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STYRET

The Occurrence of the Nordic Beetle *Atomaria Sahlbergi* Sjöberg (Col., Cryptophagidae) in Central Europe, with Biological and Zoogeographical Notes

PETR NOHEL

Nohel, P. 1973. The Occurrence of the Nordic Beetle *Atomaria sahlbergi* Sjöberg (Col., Cryptophagidae) in Central Europe, with Biological and Zoogeographical Notes. *Norsk ent. Tidsskr. 20,* 221–224.

The new discovery in central Europe (Czechoslovakia: the Silesian Beskydy mountains) of *Atomaria sahlbergi* Sjöberg 1947, so far considered as exclusively Nordic, is reported, with notes on bionomics and zoogeographic implications of the presented records.

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Atomaria sahlbergi Sjöberg 1947 is a little known species, only reliably recorded as yet from northern and north-central Fennoscandia and from northern Scotland (Horion 1960, Lohse 1967, Johnson 1971). Thus, although Lohse (1967) anticipated the presence of this species in central Europe, the present first central European records are of considerable interest.

MATERIAL

Amongst the material of the Atomariinae collected by the writer in Czechoslovakia, 1965–1970, and kindly identified by Dr. Colin Johnson, there were three specimens of *Atomaria sahlbergi* Sjöberg. They were taken at the following localities (see also the map, Fig. 1):

Czechoslovakia: Czech Silesia: the Silesian Beskydy Mts. The Mionší primeval forest state nature reserve, 23 July 1965, one specimen sieved from fir-wood litter. Same locality but 17 Oct. 1970, 750 m a.s.l., one specimen sieved from fir wood debris (coll. C. Johnson, Manchester). – Silesian Beskydy Mts.: Mt. Čantorija, montane primeval forest on steep slope near the summit, 900 m a.s.l., 27 Oct. 1967, one specimen sieved from fir wood debris.

BIOLOGICAL OBSERVATIONS

In all three cases, specimens were collected in a macrohabitat which may be described as a typical Carpathian mixed montane primeval forest (Abieteto-Fagetum). As all specimens were associated with firs and extracted from nearly dry wood debris, the following particular microhabitat is certainly worthy of note. It consisted of large quantities of nearly dry, decaying fir wood litter and decaying remains of fir bark, mixed in with partially decomposed fir needles, and occasionally grass roots. Such litter heaps as a rule accumulate around the bottom parts of large decaying fir trunks; the bulk of moulds and mycelia of various species of fungi often grow through these heaps. Fruit bodies of some lower fungi, apparently belonging to the order Pezizales, were frequently seen in the microhabitat. This proved to be very productive, as can be seen from the synopsis below of the coleopterous faunas associated with the respective microhabitats on the dates when specimens of *Atomaria sahlbergi* Sjöberg were found:

1. Mionší, 23 July 1965: Scydmaenidae: *Microscydmus nanus* Schaum (one specimen), *Neuraphes*

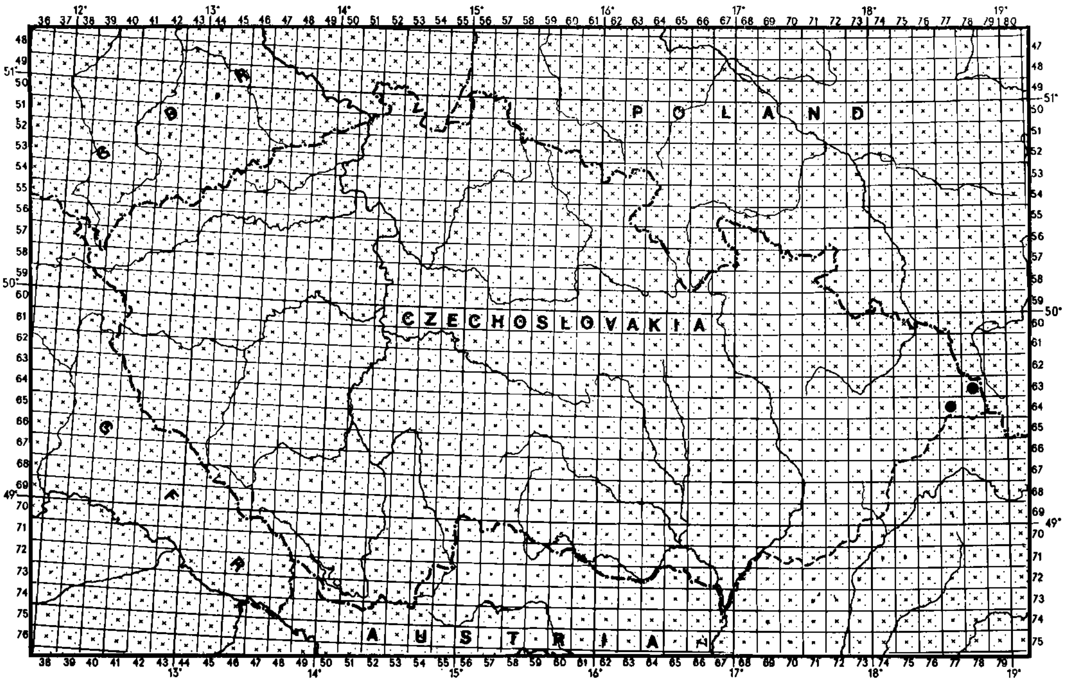

Fig. 1. Map showing present central European distribution of *Atomaria sahlbergi* Sjöberg. Dots show localities in the Silesian Beskydy Mts.

carinatus Mulsant (1); Pselaphidae: *Plectophloeus rhenanus* Reitter (1), *Euplectus bescidius* Reitter (1); Staphylinidae: *Phyllodrepa melanocephala* (Fabricius) (2), *Leptusa ruficollis* Erichson (1); Cryptophagidae: *Cryptophagus quercinus* Kraatz (2), *Atomaria bescidia* Reitter (1); Ptinidae: *Ptinus* sp. cf. *bescidicus* Reitter (1); Melandryidae: *Zilora sericea* Sturm (remains of a single dead specimen).

2. Mionší, 17 Oct. 1970: Scydmaenidae: *Microscydmus nanus* Schaum (2 specimens); Pselaphidae: *Euplectus punctatus* Mulsant (2); Histeridae: *Gnathoncus nannetensis* Marseul (1); Staphylinidae: *Phyllodrepa melanocephala* (Fabricius) (1), *Phyllodrepa linearis scabriuscula* Zetterstedt (2), *Phyllodrepa pygmaea* (Gyllenhal) (3); Cryptophagidae: *Cryptophagus dentatus* Herbst (2), *Atomaria morio* Kolenati (1), *Atomaria bescidica* Reitter (1); Ptinidae: *Ptinus* sp. (1).

3. Čantorija, 27 Oct. 1967: Scydmaenidae: *Microscydmus nanus* Schaum (35); Pselaphidae: *Euplectus punctatus* Mulsant (10); Staphylinidae s. lat.: *Conosoma bipunctatum* Gravenhorst (15); Cryptophagidae: *Cryptophagus dentatus* Herbst (1), *Atomaria affinis* Sahlberg (1); Ptinidae: *Ptinus* sp. (2).

DISCUSSION

From the foregoing a picture emerges of a microhabitat rich in great aggregations of mycelia of lower fungi and moulds, these seeming to constitute the primary and ample source of food for the afore-mentioned species. The rare beetles encountered there seem to be unequivocally associated with some rarer fungi which, in turn, are associated with the peculiar conditions in the respective microhabitats. It seems that the presence or absence of lower fungi and moulds in the heaps of wood debris, and consequently the presence of associated coleopterous fauna, is largely governed by two main factors: the origin of wood debris and the relative dryness of the microhabitat. According to the writer's experience, both factors are of equal importance. In the Carpathian montane primeval forests there exist microhabitats which are superficially extremely similar to that dealt with above, but which are exclusively formed by spruce wood debris, bark, and decomposed needles accumulated usually around or near old spruce trunks. Yet the latter type of coleopterous habitat, to the writer's knowledge, has never contained such associations as those listed above. Frequently it is inhabited by ground-beetles (genera *Trechus*, *Notiophilus* and *Trichotichnus*), and staphylinid beetles (mostly members of the genera *Othius*, *Quedius*, *Leptusa* and *Atheta*); scydmaenid beetles are seldom encountered here and if so, they are represented by *Neuraphes elongatulus* (Müller et Kunze) and *Neuraphes coronatus* Sahlberg; pselaphid beetles aré represented by frequent species, viz. *Euplectus nanus* Reichenbach and *Euplectus karsteni* Reichenbach (the rarer species of the genera *Plectophloeus* and *Euplectus* seem to be exclusively associated with firs, beeches or oaks); Cryptophagidae-Atomariinae are rarely found, *Atomaria alpina* being the only representative. The relative humidity of the fir wood litter is a factor strongly influencing the composition of its coleopterous fauna – the wetter the fir microhabitat, the larger the proportion of the scavengers, mostly carabid beetles and staphylinid beetles. Suitably damp litter is inhabited by species of *Carabus*, *Ocypus*, *Quedius*, and other species which hunt for snails, whereas the cryptophagid or ptinid beetles are never associated with damp conditions, showing clear preference for the driest microhabitats.

ZOOGEOGRAPHICAL IMPLICATIONS

Firstly, it would appear highly unlikely that *sahlbergi*'s presence in the Silesian Beskydy mountains is due to its being accidentally imported with wood materials. Thus it appears that *Atomaria sahlbergi* is established in the Silesian Beskydy mountains as a relic that survived from the Last Glaciation in the Beskydy montane primeval forests. It is decidedly not one of the most recent immigrants, as seems to be the case with the hydroporine dytiscid beetle *Oreodytes borealis* (Gyll.) (Nohel 1973a), and the omaline staphylinid beetle *Phyllodrepoidea crenata* (Grav.) (Nohel 1973b). The presence of *A. sahlbergi*, so far considered as being exclusively Nordic in its distribution, in the remains of Beskydy primeval forests may be explained by the climate, which in those macrohabitats is typically montane. Mention must here be made that the colepterous fauna of Beskydy montane primeval forests contains a relatively high proportion of species that are today restricted to the north of Europe, also occurring occasionally in the high mountains further south, or species which show clear preferences for cold forested areas whose present day distribution, though not purely boreoalpine in the strict sense of Holdhaus (1912) or Székessy (1934), suggests that such species have attained their distribution in central Europe either by immigration from the north or by surviving during the Late Würm retreat stages and the subsequent warm interstadial. It would be inappropriate to list in this paper all these species, since the list is long. Yet, a number of these species are typical inhabitants of the montane primeval forests, not being any longer known even from the adjacent spruce, beech, or mixed forests, which are much younger and as a rule much more influenced by human activity than the primeval forests. Such species include, for example, staphylinid beetles *Omalium strigicolle* Wankowicz and *Olisthaerus substriatus* Gyllenhal; scydmaenid beetle *Neuraphes coronatus* Sahlberg; cryptophagid beetles *Pteryngium crenatum* Gyllenhal, *Atomaria affinis* Sahlberg, and *Atomaria bescidica* Reitter; cucujid beetle *Dendrophagus crenatus* (Fabricius); melandryid beetles *Phryganophilus ruficollis* (Fabricius), *Zilora sericea* Sturm, and many others. On the other hand, there is at least one case in favour of coleoptera surviving the Last Glaciation in refugia (possible in the remains of the primeval forests also) in the Silesian Beskydy mountains. This is the presence of the pselaphid beetle *Euplectus tholini* Guillebeau in the Mionší primeval forest (Nohel 1970). This species is nowadays restricted to a few scattered localities in France, Italy, and Greece. The derodontid beetle *Derodontus macularis* Fuss, whose presence in the Beskydy primeval forests has only been discovered very recently (Nohel 1970, 1973c), may well be a further example of a beetle species indicating that there must have existed refugia where some beetle species managed to survive the Late Glaciation.

It therefore seems that the more detailed analysis of as yet relatively unexplored coleopterous fauna of Beskydy montane primeval forests could improve our understanding of the origin and affinities of the present-day beetle fauna of the northwestern Carpathians.

ACKNOWLEDGEMENTS

I wish to thank Dr. Colin Johnson, University of Manchester, for identification of the *Atomaria* specimens and for information concerning *Atomaria sahlbergi.*

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Effects of Larval Density on the Development of *Lygaeus equestris* (L.) (Het., Lygaeidae) in the Laboratory

OTTO KUGELBERG

Kugelberg, O. 1973. Effects of Larval Density on the Development of *Lygaeus equestris* (L.) (Het., Lygaeidae) in the Laboratory. *Norsk ent. Tidsskr. 20*, 225–228.

Larvae of the seed-feeding bug *Lygaeus equestris* (L.) were bred in groups of 1, 2 and 10 animals. The group size affected the survival and the developmental rate of the larvae and the weight of the newly emerged adults. The mortality was highest and the development was fastest in groups of 10 bugs. The adults from larvae bred in isolation became the heaviest. The sexes differed with respect to developmental rate and weight. The females developed faster and became heavier than the males.

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It is well known in insects, as in other organisms, that density may influence several processes during their life (Andrewartha & Birch 1954, pp. 368–382). A given difference between isolated and crowded organisms may represent the result of extra stimuli occurring in the crowd, or the absence of stimuli normal to the species occurring in conditions of isolation (Long 1953). The effects of group size on the larval development in the laboratory have been demonstrated in for example the heteropterans *Oncopeltus fasciatus* (Dallas) (Feir 1963, Dingle 1966, 1968), *Dysdercus intermedius* Distant (Youdeowei 1967), *D. fasciatus* Sign. (Hodjat 1969), *Nezara viridula* L. (Kiritani 1964, Kiritani & Kimura 1965) and *Eurydema rugosum* Motschulsky (Kiritani & Kimura 1966).

In nature, larvae as well as adults of the seed-feeding bug *Lygaeus equestris* (L.) are often found together feeding on the same plant. However, the population density of bugs is often very high and the distribution of food resources shows a strong heterogeneity in time and space (Solbreck & Kugelberg 1972). Thus it is very difficult to determine how to interprete these accumulations of bugs. Besides, nothing is known about the possible effects of aggregations on the food plants on the general biology of the species. As long as we lack field data about this, it ought to be of some interest to study the possible effects of grouping bugs in laboratory experiments.

In the laboratory, when offered plenty of seeds, first instar larvae cluster when feeding. When one larva has begun to pierce a seed, others gather around it and try to do the same. During the later instars this behaviour diminishes. Adults are seldom seen to suck the same seed at the same time when they are offered an excess of seeds.

The main purpose of the present study was to determine if rearing alone or in groups made any difference to the larval development of *L. equestris*. In addition, comparisons between the sexes of developmental rate and weight of newly emerged adults were carried out.

MATERIALS AND METHODS

The *L. equestris* larvae used were obtained from parents collected in the field during hibernation. Within a few hours after hatching, the first instar larvae were divided into groups of 1, 2 and 10 individuals and removed into 5 ml plastic cylinders.

Our knowledge about aggregations of young larvae in the field is poor. The group size of 10 bugs chosen in the present experiment has, however, biological relevance. Aggregations of this size of first instar larvae have been observed in the field.

The number of groups started were 49, 10 and 5 respectively. After seven days the groups were removed into 155 ml jars. The rearing jars are described in other papers (Kugelberg 1973, Coulianos & Kugelberg 1973.).

The larvae were supplied with water and a mixture of unpeeled seeds of *Adonis vernalis* L., *Cirsium arvense* (L.) Scop., *Cynanchum vincetoxicum* (L.) Pers. and *Helianthus annuus* L. The seeds were given in excess. Water and seeds were renewed weekly and the jars cleaned. The photoperiod was 18L - 6D, the temperature 25 ± 1° and the relative humidity 60 ± 10% in the rearing cabinet. The bugs were weighed in the active stage the same day as they became adults, on a torsion balance, calibrated in 0.2 mg. Bugs that died during the development were not replaced.

The terms 'density' and 'group size' have been used as synonyms, since the bugs were reared in jars of equal sizes.

