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Facultative parthenogenesis in *Psylla myrtilli* Wagner (Hom., Psyllidae): the saga continues in Norway

IAN D. HODKINSON

Hodkinson, I.D. 1983. Facultative parthenogenesis in *Psylla myrtilli* Wagner (Hom., Psyllidae): the saga continues in Norway. *Fauna norv. Ser. B. 30,* 1—2.

This paper reports the discovery of a population of *Psylla myrtilli* Wagner from Norway in which males and females were equally abundant. The species was thought to be parthenogenetic throughout Europe as males have not previously been taken, even in very large collections. The male genitalia are illustrated and compared with the genitalia of odd males collected in central and eastern U.S.S.R.

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Facultative parthenogenesis is suspected to occur in a number of psyllids including *Psylla rara* Tuthill, *Psylla ledi* Flor, *Trioza pletschi* Tuthill and a number of Australian species of *Glycaspis* Taylor (Hodkinson 1978, Moore 1970). The best documented example, however, conerns the holarctic species *Psylla myrtilli* which feeds on *Vaccinium* species. *Psylla myrtilli* was described from Austria by Wagner (1947) from about four hundred females and a single damaged male. Subsequently, the male was shown to be *Psylla corcontum* Sulc and therefore not conspecific with the female type (Ossiannilsson 1975). Later work showed that *P. myrtilli* was widespread in Europe but males were never found, even in very large collections. This led several workers to conclude that *P. myrtilli* was normally parthenogenetic (Linnavouri 1951, Lauterer 1953, Ossiannilsson 1975).

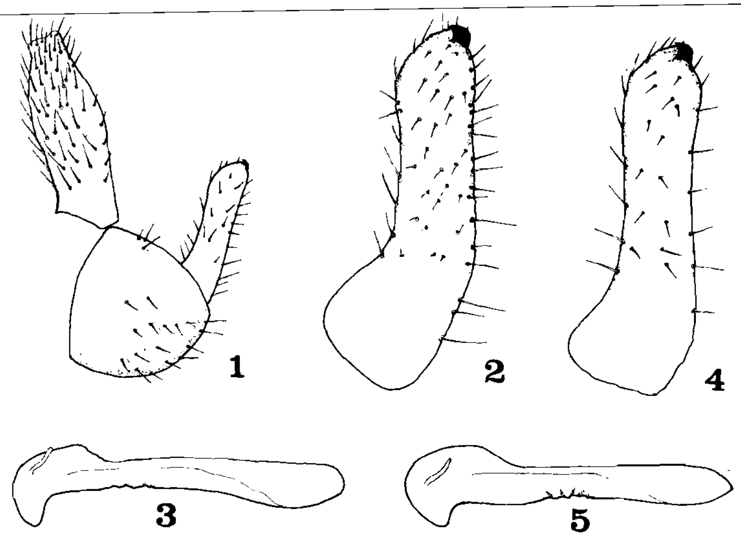
Recently, odds males have been recorded from Shansi, N. China (Kuwayama and Miyatake 1971), the Bieszczady Mountains of Southern Poland (Klimaszlwski, 1971) and from three sites in the U.S.S.R. at Chanty-Mansijsk in the Ural Mountains, North Karelia and Aborigen in the Kolyma Highlands, Chukotka (Ossiannilsson, 1975; Hodkinson & MacLean 1980). Hodkinson (1976) discovered a population in the Rocky Mountains of Alberta, Canada in which males and females were equally abundant and he described this as a new sub-species *canadensis*. However, males were absent from populations of this subspecies at several sites in central Alaska (Hodkinson 1978).

On recent collecting visits to Norway I have made large collections of *P. myrtilli* from *Vaccinium uliginosum* at sites in Hemsedal and the Jotunheim but failed to find males. However, at a single site on Riddehova, near Sjoa in Gudbrandsdalen I discovered population in which males were common. This is the first mixed-sex population found in Europe and I take this opportunity to provide detailed illustrations of the male genitalia of the European specimens (figs. 1—3).

Ossiannilsson (1975) illustrated the genitalia of two males from sites in the U.S.S.R. and showed some variation in the form of the parameres and penis. The Norwegian *P. myrtilli* differ from Ossiannilsson's illustrations and from subspecies *canadensis,* particularly in the shape of the penis. The paramere and penis of a male from Aborigen, which is much closer to Ossiannilsson's material, is therefore illustrated for comparison (figs. 4 & 5). It should be noted that in lateral view the denticle at the paramere apex only becomes fully exposed, as shown by Ossiannilsson, when the genitalia are flattened in a slide preparation.

Psylla myrtilli feeds throughout its range on *Vaccinium* species, particularly *V. uliginosum* a species with a broad circumpolar distribution (Hultén 1968). Thus while there is geographical variation in the form of the genitalia this should not be used as a basis for splitting *P. myrtilli* into a number of intergrading 'species'. The two other closely related *Vaccinium*-feeding species *P. amabilis* Ossiannilsson (1975) from the Kurile Is., U.S.S.R. and *P. vaccinii* Miytake (1964) from Japan appear at present to be distinct from *P. myrtilli* but it is not inconceivable thet further collecting will reveal additional intermediate forms.

The problem of parthenogenesis remains and



Figs. 1—3 *Psylla myrtilli* Wagner, ♂ from Riddehova, Norway. 1. Genitalia lateral view. 2. Right paramere inner view. 3. Penis.

Figs. 4—5. *Psylla myrtilli* Wagner, ♂ from Aborigen, U.S.S.R. 4. Right paramere inner view. 5. Penis.

there seems to be no obvious explanation as to why, how and when males are produced. Certainly there is no clear cut geographical pattern linked perhaps to severity of climate. Males are apparently absent from most populations and it is reasonable to assume that reproduction is parthenogenetic. Some populations, however, contain males and females in approximately equal numbers and normal mating suggests that reproduction is sexual. Yet other populations contain odd males which appear insufficiently numerous to fertilize the female population. Studies on the mechanisms of reproduction in *P. myrtilli* are long overdue.

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The life history of *Psylla mali* Schmidberger (Hom., Psyllidae); and its relationship to the development of the apple blossom

NINA JONSSON

Jonsson, N. 1983. The life history of *Psylla mali* Schmidberger (Hom., Psyllidae); and its relationship to the development of the apple blossom. *Fauna norv. Ser. B. 30*, 3—8.

The aim of the present paper was to investigate the life cycle and microhabitat of *Psylla mali* Schmidberger on apple. It was found that: 1) *Psylla mali* nymphs were significantly more abundant in blossom clusters than in leaf clusters. 2) The nymphs in instar stage 1 emerges synchronously with the flower clusters and the adults emerged at flower fall. 3) From June—August the sex ratio was in favour of males, while in September—October the sex ratio was equal. 4) The females were significantly larger than the males all months, and the body length of the females increased and the body length of the males decreased during autumn. 5) The population density was highly correlated with the density of the blossom clusters.

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INTRODUCTION

The apple sucker, *Psylla mali* Schmidberger, is widespread in Europe, Asia, North America, and Australia (Speyer 1929). It is a very common noxious insect on apple in most part of its range (Speyer 1929, 1936, Przybylski 1970, Baeschlin & Taksdal 1979). The nymphs and adults suck plant juice from leaves, flowers, leaf and flower stalks, and the fruit (Schöyen 1914), and destroy the quality and quantity of the fruits. The life cycle and microhabitat of *P. mali* is not investigated in detail, but Przybylski (1970) reported that the nymphs emerged at the time of flower emergence, that the nymphs lived among leaves and flowers, and that the adults were observed some time after flower fall.

The nymphs are small and move slowly, especially in first and second instar stages. They are vulnerable to hostile weather conditions, and easily caught by predators e.g. bugs and ladybirds (Speyer 1929). Thus it is important for young nymphs to live in a habitat with satisfactory shelter and food conditions. Newly blown flower clusters contain hiding places and thin cuticle, which make it easy to suck plant juice (Miller 1973). Therefore I hypotesized that 1) the nymphs lived in blossom clusters, 2) the nymphs emerged concurrently with the apple blossoms and the adults emerged concomitantly with the flower fall, 3) the population density depends on the density of the blossom clusters.

In order to investigate this I first tested the number of nymphs found in blossom clusters against the number in leaf clusters on the same branches. Then I investigated the life cycle of *P. mali* in the relation to the flower development, and studied whether there was sexual differences or not. At last, I tested the number of nymphs in flower clusters of trees in heavy bloom against the number of nymphs in clusters of trees in light bloom.

STUDY AREA

The study was carried out in an apple orchard at Gaustad, Oslo, south—eastern Norway.

The mean air temperature for the months April—November 1979 and 1980 for Oslo are given in Fig. 1. The studied area, which was approx. 2500 m^2, consist of 39 apple trees, alined in three rows. The dominating varieties were Cox's Pomona, Åkerø, and Signe Tillisch, all well-kept trees of old age. No pesticides were applied to the orchard during the sampling periods.

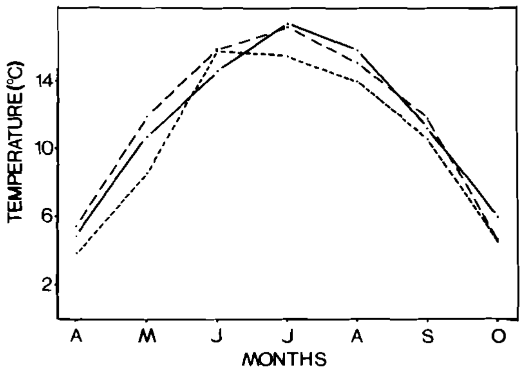

Fig. 1. The monthly mean air temperature from April—October 1979 (----) and 1980 (— — —), and the monthly air temperature for the years 1931—1960 (— — —) in Oslo, south-eastern Norway.

The apple trees flowered 2 weeks later in 1979 than in 1980 and 1981. The bloom was conspicuously richer in 1980 than in 1979 and 1981, but the yield was approximately the same all years.

METHODS

Specimens of *P. mali* were collected at regular intervals from May till early November 1979 and 1980 by the beating method of Steiner (1962). The branches were knocked with a stick, and falling insects collected in a net with an opening frame of 0.25 m^2. On each day of collection a total of 52 branches were knocked, each receiving 5 rapid knocks. An equal number of branches on the sunny side and in the shade were utilized. Young nymphs are quite difficult to collect when using the beating method, but some were sampled from the flower clusters, which fell into the net. To obtain better estimates of nymphs, they were also sampled directly from clusters with flowers and leaves, and leaves only, during the period of 30 April—13 June 1980 and 2 May—10 June 1981. An amount of 50—100 clusters were picked with 2—3 days interval during these sampling periods. On each day of collection clusters were taken from all apple trees in the orchard.

Apple trees with light bloom is defined as 0—7 blossom clusters per 1 m branch, and heavy bloom as 12—34 blossom clusters per 1 m branch.

Specimens of *P. mali* were examined and counted under a stereoscopic microcope (10x). On each day of collection the total body length of a random sample of 25 adult males and 25 adult females were measured.

All statistical tests in the present paper are based on a 5% significance level.

RESULTS AND DISCUSSION

1. The habitat and life cycle

The number of nymphs collected from clusters with flowers and leaves, and leaves only are shown in Table 1. According to «Mann-Whitney U-test» (Elliott 1971) nymphs were more abundant in clusters with flowers and leaves than in clusters with leaves only ($P < 0.05$).

The development of the nymphs occurred synchronously with the development of the apple blossoms (Fig. 2). The psyllids appeared mainly as first and second instars during leaf emergence and in green cluster stage. The first and second instars live on leaf stalks and within curled leaves. Third instar nymphs were found at the time when the apple blossoms were in the ballon and flowering stages. These instars mainly appeared on leaf and flower stalks, but also on the leaf surfaces. Fourth instar nymphs mainly appeared when the apple were in flower, the fifth instar nymphs when the apple were in the flowering and faded flower stages. These individuals were observed on the surface of the leaves, and were especially abundant on the underside of the leaves as well as on leaf and flower stalks. The adults emerged quite synchrono-

Table 1. Numbers of *Psylla mali* nymphs in leaf clusters and blossom clusters in different developmental stages, sampled on apple in 1981.

Date	Blossom stage	No. of blossom clusters	No. of nymphs	No. of leaf clusters	No. of nymphs
19 May	Ballon	35	245	20	61
24 May	Flowering	55	170	49	100
27 May	Flowering	37	193	60	52
30 May	Flowering	65	358	33	78
2 June	80% faded flower	40	151	10	3
Total		232	1117	172	294

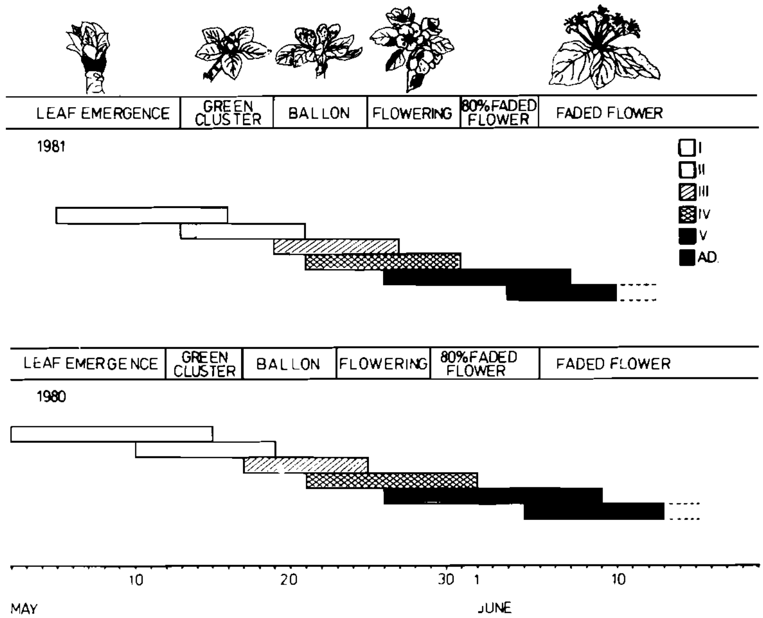

Fig. 2. The development of *Psylla mali* nymphs in instar I—V in realtion to the development of the apple blossoms at Gaustad, Oslo, in 1980 and 1981. The nymphs were sampled directly from the blossom clusters.

usly. During 2—3 days the nymphs were transformed to imagines. The adults appeared from the flower fall onwards, and were mainly found on leaf surfaces and on the fruits.

In the blossom clusters the nymphs obtain protection in a predictable environment offering satisfactory food conditions. The nymphs move very slowly while the adults are firm jumpers and much more difficult to catch for any predators. Thus it appeared favorable for *P. mali* to have reached the adult stage when the flowers have shed their leaves.

