ikke kjent fra Nord-Norge.

Harpalus quadripunctatus Dej. Fø: Lyngmo, juli 1966. Et eksemplar på noe fuktig finsand.

Bradycellus collaris Payk. Nnø: Sandvika i Skjomen, juli 1974. Et par eksemplarer tatt under stein på grasmark.

Amara quenseli Schönh. Nnø: GAMES i Skjomen, juli 1974. Et eksemplar på tørr morenebunn.

Agonum sexpunctatum L. Fø: Lyngmo, juli 1966. Et eksemplar tatt sammen med *Harpalus quadripunctatus*. Ellers ikke tatt i Finnmark fylke.

Dytiscus lapponicus Gyll. Nnø: Krokmyrvatn i Skjomen, juni 1976.

Cercyon unipunctatus L. Nnø: Forselv i Skjomen, juni 1975.

Oecoptoma thoracicum L. TRy: Skrolsvik på Senja. Leg. G. Eliseussen.

Phloenomus monilicornis Gyll. Nnø: Forselv i Skjomen, mai 1974. Et par eksemplarer siktet fra furubark angrepet av *Blastophagus piniperda* L. Tidligere kjent nordligst fra Nsi: Storjord i Saltdalen.

Phloenomus lapponicus Zett. Nnø: Forselv, august 1973 og mai 1974. Mange eksemplarer ved sikting av furubark angrepet av forskjellige barkbiller (*Blastophagus piniperda*, *Pityogenes*-arter).

Acidota crenata F. Nnø: Langvatn i Skjomen. Et eksemplar i røyemage. (leg. A: Klemetsen).

Coryphium hyperboreum Mäkl. Nnø: Gautelivvatn i Skjomen 852 m.o.h. På grus ved vatnet. Tidligere kjent fra Troms og Finnmark.

Bledius litoralis Heer. Nnø: Elvestrand. To eksemplarer på silt ved utløpet av Skjoma, august 1972. TRi: Balsjordelva og Nordkjosbotn. I Troms tidligere bare kjent fra Målselvdistriktet.

Bledius arcticus J. Sahlb. Nnø: Gamnes og Elvestrand, juli og august 1972. Tallrike eksemplarer på siltbunn v/elva.

Stenus bimaculatus Gyll. Nsi: Potthus i Saltdalen, juni 1972. Et eksemplar på temmelig skyggefull bunn ved Saltdalselva. Fra Nord-Norge tidligere bare kjent fra TRi: Rundhaug.

Bolitochara lunulata Payk. Fø: Lyngmo, juli 1966.

Atheta silvicola Kr. Nsi: Bleiknesmo i Saltdalen, august 1966. Et eksemplar på tørr, sparsomt bevakst silt ved elva.

Zyras humeralis Grav. Fø: Lyngmo, juli 1967. Flere eksemplarer. Tidligere ikke kjent fra Finnmark.

Chilopora rubicunda Er. Nnø: Gamnes, juli 1974. Flere eksemplarer blant lauv og vegetasjon ved elva.

Plegaderus vulneratus Panz. Fø: Lyngmo, juli 1966. To eksemplarer under bark på tørr furustamme. Ikke funnet andre steder i Finnmark.

Myrmetes piceus Payk. Nnø: Forsheim i Skjomen, juni 1975. I tue av *Formica* av *rufa*-gruppen.

Lygistorus sanguineus L. Fø: Lyngmo, juli 1966 og 1967. Dels på blomster av balderbrå, dels under bark.

Hylecoetus dermestoides L. Nnø: Forsheim i Skjomen, juni 1975.

Adelocera conspersa Gyll. Fø: Lyngmo, juli 1966. Bakkropp av et individ funnet under løs furubark. Ellers ikke kjent fra Nord-Norge.

Melanophila acuminata De G. TRy: Tromsø, august 1961. Et eksemplar i museets samling. TRi: Skakterdalen i Dividalen 17. juli 1973. To eksemplarer fanget i det de kom flygende til et bål. Fra Troms er den tidligere bare kjent fra Bukta i TRi.

Agrilus viridis L. Fø: Nyrod i Øvre Pasvik, juli 1966. Et eksemplar håvet på bjørk. Ellers ikke funnet i Finnmark.

Heterocerus flexuosus Steph. Nnø: Elvestrand, august 1972. Flere eksemplarer på silt ved utløpet av Skjoma.

Dermestes lardarius L. Funn fra TRy: Tromsø står oppført med spørsmålsteget i Strand (1946). Arten er imidlertid meget vanlig i hus i Tromsø og omegn.

Reesa vespulae Milliron. Mehl (1975) angir at denne arten i TRy: Tromsø første gang ble funnet i 1974. Første gang var imidlertid i mai 1973. Arten er nå vel etablert både på Tromsø Museum og i enkelte private boliger. Imago er bare tatt i mai, juni og juli.

Byturus tomentosus F. Nnø: Forsheim i Skjomen, juni 1976. Håvet på hegg. Tidligere funnet nordligst i Nsy: Fykanvatn (Johnson 1967).

Morychus dovrensis Munst. TRy: Tønsvikelv, juni 1973. En imago og flere larver på tørr sand i sandtak.

Librodor hortensis Fourc. Nnø: Forsheim i Skjomen, juni 1976.

Rhizophagus dispar Payk. Nnø: Forselv, august 1973 og mai 1974. Flere eksemplarer ved sikting av furubark.

Monotoma conicicollis Aubé. Nnø: Forsheim i Skjomen, juni 1975. I tue hos *Formica* av *rufa*-gruppen.

Monotoma angusticollis Gyll. Nnø: Forsheim i Skjomen, juni 1975. I tue hos *Formica* av *rufa*-gruppen.

Endomychus coccineus Panz. Nnø: Forselv, mai 1974. Et eksemplar tatt krypende på husvegg.

Adalia bipunctata L. Nsy: Bodø. Leg. H.

Andersen. Flere eksemplarer. Tidligere funnet nordligst i NTi.

Octotemnus glabriculus Gyll. TRy: Tromsø. Tatt på *Polyporus* på bjørk.

Cis bidentatus Ol. Nnø: Forselv, august 1973. Tatt på sopp på bjørk.

Ptinus raptor Sturm. Nnø: Forselv i Skjomen, juni 1975. I morken stubbe av bjørk.

Oedemera virescens L. Nnø: Sandvika i Skjomen, juni 1976.

Pytho depressus L. Nnø: Forselv, august 1973. Tallrike eksemplarer under fuktig, løs furubark.

Salpingus castaneus Panz. Nnø: Forselv, mai 1974. Et dødt eksemplar siktet fra bark av furu angrepet av barkbiller. Tidligere nordgrense var Nsi: Mosjøen.

Rabocerus foveolatus Ljungh. Nnø: Forselv i Skjomen, juni 1975.

Rhinosimus ruficollis L. Fn: Vestre Jakobselv, juli 1967. Et par eksemplarer tatt flygende.

Hypophloeus linearis F. Nnø: Forselv, mai 1974. TRi: Frihetsli i Dividalen, mars 1974; Holt, mai 1974; Skibotn, juli 1974. Dyra er siktet eller klekket fra kvister, greiner og tynnbarkete stammer av furu, som var angrepet av *Pityogenes*-arter. Tidligere kjent nordligst fra Nsi: Storjord i Saltdalen. Arten er åpenbart utbredt både i Nordland og Troms, men har blitt fullstendig oversett.

Geotrupes stercorosus Scriba. TRi: Balsfjord 20. aug. 1969 (leg. S. Sørensen). Tidligere nordligst i Nnv: Hadsel.

Trichius fasciatus L. Fø: Lyngmo, juli 1966 og 1967. Flere eksemplarer på blomster av balderbrå. Nnø: Gamnes i Skjomen, august 1972. Arten er oppført med spørsmålstegn fra Nnø: Hamarøy (Strand 1946).

Rhagium inquisitor L. Nnø: Forselv, august 1973, mai og juli 1974, juni 1975. Arten er vanlig under furubark.

Leptura virens L. Fø: Lyngmo, juli 1966. En dekkvinge.

Monochamus sutor L. Fv: Hammerfest (leg. R. Albrigtsen).

Saperda scalaris L. Nnø: Klubbvikvatn. Et eksemplar tatt flygende 27. juni 1973 (leg. A. Klemetsen).

Gastroidea viridula De G. TRy: Tromsø 3. juli 1972 (leg. G. Johansen).

Phyllodecta polaris Sp. Schneid. Nnø: Vannaksvatn i Skjomen, august 1972. Flere eksemplarer under stein på tørr hei over tregrensa.

Otiorrhynchus sulcatus Fabr. Nni: Mosjøen. Flere individ i hus (leg. E. Arnkværn) TRy: Tromsø 3 eksemplarer i hus (leg. G. Johansen). Arten er tidligere bare kjent fra Sør-Norge, men er muligvis i ferd med å spre seg over hele landet ved menneskets hjelp. Spredningen skjer muligvis via potteplanter.

Blastophagus piniperda L. Nnø: Forselv, august 1973. Tallrike eksemplarer under furubark. Gangsystem i eldre, døde furutrær viser at arten er meget vanlig i området.

Hylurgops palliatus Gyll. Nnø: Forselv. Vanlig sammen med foregående.

Pityogenes bidentatus Hbst. Nnø: Forselv, august 1973 og mai 1974. Tallrik i greiner og kvister av furu.

Pityogenes quadridens Hart. Nnø: Forselv, mai 1974. Flere eksemplarer i greiner og tynnbarkete stammer av furu.

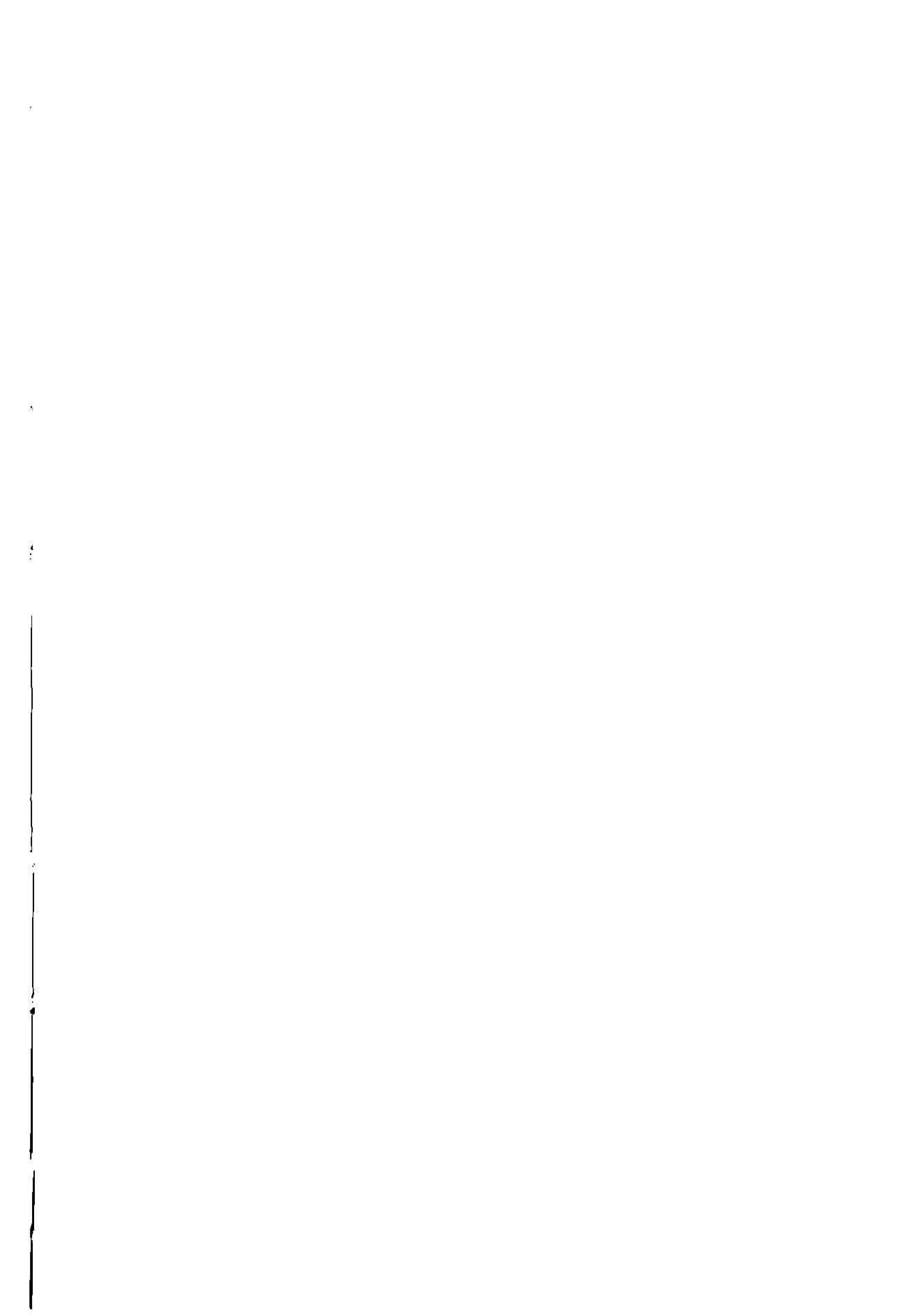
Trypodendron domesticum L. Nnø: Forselv i Skjomen, juni 1975. Flere eksemplarer på bjørk. Tidligere kjent nordligst fra Rana.

Scolytus ratzeburgi Jans. Nnø: Klubbvikvatn. Gamle ganger og rester av et eksemplar på bjørk, juni 1976.

Dryocoetes alni Georg. Nnø: Forselv i Skjomen, juni 1976. På or.

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

FREJ OSSIANNILSSON

Ossiannilsson, F. 1977. Mire invertebrate fauna at Eidskog, Norway. V. Auchenorrhyncha, Psylloidea and Coccoidea (Hem.). *Norw. J. Ent.* 24, 11–14.

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 xanthoneurus* 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.

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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

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Table I. Pitfall catches of Auchenorrhyncha, Psylloidea and Coccoidea in thirteen mire habitats at Eidskog, South Norway.

Species:	Habitat:													No. of species
	1	2	3	4	5	6	A	B	C	D	I	II	III	
Auchenorrhyncha:														
<i>Cixius</i> sp. (<i>similis</i> Kbm.?), juv.	-	-	-	1	1	-	1	-	2	-	-	-	-	5
<i>Tyrphodelphax distinctus</i> (Flor)	6	5	-	-	1	-	1	-	-	-	-	-	1	14
<i>Oncodelphax pullulus</i> (Boh.)	-	-	-	-	1	-	-	-	-	-	-	-	-	1
<i>Neophilaenus lineatus</i> (L.)	5	2	1	-	2	-	2	-	-	-	-	-	-	12
<i>Aphrophora alni</i> (Fall.)	-	-	1	-	-	-	1	-	-	-	-	-	-	2
<i>Ulopa reticulata</i> (F.)	-	-	-	-	-	-	-	2	1	-	-	-	-	3
<i>Agallia brachyptera</i> (Boh.)	-	-	11	-	-	5	-	2	1	2	-	-	-	21
<i>Agallia venosa</i> (Fourcr.)	-	-	1	-	-	-	-	-	-	-	-	-	-	1
<i>Aphrodes bicinctus</i> (Schrnk.) f. <i>diminuta</i> Rib.	2	6	1	-	4	1	5	-	-	1	-	-	-	20
<i>Stroggylocephalus livens</i> (Zett.)	-	-	-	10	-	4	-	6	3	-	-	-	-	25
<i>Arboridia parvula</i> (Boh.)	-	-	-	-	-	1	-	-	-	-	-	-	-	1
<i>Linnavuoriana sexmaculata</i> (Hdy.)	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Macrosteles</i> sp.?	3	-	-	-	-	-	-	-	-	-	-	-	-	3
<i>Idionotus cruentatus</i> (Panz.)	-	-	-	1	-	-	-	-	1	-	-	1	-	3
<i>Macustus grisescens</i> (Zett.)	-	-	2	-	-	-	-	4	-	-	-	-	-	6
<i>Scleroracis russeolus</i> (Fall.)	-	-	1	-	1	-	2	-	-	-	-	1	-	5
<i>Sorhoanus xanthoneurus</i> (Fieb.)	-	1	-	-	-	-	-	-	1	-	2	-	-	4
<i>Cosmotettix panzeri</i> (Flor)	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Unidentified Cicadellid nymphs	1	3	4	7	2	7	-	-	1	-	9	27	15	73
Sum Auchenorrhyncha														201
Psylloidea:														
<i>Strophingia ericae</i> (Curt.)	-	-	-	-	8	1	2	-	-	1	3	-	-	15
Sum Psylloidea														15
Coccoidea:														
<i>Atrococcus paludinus</i> (Green)	-	-	-	-	-	24	7	-	4	-	-	-	-	35
<i>Spinococcus oalluneti</i> (Ldgr.)	3	2	-	-	11	7	1	-	-	-	-	-	-	24
Sum Coccoidea														59
Total no. of specimens per habitat:	20	19	14	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., Dsl., Upl., Vrm., Dlr., Ång., Vb., Ås. Lpm., P. Lpm. *Stroggylocephalus 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. *Oncodelphax pullulus* 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

Table II. Affinity of the recorded species to mire habitats

Species found only in mire habitats	<u><i>Tyrphodelphax distinctus</i></u> <u><i>Stroggylocephalus livens</i></u> <u><i>Cosmotettix panzeri</i></u> <u><i>Sorhoanus xanthoneurus</i></u>
Species typical to mire habitats, but not absolutely bound to these sites	(<u><i>Cixius similis</i></u>) <u><i>Oncodelphax pullulus</i></u> <u><i>Macustus griseocens</i></u> <u><i>Atrococcus paludinus</i></u>
Species common in mires, but equally common in other types of habitats	<u><i>Neophilaenus lineatus</i></u> <u><i>Aphrophora alni</i></u> <u><i>Ulopa reticulata</i></u> <u><i>Agallia brachyptera</i></u> <u><i>Arboridia parvula</i></u> <u><i>Linnavuoriana sexmaculata</i></u> <u><i>Aphrodes bicinctus</i></u> <u><i>Idiodonus cruentatus</i></u> <u><i>Scleroracrus ruseolus</i></u> <u><i>Strophingia ericae</i></u> <u><i>Spinococcus calluneti</i></u>
Species occasionally found in mire sites, but more common in other habitats	<u><i>Agallia venosa</i></u>

1962). It has also been recorded from France, on *Trifolium* sp. (Goux 1933, 1941), and from *Psamma arenaria* in Holland (Reyne 1965). In Sweden, *A. paludinus* has been found in Ul., Gtl., Vg., Dsl., Uppl., 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 zotopes. *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., Uppl., Vstm. (Ossiannilsson 1951, 1959, 1971) and Hls. Also *Scleroracrus ruseolus* 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, *Stroggylocephalus livens*, *Cosmotettix panzeri*, and *Sorhoanus xanthoneurus* can be used as indicator species to the habitats where they live.

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Mire invertebrate fauna at Eidskog, Norway. VI. Hemiptera Heteroptera

SIGMUND HÅGVAR

Hågvar, S. 1977. Mire invertebrate fauna at Eidskog, Norway. VI. Hemiptera Heteroptera. *Norw. J. Ent.* 24, 15–17.

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* Thoms., *Acalypta nigrina* (Fall.), *Ligyrocoris silvestris* (L.), and *Drymus brunneus* (F. Sahlb.). The main material consisted of *A. nigrina* and *L. silvestris*, each of which were recorded from five different mire habitats.

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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 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, Hågvar & 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 Eidskog, south Norway

Species:	Habitat:								No. per species	
	1	5	6	A	B	C	D	I II		
<i>Saldula opacula</i> (Zett.)	-	-	-	-	-	-	-	1	1	
<i>Coranus subapterus</i> (DeG.)	-	-	-	-	-	1	-	-	1	
<i>Myrmedobia exilis</i> (Fall.)	-	-	-	-	-	1	-	-	1	
<i>Hallodapus rufescens</i> (Burm.)	-	-	-	-	-	-	-	1	1	
<i>Gerris odontogaster</i> (Zett.)	-	-	-	-	-	-	1	-	1	
<i>Hebrus ruficeps</i> Thoms.	1	-	-	-	-	-	-	-	1	
<i>Acalypta nigrina</i> (Fall.)	-	1	5	1	-	1	1	-	9	
<i>Ligyrocoris silvestris</i> (L.)	-	1	1	2	-	-	1	2	7	
<i>Stygnocoris pedestris</i> (Fall.)	-	-	-	-	-	-	1	-	1	
<i>Drymus brunneus</i> (F. Sahlb.)	-	-	-	-	1	-	-	-	1	
Total no. of specimens per habitat:	1	2	6	3	1	1	5	1	4	24
Total no. of species per habitat:	1	2	2	2	1	1	5	1	3	10

in sand-dunes and other sandy habitats (Jensen-Haarup 1912, Southwood & Leston 1959, Wagner 1967).

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

Hallodapus 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.

Table II. Affinity of the recorded species to mire habitats

Species typical to mire habitats, but not absolutely bound to these sites	<i>Saldula opacula</i> <i>Myrmedobia exilis</i> <i>Hebrus ruficeps</i> <i>Acalypta nigrina</i> <i>Ligyrocoris silvestris</i> <i>Drymus brunneus</i>
Species common in mires, but equally common in other types of habitats	<i>Hallodapus rufescens</i> <i>Gerris odontogaster</i> <i>Stygnocoris pedestris</i>
Species occasionally found in mire sites, but more common in other habitats	<i>Coranus subapterus</i>

Acalypta nigrina. Collected 11 and 24 July, and 7 and 28 September. The specimens varied considerably in taxonomic characters, but Ossiannilsson (pers. comm.) considered them to belong to the same species. The species typically occurs amongst moss (Southwood & Leston 1959, Wagner 1967). Of the five habitats in which it was found, only No. 5 was open mire. None of the actual habitats were very wet.

Ligyrocoris silvestris. 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 pedestris. 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.

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Simuliidae (Diptera) of Rendalen, Norway.

IV. Autogeny and anautogeny

D. M. DAVIES, H. GYÖRKÖS & J. E. RAASTAD

Davies, D. M., Györkös, H. & Raastad, J. E. 1977. Simuliidae (Diptera) of Rendalen, Norway. IV. Autogeny and anautogeny. *Norw. J. Ent.* 24, 19–23.

Newly emerged females of 19 simuliid species were maintained on dry sucrose and water to determine whether they could mature eggs autogenously. Females of 3 species with reduced mouthparts – *Prosimulium ursinum* (Edwards), *Cnephia lapponica* (Enderlein), *Eusimulium crassum* (Rubzov) – and those of 2 species with well-developed mouthparts – *Schoenbaueria pusilla* (Fries), *Simulium argyreatum* Meigen – proved to be autogenous, the last two being presumably anautogenous for egg cycles beyond the first. The other 14 species appeared to be anautogenous for any egg production.

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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 'Tuneflua' (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 simuliid species are able (autogenous), or unable (anautogenous), to mature eggs without a blood meal. A knowledge of whether or not a simuliid 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 cellulocotton 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 cellulocotton 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 $15 \pm 3^\circ\text{C}$ in 1967 and $13 \pm 2^\circ\text{C}$ 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.

a) Species presumably anautogenous (no mature eggs formed)	Dates of Emergence	Number of females tested for different periods (days)					Total Numbers
		1-4	4-7	7-10	10-15	15-17	
<i>P. ferrugineum</i>	20-22 July 1967	1			1	1	3
<i>P. hirtipes</i>	29 June- 1 July 1968			1	6		7
<i>M. fuscipes</i>	1-22 July 1967	2	6	18	27	18	71
<i>E. vernum</i> group	{ 29 June- 1 July 1967 24-26 July 1968 }			1	1	12	14
<i>E. bicorne</i>	22 July- 8 Aug. 1968			1	3		4
<i>E. meigeni</i>	22 July 1968				1		1
<i>E. aureum</i>	23 July 1968	1					1
<i>S. rostratum</i>	1- 7 July 1967		3		1	1	5
<i>S. nitidifrons</i>	28 July 1968			1			1
<i>S. ornatum</i>	16 June 1967	1		1		2	4
<i>S. monticola</i>	1- 7 July 1967		1			1	2
<i>S. tumulosum</i>	1- 3 July 1967					2	2
<i>S. truncatum</i>	1- 7 July 1967		1	19	3	13	36
<i>S. sublacustre</i>	6- 9 July 1967		4	1	3		8
b) Species autogenous (mature eggs formed)							
<i>P. ursinum</i>	{ 6 Aug. 1967 24 July 1968 }	3					3
<i>C. lapponica</i>	{ 10-11 July 1967 19-20 July 1967* }	4	4	2	5	1	16
<i>E. crassum</i>	5 Aug. 1967	1					1
<i>S. pusilla</i>	20-21 July 1967		1		1		2
<i>S. argyreatum</i>	14-18 July 1968				2		2

* collected mating at river's edge

Edwards, *S. tumulosum* Rubzov, and *S. argyreatum* Meigen.

Fourteen species, comprising 159 females, gave negative results as no mature eggs were developed (Table Ia). 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 Ib). 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 laciniae 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 man-

dibles and laciniae. 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 simuliids (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 ferrugineum*, *P. hirtipes*, *Meta-cneiphia fuscipes*, *Eusimulium vernum* (group), *E. bicorne*, *E. curvans*, *E. aureum*, *Simulium monticola*, *S. nitidifrons*, *S. ornatum*, *S. rostratum*, *S. truncatum*, *S. sublacustre*, and *S. tumulosum*. They are all known to be blood-suckers 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. ferrugineum*, *P. hirtipes*, *S. monticola*, *S. nitidifrons*, *S. ornatum*, *S. rostratum*, (as *forsi*), *S. truncatum* (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. ferrugineum*, *E. vernum* and *S. nitidifrons*, and in addition *S. sublacustre*, were collected around cattle in Rendalen (Golini et al. 1976). The other Rendalen species, except *S. truncatum*, are known to be ornithophilic (Golini 1970): *M. fuscipes* (as *pallipes*), *E. aureum*, *E. bicorne*, *E. curvans*, and *E. vernum* group (as *latipes*). Raastad (1974) considered *S. truncatum* 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.

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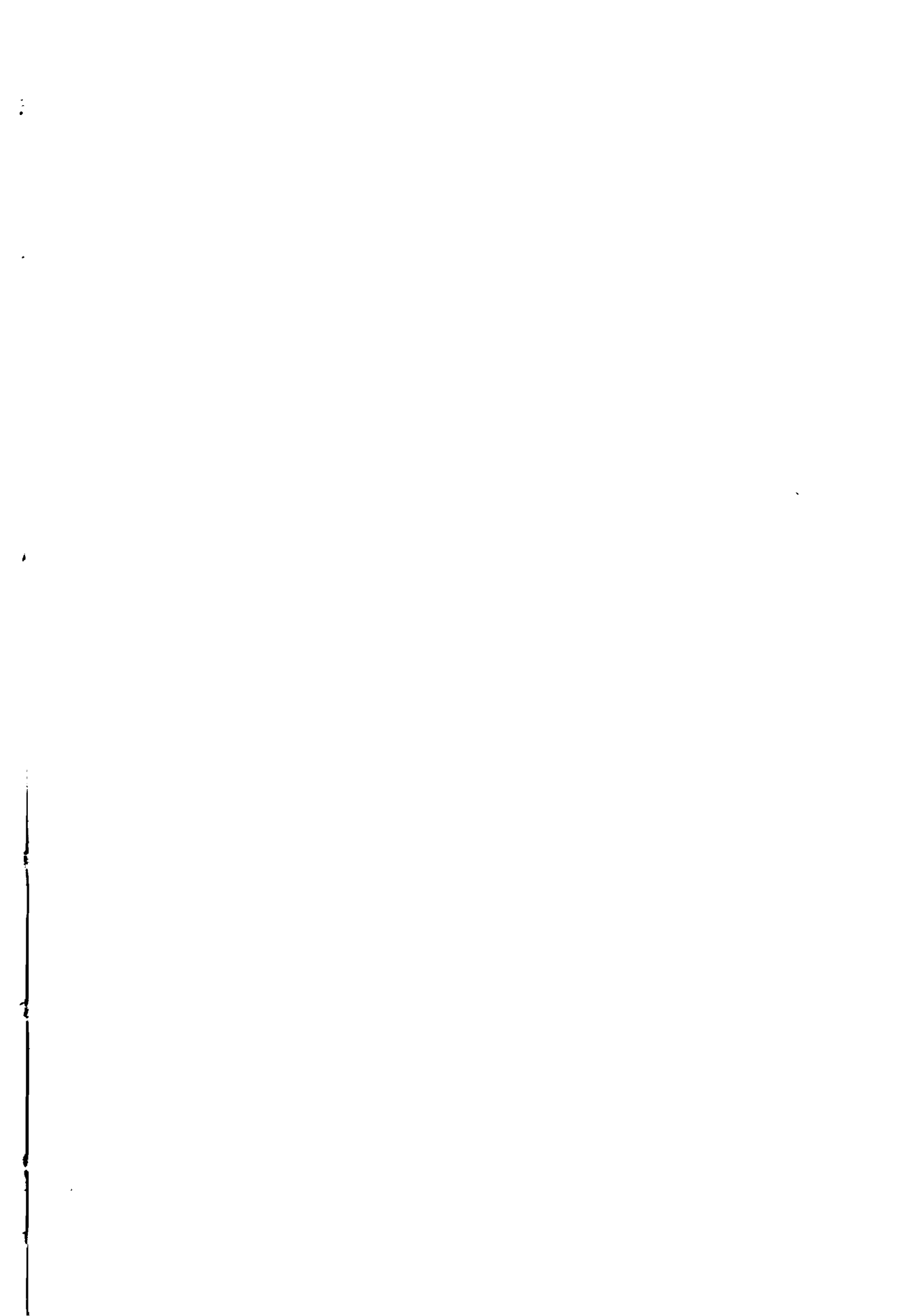
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Effects of glycerol in freeze-tolerant *Pytho depressus* L. (Col., Pythidae)

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Zachariassen, K. E. 1977. Effects of glycerol in freeze-tolerant *Pytho depressus* L. (Col., Pythidae). *Norw. J. Ent.* 24, 25-29.