RESULTS

The larval development was successful in all the three group sizes. Table I shows the survival, developmental time and weight of newly emerged adults at the different group sizes. The mortality did not exceed 20% in any case. It was highest in groups of 10 bugs and significantly different (at P = 0.05) from the others.

The developmental time was significantly shortest in groups of 10 bugs. There was no difference between groups of 1 and 2 bugs. The females developed significantly faster than the males of the same group size. There were no indications of any stronger synchronism of the final moults among bugs reared together than among isolated bugs. Three days were required for the completion of larval development of over 50% of the bugs both among groups of 10 bugs and among isolated bugs.

The heaviest adults were obtained from the isolated larvae. Although the weights may vary considerably between individuals, their mean weight was significantly different from those of groups of 2 or 10 bugs. There was no difference between groups of 2 and 10 bugs. The females, except those in groups of 2 bugs, were significantly heavier than the males of the same group size.

Within each group size, no correlation was found between weight and developmental time among newly emerged adults of each sex.

DISCUSSION

In *L. equestris*, larval density obviously has physiological effects on the development. The mechanisms involved are, however, not clear. The present findings, viz. increased mortality, accelerated development and lighter adults with increasing group size, are in agreement with most

Table I. Survival, developmental time and weight of adults at different densities during larval development in *L. equestris*. Bracket-ends join significantly different figures ($P < 0.05$). *95% confidence limits.

Bugs per jar	No. of jars	Percent survival	No. of surviving to adult		Days to adult $x \pm ts_{\bar{x}}$ *		Weight of adults (mg) $x \pm ts_{\bar{x}}$ *	
			♀♀	♂♂	♀♀	♂♂	♀♀	♂♂
1	49	98	20	28	33.9±0.5	34.8±0.4	41.9±1.5	38.2±1.1
2	10	100	12	8	33.6±0.5	34.4±0.4	35.5±1.7	33.1±2.6
10	5	80	19	21	32.6±0.5	33.5±0.5	36.7±1.9	33.4±1.6

of the findings in other Heteroptera. The faster development in groups of 10 bugs cannot be explained by any influence of parental age. This may affect the developmental rate in bugs, as shown by Kiritani (1963). Adopting his method in the present study (using the date of egg-laying as an expression of parental age among hibernated adults), all the parents used were of the same age. The lower mean weight of adults developing together was not caused by starvation since there always was an excess of seeds.

The survival rate was high at every group size. It was, however, favoured by rearing alone or in groups of 2 bugs. During early instars, the bugs in groups of 10 were frequently observed to cluster when feeding. Formation of feeding aggregations thus seem to be of no advantage considering survival of bugs in the laboratory with a sufficient supply of seeds easy to find.

Several bugs form aggregations when feeding. Some species show this behaviour both during larval and adult life, for example *Oncopeltus fasciatus*, *Pyrrhocoris apterus* L. (Bongers & Eggermann 1971), *Dysdercus* spp. (Youdeowei 1966, Bongers & Eggermann 1971), *Eurydema rugosum* (Kiritani & Kimura 1966), while in others, for example *Nezara viridula* (Kiritani 1964), it only occurs during the earlier part of the larval period.

The formation of feeding aggregations during early instars in *L. equestris* in the laboratory also shows that density has behavioural effects on the young larvae. During the remaining parts of the life-cycle the bugs seldom cluster when feeding in the laboratory. It can, however, not be excluded that the presence of other (feeding) individuals may have an influence on their feeding behaviour. In *Oncopeltus fasciatus* and *Dysdercus fasciatus* the feeding activity and the volume of food ingested is higher in small groups (2–4 bugs) than in isolated individuals (Bongers & Eggermann 1971). Perhaps behavioural effects partly induce the physiological effects of density on development in *L. equestris*.

Apart from the fact that bugs reared in groups of 10 become lighter and develop more rapidly than isolated ones, no correlation was found between weight and developmental time among bugs of each sex at each group size. The weights may differ up to 30% among individuals of the same length of larval development in the laboratory. Among adults from the field (with unknown length of larval life), brought to the laboratory as fifth instars, the weights may also differ to the same degree. As in most bugs, newly emerged females of *L. equestris* are heavier than males in the field (Kugelberg 1973). The same was found in the present experiment in groups of 1 or 10 bugs. In groups of 2 bugs the number of insects was too small to distinguish any significant difference.

The more rapid development of females than males in the present study has not earlier been distinguished (Kugelberg 1973) because of insufficient number of bugs. Whether this difference between the sexes really exists under field conditions is unknown. The sex ratio among the new generation of adults in the field prior to hibernation was found to be 1:1 (Solbreck 1971), and it almost constantly remains so during the rest of the life-cycle.

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New Localities for Some Species of Odonata from Østfold, Norway

JAN-FREDRIK BJÅNES

Bjånes, J. F. 1973. New Localities for Some Species of Odonata from Østfold, Norway. *Norsk ent. Tidsskr. 20,* 229-230.

New localities are listed for some species of Odonata. The localities for *Onychogomphus forcipatus* (L.), *Sympetrum sanguineum* (Müll.), and *Sympetrum vulgatum* (L.) are of special interest because the earlier records of these species are very few and uncertain. The large number of *S. vulgatum* found indicates that this species is established in Norway.

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Earlier records of the Odonata in Østfold county, Norway were published by Sømme (1937) and Åbro (1966); this paper provides additional information. The present collection of Odonata was made during the period of June-July-August 1972.

Species known to be common in all parts of southern Norway are not included in the species list below. Fig. 1 gives the localities for species of more special interest. In the species list the locality references are also indicated with UTM grid system.

Fig. 1. Map of investigated area. 1) Seutelven. 2) Stordammen. 3) Borredalsvann. 4) Børteelv. 5) Vestvatn. 6) Erteelv. 7) Laksebekk. 8) Flesjøvatn.

Calopteryx virgo (L.)

Børteelv 17 July (32VPL306737).

Platycnemis pennipes Pall.

Børteelv 17 July (32VPL306737), Erteelv 22 July (32VPL358815), Laksebekk 23 July (32VPL 118898). The species was most numerous, especcially at Erteelv.

Erythromma najas (Hansemann)

Laksebekk 23 July (32VPL118898).

Coenagrion concinnum (Joh.)

Sjursbråtetjønna 27 July (32VPL117867).

Aeshna cyanea (Müll.)

Borredalsvann 6 Aug. (32VPL125706), Flesjøvatn 4 Aug. (32VPL111911), Børteelv 17 July (32VPL306737). The species was not common at any locality, and I found only a few individuals.

Aeshna subarctica Walker

Sjursbråtetjønna 27 July (32VPL117867), Stordammen (32VPL114698). *A. subarctica* seems to be a part of the species community in acid marshes. Here it is often found together with *C. concinnum.*

Cordulegaster annulatus (Latr.)

Børteelv 17 July (32VPL306737)

Onychogomphus forcipatus (L.)

Børteelv 17 July (32VPL306737). Previously only recorded by Sømme (1937) and Åbro (1966). I found it with *C. annulatus*, *C. virgo*, and *P. pennipes*. Børteelv is a rather fast-moving, eutrophicated river running through quarternary clay areas. These species tend to occur together in biotopes like this (Sømme 1937). Sømme (1937) mentioned further that *Calopteryx splendens* Harris had the same biotopical demand, but this species was not observed. It was recorded by Sømme (1937) and Solem (1969).

Sympetrum flaveolum (L.)

Vestvatn 12 Aug. (32VPL184771), Flesjøvatn 2 Aug. (32VPL111911), Seutelven 16 Aug. (32 VPL088722). At Vestvatn the species was most numerous, together with *Sympetrum danae* (Sulz).

Sympetrum sanguineum (Müll.)

Seutelven 16 Aug. (32VPL088722), Vestvatn 12 Aug. (32VPL184771), Borredalsvann 20 Aug. (32VPL125706).

Sympetrum vulgatum (L.)

Seutelven 16 Aug. (32VPL088722). The previous records of *S. vulgatum* are very few (Sømme 1937, Økland 1964, Åbro 1966) and the find is therefore of special interest. It was found in enormous numbers together with *S. danae* and *S. sanguineum*. Tjønneland (1952) did not consider the species a Norwegian one, but according to my record the species is now established in Norway.

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Two Partially Duplicated Antennae in Sciomyzidae (Diptera) of Western Europe

C. O. BERG

Berg, C. O. 1973. Two Partially Duplicated Antennae in Sciomyzidae (Diptera) of Western Europe. *Norsk ent. Tidsskr. 20*, 231–235.

The teratological antennae described here were found on a male *Trypetoptera punctulata* Scopoli collected in Norway, and on a male *Tetanocera hyalipennis* von Roser collected in Belgium. Each has a laterally expanded basal segment that bears almost perfectly duplicated second and third segments in side-by-side positions. Other examples of abnormal antennae in Diptera are cited, and possible causes are suggested.

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Lamb (1911) considered antennal teratology in the Diptera to be 'very rare'. He described an example in the Otitidae as the only one he or his associates had seen or heard about. Cappe de Baillon's (1927) monograph on teratology suggests the same conclusion. That author cited very few papers on flies and did not even mention the Diptera in his section 'Monstres à antennes surnuméraires'. More recent dipterists have reported antennal abnormalities in the Ceratopogonidae (Callot 1959), Muscidae (Rubini-Franco 1963), Tabanidae (Philip 1965), Syrphidae (Nielsen 1966), Culicidae (Sokoloff et al. 1967), and Lauxaniidae (Steyskal 1968). Many examples are known in the Drosophilidae (e.g. Zimm 1951, Inouye & Takaya 1964, Gardner 1970), and information on the causes of such anomalies has come principally from studies of *Drosophila.*

Both examples described here involve more nearly complete duplication than most of the instances cited above. Each anomalous antenna has a laterally expanded basal segment that bears almost perfectly duplicated second and third segments in mirrored, side-by-side positions. The opposite antenna is normal on both specimens.

Although the cause of these anomalies is not known, publication of these observations may contribute to an eventual understanding of such teratology. Reports and descriptions of *Drosophila* anomalies alerted biologists to look for them and led to knowledge of their genetics and morphogenesis.

Trypetoptera punctulata Scopoli occurs throughout most of Europe and is widely distributed in southern Norway (Knutson & Berg 1971, Fig. 2). A teratological male specimen of this species (Fig. 1) was discovered by the writer while checking Sciomyzidae in the Diptera collection of the Zoological Museum of Bergen. It bears the label: Måbødalen, Tveito, HOi: Eidfjord, 24 July 1967, A. Løken, leg. Its anomalies had not been noticed, and Curator Løken could not supply any further information concerning it. In addition to the partially duplicated left antenna, it has an abnormally small compound eye on the left side, and the frontal area of the head is not bilaterally symmetrical (Fig. 1). Except for these points, the specimen appears to be normal. It has only 5 small bristles on the ocellar convexity, compared with 18 on a female specimen bearing the same date-locality data, and the pigment stripes at the anterior edge of the front just above the antennal bases are much shorter on the aberrant male. However, these characters vary widely among normal specimens. On *T. punctulata* from the Norwegian county of Hordaland, the number of small bristles among the ocelli varies downward from the 18 found on that female to 16, 14, 12, 11, 10, 9, 8, 7, and 6. Other flies have pigment stripes just as short as those of the tera-

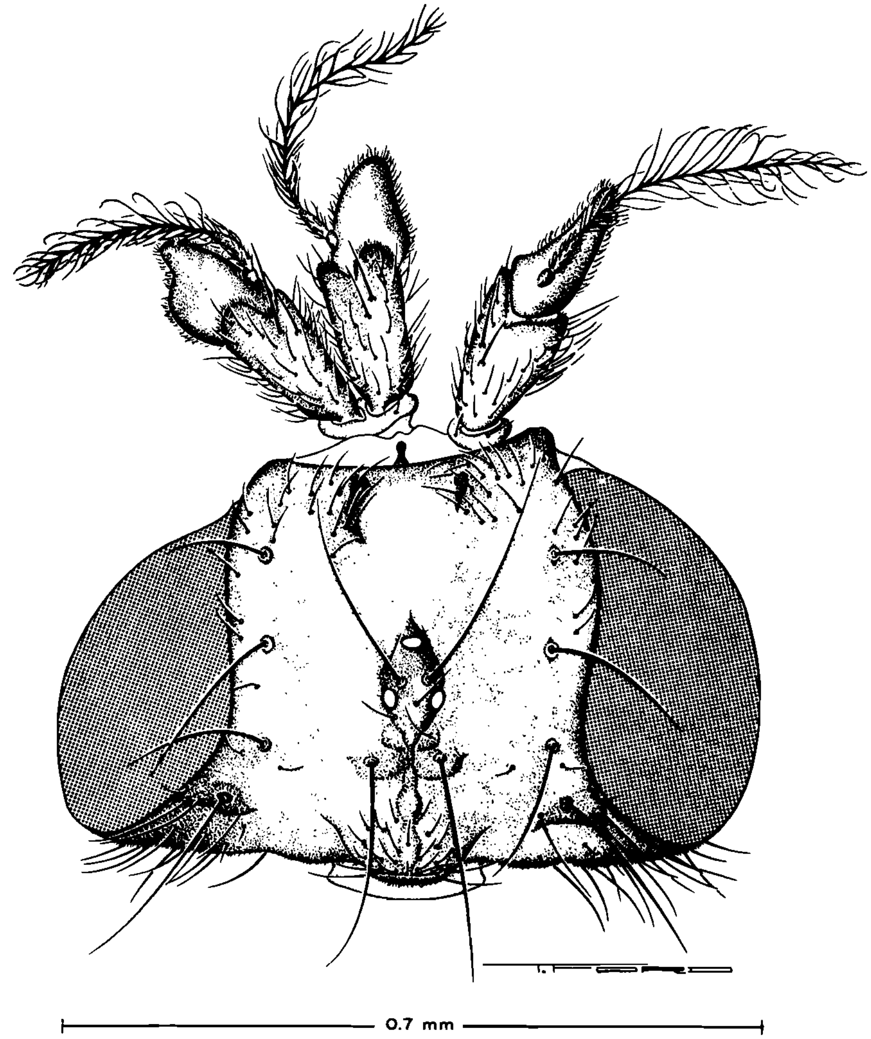

Fig. 1. Teratological male of *Trypetoptera punctulata* – dorsal view of the head.

tological specimen, and some lack those stripes completely.