The life cycle of *P. mali* on apple is shown in Fig. 3 & 4. In 1979, the hatching of *P. mali* occurred 2—3 weeks later than in 1980. This may be due to the low air temperatures in April and May 1979 (Fig. 1). The samples sizes of the nymphs were limited (Fig. 3 & 4), as they live well protected among the leaves and flowers, but the duration of each nymphal stage is in agreement with the data presented in Fig. 2. The nymphal stages of *P. mali* lasted for relatively short time; the nymphs were found on apple for approx. 5 weeks. The adult stage, however, occurred on apple for approx. 5 months. In both years the eggs of *P. mali* were observed on the bark of the apple branches in early September. In 1980, copulation as late as 21 October was observed. According to Speyer (1929) in Germany *P. mali* copulate between June and October while the eggs are laid during September and October. These results are in agreement with my observations from Oslo. Consequently, a long period of time passed from the commencement of the copulation period to the first eggs were observed in the autumn. The eggs are placed on the bark of the branches and are probably much more vulnerable to predation than the fast moving adults. Since adult mortality increases with time, the egglaying cannot be postponed too long. Thus, it appears reasonable to expect that the eggs are laid at the time which give the highest number of viable offspring when integrated over the total adult life span. The oviposition period lasted throughout two months. In spite of this long period the nymphal development occurred synchronously in the spring. Thus, there may be an egg diapause during winter, as suggested by Skånland & Sømme (1981).

2. The sex ratio and body length

The sex distribution of *P. mali* on apple is shown in Fig. 3 & 4. Both sexes occurred simultaneous on apple. However, the males dominated significantly all months between June—August ($P < 0.001$), while the sex ratio appeared equal in

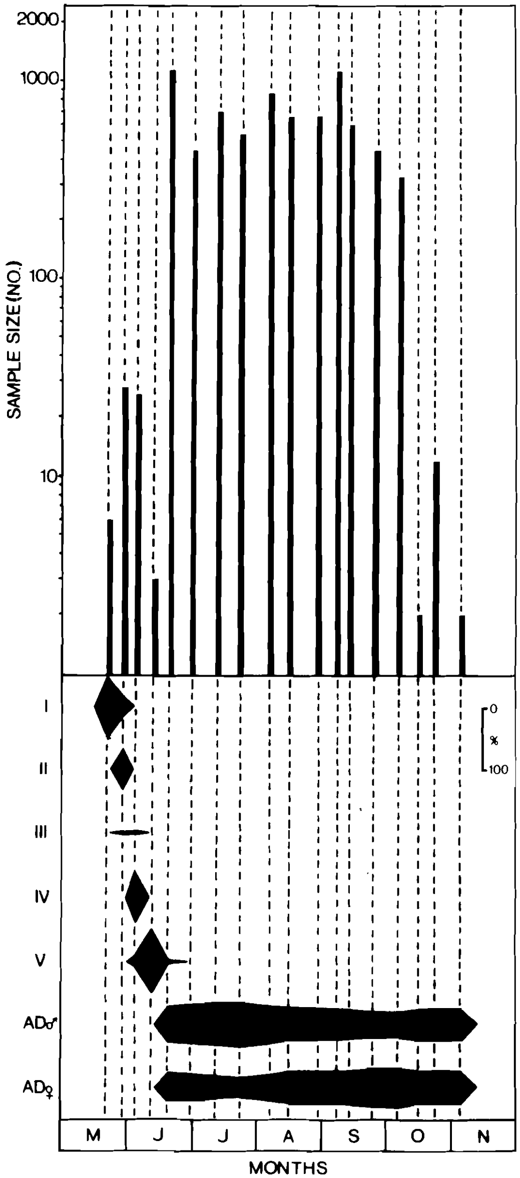

Fig. 3. The life cycle of *Psylla mali* on apple at Gaustad, Oslo, from 21 May—6 November 1979. The nymphal instars I—V and adult males and females are estimated in per cent of total number of *P. mali* individuals in each sampling series. The material was collected by Steiner's (1962) beating method.

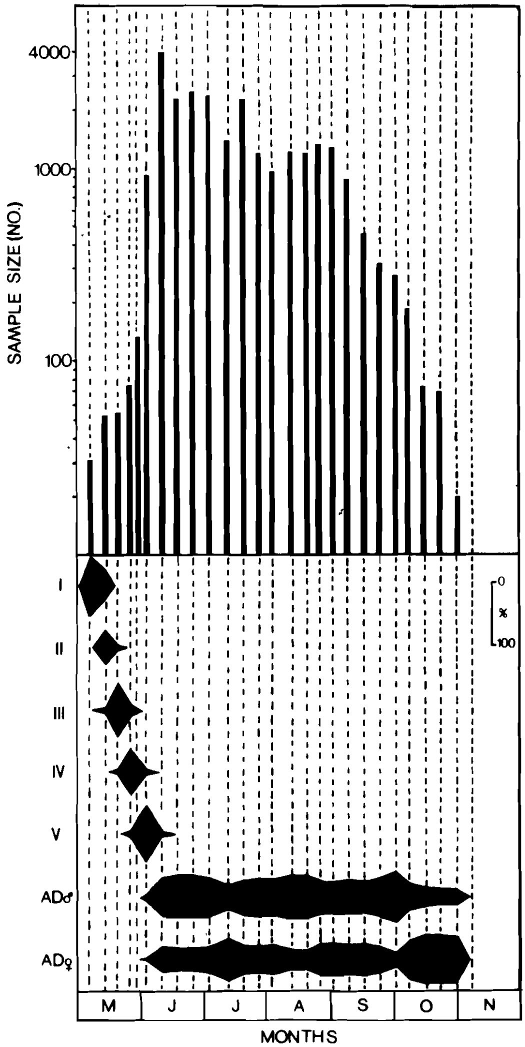

Fig. 4. The life cycle of *Psylla mali* on apple at Gaustad, Oslo, from 6 May—7 November 1980. The nymphal instars I—V and adult males and females are estimated in per cent total number of *P. mali* individuals in each sampling series. The material was collected by Steiner's (1962) beating method.

September and October («Test of significance of binominal proportion.» Snedecor & Cochran 1967). In both years, the average sex ratio (female/male) was 0.77. According to Speyer (1929) apple is the main food plant of *P. mali*, but the adults often migrate to other plants searching for food. Speyer (1929) maintains that such migrations may take place from June—September. The sex ratio of *P. mali* found in the present study indicate that if such migrations occur, the majority among the migrants were females. As one male can fertilize the oocytes of several females (Speyer 1929), it is not the

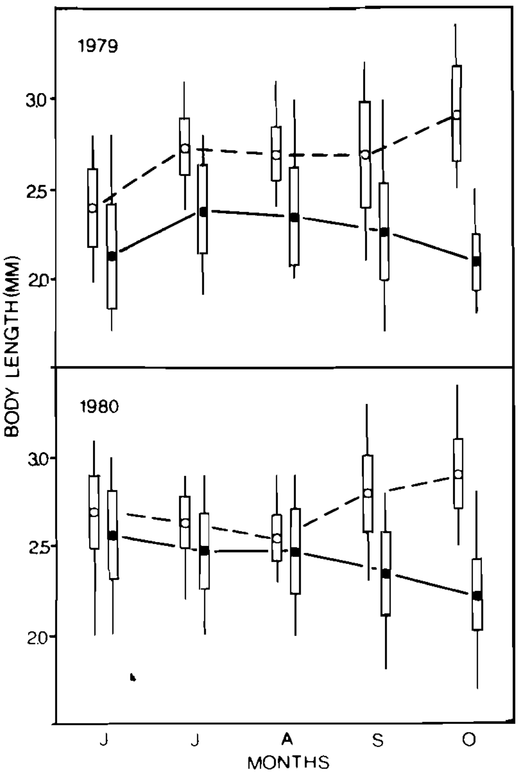

Fig. 5. Average body length, standard deviation, and total range of variance of the measured adult females (-----) and males (-----) of *Psylla mali* caught at Gaustad, south-eastern Norway, between June-November 1979 and 1980.

male but the female fecundity which gives the upper limit for the number of possible offspring in a population. Thus, it may be more important for females than males to obtain proper food conditions, and when food is limited it may be a higher selective premium for migratory females than males. The greater need for food among females than males is also indicated by the fact that the males were generally smaller than the females (Fig. 5). The difference between the sexes was highly significant all months ($P < 0.01$), tested with Student's 't'-test (e.g. Snedecor & Cochran 1967). The difference were most pronounced in September and October ($P < 0.001$). A reason for this sexual differences may be that larger females are more fecund than smaller females, while males have no similar selective advantage by being large.

The average body length of the females increased during autumn. This may be an effect of the female fecundity, as the abdomen at that time was filled with oocytes in different developmental stages.

3. The population density

A total of 7753 specimens of *P. mali* was collected during 18 samplings in 1979 and 25350 specimens during 27 samplings in 1980 (Fig. 3 & 4). The population density was much higher in 1980 than in 1979, although predators as ladybirds and the bugs *Anthocoris nemorum* (L.), *Atractotomus mali* (Meyer-Dür), *Orthotylus marginalis* Reuter, and *Psallus ambiguus* (Fallén) were also more numerous in 1980 (Jonsson 1981). A limiting factor for the population density may be the number of suitable nymphal sites; i.e. the density of blossom clusters. This is indicated by the observation that there was no significant difference in the amount of nymphs in blossom clusters from trees with light and heavy bloom (Table 2), when tested by «Comparison of means and variance of two large samples» (Elliott 1971). This hypothesis is further supported by the fact that the blossom clusters occurred much more abundant in 1980 compared with 1979. However, the weather conditions may also be important for the population size (Speyer 1929). The air temperature was higher during spring in 1980 than in 1979, and this may also account for the higher population density in 1980.

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Table 2. Mean number of *Psylla mali* nymphs per blossom cluster in 7 apple trees in light bloom and 7 apple trees in heavy bloom, sampled from 20—22 May 1981.

Bloom	Mean numbers of nymphs							Total no. of nymphs	Total no. of blossom cluster
	1	2	3	4	5	6	7		
light	3.66	8.80	6.00	5.04	9.61	6.96	4.81	781	121
heavy	8.94	7.50	5.42	6.32	4.26	6.53	10.14	1097	158

land sampled the nymphs in the blossom clusters in 1980. I am most grateful to drs. Bror Jonsson, Nils Chr. Stenseth, and Lauritz Sømme who read and commented critically a draft of this paper.

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The bug fauna (Hem., Heteroptera) on apple trees in south-eastern Norway.

NINA JONSSON

Jonsson, N. 1983. The bug fauna (Hem., Heteroptera) on apple trees in south-eastern Norway. *Fauna norv. Ser. B. 30*, 9—13.

The bug fauna on apple trees were investigated at Gaustad, Oslo, during three consecutive years. Seven families, Miridae (30 species), Cimicidae (9), Pentatomidae (4), Acanthosomidae (1), Microphysidae (1), and Piesmidae (1), were found. Approximately 90% of the individuals belonged to the family Miridae in all three years. The abundant species collected in descending order of abundance: *Campylomma verbasci, Atractotomus mali, Blepharidopterus angulatus, Psallus ambiguus, Anthocoris nemorum, Orthotylus marginalis, Phytocoris tilia*, and *Psallus perrisi*. Each of these species made up more than 2% of the total sample size in at least two of the three years. Factors affecting abundance differences between years are discussed.

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INTRODUCTION

Previous investigations of the arthropods on apple trees show that Heteroptera make up a high percentage of the fauna (e.g. Skånland 1981a, Steiner et al. 1970). Most of the predatory bugs on apple trees belong to the families Anthocoridae, Miridae, Nabidae, and Pentatomidae (Baeschlin & Taksdal 1979, Korcz 1967, Leski 1967, Redenz-Rüsch 1959, Zeletski & Rinnhofer 1966), of which many species may be important in e.g. biological control of pests on apple. Norwegian investigations of the bug fauna on apple trees have showed great variations in the species compositions between localities and years (Austreng & Sømme 1980, Baeschlin & Taksdal 1979, Sørum 1977a), and more investigations are needed to obtain detailed information about the local bug communities on apple trees. In the present study I investigated the species composition of the bug fauna on apple trees in a Norwegian orchard during three consequtive years. I give notes on the most abundant species, including life cycle, host plants, and prey species. In addition, I discuss factors affecting the variation in the population size during these years.

MATERIAL AND METHODS

From 21 May—6 November 1979, 6 May—7 November 1980, and 13 May—4 November 1981, I sampled bugs on apple trees at Gaustad, Oslo, south-eastern Norway. In 1979 two orchards (Orchard 1 and Orchard 2), 400 m apart were used. The first orchard consisted of 39 and the second orchard of 56 apple trees, all of middle to old age. In 1980 and 1981 samples were taken in the first orchard only. In both orchards varieties of the apple trees were Cox's Pomona, Signe Tillisch, and Åkerø. No pesticide was applied to the orchards during the investigation. The monthly mean air temperature for the months April—October 1979, 1980, and 1981 is given in Table 1.

The bugs were sampled at 5—12 days intervals by the beating method of Steiner (1962). In orchard 1, a total of 52 branches were knocked on each day of collection. Each branch received 5 rapid knocks. In orchard 2, however, 33 branches were utilized, each receiving 3 rapid knocks. As far as possible new trees were utilized for each collection, and an equal number of branches on the sunny and shady sides were utilized.

RESULTS AND DISCUSSION

1. The bug fauna on apple trees

Forty-six species of 6 families were sampled on apple trees in 1979—1981 (Table 2). The families, in terms of number of species sampled,

Table 1. The monthly mean air temperature from April—October of the years 1979—1981 and 1931—1960 (the standard) in Oslo, south-eastern Norway.

	1979	1980	1981	1931—1960
April	3.8	5.4	4.5	4.7
May	8.5	11.8	12.0	10.6
June	15.8	16.0	12.6	14.6
July	15.5	17.2	16.1	17.4
August	14.0	15.2	15.3	15.9
September	10.5	11.8	12.2	11.2
October	4.7	4.7	5.0	6.0

were Miridae (30 species), Cimicidae (9 species), Pentatomidae (4 species). Only one species was sampled from the families Acanthosomidae, Microphysidae, and Piesmidae. The most abundant families and species in the orchards are presented in more detail below.

Miridae

The mirids were represented by 23 species in 1979, 22 species in 1980, and 14 species in 1981, whereas the number of individuals made up approx. 90% of the total sample size all three years. Seven mirid species were abundant in the present study, i.e. each species comprised more than 2% of the total sample size in at least two of the years.

The most numerous mirid, *Campylomma verbasci* (Meyer-Dür) were present from May to September. In 1980 some adults were sampled as late as October. *C. verbasci* hibernated in the egg stage. In Norway, the species have one generation per year (Austreng & Sømme 1980, Skånland 1981a). Elsewhere, as in Canada, *C. verbasci* may have two generations a year (MacPhee 1976, Southwood & Leston 1959) *C. verbasci* occur on several host plants, e.g. hollyhock, mullein, pear, potato, oak, and apple (McMullen & Jong 1970, Southwood & Leston 1959). The nymphs live mainly phytophagous, but need some animal juice to complete their development. The adults are more zoophagous (McMullen & Jong 1970, Niemczyk 1978, Lord 1971). Important prey items for *C. verbasci* are eggs and nymphs of *Psylla pericola* Föerster, and eggs and active stages of *Aphis pomi* (De Geer), *Bryobia praetiosa* Koch, *Panonychus ulmi* (Koch), *Tetranychus mcdaniel* McG, *T. telarius* (L.) (McMullen & Jong 1970, Lord 1949, 1971).

The second most numerous mirid, *Atractotomus mali* (Meyer-Dür), were present from May — September. It hibernated in the egg stage, and have one generation per year in Norway (Austreng & Sømme 1980, Skånland 1981a). *A. mali,* live mainly on apple trees and hawthorn (Southwood & Leston 1959). The nymphs are mainly phytophagous, but they need some animal juice to grow. The adults live more zoophagous (Lord 1971, Sandford 1964, Strawinski 1964). Active stages of aphids, psyllids, and mites, and lepidopterous larvae are important prey species of nymphs and adults (Leonard 1965, Sandford 1964).