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, Sømme 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 palaeartic 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 $+4^{\circ}\text{C}$ 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 Sømme (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 centri-

fuged, 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 Metznerburg & 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 osmolal melting point depression (-1.86°C per osmolal).

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 μ l samples of 0.9% NaCl, containing 5 vol% hemolymph. Samples of 5 μ l 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.

TABLE I. LOW TEMPERATURE TOLERANCE OF ADULT *P. DEPRESSUS* WITH DIFFERENT CONCENTRATIONS OF GLYCEROL IN THE BODY FLUID

GLYCEROL CONCENTRATION (MMOLES/KG BODY WATER)	LOWER LIMIT OF TOLERATED TEMPERATURE RANGE (°C)
0	≈ -7,5 (4)
1475 ± 285	≈ -27 (10)

NUMBER OF EXPERIMENTS GIVEN IN PARENTHESIS

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 $y = -3.99 - 0.00116x$, 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

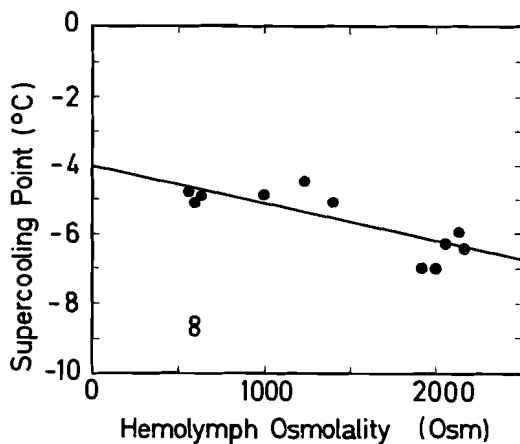


Fig. 1. Supercooling points of adult *P. depressus* collected in the winter (●) and in the early summer (○), plotted as a function of the hemolymph osmolality of the beetles. The solid line represents the calculated regression line of the values of the winter beetles.

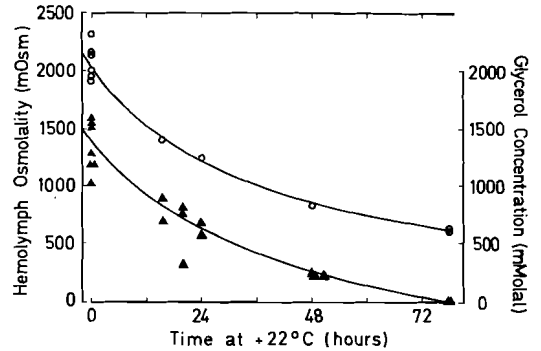


Fig. 2. Hemolymph osmolality (○) and glycerol concentration (▲) of adult *P. depressus* plotted as a function of time spent at room temperature.

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-

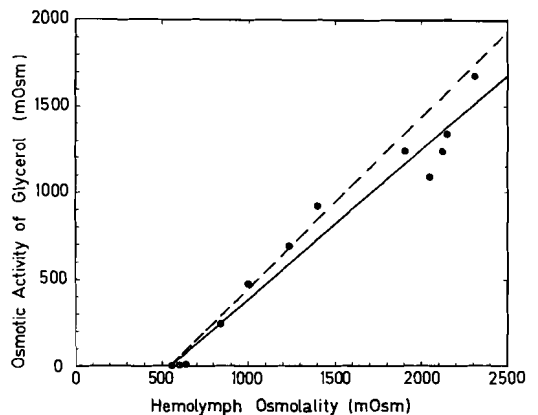


Fig. 3. Osmotic contribution of glycerol plotted as a function of the total osmotic concentration in the body fluid of the beetles. The solid line represents the calculated regression line. The dashed line has a slope equal to 1.0.

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 $y = -460 + 0.85 \chi$. 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 $-8.9 \pm 1.2^\circ\text{C}$ (\pm S.D.). The corresponding supercooling point of NaCl-solution containing hemolymph from a beetle collected in the month of May was -15.5°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 osmolal 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 osmolal 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 *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

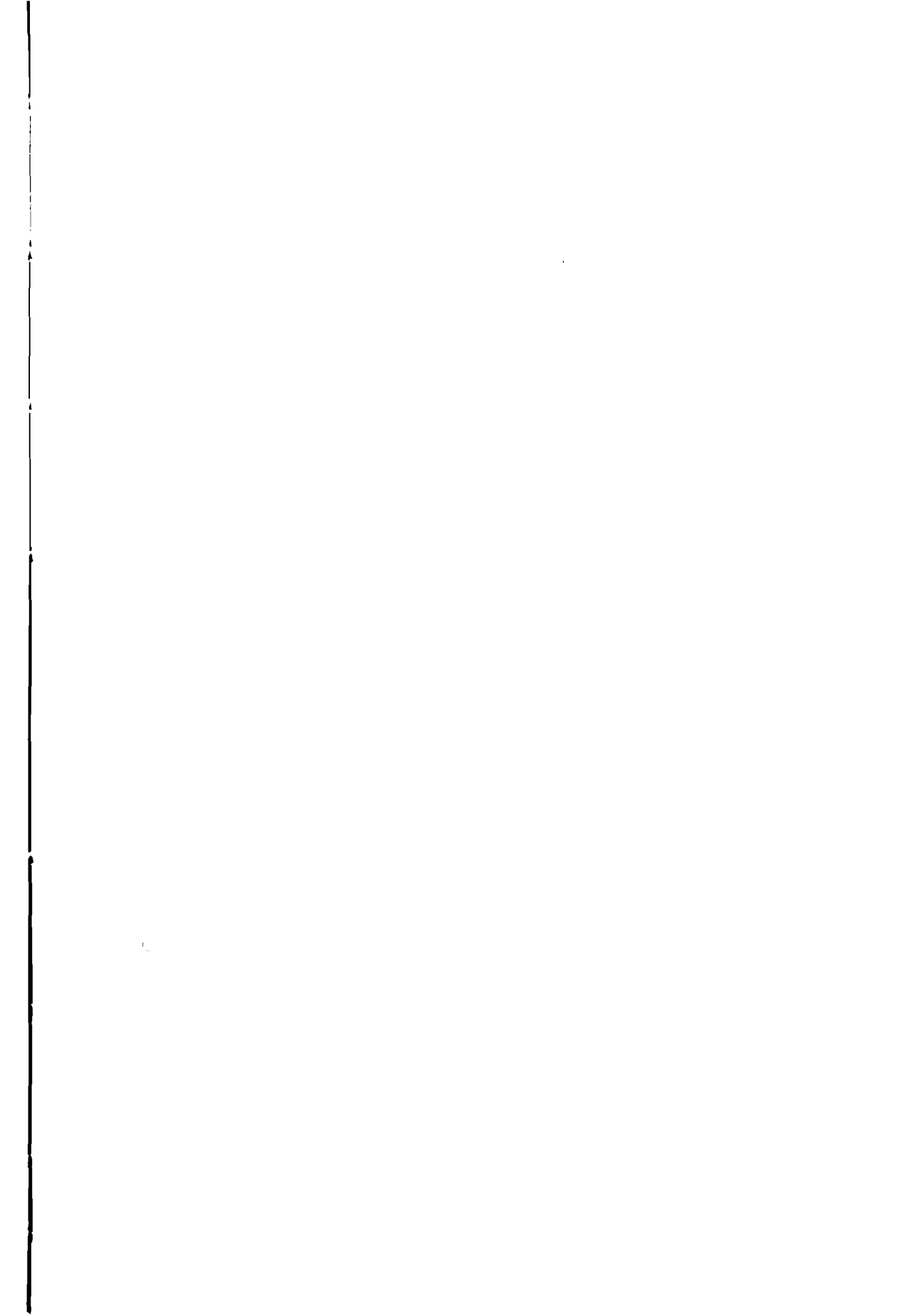
as high as 250 mOsm. In any case, of the solutes responsible for the osmolality increase beyond 600 mOsm, glycerol seems to be the quantitatively dominating one, even in those beetles which had the highest osmolality values.

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

TORSTEIN KVAMME

Kvamme, T. 1977. On the distribution and habitat choice of *Agonum dorsale* Pont. (Col., Carabidae) in Norway. *Norw. J. Ent.* 24, 31-32.

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. Pit-fall 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 melanocéphalus* 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 crepitans* L. and *Harpalus azureus* F. (Lindroth

1945, 1949). None of these species have been recorded in Norway. *B. crepitans*, however, is known from middle Sweden, and it would therefore be reasonable to seek for this species in Norwegian localities for *A. dorsale*.

ACKNOWLEDGEMENT

I am indebted to all persons who have given me information: Dr. Albert Lillehammer, Mr. Kaare Aagaard, Dr. Holger Holgersen, Dr. Andreas Strand, Mr. Arne Fjellberg, Prof. Carl H. Lindroth, Mr. Christian Stenseth and Mr. Karl E. Zachariassen. I also wish to thank Mr. Sigmund Hågvær for his valuable help.

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Black flies (Dipt., Simuliidae) new to Norway

J. E. RAASTAD & D. M. DAVIES

Raastad, J. E. & Davies, D. M. 1977. Black flies (Dipt., Simuliidae) new to Norway. *Norw. J. Ent.* 24, 33-34.

Norwegian records of nine black-fly species are given. *Prosimulium macropygum* (Lundström), *Cnephia lapponica* (Enderlein), *C. freyi* (Enderlein), *C. dogieli* (Ussova), and *Eusimulium baffinense* (Twinn) are new to Norway. *Eusimulium olonicum* Ussova, *E. crassum* (Rubzov), *E. beltukovae* Rubzov, and *Simulium rotundatum* (Rubzov) are previously unknown outside USSR.

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D. M. Davies, Department of Biology, McMaster University, Hamilton, Ontario, Canada.

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
Material: Akershus, Nannestad, Tømte, 21 June 1970, 1 larva, 3 pupae. Leg. H. Dunker. Troms, Bardu, Dividalen, 18 Aug. 1968, 3 pupae. Leg. H. Nordby.

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

Material: Hedmark, Tynset, Lauvåsen, 12 May 1970, 9 exuviae. Leg. J. E. R.

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)

Material: Hedmark, Tynset, Lauvåsen, 12 May 1970, 2 exuviae. Leg. J. E. R. Hedmark, Y. Rendal, Osdalen, 14 July 1967, 1 exuvia. Leg. D. M. D.

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

Material: Telemark, Hjartdal, Sjøvann, 17 July 1969, 1♀ imago. Leg. H. Dunker.

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)

Material: Hedmark, Y. Rendal, Renådalen, 13 Aug. 1968, 11 larvae, 1 pupa. Leg. D. M. D. & J. E. R.

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)

Material: Finnmark, S-Varanger, Passvik, 15 June 1966, 4 larvae. Leg. R. Mehl.

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

Material: Hedmark, Y. Rendal, Renådalen, 5 Aug. 1968, 1 pupa. Leg. D. M. D. & J. E. R. Telemark, Tinn, Lufsjå, 19 Sept. 1969, 8 larvae, 6 pupae. Leg. J. E. R.

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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We are grateful to the Zoological Museum, University of Oslo, and to cand. real. Henning Dunker for providing us with this material.

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Communication by sound between desert tenebrionids

KARL ERIK ZACHARIASSEN

Zachariassen, K. E. 1977. Communication by sound between desert tenebrionids. *Norw. J. Ent.* 24, 35-36.

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).

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.

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 tappings 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

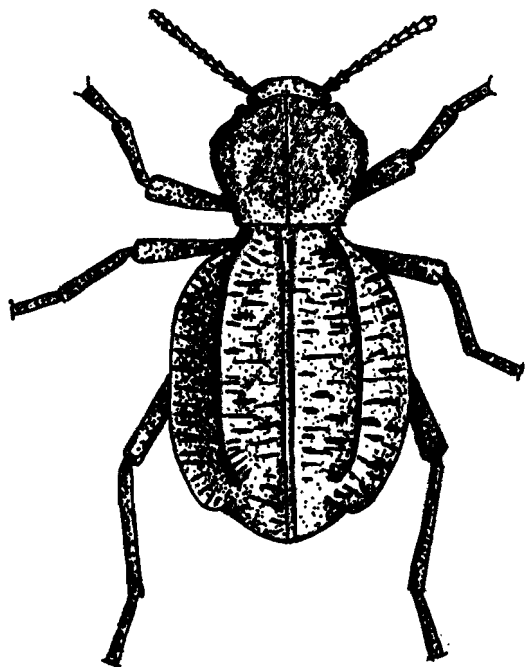


Fig. 1. *Phryanocolus somalicus* Wilke.

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 mechani-

cal 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.

ACKNOWLEDGEMENTS

The beetles were collected during a stay in Kenya which was supported by the Norwegian Research Council for Science and the Humanities.

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

NIELS HAARLØV

Haarløv, N. 1977. Ectoparasites (Mallophaga, Siphonaptera, Acarina) from birds of Jan Mayen Island, Norway. *Norw. J. Ent.* 24, 37-41.

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, collembolids, 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% 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.

Philopterus gonothorax Giebel 1874 (= *Saemundssonina gonothorax* (Giebel) 1874) from *Uria lomvia*.

Degeeriella brachythorax Giebel 1876 (= *Brüelia brachythorax* (Giebel) 1876) from *Plectrophenax nivalis*.

Esthiopterum nigrolimbatus Giebel 1874 (= *Perineus nigrolimbatus* (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 (Fristrup 1942, MacFadyen 1954, Krczal 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, 1♀ and 1 juv., taken together with *Saemundssonina 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 *Luniceps* sp. of a *Calidris alpina*. Identified according to Timmermann (1957).

Chadriceps hiaticulae (O. Fabr.) 1780

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

Luniceps 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 *Quadriceps*. Zlotarzycka (1967), however, in her revision of the *Quadriceps* group, distinguished between species with one or with two long temporal hairs, and in that connection the original *Quadriceps klatti* distinctly belongs to the former group including the genus *Mjöberginirmus*.

Quadriceps fissus (Burm.) 1838

Stasjonsbukta, 25 June 1972, about 55 specimens (adults, juvenes) were collected together with *Chadriceps hiaticulae* from *Charadrius hiaticulae*. Identified according to Timmermann (1953, 1957) and Zlotarzycka (1967).

Perineus nigrolimbatus (Giebel) 1874

Båtvika, 19 July 1972, about 50 specimens, taken together with *Saemundssonina 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.

Saemundssonina 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).

Saemundssonina 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*.

Saemundssonina 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*.

Saemundssonina tringae (O. Fabr.) 1780

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

Saemundssonina 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 Krzsal (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), Henriksen (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 (Krzsal 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.

Hosts	Ectoparasites		
	Mallophaga	Siphonaptera	Acarina
Fulmarus glacialis	Perineus nigrolimbatus (M, S) Saemundssonina occidentalis (?)* (M, F)	-	-
Alle alle	Mjöberginirmus klatti* (M,S) Saemundssonina merguli* (M,G)	-	-
Uria lomvia	Holomenopon albofasciatum (M) Austromenopon nigropleurum* (M,S) Saemundssonina gonothorax (M) Saemundssonina calva* (M)	-	Ceratrixodes uriae* (M,I,F,G)
Fratercula arctica	-	-	Pygmephorus spinosus* (M)
Rissa tridactyla	Saemundssonina lari* (M,I,F,G)	Mioctenopsylla arctica* (M,S,I)	-
Tringa sp.	Austromenopon lutescens (M)	-	-
Charadrius hiaticulae	Chadrapeps hiaticulae* (M,S,F,G) Quadrapeps fissus* (M)	-	-
Calidris alpina	Carduiceps meinertzhageni* (M) Luniceps sp* (M) Saemundssonina tringae* (M)	-	-
Plectrophenax nivalis	Briëlia brachythorax (M,G)	-	-

presence of *Pygmephorus 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.

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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.

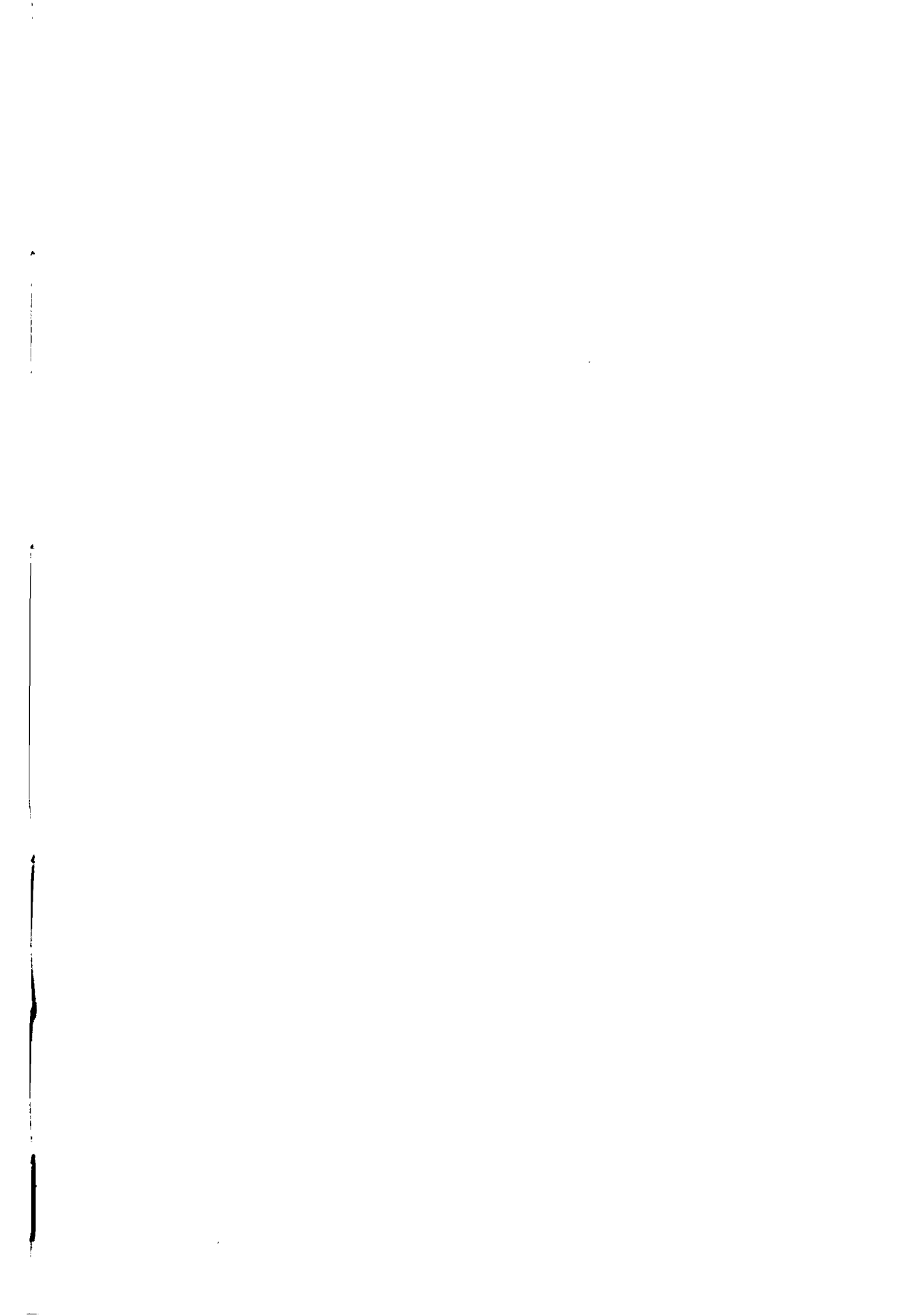
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The *Eupithecia* group (Lep., Geometridae) in Norway

NILS KNABEN

Compiled by Magne Opheim

Knaben, N. 1976. The *Eupithecia* group (Lep., Geometridae) in Norway. *Norw. J. Ent.* 24, 43–82.

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. cauchiata*, (Duponchel), have been added by M. Opheim. *Magne Opheim, Zoological Museum, University of Oslo, Sars gt. 1, Oslo 5, Norway.*

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).

M. Opheim

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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. *Tephroclystia tenuiata*; Barca 1910.

Localities: Østfold: Jeløy (EB, AN, GN); Sarpsborg (EB). *Akershus*: Ås (He); Bærum; Slepanden (AU). *Oslo*: Kristiania (Si), Tåsen ex larvae (NK). *Oppland (On)*: V. Slidre; Hausåker (NK). *Vestfold*: Sem; Narverød (CFL). *Telemark (TEi)*: Bolkesjø (EB). *Aust-Agder (AAy)*: Risør; Laget (NK). *Vest-Agder (UAY)*: Kristiansand (KB); Søgne (CFL). *Rogaland (Ry)*: Klepp; Vig (AN); Sandnes; Dale (AN). *Hordaland (HOy)*: Ølen; Heggens Mølle (Lu). *HOi*: Ullensvang (NG); Granvin; Eide (JR); Voss; Vossevangen (NG). *Sogn og Fjordane (SFy)*: Nordfjordeid (NK). *SFi*: Aurland; Vassbygdi (NK); Hornindal; Fannemel (NK). *Nord-Trøndelag (NTi)*: Inderøy (WMS).

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

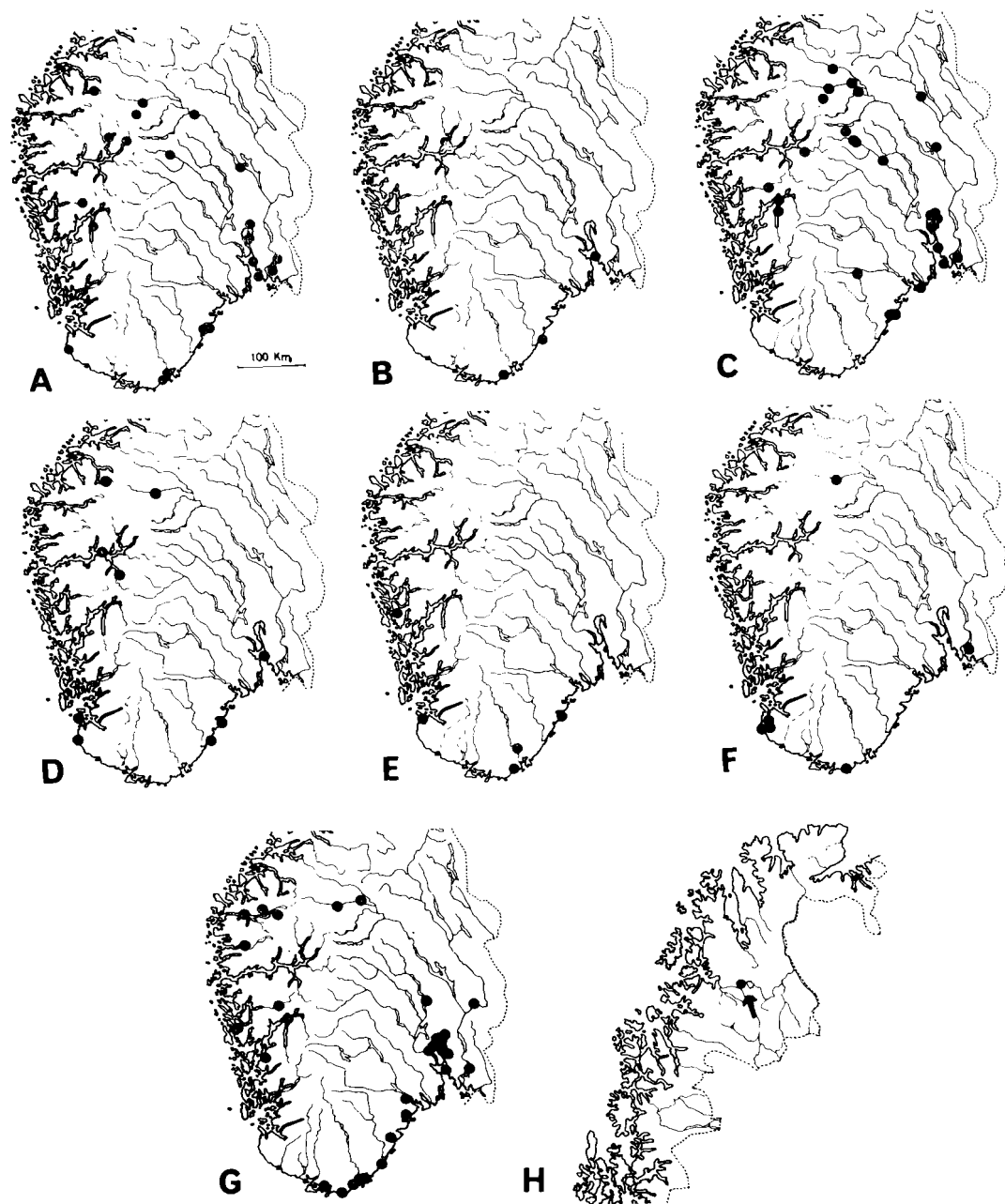


Fig. 9. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia linariata*, B. *E. tripunctaria*, C. *E. sinuosaria*, D. *E. pimpinellata*, E. *E. dodoneata*, F. *E. lariciata*, G. *Chloroclystia debiliata*, H. *E. undata*.

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: Vigeland 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. *Vertical distribution:* From sea level to 500 m (TEi: Bolkesjø). *First capture:* Oslo ♂ 18 July 1846 (Si). *Recorded food-plant:* *Salix*. *Flight:* 11 July–19 Aug.

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

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

Norwegian records: *Eupithecia inturbata*: Schøyen 1887; Lühr 1970, 1973; Opheim 1972. *Eupithecia subciliata*; Schøyen 1893. *Tephroclystia tenuata*; Hawkshaw 1919. *Tephroclystia inturbata*; Barca 1923.

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

Doubtful record: *Tephroclystia inturbata*, Grønlien 1921: 78 (HOi: 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. inturbata* is a lowland species, not found above 100 m. *First capture:* Oslo, Frogner 15 July 1845 (Es). *Recorded food-plant:* *Acer campestre*, flowers. *Flight:* 21 July–1 Sept.

Eupithecia immundata (Zeller, 1846) (Figs 1C, 10B)

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

Localities: Østfold: Jeløy ♀ 20 June, ♂ 27 June 1953 (GN). Akershus: Oslo: Rosenhof ♀ 6 July 1849 (Si); Bærum: Bjørum Sag ♂ 26 June 1952 (NK), Slepanden ♂ 15 June 1963 (AU); Asker ♀ 5 July, ♂ 8 July 1957, ♂ 7 June 1959 (CFL). Buskerud Bø: Lier: S. Linnes ♂, 2 ♀♀ 20 June 1953 (NK). Vest-Agder (UAY): Søgne 3 ♂♂ 25 June 1966 (CFL).

Distribution: Around the Oslofjord and in Vest-Agder. *Vertical distribution:* Lowland species, not found above 150 m. *Recorded food-plant:* *Actaea spicata*. *Flight:* 7 June–8 July.

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; Sparre 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.

Localities: Østfold: Sarpsborg (EB); Jeløy (EB, GN), Rauer (AB). Akershus: Nesodden: Spro (KH); Oslo (Es), Nordstrandshøyden (EB); Ullensaker (WMS). Oppland (Os): Land (ES); Ringebu (EB). On: V. Slidre: Hausåker, Einang (NK); Ø. Slidre: Beito (NK, MO); Lom (CFL). Buskerud (Bø): Lier, S. Linnes (NK); Modum (WMS). Bv: Gol (NK). Aust-Agder (AAy): Risør: Laget (NK); Tromøy (AB). Vest-Agder (UAY): Kristiansand (KB); Søgne (CFL); Mandal (WMS); Kvinesdal: Gjemlestad (NK); Sireosen (ES). UAI: Sirdal (ES). Rogaland (Ry): Sandnes: Gramstad (AN), Gausel (AN, Fu). Hordaland HOy): Fana: Skipanes ♂ 25 June 1907 (EB). HOi: Ullensvang (NG); Kinsarvik: Djonno (Lu); Voss (NG, EB). Sogn og Fjordane (SFy): Gaular: Sande (NK); Jølster: Skei (NK). SFi: Borgund: Eggum (NK); Stryn: Vinsrygg (NK). Møre og Romsdal (MRy): Ørskog; Skodje; Vestnes (WMS). Sør-Trøndelag (STy): Åfjord: Monstad, By (MO). Nord-Trøndelag (NTi): Snåsa (WMS). Nordland Nsi): Saltdal (WMS), Storjord (JR). Nnø: Sørfold: Bonnasjøen (CFL); Hamarøy (ES); Tysfjord (ES); Skjomen: Elvegård (MO). Nnv: Lødingen (ES, EB). Finnmark (Fi): Alta (EB).