Tetanocera hyalipennis von Roser is also widely distributed in Europe, although not reported from Norway until recently (Knutson & Berg 1971). An anomalous male specimen (Fig. 2) was collected by the writer by sweeping in marshy margins of ponds at the abbey of the Rouge Cloître, Brabant, Belgium, 2 July 1959. It is deposited in the insect collection of Cornell University. The partially duplicated right antenna is very similar to the left antenna of the *Trypetoptera* described above, but the abnormal side of the head is far more grotesquely teratological. The compound eye and the fronto-orbital and inner and outer vertical bristles on the right side are missing; the frontal region of the head is so badly deformed that the ocelli and all bristles near the median line are obviously displaced; and the right ocellar and right postvertical bristles are badly deformed. The dorsal surface of the head is normally sclerotized only from the orbit of the left compound eye to a line that extends from the base of the left antenna obliquely backward

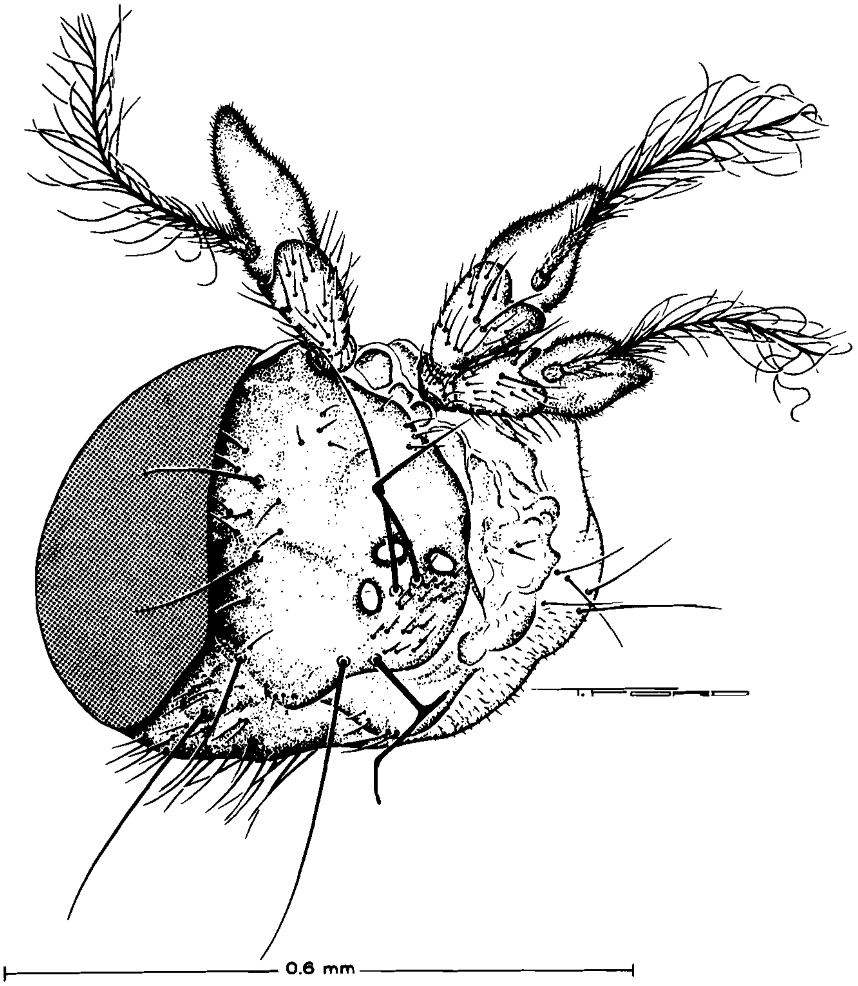

Fig. 2. Teratological male of *Tetanocera hyalipennis* – dorsal view of the head.

across the median line, continues backward just to the right of the ocelli, and then swings to the left again behind the displaced postvertical bristles. All surface area to the right of that line is obviously abnormal. Strange islands of sclerotization between the antennal bases merge posteriorly into a roughly irregular, poorly sclerotized integument. This bears bristles of various sizes in a haphazard arrangement that suggests no discernible pattern (Fig. 2).

Since nothing can now be proved, there is little value in extensive conjecture concerning the cause(s) of these anomalies. They were not noticed until after the flies had been killed, and the flies were not fixed and preserved for future study. Intersexuality induced by nematode parasitism is known to cause antennal abnormalities in the Diptera (Callot 1959), but the anomalies described here are clearly not of that type. The incomplete head capsule shown in Fig. 2 may suggest injury resulting in loss of the tissues from which the right side of the head should have developed. Such losses of healthy germinal tissues could be caused by trauma, by virus infections, or by the development of abnormal tissue masses often referred to as 'tumors'. They would not in themselves explain the partial duplication of the right antenna, but compensatory hypertrophy of a structure when an adjacent one fails to develop is not an uncommon phenomenon.

However, a genetic cause seems more probable, partly because similar anomalies of both antennae and eyes are known to be inherited in *Drosophila*. The antennae are duplicated to varying degrees, and reductions of the compound eyes range from the loss of a few ommatidia to total obliteration. Inouye & Takaya (1964) stated '. . . the antennal supernumerary is a hereditary character, transmission of which is linked together with the deficiency of compound eyes. The same has been found by Patterson and Muller (1930), Gottschewski & Ma (1937), and Zimm (1951).' In fact, it was also reported by Vogt (1947). Inouye & Takaya (1964) concluded '. . . it may be assumed that the deficiency of compound eyes is a prerequisite for the antenna to become irregular.'

It is not suggested that genetic linkages found in *Drosophila* should be expected to occur also in the Sciomyzidae. A very different chromosomal complex from that of *Drosophila* is indicated by the finding of 6 pairs of chromosomes in nearly all species of Sciomyzidae examined (Boyes et al. 1969).

However, there is probably no genetic linkage involved in the combined transmission of eye and antenna anomalies in *Drosophila*. At least 5 different mutants are known to induce these effects. Patterson & Muller (1930) were studying Eyeless-dominant; Gottschewski & Ma (1937), Kidney; Vogt (1947), Deformed; Zimm (1951) Lobe D; and Inouye & Takaya (1964), Erosion eyes. To decide that these 'eye mutants' control eyes only, we would have to postulate that a mutant inducing antennal duplication happens to be located near each of 5 eye mutants, which are distributed in various chromosomal loci.

It is far more probable that each of these 5 is a single mutant that affects both eyes and antennae because it affects the germinal tissue of the optic-antennal disc (Zimm 1951). Morphogenesis of the compound eyes and the antennae is intimately related in all of the higher Diptera; any gene that modifies the optic-antennal disc is apt to cause phenotypic effects on both organs.

However, the close association of eyes and antennae in morphogenesis would lend credibility to a non-genetic as well as to a genetic hypothesis for the origin of these anomalies. If gross anomalies of both eyes and antennae can be induced by a single mutant, they could also be induced by a single injury, 'tumor', or viral infection.

To obtain the maximum yield of new information when an anomaly is discovered, the following points should be observed. (1) No teratological insect should be killed until it has been observed carefully to determine the extent of incompetence, if any, resulting from its anomalies. (2) If possible, a special effort should be made to investigate its reproductive competence; proof that it can reproduce may also indicate or prove whether the anomaly is hereditary. (3) If so, genetic tests should be made to determine how it is inherited. (4) When the animal is killed, it should be fixed immediately to preserve internal tissues for future sectioning and study. Use a strongly penetrating fixative such as AFA (5 ml acetic acid, 5 ml formalin, and 100 ml 70% ethyl alcohol). Cut or punch holes in the cuticle to enable the fixative to penetrate quickly. Remove air from the tracheae by subjecting specimen to negative pressure in a vacuum chamber, while immersed in the fixative, until bubbles no longer appear.

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The Biology of *Strophingia ericae* (Curtis) (Homoptera, Psylloidea) with Notes on Its Primary Parasite *Tetrastichus actis* (Walker) (Hum., Eulophidae)

I. D. HODKINSON

Hodkinson, I. D. 1973. The Biology of *Strophingia ericae* (Curtis) (Homoptera, Psylloidea) with Notes on Its Primary Parasite *Tetrastichus actis* (Walker) (Hym., Eulophidae). *Norsk ent. Tidsskr. 20*, 237–243.

Strophingia ericae (Curtis) has five nymphal instars which are here described. The nymphs of *S. ericae* are phloem feeders and require an open basal *Calluna vulgaris* leaf axil in which to live and feed. On upland sites *S. ericae* has a two-year life cycle, whereas on lowland sites the life cycle is of one-year duration. A parasitic hymenopteran *Tetrastichus actis* (Walker) is parasitic on fourth and fifth instar nymphs. Only male *T. actis* emerge from fourth instar nymphs, but both males and females emerge from fifth instar nymphs.

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Strophingia ericae (Curtis) is a small psyllid species which often occurs at high densities on its food plant *Calluna vulgaris* L. Hull. It was intensively studied over a three-year period as part of the International Biological Programme upland productivity project being carried out on the Moor House National Nature Reserve, England (G.R.NY 757328). In addition, comparative life cycle studies were made during 1971 on two 'lowland' sites. Very little was known about the biology of *S. ericae*, and this necessitated the basic work which forms the substance of this paper.

Calluna vulgaris is the dominant plant species on large areas of the Moor House Reserve, and *S. ericae* is present wherever it occurs. One main and two subsidiary *Calluna* sites were selected for intensive psyllid population studies. The main study site on Sike Hill (549 m a.s.l.) was a Calluneto-Eriophoretum with a mean *Calluna* age of 11.5 years (Forrest 1971). The first subsidiary site, referred to as the Hill site (549 m a.s.l.) was slightly wetter than Sike Hill and the mean age of *Calluna* was 8.5 years. The second subsidiary site, referred to as the Gate site (549 m a.s.l.) differed markedly from the other two sites; the *Calluna* here was much younger and grew in a protected situation among *Eriophorum-Sphagnum* tussocks.

A parasitic hymenopteran *Tetrastichus actis* (Walker) is parasitic on the nymphs of *S. ericae*. The life cycle of *T. actis* was followed both in the field and by examination of material obtained while sampling for psyllids. However the efficiency of sampling for *T. actis* is unknown and so the data are not quantitative.

SAMPLING METHODS

On Sike Hill 72 *Calluna* samples, each of approximately 5 gm dry weight, were taken randomly every fortnight over the period October 1968 to June 1971. On the Hill and Gate sites 36 similar samples were taken at monthly intervals over the period November 1969 to June 1971. Heat extraction in a 'Burkard' extractor was used to remove psyllids from the field samples as it proved impossible to count the psyllids accurately in situ on the plant. The efficiency of extraction for nymphs was very high (>96%), but the efficiency for adults was only 43%, though this figure remained relatively constant.

THE BIOLOGY OF *S. ERICAE*

Nymphal instars

The usual number of nymphal instars in the Psylloidea is five (Imms 1964, Dobreanu & Manolache 1962). In order to determine the number of nymphal instars in *S. ericae*, measurements of head width were made on a large number of nymphs representing all instars and the resulting distribution plotted as a histogram (Fig. 1). This exhibits 5 distinct peaks indicating that *S. ericae* has 5 nymphal instars.

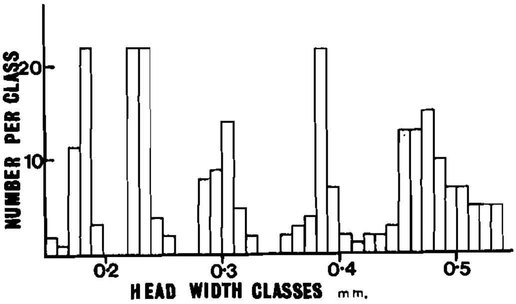

Fig. 1. Histogram showing distribution of nymphal head widths for *S. ericae*

The fifth nymphal instar of *S. ericae* was figured by Klimaszewski (1964), but no full nymphal description has previously been given.

Instar 1 (Fig. 2a). Antennae 2 segmented. Abdomen with 16 marginal setae. Wing buds rudimentary, without marginal setae. Tarsi undifferentiated. Head width 0.15 to 0.20 mm.

Instar 2 (Fig. 2b). Antennae 2 segmented. Abdomen with 22 to 24 marginal setae. Fore and hind wing buds small, oval, not separate. Each forewing bud with 8 marginal setae, each hindwing bud with 6 to 7 marginal setae. Tarsi undifferentiated. Head width 0.22 to 0.26 mm.

Instar 3 (Fig. 2c). Antennae 3 segmented. Abdomen with 28 to 30 marginal setae. Forewing buds with definite posterior lobes. Each forewing bud with 16 to 18 marginal setae, each hindwing bud with 6 to 8 marginal setae. Tarsi undifferentiated. Head width 0.28 to 0.33 mm.

Instar 4 (Fig. 2d). Antennae 3 segmented. Abdomen with 30 to 36 marginal setae. Forewing buds overlapping hindwing buds. Total number of marginal setae on each pair of fore and hind wing buds 30 to 36. Tarsi undifferentiated. Head width 0.35 to 0.42 mm.

Instar 5 (Fig. 2e). Antennae 3 segmented. Number of marginal setae on abdomen very variable. Fore and hind wing buds greatly overlapping with 38 to 47 marginal setae on each pair. Tarsi unisegmented. Head width 0.42 to 0.54 mm. Male and female fifth instar nymphs can be separated by the absence or presence respectively of a suture immediately anterior to the anal ring (Fig. 2f). Such a sexual difference has been previously reported for the genus *Psylla* (Geoffroy) (Ball & Jensen 1966, Ossiannilsson 1970).

The colouration is similar in all instars, the basic colour being yellow, with the plates of sclerotization varying from light brown in instars 1 to 3 to dark brown in instars 4 and 5. The abdomen often develops a bluish green colouration in the final stage of instar 5. The eyes and ocelli are bright red.

The nymphs of *Strophingia cinereae* Hodkinson (1971) can be distinguished from those of *S. ericae* in the 5th instar by the absence of fringing setae on the wing buds.

Geographical distribution

Strophingia ericae is widely distributed throughout Europe and follows closely the distribution of *Calluna vulgaris* (Beijerinck 1940). It has been recorded from the following countries: Great Britain, Norway, Sweden, Finland, Denmark, Germany, Netherlands, France, Belgium, Spain, Switzerland, Poland, Czechoslovakia, Rumania and Russia. In Great Britain *S. ericae* has a vertical distribution ranging from sea level to almost 915 m (Ing 1966).

Within host plant distribution

Preliminary investigations were carried out in which single *Calluna* plants were divided into

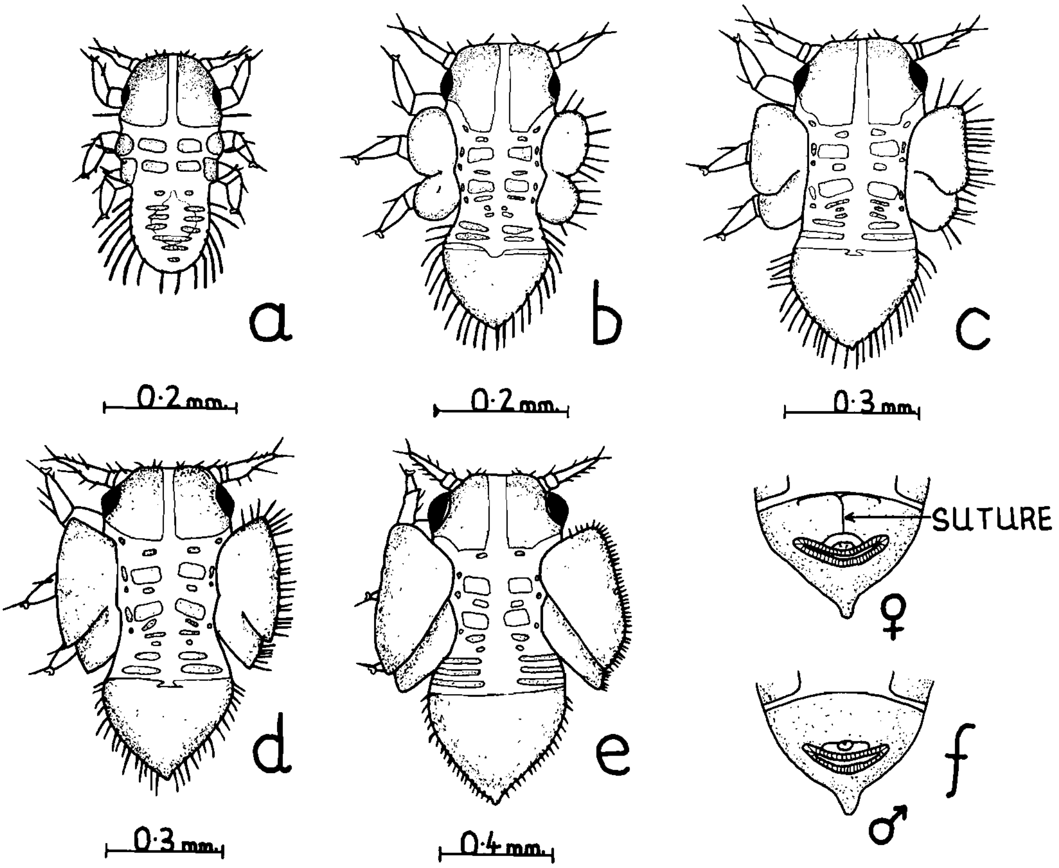

Fig. 2. The nymph of *S. ericae*. (a) instar 1 nymph; (b) instar 2 nymph; (c) instar 3 nymph; (d) instar 4 nymph; (e) instar 5 nymph; (f) ventral abdominal views of male and female fifth instar nymphs.

woody stems and green shoots and the psyllids' heat extracted from each. Of the 6003 nymphs obtained, 99.7% were collected from the green shoots, thus showing that *S. ericae* nymphs are confined to the green shoot material. In order to investigate the within green shoot distribution of psyllids, an experiment was carried out to test for differences in psyllid densities between the edge and centre of individual *Calluna* stands at basal and apical shoot levels. The distinction between apical and basal shoots was made by taking individual *Calluna* sprigs and cutting the green shoots horizontally into equal basal and apical portions. A series of random samples (each of 2 g of *Calluna* green shoots) was taken from Sike Hill and the psyllids' heat extracted. The results are given in Table I. These data were subjected to an analysis of variance and a significant difference between sample locations was found ($F = 6.49$; $P < 0.01$). The contrast between apical and basal proved to be significant ($F = 19.40$; $P < 0.001$) while the contrast between centre and edge ($F = 0.045$; $P > 0.05$) and the interaction ($F = 0.008$; $P > 0.05$) were not significant. Thus

Table I. Numbers of nymphs from different locations within the canopy

Location of	Stand					
sample	1	2	3	4	5	6
Apical edge	3	9	14	0	10	23
Apical centre	25	8	13	5	3	39
Basal edge	59	29	118	59	147	157
Basal centre	242	21	76	48	123	73
Total	329	67	221	112	283	292

nymphs are aggregated on basal shoots. This appears to be due to their requirement for an open leaf axil in which to sit and feed. The basal shoots within a *Calluna* sprig consist almost entirely of open leaf axils while the apical shoots consist of leaf axils which are not fully open. Examination of 200 nymphs on the host plant showed that 195 (97.5%) were sitting in an inverted head-down position in a leaf axil, while only 5 (2.5%) were walking about on the plant. The basal shoots are generally the ones which are produced in the previous year's growth.