Orthotylus marginalis Reuter and *Psallus ambiguus* (Fallén) were present from May to July. Both species hibernated in the egg stage, and have one generation per year under Norwegian conditions (Austreng & Sømme 1980, Skånland 1981a). *O. marginalis* are common and often abundant on sallow, willow, alder, and apple, and are less commonly found on currants and sloe (Southwood & Leston 1959). *P. ambiguus,* however, occur on apple, hawthorn, sallow, and alder trees (Southwood & Leston 1959). The nymphs of *O. marginalis* and *P. ambiguus* are mainly phytophagous, but need animal juice to grow. According to Morris (1965) *P. ambiguus* nymphs die after one or two days when fed on apple leaves only, but some nymphs survive when fed on apple flowers. The adults live more zoophagous (Morris 1965, Petherbridge & Husain 1918). Important prey items for nymphs and adults are aphids, mites, psyllids, and small insects (Collyer 1953, Kullenberg 1946, Morris 1965, Southwood & Leston 1959). *P. ambiguus,* however, do not feed on eggs of *P. ulmi* and *P. mali* (Morris 1965). The nymphs of *O. marginalis* and *P. ambiguus* are often parasitized by braconids (Southwood & Leston 1959).

The Miridae, although characterized in some of the early literature as strictly a plant-feeding family, e.g. Butler (1923), contains predaceous species, too. *Blepharidopterus angulatus* (Fallén) and *Phytocoris tilia* (Fabricius) live mainly zoophagous in all developmental stages (Collyer 1952, Collyer & Massee 1958, Glen 1973, Lord 1971). But according to Strawinski (1964), these species also need some plant juice to grow. Glen (1973), however, claims that plant juice has no value as food for *B. angulatus. B. angulatus* are an effective predator on eggs and active stages of the red spider mite, *P. ulmi,* aphids, and other small insects, while *P. tilia* prey on caterpillars, ladybird pupae, red spider mites, and small insects (Butler 1923, Collyer 1952, Muir 1965, Skånland 1981b, Speyer 1933). The main host-plants of *B. angulatus* are apple, alder, elm, birch, and lime (Southwood & Leston 1959). *P. tilia* are found on almost all deciduous trees, especially oak, ash, lime, and apple (Southwood & Leston 1959). In the samples *B. angulatus* were present from May to October, and *P. tilia* from June to September. Both species hibernate in the egg stage (Collyer 1954, Muir 1966), and have one generation per year (Austreng & Sømme 1980, Skånland 1981a).

Psallus perrisi Mulsant & Rey were sampled as adults only. It was present from June to July. *P. perrisi* occur mainly on oak, but the adults often migrate to other food-plants, such as apple trees (Southwood

Table 2. Heteroptera sampled on apple trees in the periods 21 May—6 November 1979, 6 May—7 November 1980, and 13 May—4 November 1981 at Gaustad, Oslo.

Species	1979 orchard 1 No.	1979 orchard 1 %	1979 orchard 2 No.	1979 orchard 2 %	1980 orchard 1 No.	1980 orchard 1 %	1981 orchard 1 No.	1981 orchard 1 %
ACANTHOSOMIDAE								
Elasmucha grisea (L.)					1	0.03		
PENTATOMIDAE								
Dolycoris baccarum (L.)			1	0.10				
Elasmostethus interstinctus (L.)			3	0.31			1	0.07
Eurydema oleracea (L.)					1	0.03		
Pentatoma rufipes (L.)	2	0.14	9	0.94	32	1.01	26	1.76
PIESMIDAE								
Piesma maculatum (Costa)					4	0.13		
CIMICIDAE								
Anthocoris gallarum-ulmi (DeGeer)					1	0.03		
Anthocoris nemoralis (Fabricius)					5	0.16		
Anthocoris nemorum (L.)	84	6.02	219	22.81	309	9.80	66	4.43
Anthocoris sibiricus (Reuter)	1	0.07	3	0.31				
Anthocoris sp.	2	0.14	23	2.40				
Elatophilus nigricornis (Zetterstedt)					3	0.10	6	0.40
Orius niger (Wolff)	3	0.22						
Orius sp.	15	1.07	29	3.02	17	0.54	14	0.94
Temnostethus gracilis Horvath					1	0.03	1	0.07
MICROPHYSIDAE								
Loricula elegantula (Baerensprung)					3	0.10	1	0.07
MIRIDAE								
Atractotomus mali (Meyer-Dür)	200	14.34	126	13.13	473	14.97	196	13.16
Blepharidopterus angulatus (Fallén)	171	12.26	41	4.27	541	17.14	167	11.22
Calocoris fulvomaculatus (DeGeer)			1	0.10				
Calocoris striatellus (Fabricius)			2	0.21	2	0.06	3	0.20
Campylomma verbasci (Meyer- Dür)	720	51.62	342	35.62	1012	32.05	107	7.19
Dryphilocoris flavonotatus Boheman							4	0.27
Exolygus wagneri Remane					5	0.16		
Lygus rugulipennis (Poppius)			1	0.10				
Lygus viridis (Fallén)					1	0.03		
Malacocoris chlorizans (Panzer)	4	0.29	1	0.10	10	0.32		
Miris striatus (L.)	2	0.14	1	0.10	1	0.03	3	0.20
Orthops basalis (Costa)	1	0.07	4	0.42	16	0.51	6	0.40
Orthotylus marginalis Reuter	5	0.36	2	0.21	91	2.88	273	18.33
Orthotylus nassatus (Fabricius)					3	0.10		
Orthotylus prasinus (Fallén)			13	1.35	18	0.57		
Orthotylus tenellus (Fallén)					4	0.13		
Phytocoris longipennis Flor	1	0.07			1	0.03		
Phytocoris populi (L.)	1	0.07			2	0.06		
Phytocoris tilia (Fabricius)	53	3.80	6	0.63	166	5.26	65	4.37
Phytocoris ulmi (L.)	7	0.50	1	0.10	19	0.60		
Phytocoris sp.							4	0.27
Pilophorus perplexus (Douglas & Scott)	5	0.36	19	1.98	15	0.48	4	0.27
Plagiognathus arbustorum (Fabricius)			11	1.15				
Psallus ambiguus (Fallén)	116	8.32	18	1.88	301	9.53	466	31.28
Psallus perrisi Mulsant & Rey			57	5.94	80	2.53	58	3.90
Psallus varians (Herrich-Schaeffer)					7	0.22		
Psallus sp.			9	0.94				
Stenodema holsatum (Fabricius)			2	0.21				
Sthenarus roseri (Herrich-Schaeffer)	2	0.14			12	0.38	18	1.21
Miridae spp.			16	1.67				
Total	1395	100.00	960	100.00	3157	100.00	1489	100.00

& Leston 1959). *P. perrisi* live zoophagous as well as phytophagous, and prey on aphids, psyllids, and mites (Kullenberg 1946).

Cimicidae

Anthocoris nemorum (L.) was the dominating species in this family in all three years. The adults hibernate, and the eggs are laid early in the spring. *A. nemorum* were present from May to October. In 1980, *A. nemorum* appeared to have two generations, since some 1. and 5. instar nymphs were sampled as late as August and September. In England, *A. nemorum* have two generations per year (Butler 1923, Collyer 1967, Hill 1957). *A. nemorum* have a wide range of habitats and are found on many deciduous trees as apple, oak, hawthorn, herbage, and nettles (Collyer 1967, Southwood & Leston 1959). It lives zoophagous in all developmental stages (Collyer & Massee 1958, Dixon & Russel 1972, Strawinski 1964). It is one of the most efficient predatory bugs in the fruit orchards (Sørum 1977b), and has a broad range of prey species e.g. Miridae, larvae of Lepidoptera and Diptera, Collembola, Thysanoptera, *Aphis fabae* (Scopoli), *Psylla mali* Schmidberger, *Aulacorthum circumflexum* (Buckt), *A. pisum* (Harris), and *P. ulmi* (Anderson 1962, Collyer 1967, Hill 1957, Russel 1970).

2. The density of the bug fauna

To compare the density of the bug fauna on apple trees between years, I have only used data from Orchard 1. There, a total of 1395 specimens of 20 species were sampled during 18 days of collection in 1979, 3157 specimens of 33 species during 27 days of collection in 1980, and 1489 specimens of 21 species during 22 days of collection in 1981. Both the number of specimens and the species were higher in 1980 than in 1979 and 1981. This may be due to several factors, e.g. air temperature, habitat variations, and food condition.

The air temperature was higher in April 1980 than in April 1979 and 1981 (Table 1). According to Collyer (1967) the fecundity of *A. nemorum* is higher at high than at low air temperature during the egg laying period in spring. A higher fecundity may give a higher population density. Furthermore, Muir (1966) reports that only a small number of the *B. angulatus* eggs hatch when incubated at low temperature; 727 day-degrees are required to hatch 50% of the eggs. The low air temperature in spring 1979 and 1981 may therefore reduce the precentage of eggs of *B. angulatus* that hatch.

A conspicuous habitat difference between the three years, was the higher number of blossom clusters in 1980 than in 1979 and 1981. The first and second instar nymphs of the species *A. mali*, *C. verbasci*, *O. marginalis*, and *P. ambiguus* live within the blossom clusters (Jonsson 1981, Morris 1965), where they obtain protection against predators and hostile weather conditions. There is an upper limit for the number of nymphs which can live in each blossom cluster. The number of blossom clusters on apple trees may therefore be a limiting factor for the population size. Furthermore, investigations from Nova Scotia (Lord 1968), showed that the population density of *A. mali* and *C. verbasci* were higher on apple trees with a greater amount of blossom clusters, compared with trees with a smaller amount of blossom clusters.

The amount of food available may also limit the population size of several bug species. The population densities of *A. pomi*, *P. mali*, and *P. ulmi*, which are important prey items for the present bug species, were approximately 3 times higher in 1980 than in 1979 and 1981 on the apple trees at Gaustad. Both the quality and the quantity of the food items are important for the fecundity of *A. nemorum* (Anderson 1962). This results in a reduced fecundity when food supply is limited. In addition, migration of adults *A. nemorum* can increase when the food conditions are bad (Anderson 1962). Thus, all these factors, the weather condition, the amount of blossom clusters, and the food condition may together determine the bug density on the apple trees. These factors appeared more favourable to the bugs in 1980 than in 1979 and 1981.

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The composition of the mosquito fauna in selected biotopes for arbovirus studies in Norway

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Descriptions are given of the quantitative and qualitative composition of the mosquito fauna from seven biotopes where attempts were made to isolate mosquito-borne arboviruses. Observations concerning the phenology of larvae and imagines were also made. The mosquito species recorded in Norway are tabulated and information concerning their host relations are presented.

Aedes hexodontus (females) was the dominant species in the August collection from the sub-arctic birch forest in Northern-Norway. However, in June we found only *Aedes communis* in the larval collections from the same locality. This indicates that *A. hexodontus* migrates down into the birch woods from the neighbouring treeless plateau. In the sub-alpine biotope in Southern Norway there was a progressional seasonal change in the dominant species from *Aedes impiger* in June to *Aedes hexodontus/punctor* and *A. communis* in the beginning of July, to *Aedes excrucians* s.l. in mid July. In two biotopes in the coniferous forests, *A. communis* was the dominant species with *A. punctor, Aedes diantaeus* and *Anopheles claviger* as sub-dominant species. *Aedes cantans* dominated in a forest biotope on the southern coast. A mosquito fauna considered to be typical for inundation areas in Central Europe and previously unknown in Northern Europe, was discovered in the delta region at the mouth of the river Glomma at Lake Øyeren, where *Aedes vexans, Aedes sticticus and Aedes rossicus* were the dominating species. *Aedes dorsalis* dominated in a salt marsh biotope.

Host relations and feeding behaviour of mosquitoes are discussed in relation to the ecology of mosquito-borne arboviruses.

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INTRODUCTION

During the past 20 years, a number of studies have demonstrated that northern species of mosquitoes are more important as vectors for arboviruses than previously supposed (Bardos et al. 1969, Henderson & Coleman 1971, McLintock & Iversen 1975, Danielova et al. 1976, Kurstak 1979).

In Finland, viruses belonging to the California encephalitis group were isolated from mosquitoes and antibodies to these viruses were common in both animals and man (Brummer-Korvenkontio 1973, Brummer-Korvenkontio et al. 1973). Subsequent serological surveys revealed other mosquito-borne viruses in Finland: Sinbis-virus, Batai-virus, and Semliki Forest-virus (Brummer-Korvenkontio & Saikku 1975).

Studies from Central Europe (Czechoslovakia and Austria) have reported that Tahyna-virus of the California encephalitis group causes an influenza-like disease. Furthermore, two American strains of this virus can cause more serious diseases in humans (Le Duc 1979).

In previous investigations we isolated viruses from ticks and conducted serological surveys for antibodies to these viruses (Traavik & Mehl 1977, Traavik, Mehl & Kjeldsberg 1977, Traavik, Mehl & Wiger 1978, Traavik 1979). On the basis of these and other findings we initiated a study to determine the importance of mosquitoes as vectors for arboviruses in Norway. Our goals included isolating viruses, conducting serological surveys of antibodies against these viruses in warm blooded hosts, and collecting data on the distribution and ecology of the mosquitoes. Finally, this information might be used in evaluating the circulation of arboviruses in the ecosystems and the potential health hazards they might represent.

The most significant study concerning the taxonomy and distribution of mosquitoes in Norway was conducted by Natvig (1948). Since then only three publications with faunistic information on mosquitoes have been published (Ardø 1958, Nielsen et al. 1981, and Natvig & Mehl 1982).

Information on mosquitoes was lacking or sparse from several districts in Norway, such as Finnmarksvidda, the mountain districts south of the Dovre mountains, and the deltas of the larger rivers. Furthermore, the western coastal regions were little studied. The faunistic descriptions reported by Natvig (1948) were not quantitative, and in his analyses of species associations he did not use the biotope or habitat concept.

Recent studies from Finland, Sweden and the USSR have revealed that species of mosquitoes which were once thought to be Nearctic species only, occurred also in the Palearctic region, and that other species which were thought to be confined to Siberia were common in Finland (Utrio 1975, 1976, 1977, 1978, 1979 and Dahl 1973, 1974, 1977).

Our main study areas were chosen so as to include several different ecosystems. Collections from these localities were supplemented with sporadic collections from other areas. This investigation concerns mainly *Aedes* species but also includes other genera when they occurred simultaneously.

This article presents descriptions of the mosquitoe fauna from the main study areas where we attempted to isolate mosquito-borne viruses.

MATERIALS AND METHODS

Five principal study areas were chosen for collecting mosquitoes for virus isolations: Masi, Kvanne, Trandum, Øyeren and Ås (locality numbers 4, 14a, 30, 33 and 35 respectively). These sites were chosen according to the following criteria: 1. typical biotope for mosquitoes in Norway, 2. characteristic biotopes for species which are known virus-vectors in other countries, 3. supported large populations of mosquitoes.

Supplementary collections of mosquitoes for virus isolations were obtained from Fokstua, Seteråsen (Trysil), Fredrikstad and Sjusjøen (locality numbers 16, 21, 34 and 47 respectively).

A total of 12500 imagines and 2300 larvae were collected.