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*

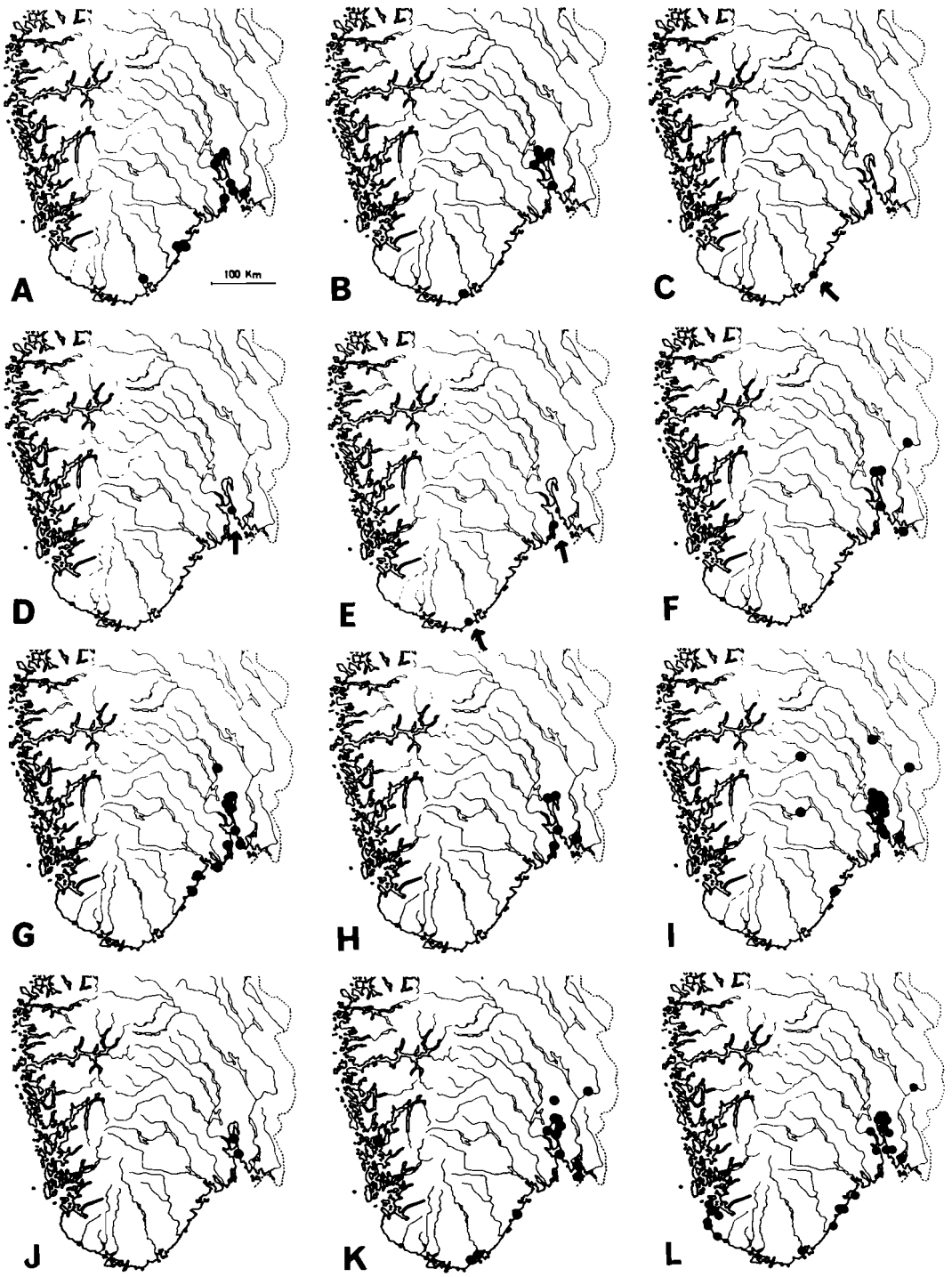


Fig. 10. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia inturbata*, B. *E. immundata*, C. *E. irriguata*, D. *E. egenaria*, E. *E. trisignaria*, F. *E. subumbrata*, G. *E. subnotata*, H. *E. innotata*, I. *E. lanceata*, J. *Chloroclystis coronata*, K. *E. exiguata*, L. *E. centaureata*.

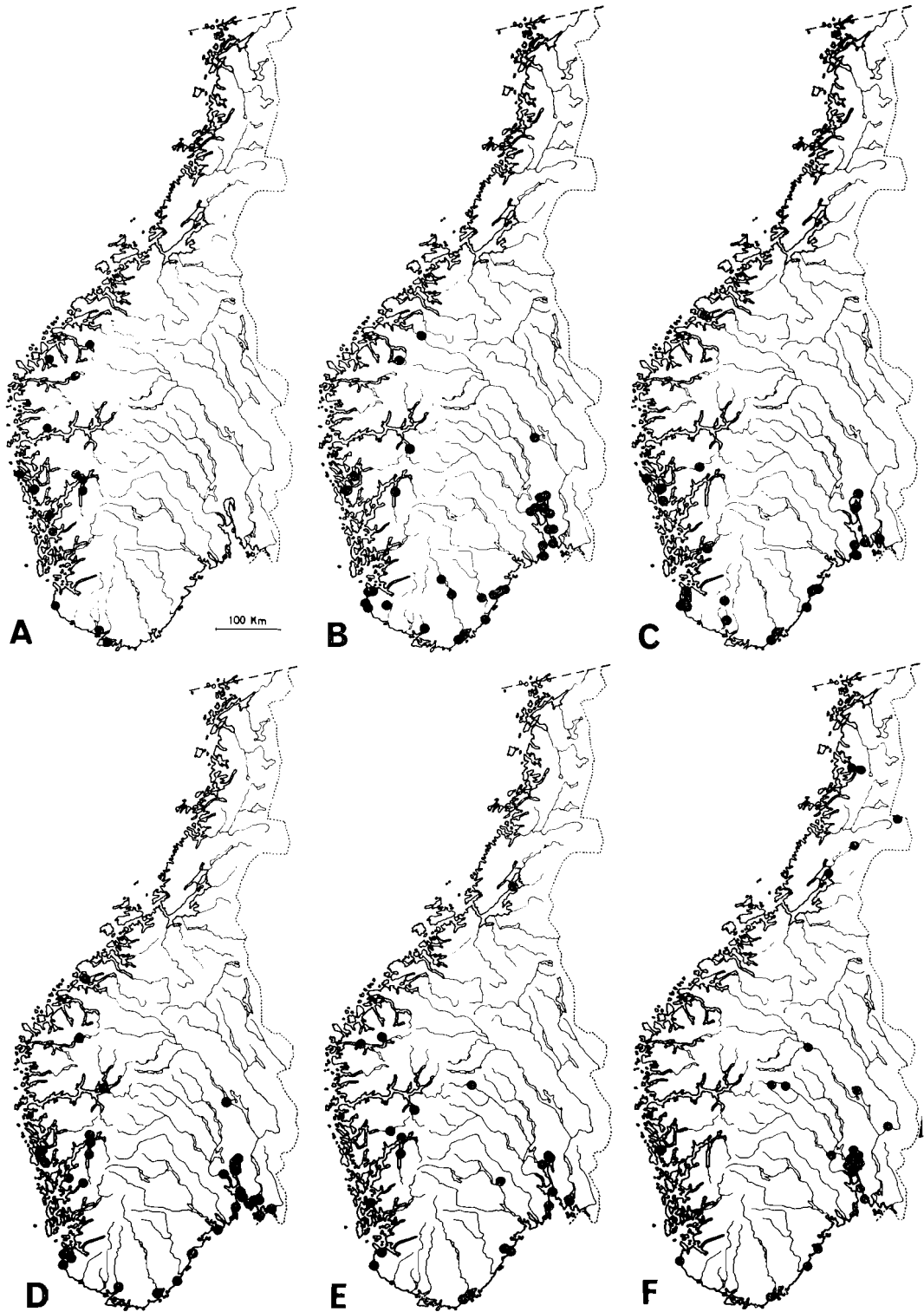


Fig. 11. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia pulchellata*, B. *E. icterata*, C. *E. nanata*, D. *Gymnoscelis pumilata*, E. *E. tenuiata*, F. *E. pini*.

distribution: From sea level to 800 m (On: Beito). *First capture*: Oslo ♀ in the 1840's (?) (ES). *Recorded food-plant*: *Melampyrum pratense*. *Flight*: 1 June–18 July.

Eupithecia pini (Retzius, 1783) (Figs 1E, 7E, IIF)

Norwegian records: *Eupithecia togata*; Sparre Schneider (1876a, 1878, 1882), Schøyen (1893). *Eupithecia abietaria*; Henrichsen (1907), Haanshus (1921). *Tephroclystia togata*; Hawkshaw (1919). *Eupithecia pini*; Bakke (1955), Feichtenberger (1965), Berggren (1970), Opheim (1972).

Localities: Østfold: Rauer (EB); Jeløy (GN). Akershus: Ås (He); Nesodden: Spro (KH); Asker (KH, CFL); Bærum: Stabekk (Es), Sandvika (EB); Oslo: Slemdal (SS), Nordmarka (WMS), Tøyen (Si), Nordstrand (EB). Hedmark (HEs): Sør-Odal (WMS): Ringsaker: Furnesåsen (AB). Oppland (Os): Sør-Fron: Harpefoss (MO). On: V. Slidre: Vollen (NK); Vang (THS). Buskerud (Bø): Vikersund (SS); Røyken: Høvik (MO). Aust-Agder (AAy): Nes Verk (SS); Risør: Laget (NK); Tromøya (AB). Vest-Agder (VAy): Kristiansand (KB); Søgne (CFL). Ragaland (Ry): Klepp: Reve (FJ). Hordaland (HOy): Bergen (MO). Nord-Trøndelag (NTi): Sparbu: Voland in vist (AB); Snåsa (WMS); Nordli: Kvemoen (MO). Nordland (Nsy): Bindal: Tosdalen (MO); Velfjord: Flatmo (MO).

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

Distribution: Scattered distribution north to 66° N.L. Not found in the western districts from Bergen to Nsy: Velfjord. *Vertical distribution*: From sea level to 500 m (On: Vang). *First capture*: Stabekk ♂ 1 June 1846 (Es). *Recorded food-plant*: *Abies*, in the cones. *Flight*: 1 June–20 July.

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

Norwegian records: *Eupithecia abietaria*; Schøyen 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

(EB, GN). Akershus: Nesodden: Spro (KH); Asker (CFL), Nesøya (MO); Bærum: Lysaker (JR); Oslo: Ekeberg (WMS), Nordstrands-høyden (EB). Oppland (On: Lom (CFL). Buskerud (Bø): Modum (SS). Aust-Agder (AAy): Risør (Th), Laget (NK); Åmli: Hovdefjell (NK). Hordaland (HOy): Fjelberg, Halsnøy, Borgundøy (MO); Tysnes: Anuglo (B & L). HOi: Voss (NG); Kinsarvik: Dønno (Lu). Sør-Trøndelag (STi): Orkdal (AB); Selbu (AB). NTi: Stjørdal (AB); Verdal (AB); Ogdal: Røysing (AB); Grong: Harran (AB); Namskogan (AB); Sørli: Udland (MO). Nordland (Nsy): Meløy: Svarftisen (SR). Nsi: Grane: Laksfors (AB); Saltdal (WMS), Storfjord (JR), Rognan (AB). Trom (TRi): Storfjord (SS); Nordreisa: Javreoivek (NK). Finnmark (Fi): Alta (EB).

Not verified records: Werner (1917), Hedmark, HEs: Løten, coll. Deinboll. Feichtenberger (1965), Nsi: Saltdal ♂ 25 June 1943. *Distribution*: From 58°40' to 70° N.L., more scattered in the north. Probably absent from the outer southern and western coast. *Vertical distribution*: From sea level to 400 m. *First capture*: Oslo ♀ 10 June 1880 (WMS). *Recorded food-plant*: *Picea*. *Flight*: 21 May–6 Aug.

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)

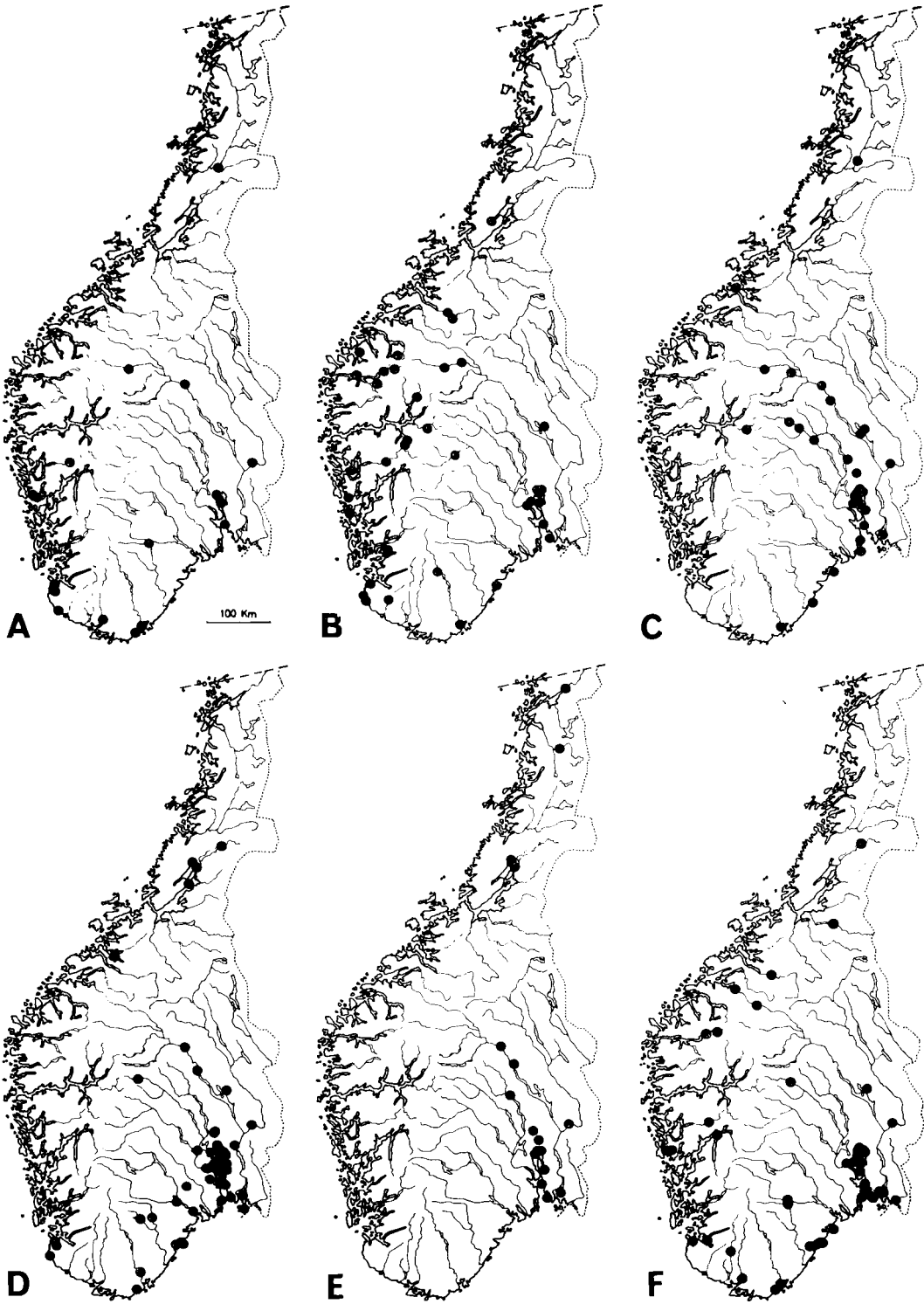


Fig. 12. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia assimilata*, B. *E. denotata*, C. *E. succenturiata*, D. *E. tantillaria*, E. *E. conterminata*, F. *Chloroclystis rectangularata*.

Norwegian records: Eupithecia linariata; Schøyen 1883, 1893; Lampa 1885; Haanshus 1921; Werner 1940; Nielsen 1956; Lühr 1962; Berggren 1970; Opheim 1972. *Tephroclystia linariata*; 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). *Aust-Agder (AAy)*: Risør (Th), Laget (NK). *Vest-Agder (UAY)*: Kristiansand (KB); Søgne (CFL). *Rogaland (Ry)*: Klepp; Vig (AN). *Hordaland (HOi)*: Voss (NG); Ullensvang (NG). *Sogn og Fjordane (SFi)*: Årdal; Utladalen (NK); Luster ex larvae (NK). *Møre og Romsdal (MRi)*: Geiranger (WMS).

Distribution: South Norway north to Geiranger except outer coast districts north of Stavanger. *Vertical distribution*: From sea level to 600 m (On: Røysheim). *First capture*: Oslo ♀ 17 July 1849 (Es). *Recorded food-plant: Linaria*. *Flight*: 20 June–15 Aug.

Remarks: The species varies considerably in size and colour of the forewings. Dark specimens might sometimes be hard to distinguish from the next species, *E. pulchellata* Steph. Regarding genitalia Hoffmeyer (1966) could not find any difference between the two, though the male genitalia differ somewhat, as the sclerified tube in aedeagus is shorter in *E. linariata*, but longer (or of equal length as aedeagus) in *E. pulchellata*.

Eupithecia pulchellata Stephens, 1831 (Figs 1H, 7A, 11A)

Norwegian records: Eupithecia pulchellata; Schøyen 1883, 1893; Lampa 1885; Lundetræ 1938; Werner 1940; Nielsen 1956; Opheim 1972; Lühr 1973. *Tephroclystia pulchellata*; Grønlien 1921.

Localities: Vest-Agder (UAY): Farsund ex larva (NK); Flekkefjord larvae in the flowers of *Digitalis purpurea* (NK). *Rogaland (Ry)*: Klepp; Vig. (AN). *Hordaland (HOy)*: Fjelberg (MO); Onarheim (MO); Bergen (MO); Herdla ex larvae from flowers of *Digitalis purpurea* (NK). *HOi*: Ullensvang; Lofthus (NG); Kinsarvik; Djønno (Lu); Voss: Bordalen (Rognebakke). *Sogn og Fjordane (SFy)*: Vadheim (NK). *SFi*: Stryn (CFL). *Møre og*

Romsdal (MRy): Ørstavik (JW). *MRi*: Valdalen (WMS).

Distribution: Along the western coast from 58° N.L. to 62°20' N.L. *Vertical distribution*: In the lowlands not exceeding 200 m. *First capture*: Valdalen ♀ 6 July 1880 (WMS). *Food-plant: Digitalis purpurea*. *Flight*: 21 May–17 July.

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 ♂ needed two winters for complete development, though the wings were reduced.

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

Norwegian records: Eupithecia irriguata; Lühr 1973; Opheim 1973.

Locality: Aust-Agder: Grimstad: Groos one ♂ and 4 specimens 30 Apr.–primo May 1973 (CFL).

Distribution in Fennoscandia: Sweden: Västergötland, Scania, Blekinge and Gotland (Nordström 1943, 1953). Not found in Finland (Mikkola pers. comm.) as mentioned by Lühr (1973). *Recorded food-plants: Quercus* and *Fagus*.

Eupithecia exiguata (Hübner, 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 ♂ 28 May 1889 (WMS); Sarpsborg ♀ 12 June 1922 (EB); Jeløy ♂ 30 May, ♀ 3 June 1908 (EB), Refsnes 2 ♂♂ 20 June 1955 (GN). *Akershus*: Nesodden: Spro ♂ 26 May 1919, ♀ 20 June 1924 (KH); Oslo: Tøyen ♂ 1 June 1849, ♀ 2 June 1850 (Si), ♀ no date (ZMT), V. Aker ♂ 13 June 1885 (WMS), Nordstrandshøyden ♂ 17 June 1924 (EB); Asker ♂ 9 June 1964, ♂ 5 June 1965 (CFL). *Hedmark (Hes)*: Sør-Odal ♀ 23 June 1885 (WMS). *Oppland (Os)*: Lunner: Roa ♀ June 1939 (MO). *Aust-Agder (AAy)*: Risør 1 specimen (Th). *Vest-Agder (UAY)*: Kristiansand fairly common on light June–July (KB); Søgne ♂ 29 May 1966 (CFL). *Horda-*

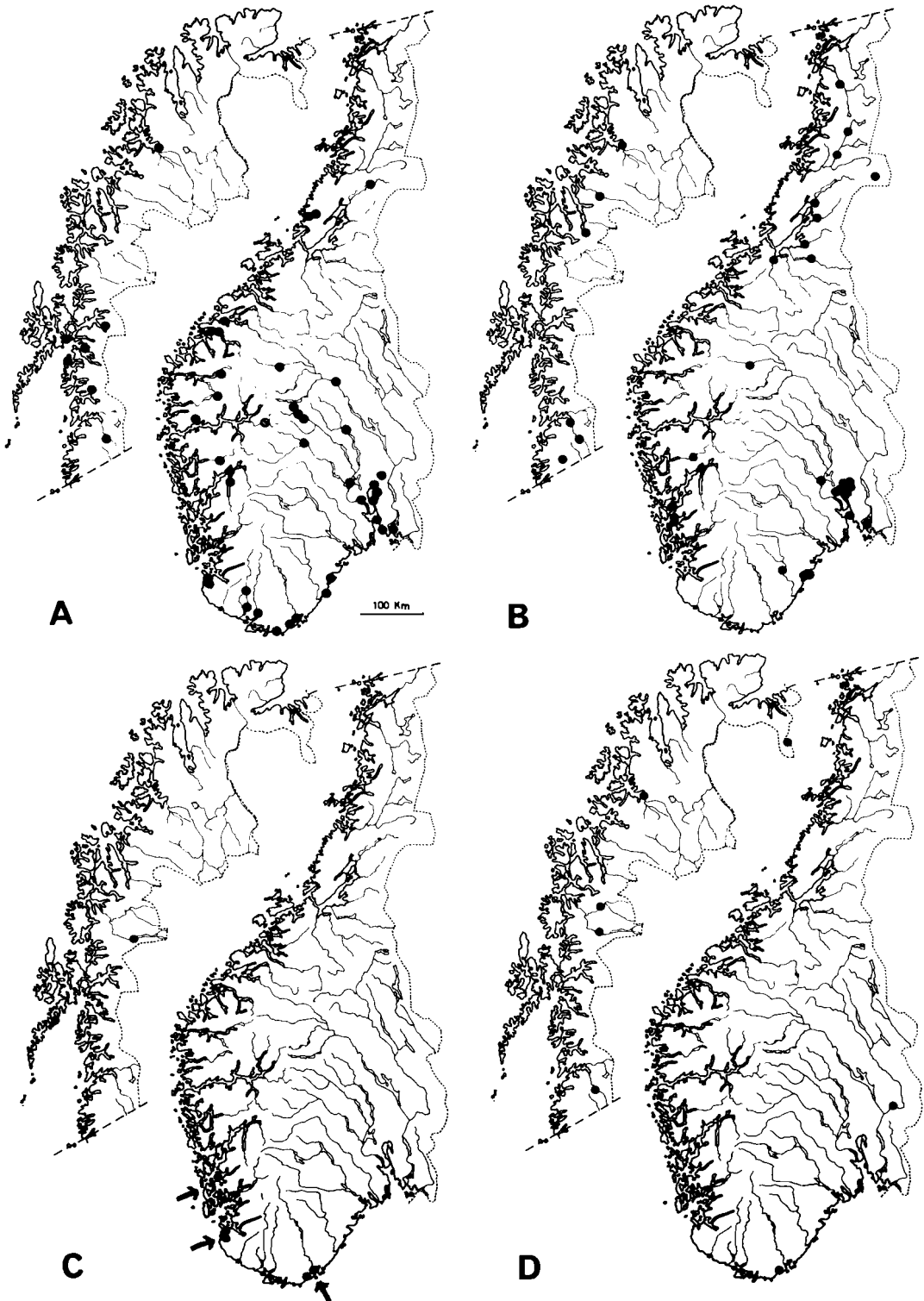


Fig. 13. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia plumbeolata*, B. *E. bilunulata*, C. *E. valerianata*, D. *E. palustraria*.

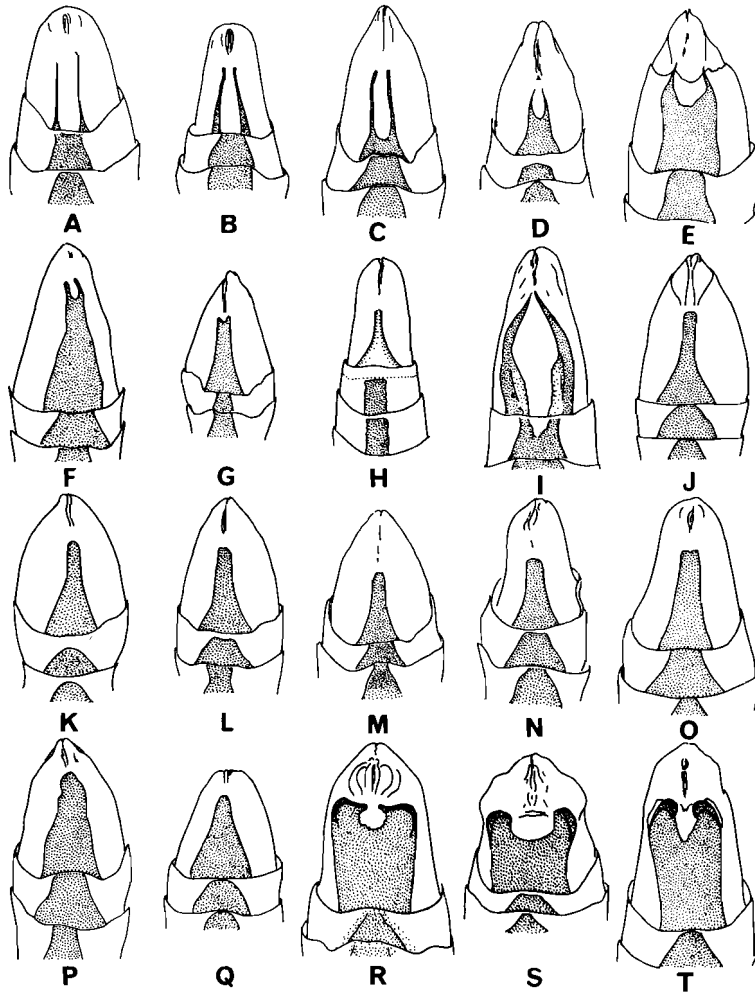


Fig. 7. Genitalia of the male, ventral plate: A. *E. pulchellata*, B. *E. plumbeolata*, C. *E. castigata*, D. *E. tantillaria*, E. *E. pini*, F. *E. sobrinata*, G. *E. indigata*, H. *G. pumilata*, I. *E. venosata*, J. *E. gelidata*, K. *E. vulgata*, L. *E. satyrata*, M. *E. nanata*, N. *E. lanceata*, O. *E. absinthiata*, P. *E. intricata*, Q. *E. assimilata*, R. *E. icterata*, S. *E. centaureata*, T. *E. succenturiata*.

land (HOy): Tysnes: Onarheim ♀ 26 June 1957 (B&L), Anuglo ♂ 25 June 1957 (B&L). *Doubtful records*: *Eupithecia exiguata*, Sparre Schneider (1876), HOy: Bergen, Kalfaret 1 specimen (Sølsberg) medio June 1870 or 1871, later corrected to *E. nanata* (Hb.) by Sparre Schneider (1901) *Eupithecia exiguata*, Schøyen (1883), MRy: Vestnes one worn specimen 25 June 1880, not present in the ZMO collection. *Tephroclystia exiguata*, Grønlien (1921), HOi: Vossevangen 1 specimen ult. June 1910, probably lost. *Distribution* (based on reliable records):

South-eastern Norway north to 60°20' N.L. and west to Søgne (58° N.L.). Isolated area in western Norway: HOy: Tysnes. *Vertical distribution*: From sea level to 400 m (Os: Roa). *First capture*: Oslo ♂ 1 June 1849 (Si). *Recorded food-plants*: Different trees and bushes. *Flight*: 26 May–26 June.