The selection of basal shoot leaf axils by nymphs appears to confer two main ecological advantages. Firstly it provides a humid microclimate which protects the nymphs from desiccation, and secondly it provides some shelter from temperature extremes.

Life cycle

The life cycle outlined below is based on the results of the intensive sampling programme outlined in the methods section of this paper. Fig. 3 represents actual field data and shows the fate of a typical cohort which originated on Sike Hill in 1969. On all three study sites at Moor House, *S. ericae* has a two-year life cycle (Fig. 3). The eggs are laid over a period extending from mid-June to early September, with a peak in July. The most usual position in which they are laid is deep in the half-opened axil of the large leaf at the base of a side shoot, with the pedicel inserted into the stem. The eggs hatch over an extended period and the nymphs which hatch from the first eggs laid have almost reached the third instar by the time the last eggs hatch. All eggs hatch in the year in which they are laid. The young nymphs feed until the end of October and then overwinter in the leaf axils, mainly as second instars. Here they remain with little or no feeding and no moulting, until the spring of year 2 when they begin feeding in late April.

In year 2 the nymphs pass through instars three and four and then overwinter for a second time. The suspension and resumption of feeding in the second winter occurs at the same time of year as in the first winter. In the spring of year 3 the overwintering fifth instars begin to produce adults about the end of May.

There are present at Moor House two overlapping generations which are out of phase by exactly one year. Thus if the psyllid population is sampled at any one time, it consists of two distinct cohorts originating in successive years.

There is some slight natural variation from year to year in the life cycle, but in three years of study, on three Moor House sites, the over-

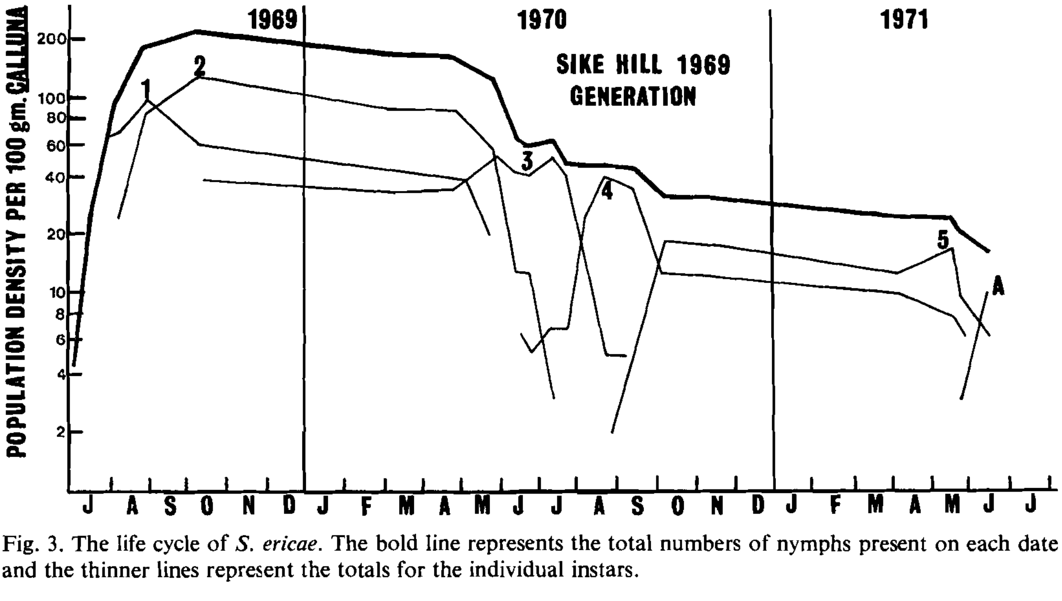

Fig. 3. The life cycle of *S. ericae*. The bold line represents the total numbers of nymphs present on each date and the thinner lines represent the totals for the individual instars.

Table II. Overwintering instar compositions of comparative cohorts on the three Moor House sites

	Instar		
	1	2	3
Sike Hill 1968–69	25	68	7
Sike Hill 1969–70	27	58	15
Sike Hill 1970–71	32	57	11
Gate Site 1969–70	19	60	21
Gate Site 1970–71	38	51	11
Hill Site 1969–70	19	61	20
Hill Site 1970–71	35	56	9

wintering instar compositions remained relatively constant (Table II).

To examine the effect of altitude on the life cycle of *S. ericae*, two further sites were examined during 1971. These were a) a lowland site at Yealand Storrs, Lancashire (G.R. SD 492762), 30 m a.s.l. and b) an intermediate site on Hutton Roof, Lancashire (G.R. SD 553786), 213 m a.s.l. On both these sites *S. ericae* has a one-year life cycle (Table III).

Feeding biology

In order to determine the plant tissue elements on which the nymphs of *S. ericae* feed, feeding second and fourth instar nymphs were narcotized with CO_2, cooled to 2 °C and killed in situ on the plant by immersion in Acrolein, a killing agent/fixative. Pieces of plant tissue with feeding nymphs attached were embedded in glycol methacrylate (Wellburn 1968) and sectioned to 4 μ.

Table III. Changes in population instar composition of *S. ericae* at Yealand Storrs and Hutton Roof sites during 1971

Yealand Storrs:

Date	Instar composition (%)						N
	1	2	3	4	5	A	
1 Apr. 71	–	1	13	77	9	–	3958
28 Apr. 71	–	–	2	17	78	3	2908
2 June 71	–	–	–	–	11	89	158
5 Oct. 71	–	6	68	26	–	–	291

Hutton Roof:

Date	Instar composition (%)						N
	1	2	3	4	5	A	
1 Apr. 71	2	4	34	60	–	–	1368
28 Apr. 71	–	–	6	36	58	–	798
2 June 71	–	–	–	5	44	51	82
5 Oct. 71	–	34	61	5	1	–	511

In both second and fourth instar nymphs the stylets are inserted into the basal part of the leaf which envelopes the shoot stem. The stylets enter the plant through the stomatal groove, which runs along the abaxial surface of each leaf, probably through a stoma. They then pass straight through the vascular bundles of the individual leaf base and through into the shoot stem, the tip lying in the shoot stem phloem.

Further evidence that nymphs feed on phloem is provided by their excreta. One would expect the excreta of an insect feeding on phloem to have a very high carbohydrate content (Auclair 1963). The excreta of *S. ericae* give a strong reaction to Molisch's test for carbohydrate and furthermore have a calorific value of 4022 cals/g dry weight which corresponds closely to the calorific value of pure carbohydrate.

THE BIOLOGY OF *TETRASTICHUS ACTIS*

At Moor House adult *T. actis* are present in the field at two periods of the year – August-September and April-May. The autumn adults, which are much less numerous than the spring adults, lay eggs which overwinter externally on the psyllid nymphs. The spring adults oviposit in May, larval development occurs during June-July, and pupation begins in August. The earliest pupae give rise to the autumn adults, but the majority overwinter and give rise to adults the following spring. The level of parasitism remained very low throughout the study period and in two years of study on the three sites only 161 females and 83 males were collected.

The female lays a single egg on the ventral surface of the psyllid nymph, to one side of the mid-line, in the groove between the thorax and the abdomen. The female *T. actis* oviposits only on fourth and fifth instar nymphs (of 53 parasitized nymphs examined all were fourth and fifth instars).

The young *T. actis* larva remains external to the nymph and feeds on the body juices of the nymph through a hole which it bites in the ventral surface. The nymph is soon killed but the parasite continues feeding until all that is left is a nymphal shell. The fully grown larva cements the base of the shell to the *Calluna* leaf with a rouge coloured cement, and then pupates inside it. The number of larval instars was not determined but is probably three, the same as for *Tetrastichus flavigaster* Brothers & Moran (Moran et al. 1969). The pupa always lies with its ventral surface towards the nymphal shell and the adult, after hatching, emerges from its puparium through a circular hole which it bites in the dorsum of the psyllid shell. In *T. actis*, only males emerge from fourth instar nymphs while both males and females emerge from fifth instar nymphs (Table IV). This appears to be related to the greater nutritive requirements of female *T. actis* as they are somewhat larger than the male.

Table IV. Contingency table showing male and female *T. actis* emerging from fourth and fifth instar *S. ericae* nymphs

	Instar parasitized		
	4	5	Total
Pupae giving rise to ♂'s	7	3	10
Pupae giving rise to ♀'s	0	13	13
Total pupae	7	16	23

$\chi^2 = 9.60$ ($P < 0.01$)

DISCUSSION

Strophingia ericae has an unusual life cycle for a psyllid and is the only species so far recorded which has a two-year life cycle. Most temperate psyllid species complete their life cycle within one year and some species have three or more generations per year (Vondracek 1957, Rasmy & MacPhee 1970, Onillon 1969). It has been shown that 34 species of Homoptera, which occur up to 671 m a.s.l. at Moor House, and which on lowland sites have a one-year life cycle, are perfectly capable of passing through their life cycle in one year at Moor House (Whittaker 1965a, b). It therefore seems unusual that the rate of development of *S. ericae* at Moor House is approximately half that on sites such as Hutton Roof. One would not expect such a gross difference in development rates if, for instance, temperature was the limiting factor. One possible explanation is that the nutritive status of *Calluna* is much higher on lowland than on upland sites. Unfortunately no analysis of *Calluna* is available for the lowland sites, but Moss (1969) showed that *Calluna* growing on soils overlying base-rich rocks has the highest nutrient content. Both Yealand Storrs and Hutton Roof sites are on limestone pavement. It is unlikely, however, that differences in nutritive status can explain why the life cycles at the different sites are exactly synchronised to one or two years. Dispersal appears to be minimal in *S. ericae* and it seems feasible that genetic strains have evolved which are specially adapted to life in what are in fact two quite different environments.

An interesting aspect of the life cycle of *T. actis* at Moor House is that the parasite has a one-year life cycle, while its host has a two-year life cycle. This means that the nymphs parasitized in one year belong to a separate cohort from those parasitized in the following year. In effect the parasite leapfrogs between the two temporally separated psyllid populations. On the lowland sites it appears probable that *S. ericae* and *T. actis* have a synchronised one-year life cycle.

At first sight it might appear surprising that for upland and lowland populations the total mortality per generation (i.e. that theoretically required to maintain a steady population, given equal fecundity) should be equal in both situations despite the fact that upland populations experience harsher conditions for a longer period. Hodkinson (in press) showed that there is no apparent difference in adult fecundity between the upland and lowland populations, but that mortality is highly concentrated at the moult. Thus as both populations experience the same number of moults, albeit spread over different lengths of time, the total overall mortality is approximately equal.

ACKNOWLEDGEMENTS

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Notes on the biology of *Dolycoris baccarum* L. (Het., Pentatomidae)

ELSE-MARGRETE CONRADI-LARSEN & LAURITZ SØMME

Conradi-Larsen, E.-M. & Sømme, L. 1973. Notes on the Biology of *Dolycoris baccarum* L. (Het., Pentatomidae). *Norsk ent. Tidsskr. 20,* 245–247.

In Southern Norway *Dolycoris baccarum* L. has one generation per year, and overwinters in the adult stage. In laboratory cultures the average developmental time from oviposition to adult is 26 days at 30° C and 16 hrs photoperiod, 48.4 days at 21° C and 16 hrs photoperiod, and 52.7 days at 21° C and 8 hrs photoperiod. Egg batches collected in the field contained an average of 23 eggs, and batches laid in the laboratory, an average of 25 eggs.

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The biology and ecology of *Dolycoris baccarum* (Het., Pentatomidae) have been extensively studied in Northern Germany (Tischler 1938, 1939) and in the Krasnodar territory of USSR by Kamenkova (1958). According to Warloe (1924), *D. baccarum* is found in Southern Norway as far north as Fron in Gudbrandsdalen. Studies on the biology of this species under conditions indigenous to Norway have not been published earlier.

During the collection of *D. baccarum*, in order to establish a laboratory culture, some data on the biology of the species under outdoor conditions were accumulated. Some of these data are presented in the present article as a contribution to the knowledge of the biology of this species from northern parts of its distributional area.

Under laboratory conditions the development of one generation of *D. baccarum* takes from 28 to 33 days at 29° C (Perepelitza 1969) and the first four larval instars have a duration of 20 days at 23°–27° (Tansky 1971). In the present investigation development was studied at 21° C, and at photoperiods of 8 hrs and 16 hrs. For comparison, some cultures were also kept at 30° C and 16 hrs light.

REARING PROCEDURES

The rearing procedure used in the present study was modified from the method described by Perepelitza (1969). The cultures were kept at 21° C or 30° C, 60–70 percent RH, and either 8 hrs or 16 hrs photoperiod. Adult bugs were kept in cages (40×40×60 cm) or in glass dishes with diameters from 7 to 21 cm. Oviposition took place on dry cotton. Young sugarbeet plants, shelled sunflower seeds, and moist cotton served as sources of food and water.

Eggs were transferred to Petri dishes with moist filter paper, and stored until hatching. Newly hatched larvae, which were allowed to remain on their empty egg-shells, were carefully transferred to glass dishes, and placed in contact with fresh plants. During the summer months plants of wild strawberries were provided, but as a permanent procedure it was found more convenient to use young sugarbeet plants from a greenhouse. The plants were placed in small tubes filled with water.

The first instar larvae remained on their egg-shells, while 2nd instar larvae moved more freely around the culture dish. Fresh plants and sunflower seeds were introduced every second or third day during larval development. In addition cotton soaked in water or in a 10% solution of honey, sprinkled with a small amount of yeast extract, was provided.

The number of larvae per culture varied, but up to 200 larvae could be reared in a glass dish of 21 cm diameter.

RESULTS

Field observations

During 1972, adults of *D. baccarum* were collected at Drøbak and at Hurdal in Akershus county, eggs at Drøbak, and larvae at Ula in Vestfold county, Drøbak, and Oslo. The occurrence of the various stages during the summer season is shown in Fig. 1. From the observations it appears that *D. baccarum* overwinters in the adult stage and has one generation per year.