In Masi, Trandum and Ås we took blood samples from birds and small mammals for subsequent investigations of viral antibodies. Mam-

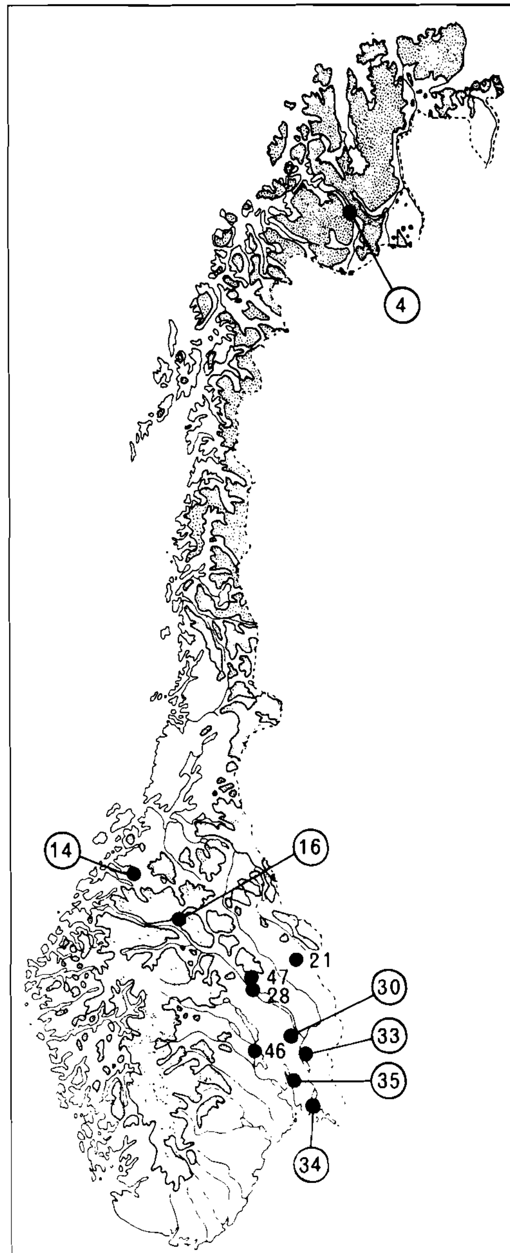

Fig. 1. Locations for mosquito collections. Encircled numbers indicate localities where mosquito communities are described. Virus isolates of the CE-group originated from localities nos. 4, 30, 33, 21 and 47, and antibodies in rodents and birds were detected at loc. no. 35.

The arctic and alpine regions are stippled. Collection sites: No. 4, Masi. 14, Kvanne. 16, Fokstua. 21, Seteråsen (Trysil). 28, Jørstadmoen. 30, Trandum 33, Øyeren. 34, Fredrikstad. 35, Ås. 46, Helgelandsmoen. 47, Sjusjøen.

mals and birds were captured alive in traps or nets.

Larvae and adults were collected several times during the snow-free season of the year in order to study seasonal variations in the composition of the mosquito fauna.

The adult mosquitoes were collected in fine meshed insect nets because experience had shown that fine meshed nets damaged the insects less than coarser nets. Both CO_2 and the investigators were used as attractants. The mosquitoes were anesthetized by placing them in CO_2 gas in the upper end of a seven liter thermos containing dry ice covered with foam rubber. The anesthetized mosquitoes were transferred to a white plastic pan and collected in an aspirator where the samples were directly sucked into a replaceable test tube (Mehl 1983). This simple device proved to be quick and efficient. The tubes were stored on dry ice after closing with a rubber stopper and sealing it with masking tape.

We collected the mosquitoes within 10—20 m of the thermos bottle containing dry ice thus enabling us to catch males which were swarming in the vicinity. On two occasions we drove newly hatched mosquitoes out of the shoreline vegetation and caught large numbers by net (Kvanne, June 23, 1975, and Øyeren, June 18, 1975).

The mosquito larvae were collected with a ladle from several sites. Care was taken to obtain samples containing individual as well as aggregations of larvae. The water samples were poured through a funnel which contained a filter. The funnel (Paterson^R), used in photographic laboratories, has a detachable filter holder which supported a roung piece of nylon netting having a 4.5 cm diameter. The netting had 0.5 mm apertures. The samples were transferred directly into 70% alcohol or into transport jars with water.

Small larvae were raised through the fourth larval stage, whereas *Culex*-larvae were raised to adults for identification purposes. Pupae were also allowed to hatch into adults.

STUDY AREAS — LOCATIONS AND DESCRIPTIONS

Investigated locations reported in this publication are shown on the map, Fig. 1. Short descriptions and date of collections are given for the seven localities from where the mosquito faunas have been described. Viruses were isolated from mosquitoes collected at Seteråsen, Trysil on August 8, 1976 and Sjusjøen, Lillehammer on August 11, 1976, (loc. no. 21 and 47), but the mosquito faunas from these localities are not described.

Masi (loc. no. 4) is a small settlement in a birch wooded valley 300 m a.s.l. located within an otherwise naked mountain plateau. Animal husbandry is the main occupation, and the main stocks are reindeer and cattle.

Collection dates: 20—24 Aug. 1975 and 30 June 1978.

Our collecting site at Søysetøra, Kvanne (loc. no. 14a) is a flat sandy area (50—200 m x 400 m) at the mouth of the Søya river. It contains a small pond with brackish water which receives renewed sea water from occasional high tides during the winter and spring seasons. The deepest part of the pond is permanent and without vegetation, whereas the shallow parts support salt rushes, *Juncus gerardii*, which together with salt grass, *Puccinellia maritima*, cover a large area. The beach is popular for swimming and recreation.

Collection dates: 23 June and 4 July 1975, 17 July 1976.

The Fokstua site (loc. no. 16) is situated 980 m a.s.l. in a transition zone between bog and the alpine birch belt. The bog Fokstumyra is a National Park and is well known for its avian fauna. The neighbouring vicinity has many vacation cottages and the highway bordering the park has many picnic areas.

Collecting dates: 22 June, 4 July and 17 July 1975. 5 June 1978.

The Trandum site (loc. no. 30) borders a pond and a grassy bog located in a mixed spruce wood 150 m a.s.l. The general area is characterized by many small narrow valleys with steep slopes. Meny farmers in this district raise cattle.

Collection dates: 17 June 1975, 2 June, 11 June, 3 Aug., and 18 Aug. 1976, 14 June 1978.

Øyeren (loc. no. 33) is a large lake (66 km^2, 100 m a.s.l.) surrounded by farms and forests and is located in Scandinavia's largest delta region. The collections site, Bjanes, Fet, was at the delta of the Glomma river entering the lake at the north-eastern end. The vegetation in the collection site included meadows and marshland with bushes (willows) and some large trees (alder and aspen). The delta region has a rich avian fauna and is an important resting area for migrating birds (ducks, waders, etc.). The Øyeren lake region has been established as a National Park. The surrounding farms raise cattle and there is a fairly dense human population in the vicinity of our collecting site.

Collecting dates: 14 and 18 June, 28 Aug. and 1 Sep. 1975, 1 May 1976, 13 June 1978.

Fredrikstad (loc. no. 34). Spruce forest on a hillside 10 m a.s.l. near the moth of the river Glomma.

Collecting date: 11 July 1975.

The main study areas at Ås in Akershus (loc. no. 35) are two peat bogs 100 m a.s.l. The one, Åsmåsan, is partly overgrown by spruce and birch wood. There are small areas where the woods are dense and dark. The other, Tierudmåsan, is an almost treeless bog 500 m in diameter. Material was also collected in the drier forest on the hillside surrounding Åsmåsan and bordering cultivated land. Åsmåsan borders a housing project. Cattle raising is scarce in the area.

Collecting dates: 17 Feb. 1974, 21, 24 and 19 May, 12 June 1978, 13 May 1979, 16 June 1976, 19 and 31 May 1980, and many other dates during April, May and June 1978, 1979 and 1980.

RESULTS

Twentyeight species of mosquitoes were identified in our material. The faunistic composition from the main collection sites revealed significant differences all according to the biotopes in question. Notable changes occurred from the sub-arctic (Masi) and sub-alpine (Fokstua) populations, through the coniferous forests (Trandum and Ås) down to the coast with sandy beaches and brackish ponds (Kvanne) (Tab. 1 and 2). The fresh water delta region at the Øyeren site had its own, characteristic mosquito fauna. In general, the results do not represent a complete picture of the mosquito fauna since the methods were inadequate for such a purpose.

Seasonal changes in the faunal composition are shown in Tab. 2 and will be presented in more detail under the descriptions of the mosquito fauna of the various biotopes.

Collections of adult mosquitoes were supplemented with information on the occurrence of larvae from the same sites. These results give a more differentiated impression of the distribution of breeding habitats within the biotope for species collected in a restricted part of the biotope (Tab. 3).

Sub-alpine and sub-arctic biotopes

In the sub-alpine region at Fokstua in the Dovre mountains adults and larvae were collected from identical sites. Adults were collected three times with biweekly intervals in 1975 (Tab. 2). The faunal composition of adults changed rapidly from almost exclusively *Aedes impiger* on June 22nd to almost only *Aedes communis* and *Aedes hexodontus/punctor* on July 4th. On July 17th we collected mostly *Aedes excrucians* s. l., but the small sample size does not allow further interpretation.

Larvae were collected at Fokstua on June 5th 1978 from small ponds in the birch woods and pools surrounded by dwarf birch and willows at the edge of the bogs. *A. communis* was the dominating species (79 %), and the other species were *A. punctor* (11 %), *A. hexodontus* (8 %) and *A. excrucians* (2 %).

The mosquitoes from Masi were collected during the second half of August, which in this region is the end of the summer. The weather during the summer was generally cold and residents reported that they were bothered by mosquitoes during a few days in August only. During our collection period, most of the insects were collected on a single day when it was «warm» and sunny. *A. hexodontus* was the dominant species in the birch woods in the bottom of the Masi valley. Collections of larvae from

Table 1. The species composition (in percent) of adult mosquitoes collected from four biotopes.

Mosquito species	Sub-arctic birch belt Masi 20 Aug. 1975 N = 520	Forest with bogs Ås 16 June 1976 N = 1942	Forest without bogs Fredrikstad 11 July 1975 N = 113	Salt marsh Kvanne 23 June 1975 N = 2787
A. hexodontus	85	—	—	—
A. punctor	2	13	—	—
A. cataphylla	8	—	—	0,15
A. communis	5	86	3	0,5
A. diantaes	—	0,05	—	—
A. leucomelas	—	—	1	—
A. cantans	—	0,4	95	—
A. cinereus			—	—
		0,7		
A. excrucians	0,2	—	—	—
A. dorsalis	—	—	—	99
C. bergrothi	—	0,1	—	—

Table 2. Seasonal fluctuations in the species composition (in percent) of adult mosquitoes collected in 1975 and 1976 from three biotopes.

	Fokstua. Sub-alpine reg.			Trandum. Mixed forest			Øyeren. Delta area	
	22 June 1975	4 July 1975	17 July 1975	2 June 1976	11 June 1976	3 and 18 Aug. 1976	18 June 1975	28 Aug. and 1. Sept. 1975
	N = 108	N = 139	N = 27	N = 592	N = 1817	N = 41	N = 1873	N = 545
A. impiger	98	2	—	—	—	—	—	—
A. punct./hexodontus	1	27	4	0,2	2	—	—	—
A. communis	1	71	22	90	70	5	—	—
A. diantaeus	—	—	—	0,3	3	17	—	—
A. intrudens	—	—	—	0,3	0,05	—	—	—
A. cantans	—	—	—	—	—	5	—	—
A. cinereus	—	—	—	—	—	—	2	10
A. excrucians s.l.	—	—	74	—	0,4	2	7	4
A. sticticus	—	—	—	—	—	—	31	—
A. vexans	—	—	—	—	—	—	51	19
A. rossicus	—	—	—	—	—	—	9	61
A. claviger	—	—	—	9	25	71	—	—
A. maculipennis s.l.	—	—	—	—	—	—	—	5

ponds amidst the birch and willow bushes on June 30, 1977 yielded *A. communis* only, (Tab. 1).

Forested areas in Southern Norway

The study areas in the mixed spruce forests in Southern Norway were situated from 10 to 150 m a.s.l. The dominant species at Ås and Trandum was *A. communis* (Tab. 1 and 2). In addition, relatively larger numbers of *Aedes diantaeus* and *Anopheles claviger* occurred at Trandum and *A. punctor* at Ås.

The results of three collections of adult mosquitoes at Trandum are shown in Tab. 2. In June, *A. communis* was the dominant species, but a number of *A. claviger* was also present. In August there were few mosquitoes but *A. claviger* dominated followed by a relatively high proportion of *A. diantaeus*. In 1975 we made one collection on June 17, containing 1045 adults. The results were similar to those from second collection in June 1976, with *A. communis* (83 %) dominating, but there were more *A. diantaeus* (9 %) and *A. excrucians* (1 %), while there was fewer *A. claviger* (7 %) and no *A. punctor*. Single specimens of *A. cantans* and *A. intrudens* were captured.

Table 3. The composition (in percent) of the collected communities of mosquito larva in: A forested with spruce and some birch, — a large open bog, — and at the edge of a forest bordering cultivated land at Ås in 1978.

	Forested bog 24 May N=931	Forested bog 12 June N=93	Open bog 29 May N=430	Forest edge without bog 21 May
A. punctor	21	28	95	-
A. punctodes	0,8	17	1,5	-
A. pionips	0,2	40	1,5	-
A. communis	78	-	2,5	24
A. intrudens	0,4	-	-	-
A. cantans	-	5	-	76
A. cinereus	-	1	-	-
C. bergrothi	-	5	-	-
C. pipiens/ torrentium	-	3	-	-

Larvae were collected from two sites at Ås. The first at Åsmåsan in dense, cold and dark spruce wood with small open areas with peatbogs with birches. (Adults were also collected from this site). The other collection site was Tierudmåsan which is a large, open peatbog surrounded by pine and spruce woods.

A. communis larvae dominated the samples form the woods at Åsmåsan during the first collection period, but *A. punctor* was also common in some pools, especially in those which were exposed to direct sunlight (Tab. 3). All of the *A. communis* had hatched by the time the samples were taken. In the largest and deepest pools remained a number of *Aedes pionips* larvae. These larvae inhabited the deeper parts of the pools whereas the *A. communis* larvae showed a preference for the strata just under and on the surface, where they appeared as a living carpet.

At Åsmåsan, in the small pools located in the open areas of the bogs containing birch saplings, the number of *A. communis* and *A. punctor* larvae were similar. On May 31, 1980 after the majority of these larvae had hatched, large numbers of *Culex pipiens/torrentium* and *Aedes cinereus* occurred.

On the large, almost treeless bog Tierudmåsan, *A. punctor* was dominant, whereas *A. communis, A. pionips* and *Aedes punctodes* occurred in small numbers only (Tab. 3).

An example of a more southern type of forest mosquito community was observed near Fredrikstad where *A. cantans* was the dominant species (Tab. 1) among adults which were captured in a spruce forest having no bogs. Adults of this species were also common in some habitats at Ås where most of the larvae occurred in pools along the border of a forest, which had no bogs, and a cultivated field (Tab. 3). On the other hand, the pools on the sphagnum bogs at Åsmåsan contained very few *A. cantans* larvae.