Eupithecia valerianata (Hübner, 1809–13)
Norwegian records: *Eupithecia valerianata*; Knaben 1955; Nielsen 1956; Berggren 1970; Opheim 1972.

Localities: Vest-Agder (UAY): Kristiansand a few specimens in June every year 1965–1970 (KB); Søgne ♂ 22 June 1960 (CFL). *Rogaland (Ry):* Sandnes: Øksnevad ex larvae on *Ualeriana officinalis*, in numbers 1954–55 (AN), Gausel ♂ 26 June 1954 (Fu). *Hordaland (HOy):* Fjelberg: Borgundøy ♂ 30 June 1957 (MO). *Nordland (Nnv):* Svolvær ♂ 27 July 1951 (MO). *Troms (TRi):* Bardu: Innsetfalla ♂ 6 July 1964 (AF).

Distribution: A few scattered localities from Kristiansand 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:* *Ualeriana officinalis*. *Flight:* 22 June–27 July.

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

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

Localities: Hedmark (HEs): Sør-Odal ♀ 4 June 1882 (WMS). *Vest-Agder (UAY):* Søgne ♀ 30 June 1966 (CFL). *Nordland (Nsi):* Saltdal ♂, ♀ 6 July 1881 (WMS), Storjord ♂ July 1918 (JR). *Troms (TRi):* Bardu: Strømsmo ♀ 8 July 1893 (SS); Målselv: Bjerkeng ♂ 17 June, 2 ♀♀ 19 June 1897 (SS). *Finnmark (Fi):* Alta: Bosekop 2 ♀♀ 26 June 1924 (EB). *Fø:* Sør-Varanger: Vaggatem ♂ 9 July 1965, Storskogen (CFL).

Doubtful and erroneous records: Tephroclystia pygmaeata, Strand (1902), Os: Land, Odnes one ♀ in the ZMO collection (= *E. plumbeolata* (Haw.)). *Eupithecia pygmaeata,* Christie (1909), Hes: Vang ♀ 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.

Distribution: Mainly found in northern Norway between 66°45" and 70° N.L., only 2 localities in the south. *Vertical distribution:*

Only captured in the lowland. *First capture:* Fi: Alta 2 ♀♀ 26 June 1878 (SS). *Recorded food-plants:* *Stellaria* and *Cerastium*. *Flight:* 4 June–9 July.

Eupithecia undata (Freyer, 1840)

ssp. *fennoscandica* Knaben, 1949 (Figs 2C, 9H) *Norwegian records: Eupithecia fennoscandica:* Knaben 1949. *Eupithecia undata:* Opheim 1972.

Locality: Finnmark (Fi): Alta: Jotkajavre ♀ 9 July 1924 (EB).

Doubtful and erroneous records: Eupithecia scriptaria, Schøyen 1885, Nsi: Saltdal ♂ and ♀ 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: Bv: Hol ♂ 8 July 1912 in the ZMO collection (= *Chloroclystis chloerata* Mab.). *Eupithecia undata,* Feichtenberger (1965), Nsi: Rana, Tverånes ♀ 18 June 1944, Selfors ♀ 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.

Distribution in Fennoscandia: Between 68° and 69°45" N.L. *Vertical distribution:* Between 400 and about 800 m. *Recorded food-plant:* *Silene rupestris* in Central Europe (Prout 1915). *Flight:* 4–20 July.

Eupithecia venosata (Fabricius, 1787) (Figs 2D, 7I, 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; Grønlien 1921; Barca 1923.

Localities: Østfold: Moss (EB), Jeløy (GN). *Akershus:* Oslo: Rosenberg (Es), Tøyen (Si,

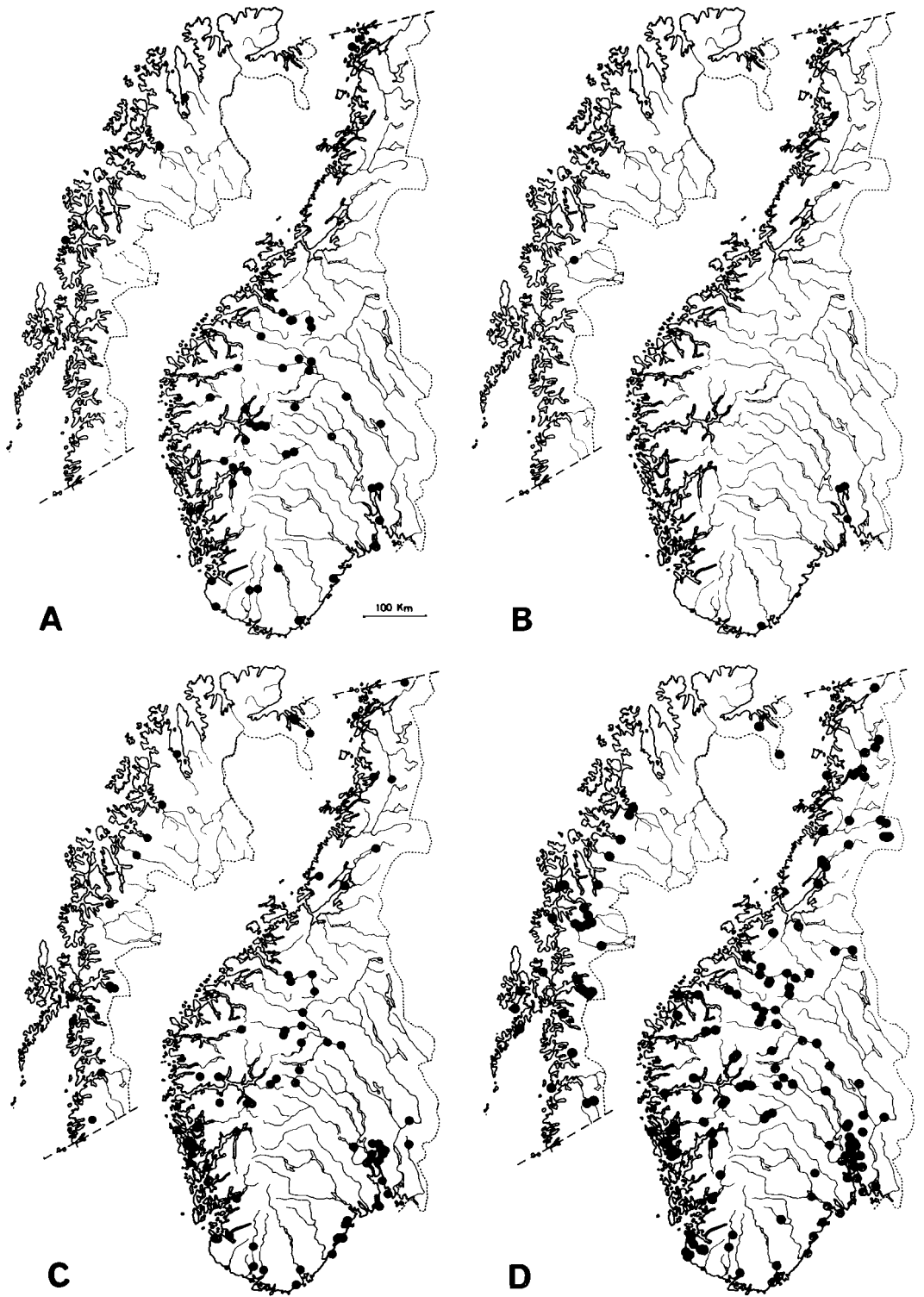


Fig. 14. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia venosata*, B. *E. actaeata*, C. *E. intricata*, D. *E. satyrata*.

WMS), Bestun (MO). *Hedmark (HEs)*: Vang: Hjellum (WC). *Oppland (Os)*: Sør-Aurdal: Bagn (KH); Øyer (JR). *On*: Ø. Slidre: Beito (MO, NK); Sel: Heidal (SS), Laurgård (WMS); Vågå: Skorvangseter (MO); Lom (MO, CFL); Lesja: Stuguflåten (JR). *Buskerud (Bu)*: Ål (ES); Høl (KH). *Vestfold*: Tjøme (MO). *Aust-Agder (AAy)*: Risør: Laget (NK). *AAi*: Bygland: Austad (ES). *Vest-Agder (UAY)*: Kristiansand (KB). *UAI*: Fjotland: Knaben gård (NK); Sirdal (ES). *Rogaland (Ry)*: Ognå (WMS); Sandnes: Gausel (AN). *Hordaland (HOy)*: Onarheim (MO); Fitjar (MO); Herdla (EB). *HOi*: Eidfjord (EB); Ullensvang (TE); Granvin (EB); Voss (NG). *Sogn og Fjordane (SFy)*: Jølster: Ålhus (EB). *SFi*: Hafslø (NK), Solvorn (NK); Aurlandsvangen (NK); Lærdal: Blåflat (NK), Bjørkum (NK), Stuvane (MO); Borgund: Vindhella (MO); Stryn: Skare (MO). *Møre og Romsdal (MRi)*: Surnadal: Kvanne (RM); Sunndal: Gikling (MO), Jenstad (MO), Svisdal (MO). *Sør-Trøndelag (STi)*: Oppdal: Drivdalen (Wck, WMS, NK), Drivstua (NG). *Nordland (Nsy)*: Lurøy: Sleneset (RM). *Nnv*: Sortland (SS). *Troms (TRy)*: Hillesøy (SS). *Finnmark (Fi)*: Alta, Kåfjord (Ch). *Fn*: Porsanger: Børselv (WMS).

Distribution: Moderately distributed north to 63° N.L., farther north a few records between 66° and 70° N.L. *Vertical distribution*: From sea level to 1000 m (On: Skorvangseter). *First capture*: Oslo: Rosenberg 1 July 1846 (Es). *Recorded food-plant*: *Silene vulgaris*. *Flight*: 14 June–11 Aug.

Eupithecia egenaria Herrich-Schäffer, 1848 (Fig. 10D)

Norwegian records: *Eupithecia egenaria*: Knaben 1957; Svensson 1957; Opheim 1972. *Locality*: Østfold: Jeløy ♀ 6 June 1953 (GN). *Recorded food-plant*: *Tilia*. *Remarks*: In the Nordic countries *E. egenaria* was later discovered in Sweden (1956), Denmark (1957) and Finland (1965).

Eupithecia centaureata (Denis & Schiffermüller, 1775) (Figs 2E, 7S, 10L)

Norwegian records: *Eupithecia centaureata*: Schøyen 1875; Nielsen 1956; Berggren 1970; Opheim 1972. *Eupithecia oblongata*: Sparre Schneider 1876a, 1890; Lampa 1885; Schøyen 1893; Henrichsen 1907, Haanshus 1921. *Tephroclystia oblongata*: Barca 1910.

Localities: *Østfold*: Sarpsborg (EB); Rygge: Dilling (EB); Moss (EB); Jeløy (EB, GN). *Akershus*: Nesodden: Spro (KH); Ås (He); Bærum: Sandvika (EB); Oslo: Tøyen (Si, WMS, NK), Tobiesens løkke (Es), Malmøya (Es), Oscarshall (Es), Kristiania (SS), Hegdehaugen (SS), V. Aker (SS), Slemdal (JR), Frogner (MO). *Hedmark (HEs)*: Sør-Odal (WMS). *Buskerud, Bø*: Lier: S. Linnes (NK). *Vestfold*: Holmestrand (NK). *Telemark (TEy)*: Jomfruland (MO). *Aust-Agder: AAy*: Risør (Th), Laget (NK); Tromøy (AB). *Vest-Agder: UAY*: Kristiansand (KB). *Rogaland: Ry*: Ognå (AN); Klepp: Vig (AN), Reve (Fu); Sandnes: Gausel (Fu); Gjesdal: Figgeren (FJ); Sola: Kolnes (FJ); Randaberg: Sande (FJ). *Distribution*: Mainly along the coast from Oslo to Stavanger. *Vertical distribution*: A lowland species, not found above 150 m. *First capture*: Oslo: Malmøya ♂ 1 June 1846 (Es). *Recorded food-plant*: Different species of Umbelliferae, Ericaceae, Campanulaceae, Compositae. *Flight*: Bivoltine, 24 May–16 July, 2–24 Aug.

Eupithecia actaeata Walderdorff, 1869

ssp. *bergunensis* Dietze, 1875 (Figs 2F, 14B) *Norwegian records*: *Eupithecia actaeata* v. *bergunensis*: Sparre Schneider 1895a. *Tephroclystia actaeata*: Sparre Schneider 1921. *Eupithecia actaeata*: Opheim 1972.

Localities: *Østfold*: Moss ♀ 25 July 1915 (EB); Jeløy ♀ 6 July 1953 (AN). *Akershus*: Oslo ♀ 25 June 1876 (as '*E. vulgata*' WMS); Bærum Slependen ♀ July 1962 (AU). *Vest-Agder (UAY)*: Søgne ♀ 25 June 1966 (CFL). *Nord-Trøndelag (NTi)*: Snåsa ♀ 10 July 1884 (as '*E. vulgata*' WMS). *Nordland (Nsy)*: Bindal, Lande ♀ 14 July 1947 (MO). *Troms (TRi)*: Målselv: Nymo 1 specimen 1 July 1884 (SS). *Distribution*: 7 localities only, from 58° to 69° N.L. *Vertical distribution*: Not above 150 m. *First capture*: Oslo ♀ 25 June 1876 (WMS). *Recorded food-plants*: *Actaea spicata*, *Thalictrum flavum*, below leaves. *Flight*: 25 June–25 July.

Remarks: It is odd that no males have been observed in Norway.

Eupithecia trisignaria Herrich-Schäffer, 1848

Norwegian records: *Eupithecia trisignaria*: Opheim 1972; Lühr 1973.

Localities: *Vestfold*: Sem: Narverød 4 Aug.

1970 (CFL). *Vest-Agder (UAY)*: Søgne ♀ 10 July 1966 (CFL).

Erroneous records: Tephroclystia trisignaria, Grønlien (1921), Hoi: Voss ♂ 22 June 1916 (= *goosensata* Mab.). *Eupithecia trisignaria*, Haanshus (1921), AK: Spro ♂ 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; Schøyen 1880, 1893; Lampä 1885; Strand 1900; Henrichsen 1907; Haanshus 1921; Lundetræ 1938. *Tephroclystia helveticaria*; Strand 1904; Sparre Schneider 1913. *Eupithecia intricata*; Opheim 1950, 1972; Nielsen 1956; Lühr 1960; Feichtenberger 1956.

Localities: Østfold: Onsøy: Rauer (EB); Jeløy (GN). Akershus: Ås (He); Nesodden: Spro (KH); Høland: Bjørkelangen (MO); Oslo: Tøyen (ST), Abildsø (ST), Nordstrandshøyden (EB), Maridalen (NK, CFL), Nordmarka (WMS); Bærum: Slepnden (AU); Asker (CFL). Hedmark (HEs): Sør-Odal (WMS). Oppland (Os): Ringebu (WMS). On: Vang: Helinstrond (NK); Ø. Slidre: Beito (NK, MO); Nord-Fron: Vinstra (MO); Vågå: Vågåmo (MO), Hindseter (CFL); Lom: Bøverdalen (WMS), Fossberg (CFL); Dovre: Dombås (WMS). Buskerud (Bø): Modum (WMS); Lier: S. Linnes (NK). Vestfold: Tjøme (NK, MO). Telemark (TEy): Kragerø (Ull?), Fosning (AU). Aust-Agder (AAy): Risør (JH), Laget (NK); Tromøy (AB). Vest-Agder (UAY): Vennesla: Vigeland (Haw); Søgne (CFL); Kvinesdal: Gjemlestad (NK); Sireosen (ES). UAI: Sirdal (ES). Rogaland (Ry): Sandnes: Gausel (AN, Fu), Dale (AN). Ri: Forsand (NK); Suldal: Lægdedn (Fu), Neset (Fu). Hordaland (HOy): Fjelberg: Eidsvik (MO), Halsnøy kloster (MO), Borgundøy (MO); Tysnes: Anuglo (B&L); Austevoll: Nausthellar (MO); Os: Nordstrøna (AN); Fana: Fjelltveitvatn (NK), Grimseid (NK), Minde (EB); Bergen: Kalfaret (MO), Starefoss (NK), Knatten (NK); Osterøy: Kleppe (MO), Njåstad (MO), Øvre Botnvatn (MO); Herdla (NK). HOI: Kinsarvik: Djonno (Lu). Sogn og Fjordane (SFy): Gaular: Sande (NK), Viken (NK). SFi: Vik: Høgeggji (NK); Aur-

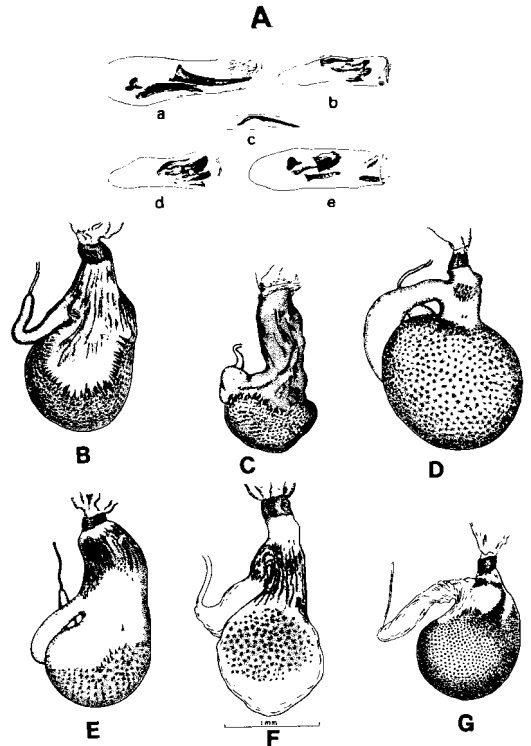


Fig. 8. Genitalia of the male, aedeagus: Aa. *E. sobrinata* AAY: Bygland 14 Aug. 1931 (NK), b. *E. vulgata* HOY: Os, Hagavik 16 May 1937 (NK), c. *G. pumilata* no loc., d. *E. assimilata* HOY: Os, Hagavik 16 May 1937 (NK), e. *E. intricata* AAY: Risør, Laget 12 June 1930 (NK). Genitalia of the female, bursa copulatrix: B. *E. absinthiata*, C. *E. sobrinata*, D. *E. castigata*, E. *E. denotata*, F. *E. tripunctaria*, G. *E. vulgata*.

land: Fretheim (NK), Aurlandsvangen (NK), Nyheim (NK), Vassbygdi (AF); Borgund: Eggum (NK), Kvamma (NK), Maristova (NK); Stryn: Videseter (MO). Møre og Romsdal (MRi): Sunndal: Vangshaugen (MO), Storfale (MO). Sør-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: Svartisen (SR). Nsi: Grane: Majavatn (MO); Nord-Rana: Svartisdal (SR); Fauske (CFL). Nno: Skjomen (MO), Elvegård (MO), Fjellbu (MO); Hamarøy (ES); Tysjord (ES). Nuv: Lødingen (ES). Troms (TRi): Malangen: Skjåvikør (SR); Kvænangen (SS); Nordreisa: Javreoaivek (NK). Finnmark (Fi): Alta (Wck.) Fn: Kistrand (Øw). Fø: Sør-Varanger: Kirkenes (We), Svanvatn (We).

Doubtful and erroneous records: ?*Eupithecia helveticaria*, Sparre Schneider (1876), Hoi: Kvam, Tangerås. *Eupithecia helveticaria*, Lie-Pettersen (1897), SFi: Lærdal, Mo 22 July 1897. *Eupithecia helveticaria*, Lie-Pettersen (1898), SFi: Stryn July 1898. ?*Eupithecia helveticaria*, Strand (1899), Bv: Ål ♀ July 1898 (= *E. denotata* (Hb.)). *Eupithecia helveticaria*, Strand (1901), Nnv: Langøy and Hadsel. ?*Eupithecia helveticaria*, Sparre Schneider (1901), HOy: Bergen 'common', Lie-Pettersen. *Tephroclystia helveticaria*, Grønlien (1921), HOi: Voss, Vossevangen 1 specimen ultimo May 1909.

Not verified records: *Larentia intricata*, Zetterstedt (1839), Nnø: Ankenes, Bjerkvik; Fn: Talvik. *Eupithecia helveticaria*, Wocke (1864), HES: Løten 3 May 1862. *Eupithecia intricata*, Feichtenberger (1965), Nsi: Nord-Rana, Tverånes and Mofjell (350 m) 4 ♀♀ 12 June–2 July.

Distribution: From 58° to 70°25' N.L. *Vertical distribution:* From sea level to 1000 m (STi: Kongsvoll). *First capture:* Fi: Alta ♂ 15 June 1860 (Wck). *Recorded food-plant:* *Juniperus communis*. *Flight:* 30 Apr.–30 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 HOi: Voss, Haugemoen the distal mark is absent.

Individual variation is considerable, specially 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).

Distribution (in Fennoscandia): Finland: Southern part; Sweden: Öland and Västergötland. *Recorded food-plant:* *Solidago virgaurea*. *Flight:* Medio June–medio July.

Remarks by M.O.: Knaben did not leave any written notes about this species except what was registered in his genitalia journal. 3 ♀♀ were dissected, two of which were considered doubtful (VAy: Søgne 22 June 1960 (CFL) and AK: Bærum, Slependsen 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. cauchita* 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 $\frac{1}{3}$ and $\frac{2}{5}$.

The specimen from V. Aker is in good agreement with the characters relating to *E. cauchiata*. The specimen from Søgne has some chitinized stripes, the row of thorns consists of fewer and weaker pieces, and the dorsal extension of thorns is about $\frac{2}{5}$ of the length of bursa + ductus. The specimen from Slependsen has few chitinized stripes, but is otherwise similar to the Søgne 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, 1898, 1901; Schøyen 1879, 1880, 1882, 1883, 1893; Lampa 1885; Lie-Pettersen 1897, 1898; Strand 1899, 1900, 1901; Heinrichsen 1907; Christie 1909; Buxton 1914; Haanshus 1921; Lundetræ 1938; Werner 1940;

Opheim 1950, 1969, 1972; Nielsen 1956; Lühr 1960; Feichtenberger 1965; Berggren 1970; Mehl 1971. *Tephroclystia satyrata*: Strand 1902, 1904; Sparre Schneider 1907, 1914, 1921; Barca 1910; Hawkshaw 1919; Grønlien 1921.

Localities: Østfold: Sarpsborg (EB); Onsøy: Rauer (EB); Jeløy (GN, AN, MO). *Akershus*: Ås: Tirudmosan (SP); Frogn: Håøya (MO, CFL); Nesodden: Spro (KH); Oppegård: Kolbotn (MO); Oslo: Kristiania (ES), Tøyen (Si), Ekeberg (Si), Rosenberg (Es), Linderud (Si), V. Aker (WMS), Sognsvann (NK), Maridalen (NK), Nordmarka (WMS), Appelsin- haugen (MO), Bogstad (JR, CFL); Bærum: Lysaker (WMS), Stabekk (Si), Ostøya (MO), Slependen (AU); Asker (CFL), Nesøya (NK); Gullhella (JH, MO); Ullensaker (WMS); Hurdal: Tømte (AB). *Hedmark (HEs)*: Sør- Odal (WMS); Vang: Hjellum (WC). *HEn*: Kvikne: Sverja (MO). *Oppland (Os)*: Lunner: Roa (MO), Mylla (MO); S. Land: Odnes (ES); Nord-Aurdal: Fagernes (MO); Lillehammer (WMS); Ringebu (EB). *On*: V. Slidre: Høyne (NK), Grønsenn (NK); Ø. Slidre: Beito (NK, MO); Nord-Fron: Vinstra (MO); Vågå: Vågåmo (AN), Kvarberg (MO), Bessheim (MO); Lom: Fossberg (CFL), Bøverdalen (WMS), Elveseter (CFL); Skjåk (MO); Dovre: Dombås (WMS). *Buskerud (Bø)*: Røyken: Høvik (MO); Lier: S. Linnes (NK); Modum (WMS); Kongsberg: Skrim (NK). *Bv*: Ål (ES); Hol: Ustaoset (Hellmann). *Vestfold*: Holmestrand (NK); Brunlanes: Nevlunghavn (EB). *Telemark (TEy)*: Porsgrunn (ES); Nome: Ulefoss (ES); Kragerø (WMS). *TEi*: Fyresdal, Kilegrend (MO). *Aust-Agder (AAy)*: Risør: Laget (NK); Tromøy: Ballesvik (CFL). *Vest-Agder (UAY)*: Kristiansand (KB); Søgne: (CFL); Venesla: Vigeland (Haw); Sireosen (ES); Kvinesdal: Gjemlestad (NK). *VAi*: Sirdal (ES), Dyngjane (AN). *Rogaland (Ry)*: Bjerkeim: Grøtteland (MO), Sandane (MO), Maudal (MO), Vaule (MO); Hå: Nærbø (WMS); Klepp: Orre (AN), Vig (AN); Sandnes: Gausel (AN, Fu), Myrland (TN), Helgeland (TN); Stavanger: Solheim (FJ), Solvang (FJ), Mosvatnet (FJ). *Ri*: Suldal: Lægdedn (Fu), Neset (Fu), Ogdedn (Fu). *Hordaland (HOy)*: Os (Lindén); Bergen: Hauglandsdalen (NK), Fjelltveitvatn (NK), Thoreshaug (EB), Minde (EB), Damsgård (SS), Knatten (NK); Osterøy: Kleppe (MO), Njåstad (MO), Ljosbu (MO), Øvre Botnvatn (MO); Herdla (NK).

HOi: Røldal (CFL), Horda (Lu); Ullensvang (NG); Kinsarvik: Djonno (Lu); Voss (EB), Vossevangen (NG), Haugamoen (NG). *Sogn og Fjordane (SFy)*: Lavik (ES); Gular: Viken (NK). *SFi*: Vik: Høglii (NK); Aurland: Fretheim (NK); Lærdal: Stuvane (MO); Borgund: Eggum (NK), Hegg (NK), Galdestølen (NK); Luster: Turtagrø ex larvae (SS), Skjolden (NK); Stryn: Hammerstadli (NK), Videseter (MO). *Møre og Romsdal (MRy)*: Ørsta (JW); Ålesund (JR); Ørskog (WMS). *MRI*: Rauma: Romsdal (WMS), Trolltindene (MO), Flatmark (MO); Sunndal: Jenstadlia (MO), Mid- dagshjellen (MO), Gikling (MO), Inderdalen (MO); Surnadal: Kvanne (RM). *Sør-Trøndelag (STy)*: Bjugn: Sæter (MO); Melhus: Benna (NK); Orkdal: Søvatn (RD). *Nord-Trøndelag (NTy)*: Namsos: Alhusvatn (SR). *NTi*: Inderøy (WMS); Beitstad (WMS); Steinkjer (WMS); Snåsa (WMS); Grong: Fiskum (CFL); Sørli: Udland (MO), Lemenvann (MO), Guspiggen (MO); Nordli: Gasterfjell (MO), Finhustjern (MO). *Nordland (Nsy)*: Bindal: Tosdalen (MO); Sømna: Sandvåg (SR); Bodø: Hernes (AF). *Nsi*: Grane: Maja- vatn (MO), Holmvassdal (MO), Fjellstuen (MO), Klovimonen (ES); Hattfjelldal (ES), Røsvatn (ES); Nord-Rana: Storfosshei (CFL); Saltdal: Storjord (MS, JR), Junkerdalsaura (SS), Solvågfejll (CFL). *Nno*: Tysfjord (ES); Skjomen: Mølne elv (MO), Elvegård (MO), Olderholmen (MO), Fjellbu (MO), Nord- dalen (MO); Narvik (MO), Kvitsand (MO); Sørfold: Bonnasjøen (CFL). *Nnv*: Lødingen (ES); Hadsel (ES); Langøy (ES); Svolvær (MO); Vestvågøy: Leitet (MO), Okstind (MO). *Troms (TRY)*: Harstad (EB); Tromsø (SS, SR, NK), Tromsdal (SS); Senja (NK). *TRi*: Bals- fjord: Storstenes (SS), Skjåvikør (SR); Bardu: Grønnfjord (CFL); Målselv: Fagerli (SS), Nymo (SS), Moen (SS), Nordmo (SS), Bjer- eng (SS); Storfjord: Skibotn (JG); Kvænangen SS, Kaisila: Nordreisa: Raipas (NK), Sappen (NK), Javreoaivek (NK). *Finnmark (Fi)*: Alta: Bossekop (WMS, SS, NG), Vina (EB), Kå- fjord (EB), Romsdal (EB). *Fø*: *Sør-Varanger*: Neiden (CFL), Vaggatem (CFL).