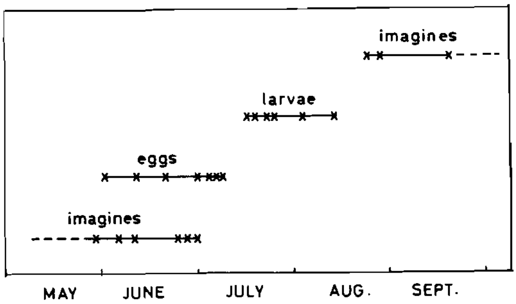

Fig. 1. Seasonal occurrence of eggs, larvae, and imagines of *D. baccarum* in Norway. x: Date of collection.

Batches of eggs were found on different plant species; leaves of strawberry (*Fragaria*–sp.), leaves of raspberry (*Rubus idaeus*), leaves of lilly-of-the-valley (*Convallaria majalis*), flowers of the marguerite (*Chrysanthemum leucanthemum*), and leaves and stalks of tomato (*Solanum lycopersicum*). The eggs were brought to the laboratory for hatching. Three of the sixteen batches collected contained sterile eggs only, while in seven batches, larvae developed from all the eggs. Table I shows the average number of eggs per batch and the fertility percentage.

Table I. Average number of eggs per batch and percentage fertility of eggs of *D. baccarum* from 16 batches collected outdoors

	$\bar{x}\pm SE$
Av. No. of eggs per batch	23±2.3
Av. No. of larvae hatched	12±2.3
Av. percent fertile eggs	60±11.4

Laboratory cultures

The duration of the egg stage and larval instars in laboratory cultures at 21° C is shown in Table II. The figures are based on observations from a varying number of cultures (n). The duration of the different stages in each culture was estimated as the time required by half of the larvae to moult from one stage to the next.

Table II. Duration in days of the egg stage and larval instars of *D. baccarum* under laboratory conditions

Stage	21° C/16 hrs		21° C/8 hrs		t-test
	n	$\bar{x}\pm SE$	n	$\bar{x}\pm SE$	
Egg	16	7.9±0.26	8	8.4±0.26	not sign.
Larvae I	20	6.2±0.23	1	6.0	–
Larvae II	18	7.4±0.29	3	9.1±0.73	$P<0.05$
Larvae III	15	6.5±0.19	5	8.0±0.57	$P<0.01$
Larvae IV	16	8.4±0.28	7	8.6±0.69	not sign.
Larvae V	19	12.0±0.29	5	12.6±0.61	not sign.
Total		48.4		52.7	–

From Table II it appears that the 1st larval instar was of shortest duration, while most time was required to complete the 5th instar. The average developmental time from oviposition to adult was 48.4 days at 16 hrs light, and 52.7 days

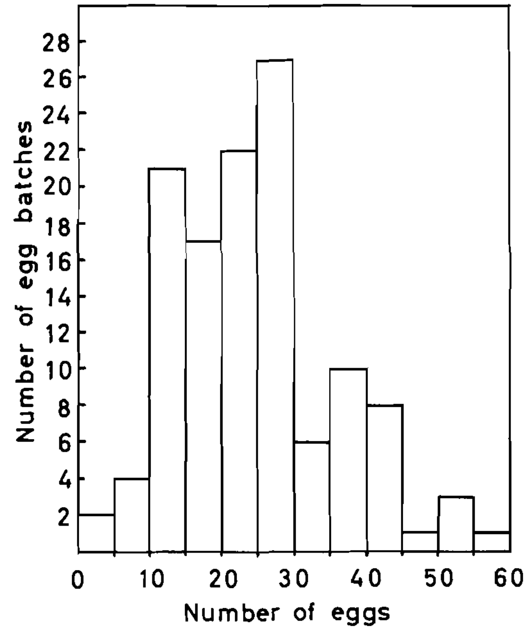

Fig. 2. Distribution of number of eggs per batch in *D. baccarum* from 124 batches deposited under laboratory conditions.

at 8 hrs light. Significant differences were found in the duration of the 2nd and 3rd larval instars.

In six cultures kept at 30° C and 16 hrs photoperiod the development from oviposition to adult lasted 26±0.4 days.

The number of eggs per batch varied considerably under laboratory conditions. The distribution of the size of 124 egg batches collected from ten cultures during a period of six weeks is shown in Fig. 2. From Table III it appears that the batches contained an average of 25 eggs, and that on an average, 65 percent of the eggs were fertile. As under outdoor conditions, the fertility varied greatly. Of 70 egg batches observed, four contained sterile eggs only, while larvae were developed from all eggs in nine of the batches.

Table III. Average number of eggs per batch and percentage fertility of eggs of *D. baccarum* deposited under laboratory conditions

	n	$\bar{x}\pm$SE
Av. No. of eggs per batch	124	25±1.0
Av. No. of larvae hatched	70	19±1.5
Av. percent fertile eggs	70	65±4.1

DISCUSSION

Although it is well known that eggs of *D. baccarum* may be deposited on a number of different plant species, new host plants were observed in the course of the present study. According to Kamenkova (1958) chickweed, sunflower, tobacco, henbane, and Jimsonweed are important plants for oviposition in the Krasnodar territory. In East Prussia *Hieracium pilosella* and *Geum rivale* were preferred for oviposition (Tischler 1939), but egg batches were also deposited on other plant species.

As may be expected from the late summers in Southern Norway, the occurrence of the various developmental stages of *D. baccarum* is slightly delayed compared to conditions in Northern Germany. In Schleswig-Holstein and East Prussia eggs of *D. baccarum* can be found from the end of May, although most eggs are laid in June (Tischler 1938, 1939). Larvae were observed from early June till the end of August, and adults appeared from the end of July. In northern localities of the USSR, e.g. Primorsk and Novosibirsk, *D. baccarum* has one generation per year (Perepelitza 1969), while in the Krasnodar territory two generations per year are developed.

In Krasnodar, Kamenkova (1958) found from 7 to 56 eggs per egg batch, with an average of 30 eggs per batch on tobacco plants. By examining 175 egg batches in the field Tischler (1939) found from 7 to 28 eggs per batch, with an average of 18 eggs. Thus the averages of 23 and 25 eggs per batch found in the present study, fall within the range of other investigations.

Besides temperature, the larval development appears to be influenced by the photoperiod. Short photoperiods may result in reduced feeding activity, at least in some larval instars, and thus in a slight delay in larval development.

Under outdoor conditions in Norway, the average summer temperatures are lower than 21° C, and the development of *D. baccarum* will therefore require more time. However diapause or a related mechanism will still be necessary to avoid oviposition and development of a new larval generation in late summer. These mechanisms are at present being investigated in the authors' laboratory.

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A Check-list and Synonyms of the Norwegian Species of Ephemeroptera

ROLF DAHLBY

Dahlby, R. 1973. A Check-list and Synonyms of the Norwegian Species of Ephemeroptera. *Norsk ent. Tidsskr. 20,* 000–000.

A check-list of the species of Ephemeroptera found in Norway and some synonyms concerning Norwegian species are given. *Caenis rivulorum* Eaton is reported new to Norway.

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The treatise by Brekke (1938) of the Norwegian Ephemeroptera includes 38 species. Since then a further 8 species have been published as found in Norway (Brekke 1943, 1965, Grimeland 1966, Müller-Liebenau 1949, Brittain 1972). This makes a total of 46 species.

This check-list, which is based on the present knowledge concerning the taxonomy and synonymy within the order, brings the number of species down to 43 including *Caenis rivulorum* Eaton, which is here reported new to Norway. This species was collected by Curator Albert Lillehammer, Zoological Museum, Oslo during the investigations carried out by this institution in the summer of 1966 in Pasvik, South-Varanger (Finnmark county). The material of Ephemeroptera is being worked on by me, and further details will appear in a special publication.

Kimmins (1960) places *Baëtis gemellus* Eaton in the synonymy of *Baëtis rhodani* (Pictet), but according to Müller-Liebenau (1969) *B. gemellus* is a valid species having a rather southern distribution in Europe. On the basis of the known distribution of *B. gemellus* and the fact that the species can hardly be identified by means of previous descriptions or keys, I prefer to omit the species from the Norwegian list. The two Norwegian finds published by Brekke (1938) of this species are most likely *B. rhodani. B. gemellus* is thoroughly described and figured by Müller-Liebenau (1969). In the present check-list the families and genera are arranged according to Edmunds (1962), and the species are arranged alphabetically within the genera. A question mark in front of a synonym means that the synonymy is probable, but needs confirmation.

FAM. SIPHLONURIDAE KLAPALEK, 1909

Gen. *AMELETUS* Eaton, 1885

1. *inopinatus* Eaton, 1887
   Syn.: *Ameletus alpinus* Bengtsson, 1913

Gen. *PARAMELETUS* Bengtsson, 1908

2. *chelifer* Bengtsson, 1908
   Syn.: *Potameis elegans* Bengtsson, 1909
   Sparrea norvegica Esben-Petersen, 1909 pro parte
   Palmenia fennica Aro, 1910
3. *minor* (Bengtsson), 1909 (sub nom. *Potameis minor*)
   Syn.: *Sparrea norvegica* Esben-Petersen, 1909 pro parte

Gen. *SIPHLONURUS* Eaton, 1869

4. *aestivalis* (Eaton), 1903 (sub nom. *Siphlurus aestivalis*)
   Syn.: *Siphlurus spinosus* Bengtsson, 1909
5. *lacustris* Eaton, 1870
   Syn.: *Siphlonurus zetterstedti* (Bengtsson), 1909 (sub nom. *Siphlurus zetterstedti*)
6. *linnaeanus* (Eaton), 1871 (sub nom. *Siphlurus linnaeanus*)

Syn.: *Siphlurella thomsoni* Bengtsson, 1909
? *Siphlurella oblita* Bengtsson, 1909

FAM. BAËTIDAE KLAPALEK, 1909

Gen. *BAËTIS* Leach, 1815

7. *fuscatus* (Linnaeus), 1761 (sub nom. *Ephemera fuscata*)
   Syn.: *Baëtis bioculatus* auct. nec *Ephemera bioculata* Linnaeus, 1758
8. *lapponicus* (Bengtsson), 1912 (sub nom. *Acentrella lapponica*)
9. *macani* Kimmins, 1957
10. *muticus* (Linnaeus), 1758 (sub nom. *Ephemera mutica*)
    Syn.: *Baëtis pumilus* (Burmeister), 1839 (sub nom. *Cloe pumila*)
11. *niger* (Linnaeus), 1761 (sub nom. *Ephemera nigra*)
    Syn.: *Baëtis incurvus* Bengtsson, 1912
12. *rhodani* (Pictet), 1843—45 (sub nom. *Cloe rhodani*)
    Baëtis wallengreni Bengtsson, 1912
    Baëtis pusillus Bengtsson, 1912
13. *scambus* Eaton, 1870
14. *subalpinus* Bengtsson, 1917
    Syn.: *Baëtis saliens* Tiensuu, 1939
15. *vernus* Curtis, 1834
    Syn.: *Baëtis tenax* Eaton, 1870

FAM. BAËTIDAE CONTINUATION

Gen. *CENTROPTILUM* Eaton, 1869

16. *luteolum* (Müller), 1776 (sub nom. *Ephemera luteola*)

Gen. *CLOËN* Leach, 1815

17. *dipterum* (Linnaeus), 1761 (sub nom. *Ephemera diptera*)
    Syn.: *Cloën inscriptum* Bengtsson, 1914
18. *simile* Eaton, 1870
    Syn.: *Cloën praetextum* Bengtsson, 1914

Gen. *PROCLOËN* Bengtsson, 1915

19. *bifidum* (Bengtsson), 1912 (sub nom *Cloën bifidum*)
    Syn.: ? *Procloëon pseudorufulum* Kimmins, 1957 (According to Kimmins (1957) *Cloëon rufulum* Eaton, 1885 nec *Cloëon rufulum* (Müller), 1776). Described under the name *Cloëon rufulum* (Müller) by Esben-Petersen (1910)

FAM. HEPTAGENIIDAE TRAVER, 1935

Gen. *HEPTAGENIA* Walsh, 1863

20. *dalecarlica* Bengtsson, 1912
21. *fuscogrisea* (Retzius), 1783 (sub nom. *Ephemera fuscogrisea*)
    Syn.: *Ecdyurus volitans* (Eaton), 1870 (sub nom. *Heptagenia volitans*) *Ecdyurus convergens* Aro, 1910
22. *joernensis* (Bengtsson), 1909 (sub nom. *Ecdyurus joernensis*)
    Syn.: *Ecdyurus flavomaculatus* Aro, 1910
23. *sulphurea* (Müller), 1776 (sub nom. *Ephemera sulphurea*)

Gen. *ARTHROPLEA* Bengtsson, 1908

24. *congener* Bengtsson, 1908
    Syn.: *Remipalpus elegans* Bengtsson, 1908
    Cinygma mirabilis Aro, 1910
    Haplogenia southi Blair, 1929
    Arthroplea frankenbergeri Balthasar 1937

FAM. AMETROPODIAE (AMETROPIDAE) BENGTSSON, 1913

Gen. *METRETOPUS* Eaton, 1901

25. *alter* Bengtsson, 1930
26. *borealis* (Eaton), 1871 (sub nom. *Heptagenia borealis*)
    Syn.: *Metretopus norvegicus* Eaton, 1901

FAM. LEPTOPHLEBIIDAE KLAPALEK, 1909

Gen. *LEPTOPHLEBIA* Westwood, 1840

27. *marginata* (Linnaeus), 1767 (sub nom. *Ephemera marginata*)
28. *vespertina* (Linnaeus), 1758 (sub nom. *Ephemera vespertina*)
    Syn.: *Leptophlebia meyeri* Eaton, 1884
    Euphyurus albitarsis Bengtsson, 1909

Gen. *PARALEPTOPHLEBIA* Lestage, 1917

29. *cincta* (Retzius), 1783 (sub nom. *Ephemera cincta*)
    Syn.: ? *Leptophlebia placita* Bengtsson, 1917
30. *strandii* (Eaton), 1901 (sub nom. *Leptophlebia strandii*)
31. *submarginata* (Stephens), 1835 (sub nom. *Ephemera submarginata*)
32. *werneri* Ulmer, 1919
    Syn.: *Paraleptophlebia tumida* Bengtsson, 1930

FAM. EPHEMERELLIDAE KLAPALEK, 1909

Gen. *EPHEMERELLA* Walsh, 1862

33. *aurivillii* (Bengtsson), 1908 (sub nom. *Chitonophora aurivillii*)
    Syn.: *Ephemerella aronii* Eaton, 1908 pro parte
34. *ignita* (Poda), 1761 (sub nom. *Ephemera ignita*)
    Syn.: *Ephemerella lactata* Bengtsson, 1909
    Ephemerella torrentium Bengtsson, 1917
35. *mucronata* (Bengtsson), 1909 (sub nom. *Chitonophora mucronata*)
    Syn.: *Ephemerella aronii* Eaton, 1908 pro parte

FAM. EPHEMERIDAE KLAPALEK, 1909

Gen. *EPHEMERA* Linnaeus, 1758

36. *danica* Müller, 1764
37. *vulgata* Linnaeus, 1758

FAM. CAENIDAE KLAPALEK, 1909

Gen. *BRACHYCERCUS* Curtis, 1834

38. *harrisella* Curtis, 1834

Gen. *CAENIS* Stephens, 1835

39. *horaria* (Linnaeus), 1758 (sub nom. *Ephemera horaria*)
    Syn.: *Caenis dimidiata* Stephens, 1835
    Caenis dimidiata var. *fennica* Aro, 1928
40. *macrura* Stephens, 1835
41. *moesta* Bengtsson, 1917
    Described under the name *Caenis halterata* (Fabricius) by Esben-Petersen (1910)
42. *nocturna* Bengtsson, 1917
    Syn.: ? *Caenis tumida* Bengtsson, 1912 (vide Saaristo 1966)
    Caenis undosa Tiensuu, 1939
43. *rivulorum* Eaton, 1884
    Syn.: *Caenis dimidiata* var. *rivulorum* Eaton, 1884
    Caenis nivea Bengtsson, 1917

GENERIC SYNONYMS

Parameletus Bengtsson, 1908
Syn.: *Potameis* Bengtsson, 1909
Sparrea Esben-Petersen, 1909
Palmenia Aro, 1910
Siphlonurus Eaton, 1868
Syn.: *Siphlurella* Bengtsson, 1909
Baëtis Leach, 1815
Syn.: *Acentrella* Bengtsson, 1912
Procloëon Bengtsson, 1915
Syn.: *Pseudocloëon* Bengtsson, 1914 nec *Pseudocloëon* Klapalek, 1905
Arthroplea Bengtsson, 1908
Syn.: *Remipalpus* Bengtsson, 1908
Haplogenia Blair, 1929
Leptophlebia Westwood, 1840
Syn.: *Euphyurus* Bengtsson, 1909
Paraleptophlebia Lestage, 1917
Syn.: *Leptophlebia* Bengtsson, 1917 nec *Leptophlebia* Westwood, 1840
Ephemerella sensu strictu
Syn.: *Chitonophora* Bengtsson, 1908
Brachycercus Curtis, 1834
Syn.: *Eurycaenis* Bengtsson, 1917

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Notes on Some Winter-Active Chironomidae

SIGMUND HÅGVAR & EIVIND ØSTBYE

Hågvar, S. & Østbye, E. 1973. Notes on Some Winter-Active Chironomidae. *Norsk ent. Tidsskr. 20*, 253-257.