Delta region of lake Øyeren

The large population of mosquitoes at the Øyeren collection site represented a great nuisance to the local residents. From a subjective point of view, this particular mosquito population was just as offensive as the notorious mosquitoes of northern Norway. At Øyeren we found a mosquito fauna which had a species composition which was previously unknown in Norway, consisting of *A. sticticus, A. vexans, A. rossicus, A. excrucians* and *A. cinereus* (Tab. 2). The same species, with the exception of *A. rossicus* were also found near Jørstadmoen (river delta) where the mosquito nuisance has been great for many years (pers. obs.) In the military camp Helgelandsmoen in the delta region of the north of the Tyrifjorden lake, the mosquitoes were so numerous and aggressive in 1977 that normal field exercises could not be carried out. An analysis of the composition of the fauna at Helgelandsmoen on July 26, 1977 revealed the following species: *A. sticticus, A. cinereus, A. cantans, A. excrucians* and *A. vexans*.

During the collection at Øyeren on June 18, 1975, there were many newly hatched mosquitoes. These mosquitoes which were driven from the shoreline vegetation formed dense swarms containing many males. The dominant species were *A. vexans* and *A. sticticus*.

During collections in August/September, *A. rossicus* dominated and the capture of a single male may suggest that hatching occurred in the not too distant past. *A. sticticus* were not recorded.

Salt marshes

A large population of *A. dorsalis* occured along the beach at Søysetøra, Kvanne (loc. 14a, (Tab. 1)). Dense populations of larvae inhabited the shallow pools of brack water. Mosquitoes were in the process of hatching during collection on June 23, 1975.

Phenology

At Ås small larvae of *A. communis* were usually found in melt water pools at the end of March, or beginning of April. The earliest collections were made on Feb. 17, 1974 (During a period of thaw). Larval growth did not commence until the sun warmed the water along the edges of the pool. The increase in water temperature and the growth of larvae progressed slowly until the beginning of May, when rapid growth commenced. The first *A. communis* and *A. punctor* hatched aorund the 15th—20th of May. In dense spruce forests with *Sphagnum* bogs, *A. communis* hatched 2—3 weeks later.

Hatching of *A. punctor* and *A. communis* occurred simultaneously in warm pools along the edge of the woods. However, both species hatched somewhat later deeper in the woods, but *A. communis* hatched earlier then *A. punctor*.

The water temperature in a sun exposed pool at the edge of a bog near Ås was 16—20°C on May 19, 1980. On this date most of the *A. communis* and *A. punctor* were pupae. The temperature in pools in dense woods, however, was 9—10°C and here the majority of *A. communis* were 3rd stage larvae and *A. punctor* 2nd stage larvae.

A. communis and *A. punctor* did not constitute a nuisance to people during the first two weeks of hatching. In the lowlands of southern Norway the nuisance due to *Aedes* species shows a general increase during the first half of June and remains at a more or less constant level until approximately the beginning of August.

In Northern Norway and in the mountains of Southern Norway the nuisance caused by *A. communis, A. punctor* and *A. hexadontus* occurs approximately one month later than in the lowlands of Southern Norway. However, the period when mosquitoes become a plague in alpine and arctic regions can show significant variations depending on warm or cold spells.

Culiseta species, which overwinter as adults,

Table 4. A composite list of the mosquitos in Norway with information on their choice of hosts. H = human, D = domestic animal, M = wild mammal, B = bird, R = reptile, A = amphibia. Symboles in paranthese indicate occasional hosts. Information from Natvig (1948), Carpenter & LaCasse (1955), Hopla (1966), Gutsevich et al. (1974), Service (1971), Zoltowski et al. (1978) and Utrio (1978, 1979).

Mosquito species	Norway This study	Norway Natvig 1948	Finland Sweden Denmark	Germany Britain Poland	USSR Siberia	USA Canada
Anopheles claviger (Meigen, 1804)	H	-	-	HDM	H	-
Anopheles maculipennis Meigen, 1818 s.l.	-	-	HD	-	HDB	-
Anopheles messeae Falleroni, 1932	-	-	H	HD	-	-
Anopheles maculipennis Meigen, 1818 s.str.	-	-	-	-	-	-
Culex pipiens L., 1758	(H)	(H)	B(HD)	B(HM)	(H)B	(H)
Culex territans Walker, 1856	-	-	-	RA	RA	A
Culex torrentium Martini, 1925	-	-	-	BM	-	-
Culiseta alaskaensis (Ludlow, 1906)	-	-	-	-	(H)M	HDMB
Culiseta annulata (Schrank, 1776)	-	HD	HD	HDMB	HMB	-
Culiseta bergrothi (Edwards, 1921)	H	D	H	-	DM	-
Culiseta subochrea (Edwards, 1921)	-	-	-	-	(H)	-
Culiseta fumipennis (Stephens, 1825)	-	-	-	-	-	-
Culiseta morsitans (Theobald, 1901)	-	-	-	HDMBR	HDBM	-
Aedes cantans (Meigen, 1818)	H	-	HD	HDMB	HM	-
Aedes caspius (Pallas, 1771)	-	-	HD	HD	HM	-
Aedes cataphylla Dyar, 1916	-	-	H	-	-	H
Aedes cinereus Meigen, 1818	H	H	HD	HDMB	H	H
Aedes communis (De Geer, 1776)	H	HB	H	HDB	HM	H
Aedes detritus (Haliday, 1833)	H	-	D	HDB	H	-
Aedes diantaeus Howard, Dyar & Knab, 1912	-	-	H	H	H	-
Aedes dorsalis (Meigen, 1830)	H	-	-	HDM	H	HD
Aedes excrucians (Walker, 1848) s.l.	H	HB	H	HDB	H	H
Aedes geniculatus (Olivier, 1791)	-	-	H	HD	H	-
Aedes hexodontus Dyar, 1916	H	-	-	-	H	H
Aedes impiger (Walker, 1848)	H	-	-	-	HM	H
Aedes intrudens Dyar, 1919	-	HDB	H	-	H	H
Aedes leucomelas (Meigen, 1804)	-	-	H	-	H	-
Aedes nigrinus (Eckstein, 1918)	-	-	-	-	-	-
Aedes nigripes (Zetterstedt, 1837)	-	-	-	-	H	H
Aedes pionips Dyar, 1919	-	-	H	-	-	-
Aedes pullatus (Coquillett, 1904)	-	-	-	-	H	H
Aedes punctodes Dyar, 1922	-	-	-	-	-	H
Aedes punctor (Kirby, 1837)	H	HB	HD	HDB	HD	H
Aedes riparius Dyar & Knap, 1907	-	-	H	H	H	H
Aedes rossicus Dolbeskin, Gorickaja & Mitrofanova, 1930	-	-	-	H	H	-
Aedes sticticus (Meigen, 1838)	H	-	H	H	H	H
Aedes vexans Meigen, 1818	H	-	HD	HD	HDM	H

are already active in early spring. *C. bergrothi* remained active at Ås from mid April to mid June.

Mosquitoes which bite man

During the study period we visited several localities, where mosquitoes represented a larger than normal nuisance for people and farm animals. We received complaints from certain areas that the mosquito populations were large and that mosquito control measures were needed. The localities included: Flisa, Hurdal, Ringebu, Jørstadmoen, Helgelandsmoen and Ostøya in Bærum. Complaints came from residential areas, army military camps, scout camps and a golf course. Anti-mosquito (adult and larvae) measures were carried out at some of these places but in general, mosquito control programs in Norway have been rather limited. However, in recent years there has been a general tendency for increased demands for mosquito control.

The mosquito species which we observed feeding on man are listed in Tab. 4. A general observation was that the dominant species in all localities (according to our collecting techniques) bit people. Published information on host preference of mosquitoes found in Norway are presented in Tab. 4.

We were never bitten by *Culex* species and the numbers of adult *Culex* collected by our methods were small. Larvae on the other hand, were common. The form *molestus* of *Culex pipiens* which bite man, occur in Oslo in some underground stations in the City and some places in the sewer system. *Anopheles maculipennis* s.l. were common at Øyeren, but they never bit us. *Anopheles claviger*, however, bit us often during field work. *Culiseta morsitans* landed on (flew close to) us but never bit. *Culiseta bergrothi* bit us on occasion but this species is easily chased away.

DISCUSSION

Four species in the present collection have not been previously reported in this contry: *A. hexodontus*, *A. pionips*, *A. punctodes* and *A. rossicus*. The occurrence of these species in Norway is described in more detail by Mehl (1983a). A characteristic fauna occurred at each of seven localities where we collected mosquitoes for virus isolation: Masi, Fokstua, Trandum, Ås, Fredrikstad, Øyeren and Kvanne. Information from Natvig (1948) and Mehl (1983a) reveal that these localities represent the most important biotope types for *Aedes* species in Norway and that the species composition is typical for such biotopes. However, these descriptions are incomplete and hence do not present a correct picture of the occurrences of *Culex* and *Culiseta* species.

The qualitative and quantitative composition of the mosquito fauna changed during the summer in those localities where several collections were taken. Consequently, a proper description of the mosquito fauna in a particular biotope can only be accomplished by sampling throughout the summer. Only one collection was made at Masi and as a result the early summer species *A. impiger* was not collected. The fauna for Masi must therefore be considered as incomplete. At Ås, *A. pionips* hatched later than the other species and hence was not present in the samples of adults. However, *A. pionips* larvae were collected during periods when *A. communis* was present as adults.

Collections of larval and adult mosquitoes at the same localities revealed that the adult fauna at any one locality could be a mixture of mosquitoes which hatched from that particular locality and individuals from neighboring areas. For example, *A. impiger* collected at the Fokstua site, and probably most *A. excrucians*, hatched in the bogs which were located several hundred meters away where Natvig (1948) found larvae of *A. impiger*. In Masi, the *A. hexodontus* flew down into the birch woods from the neighboring treeless plateau, a dispersion pattern which has been described from Canada (Klassen & Hocking 1964). In the woods at Ås and the salt marsh at Kvanne there were generally good correlations between the population of larvae and adults at the same site. Larvae were not collected from Trandum, Øyeren and Fredrikstad.

The great nuisance caused by mosquitoes in the arctic and sub-arctic regions in Fennoscandia are renown from descriptions in the literature (Natvig, 1948). Nevertheless, because of a cool summer we did not encounter large swarms of mosquitoes on the Finnmarksvidda plateau. *A. hexodontus* was the dominant species at Masi, but species which were not encountered in our samples were *A. nigripes*, *A. impiger* and *A. pullatus*, and these probably are important elements in the mosquito fauna on Finnmarksvidda plateau and adjacent areas (Natvig, 1948, Utrio, 1979).

Typical tundra species in North America are *A. hexodontus*, *A. impiger* and *A. nigripes*. The adults display a great potential for spreading over the great open areas and are notorious biters (Jenkins, 1958). *A. hexodontus* and *A. impiger* also occur in alpine regions of North America whereas *A. nigripes* is limited to arctic areas. There is a similar pattern in Scandinavia. *A. hexodontus* dominated in the alpine and sub-alpine biotopes on the Hardangervidda plateau in Southern Norway (Nielsen 1981, Mehl 1983a), whereas at Fokstua in the Dovre mountain there were greater numbers of *A. communis, A. punctor, A. impiger* and *A. excrucians*.

Control of the tundra mosquitoes is very difficult because the species disperse and migrate widely. Even though control measures may prove possible within a limited area, new invasions of mosquitoes from the neighboring areas can occur within a few days (Jenkins 1958).

Forest mosquitoes pose the greatest nuisance to the general public and domestic animals. The majority of mosquitoes that invade residental areas are forest species. The species which was the most dominant and the greatest nuisance in the forested areas around Trandum and Ås was *A. communis*. This also seems to be the case in the forests of most of Fennoscandia with the exception of the most southern and western regions (Natvig 1948, Dahl 1975, Mehl 1983a).

A. cantans dominated the Fredrikstad area. This observation exemplifies that in certain biotopes along the southern coast this species may be abundant or even the dominant species (Mehl 1983a). The mosquito fauna from these areas resemble those found in the forests of Southern Sweden and Denmark (Ardø 1951, Arevad, Iversen & Lodal 1973, Dahl 1975).

The second-most common species at Ås was *A. punctor*. Among the Norwegian mosquitoes, this species has the widest distribution occurring both at higher altitudes and closer to the coastline than *A. communis*, but on the other hand it is less abundant (Mehl 1983a).

At Trandum *A. diantaeus* accounted for a larger proportion of the population than one would anticipate from Natvig's (1948) studies. The geographic distribution of the species was also found to be more extensive (Mehl 1983a). Trandum was also notable in that it supported a small number of *A. punctor* and a large population of *A. claviger*. This is the only published locality for *A. claviger* in Norway.

The forest mosquitoes remain in biotopes supporting trees and bushes. It is generally considered that they do not fly more than a few hundred meters from their hatching site.

In the delta region at the northern end of lake Øyeren we discovered a mosquito fauna which is typical for Central Europe and was previously unknown in northern Europe. It was dominated by *A. vexans, A. sticticus* and *A. rossicus*. Previously only single specimens of *A. vexans* and *A. sticticus* were known from Norway (Natvig 1948). *A. rossicus* was formerly unknown in northern Europe (Dahl & White 1978). Mosquito fauna containing these species are found in Central Europe in flooded regions along large rivers (Mohrig 1969, Peus 1972, Skierska & Szadziewska 1978). It was indeed a surprise to find such large populations of these species. *A. sticticus* and *A. vexans* were collected at several localities (Mehl 1983a) and probably have a wide distribution along the largest waterways.

Natvig (1948) found the largest populations of *A. excrucians* s.l. along large rivers and shallow lakes, observations which our findings corroborate since this species was the fourth most common at Øyeren.

A typical feature of the meadow species, *A. vexans* and *A. sticticus*, are their great ability to spread over open terrain. Large numbers can spread far from their hatching sites and cause considerable human discomfort. In Norway many complaints to the National Institute of Public Health (SIFF) concerning large populations of aggressive mosquitoes originate from places where these two species occur. Typically, the population sizes of these species show great variations from year to year depending upon flooding conditions. The eggs, especially of *A. vexans*, are known to remain viable for several years and hatch during eventual flood conditions.

Along the shore at Kvanne, the brackish water species, *A. dorsalis*, dominated. This species is an aggressive biter. *A. caspius* and *A. detritus* are also brackish water species which occur along the southern coast of Norway. These do not occur in such enormous numbers here as they do in coastal areas in Denmark, Germany and England. These brackish water species have shown a great ability to spread, often causing great distress for the inhabitants in regions surrounding their hatching sites (Natvig 1948, Larsen 1948, Ardø 1951, Arevad 1969, Mohrig 1969, Dahl 1977).

Knowledge concerning host specificity of mosquitoes is essential for understanding how arboviruses and vector-born microorganisms circulate among animals and humans. Natvig (1948), Ardø (1958) and Arevad (1981) published information on mosquitoes and their hosts in Scandinavia. The majority of *Aedes*-species from Tromsø contained bird blood.

Our observations concerning mosquitoes which bite humans are similar to other findings from the Holarctic. However, it appears that *Aedes*-species attack birds, mammals and humans, displaying no obvious preference. The prevelance of different host blood in mosquitoes (Service 1971, Zóltowski et al. 1978) provides information as to which host species are common and readily accessible as a source of blood, and should not be interpretted as an expression of host preference. Observations have shown that mosquitoes feed on small rodents, but their significance as hosts has not been assesed by analysing mosquitoes containing blood.