Not verified records: The record of Sparre Schneider (1876) refers to HOi: Kvam, Tan- gerås, and that of (1878) to Bø: Drammen, Gulskogen. Schøyen (1879), On: Sel, Laur- gård. Sparre Schneider (1880), Nsi: Berarn, Tollå. Schøyen (1882), Nsy: Bodø (Schilde) and Nsi: Saltdal, Rognan (Schilde). Sparre

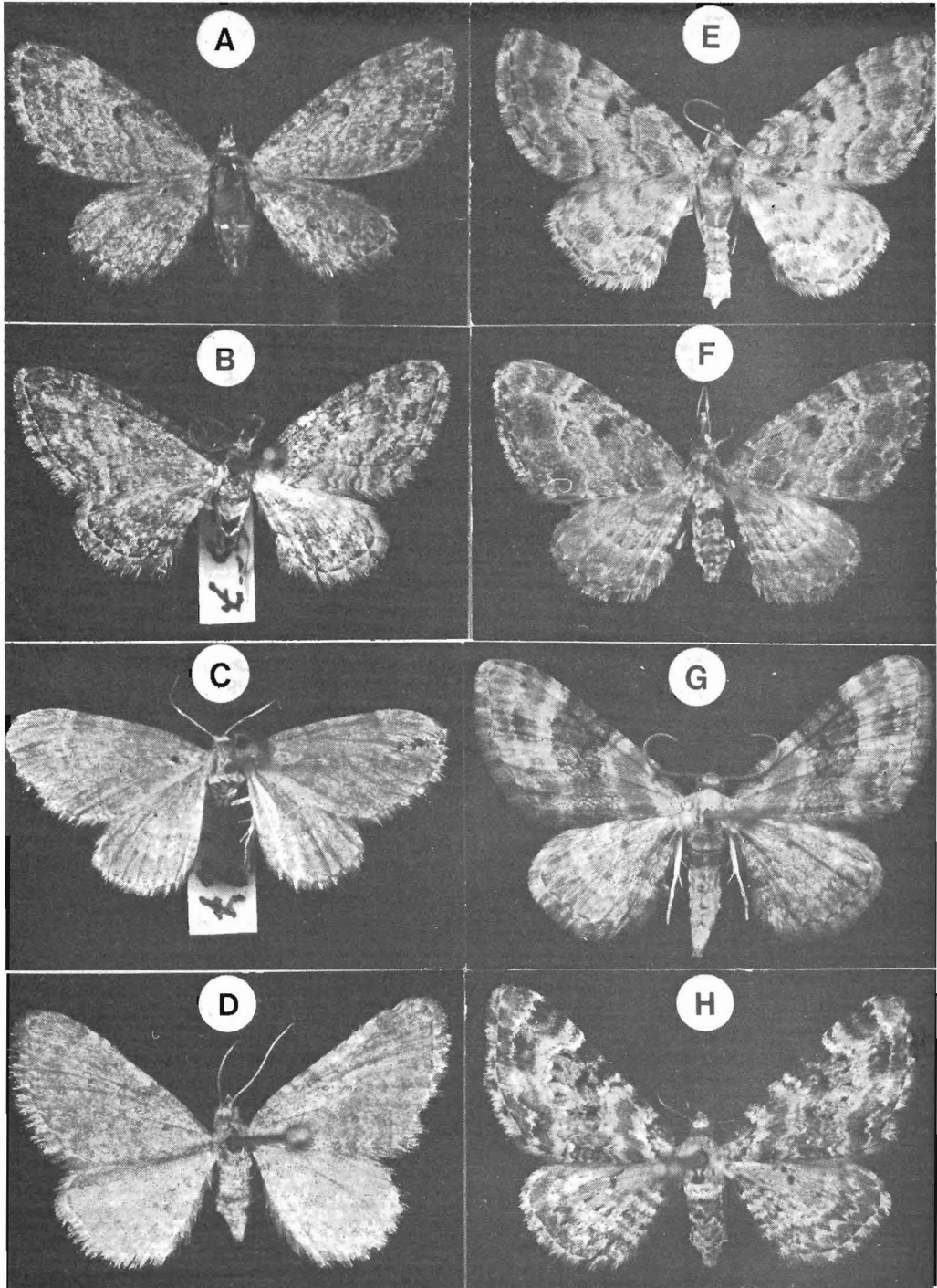


Fig. 1. A. *E. tenuiata* Hb. ♀ Sarpsborg 21 July 1921 (EB). B. *E. iniurbata* Hb. ♂ Bærum, Sandvika 30 July 1934 (EB). C. *E. immundata* Z. ♀ Oslo, Rosenhof 6 July 1849 (Si). D. *E. plumbeolata* Haw. ♀ Oslo, Nordstrandshøyden 8 July 1923 (EB). E. *E. pini* Retz. ♀ Sør-Odal 23 June 1885 (WMS). F. *E. bilunulata* Zett. ♀ Sarpsborg 5 June 1922 (EB). G. *E. linariata* Schiff V. Slidre ex larva 5 May 1945 (NK). H. *E. pulchellata* Steph. ♀ Ullensvang 21 June 1908 (NG).

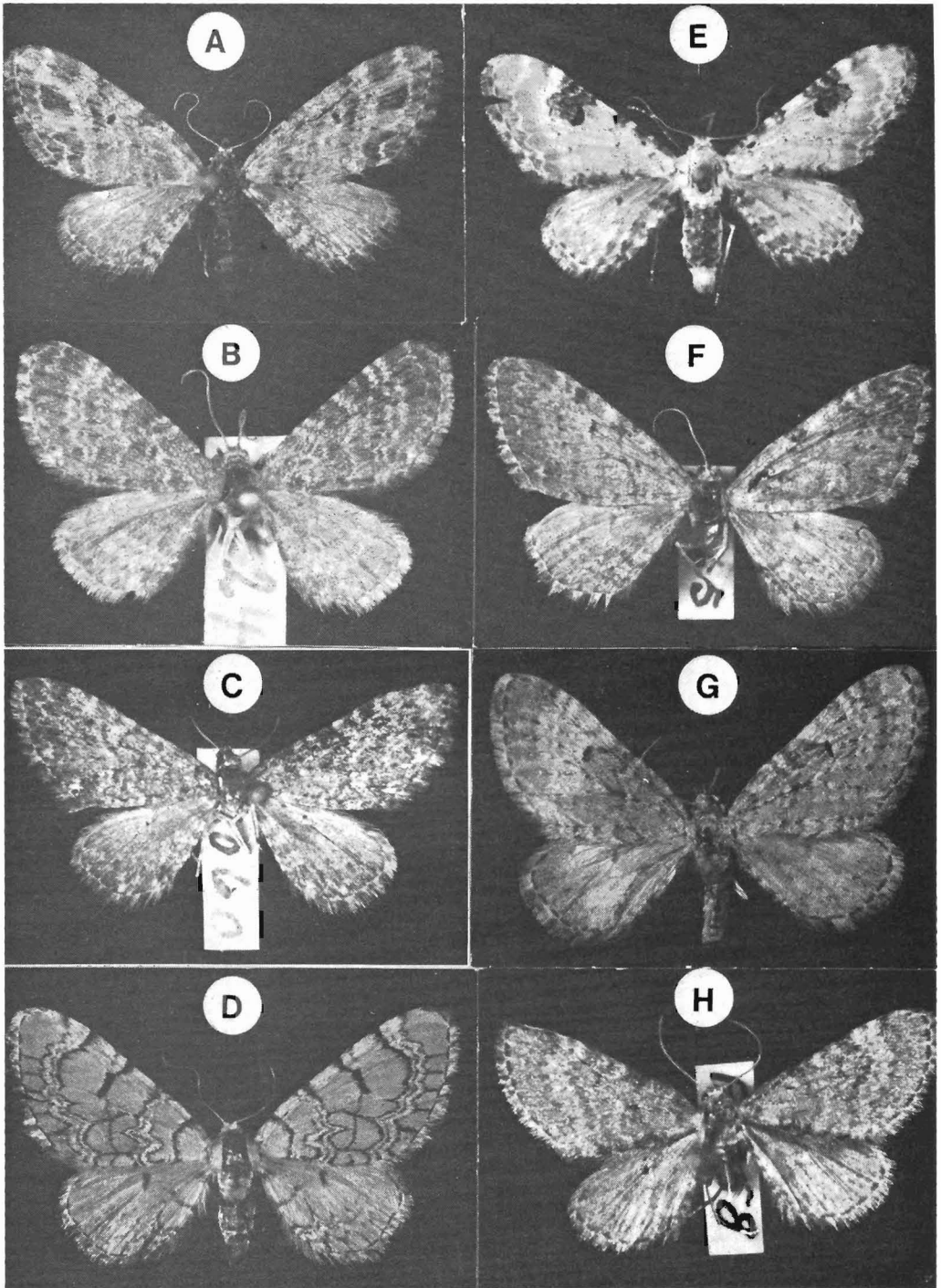


Fig. 2. A. *E. exiguata* Hb. ♀ Jeloy, Orkerød 3 June 1908 (EB). B. *E. palustraria* Dbl. ♂ Saltdal 6 July 1881 (WMS). C. *E. undata fennoscandia* Knb. ♀ Alta, Jotkajavre 9 July 1924 (EB). D. *E. venosata* F. ♀ Sel, Heidal July 1913 (SS). E. *E. centaureata* Schiff. ♀ Oslo, Slemdal Aug. 1913 (JR). F. *E. actacata bergunensis* Dietze ♀ Oslo 25 June 1876 (WMS). G. *E. intricata* Zett. ♂ Kvænangen July 1881 (SS). H. ♀ *E. veatraria* H. S. ♀ Alta, Romsdal 6 June 1914 (EB).

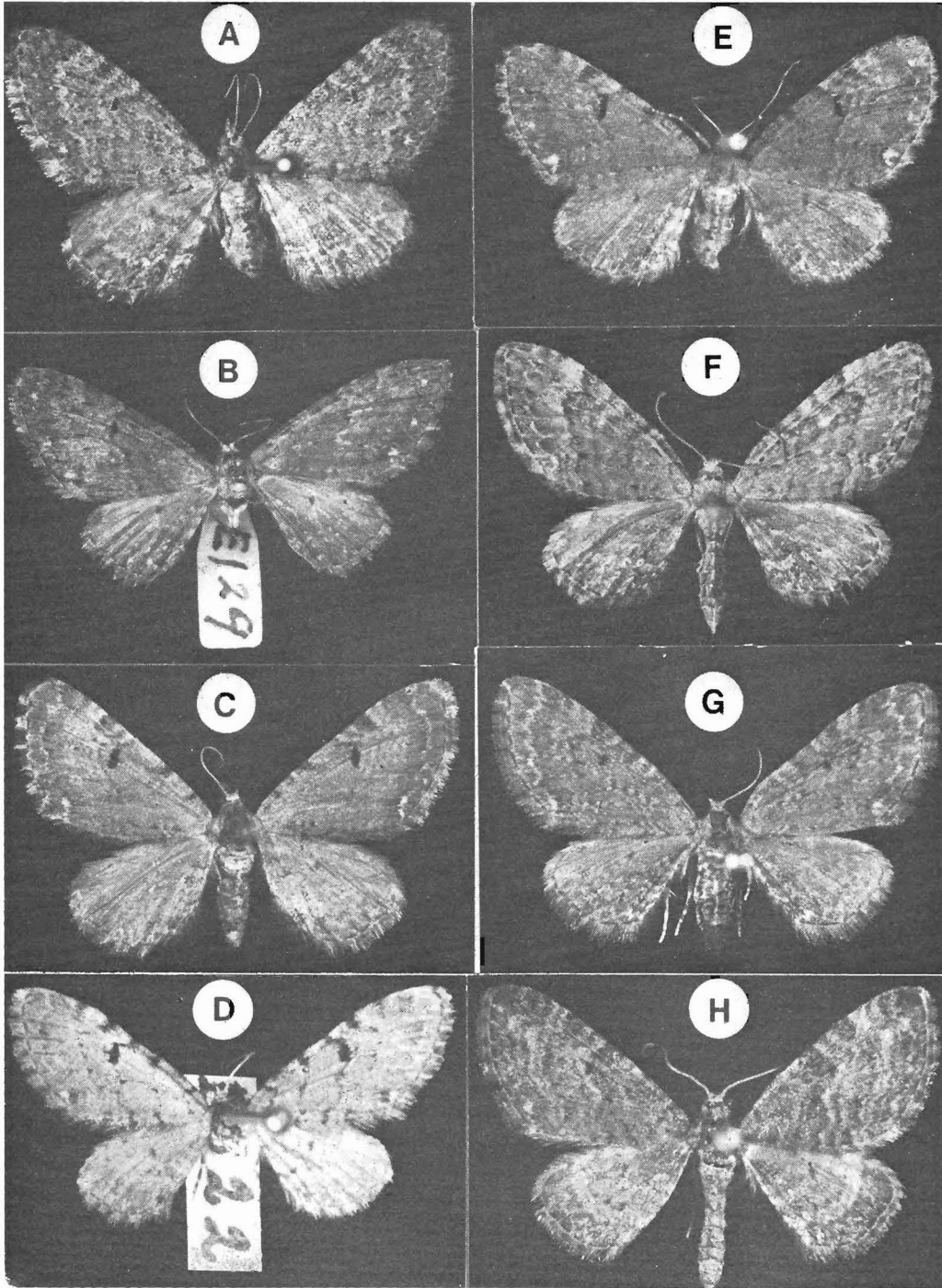


Fig. 3. A. *E. satyrata* Hb. ♀ Sarpsborg 5 June 1922 (EB). B. *E. tripunctaria* H. S. ♀ Hafslø, Kjos 6 July 1938 (NK). C. *E. absinthiata* Cl. ♀ Oslo, Tobiesens løkke 26 July 1847 (Es.). D. *E. goossensii* Mab. ♂ Voss 22 June 1916 (NG). E. *E. assimolata* Dbl. ♀ Sør-Odal 10 June 1883 (WMS). G. *E. denotata* Hb. ♀ Jeløy, Orkerød 7 July 1908 (EB). H. *E. castigata* Hb. ♂ Frogn, Håøya 15 June 1947 (MO).

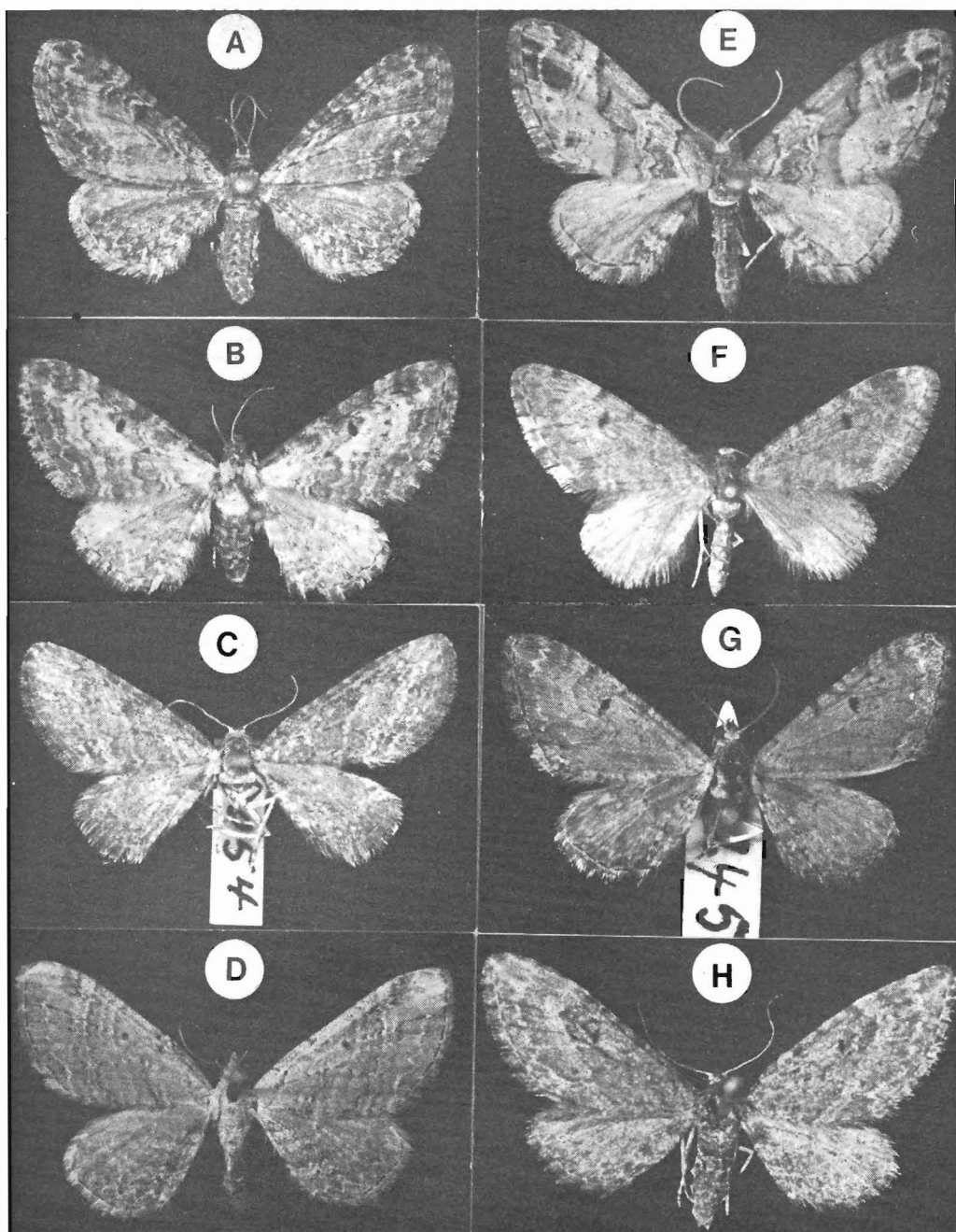


Fig. 4. A. *E. icterata* Vill. ♀ Nesodden, Spro 22 July 1912 (KH). B. *E. succenturata* L. ♀ Sarpsborg 25 June 1921 (EB). C. *E. subumbrata* Schiff. ♀ Oslo, V. Aker 6 June 1899 (SS). D. *E. subnotata* Hb. ♀ Nesodden, Spro 2 Aug. 1915 (KH). E. *E. sinuosaria* Ev. ♂ Sarpsborg 22 June 1922 (EB). F. *E. indigata* Hb. ♂ Oslo, Ekeberg 10 May 1880 (WMS). G. *E. pimpinellata* Hb. ♂ Leikanger, Foshage 2 July 1939 (NK). H. *E. gelidata hyperboreata* Stgr. ♀ Sør-Varanger July 1882 (SS).

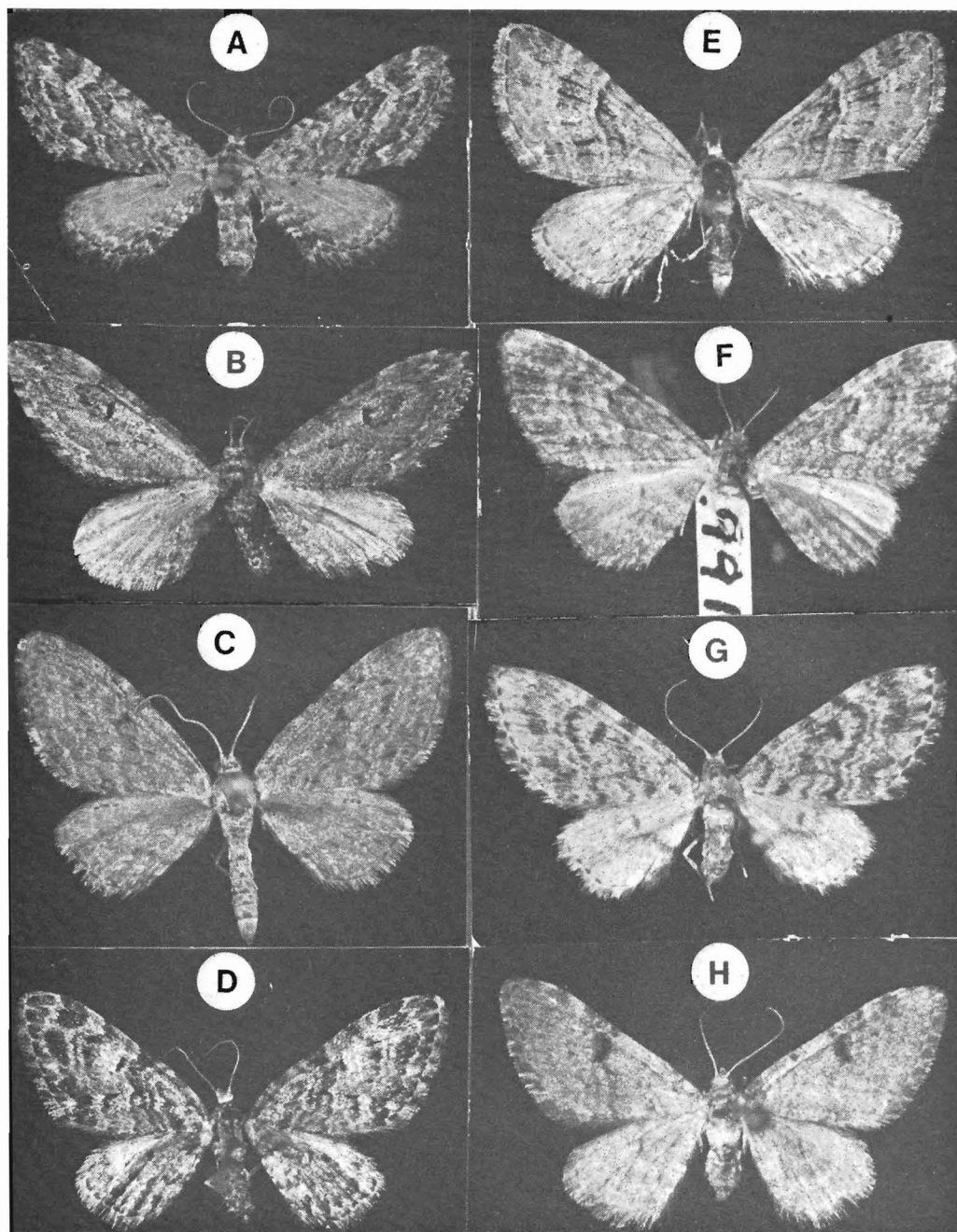


Fig. 5. A. *E. nanata* Hb. ♀ Sarpsborg 25 June 1921 (EB). B. *E. innotata* Hufn. ♂ Sarpsborg 5 June 1922 (EB). C. *E. virgaureata attenaria* Stgr. ♂ Sor-Varanger, Strand 28 June 1892 (SS). D. *E. dodo-neata* Gn. ♀ Sandnes, Gausel 25 May 1953 (AN). E. *E. sobrinata* Hb. ♂ Ø. Slidre, Beito 7 Aug. 1946 (NK). F. *E. lariciata* Frr. ♀ Sarpsborg 24 June 1922 (EB). G. *E. tantillaria piceata* Prt. ♀ Sarpsborg 20 May 1920 (EB). H. *E. conterminata* Z. ♀ Sarpsborg 15 May 1920 (EB).

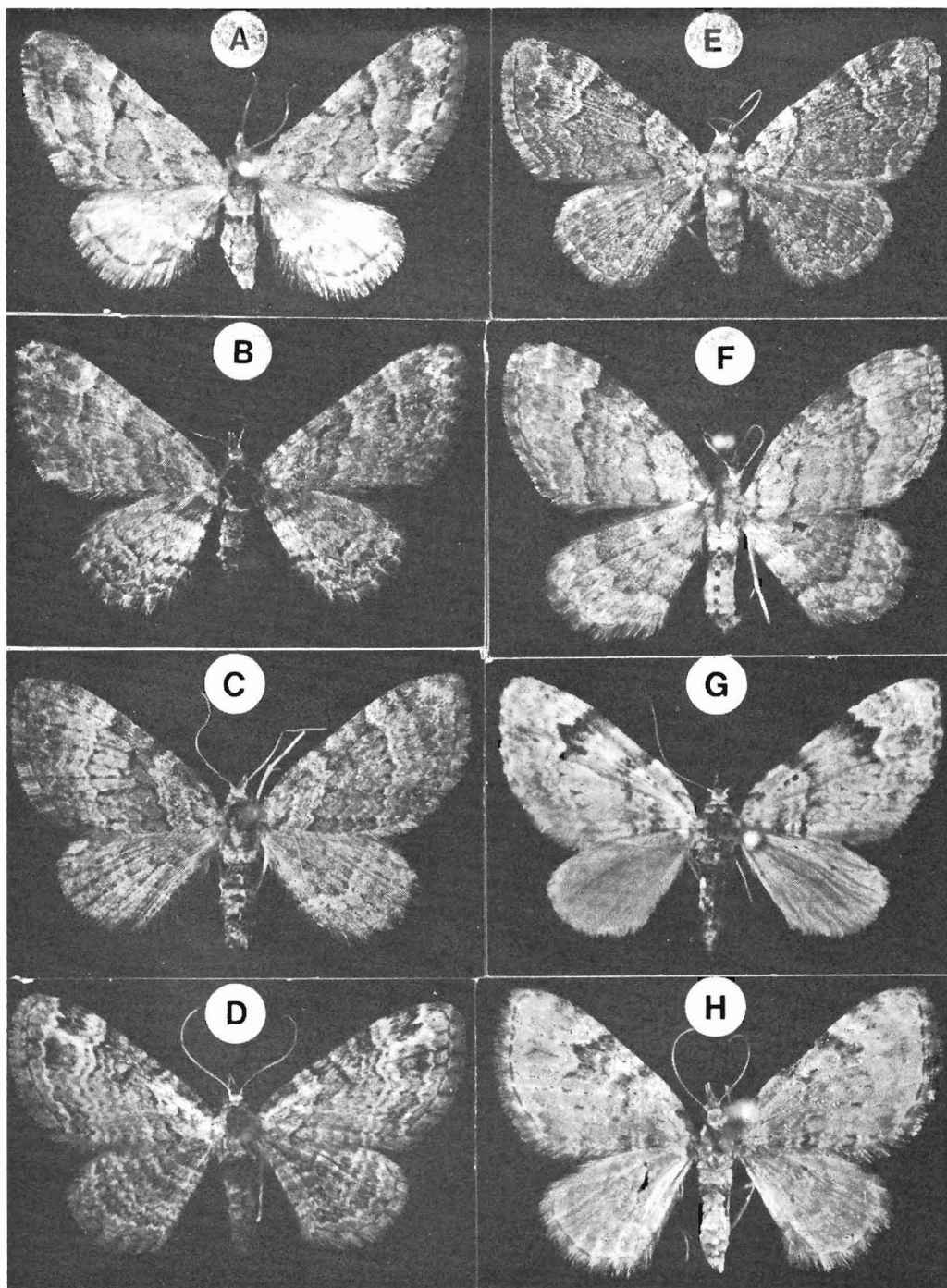


Fig. 6. A. *E. lanceata* Hb. ♀ Bærum, Sandvika 15 May 1934 (EB). B. *G. pumilata* Hb. ♀ Sarpsborg 20 May 1922 (EB). C. *C. chloerata* Mab. ♀ Saltedal, Storfjord 5 July 1898 (SS). D. *C. rectangulata* L. ♀ Sarpsborg 25 June 1921 (EB). E. *C. rectangularata* L. ♀ Oslo 19 July 1885 (WMS). F. *C. debiliata* Hb. ♀ Nesodden, Spro 21 July 1916 (KH). G. *C. coronata* Hb. ♂ Moss July 1916 (EB). H. *C. coronata* Hb. ♀ Frogn, Håøya 15 June 1947 (MO).

Schneider (1882), AAY: Tvedestrand, Nes Verk. Lie-Pettersen (1897), SFi: Lærdal, Blåflat. Strand (1900), Nsy: Dønna, and TEy: Skien. Strand (1901), Nnø: Hamarøy. Barca (1910), Ø: Moss. Buxton (1914), MRi: Surnadal, Moen. Feichtenberger (1965), Nsi: Nord-Rana, Tverånes and Mofjell (350 m).

Doubtful or erroneous records: *Eupithecia satyrata*, Schøyen (1881), Fø: Kirkenes. *Eupithecia satyrata*, Sparre Schneider (1883), Fø: Melkefoss. *Eupithecia satyrata*, Sparre Schneider (1895a), Fø: Kirkenes, Melkefoss, Strand.

Distribution: From 58° to 70° N.L. *Vertical distribution:* From sea level to 1000 m (Bv: Ustaoset). *First capture:* Oslo ♂, ♀ 11 June 1846 (Si). *Recorded food-plants:* Different Compositae, Dipsacae etc. *Flight:* 5 May–3 July.

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

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

Norwegian records: *Eupithecia tripunctaria*, Knaben 1944; Opheim 1972; Lühr 1973.

Localities: Østfold: Jeløy ♂ 1952, ♀ 6 June 1953, ♀ 15 Aug., ♀ 15 Sept. 1954, 2 ♂♂ 20 June, ♂ 25 June 1955, ♀ 8 July 1956 (GN). Akershus: Asker 23 June 1959 (CFL). Aust-Agder (AAY): Tromøy ♀ 28 June 1957 (AB). Vest-Agder (UAY): Søgne ♀ 16 June, ♀ 22 June 1960 (CFL). Sogn og Fjordane (SFi): Hafslø ♀ 6 July 1938 (NK).