The occurrence of some winter-active Chironomidae from South Norway is reported. Adults of the species *Chaetocladius laminatus* Brund. (ssp. n.), *Diamesa permacer* (Walk.), *D. bohemani* (Goetgh.) Edw., and *Pseudodiamesa branickii* (Now.) were observed on the snow surface, in some cases flying, during the months from December to April. Some were copulating. Besides information on localities, habitats, collecting dates, climatic conditions, and number of animals collected, the paper discusses the phenology of the species with some remarks on adaptations to winter life.

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During winter, many groups of invertebrates may occur on the snow surface. The presence of most of them is, however, accidental. A few groups reproduce during this time of the year. Among these, winter-active Chironomidae have been only superficially investigated.

Collections of Chironomidae retrieved from the snow surface were made during the winter period at different localities in South Norway from 1963 to 1970.

MATERIAL

The species recorded, with data on localities, habitats, collecting dates, climatic conditions, and number of individuals, are listed below.

Chaetocladius laminatus Brund. (ssp. n.)

Sylling, Lier, Bø: 25–28 Dec. 1963, 1 ♀. On snow in mixed forest, far from open water, 200 m a.s.l., temperature around 0 °C. 27 Feb. 1966, 3 ♂♂, 2 ♀♀. A great number of animals swarming, found both on the snow and free-flying. In mixed forest, near open water holes, along a small brook, approx. 180 m a.s.l., temperature around 0 °C.

Kolsåsen, Bærum, AK: 12 March 1970, 4 ♂♂. On snow near open water in small brook, about 130 m a.s.l. (Fig. 1). Cloudy, no wind, —1.0 °C at the snow surface. 18 March 1970, 2 ♀♀. On snow near open water in small brooks, about 130 m a.s.l. (Figs. 1 and 2). Sunny, partly cloudy, a little wind, around 0 °C at the snow surface. 10 April 1968, 1 ♂, 1 ♀. In copulation on snow, open place about 200 m from the locality in Fig. 1.

Fig. 1. Open brooklet near Oslo, 130 m a.s.l. with slowly running water 1–5 cm deep. Habitat for *Chaetocladius laminatus* and *Diamesa permacer* (Photo S. Hågvar).

Chaetocladius sp. (probably *laminatus*)

Lake Gulsjøen, Gran, Os: 31 March 1968, 1 ♀. On snow in spruce forest, about 500 m a.s.l.

Valler, Bærum, AK: 3 April 1968, 1 ♀. On snow in mixed forest, about 130 m a.s.l.

Diamesa permacer (Walk.)

Lake Dælivannet, Bærum, AK: 24 Feb. 1969, 1 ♀. On snow in mixed forest, about 130 m a.s.l. About 0 °C.

Kolsåsen, Bærum, AK: 12 March 1970, 18♂♂, 1 ♀. On snow near open water in small brook, about 130 m a.s.l. (Fig. 1). Cloudy, no wind, —1.0 °C at the snow surface.

D. bohemani (Goetgh.) Edw.

Kolsåsen, Bærum, AK: 23 Feb. 1969, 1♂, 1 ♀. On snow in spruce forest, about 200 m a.s.l. About —2°C.

Eggemoen, Ringerike, Bø: 26 Feb. 1969, 2♂♂, 4♀♀. On snow in spruce forest about 100 m a.s.l., temperature around 0 °C.

Diamesa sp.

Bøverdalen, Lom, On: 1 April 1969, 1 ♀.

Lake Furusjøen, Sel/Fron, On: 20 April 1969, 1 ♀. On snow in wood of Scotch pine and birch, about 850 m a.s.l.

Finse, Ulvik, HOi: 24 April 1965, 1 ♀. On snow in (lower) alpine region, several flying (not collected) along a river with open water, 1210 m a.s.l.

Pseudodiamesa branickii (Now.)

Bekkestua, Bærum, AK: 5 April 1969, 1 ♀.

HABITATS

Fig. 1 shows a habitat where *C. laminatus* and *D. permacer* were found. The water in the brooklet, only 1–5 cm deep, was running very slowly. The bottom was covered with stones, and mosses were growing at the edges. In the habitat shown in Fig. 2 (about 1 km apart from the first one), only *C. laminatus* was found. Here the small amounts of water were stagnant. Both pictures were taken in March 1970 at Kolsåsen, Bærum, about 130 m a.s.l.

Fig. 2. Open brooklet near Oslo, 130 m a.s.l. with a few cm stagnant water. Habitat for *Chaetocladius laminatus* (Photo S. Hågvar).

RESULTS

Winter-active chironomids were found from lowland to alpine habitats. In several cases individuals were observed far away from open water, indicating spreading by wind or by active movements.

Fig. 3 illustrates the phenology of the species, including additional data from Norway and Sweden according to Brundin (1947), Pagast (1947), and Serra-Tosio (1969).

The highest density of *D. permacer* on snow was found in the habitat shown in Fig. 1. On 12 March 1970 at Kolsåsen, the density was about one animal per m^2, within one metre from open water. Very few animals were found further apart from water. The air temperature close to the snow surface was —1 °C, and some individuals were flying at this temperature. It was cloudy and there was no wind.

A great number of *C. laminatus* were found swarming along a small brook with some open water, in Sylling on 27 Feb. 1966. Several animals were observed flying, together with several walk-

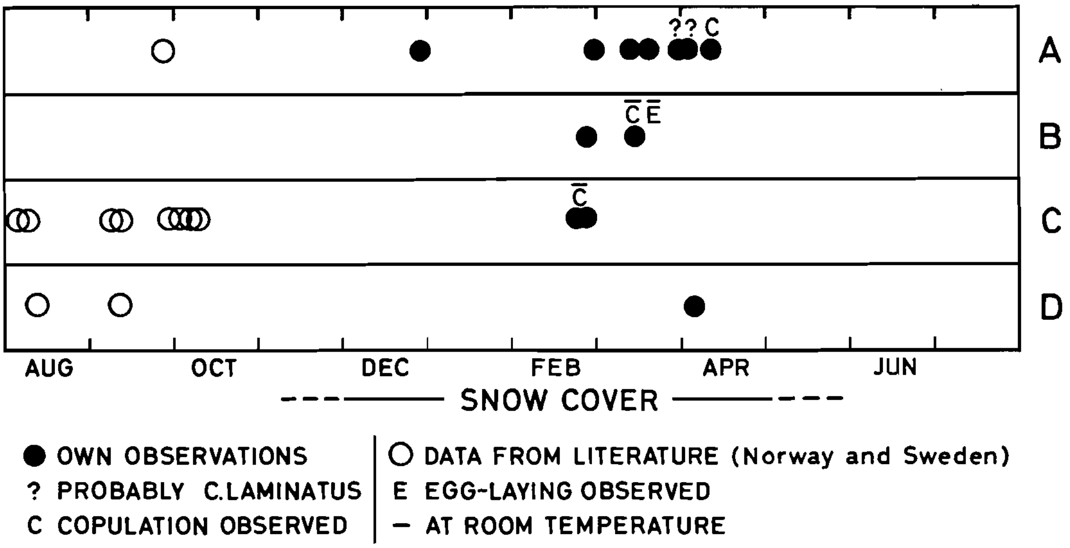

Fig. 3. The occurrence (phenology) of winter-active Chironomidae. A. *Chaetocladius laminatus*, B. *Diamesa permacer*, C. *D. bohemani*, D. *Pseudodiamesa branickii.*

ing on the snow along the banks of the brook. The weather was calm and foggy, with temperature around 0 °C.

Several chironomids were flying along an open river at Finse on 24 April 1965. The weather was partly cloudy with a daily temperature maximum of 7 °C. Only one specimen, a female, was collected and determined to *Diamesa* sp. The next day, several animals were seen flying along the river, together with many observed on the snow. On this day, the weather was foggy with dense snow falling and temperatures ranging from 0 °C to 4 °C. No animals were collected.

Animals were also found (in the field) during sunny weather. At Kolsåsen on 18 March 1970, one female of *C. laminatus* was flying when the temperature, measured with a shaded thermometer, near the snow surface was 0 °C. A pair of *C. laminatus* was found in copulation on the snow during sunny weather at Kolsåsen 10 April 1968, not far from the habitat shown in Fig. 2. The air temperature in shadow, one m above the snow, was about 5 °C.

18 specimens of *D. permacer* collected 12 March 1970 at Kolsåsen were kept under a plastic cover on the snow, and their activity was noted at different temperatures during several days. They survived —13.5 °C during the night and were capable of active movements at —4.5 °C. Copulation occurred without swarming at —1 °C. Both sexes were very active on the snow surface at this temperature; males were opening and closing their hypopygium.

Some specimens of *D. permacer* were kept at —22.5 °C for one hour, but they did not survive this temperature.

A pair of *D. permacer*, which was collected at Kolsåsen 12 March 1970 and kept in a small glass at 18 °C, copulated next day. Copulation lasted for at least half an hour. Two days later about 400 eggs were laid in a small amount of water offered.

As in *D. permacer* and *C. laminatus*, *Diamesa bohemani* mated without swarming activity. A male and female collected on snow at Kolsåsen 23 Feb. 1969 copulated immediately when brought together in a small glass container. Copulation occurred at a somewhat higher temperature than at the place where they were found, but even at the latter temperature (—2 °C) they were very active, although not flying. The animals were left at —2 °C, and copulation lasted for at least 15 minutes.

In cultures of *D. permacer* and *C. laminatus*, animals were seen pressing their heads for some seconds against wet filter paper or against snow, probably imbibing water.

DISCUSSION

The number of species recorded is low, taking the different localities, habitats, and years into consideration. Obviously, the ability to use the late winter months for hatching and reproduction seems to be a rare adaptation among chironomid species.

Of the species listed, *Diamesa permacer* is new to Fennoscandia, and *Chaetocladius laminatus* is new to Norway. According to O. A. Sæther (pers. comm.), the antennal ratio of the *C. laminatus* specimens differs from the original description of the species. For the present, the specimens are listed as ssp. n., as the genitalia are identical with those of *C. laminatus* (O. A. Sæther, pers. comm.).

All earlier records of *C. laminatus*, *D. bohemani*, and *P. branickii* have been noted in the autumn (August–October). Obviously these species may hatch both during autumn and winter in Scandinavia. *D. permacer* has been recorded only in late winter, and some records of the species from Germany are also from this time of year, viz. April (Pagast 1947). Further south, *P. branickii* may occur in every month from February to August. This species has also previously been found when the ground has a snow covering (Pagast 1947). If *D. permacer* does not occur at other times of the year, this species is the one with the most limited adaptation to winter conditions. Concerning *C. laminatus*, *D. bohemani* and *P. branickii*, it is not known whether they have one or more generations a year. Pagast (1947) believes that *P. branickii* has only one generation a year. According to O. A. Sæther (pers. comm.), many larvae of the subfamily Orthocladiinae (covering all species mentioned in this paper) seem to grow only at temperatures below 5 °C; they may perhaps be at rest in summer during the second stage. Theoretically, the occurrence of imagines both during autumn and late winter can be explained by the existence of two simultaneous generations, each using one year to fulfil their life cycle.

D. bohemani and *P. branickii* are arctic, circumpolar species. *D. permacer* and *C. laminatus* also occur in arctic conditions, e.g. the Alps (Fittkau et al. 1967). Oliver (1968) states that chironomids that have been able to adapt to spring conditions in the temperate regions have also successfully invaded the arctic regions. This conclusion accords very well with the present data.

According to Oliver (1968), the proportion of chironomid species which mate on the ground without swarming is probably no higher in the arctic than elsewhere. However, it is obviously a great advantage for an arctic species to be able to mate without swarming, as flight may often be impossible because of low temperature. The smooth and white snow cover also facilitates the meeting of the sexes on the ground. In this connection it is interesting to note that some of the most typical winter-active insects occurring on the snow (*Chionea* sp., Diptera Tipulidae, and *Boreus* sp., Mecoptera) are wingless. *D. permacer*, *D. bohemani* (and perhaps *C. laminatus*) are not mentioned by Oliver (1968) among arctic species mating without swarming.

Oliver (1968) also observed that Chironomidae might imbibe water; all of the nine arctic species investigated by him were able to complete the maturation of their eggs using only the nutrient material collected during the larval stage. The number of eggs (about 400) laid by *D. permacer* is higher than in *P. arctica* (maximum about 230, Oliver 1968).

D. permacer, *D. bohemani*, and *P. branickii* occur mainly in running water (Fittkau et al. 1967), but *C. laminatus* may occur in stagnant water during arctic conditions (O. A. Sæther, pers. comm.).

The most typical winter insects reproduce only during the winter, and are able to withstand temperatures well below 0 °C (Sømme & Østbye 1969). Obviously *D. permacer*, and even the other species mentioned, are well adapted to low temperatures, However, at least three of the species also reproduce in the autumn, before snow covers the ground. None of the species mentioned, with the possible exception of *D. permacer*, should be listed among the typical winter insects, but they all belong to the exclusive group of insects that are able to use the snow cover as habitat for their reproductive activities.

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We are greatly indebted to Dr. O. A. Sæther for identification of the material, to Mr. B. Faafeng for kindly putting material at our disposal, and to Mrs. M. Espeland for improving the English.

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Seasonal Variation in Hemolymph Osmolality and Osmotic Contribution of Glycerol in Adult *Rhagium inquisitor* L. (Col., Cerambycidae)

KARL ERIK ZACHARIASSEN

Zachariassen, K. E. Seasonal Variation in Hemolymph Osmolality and Osmotic Contribution of Glycerol in Adult *Rhagium inquisitor* L. (Col., Cerambycidae). *Norsk ent. Tidsskr. 20*, 259–262.

Hemolymph osmolality of the adult *Rhagium inquisitor* L. (Col., Cerambycidae) is markedly increased during winter. This increased osmolality seems to be induced by low temperature and is mainly due to an increased glycerol concentration, but there is also a significant osmotic contribution from other solutes.

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INTRODUCTION

Many species of insects live exposed to low temperatures during winter. The survival of insects under these circumstances is based upon supercooling of the body fluids or upon tolerance to freezing. Both increased ability to supercool and freezing tolerance seem to be due to an increase in the concentration of solute particles in the insect's body fluid (Salt 1959). In several insect species, glycerol has been shown to be of great importance as an osmotically active substance (Salt 1959, Sømme 1964). However, only a few investigations have shown the exact quantitative contribution of glycerol and other solutes to the total solute concentration in insects.