Only a small percent of small rodents tested for antibodies to California encephalitis virus in Finland were positive, indicating that small rodents are of little importance as reservoirs compared to large mammals (Brummer-Korvenkontio, 1973). Naturally, this is also a result of large mammals providing greater accessibility for more mosquitoes over a longer lifetime. However, mosquito-borne tularemia epidemics indicate that small rodents can be important hosts for at least some mosquito species, for example, *A. cinereus* from which *Francisella tularensis* has been isolated in Sweden (Olin 1942, Hopla 1974).

Multiple blood meals increase the potential ability to transmit diseases in mosquitoes. Northern mosquitoes do to some degree feed and ovoposit more than once (Carpenter & Nielsen 1965). Some studies have shown that interrupted blood meals from several hosts are common for *Aedes*-species which also occur in Norway. Other investigations have not observed this as a common phenomenon (Service 1971, Klowden & Lea 1978, Zoltowski & Kazmierczuk 1978). Such discrepancies can be attributed to techniques, which do not permit discrimination between blood meals of several individual from the same host species.

We have isolated viruses belonging to the *California encephalitis* group from the following localities and *Aedes*-species (the number of isolates in parentheses): Masi from *A. hexodontus* (1); Trandum from *A. communis* (3) and *A. diantaeus* (1); Øyeren from *A. sticticus* (1); Sjusjøen from *A. punctor* (1) and Seteråsen (Trysil) from *Aedes* sp. (1) (Traavik, Mehl & Wiger 1978). The isolation attempts using mosquitoes from Ås are not finished, but antibodies against CE-virus in squirrels (*Sciurus vulgaris* L., 1758), bank voles (*Clethrionomys glareolus,* Schreber 1780) and bird (Traavik, Mehl & Wiger 1983) indicate that these viruses exist in mosquitoes from Ås.

Two virus isolates belonging to the Bunyamwera-group have been isolated from *Anopheles claviger* from Trandum.

Viruses were isolated from the most dominant mosquito species at the respective localities. The preliminary conclusion at this stage of the program is that the chances for being infected by CE-viruses is greatest where the populations of *Aedes*-species are dense, irregardless of species. This implies that different mosquito species have similar ability to transfer viruses while imbibing their blood meals.

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Some Diptera (Tachinidae, Calliphoridae, Fanniidae, Muscidae) from the mountains of the Finse area, Southern Norway

KNUT ROGNES

Rognes, K. 1983. Some Diptera (Tachinidae, Calliphoridae, Fanniidae, Muscidae) from the mountains of the Finse area, Southern Norway. *Fauna norv. Ser. B. 30*, 25—33.

Records of 44 species of Tachinidae (1), Calliphoridae (5), Fanniidae (2) and Muscidae (36) captured in the high mountain area of Finse, Southern Norway, during the summer 1981 are given. *Chaetovoria antennata* Villeneuve, 1922 (Tachinidae), *Spilogona brunneifrons* (Ringdahl, 1931), *S. malaisei* (Ringdahl, 1920) and *S. nitidicauda* (Schnabl, 1915) (Muscidae) are reported as new to Norway. For several arctic and subarctic species the records from Finse represent important southern extensions of their known range in Fennoscandia.

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Below are given records of tachinid, calliphorid, fanniid and muscid flies (683 specimens) captured at Finse (Hordaland, HOI, Ulvik) during a six day stay during the summer 1981. No records of these families have previously been presented from the area. As information on the calypterate fauna of the montains of southern Norway is very scarce, the results are also of general interest.

The Finse area, i.e. the area in the vicinity of the Finse railway station (60° 36'N 7° 31'E), lies well above the tree limit in the north-western part of the Hardangervidda mountain plateau in South Norway. A short general description of the area including a list of the known terrestrial invertebrate fauna is given by Østbye & Hågvar (1972), and a survey of the geology (brief) and vegetation by Fægri (1967; updated by Elven, Løkken & Aarhus 1980). The Finse area belongs to Region 35, subregion c, of Norden, general information of which is given in Nordiske Utredninger (1977).

The climate is humid and strong winds from W and E prevail in the area. Standard normals for temperature (1931—1960, in °C) at the meteorological station at Finse (1224 m) are for the whole year — 1.4, for January —9.3, February —9.3, March —7.4, April —4.0, May 0.9, June 4.7, July 8.0, August 7.5, September 3.8, October —0.7, November —6.9, and December —6.9. Standard normals for precipitation (1931—1960, in mm) at the meteorological station at Slirå (1300 m, 5 km W of Finse railway station) are for the whole year 1006, for January 79, February 62, March 41, April 51, May 43, June 77, July 110, August 120, September 136, October 116, November 81 and December 90. The standard normal (1931—1960) of annual number of days with snow cover is 261 (at Slirå), and the normal length (1931—1960) of the vegetation period (t ≥, 6°C) 61 days (at Slirå), which is very low. (Data from Værvarslinga på Vestlandet, Bergen, in litt. 7 Aug. 1981).

The localities worked were: (1) Nordnut, southern slopes, 1220—1350 m, lower alpine zone (cf. Fægri 1967: 6, 24—25); (2) Jomfrunut, southern slopes, 1220—1469 m, middle alpine zone; (3) Kvannjolnut, south-western slopes, 1217—1469 m, lower alpine zone, mainly *Salix* scrub, into middle alpine zone; (4) Finsefetene, western part, 1200 m, lower alpine zone, mainly *Salix* scrub; (5) Area in the immediate vicinity of High Mountain Ecology Research Station near Torbjørnstølen, 1220 m, including the river banks. In addition captures were made at the eastern slopes of Lille Finsenut, 1250 m, (G.A. Evje leg.), and between Finse railway station and the Research Station. (All locality names will be found on the map «Norway-Norge 1:50 000 Hardangerjøkulen Sheet 1416 II AMS Series M 711»). All recorded captures are from EIS square 42.

Most captures were made singly with a hand net, but a Malaise-trap was operated for the whole period near the Research Station, most of the time in a marsh («myr») bordering a stream.

A baited blow-fly trap was operated on the sunny side of the main building one day for a few hours.

Specimens (male and female) were as a rule mounted with the terminalia extended. For the works used in the identification of species and other matters pertaining to the presentation of the data see Rognes (1982a, 1982b). Some identifications have been confirmed by A.C. Pont, British Museum (Natural History), London (marked A.C.P. below). Specimens are in my collection except for a few wich are in British Museum (Natural History) or in the Canadian National Collection, Ottawa (BMNH, CNC, respectively, below). Species marked with an asterisk are new to Norway.

Family Tachinidae

* *Chaetovoria antennata* Villeneuve, 1922.
Taxonomy: Mesnil 1974: 1272.
Material: 1 ♂. — Jomfrunut 1 ♂ 19 July. Taken on the ground between flowers below steep south-facing black schist cliffs at about 1350 m.
Distribution: Sweden (Torne Lappmark, Jämtland, Härjedalen), Finland (Lapponia inarensis), Alps (France, Austria, Italy) (Ringdahl 1952, Hedström & Nuorteva 1971, Mesnil *l.c.*). New to Norway.

Family Calliphoridae

Calliphora alpina (Zetterstedt, 1838).
Taxonomy and previous records: See Rognes 1982b.
Material: 6 ♂♂ 4 ♀♀. — Nordnut 1 ♂ 17 July; Research station 1 ♂ 18 July; 1 ♀ 22 July; 2 ♂♂ 3 ♀♀ 22 July (baited trap); Jomfrunut 2 ♂♂ 19 July.
Distribution: Fennoscandia, Scotland, North England, Alps (Emden 1954, Zumpt 1956, Hackman 1980, Dear 1981).

Calliphora uralensis Villeneuve, 1922.
Previous records: See Rognes 1982b.
Material: 1 ♂ 1 ♀. — Research station 1 ♀ 18 July; Kvannjolnut 1 ♂ 21 July.
Distribution: Mongolia, USSR (Ural, Murman Coast), Fennoscandia, W. Ireland, Scotland (incl. Shetland, Fair I., Hebrides, St. Kilda), Iceland, Central Europe (mainly in the mountains), Greenland (Emden 1954, Zumpt 1956, Hall 1965, Grunin 1969, 1971, Irwin 1976, Dear 1981).

Calliphora vicina Robineau-Desvoidy, 1830.
Previous records: *Musca erythrocephala* Meig. — Zetterstedt 1838: 656—657; Zetterstedt 1845: 1329—1330; Siebke 1877: 98; Strand 1900: 70; *Calliphora erythrocephala* Meig. — Bidenkap 1892: 238; Bidenkap 1901: 61; Soot-Ryen 1925: 141, 144; Strand 1903: 7; Ringdahl 1944a: 80; Ringdahl 1944c: 6; Ringdahl 1952: 148—149 No. 357; Nourteva & Vesikari 1966: 545.
Material: 5 ♂♂ 2 ♀♀. — Nordnut 1 ♂ 1 ♀ 17 July; Research station 1 ♂ 18 July; 1 ♀ 19 July (indoors); 2 ♂♂ 22 July; Kvannjolnut 1 ♂ 21 July.
Distribution: Cosmopolitan. Palaearctic and Nearctic Regions (incl. Svalbard and Japan), Afrotropical Region, Australia, New Zealand, Oriental Region, Neotropical Region (Collin 1925, Zumpt 1956, Hall 1965, Kano & Shinonaga 1968, James 1970, 1977, Pont 1981).

Cynomya mortuorum (L.).
Previous records: See Rognes 1982b.
Material: 2 ♂♂ 2 ♀♀. — Research station 1 ♀ 18 July; 1 ♂ 1 ♀ 22 July (baited trap); Jomfrunut 1 ♂ 19 July.
Distribution: Mongolia, Turkestan, Caucasus, Europe, Greenland, Alaska (Zumpt 1956, Hall 1965, Grunin 1969).

Protophormia terraenovae (Robineau-Desvoidy, 1830).
Previous records: See Rognes 1982b.
Material: 1 ♂. — Research station 1 ♂ 22 July.
Distribution: Japan, China, Mongolia, Siberia, northern Europe (incl. Svalbard), Greenland, North America (Collin 1925, Zumpt 1956, Hall 1965, Kano & Shinonaga 1968, Grunin 1969, 1971).

Family Fanniidae

Fannia mollissima (Haliday in Westwood, 1840).
Taxonomy: Hennig 1955: 95 *(Coelomyia)*; Chillcott 1961 *(Coelomyia)*; Pont 1964.
Previous records: *Aricia spathulata* Zett. — Zetterstedt 1845: 1543—1544; Siebke 1877: 112; *Homalomyia spathulata* Zett. — Bidenkap 1901: 72; *Coelomyia spathulata* Zett. — Ringdahl 1928: 27; Ringdahl 1944c: 17; Ringdahl 1952: 158—159 No. 558; Dahl 1968: 22—23.
Material: 4 ♂♂. — Between Finse railway station and Research station 1 ♂ 16 July; Nordnut 3 ♂♂ 17 July.
Distribution: Europe (incl. Faroes and Iceland), Alaska, Yukon Territory, Northwest Territories (extreme north-western part) (Hennig 1955, Chillcott 1961).

Fannia postica (Stein, 1895).
Taxonomy: Hennig 1955: 72; Chillcott 1961; Fonseca 1968.
Previous records: *Fannia postica* Stein — Ringdahl 1944b: 84; Ringdahl 1944c: 17; Ringdahl 1952: 158—159 No. 544.
Material: 9 ♂♂. — Nordnut 9 ♂♂ 17 July. All specimens have rather dark squamae and halteres and a broad frons.
Distribution: Northern Europe (incl. British Isles and Iceland), Germany, France, Alps, Spain, North America (Hennig 1955, Chillcott 1961, Pont 1969).

Family Muscidae

Thricops aculeipes (Zetterstedt, 1838).
Previous records: *Anthomyza aculeipes* Zetterstedt 1838: 674; *Aricia aculeipes* Zett. — Zetterstedt 1845: 1487—1488; Siebke 1877: 109; *Lasiops aculeipes* Zett. — Bidenkap 1901: 74; Ringdahl 1928: 17—18; Ringdahl 1944b: 83; Ringdahl 1944c: 15; Ringdahl 1952: 154—155 No. 468; Dahl 1968: 22—23; *Thricops aculeipes* Zett. — Pont 1971: 118; *Lasiops subrostrata* Zett. — Bidenkap 1901: 74 (misidentification, cf. Ringdahl 1928: 18 and below under *hirtula*).
Material; 32 ♂♂ 15 ♀♀. — Between Finse railway station and Research station 14 ♂♂ 2 ♀♀ 16 July; Nordnut 10 ♂♂ 9 ♀♀ 17 July; Jomfrunut 1 ♀ 19 July; Finsefetene 5 ♂♂ 1 ♀ 20 July; Kvannjolnut 2 ♂♂ 1 ♀ 21 July; Research station 1 ♀ 21 July (Malaise-trap); 1 ♂ 22 July.
Distribution: Central and north Europe (Pont 1971).

Thricops hirsutula (Zetterstedt, 1838).
Previous records: *Anthomyza hirsutula* Zetterstedt 1838: 673—674 (Norwegian specimens later transferred by Zetterstedt to *innocua*, cf. Zetterstedt 1845: 1494); *Aricia hirsutula* Zett. — Zetterstedt 1845: 1494—1495; Siebke 1877: 109; *Lasiops hirsutula* Zett. — Bidenkap 1898: 147; Bidenkap 1901: 74—75; *Trichophthicus hirsutulus* Zett. — Strand 1906: 103; *Trichopticus hirsutulus* Zett. — Strand 1913: 326; *Lasiops hirsutulus* Zett. — Ringdahl 1928: 16; Ringdahl 1944b: 83; Ringdahl 1944c: 14—15; Forsslund 1951: 201; Ringdahl 1952: 154—155 No. 472.
Material: 2 ♂♂ 3 ♀♀. — Jomfrunut 1 ♂ 19 July; Kvannjolnut 1 ♀ 21 July; Research station 1 ♀ 19 July (Malaise-trap); 1 ♂ 1 ♀ 21 July (Malaise-trap).
Distribution: Europe (incl. Denmark), east to Japan and Kamtchatka (Pont 1971, Shinonaga & Kano 1971, Michelsen 1977). Not recorded from North America by Huckett (1965).

Thricops hirtula (Zetterstedt, 1838).
Taxonomy: Ringdahl 1939: 141, 152; Hennig 1962: 639.
Previous records: *Aricia subrostrata* Zetterstedt 1845: 1496—1497; Siebke 1877: 109; *Trichophthicus subrostratus* Zett. — Strand 1906: 103; *Trichopticus subrostratus* Zett. — Strand 1913: 326; *Lasiops subrostrata* Zett. — Bidenkap 1901: 74 (specimens belong to *aculeipes* according to Ringdahl 1928: 18, see above); *Lasiops subrostratus* Zett. — Ringdahl 1928: 18; Ringdahl 1944c: 15; Ringdahl 1952: 154—155 No. 478.
Material: 58 ♂♂ 46 ♀♀. — Between Finse railway station and Research station 2 ♂♂ 3 ♀♀ 16 July; Nordnut 8 ♂♂ 8 ♀♀ 17 July; Research station 2 ♀♀ 17 July (Malaise-trap); 8 ♂♂ 8 ♀♀ 18 July; 4 ♂♂ 2 ♀♀ 19 July; 1 ♂ 2 ♀♀ 20 July; 9 ♂♂ 2 ♀♀ 21 July (Malaise-trap); Jomfrunut 8 ♂♂ 8 ♀♀ 19 July; Finsefetene 8 ♂♂ 3 ♀♀ 20 July; Kvannjolnut 9 ♂♂ 7 ♀♀ 21 July; Lille Finsenut 1 ♂ 1 ♀ 21 July (G.A. Evje leg.).
Distribution: Karskaja Tundra, Kanin peninsula, Kola peninsula, Fennoscandia, British Isles, northern North America (Hennig 1962, Huckett 1965). The only known record from Japan is not accepted by Shinonaga & Kano (1971: 106).