Distribution: Only 4 localities on the southeast coast and one in the inner part of western Norway. *Vertical distribution:* Not above 100 m. *First capture:* SFi: Hafslø ♀ 6 July 1938 (NK). *Recorded food-plants:* Different Umbelliferae, also *Sambucus* (1. generation). *Flight:* 6 June–8 July, 15 Aug.–15 Sept.

Eupithecia absinthiata (Clerck, 1759) (Figs 3C, 7O, 8B, 15A)

Norwegian records: *Eupithecia absinthiata*; Sparre Schneider 1881, 1893, 1901; Schøyen 1882, 1893; Lampa 1885; Huitfeldt-Kaas 1892; Haanshus 1921; Opheim 1938, 1950, 1972; Nielsen 1956; Lühr 1960; Feichtenber-

ger 1965. *Tephroclystia absinthiata*; Barca 1910; Hawkshaw 1919, Grønlien 1921.

Localities: Østfold: Sarpsborg (Grimsgaard, EB); Moss (EB); Jeløy (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); Asker (JH, CFL). Hedmark, HES: Kvikne: Sverja (MO). Oppland (On): Lom (CFL). ?Buskerud (Bø): Ådal: Maribo (JR) ex larvae. Vestfold: Sem: Skallevoll (OK), Jarlsberg hovedgård (OK), Narverød (CFL); Tjøme: Ormelet (KH). Telemark (TEi): Seljord: Flatdal (MO). Aust-Agder (AAY): Risør (Th), Laget (NK); Tromøya (MO); Grimstad (CFL). Vest-Agder (UAY): Vennesla: Vigeland (Haw); Søgne (CFL); Kvinesdal: Gjemslestad (NK, Ro). Rogaland (Ry): Klepp: Vig (AN); Sandnes (AN), Gausel (AN(Fu)). Ri: Sauda (FJ). Hordaland (HOy): Fjelberg: Sæbø (MO); Os: Nordstrøna (AN); Bergen: Munkebotn (SS), Fløyen (EB). HOi: Voss (NG). Sogn og Fjordane (SFi): Aurland (NK). Møre og Romsdal (MRi): Sunndal: Jenstad (MO). Sør-Trøndelag (STy): Ørland (MO); Åfjord: Monstad (MO). STi: Trondheim (MO). Nord-Trøndelag (NTi): Snåsa (SS); Grong (WMS); Nordli (MO). Nordland (Nsy): Bindal: Tosebotn (MO). Nsi: Grane: Klovimoen (ES); Hattfjellidal (ES), Pantdalslien (ES); Saltdal (WMS); eBiarn: Tollå (SS). Nnø: Tysfjord (ES). Nnv: Svolvær (MO). Troms (TRy): Senja (NK). TRi: Bardu: Altevatt (CFL); Målselv: Dividal (CFL); Balsfjord: Skjåvikør (SR); Nordreisa: Sappen (NK).

Not verified records: Lie-Pettersen (1898), SFi: Stryn July 1898. Feichtenberger (1965), Nsi: Nord-Rana: Tverånes and Saltdal: Storfjord.

Distribution: Between 58° and 70° N.L. *Vertical distribution:* From sea level to 600 m (HEn: Sverja). *First capture:* Oslo: ♀ 25 June 1846 (Es). *Recorded food-plants:* Different species of Compositae. *Flight:* 9 May–8 June, 22 June–3 Sept.

Remarks: *E. absinthiata* and the next species, *E. goossensiata*, 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.

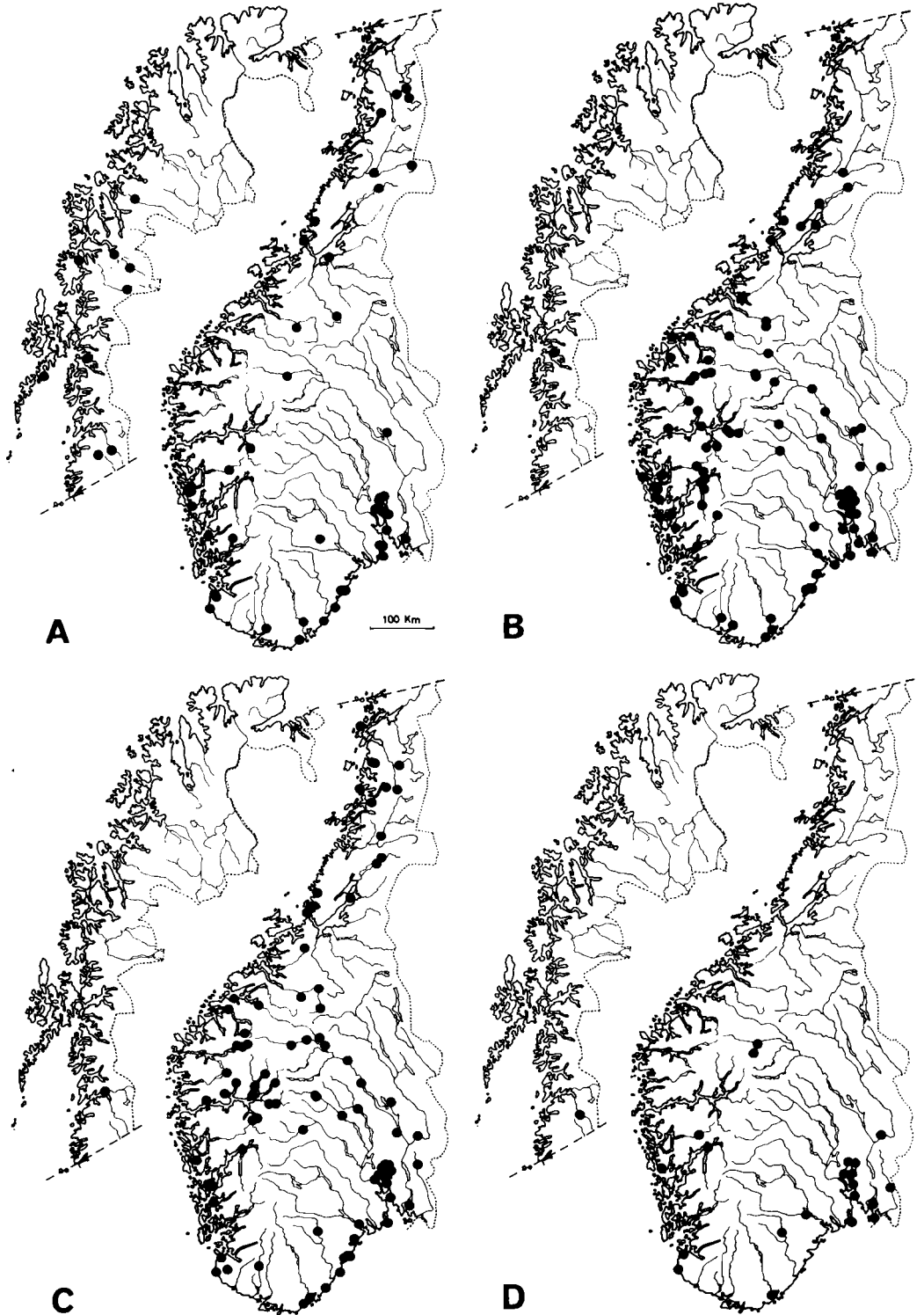


Fig. 15. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia absinthiata*, B. *E. vulgata*, C. *E. castigata*, D. *E. indigata*.

Eupithecia goossensiata Mabilie (1869) (Fig. 3D)

Norwegian records: Eupithecia goossensiata; Opheim (1972).

Localities: Akershus: Nesodden: Spro (KH). Aust-Agder (AAy): Risør: Laget (NK). Hordaland (HOi): Voss (as 'T. trisignaria' NG). Nordland (Nsi): Hattfjelldal (ES).

Distribution: A few localities north to 65°30' N.L. Vertical distribution: Not found above 200 m. First capture: Nsi: Hattfjelldal ♂ 19 July 1899 (ES). Recorded food-plant: Calluna. Flight: 31 May–3 Sept.

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)

Norwegian records: Eupithecia minutata; Schøyen 1875. *Eupithecia minutata*; Schøyen 1880a, 1893. *Tephroclystia assimilata*; Torpe 1926. *Eupithecia assimilata*; Haanshus 1930; Nielsen 1956; Berggren 1970; Opheim 1972. *Localities: Østfold: Jeløy (EB). Akershus: Nesodden: Spro (KH); Bærum: Slependen (AU). Hedmark (HEs): Sør-Odal (WMS). Oppland (Os): Ringebru (EB). On: Lom (CFL). Telemark (TEi): Kviteseid: Vrådal (JR). Vest-Agder (UAY): Kristiansand (WMS, KB); Søgne (CFL); Kvinesdal: Gjemlestad (NK). Rogaland (Ry): Ognå (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 minutata, Sparre Schneider (1890), AK: Oslo: St. Hanshaugen, a few specimens.

Distribution: Moderately distributed from 58° to 62° N.L. North of this area an isolated locality at 64°30' N.L. Vertical distribution: From sea level to 400 m (On: Lom). First capture: HEs: Sør-Odal 2 ♀♀ 10 June 1883 (WMS). Recorded food-plants: Humulus, Ribes nigrum. Flight: 6 May–20 July.

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 1938, 7950, 1972; Lundetræ 1938; Werner 1940; Nielsen 1956; Lühr 1960; Berggren 1970; Mehl 1971. *Tephroclystia vulgata*; Strand 1904; Barca 1910; Grønlien 1921.

Localities: Østfold: Hvaler (ES); Onsøy: Rauer (EB); Sarpsborg (EB); Moss (EB); Jeløy (EB, GN, MO). Akershus: Ås (He); Frogn: Håøya (CFL), Asponn (PS); Nesodden: Spro (KH); Oslo: Rosenberg (Es), Vettakollen (MO); Bærum: Sandvika (EB), Slependen (AU), Kjaglidalen (CFL); Asker (CFL), Gullhella (MO); Eidsvoll (WMS). Hedmark (HEs): Sør-Odal (WMS); Løten (JW); Vang: Hjellum (WC); Hamar (CFL). Oppland (Os): S. Land: Odnes (ES); Lillehammer (WMS), Nansenskolen (AN); Ringebru (EB). On: V. Slidre: Einang (NK); Vågå: Hindseter (CFL); Lom: Fossberg (CFL), Solell (CFL); Dovre: Dombås (WMS). Buskerud (Bø): Røyken: Høvik (MO); Kongsberg: Raje (MO), Skrim (MO). Bv: Gol (NK). Vestfold: Holmestrand (NK); Tjøme: Rød (MO); Brunlanes: Nevlunghavn (EB). Telemark (TEy): Skien (WMS); Kragerø (ACU). Aust-Agder (AAy): Risør (Th), Laget (NK). Vest-Agder (UAY): Kristiansand (KB); Vennessla: Vigeland (as 'Chloroclystis rectungulata' Haw.); Søgne (CFL); Kvinesdal: Gjemlestad (NK); Sireosen (ES). Rogaland (Ry): Klepp: Vig (AN), Orre (AN, NK), Åse (AN), Reve (FJ); Sandnes: Gausel (EF, AN), Ri: Sand NK). Hordaland (HOy): Fjelberg: Halsnøy kloster (MO); Tysnes: Onarheim (MO); iFtjar (MO); Os: Hagavik (NK); Bergen: Skipanes (EB), Thoreshaug (EB), Minde (EB), Kalfaret (MO), Fjellveien (NK), Starefoss (NK), Fløyen (NK); Herdla (NK); Osterøy: Kleppe (MO). HOi: Røldal (CFL); Odda (To); Ullensvang (NG); Utne (EB); Kinsarvik: Djønno (Lu, NK); Granvin (EB); Voss (NG). Sogn og Fjordane (SFy): Høyanger: Vadheim (NK); Jølster: Skei (NK). SFi: Balestrand: Bøyum (NK); Leikanger: Foshage (NK); Aurland: Gudvangen (NK), Otternes (NK); Lærdal: Ødegård (MO), Eri (MO); Borgund: Vindhella (NK), Eggum (NK); Innvik: Bruland (NK); Stryn: Hammerstadlia (NK), Årheim (NK), iVsnes (NK), Videseter (MO). Møre og Romsdal (MRy): Ørsta (JW); Ålesund (JR); Ørskog (WMS). MRi: Stranda: Geiranger (CFL); Rauma: Skiri (MO); Sunndal: Jenstad (MO), Jenstadlia (MO), Gjæra (MO); Surnadal: Kvanne (RM). Sør-Trøndelag

(*STy*): Ørland (MO); Åfjord: Monstad (MO). *Nord-Trøndelag (NTi)*: Verran: Fines (MO); Inderøy (WMS); Beitstad (WMS); Snåsa (WMS); Grong (WMS). *Nordland (Nnø)*: Tysfjord (as '*E. castigata*' and '*E. satyrata* trans var. *callunaria*' ES).

Doubtful and erroneous records: Eupithecia vulgata, Strand (1900), Nsy: Dønna. *Eupithecia vulgata*, Lie-Pettersen (1902), HOi: Hardangervidda, Fossli, Bjoreidal, Isdal, Sysseidal. Haanshus (1921), Ak: Epro, in part = *E. sobrinata* and *E. castigata*.

Distribution: Fairly common from 58°0 to 64°30" N.L. In North Norway one locality only at 68° N.L. (Nnø: Tysfjord). *Vertical distribution*: From sea level to 1200 m (On: Solell). *First capture*: Oslo: Rosenberg ♀ 6 July 1848 (Es). *Recorded food-plants*: Scrubs and lower plants. *Flight*: 30 Apr.–17 July.

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

Norwegian records: Eupithecia denotata: Knaben 1944; Opheim 1950, 1972; Nielsen 1956; Lühr 1960; Løken 1966; Berggren 1970. *Localities: Østfold*: Onsøy: Rauer (EB); Moss (EB); Jeløy: Orkerød (EB), Refsnes (GN). *Akershus*: Nesodden: Spro (as '*immundata*' KH); Oslo: Kristiania (ZMT, ex pupa as '*castigata*' JR), Tøyen (as '*helveticaria*' WMS), Rosenberg (Es), Slemdal (JR), Oscarshall (as '*castigata*' Es), Bygdøy (Mu), Berg (NK); Asker (CFL). *Hedmark (HEs)*: Hamar (CFL). *Oppland (On)*: Vågå: Vågåmo (MO, AN); Lom: Fossberg (CFL, MO). *Buskerud (Bø)*: Lier: S. Linnes (NK). *Bv*: Ål (as '*helveticaria*, ?*conterminata*, ?*hyperboreata*' ES). *Aust-Agder (AAy)*: Risør: Laget (NK). *AAi*: Bygland: Austad (ES). *Øst-Agder (UAY)*: Kristiansand (KB). *Rogaland (Ry)*: Bjerkreim: Austrumdal (FJ); Klepp: Orre (AN), Vig (AN, MO), Reve (FJ); Sandnes: Gausel (EF, AN)). *Ri*: Erfjord (ES). *Hordaland (HOy)*: Fitjar (MO); Os: Nordstrøna (AN); Osterøy: Kleppe (MO, AN). *HOi*: Voss (NG). *Sogn og Fjordane (SFy)*: Nordfjordeid (NK). *SFi*: Aurland: Vassbygdi (NK), Flåm (Peltonen); Borgund: Vindhella (NK); Luster: Skjolden (NK); Breim: Byrkjelo (NK); Stryn (NK), Årheim (NK), Hjelle (NK). *Møre og Romsdal (MRy)*: Ørsta (JW). *MRi*: Stranda: Geiranger (as '*castigata*' WMS); Sunndal: Havsås (MO), Gikling (MO). *Nord-Trøndelag (NTi)*: Verran: Fines (MO).

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

Doubtful record: Knaben (1944), NTi: Snåsa ♀ 10 July 1884 (WMS). This locality which is the northernmost in Norway does not figure in Knaben's list.

Distribution: Occurs not uncommonly from 58° to 62°50" N.L. North of the area one locality only, at 63°50" N.L. (NTi: Fines). *Vertical distribution*: From sea level to 800 m (MRi: Havsås). *First capture*: Oslo ♂ July 1846 (ZMT). *Recorded food-plant: Campanula*. *Flight*: 10 June–19 Aug.

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.

Eupithecia castigata (Hübner, 1809–13) (Figs 3H, 7C, 8D, 13B)

Norwegian records: Eupithecia castigata: Schøyen 1879, 1883, 1893; Lampa 1885; Strand 1899, 1900; Haanshus 1921; Lundetræ 1938; Werner 1940; Opheim 1950, 1959, 1972; Nielsen 1956; Lühr 1960; Berggren 1970. *Tephroclystia castigata*; Strand 1902.

Localities: Østfold: Sarpsborg (EB); Jeløy (EB, GN, MO, AN). *Akershus*: Frogn: Asponn (PS), Håøya (MO, CFL); Nesodden: Spro (KH); Oslo: Tobisens løkke (E), Tøyen (ST), Aker (WMS), Nordstrandshøyden (EB), Hovedøya (MO); Bærum: Sandvika (EB), Slependen (AU); Asker (MO, CFL), Nesøya (NK); N Høland: Bjørkelangen (NK, MO); Hurdal: Tømte (AB). *Hedmark (HEs)*: Sør-Odal (WMS); Hamar (CFL). *Oppland (Os)*: S. Land: Odnnes (ES); Sør-Aurdal (WMS); Lillehammer (WMS); Ringebu (EB). *On*: V. Slidre: Einang (NK), Hausaker (NK); Vågå: Kvarberg (MO), Vågåmo (AN); Sel: Otta (MO), Laurgård (WMS); Lom (CFL). *Buskerud (Bø)*: Lier: S. Linnes (NK). *Bv*: Ål (as '*lariciata*' ES), Tune (ES). *Østfold*: Tjøme (MO). *Telemark (TEy)*: Porsgrunn (ES); Kragerø: Fosning (AU). *TEi*: Nissedal, Nes (MO). *Aust-Agder (AAy)*: Risør (Th), Laget (NK); Tromøya (MO); Eide: Nørholmen (NK). *Øst-Agder (UAY)*: Kristiansand (KB); Søgne (CFL). *UAI*: Sirdal (ES). *Rogaland (Ry)*: Vaule (AN), Klepp: Orre (AN); Sandnes: Gausel (AN, EF). *Hordaland (HOy)*: Fjelberg: Borgundøy (MO); Tysnes: Onarheim

(MO), Anuglo (B&L); Bergen: Minde (EB). *HOi*: Kinsarvik Djønno (Lu). *Sogn og Fjordane (SFy)*: Høyanger: Vadheim (NK); Gaular: Viken (NK); Jølster: Skei (NK). *SFi*: Balestrand: Bøyum (NK); Sogndal: Bergeplass (NK); Luster: Solvorn (NK), Skjolden (NK); Aurland: Fretheim (NK), Nyheim (NK), Otternes (NK), Vassbygdi (NK); Lærdal: Blåflat (NK); Borgund: Eggum (NK), Vindhella (NK); Årdal: Øvre Årdal (NK); Stryn: Nedstryn (NK), Hjelle (NK), Videseter (MO). *Møre og Romsdal (MRy)*: Ørskog (WMS); Sunndal: Jenstadlia (MO). *Sør-Trøndelag (STy)*: Ørland (MO); Bjugn: Sæter (MO); Åfjord: Monstad (MO). *STi*: Oppdal: Kongsvoll (NK); Orkdal: Søvatn (RD). *Nord-Trøndelag (NTi)*: Inderøy (WMS); Grong: Fiskum (CFL); Snåsa (WMS), Finsås (AB). *Nordland (Nsy)*: Bindal (Dahl), Tosdalen (MO); Sømna: Sandvåg (MO); Vevelstad: Aursletta (NK), Visten (NK); Herøy: Dønna (ES); Fauske (CFL). *Nsi*: Grane: Majavatn (MO), Klovimoen (ES).

Not verified records: Schøyen (1883), MRi: Geiranger. Strand (1900), Nsi: Hattfjelldal, Dalen.

Doubtful records: ?*Eupithecia castigata*, Christie (1909), HES: Vang, Hjellum VI. *Eupithecia castigata*, Feichtenberger (1965), Nsi: Nord-Rana, Tverånes, Selforsfjell (150 m) 18 June–4 July, quite common.

Distribution: Occurs in many districts from 58° to 67°20' N.L. *Vertical distribution*: From sea level to 600 m (On: Vågå, Kvarberg). *First capture*: Oslo ♀ 21 June 1849 (Es). *Recorded food-plants*: Many plants and trees. *Flight*: 3 Apr., 22 May–25 July, 9 Aug.

Remarks: *E. castigata* has been confused with species like *E. denotata*, *E. lariciata* and *E. vulgata*.

Eupithecia icterata (Villers, 1789) (Figs 4A, 7R, 11B)

Norwegian records: *Eupithecia subfulvata*: Sparre Schneider 1876a, 1882; Schøyen 1883, 1893; Lampa 1885; Henrichsen 1907; Haanshus 1921; Berggren 1970. *Tephroclystia subfulvata*; Strand 1904; Barca. *Tephroclystia succenturiata* v. *subfulvata*; Grønlien 1921. *Eupithecia* (sic!) *icterata*; Haanshus 1935. *Eupithecia icterata*; Werner 1940; Opheim 1950, 1972; Nielsen 1956; Løken 1966; Seglen 1967. *Localities*: Østfold: Onsøy: Rauer (EB); Moss (EB); Vansjø: Dalen (EB); Jeløy: Rosnes

(EB), Orkerød (EB), Refsnes (GN, AN). *Akershus*: Ås (He); Nesodden: Spro (KH); Oslo: Dragonskogen (Es), Frogner (Es), Incognito (Es), Rosenberg (Es), Tøyen (Si), Bygdøy (Mu, MO); Bærum: Høvik (NK); Asker (CFL). *Oppland (Os)*: Gjøvik (Aa). *Buskerud (Bø)*: Lier: S. Linnes (NK). *Vestfold*: Sem (CFL); Tjøme: Ormelet (KH). *Aust-Agder (AAy)*: Risør (Th), Laget (NK); Nes Verk (SS); Froland: Nelaug (MO); Grimstad (CFL). *AAi*: Bygland: Austad (ES), Dale (PS). *Vest-Agder (UAY)*: Kristiansand (KB); Søgne (CFL); Kvinesdal: Gjemlestad (NK). *Rogaland (Ry)*: Bjerkreim (AN); Klepp: Vig (AN, MO), Reve (FJ); Sandnes: Gausel (EF); Sola: Kolnes (FJ). *Hordaland (HOy)*: Bergen (MO); Osterøy: Losstad (MO). *HOi*: Ullensvang (NG). *Sogn og Fjordane (SFi)*: Aurland: Vassbygdi (Sotavalta). *Møre og Romsdal (MRi)*: Stranda: Geiranger (WMS); Rauma: Flatmark (MO). *Not verified record*: Haanshus (1935): Ry: Jæren (FJ).

Distribution: From Gjøvik (60°50' N.L.) in eastern Norway along the coast to Romsdal (62°30' N.L.). *Vertical distribution*: Lowland species, not found above 250 m. *First capture*: Oslo 12 July 1845 (Es). *Recorded food-plants*: *Achillea*, *Tanacetum*, *Artemisia*. *Flight*: 6 June–17 Aug.

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

Norwegian records: *Eupithecia succenturiata*: Siebke 1853; Schøyen 1875, 1879, 1893; Sparre Schneider 1876a, 1882, 1890; Lampa 1885; Huitfeldt-Kaas 1892; Henrichsen 1907; Christie 1909; Haanshus 1921; Lühr 1960, 1973; Berggren 1970, Opheim 1972. *Tephroclystia succenturiata*; Barca 1910.

Localities: Østfold: Sarpsborg (EB); Moss (EB); Jeløy (GN). *Akershus*: Ås (He); Nesodden: Spro (KH); Oslo: Rosenberg (ES), Frogner (ES), Youngsløkke (Si), Tøyen (Si, WMS), V. Aker (SS), Bygdøy (Mu), Slemdal (SS), Grefsen (MO); Bærum: Slepanden (AU), Ostøya (CFL); Asker (CFL). *Hedmark (HEs)*: Sør-Odal (WMS); Vang: Hjellum (JR); Hamar (AB); Ringsaker: Helgøya (WC). *Oppland (Os)*: Lunner: Svea (MO); Gran: Røykenvik (THS); Sør-Aurdal: Bagn (KH); Nord-Aurdal (WMS); Øyer (Si, JR); Ringebu (WMS). *On*: V. Slidre: Einang (NK); Sel: Heidal (SS); Lom (CFL). *Vestfold*: Sem

(CFL); Tjøme (KG). *Telemark (TEy)*: Jomfruland (MO). *Aust-Agder (AAy)*: Tromøya (AB). *Vest-Agder (VAy)*: Kristiansand (KB). *Sogn og Fjordane (SFi)*: Borgund: Vindhelle (NK). *Møre og Romsdal (MRy)*: Tingvoll: Straumsnes (KK). *Nord-Trøndelag (NTi)*: Grong; Harran (CFL).

Distribution: Eastern Norway between 58° and 62° N.L., but only two localities in western Norway (SFi: Borgund, Vindhella and MRy: Tingvoll, Straumsnes), and an isolated locality at 64°30' N.L. *Vertical distribution*: From sea level to 500 m. *First capture*: Oslo ♂ 6 July 1848 (Es). *Recorded food-plants*: *Artemisia*, *Achillea*. *Flight*: 22 June–6 Aug.

Eupithecia subumbrata (Denis & Schiffermüller, 1775) (Figs 4C, 10F)

Norwegian records: *Eupithecia subumbrata*; Opheim 1968, 1972.

Localities: *Østfold*: Jeløy ♂, 2 ♀♀ 6 June 1953, ♂ 25 June 1955, ♂ 11 June 1956 (GN); Hvaler: S. Sandøy ♂ 11 June 1967 (MO). *Akershus*: Oslo: V. Aker ♀ 6 1899 (SS), Tveita ♂ 15 June 1967 (KM). *Hedmark (HEs)*: Sør-Odal ♂ 4 June 1882, ♂ June 1882 (WMS).

Doubtful and erroneous records: ?*Eupithecia scabriosata*, Sparre Schneider (1882). *Eupithecia scabriosata*, Lampa (1885), AAy: Nes Verk 5 Aug. 1876, several specimens. There are no specimens from Nes Verk in the Norwegian collections. *Eupithecia subumbrata*, Lühr (1970), On: Lom, Fossberg 30 June 1968. I (MO) have not seen the specimen from Lom, and I consider it improbable that the species occurs far north of the known area of distribution.

Distribution: Eastern part of the Oslofjord district, and then inland to HEs: Sør-Odal (60°14' N.L.). *Vertical distribution*: Lowland species, below 150 m. *First capture*: HEs: Sør-Odal ♂ 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.

Localities: *Østfold*: Onsøy: Rauer (EB); Moss (EB). *Akershus*: Nesodden: Spro (KH); Oslo: Frogner (Es), Rosenberg (Es), Tobisens løkke (Es), Tøyen (ST); Asker, Brønnøya (SP).

Oppland (Os): Gran: Stastad (MO). *Vestfold*: Sem (OK); Stavern (JR). *Telemark (TEy)*: Kragerø (JR). *Aust-Agder (AAy)*: Risør (Th). – In all 32 specimens, the main part collected between the years 1913–27.

Distribution: Eastern Norway between 58°40' and 60°30' N.L. *Vertical distribution*: In the lowlands up to 200 m. *First capture*: Oslo: Frogner 2 ♂♂ 1 July 1848 (Es), and latest capture: Vestfold: Sem ♀ 15 Aug. 1939 (OK). *Recorded food-plants*: *Chenopodium*, *Atriplex*. *Flight*: 1 July–15 Aug.

Eupithecia sinuosaria (Eversmann, 1848) (Figs 4E, 9C)

Norwegian records: *Tephroclystia sinuosaria*; Barca 1910; Grønlien 1921. *Eupithecia sinuosaria*; Wahlgren 1921; Haanshus 1921; Christie 1923; Opheim 1938, 1972; Lundetræ 1938; Lühr 1960.

Localities: *Østfold*: Sarpsborg (EB); Onsøy: Rauer (EB); Moss (EB); Jeløy (EB, GN). *Akershus*: Ås (He); Nesodden: Spro (KH); Oslo: Nordstrand (WMS), Kristiania (JR), Bygdøy (Mu). *Hedmark (HEs)*: Vang: Hjelalum (WC); Mamar (Rost). *HEn*: Stor-Elvdal: Koppang (Granberg). *Oppland (Os)*: Sør-Aurdal: Bagn (KH). *On*: V. Slidre: Løken (EB), Vollen (NK); Ø. Slidre: Beito (MO); Sel: Heidal (SS); Vågå: Vågåmo (AN); Lom: Røysheim (JR), Fossberg (CFL, NK); Dovre: Rudi (EB). *Vestfold*: Nevlunghavn (EB). *Telemark (TEy)*: Kviteseid: Vrådal (JR). *Aust-Agder (AAy)*: Risør (Th), Laget (NK). *Hordaland (HOi)*: Ullensvang (NG); Kinsarvik: Djonno (Lu); Voss (NG). *Sogn og Fjordane (SFi)*: Lærdal: Ødegård (MO).