The longicorn beetle *Rhagium inquisitor* L. lives under the bark of dead conifer trunks and stumps. Adult beetles appear in August-September, after having lived as larvae for 1 to 3 years (Hansen 1966). Adults stay in their pupal chambers during winter until the beginning of May. Pupal chambers can often be found in parts of dead trees which are above snow level during winter. In contrast to most other overwintering species, the species is not shielded by a thermically insulating snow cover, which, according to Sømme & Østbye (1969), protects the insects from being exposed to extremely low temperatures. Lindroth (1960) reported that *R. inquisitor* is found all over Norway. It is very common in the inner parts of Østlandet, where winter temperatures frequently drop to −20 or even −30 °C. The species has to survive very low temperatures, and is thus interesting from a cryobiological point of view. The beetles are quite large (12 to 18 mm in length) and are therefore well suited for quantitative examinations of solutes in the hemolymph.

The purpose of the present examination was to find out how the hemolymph osmolality in adult *R. inquisitor* varies during the year, to discover whether glycerol occurs in the hemolymph during winter, and to determine, if possible, the quantitative contribution of glycerol to the total hemolymph osmolality.

MATERIAL AND METHODS

Hemolymph osmolality was measured on beetles which were collected in the Oslo area from 1969 to 1972. The beetles were brought directly to the laboratory and analysed immediately, or they were kept at outdoor temperatures during the night and analysed the next day. All beetles collected during winter were taken from pupal chambers located above snow level.

Hemolymph samples were obtained by tearing off one of the elytra. The hemolymph drop exuded was drawn into a glass micro-capillary tube by means of the capillary forces. From the capillary tube the samples were transferred to the osmometer with a micro-syringe.

Osmolality was determined by measuring freezing-point depression. Measurements were made partly on a Ramsay & Brown micro-osmometer and partly on a Clifton Nanoliter osmometer. The principles of this method are described by Ramsay & Brown (1955). Only minute amounts of hemolymph were necessary for the osmolality determinations.

Corresponding values of hemolymph osmolality and glycerol concentration were measured on beetles, whose osmolality was made to vary under laboratory conditions. Beetles were kept at —10 °C for 20 hours and then transferred to room temperature (20 °C). During incubation at room temperature the hemolymph osmolality was markedly reduced, and corresponding values of osmolality and glycerol concentration were measured after 1 to 70 hours at room temperature. Before being used in the experiments, the beetles had been kept for 1 to 8 weeks at 5 °C.

To make hemolymph samples available for other analyses (which will be published in a later article), the glycerol concentrations were measured on whole beetles, from which hemolymph samples had been taken. Glycerol is supposed to be passively transported across cell membranes, and should therefore appear in the same concentrations in all fluid compartments of an animal. This was verified by test measurements, which gave good agreement between values obtained from hemolymph samples and values obtained on whole beetles and related to the water content (Fig. 1).

For glycerol measurements, the beetles were homogenized in a mixture of sea sand and 70% ethanol. The mixture was centrifuged and then washed in 70% ethanol and centrifuged twice. The combined supernatants were dried at room temperature and dissolved in 2 ml distilled water. The dissolved samples were frozen and stored for 2 to 60 days before the glycerol concentrations were measured.

Glycerol concentrations were measured by using a paper chromatographic method described by Metzenburg & Mitchell (1954). By using this method, glycerol appears on the chromatograms as distinct white spots, the areas of which are proportional to the amount of glycerol. The concentration in each specimen was determined by running three parallel unknown samples on each chromatogram, together with three standard samples. The amount of glycerol in each sample was determined by weighing paper discs which were copied from the developed chromatogram spots of the standard and the unknown samples. The glycerol amounts obtained were related to the water content of the beetles, which was measured by drying the beetles to constant weight at 60 °C. According to Sømme (1964), no glycerol disappears by this treatment. The osmotic contribution of glycerol is found by comparing the molal concentrations of glycerol with the corresponding values of hemolymph osmolality. It is presumed that the osmotic activity coefficient of glycerol is equal to 1.0.

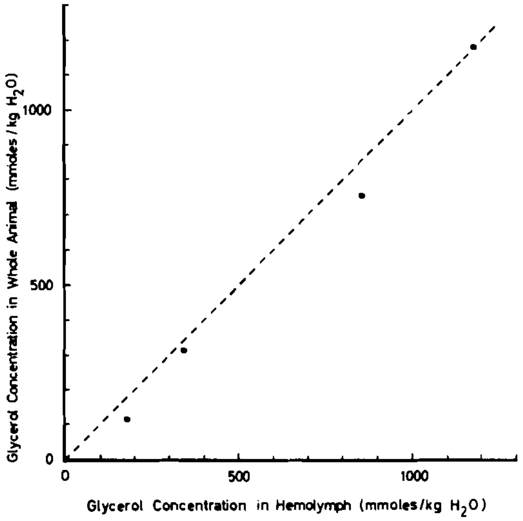

Fig. 1. Glycerol concentration in hemolymph sample from *R. inquisitor* related to glycerol concentrations obtained from whole beetles, calculated in relation to water content of beetle. The dashed line represents equal values.

RESULTS AND DISCUSSION

The results (Fig. 2) show that the hemolymph osmolality varies markedly during the year. The values increase during winter to a level of about ten times the summer values. The observed peak value of about 3200 mOsm corresponds to a freezing point of about —6 °C, which is far lower than the freezing points reported for most other cold-adapted insects. Sømme & Østbye (1969), for instance, reported freezing points from —0.42 to —2.05 °C for various winter-active insect species. For larvae of *Brachon cephi*, however, freezing points down to —17 °C and supercooling points of —47 °C have been reported (Salt 1959).

Pilot studies in the laboratory show that *R. inquisitor* with a hemolymph osmolality of 1800 mOsm could be supercooled to about —16 °C before freezing. Beetles with a hemolymph osmolality of over 3000 mOsm should thus be expected to have supercooling points lower than —16 °C.

It is reasonable to believe that the high winter osmolality is induced by the low winter temperature. To test this hypothesis, hemolymph osmolality was related to the mean temperatures observed at Blindern on the last three days before the beetles were collected (Fig. 3). The results tend to confirm the hypothesis. The hemolymph osmolality increased when the mean temperature fell under 6 to 8 °C, and the highest osmolality values appeared at the lowest temperatures. The scatter of the points may be due to several factors. The micro-climatic temperatures at the collection sites can be quite different from the temperatures observed at Blindern, especially if the stubs are exposed to sun or are located in the bottom of valleys with cold air 'rivers'. The degree of scatter may also be due to a time-dependent accumulation of important solutes in the hemolymph. The hypothesis of temperature-dependent hemolymph osmolality is further supported by laboratory studies showing that the osmolality in cold-adapted *R. inquisitor* is markedly reduced when the beetles are incubated at room temperature. It is also supported by Sømme (1964), who found that the glycerol content in various insect species increased when they were kept at low temperatures, and decreased at high temperatures.

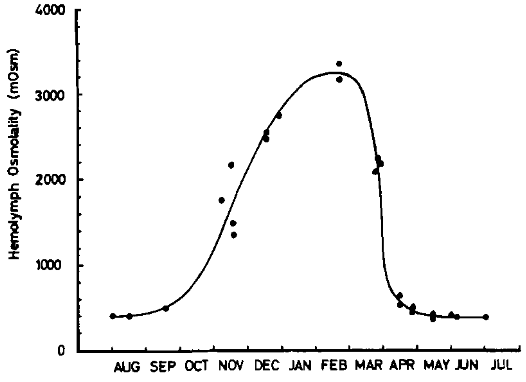

Fig. 2. Hemolymph osmolality of *R. inquisitor* during the year.

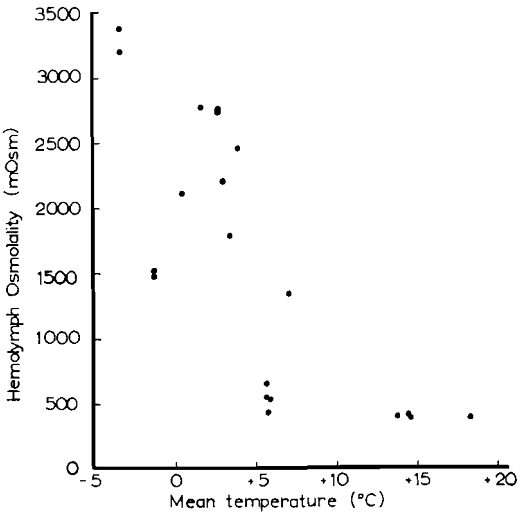

Fig. 3. Hemolymph osmolality of *R. inquisitor* related to mean temperature at Blindern the last three days before the beetles were collected. The mean temperatures are calculated from values obtained at 0700, 1300, 1900 hrs at Meteorologisk Institutt.

Fig. 4 shows that glycerol is not present in beetles with osmolality values below about 600 mOsm. Thus the decrease in osmolality from 400 to 600 mOsm must be due to other solutes. At osmolality values over 600 mOsm, glycerol seems to play an important part as an osmotically active substance in that the increase in osmolality above this value seems to be mainly due to glycerol. The glycerol concentration seems further to be linearly related to the hemolymph osmolality. The values give the regression line y = —432 + 0.687x with the stand-

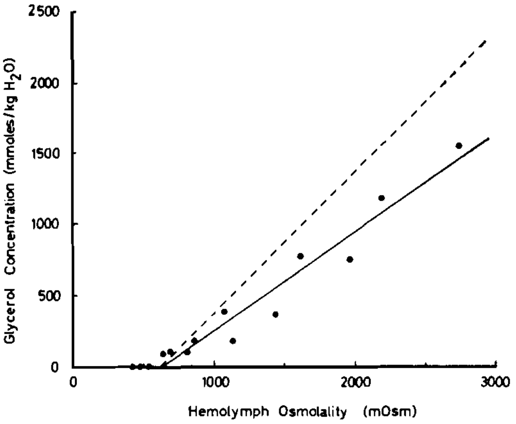

Fig. 4. Glycerol concentration in *R. inquisitor* related to hemolymph osmolality. Solid line: Calculated regression line. Dashed line: Hypothetical line with angular coefficient equal to 1.0.

ard deviation ±128. If glycerol were the only solute responsible for the increased hemolymph osmolality, the regression line would have an angular coefficient of 1.0. However, the regression line calculated from the observed values deviates significantly, on level $p<0.001$, from a line with an angular coefficient of 1.0 (tested by Students t-test). This significant deviation shows that glycerol is not the only osmotically active substance which contributes to the increased osmolality. Fig. 4 indicates that about 30 per cent of the increase in hemolymph osmolality must be due to other solutes.

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I would like to thank Dr. Lauritz Sømme for valuable advice concerning the glycerol measurements, and cand. real. Hans Jørgen Fyhn for teaching me to handle the Clifton osmometer.

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Observations of *Onychiurus nervosus* Stach, 1954 (Collembola, Onychiuridae) in Eastern Norway

ARNE FJELLBERG

Fjellberg, A. 1973. Observations of *Onychiurus nervosus* Stach, 1954 (Collembola, Onychiuridae) in Eastern Norway. *Norsk ent. Tidsskr. 20*, 263–265.

Onychiurus nervosus Stach has been found under bark of dead *Populus tremula*, *Betula odorata*, and *Pinus silvestris* at Tjøme, Vestfold County. Some morphological details concerning the antennal sensilla, seta of male ventral organ, and pseudocelli of head are discussed.

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Onychiurus nervosus was discovered by Stach (1954) under loose bark of pine and spruce in the Czarnohora Mountains, East Carpathians. It was supposed to be an endemic species, and has not been reported since it was described.

At the island of Tjøme, Vestfold County in Eastern Norway, I have several times found this species in colonies under bark of dead trees *(Populus tremula, Betula odorata, Pinus silvestris)*. The Norwegian specimens correspond well with Stach's description, but some details seem to be different:

Antenna III and IV have two short, sensorial seta not mentioned by Stach (1954). They are found in shallow depressions lateral of antennal organ III and baso-lateral on antenna IV (Fig. 1).

Number and position of seta in ventral organ of adult males (Fig. 2) are as described by Stach (1954). The typical, broad seta are only present when the males are in reproductive phase. During this phase the genital tractus, which ends in the genital area of abdomen V, is visible inside the body of cleared specimens. In pre- and post-reproductive phases the seta are undifferentiated but occupy the same position. I have seen pre-reproductive males killed just before ecdysis whose broad seta are just beneath the normal seta, and corresponding reproductive males whose normal seta of the post-reproductive skin are beneath the broad seta. The modified seta, which Stach (1954) calls sensory seta, are broad, sharply pointed, and furnished with longitudinal,

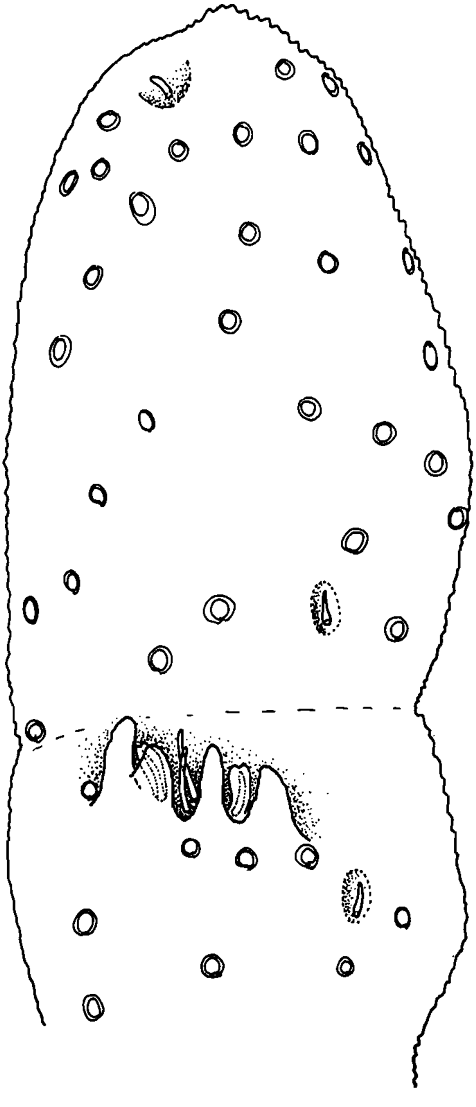

Fig. 1. Lateral view of right antenna III and IV, showing the position of the sensilla.

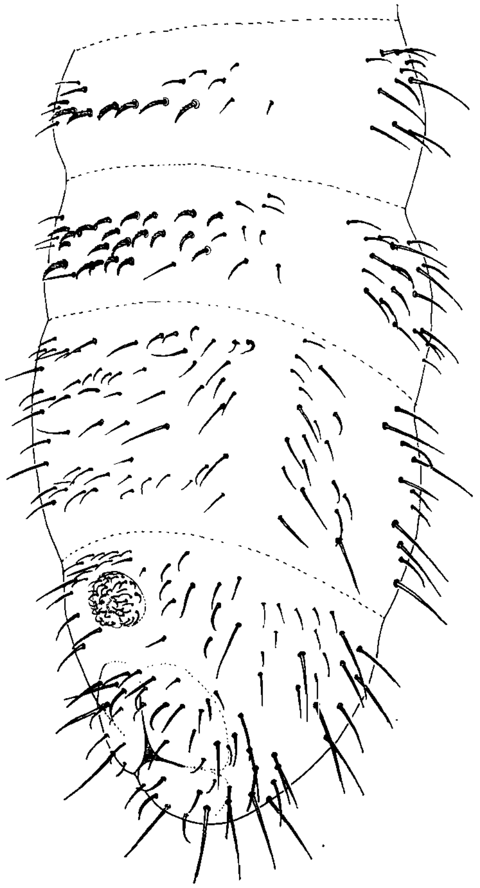

Fig. 2. Ventro-lateral view of abdomen II–VI of a reproductive male with ventral organ on sternites II and III.