Thricops longipes (Zetterstedt, 1845).
Taxonomy: Ringdahl 1939: 149; Hennig 1962: 641.
Previous records: *Lasiops ater* Fall. — Ringdahl 1944b: 83; Ringdahl 1944c: 15; Ringdahl 1952: 154—155 No. 469; Dahl 1968: 22—23; *Aricia longipes* Zetterstedt 1845: 1403—1404; Siebke 1877: 102; Bidenkap 1892: 240; Bidenkap 1901: 66; Strand 1906: 103; *Lasiops longipes* Zett. — Ringdahl 1928: 16; *Aricia anthomyzoides* Storm 1895: 239, cf. Ringdahl 1944b: 82; *Anthomyza variabilis* Zetterstedt 1838: 663 (all Norwegian specimens belong to *longipes* according to Zetterstedt 1845: 1403—1404).
Material: 6 ♂♂. — Nordnut 4 ♂♂ 17 July; Kvannjolnut 2 ♂♂ 21 July.
Distribution: Asia, Europe (Hennig 1962).

Thricops nigritella (Zetterstedt, 1838).
Previous records: *Anthomyza nigritella* Zetterstedt 1838: 666—667; *Aricia nigritella* Zett. — Zetterstedt 1845: 1409—1410; Siebke 1877: 103; *Spilogaster nigritella* Zett. — Bidenkap 1901: 67; Strand 1906: 103; *Lasiops nigritellus* Zett. — Ringdahl 1928: 17; Ringdahl 1944c: 15; Ringdahl 1952: 154—155 No. 474; Dahl 1968: 22—23; *Lasiops nigritella* Zett. — Ringdahl 1944b: 83; *Thricops nigritella* Zett. — Pont 1971: 119.
Material: 32 ♂♂ 8 ♀♀. — Between Finse railway station and Research station 1 ♂ 1 ♀ 16 July; Nordnut 19 ♂♂ 4 ♀♀ 17 July; Finsefetene 9 ♂♂ 1 ♀ 20 July; Kvannjolnut 3 ♂♂ 2 ♀♀ 21 July.
Distribution: Asia, Europe (Hennig 1962).

Thricops rostrata (Meade, 1882).
Previous records: *Trichopticus rostratus* Mde. — Strand 1913: 326 (P. Stein det.); *Lasiops rostratus* Meade — Ringdahl 1928: 18; Ringdahl 1944b: 83; Ringdahl 1944c: 15; Ringdahl 1952: 154—155 No. 475.
Material: 5 ♂♂ 4 ♀♀. — Jomfrunut 5 ♂♂ 4 ♀♀ 19 July.
Distribution: Kola peninsula, Sweden, British Isles, Faroes, Alps, Pyrenees (Hennig 1962). In Sweden not reported south of Härjedalen (Ringdahl 1952). In Norway not previously recorded south of Trøndelag. Not reported within present boundaries of Finland (Hackman 1980).

Alloeostylus lividiventris (Zetterstedt, 1845).
Previous records: *Aricia lividiventris* Zett. — Siebke 1877: 106; *Alloeostylus lividiventris* Zett. — Ringdahl 1928: 15; Ringdahl 1944c: 14; Ringdahl 1952: 154—155 No. 463; Hennig 1962: 659.
Material: 1 ♂. — Research station 1 ♂ 19 July (Malaise-trap).
Distribution: East Asia (Manchuria), Europe, North America (Yellowstone park, Alaska) (Hennig 1962, Huckett 1965).

Alloeostylus sundewalli (Zetterstedt, 1845).
Previous records: *Anthomyza sundewalli* Zett. — Siebke 1877: 120; *Spilogaster sundevalli* Zett. — Strand 1906: 103; *Anthomyia sundewalli* Zett. — Bidenkap 1901: 79; *Alloeostylus sundewalli* Zett. — Ringdahl 1928: 15; Ringdahl 1944c: 14; Ringdahl 1952: 154—155 No. 467; Pont 1971: 119.
Material: 12♂♂ 3♀♀. — Between Finse railway station and Research station 1♀ 16 July; Nordnut 4♂♂ 17 July; Jomfrunut 1♂ 19 July; Finsefetene 3♂♂ 20 July; Kvannjolnut 4♂♂ 2♀♀ 21 July.
Distribution: Europe (Hennig 1962).

Hydrotaea dentipes (Fabricius, 1805).
Previous records: *Aricia dentipes* Fabr. — Zetterstedt 1845: 1426—1427; Siebke 1877: 104—105; Strand 1900: 70; *Hydrotaea dentipes* Fabr. — Bidenkap 1892: 244; Bidenkap 1901: 68—69; Strand 1906: 103; Ringdahl 1928: 24; Ringdahl 1944b: 83; Ringdahl 1944c: 16; Ringdahl 1952: 154—155 No. 493; Ardö 1957: 150.
Material: 1♂. — Between Finse railway station and Research station 1♂ 16 July.
Distribution: Asia, Europe, North America, South America (Hennig 1962; Huckett 1965; Pont 1972, 1977).

Lophosceles frenatus (Holmgren 1872).
Previous records: *Phaonia frenata* Holmgr. — Ringdahl 1928: 14; *Lophosceles frenatus* Holmgr. — Ringdahl 1952: 154—155 No. 457.
Material: 1♂. — Between Finse railway station and Research station 1♂ 16 July.
Distribution: Kola peninsula, Fennoscandia (northern Finland to Jämtland in Sweden), Alps, Greenland, northern part of North America (Tiensuu 1935; Ringdahl 1952, Hennig 1962, 1964: 1080; Huckett 1965; Pont 1971). From Norway previously reported only from Narvik.

Phaonia alpicola (Zetterstedt, 1845).
Previous records: *Aricia alpicola* Zetterstedt 1845: 1401—1402; Siebke 1877: 102; Bidenkap 1901: 65;*Phaonia alpicola* Zett. — Ringdahl 1928: 12—13; Ringdahl 1944b: 83; Ringdahl 1944c: 14; Ringdahl 1952: 150—151 no. 402.
Material: 44♂♂ 30♀♀. — Between Finse railway station and Research station 7♂♂ 5♀♀ 16 July; Nordnut 7♂♂ 1♀ 17 July; Research station 1♂ 17 July (Malaise-trap); 3♂♂ 6♀♀ 18 July; 1♂ 19 July (Malaise-trap); 5♂♂ 1♀ 20 July (Malaise-trap); 4♂♂ 2♀♀ 21 July (Malaise-trap); Jomfrunut 8♂♂ 8♀♀ 19 July; Finsefetene 3♂♂ 3♀♀ 20 July; Kvannjolnut 5♂♂ 4♀♀ 21 July.
Distribution: North-eastern Siberia, Kola peninsula, Fennoscandia, Alps, northern part of North America (Hennig 1962, Huckett 1965). In Norway not previously recorded south of Trøndelag.

Phaonia consobrina (Zetterstedt, 1838).
Previous records: See Rognes 1982a.
Material: 1♂. — Jomfrunut 1♂ 19 July.
Distribution: Asia (?), Europe (mostly in mountains), northern part of North America (Hennig 1963, Huckett 1965).

Phaonia lugubris Meigen, 1826.
Previous records: *Aricia lugubris* Meig. — Bidenkap 1901: 65—66; *Phaonia lugubris* Meig.. — Ringdahl 1928: 12; Ringdahl 1944b: 83; Ringdahl 1944c: 14; Ringdahl 1952: 152—153 No. 422.
Material: 1♂. — Jomfrunut 1♂ 19 July.
Distribution: Asia, Europe (mostly in mountains) (Hennig 1963).

Phaonia morio (Zetterstedt, 1845).
Previous records: *Aricia morio* Zetterstedt 1845: 1399; Siebke 1877: 102; Strand 1906: 103; Bidenkap 1892: 240; Bidenkap 1901: 65; *Phaonia morio* Zett. — Strand 1913: 327 (P. Stein det.); Ringdahl 1928: 11—12; Ringdahl 1944b: 83; Ringdahl 1944c: 13; Ringdahl 1952: 152—153 No. 424.
Material: 30♂♂ 17♀♀. — Between Finse railway station and Research station 8♂♂ 2♀♀ 16 July; Nordnut 1♂ 17 July; Research station 3♂♂ 1♀ 18 July; 2♂♂ 2♀♀ 19 July (Malaise-trap); 3♂♂ 1♀ 20 July (Malaise-trap); 3♂♂ 2♀♀ 21 July (Malaise-trap); 1♂ 22 July; Jomfrunut 3♂♂ 6♀♀ 19 July; Finsefetene 3♂♂ 20 July; Kvannjolnut 3♂♂ 2♀♀ 21 July; Lille Finsenut 1♀ 21 July (G.A. Evje leg.).
Distribution: Karskaja Tundra, Kola peninsula, Fennoscandia, Scotland, Alps, Greenland, northwestern part of North America (Hennig 1963, Huckett 1965).

Phaonia pallidisquama (Zetterstedt, 1849).
Previous records: *Phaonia pallidisquama* Zett. — Ringdahl 1928: 12; Ringdahl 1952: 152—153 No. 429.
Material: 1♂ 4♀♀. — Between Finse railway station and Research station 1♀ 16 July; Nordnut 1♀ 17 July; Research station 1♀ 18 July; Jomfrunut 1♂ 1♀ 19 July.
Distribution: Fennoscandia (Finland: Lapponia enontekiensis; Sweden: Torne Lappmark southwards to Härjedalen) Greenland (west coast), Baffin I., Labrador (Tiensuu 1935, Ringdahl 1952, Huckett 1965). In Norway previously reported only from Finnmark.

Phaonia subfuscinervis (Zetterstedt, 1838).
Previous records: *Aricia subfuscinervis* Zett — Zetterstedt 1845: 1489—1490; Siebke 1877: 109; *Lasiops subfuscinervis* Zett. — Bidenkap 1901: 74; *Phaonia subfuscinervis* Zett. — Ringdahl 1954: 50; Rognes 1982a: 41.
Material: 2♂♂ 3♀♀. — Research station 1♀ 18 July; Jomfrunut 2♀♀ 19 July; Finsefetene 2♂♂ 20 July.
Distribution: Fennoscandia, Scotland, Greenland, northern North America (Hennig 1963, Huckett 1965).

Helina annosa (Zetterstedt, 1838).
Previous records: *Aricia annosa* Zett. — Siebke 1877: 102; Bidenkap 1892: 240; *Helina annosa* Zett. — Ringdahl 1944b: 84; Ringdahl 1944c: 18; Ringdahl 1952: 160—161 No. 593; Hennig 1957: 160.
Material: 1♀. — Jomfrunut 1♀ 19 July.
Distribution: Asia (incl. Palestine and Japan),

north and central Europe, northern part of North America (Hennig 1957, 1964; Huckett 1965).

Helina evecta (Harris, 1780).

Taxonomy: Pont & Michelsen 1982.

Previous records: *Anthomyza lucorum* Fall. — Zetterstedt 1838: 662; *Aricia lucorum* Fall. — Zetterstedt 1845: 1391; Siebke 1877: 101; Bidenkap 1892: 240; Bidenkap 1901: 63—64; *Spilogaster lucorum* Fall. — Strand 1906: 103; *Mydaea lucorum* Fall. — Strand 1913: 327; *Helina lucorum* Fall. — Ringdahl 1928: 21; Ringdahl 1944b: 84; Ringdahl 1944c: 18; Ringdahl 1952: 160—161 No. 614; *Aricia nivalis* Zett. — Siebke 1877: 102; Bidenkap 1892: 240; Bidenkap 1901: 64 (specimen belong to «*marmorata* (Zett.) Stein» (= *rothi* Ringd. = *subvittata* Séguy) according to Ringdahl 1928: 21, see below); *Helina laetifica* R.-D. — Pont 1971: 120.

Material: 2 ♂♂. — Nordnut 1 ♂ 17 July; Kvannjolnut 1 ♂ 21 July. The male from Nordnut suits Ringdahl's (1924, 1939, 1956) description of the variety named «*nivalis* Zett». In addition to the features mentioned by him my specimen has the *pra* very nearly as long as the *post npl* seta and the prosternum with 1—2 very short inwardly directed hairs close to the middle of each margin.

Distribution: Socotra, South Yemen, Yemen, India, Sri Lanka; Palaearctic Region; North America; Mexico, Venezuela (Pont 1981).

Helina flavisquama (Zetterstedt, 1849).

Previous records: *Helina flavisquama* Zett. — Ringdahl 1928: 22; Hennig 1957: 182; *Helina basalis* Zett. — Ringdahl 1944c: 19; Ringdahl 1952: 160—161 No. 595.

Material: 1 ♂. — Research station 1 ♂ 19 July (Malaise-trap). The specimen has no seta on shaft of front tibiae and 4 *post dc* on each side. The extra *dc* is between the first and second normally situated ones on each side.

Distribution: Kamchatka, Kola peninsula, Fennoscandia, Alps, North America (Hennig 1957, Huckett 1965). In Scandinavia not previously reported south of Härjedalen in Sweden (Ringdahl 1956: 110).

Helina subvittata Séguy, 1923.

Previous records: *Spilogaster marmorata* Zett. — Strand 1906: 103 (det. P. Stein); *Helina marmorata* (Zett.) Stein — Ringdahl 1928: 21; *Helina rothi* Ringd. — Ringdahl 1944b: 84; Ringdahl 1944c: 18; Ringdahl 1952: 162—163 No. 628; *Aricia nivalis* Zett. — Bidenkap 1901: 64 (misidentification, cf. Ringdahl 1928: 21 and above under *evecta*).

Material: 2 ♂♂. —Jomfrunut 2 ♂♂ 19 July.

Distribution: Asia, central and north Europe, North America (Hennig 1958, Huckett 1965).

Mydaea orichalcea (Zetterstedt, 1849).

Previous records: *Aricia orichalcea* Zetterstedt 1849: 3285—3286; Siebke 1877: 109; *Mydaea orichalcea* Zett. — Ringdahl 1928: 20—21; Ringdahl 1952: 160—161 No. 583.

Material: 1 ♀. — Nordnut 1 ♀ 17 July.

Distribution: Kamchatka, Fennoscandia, North America (Hennig 1958, Huckett 1965). Apart from the specimen from Oslo cited by Zetterstedt (*l.c.*), the species is not previously recorded south of Härjedalen (Sweden) in Scandinavia. In Norway also known from Tromsø.

Mydaea palpalis Stein, 1916.

Previous records: *Mydaea palpalis* Stein — Ringdahl 1928: 20; Ringdahl 1952: 160—161 No. 585.

Material: 1 ♂. — Between Finse railway station and Research station 1 ♂ 16 July.