Distribution: Eastern Norway from 58°40' to 62° N.L., and a few localities in inner part of western Norway. *Vertical distribution*: From sea level to 800 m (On: Beito). *First capture*: Oslo: Nordstrand Aug. 1907 (WMS). *Recorded food-plants*: *Chenopodium*, *Atriplex*. *Flight*: 25 May–2 Aug.

Eupithecia indigata (Hübner, 1809–13) (Figs 4F, 7G, 15D)

Norwegian records: *Eupithecia indigata*; Schøyen 1882, 1893; Lampa 1885; Sparre Schneider 1893; Strand 1900, 1901; Haanshus 1927, 1928; Nielsen 1956; Lühr 1960; Berggren 1970; Opheim 1972. *Tephroclystia indigata*; Barca 1910, 1923; Grønlien 1921.

Localities: *Østfold*: Hvaler (as 'conterminata',

ES); Sarpsborg (EB); Øymark (ES); Jeløy (EB, GN). *Akershus*: Frogn: Håøya (CFL); Nesodden: Spro (KH); Oslo: Ekeberg ♂ (as 'conterminata', WMS), Bogstad (JR); Asker: Gullhella (MO). *Hedmark* (HEs): Sør-Odal (WMS). *Oppland* (On): Lom: Røysheim (JR), Fossberg (CFL). *Vestfold*: Hvasser (NK). *Telemark* (TEy): Nome: Ulefoss (ES). *TEi*: Nissedal: Treungen (FS). *Uest-Agder* (UAY): Kristiansand (KB). *Rogaland* (Ry): Klepp: Vig (AN); Sandnes: Gausel (EF). *Hordaland* (HOy): Os: Hagavik (NK). *HOi*: Kinsarvik: Dønno (NK). *Nordland* (Nsi): Saltdal (WMS).

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

Doubtful and erroneous records: *Eupithecia indicata*, Schøyen 1880, Nsi: Saltdal: Sundby and Storfjord several specimens primo June 1879 (= *E. virgaureata altenaria* Stgr.). Schøyen (1882), Nsi: Saltdal 1881. Only one ♀ 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), Nnø: Tysfjord 1900. Doubtful record. ?*Tephroclystia indigata*, 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: Røysheim). *First capture*: Oslo: Ekeberg ♂ 10 May 1880 (WMS). *Recorded food-plants*: *Pinus*, *Larix*. *Flight*: 30 Apr.–19 July.

Remarks: *E. indigata* was considered in the last century by many lepidopterologists to be a variety of *E. virgaureata* (Sparre Schneider 1895). Accordingly most specimens of the latter from that time were placed under the *E. indigata* label in the museum's collection.

Eupithecia pimpinellata (Hübner, 1809–13) (Figs 4G, 9D)

Norwegian records: *Eupithecia pimpinellata*: Schøyen 1883, 1893; Lampa 1885; Werner 1940; Nielsen 1956; Lühr 1960; Løken 1966; Opheim 1972.

Localities: *Østfold*: Jeløy ♂ 1952 (GN). *Oppland* (On): Lom 15 July 1956, ♀ 11 July 1960 (CFL). *Aust-Agder* (AAy): Risør ♂ (Th); Tromøya ♂ 14 July 1955 (AB). *Rogaland* (Ry):

Klepp: Vig ♂, ♀ 1 Aug. 1950, 2 ♂♂ 17 July 1952, ♂ 24 July 1956 (AN), ♂ 14 Aug. 1949 (FJ); Randaberg: Sande ♂ 1 July 1936 (FJ). *Sogn og Fjordane* (SFi): Leikanger: ♂ 2 July 1939 (NK); Aurland: Vassbygdi 15 Aug. 1965 (Sotavalta). *Møre og Romsdal* (MRi): Stranda: Geiranger ♀ medio July 1880 (WMS).

Erroneous record: *Eupithecia pimpinellata*, Haanshus (1927, 1928), AK: Spro (= *E. absinthiata* (Cl.)).

Distribution: In south-eastern Norway along the coast, and in the western districts from 58°40" to 62°10" N.L. in few localities. In north-eastern Norway, one locality only, at 62° N. L. *Vertical distribution*: From sea level to 400 m (On: Lom). *First capture*: MRi: Geiranger ♀ medio July 1880 (WMS). *Recorded food-plants*: *Pimpinella* and also other Umbelliferae, and Compositae. *Flight*: 1 July–15 Aug.

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

Norwegian records: *Eupithecia hyperboreata*: Staudinger 1861; 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. *Localities*: *Hedmark* (HEN): Trysil: Tørberget (FS). *Oppland* (Os): Ringebu (WMS) *On*: V. Slidre: Grønsenn sr. (NK); Ø. Slidre: Beito (NK, MO); Lom: Bøverdalen (WMS); Sel: Høvringen (CFL); Dovre: Dombås (WMS). *Buskerud* (Bv): Gol (AN); Flå (RB). *Hordaland* (HOi): Røldal: Horda (Lu); Voss (NG). *Sogn og Fjordane* (SFi): Vik: Målset (NK); Stryn: Bruland, Vinsrygg and Hammerstadli (NK). *Møre og Romsdal* (MRy): Ørskog (WMS); Smøla: Hopen (RD). *MRi*: Sunndal: Havsås (MO). *Sør-Trøndelag* (STi): Oppdal: Kongsvoll (NG, NK); Orkdal: Søvatn (RD). *Nordland* (Nsy): Dønna (ES). *Nsi*: Hattfjell-dal: Dalen (ES). *Nnø*: Skjomen: Elvegård (MO). *Nnv*: Lødingen (ES). *Troms* (TRy): Tromsø: Tromsdal (SS), Ramfjord (SR); Senja (NK). *TRI*: Målselv: Mauken and Bjerkeng (SS); Kvænangen (SS); Nordreisa: Javreoaivek (NK). *Finnmark* (Fi): Alta: Bosekop (ES, JR, EB), Kåfjord (EB). *Fn*: Porsanger: Kistrand (Øw), Banak (CFL). *Fø*:

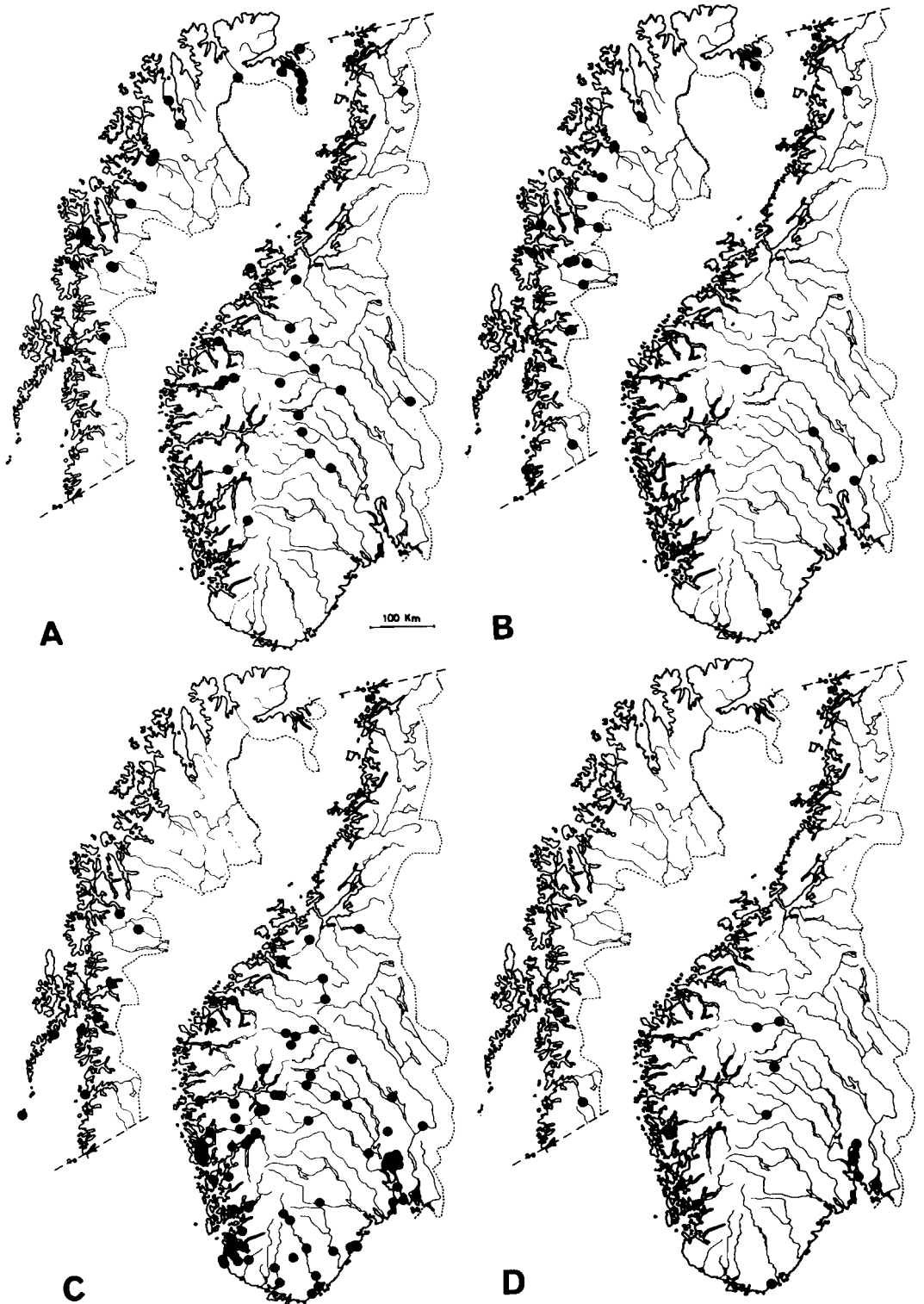


Fig. 16. Distribution of the *Eupithecia* group in Norway. A. *Eupithecia gelidata*, B. *E. virgaureata*, C. *E. sobrinata*, D. *Chloroclystis chloerata*.

Polmak: Aleknjarg (SS); Sør-Varanger: Neiden (CFL), Strand (SS, We), Kirkenes, Svanvik, Svanvatn, Melkefoss, Mennika and Jacobselv (We), Elvenes (OK), Vaggetem (CFL).

Doubtful and erroneous records: Eupithecia hyperboreata, Schøyen (1882), and *Tephroclystia hyperboreata*, Sparre Schneider (1907), Nsi: Saltdal. There are no specimens from this locality in the Norwegian Zoological Museums. ?*Eupithecia hyperboreata*, Strand (1899), Bv: Ål, = *E. denotata* (Hb.). *Eupithecia gelidata*, Lühr (1973), VE: Narverød 24 Aug. 1968.

Not verified records: Schøyen (1879), Os: Ringebu, Asdalen. Schøyen (1880): Fn: Porsanger, Lakselv. Schøyen (1881), Fø: Sør-Varanger. (His specimens not present in the collections). Strand (1900); Nsi: Hattfjelldal, Røsvatn. Strand (1901), Nnø: Tysfjord. Feichtenberger (1965), Nsi: Rana, Mofjell 2 May–16 July.

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. Vertical distribution: In eastern Norway from 400 m to 1000 m, in the western districts from sea level to 850 m. A lowland species in northern Norway. First capture: Alta, Bosekop medio June 1860 (Stgr & Wck). Recorded food-plants: Ledum palustre (in Sweden and Finland), Betula sp. (McDunnough 1949), Betula nana and Salix glauca (Wolff 1964). Flight: 10 June–4 Aug.

Eupithecia nanata (Hübner, 1809–13) (Figs 5A, 7L, 11C)

Norwegian records: Eupithecia altenaria; Schøyen 1893; Sparre Schneider 1901; Barca 1923; Haanshus 1927, 1929; Berggren 1970; Opheim 1972. *Tephroclystia nanata; Strand* 1904; Grønlien 1921.

Localities: Østfold: Onsøy: Rauer (EB); Sarpsborg (EB). *Akershus: Nesodden: Spro* (KH); Oslo: Rosenberg (Es). *Aust-Agder (AAy): Risør* (Th), Laget (NK); Tromøy (AB). *Vest-Agder (VAy): Sireosen* (ES); Søgne (CFL); Kristiansand (KB). *VAi: Sirdal* (ES). *Rogaland (Ry): Hå: Nærbø* (WMS); Klepp: Vig (AN); Time: Åsland (AN); Sandnes (WMS), Øksnevad (AN), Gausel (AN, Fu, FJ); Jæren (Co, LP). *Ri: Suldal: Lægdedn*

(Fu). *Hordaland (HOy): Os: Hagavik* (NK); Bergen: Knatten (NK); Herdla (NK). *HOi: Voss: Vossevangen* (NG). *Møre og Romsdal (MRy): Molde* (JR).

Erroneous record: Eupithecia nanata, Strand (1900), Nsy: Dønna 3 specimens 25 June 1899 (= *E. hyperboreata* Stgr.).

Not verified record: Sparre Schneider (1901), HOy: Bergen one specimen (LP).

Distribution: A coastal species with a range from Oslo in the east to Molde (62°45' N.L.) in the northwest. The area of distribution of E. nanata (Hb.) is fairly well separated from that of *E. hyperboreata*. Overlapping occurs at HOi: Voss, but the species probably are met with at different levels. *Vertical distribution: In the lowland, hardly exceeding 100 m. The distance between the northernmost locality, MRy: Molde, and the lowland locality, MRy: Ørskog, of E. hyperboreata* Stgr. 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)

Norwegian records: Tephroclystia innotata; Barca 1923. *Eupithecia innotata: Opheim* 1972; Lühr 1973.

Localities: Østfold Sarpsborg ♂ 5 June 1922 (EB); Moss ♀ 25 July 1915 (EB). *Akershus: Oslo: Tøyen* 4 ♀♀ 14 Aug., ♂ 20 Aug. 1949 (NK), Bestum ♀ 17 Aug., ♀ 27 Aug. 1950 (NK). *Vestfold: Sem: Narverød* 23 Aug. 1968 (CFL). *Doubtful records: Tephroclystia innotata, Torpe* (1926), HOi: Voss July (NG). There was no *E. innotata* (Hufn.) in the collection of Grønlien, *Eupithecia innotata*, Lühr (1973), On: Lom 9 Aug. 1968.

Distribution: Extreme southeastern part of Norway. Vertical distribution: Lowland, not above 100 m. First capture: Ø: Moss ♀ 25 July 1915 (EB). *Recorded food-plant: Artemisia. Flight: 5 June–27 Aug., most probably in two generations.*

Eupithecia virgaureata Doubleday, 1861

spp. *altenaria* Staudinger, 1861 (Figs 5C, 16B) *Norwegian records: Eupithecia nanata; Staudinger* 1861; Sparre Schneider 1876a, 1893, 1895a; Schøyen 1880, 1893; Lampa 1885. *Eupithecia indigata* (part.); Schøyen 1882. *Eupithecia indigata; Strand* 1900, 1902. *Tephroclystia lariciata* (part.); Hawkshaw

1919; *Tephroclystia virgaureata* v. *alternaria*; Sparre Schneider 1921. *Eupithecia virgaureata* cum f. *alternaria*; Feichtenberger 1965. *Eupithecia virgaureata*; Opheim 1972; Lühr 1973.

Localities: Akershus: Ullensaker ♀ 5 June 1887 (WMS). Hedmark (HEs): Sør-Odal ♂ 5 June, ♀ 8 June 1884 (WMS). Oppland (Os): Lunner: Mylla ♂ 12 June 1943 (MO); S. Land: Odnes ♀ 1901 (ES). On: Lom (CFL). Vest-Agder (UAY): Vennessla: Vigeland 7 June 1904 (Haw). Sogn og Fjordane (SFy): Jølster: Skei ♀ 3 July 1942 (NK). Nordland (Nsy): Meløy (SR). Nsi: Grane: Klovimoen (ES); Saltdal (WMS). Nnø: Skjomen: Fjellbu (MO). Troms (TRy): Tromsø: Prestvatn (SR); Senja (NK). TRi: Bardu: Innsetfallet (AF); Målselv: Nordmo (SS), Olsborg (NK), Bjerkeng (SS), Dividal (CFL); Storfjord: Skibotn (SS), Helligskogen (CFL); Nordreisa: Javreoaivek (NK); Kvænangen (Kaisila). Finnmark (Fi): Alta (Stgr., WMS, EB), Vana (EB), Romsdal (EB). Fn: Porsanger: Lakselv (WMS). Fø: Sør-Varanger: Strand (SS), Elvenes (OK), Vaggatem (CFL), Jarfjord (CFL). *Doubtful record*: *Eupithecia altenaria*, Sparre Schneider 1879, HOi: Kvam, Tangerås very worn specimen primo July 1874, det. Stgr.

Not verified records: Sparre Schneider (1921), TRi: Målselv, Melkelvli one specimen 2 July 1893. Feichtenberger (1965), Nsi: Rana, Tverånes and Sjøfossen many specimens 6–12 July.

Distribution: Scarce in South Norway between 58° and 61°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. altenaria*, 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. altenaria*. *Flight*: 2 June–12 July.

Remarks: Everyone of the examined specimens belonged to ssp. *altenaria*. 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, Öland and Gotland. The southern limit of distribution of *E. v. alternaria* goes from Dalecarlia to Ångermanland (Nordström 1943, 1953).

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

Norwegian records: *Tephroclystia dodoneata*; Hawkshaw 1919. *Eupithecia dodoneata*; Knaben 1955; Nielsen 1956; Opheim 1972.

Localities: Aust-Agder (AAy): Risør ♂ (Th). Vest-Agder (UAY): Vennessla: Vigeland 14 May 1907 (as 'lariciata' Haw); Søgne ♂ 12 June 1960 (CFL). Rogaland (Ry): Sandnes: Gausel ♀ 13 June, ♀ 26 June 1951, 3 ♂♂, ♀ 4 June 1952, ♀ 25 May, ♀ 30 May, ♂ 10 June, ♀ 15 June 1953, ♂ 23 May, ♂ 3 June 1954 (AN), ♀ 10 June 1953, ♂, 4 ♀♀ 26 May 1954 (Fu). Hordaland (HOy): Bergen: Myrvann ♀ 15 May 1965, ♂ 4 June 1966 (AF).

Distribution: Along the coast from Risør in the southeast to Bergen in the west. *Vertical distribution*: Below 100 m. *First capture*: VAY: Vigeland 14 May 1907 (Haw). *Recorded food-plant*: *Quercus*. *Flight*: 23 May–25 June.

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

Norwegian records: *Eupithecia sobrinata*; Staudinger 1861; Sparre Schneider 1876a, 1893, 1901; Schøyen 1880, 1893; Lampa 1885; Strand 1901; Haanshus 1921; Lundetræ 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), Nordstrandshøyden (EB), Tøyen (WMS, NK); Bærum: Sandvika (EB), Slependen (AU); Asker (CFL). Hedmark (HEs): Sør-Odal (WMS); Ringsaker: Helgøya (Es). Oppland (Os): Lunner: Roa (MO); Sør-Aurdal: agn (KH, CFL); Nord-Aurdal: Aurdal (MO); Gausdal: Skeikampen (Rui). On: Ø. Slidre: Beito (NK, MO); Vang (THS); Vågå: Bukkehaug (Hackman); Lom: Bøverdalen (WMS), Fossberg (KN, CFL); Skjåk: Jøingsli (CFL). Buskerud (Bø): Modum (WMS). Bu:

Ål (ES). *Vestfold*: Sem (CFL). *Telemark* (TEi): Kviteseid (MO). *Aust-Agder* (AAy): Risør (Th), Laget (NK); Åmli: Nelaug (MO). *AAi*: Bygland: Langerak (NK), Lenggjei (NK); Valle (NK); Bykle (NK). *Vest-Agder* (VAy): Kristiansand (KB); Vennesla: Vigeland (Haw); Søgne (CFL); Kvinesdal: Gjemlestad (NK, Ro). *VAi*: Fjotland: Narvestad (NK), Åseral (HG). *Rogaland* (Ry): Bjerkreim (AN), Malmin (AN), Vaule (AN); Klepp: Vig (AN), Reve (FJ); Sandnes (AN), Bråstein (AN), Figgjo (AN), Forus (AN), Gausel (AN, Fu), Dale (Fu), Høle (FJ); Finnøy: Hidle (FJ); Imsland: Imsland brygge (Lu). *Ri*: Forsand (Tj); Årdal (AN); Suldal (ES, Fu). *Hordaland* (HOy): Tysnes: Flatråker (MO); Bergen: Minde (EB), Apeltunvatn (NK), Espesgrend (MO), Skipanes (EB), Fløyen (NK), Bellevue (NK), Kalfaret (MO), Landås (Sv), Eidsvågsnes (NK), Eidsvåg (MO); Osterøy: Øvre Botnvatn (MO). *HOi*: Kvinnherad: Omvik (Lu); Kinsarvik: Djonno (Lu), Utne (NK); Kvam: Østese (To); Voss (NG), Kvanndalen (NK); Ulvik (NK). *Sogn og Fjordane* (SFy): Lavik (ES). *SFi*: Vik: Framfjord (NK); Aurland (NK, AF, So), Otternes (NK), Steine (NK), Vassbygdi (NK, AF, So), Flom (Af, Pe), Kvammadal (IS), Kvammahagene (AF), Li (AF), Lærdal (ES), Ljøse (NK); Borgund: Vindhella (NK); Luster: Hodnadr sr. (NK). *Møre og Romsdal* (MRy): Ørsta: Ørstavik (JW); Ålesund (EB); Ørskog: Svorta (RM). *MRI*: Surnadal: Kvanne (RM). *Sør-Trøndelag* (STi): Oppdal: Kongsvoll (NK); Selbu (WMS); Orkdal: Søvatt (RD). *Nordland* (Nnø): Hamarøy (SS); Tysfjord (ES); Narvik: Fagernes (SS). *Nnv*: Røst: Skomvær (WMS); Svolvær (MO). *Troms* (TRi): Balsfjord: Skjåvikør (SR); Målselv: Dividal (CFL).

Doubtful record: *Eupithecia scoriata*, Chapman & Lloyd 1899, Fi: Kåfjord. *E. sobrinata scoriata* Stgr. occurs in Iceland and Greenland (Wolff 1964, 1971).

Not verified record: Staudinger (1861), Nsy: Bodø 14 Aug. 1860.

Distribution: Occurs commonly most places from 58° to about 64° N.L. and then from 67° to 69° N.L. Records from Finnmark are considered doubtful. *Vertical distribution*: From sea level to about 1000 m. *First capture*: HES, Helgøya ♀ 1840'th (Es). *Recorded food-plant*: *Juniperus*. *Flight*: (25 March), 10 June -5 Oct.

Eupithecia lariciata (Freyer, 1842) (Figs 5F, 9F)

Norwegian records: *Eupithecia lariciata*; Schøyen 1885, 1893; Lampa 1885; Lühr 1960; Opheim 1972.

Localities: *Østfold*: Sarpsborg ♀ 24 June 1922 (EB). *Oppland* (On): Lom ♀ 15 July 1956 (CFL). *Vest-Agder* (VAy): Mandal ♂ June 1882 (WMS). *Rogaland* (Ry): Klepp: Vig ♀ 15 Aug. 1951 (AN), Øksnevad ♀ 18 June 1953 (AN); Time: Åsland ♀ 28 June 1952 (AN).

Doubtful and erroneous records: ?*Eupithecia lariciata*, Strand (1899), Bv: Ål July 1898 (= *E. castigata* Hb.). *Tephroclystia lariciata*, Strand (1902), Os: Odnes (= *E. virgaureata altenaria* Stgr.). ?*Eupithecia lariciata*, Christie (1909), HES: Vang, Hjellum 3 specimens June 1906. *Tephroclystia lariciata*, Hawkshaw (1919), VAY: Vigeland (= *E. intricata* Zett., *satyrata* Hb., *virgaureata altenaria* Stgr., *dodoneata*, *sobrinata* Hb.). *Eupithecia lariciata*, Haanshus (1921, 1927, 1930), AK: Spro ♂ 20 June 1918 (= *E. castigata* Hb.). *Eupithecia lariciata*, Feichtenberger (1965), Nsi: Tverånes 7 June, Nnø: Kjølsvik 14 Aug. Caught among *Juniperus*.

Distribution: At the southern coast from Sarpsborg to Jæren, south of 59°20' N.L. Outside the area surprisingly found at 62° (On: Lom). *Vertical distribution*: Below 100 m in the south of Norway, but as high as 400 m in Lom. *First capture*: VAY: Mandal ♂ June 1882 (WMS). *Recorded food-plants*: *Larix decidua*, ? *Juniperus*. *Flight*: 18 June-15 Aug.

Remarks: The species also occurs in North America as ssp. *luteata* Packard, 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; Schøyen 1879, 1893; Lampa 1885; Strand 1900, 1901; Haanshus 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). *Akershus*: Ås (He); Frogd: Håøya (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), Appelsinhaugen (MO); Bærum: Lysaker (WMSæ, JR), Sandvika (EB), Haslum (MO), Ostøya (NK), Slepnden (AU), Kolsås (MO), Bjørum sag (NK), Kjaglidalen (CFL); Asker (MO, CFL, TE); Nittedal: Movatn (MO); Ullensaker (WMS). *Hedmark (HEs)*: Sør-Odal (WMS); Vang: Hjellum (WC). *Oppland (Os)*: Lunner: Mylla (MO), Roa (MO); Ringebu (WMS). *On*: Vang (THS). *Buskerud (Bø)*: Røyken: Høvikvollen (MO); Hurum (CFL). Toftelholmen (JR); Lier: S. Linnes (NK); Modum (WMS); Kongsberg: Skrim (NK, MO), Raje (MO). *Uestfold*: Sande (ES); Sem: Vally (ES). *Telemark (TEy)*: Porsgrunn (ES); Nome: Llefoss (ES). *TEi*: Nissedal, Nes; Fyresdal, Momrak (MO). *Aust-Agder (AAy)*: Risør (Th), Laget (NK). *Uest-Agder (UAY)*: Søgne (CFL). *Rogaland (Ry)*: Klepp: Vig (AN); Sandnes: Helgeland (AN), Gausel (AN (Fu)). *Møre og Romsdal (MRi)*: Surnadal: Kvanne (RM). *Nord-Trøndelag (NTi)*: Inderøy (WMS); Beitstad (WMS); Steinkjær (WMS); Snåsa (WMS).

Not verified records: Sparre Schneider (1878), Bø: Gulskogen, common). Schøyen (1879): 193 (Os: Lillehammer). Hawkshaw (1919): 67 (VAY: Vigeland).

Distribution: The main area is between 58° and 61° N.L., eastern Norway to Jæren in the west. Isolated areas: MRi: Surnadal (63° N.L.) and NTi (about 64° N.L.). *Vertical distribution*: From sea level to 600 m. *First capture*: Oslo: Skøyen ♂ 23 June 1847 (Si). *Recorded food-plants*: *Picea*, *Abies*. *Flight*: 15 Apr.–8 July.

Eupithecia conterminata (Zeller, 1846) (Figs 5H, 12E)

Norwegian records: *Eupithecia conterminata*; Schøyen 1879; Strand 1900; Henrichsen 1907; Feichtenberger 1965; Opheim 1972. *Tephroclystia conterminata*; Strand 1902; Barca 1910. *Localities*: Østfold: Onsøy: Rauer (EB); Sarpsborg (EB); Jeløy (MO, GN, AN). *Akershus*: Ås (He); Oslo: Tøyen (ST), V. Aker (SS,

WMS); Bærum: Lysaker (WMS), Sandvika (EB); Nittedal: Movatn (MO). *Hedmark (HEs)*: Sør-Odal (WMS). *Oppland (Os)*: Lunner: Mylla (MO); S. Land: Odnes (ES); Fåberg (AB); Ringebu (WMS). *Nord-Trøndelag (NTi)*: Beitstad (WMS); Steinkjær (WMS). *Nordland (Nsi)*: Grane: Klovimoen (ES).

Not verified record: Feichtenberger (1965), Nsi: Rana: Hverånes, Grubheia 1 – 18–30 June.

Doubtful and erroneous records: *Eupithecia conterminata*, Sparre Schneider (1876a), and Lampa (1885), Oslo: Hegdehaugen June 1973 and Bv: Nummedal (Wallengren). ?*Eupithecia conterminata*, Strand 1899), Bv: Ål 1898). *Tephroclystia conterminata*, Strand (1904), (Ø: Hvaler 9 ♂♂ 17 May–7 June 1902 (= *E. indigata* Hb.). Barca (1910): 19 (Ø: Moss several specimens June 1908).

Distribution: Eastern Norway between 59° and 61°30' N.L. and inner part of Trøndelag and Nordland between 64° and 65°30' N.L. (? 66°20' N.L.). *Vertical distribution*: From sea level to 400 m. *First capture*: Oslo: V. Aker ♂ 3 June 1876 (SS). *Recorded food-plant*: *Picea*. *Flight*: 15 May–30 June.