Fig. 4. Stereoscan micrograph of seta from ventral organ of a reproductive male.

irregular ridges that are twisted along the length axis (Figs. 3 and 4). According to Stach (1954, p. 168) the seta are sharply pointed and 'In their inside there is a seta-like shaft wrapped by a fine

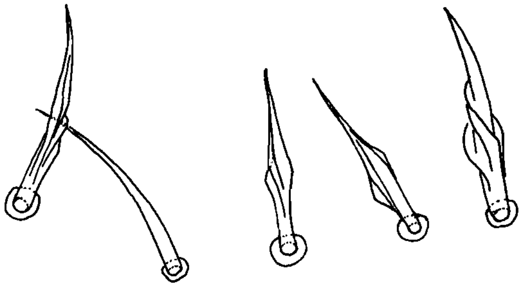

Fig. 3. Seta from ventral organ of abdomen III of a reproductive male as seen by transmission light microscope.

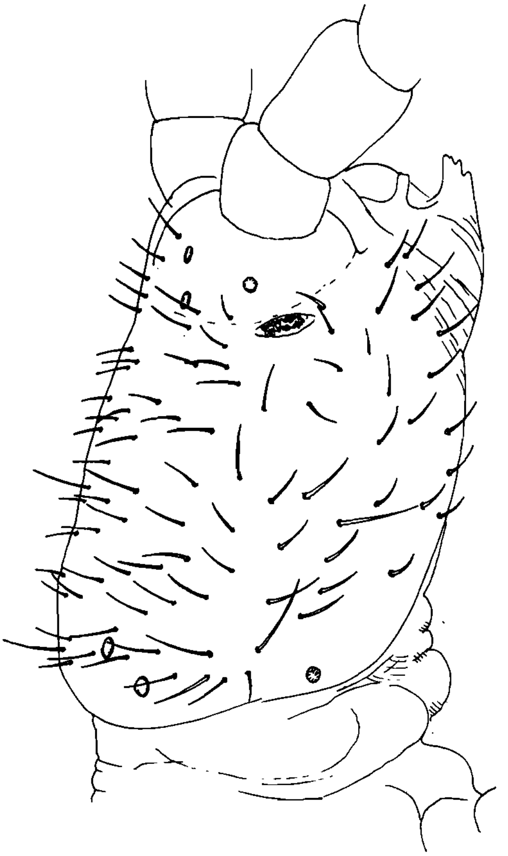

Fig. 5. Lateral view of head showing the position of the pseudocelli.

cover more or less broadened in its half length and slit longitudinally on one side'.

Ventrally on the head Stach (1954) occasionally observed one pseudocellus 'on each side laterally about half the length of the head'. I have seen no specimens with pseudocellus in this position, but most of the Norwegian specimens have a weak, ventro-lateral pseudocellus at the posterior corner of the head (Fig. 5). This is not mentioned by Stach (1954).

The largest specimens seen by Stach (1954) were 1.5 mm. The largest Norwegian specimens measure 1.2 mm.

I observed males in reproductive phase in late April and August.

Norwegian records: Vestfold: Tjøme. Solvangskogen, 9 April 1971, 24 Dec. 1971, 10 Aug. 1972 and 23 Dec. 1972. Under bark on fallen *Populus tremula*. Most specimens in the thick, fibrous bark near the root. Eidene, 29 Apr. 1972. Under bark on fallen *Betula odorata* and a dead *Pinus silvestris* that had not yet fallen.

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Received 19 March 1973

The Nymph of *Capnopsis schilleri* (Rostock) 1892. Notes on Its Morphology and Emergence

ALBERT LILLEHAMMER

Lillehammer, A. 1973. The Nymph of *Capnopsis schilleri* (Rostock) 1892. Notes on Its Morphology and Emergence. *Norsk ent. Tidsskr. 20*, 267–268.

Notes on the morphology and emergence of the little-known nymph of *Capnopsis schilleri* (Rostock) 1892 (Plecoptera, Capniidae) are given. This species is a common inhabitant of small and silted streams in south-eastern and northern Norway.

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The nymph of *Capnopsis schilleri* is little known. Aubert (1958) described the nymph from specimens captured at Mucone, Italy, 15 Apr. 1956, and Kazlauskas (1962) gave further information about its morphology.

The nymphs in the author's collection differ to some degree from the original description, and emergence from the nymph to the adult was not described by Aubert (1958). Therefore, it is felt necessary to supplement the original description and give information regarding its emergence.

DISTRIBUTION

In Norway, the first nymphs were collected by the author from Sæterbekken, Bærum, near Oslo. Subsequently, the nymph has been shown to be common in the south-eastern parts of Norway, and has been captured in the counties of Trøndelag, Nordland, Troms and Finnmark.

BIOTOPES

The species is a common inhabitant of small, silted streams from which they can be collected in large numbers in situations where there are clumps of leaves and other vegetable matter. A brief description of the biotopes will be given in a later work.

EMERGENCE

About 15 nymphs, ready for emergence, were taken from Sæterbekken in the middle of April and reared in the laboratory for a week. During this period 5 ♂♂ and 6 ♀♀ emerged.

During the days prior to emergence the nymphs moved up onto the stones, just under the water-level, then finally crawled onto dry land during the night and emergence took place early the following morning. Three specimens were killed at different stages of emergence; these are shown in Fig. 1 a, b and c.

Fig. 1. Three phases in the emergence of *Capnopsis schilleri:* a) The nymphal skin has split dorsally and the thorax is free. b) The nymphal skin is nearly off (♂). c) Next column.

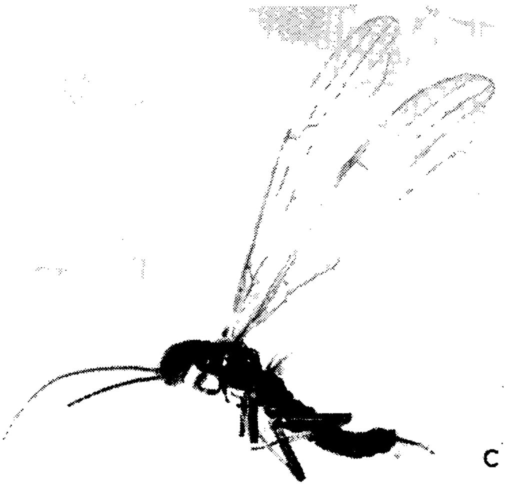

Fig. 1. c) Emergence is over and the wings are unfolded for drying (♀).

When ready for emergence, the nymphal skin opened first on the dorsal side of the thorax. Then the legs, head, and antenna were drawn out of the nymph skin. The last parts to be freed were the abdomen and the cerci. The wings were unfolded and stretched upwards for drying (Fig. 1c). Sometimes the wings were held in the nymphal skin, preventing normal emergence (Fig. 1b).

DESCRIPTION OF THE NYMPH

Nymphs ready for emergence had a body length of between 4.5 and 6.0 mm, the male nymphs from 4.5 to 5.5 mm and the female nymphs from 5.5–6.0 mm.

The male nymphs can easily be identified by the apex of their abdomen, where the supra-anal lobe is visible under the nymphal skin (Fig. 2A).

The antennae and cerci break easily, and specimens with undamaged antenna and cerci are rare. However, nymphs with a body length of 5 mm have antennae which are 2–3 mm long and cerci of about 3 mm. Both cerci and antennae, then, are relatively long.

The general colour of the body is dark red-brown on the dorsal side and a lighter brown ventrally.

The entire body is covered with long fine hairs. The pronotum has a fringe of long hairs, and around the eyes there is a fringe of fine hairs (Figs 2B and C). The antennae and cerci support hairs which in the basal parts are longer than the segments (Figs 2A and C). The labrum has a band of long hairs on its dorsal side (Fig. 2D). The ocelli are only distinctly visible just before the emergence. They are not to be seen in earlier instars. The mandibles, which are broad and stout (Fig. 2E), differ to some degree from the description given by Aubert (1958, Fig. 6).

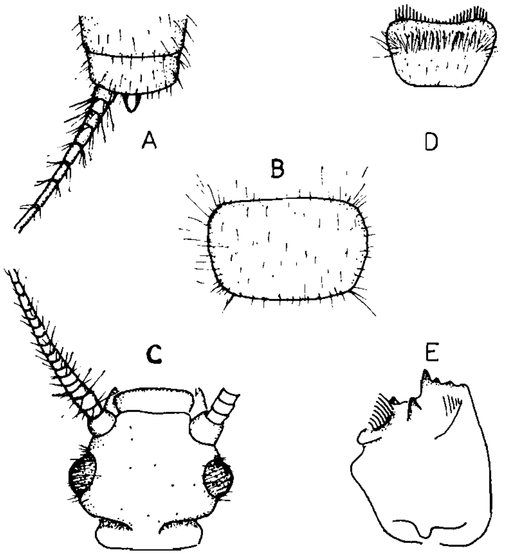

Fig. 2. A. The apex of abdomen, with the left cercus and the supra-anal lobe. B. Pronotum, C. Head, D. Labrum, E. Right mandible.

The nymph is very characteristic and can easily be separated from all other Capniids in Norway by its long hairs, which cover the whole body. Besides *Capnopsis schilleri*, only *Leuctra nigra* of the Norwegian stoneflies is densely hairy. However, the Leuctridae have complete abdominal segment rings and not the ventrally divided segment rings characteristic of the nymphs of the Capniidae.

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Norsk ent. Tidsskr. Vol. 20, No. 2, 1973

Short Communications

A Small Collection of Sciomyzidae from Southern Norway

LITA GREVE

New records from southern Norway are reported for four species of Sciomyzid flies. *Dictya umbrarum* and *Euthycera chaerophylli* are reported for the first time from western Norway.

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The distribution of the different species of the Sciomyzidae in Norway has recently been treated by Knutson & Berg (1971). While working on a small collection of Diptera, however, I found a total of 26 specimens belonging to four species of Sciomyzidae from the localities listed below which offers more information on the distribution in southern Norway. Abbreviations used in the text: T. R. N. = Tore Randulff Nielsen, L. G. = Lita Greve.

Dictya umbrarum L.

Ry: Klepp, Øksnevad 21 June 1964 (4 specimens), from humid bog, leg. T. R. N. Knutson & Berg (1971, Fig. 2) show a distribution map for Norway. The record from Øksnevad is the first one from western Norway.

Trypetoptera punctulata Scopoli

VE: Sandar, Årø 29 July 1969; 7 July 1970 (2 specimens) leg. L. G. Sandar, Nes 5 July 1970 (2 specimens). *TEi:* Bø, 2 km south of Bø center, 4 July 1970 leg. L. G. *Ry:* Høyland, Figgjo 16 June 1963 leg. T. R. N. *HOy:* Osterøy, Kringastemma 30 June 1972, near lake, leg. L. G. Meland, Brakstad 6 June 1965; 18 June 1967; 8 July 1967 (2 specimens); 3 June 1968 (2 specimens) leg. L. G. *SFy:* Gloppen, Sandane 28 June 1965 (3 specimens) leg. L. G.

For distribution in Norway see Knutson & Berg (Fig. 2) (1971). The records from Vestfold and Telemark fit well in the empty gap between Oslo and West-Agder.

Pherbina coryleti Scopoli

VE: Tjøme, Kjære 10 July 1966 leg. T. R. N., det. L. Lyneborg. Not a common species in Norway as it was earlier known from eight localities only (Knutson & Berg 1971).

Euthycera chaerophylli Fabr.

VE: Tjøme, Kjære 10 August 1966 (3 specimens) leg. T. R. N. *Ry:* Høyland, Figgjo 28 July 1962 leg. T. R. N.

This species has hitherto only been found in the area around Oslofjord. The locality from Rogaland is the first from western Norway.

ACKNOWLEDGEMENT

I am indebted to Dr. Leif Lyneborg, who determined the specimen of *Pherbina coryleti* and kindly verified my determination of the rest of the material.

REFERENCE

Knutson, L. V. & Berg, C. O. 1971. The malacophagous flies of Norway (Diptera, Sciomyzidae). *Norsk ent. Tidsskr. 18,* 119–134.

Received 14 November 1972

Pararge aegeria egerides Stgr. (Lep., Satyridae), ny nordgrense i Fennoskandia

DAGFINN REFSETH

Pararge aegeria egerides Stgr. (Lep., Satyridae) is reported from Stadsbygd, Sør-Trøndelag, where one male was found 4 July 1971. The species has previously not been observed so far north in Fennoscandia.

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I følge Nordstrøm (1955) er *Pararge aegeria egerides* Stgr. (Lep., Satyridae) under sakte utbredelse i Fennoscandia. Han oppgir at den er vanlig i den sørlige delen av Østlandet fra Stange (HEs) i nord til Krødsherad (Bø) i sør-vest, dessuten er den funnet i Odda (HOi), Dombås (On) og Molde (MRy). Ellers er den beskrevet som vanlig på forsommeren i Tingvoll, Stangvik, Nes og Kvanne (MRy) (Mehl 1970). Nordligste funn er Ång Näske i Sverige på 63°10′ N (Nordström 1955).

Den 4. juli 1971 fanget jeg en hann i Stadsbygd STy, beliggenhet 63°30′ N, høyde 100 m.o.h. Den fløy i åpen bjørkeskog med innslag av einer og hassel. Eksemplaret var svært avfløyet og kan ha kommet fra fjerntliggende lokaliteter. Nærmeste kjente lokalitet er Kvanne (MRy) (Mehl 1970) som i luftlinje ligger ca. 100 km unna. Det er ikke umulig for en dagsommerfugl å tilbakelegge en slik distanse, men det er også mulig at arten kan finnes på steder som ligger nærmere.

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Received 6 November 1972

Bemerkninger til Catalogue of the Lepidoptera of Norway, Part III

C. F. LÜHR

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I Catalogue of the Lepidoptera of Norway, Part III (Opheim 1972), har forfatteren en del kommentarer som berører noen av mine tidligere funn av sommerfugler. Jeg finner det nødvendig å gi nærmere opplysninger om funnene:

1. *Epirrhoe rivata* Hb. På Katalogens s. 33 skriver han: «Epirrhoe rivata Hb. New to Norway, VAy: Kristiansand ♀ July 1st 1968 (Berggren)». Allerede i 1958 fant jeg *E. rivata* i Lom, On. (Lühr 1960). Mitt eksemplar er kontrollbestemt av bl. a. Ingvar Svensson, Wilhelm van Deurs og Ib. Norgaard og står i min samling.

2. *Eupithecia cauchiata* Dup. Denne arten blir omtalt på s. 33 bl. a. slik: «while a ♀ from VAy: Søgne June 22nd 1960 (Lühr) . . . are (is) considered as doubtful». Konservator Nils Knaben har gjennomgått min samling av slekten *Eupithecia.* Han meddelte meg at han hadde funnet *E.*

cauchiata i materialet og at han gjerne ville publisere dette funnet sammen med sitt øvrige *Eupithecia*-materiale. Dette arbeidet fikk han ikke avsluttet før han døde. Da hverken Knaben eller jeg har skrevet eller uttalt oss om funnet finner jeg det meget beklagelig at det skal publiseres av Opheim (1972) på en slik måte og uten at han har forespurt meg.

3. *Hepiolus sylvinus* L. På s. 35 i katalogen knytter Opheim (1972) følgende kommentarer til *H. sylvinus:* «The record of the species from Fø: Kirkenes July 16th 1968 (Lühr) is doubtful as *H. sylvinus* in Fennoscandia has not been found north of Trondheim. I have not seen the specimen.» Sommerfuglen står i min samling.

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Opheim, M. 1972. *Catalogue of the Lepidoptera o, Norway Part III. Geometridae, Arctiina, Zygaenina, Psychina, Cossina and Jugatae.* Norsk lepidopterologisk selskap, Oslo.

Received 12 March 1973

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Løken, A. 1964. Social wasps in Norway (Hymenoptera, Vespidae). *Norsk ent. Tidsskr. 12*, 191-218.

Schwarts, R. J. 1955. *The Complete Dictionary of Abbreviations*. 211 pp., T. Y. Cromwell Co., New York.

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

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Strand, A. und Vik, A.: Die Genitalorgane der nordischen Arten der Gattung Atheta. Norsk ent. Tidsskr. 12, 1964. N.kr. 20,-
Sundt, E.: Revision of the Fenno-Scandian species of the genus Acrotrichis. Norsk ent. Tidsskr. 10, 1958. N.kr. 4,-
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