Eupithecia lanceata (Hübner, 1826) (Figs 6A, 7N, 10I)

Norwegian records: *Eupithecia lanceata*; Schøyen 1893; Henrichsen 1907; Opheim 1972. *Tephroclystia lanceata*; Strand 1902; Barca 1910, 1923.

Localities: Østfold: Sarpsborg (EB); Rygge: Larkollen (ES); Jeløy (GN, MO). *Akershus*: Ås (He); Oppegård (NK); Oslo: Nordstrand (EB), Ekeberg (WMS), V. Aker (WMS), Holmenkollen (JR), Bygdøy (JR); Barum: Lysaker (JR), Sandvika (EB); Asker (CFL), Nesøya (JR). *Hedmark (HEs)*: Sør-Odal (WMS). *Oppland (Os)*: Gjøvik (Aa). *Buskerud (Bø)*: Hurum: Filtvedt (ES). *Bv*: Torpo (CFL). *Telemark (TEi)*: Rjukan (CFL). *Aust-Agder (AAy)*: Risør: Laget (NK).

Doubtful and erroneous records: *Eupithecia lanceata*, Sparre Schneider (1876a), and Lampa (1885), Oslo: Tøyen (Si). *Tephroclystia lanceata*, Grønlien (1921), HOi: 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-

dal). Probably due to a printing error in the Haanshus' list (1933).

Distribution: Eastern Norway between 58°40" and 61° N.L. *Vertical distribution*: From sea level to 400 m. *First capture*: Oslo: Ekeberg 8 27 Apr. 1879 (WMS). *Recorded food-plants*: *Pinus*, *Picea*. *Flight*: 3 Apr.–2 June.

GYMNOSCELIS Mabille, 1868

Gymnoscelis pumilata (Hübner, 1809–13) (Figs 6B, 7H, 8Ac, 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; Lundetræ 1938; Werner 1940; Nielsen 1956; Berggren 1970.

Localities: Østfold: Tune: Vister (Ih); Hvaler (WMS); Halden (EB); Onsøy (ES); Rygge: Larkollen (ES); Sarpsborg (EB); Moss (EB); Jeløy (EB, GN, AN). *Akershus*: Nesodden: Spro (KH); Oslo: Tøyen (Si, WMS), Kristiania (Mu), Bygdøy (Mu). *Oppland (Os)*: Gjøvik (Aa). *Buskerud (Bø)*: Lier: S. Linnes (NK). *Uestfold*: Sem (CFL); Brunlanes: Nevlungshavn (EB). *Aust-Agder (AAy)*: Risør: (Th), Laget (NK); Grimstad (CFL). *Uest-Agder (UAY)*: Kristiansand (KB); Kvinesdal: Gjemlestad (NK). *Rogaland (Ry)*: Klepp: Vig (AN); Sandnes (AN), Bråstein (AN), Gausel (Fu); Sola: Tananger (AN). *Hordaland (HOy)*: Os: Hagavik (NK); Bergen: Flesland (MO), Museumshagen (NK). *HOi*: Skånevik: Fjæra (Lu); Kvinnherad: Omvik (Lu); Ullensvang (JR, NG); Kinsarvik: Djønno (Lu); Granvin (NG). *Sogn og Fjordane (SFi)*: Sogndal: Amla (MO); Stryn (CFL). *Møre og Romsdal (MRy)*: Molde (WMS).

Distribution: Mainly coastal, in eastern Norway as far north as 60°45" N.L., in the west to 62°45" N.L. *Vertical distribution*: In the lowland, not above 200 m. *First capture*: MRy: Molde ♀ ult. June 1880 (WMS). *Recorded food-plants*: *Salix*, *Calluna*, *Eupatorium* etc. *Flight*: 9 Feb., 26 Apr.–30 June, 18 July–1 Sept.

CHLOROCLYSTIS Hübner, 1825

Chloroclystis chloerata (Mabille, 1870) (Figs 6C, 16D)

Norwegian records: *Eupithecia rectangulata* ab. *cydoniata*; Strand 1901. *Chloroclystis chloerata* v. *hadenata*; Strand 1902, 1904. *Chloroclystis rectangulata* ab. *cydoniata*; Sparre Schneider 1907. *Chloroclystis chloerata*; Barca 1922, 1923; Opheim 1950, 1972; Lühr 1960; Feichtenberger 1965.

Localities: Østfold: Sarpsborg (EB); Jeløy (EB, AN). *Akershus*: Frogn. Håøya (MO); Nesodden: Spro (KH); Oslo: Tøyen (Si). *Oppland (On)*: Ø. Slidre: Beito (NK); Vågå: Vågåmo (MO, AN); Lom (CFL). *Buskerud (Bv)*: Hol (KH). *Uest-Agder (UAY)*: Søgne (CFL). *Hordaland (HOy)*: Fjelberg: Borgundøy (MO); Osterøy: Kleppe (MO). *Nordland (Nsi)*: Saltdal: Storjord (SS). *Nnø*: Tysfjord (ES).

Not verified records: Strand (1904), Nnø Ankenes: Rombaksbotn 1901 (Wahlgren). Barca (1922); Ø: Varteig. Feichtenberger (1965); Nsi: Storjord 500 m ♀ 13 July 1945. *Distribution*: Scattered localities from 58° to 68° N.L. *Vertical distribution*: From sea level to 800 m. *First capture*: Oslo: Tøyen ♀ 10 July 1847 (Si). *Recorded food-plants*: *Prunus spinosa* and *P. padus*. *Flight*: 5 June–17 July.

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. *nigrosericeata*; 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); Onsøy: Hankøundet (Ih, JF); Rygge: Larkollen (Ta); Moss (EB); Jeløy (EB, GN). *Akershus*: Ås (He, JF); Nesodden: Spro (KH); Oslo: Kristiania (WMS), Ekeberg (SP), Tøyen (Si), Rosenhof (Es), Wratz løkke (Es), Dragonskoven (Es), Frogner (NK), Tåsen (NK), Bygdøy (Mu), Oscarshall (Es); Asker (CFL), Nesøya (MO). *Hedmark (HEs)*: Sør-Odal (WMS); Hamar (AB). *Oppland (On)*: V. Slidre: Hausåker (NK); Lesja: Stuguflåten (MO). *Buskerud*

(Bø): Hurum: Hermansbråten (Ta); Lier (JF). *Vestfold*: Sem (CFL). *Telemark* (TEy): Jomfruland (MO). *TEi*: Kviteseid (MO), Vrådal (JR). *Aust-Agder* (AAy): Risør (Th), Laget (NK); Nes Verk (SS). *Vest-Agder* (VAy): Kristiansand (KB); Søgne (CFL); Kvinesdal: Gjemlestad (Ro). *VAi*: Sirdal (ES). *Rogaland* (Ry): Sandnes: Gausel (AN), Li (Fu). *Ri*: Forsand (Tj). *Hordaland* (HOy): Bergen: Skjold (NK), Flesland (MO). *HOi*: Kinsarvik: Djonno (Lu); Voss (NG). *Sogn og Fjordane* (SFi): Stryn: Årheim (NK), Hammerstadli (NK), Hjelle (NK). *Møre og Romsdal* (MRi): Rauma: Trolltindene (MO); Sunndal: Storfale (MO). *Sør-Trøndelag* (STi): Selbu (WMS). *Nord-Trøndelag* (NTi): Snåsa (WMS).

Not verified records: Sparre Schneider (1876), HOi: Tangerås and Skålheim. Huitfeldt-Kaas (1892), Oslo: Oscars gate. Sparre Schneider (1901, HOy: Bergen, Hop and Kråkenes. Grønlien (1921), HOi: Granvin and Eidfjord. *Erroneous record*: *Chloroclystis rectangulata*, Hawkshaw 1919, VAY: Vigeland (= *E. vulgata* Haw.).

Distribution: From 58° to 64° N.L., mainly in coastal districts. *Vertical distribution*: From sea level to about 500 m. *First capture*: Oslo: Tøyen ♂ July 1842 (Si). *Recorded food-plants*: *Pyrus*, *Crataegus*, *Prunus*. *Flight*: 12 June–25 Aug.

Chloroclystis debiliata (Hübner, 1814–17) (Figs 6F, 9G)

Norwegian records: *Eupithecia debiliata*; Sparre Schneider 1882; Lampa 1885; Schøyen 1893. *Chloroclystis debiliata*; Barca 1910; Haanshus 1921; Lundetræ 1938; Berggren 1970; Opheim 1972; Lühr 1973.

Localities: *Østfold*: Varteig (EB); Jeløy (GN, AN). *Akershus*: Ås (He); Nesodden: Spro (KH); Oslo: Tøyen (ST), Bygdøy (MO); Bærum: Sandvika (EB); Asker: Nesøya (MO). *Hedmark* (HEs): Sør-Odal (WMS). *Oppland* (Os): Gran: Røykenvik (THS). *On*: Vågå: Vågåmo (AN); Lom (CFL). *Buskerud* (Bø): Lier: S. Linnes (NK). *Telemark* (TEy): Solum: Bjørnstad (JF); Kragerø: Fossing (AU). *Aust-Agder* (AAy): Nes Verk (SS); Grimstad (CFL). *Vest-Agder* (VAy): Kristiansand (KB), Randesund (WMS); Søgne (CFL); Mandal (WMS); Lyngdal (WMS). *Hordaland* (HOy): Bergen: Knatten (NK). *HOi*: *Kvinnherad*: Omvik (Lu); Kinsarvik:

Djonno (Lu); Voss (NG). *Sogn og Fjordane* (SFi): Førde (NK); Eid: Nordfjordeid (NK). *SFi*: Gloppen: Olden (NK); Hornindal: Fannemel (NK).

Doubtful record: *Chloroclystis debiliata*, Feichtenberger (1965), Nsi: Storfjord worn ♀ 7 Aug. 1944 on *Vaccinium*.

Distribution: From 58° to 62° N.L. mainly in southern and western districts. *Vertical distribution*: From sea level to about 400 m. *First capture*. AAy: Nes Verk ♂ 12 July 1873 (SS). *Recorded food-plant*: *Vaccinium*. *Flight*: 10 May–11 Aug.

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

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

Localities: *Østfold*: Moss ♂ July 1916 (EB); Jeløy ♀ 10 July 1955 (GN). *Akershus*: Frogn: Håøya ♀ 15 June 1947 (MO).

Distribution: Inner part of the Oslofjord district. *Vertical distribution*: Below 50 m. *First capture*: Ø: Moss ♂ July 1916 (EB). *Recorded food-plants*: *Sambucus*, *Solidago*, *Lythrum* etc. *Flight*: 15 June–10 July.

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 a ♂ 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; ?*Eupithecia veratraria*, Opheim 1972. *Remarks*: The species was recorded from TRI: Målselvdalen by Sparre Schneider (1893), but deleted in his lepidoptera-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.

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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.

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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 (Nnö: 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.

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

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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.

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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 Lysekloster 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 *Æschna cyanea* and *Tanypterynx hageni* Selys have been kept alive for weeks in jars containing moist weed or mud (East 1900, Svihla 1959).

Fischer (1961) reports that larvae of *Coenagrion 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

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

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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,

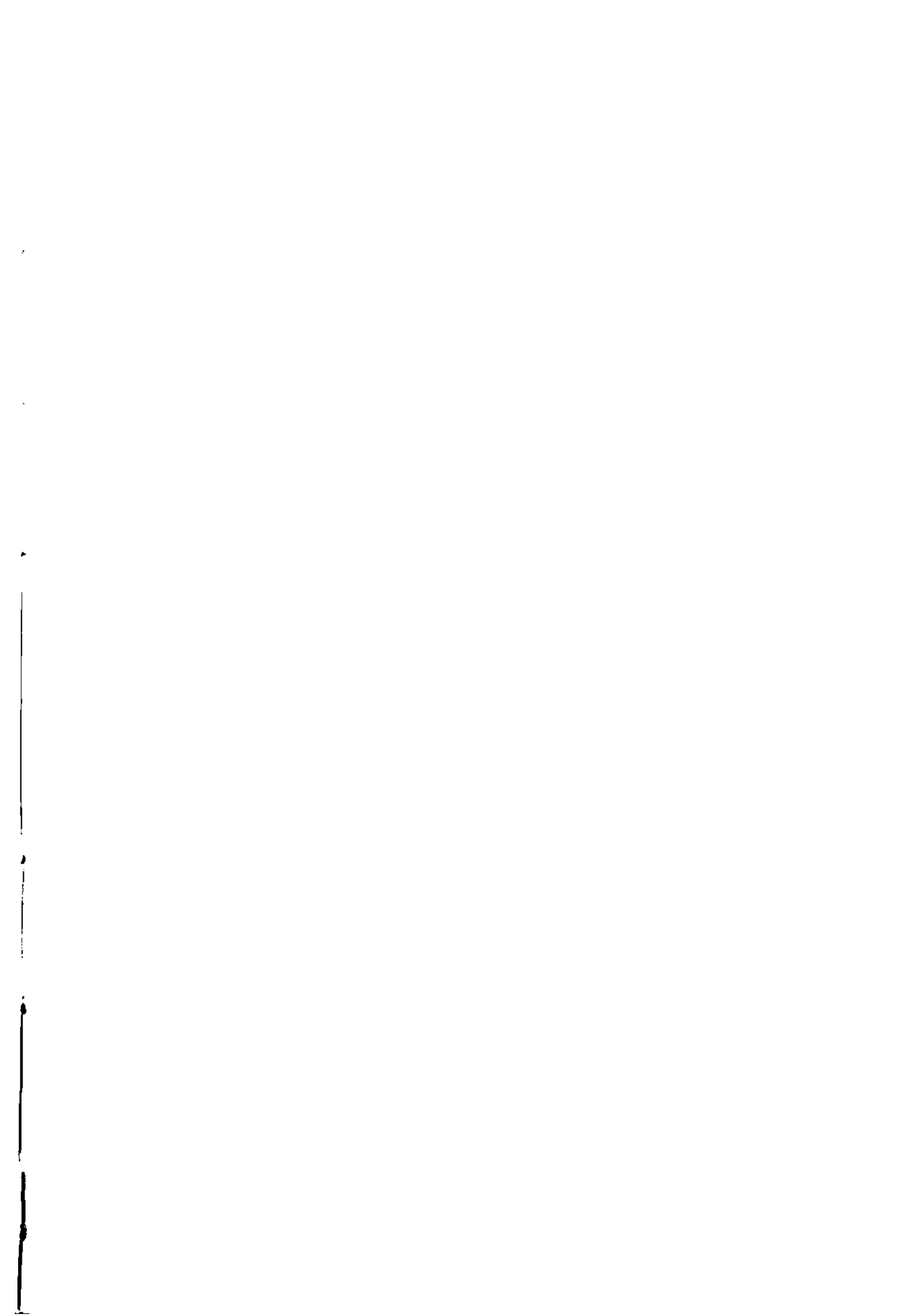
where the climate is not as harsh as on the northern coast.

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

H. H. Eidmann & A. Klingström. 1976. *Skadegjørare i skogen*. 288 pp. LTs förlag, Stockholm. Pris sv. kr. 60.-.

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 lærebok i skogskoler, og til andre undervisningsformål hvor den måtte passe. Ifølge forordet har man også tenkt på alle som er interessert i skogen og dens biologi, og som vil gjøre seg kjent med grunnprinsippene for skadegjørernes leveis og betydning.

Den delen av boken som omhandler insektene innledes 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 inndelt etter hvilke deler av planten skadedyrene angriper. Således får vi først et kapittel om skadedyr på unge planter, hvor særlig gransnutebillen får en grundig omtale.

Senere kapitler tar for seg insekter på nåler og blad, sugende insekter på grener og nåler, insekter som angriper knopper og skudd, insekter i kongler og frø, og insekter som lever under barken 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 utførlige kapitler med gode strektegninger av barkbillenes gangsystem, og Paul Spessivtseffs 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 smågnagere, 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 skadeinsekter. I teksten fins strektegninger og en rekke fotografier i sort og hvitt. Noen av fotografiene 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 – denne grensen som setter et skille for innholdet i bøker, men ikke for dyrenes utbredelse.

Lauritz Sømme

V. B. Wigglesworth. 1976. *Insects and the Life of Man*. Collected essays on pure science and applied biology. 217 pp. Chapman & Hall, London. Pris (paperback) £ 3,25.

I denne boken har Sir Vincent B. Wigglesworth samlet en rekke foredrag og essay forfattet i årenes løp. Mange av dem er høyst 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 opplevet 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 uforsiktig bruk av DDT, og muligheten for at det kunne utvikles insekter som er resistente mot dette stoffet. Det er interessant at motforestillinger mot DDT kom frem på et så tidlig tidspunkt, selv om det gikk mange år før bruken av dette insektmidlet ble begrenset.

«Insekt-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 brøkdelen av sin tid på dette området, gjorde han en betydelig innsats i sine studier av adferd hos bier og maur. Som bokens tittel sier har Wigglesworth vært meget

opptatt av problemene omkring anvendt forskning og grunnforskning, og han tar dette opp i flere av artiklene. Etter hans oppfatning er ikke kløften stor så som man av og til får inntrykk av. Den anvendte entomologiske forskning har dype fundament i den generelle forskning som gjør det mulig å skille mellom artene, og kjenne deres biologi og fysiologi. Han fremhever som et eksempel hvorledes grunnforskning omkring insektenes kutikula har hatt betydning innen anvendt entomologi.

Kutikula har også fått bred plass i et essay om epidermiscellene hos insekter.

Dette er en rent populærvitenskapelig artikkel, som på en fengslende måte beskriver epidermiscellenes mange funksjoner. Som han sier til slutt, illustrerer disse cellene hvorledes tilsynelatende enkle strukturer bærer de mest kompliserte ideer i seg.

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

Lauritz Sømme

N. Gilbert, A. P. Gutierrez, B. D. Frazer, and R. E. Jones. 1976. *Ecological Relationships*. 157 pp. W. H. Freeman and Company, Reading and San Francisco.

Da elektroniske datamaskiner ble forholdsvis vanlige ved universiteter og andre forskningsinstitusjoner (særlig i USA) i slutten av 50 tallet, skiltes to grupper ut fra deskriptiv økologi: Den første, systemøkologene, tok i bruk elektroniske regnemaskiner for, bl. a. å utvikle detaljerte simuleringmodeller (dvs. teoretiske/matematiske modeller som ved hjelp av regnemaskiner etterligner fenomen i den virkelige verden); den andre som i den senere tid har gått under navnet evolusjonær økologi, gjorde bruk av mye enklere matematiske modeller som oftest kan analyseres bare med papir og blyant. Evolusjonær økologi slik vi kjenner den i dag, bygger mye av sitt arbeid på ideer og metoder utviklet av Charles Darwin, Ronald A. Fisher og Robert H. MacArthur.

Begge de nye skolene gjorde bruk av modeller, men av meget forskjellig kompleksitetsgrad (eller detaljrikdom). Dette var det nye relativt til tradisjonell økologi. I slike modeller gjøres antagelser om hvordan forskjellige faktorer virker inn på hverandre: For eksempel, under en spesifisert temperatur vil ingen vekst finne sted hos insekter. P.g.a. at slike spesifikke antagelser ikke alltid stemmer med den virkelige verden til minste detalj, ble tilhengerne av disse nye skolene kritisert for ikke å ha kontakt med den virkelige verden, dvs. med naturen som de tross alt påstod at de studerte. På samme måte kritiserte systemøkologene evolusjonærøkologene for å ha mistet kontakten med den virkelige verden etter som f. eks. MacArthur gjorde antagelser i sine logiske re-

sonnementer som ikke var riktige i alle tilfelle, ja kanskje bare riktig i noen få.

Den foreliggende bok diskuterer sentrale økologiske fenomen som f. eks. predasjon og herbivori, innen rammen av systemøkologiens mest sentrale hjelpemiddel, simuleringmodeller. Forfatterens modeller er imidlertid mye enklere og mindre omfattende enn mange liknende modeller utviklet innen Det internasjonale Biologiske Program (IBP). Boka er i mange henseende bra, ja noen av kapitlene er *meget* bra. Den er kort og greit skrevet på et lettfattelig engelsk. Men den har enkelte avsnitt som er meget tendensiøse, og etter min mening feilaktige. Mange av uttalelsene i boka må ses på bakgrunn av den historiske utvikling jeg ovenfor har skissert.

Boka er delt i to deler: Del 1 som gir det økologiske (teoretiske) grunnlag; en beskrivelse av en del sentrale aspekter ved økologiske eksperimenter og prøvetagning; samt et avsluttende kapittel om hvorfor simuleringmodeller i det hele utvikles, og hva slike modeller kan brukes til. Del 2 gir, i form av et eksempel (bladlus, *Masonaphis maxima*, på *Rubus parviflorus* og dens parasitt, *Aphidius rubifolii*), hvordan en simuleringmodell utvikles: Her gis knepene; suksessive versjoner av modellen er gitt i form av EDB-programmer, med feil som forfatterne oppdaget før den endelige versjonen ble publisert i *Journal of Animal Ecology* (1973, vol. 42, sidene 323-340). Programmeringsdetaljer er meget godt beskrevet, slik at enhver som bare så vidt har vært i berøring med FORTRAN-programmering, vil kunne følge argumentene. Boka er avsluttet med et appendix der den filosofiske disiplinen metodelære (eller vitenskapsfilosofi) beskrives. Her beskrives også metodelærens implikasjoner for økologisk forskning. Til tross for at dette er et interessant, og av mange økologer dessverre oversett felt, hører appendixet på mange måter ikke hjemme i boka. Dette skyldes at denne diskusjonen er altfor kort.

Først de negative sidene ved boka:

(i) Introduksjonen er et angrep på evolusjonærøkologene, samt på økologiske laboratorieeksperimenter. Det er riktig at resultater oppnådd ved laboratorieeksperimenter bare med forsiktighet kan generaliseres til å gjelde i naturen. Men det er mulig: C. B. Huffaker's predator-byttedyr eksperimenter med to middarter i et heterogent habitat er et av mange eksempler på slike laboratorieeksperimenter som har gitt øket forståelse av generelle økologiske fenomen. Videre er påstanden om at MacArthur's og hans students arbeid ikke har bidratt til vår forståelse av økologiske prosesser (etter min mening) feilaktig. Et eksempel på dette er MacArthur og Wilson's teori om biogeografiske forhold på øyer. Den har gitt oss en øket forståelse av hvilke typer arter som koloniserer nytt land, og hvilke dynamiske prosesser som finner sted i tilsynelatende stabile plante- og dyresamfunn. Etter min mening har få (om i det hele noen) simuleringstudier kunnet vise tilsvarende resultater av generell karakter. Slike eksempler finnes heller ikke i foreliggende bok. (Dermed er ikke sagt at simuleringstudier ikke har noe som helst å bidra med!) På grunn av disse tendensiøse påstander vil jeg ikke anbefale boka lest

uten samtidig å lese en bok som gir en bedre framstilling av Darwin-Fisher-MacArthur tradisjonen: «Theoretical ecology» (Robert M. May (red.), 1976, Blackwell Scientific Publ.), kan i denne forbindelse anbefales.

(ii) Ved å kaste et blikk på innholdsfortegnelsen, slo det meg som et meget positivt trekk at Darwin/Fisher's teori for naturlig seleksjon var omtalt i denne boka. Dette fordi evolusjonære aspekter ofte utelates i simulerings-studier. Men etter å ha lest kapittelet, er jeg langt mindre imponert. Der er en alvorlig feil i uttrykksmåten. Forfatterne påstår at, ifølge Darwin/Fisher, etablerer genetisk kodete egenskaper seg i populasjonen dersom de er til fordel for arten (eller populasjonen), men ikke nødvendigvis fordelaktig for individene. Dette er riktignok en populær framstilling av Darwin's teori, men dessverre feilaktig. Darwin/Fisher sier at egenskaper etablerer seg i populasjonen hvis og bare hvis de innebærer fordeler for individene m.h.t. netto reproduktivt utbytte. I rettferdighetens navn bør det dog sies at det synes som om forfatterne nok mener det riktige, men ordlegger seg feilaktig. Ikke desto mindre, får man et noe fordreid bilde av hva Darwin/Fisher egentlig antok. Men positivt er det absolutt at forfatterne råder forskere som utvikler simuleringsmodeller å etterprøve, teoretisk, om modellen er konsistent med evolusjonsteorien!

(iii) Beklagelig er det også at forfatterne er for mye opptatt 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 vært trukket inn. Derfor kan boka ikke sies å gi en god oversikt over stimulering innen insektsforskningen. 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 populasjonsdynamikk. 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 matematikk man trenger som populasjons-øko-log 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 matematikeren også deltar i felt! Dermed advarer de mot den dessverre vanlige form for datainnsamling utført av feltbiologer som går til statistikkeren og spør: «hva kan du finne ut av disse dataene?»

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

(iii) Et vanlig argument brukt av forskere som utvikler simuleringsmodeller, 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 simuleringsmodeller 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 simuleringsmodeller 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 faglitteratur bare publiserer den mer fullstendige versjonen.

Som konklusjon vil jeg anbefale denne boka, lest sammen med annen litteratur, slik at motforestillinger mot en del av uttalelsene i boka kan dannes. Boka vil kunne egne seg som lærebok i et universitets- (eller høyskole-) 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-fabrikk og forretninger kan en rekke dyrearter opptre som skadedyr eller sjenerende gjester. Flertallet av artene hører hjemme blant insektene og edderkoppdyrene, men også blant fugler og pattedyr er det arter som vi ikke ønsker å ha for nært inn på livet. De fleste mennesker ser med skepsis på småkryp som dukker opp innenfor husveggene, 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 fulgt med importerte matvarer, tekstiler, gjenstander av tre o. a.

To medarbeidere ved Statens Skadedyrlaboratorium i Danmark, Henri Mourier og Ove Winding, som daglig besvarer en rekke henvendelser om skadedyr, har skrevet ei bok med tittelen «Vilde dyr i hus og hjem». Boka er illustrert med plansjer, tegninger og fotografier i svart/hvitt og farger. Ebbe Sunesen har utført tegninger og plansjer, mens Skadedyrlaboratoriets sjef, Preben Bang, er ansvarlig for de fleste fotografiene.

Innledningsvis omtales huset som tilholdssted for dyr og hvorfor nettopp hus egner seg svært godt for en rekke spesialiserte arter. Det gis en kort innføring i systematikk og leddyrenes bygning, sanser og utvikling. Videre finnes enkle bestemmelsesnøkler med illustrasjoner til hovedgruppene.

Boka omfatter både arter som er virkelige skadegjørere og andre som er sjenerende eller forholdsvis harmløse gjester. Eksempler på viktige skadegjørere er omtalt i kapitlene om stikkende og bitende arter, dyr som lever av matvarer og dyr

som angriper tekstiler, papir, lær, kunststoffer og trevirke. I disse gruppene opptrer de fleste av de mere alvorlige skadedyrene. Men murvegger, isoleringsmaterialer og metall blir også hjemsøkt 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. Forfatterne ser ut til å ha fått med det alt vesentligste av dyr som kan påtreffes i hus av forskjellig slag.

Den norske utgaven følger nøye oppsettet i den danske originalen. Dette har medført at en del arter omtales som ikke opptrer her i landet. Kapitlet om treborende insekter er omarbeidet og tilpasset norske forhold, mens innholdet forøvrig er en direkte oversettelse fra dansk til norsk. Navnsettingen av enkelte arter har ført til uoverensstemmelser med Norske Dyrenavn, insekter og edderkopper fra 1968, men dette er vel av mindre betydning. Noen misvisende krysshenvisninger vil muligens skape noe forvirring hos lesere som ikke har kunnskaper om entomologi. I noen tilfeller er det benyttet ett artsnavn på plansjene, mens et annet navn finnes i teksten. Fagentomologer vil kanskje ha noe å utsette på at norske gruppe-

navn er knyttet til den latinske betegnelsen for en bestemt art.

Ved sammenlikningen av den danske og norske utgaven er det særlig en ting som bemerkes. Det går ikke fram av den norske utgaven hvem som er ansvarlig for tegninger og plansjer. Dessuten er fotografenes navn utelatt.

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 helse råd, 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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Separate sheets should be used for the following: (1) Title page, with the author's name; (2) Abstract not exceeding 11 lines (770 letters and spaces) with the name and full postal address of the author underneath; (3) References; (4) Tables with their headings; (5) Legends to Figures.

In the case of articles submitted in a language other than English, the Abstract, Table headings and Figure legends must be accompanied with an English translation.

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All illustrations will be considered as Figures. Each graph, drawing or photograph should be numbered in sequence with arabic numerals, and should be identified lightly on the back with the name of the journal, the author's name, and the Figure number. The top should be indicated. The Figures should be the original drawings and should be constructed in proportion to either the entire width of the type area (14 cm) or to the column width (6.7 cm). Lines must be thick enough to allow for reduction. Letters and numbers must not be less than 2 mm in the printed illustration. Photographs should be submitted as unmounted glossy enlargements showing good detail.

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

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