Distribution: Kanin peninsula, Kola peninsula, Fennoscandia, Iceland, North America (Hennig 1956, Huckett 1965). In Scandinavia not previously known south of Jämtland (Sweden). In Norway previously known only from Narvik.

Myospila meditabunda (Fabricius, 1781).

Previous records: See Rognes 1928b: 113.

Material: 3 ♂♂ 1 ♀. — Nordnut 1 ♂ 1 ♀ 17 July; Finsefetene 1 ♂ 20 July; Research station 1 ♂ (Malaise-trap).

Distribution: Holarctic, Oriental and Neotropical Regions (Pont 1977).

Spilogona alpica (Zetterstedt, 1845).

Previous records: *Aricia alpica* Zetterstedt 1845: 1624; Siebke 1877: 115.

Material: 24 ♂♂ 6 ♀♀. — Nordnut 1 ♂ 1 ♀ 17 July; Research station 15 ♂♂ 4 ♀♀ 18 July (A.C.P.); 1 ♀ 20 July (Malaise-trap); Jomfrunut 6 ♂♂ 19 July; Finsefetene 1 ♂ 20 July; Kvannjolnut 1 ♂ 21 July. One aberrant male (Research station) has 4 *post dc* on the left side and 5 *post dc* on the right. The females have 1 og 2 «Lückenborsten», contrary to Hennig's (1959: 267, couplet 71 (66)) statement to the effect that the females are lacking such supplementary mesopleural setae. Most specimens were captured early in the day on the sunny side of stones close to the ground.

Distribution: Sweden (Torne Lappmark, Lule Lappmark, Jämtland), Finland (Kuusamo), Scotland, Alps, Jan Mayen I., Iceland, Greenland, Quebec, Labrador (Tiensuu 1935, Ringdahl 1952, Hennig 1959, Huckett 1965, Pont 1971). In Norway reported by Zetterstedt from Kälahög, near Sul (NTI, Verdal). In addition to the above records I have a male from the southernmost part of the Scandinavian mountain range in the uppermost part of the subalpine birch zone (Rogaland, RI, Forsand: towards Prekestolen 500 m 1 ♂ 13 June 1981, K. Rognes leg.).

* *Spilogona brunneifrons* (Ringdahl, 1931).

Material: 1 ♂ 3 ♀♀. — Finsefetene 1 ♂ 3 ♀♀ 20 July (A.C.P.).

Distribution: Kola peninsula, Sweden (Torne Lappmark, Jämtland) (Tiensuu 1935, Ringdahl 1952). New to Norway.

Spilogona brunneisquama (Zetterstedt, 1845).

Previous records: *Aricia brunneisquama* Zetterstedt 1845: 1462; Siebke 1877: 107; *Limnophora brunneisquama* Zett. — Bidenkap 1901: 71; Ringdahl 1928: 29; Ringdahl 1944b: 84; Ringdahl

1944c: 20; Ringdahl 1952: 162—163 No. 659.
Material: 5♂♂. — Finsefetene 1♂ 20 July; Kvannjolnut 3♂♂ 21 July (on the walls of a small house at Torbjørnstølen 1220 m); Research station 1♂ 22 July (Malaise-trap).
Distribution: Siberia, central and north Europe (mostly in mountains) (Hennig 1959).

Spilogona contractiofrons (Zetterstedt, 1838).
Previous records: *Anthomyza contractifrons* Zetterstedt 1838: 683; *Aricia contractifrons* Zett. — Zetterstedt 1845: 1463—1464; Siebke 1877: 107; *Limnophora contractifrons* Zett. — Bidenskap 1901: 69; Ringdahl 1928: 29; Ringdahl 1944c: 20; *Spilogona contractifrons* Zett. — Ringdahl 1952: 162—163 No. 662; *Anthomyza arctica* Zetterstedt 1838: 669; *Spilogona contractifrons arctica* Zett. — Ringdahl 1952: 162—163 No. 662a; *Aricia fumipennis* Zett. — Siebke 1877: 108; *Limnophora fumipennis* Zett. — Ringdahl 1944c: 21.
Material: 76♂♂ 25♀♀. — Nordnut 2♂♂ 1♀ 17 July; Research station 30♂♂ 2♀♀ 18 July; 1♂ 18 July (Malaise-trap); 8♂♂ 1♀ 19 July (Malaise-trap); 3♂♂ 1♀ 20 July (Malaise-trap); 7♂♂ 3♀♀ 21 July (Malaise-trap); 11♂♂ 1♀ 22 July (Malaise-trap); Jomfrunut 1♂ 19 July; Finsefetene 4♂♂ 9♀♀ 20 July; Kvannjolnut 9♂♂ 7♀♀ 21 July. The specimens belong to *S.c. arctica* sensu Ringdahl 1956: 136. The structure of the fifth sternite and genitalia (3 dissections) agrees with Collin's figures of *contractifrons* rather than with those of *arctica* (Collin 1931: 81—82).
Distribution: Asia, Europe, Greenland, North America, (Hennig 1959, Huckett 1965, Pont 1970).

Spilogona dorsata (Zetterstedt, 1845).
Previous records: *Aricia dorsata* Zetterstedt 1845: 1472; Siebke 1877: 108; *Limnophora dorsata* Zett. — Ringdahl 1944c: 21; *Spilogona dorsata* Zett. — Ringdahl 1952: 164—165 No. 667.
Material: 1♀. — Finsefetene 1♀ 20 July. The specimen runs to *dorsata* in both Ringdahl's (1956), Hennig's (1959) and Huckett's (1965) keys. It differs from Hennig's description in having the frontal triangle almost reaching the fore margin of the frontal stripe, and in having only 1 *ad* and 1 *v* seta on each mid tibia and 2 *av* on each hind tibia.
Distribution: Wrangel I., Taymyr peninsula, Yenisei Gulf, Sweden (Torne Lappmark, Lule Lappmark, Jämtland), Norway, Svalbard, Greenland, northern part of North America (Ringdahl 1952, Hennig 1959, Huckett 1965, Pont 1970, 1971). In Norway previously reported south of Trøndelag only by Siebke whose record from Oslo cannot be accepted without strong reservation.

* *Spilogona malaisei* (Ringdahl, 1920)
Material: 1♂. — Research station 1♂ 18 July (A.C.P.).
Distribution: USSR: Murmansk Region (Gavrilovo, Pechenga); Sweden (Torne Lappmark, Lule Lappmark, Åsele Lappmark); Greenland; northern North America (Ringdahl 1952, Hennig 1959, Huckett 1965, Pont 1971). New to Norway.

Spilogona meadei (Schnabl, 1915).
Previous records: *Limnophora subalpina* Ringd. — Ringdal 1928: 29; *Spilogona subalpina* Ringd. — Ringdahl 1954: 51; *Spilogona kuntzei* Schnabl (*subalpina* Ringd.) — Ringdahl 1952: 164—165 No. 672.
Material: 1♀. — Research station 1♀ 18 July.
Distribution: USSR: Murmansk Region; Sweden; British Isles; the mountains of central Europe (Hennig 1959). In Norway previously reported from Tromsø and Turtagrø.

Spilogona megastoma (Bohemann, 1866)
Previous records: *Spilogona megastoma* Boh. — Ringdahl 1952: 164—165 No. 680; Hennig 1959: 317.
Material: 3♂♂ 5♀♀. — Research station 2♂♂ 3♀♀ 18 July; Finsefetene 1♂ 2♀♀ 20 July (A.C.P.).
The *megastoma* females should have *av*, *v* or *pv* setae on the middle tibiae according to Hennig's key (1959: 265, couplet 7 (52)). Two of my females (Research station) do not have any such setae on any side, the remaining three have a singe *av* or *pv* seta on one middle tibia only. All the females have the parafrontals brown dusted, the scutellum with a grey dusted stripe along middle, the dorsum of thorax evenly brown dusted with no obvious darker stripes, the basal half of hind femur with long *pv* setae, and yellow to purplish halteres.
Distribution: Novaya Zemlya, Svalbard, Fennoscandia, (south to Härjedalen in Sweden), Iceland, Jan Mayen, Greenland, northern North America (Hennig 1959, Huckett 1965). Both Ringdahl (*l.c.*) and Hennig (*l.c.*) report it from Norway without giving localities.

* *Spilogona nitidicauda* (Schnabl, 1915).
Material: 50♂♂ 19♀♀. — Nordnut 19♂♂ 3♀♀ 17 July (A.C.P.) (2♂♂ in BMNH, 3♂♂ in CNC); Finsefetene 24♂♂ 13♀♀ 20 July (3♂♂ in CNC), Kvannjolnut 3♂♂ 1♀ 21 July; Lille Finsenut 3♂♂ 2♀♀ 21 July (G.A. Evje leg.); Research station 1♂ 21 July (Malaise-trap). The specimens have 1 og 2 mesopleural supplementary setae («Lückenborsten») and yellow halteres.
Distribution: USSR: Karskaja Tundra; Sweden: Torne Lappmark and Jämtland; northern North America (as *imitatrix* Malloch, 1921, probable synonym according to Hennig 1959: 319) (Hennig 1959, Huckett 1965). New to Norway.

Spilogona triangulifera (Zetterstedt, 1838).
Previous records: *Anthomyza triangulifera* Zetterstedt 1838: 680; *Aricia triangulifera* Zett. — Zetterstedt 1845: 1467—1468; Siebke 1877: 108; Bidenkap 1901: 69—70; *Limnophora triangulifera* Zett. — Ringdahl 1928: 30; *Spilogona triangulifera* Zett. — Ringdahl 1952: 164—165 No. 701.
Material: 22♂♂ 26♀♀. — Between Finse railway station and Research station 1♂ 16 July;

Nordnut 1 ♂ 1 ♀ 17 July; Research station 1 ♀ 17 July; 2 ♀ ♀ 17 July (Malaise-trap); 17 ♂ ♂ 10 ♀ ♀ 18 July; 1 ♂ 2 ♀ ♀ 19 July (Malaise-trap); 1 ♀ 21 July (Malaise-trap); 1 ♀ 22 July; 1 ♀ 22 July (Malaise-trap); Jomfrunut 1 ♂ 5 ♀ ♀ 19 July; Finsefetene 2 ♀ ♀ 20 July; Kvannjolnut 1 ♂ 21 July. Most specimens were taken close to running water or snowbeds, many even on the snow.
Distribution: USSR: «Jana-land, auf der Tundra beim See Kederan» (Hennig 1959: 352) (by the river Yana?), Kanin peninsula, Kola peninsula; Fennoscandia; Scotland; northern North America (Tiensuu 1935, Hennig 1959, Huckett 1965).

Spilogona tundrae (Schnabl, 1915).
Previous record: *Spilogona macropyga* Frey — Dahl 1968: 23.
Material: 1 ♂. — Research station 1 ♂ 22 July (Malaise-trap).
Distribution: Wrangel I., Kolyma delta, Taymyr peninsula, Karskaja tundra, Kanin peninsula, Kola peninsula, Sweden (Torne Lappmark), Greenland, northern North America (Ringdahl 1952, Hennig 1959, Huckett 1965). Previously reported from three (unspecified) localities in Northern Norway (Dahl *l.c.*).

Lispocephala erythrocera (Robineau-Desvoidy, 1830).
Previous records: *Lispocephala erythrocera* R.-D. — Ringdahl 1928: 31; Ringdahl 1944c: 21; Ringdahl 1952: 166—167 No. 718; Dahl 1968: 23.
Material: 1 ♀. — Research station 1 ♀ 19 July (Malaise-trap).
Distribution: Palaearctic and Oriental (?) Asia, central and northern Europe, North America (Hennig 1961, Huckett 1965, Pont 1977).

Coenosia ?pumila (Fallén, 1825)
Previous records: *Anthomyza pumila* Fall. — Zetterstedt 1838: 694; Zetterstedt 1845: 1730—1731; Siebke 1877: 123; *Coenosia pumila* Fall. — Bidenkap 1901: 80; Strand 1913: 326 (P. Stein det.); Ringdahl 1928: 43; Ringdahl 1944c: 22; Ringdahl 1952: 168—169 No. 751; Ardö 1957: 154—155.
Material: 1 ♀. — Nordnut 1 ♀ 17 July.
Distribution: Asia, Europe (incl. Faroes, Iceland), North America (Hennig 1962, Huckett 1965).

DISCUSSION

Ringdahl's (1951) paper on the dipterous fauna of the Swedish mountain regions remains the most important source of information regarding this fauna in the Scandinavian mountains in general. In his lists of Tachinidae (as Phasiinae, Rhinophorinae, Dexiinae, Tachininae) 17 species are recorded as having been captured above the tree line (alpine zone, Ringdahl's regio arctica), in the list of Calliphoridae (as Calliphorinae) the corresponding number is 14. Compared to these numbers the captures at Finse are very poor. Obviously many more species of these familie remains to be taken there. As to Fanniidae and Muscidae (Ringdahl's Muscidae excl. Anthomyiinae) a total of 102 species are recorded as having been taken above the tree-line. Pont (1971) captured 20 species of Muscidae (incl. Fanniidae) above the tree-line in Lule Lappmark. Although the 38 species of muscids and fanniids recorded from Finse in the present paper is a relatively high number, it is fairly obvious that the investigation of the fanniid and muscid fauna of the Finse area is also very far from complete.

Not surprisingly, all the species recorded from Finse except *Coenoisa pumila* (identification queried) have also been recorded from the alpine zone i Sweden. Three species from Finse, viz. *Spilogona dorsata*, *S. malaisei* and *S. tundrae*, are classified by Ringdahl as arctic, i.e. they are confined to the area above the tree-line or rarely extends into the upper part of the subalpine birch zone (cf. Ringdahl 1951: 115). Twelve species, viz. *Chaetovoria antennata*, *Caliphora alpina*, *Thricops hirtula*, *Lophosceles frenatus*, *Phaonia pallidisquama*, *P. subfuscinervis*, *Mydaea palpalis*, *Spilogona alpica*, *S. brunneifrons*, *S. megastoma*, *S. nitidicauda*, *S. triangulifera*, are classified by Ringdahl as arctic-subarctic, i.e. they occur in the mountains both above the tree-line and in the subalpine birch zone or in the neighbouring upper parts of the coniferous region (cf. Ringdahl 1951: 115—116) (some of these species also occur in the Alps). For several of these arctic and arctic-subarctic species the records from Finse represent important southern extensions of their known range in Fennoscandia.

The remaining species captured at Finse are classified by Ringdahl in ecological groups with wider range of distribution. The following 13 species belong to Ringdahl's group of arctic-highboreal species (most of them also occur in the mountain of central Europe): *Calliphora uralensis*, *Thricops aculeipes*, *T. nigritella*, *T. rostrata*, *Alloeostylus lividiventris*, *A. sundewalli*, *Phaonia alpicola*, *P. consobrina*, *P. morio*, *Helina flavisquama*, *Mydaea orichalcea*, *Spilogona brunneisquama*, *S. meadei*. The remaining 16 species are generally distributed in Sweden: *Calliphora vicina*, *Cynomya mortuorum*, *Protophormia terraenovae*, *Fannia mollissima*, *F. postica*, *Hydrotaea dentipes*, *Thricops hirsutula*, *T. longipes*, *Phaonia lugubris*, *Helina annosa*, *H. evecta*, *H. subvittata*, *Myospila meditabunda*, *Spilogona contractifrons*, *Lispocephala erythrocera*, *Coenosia pumila*.

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Notes on *Micrargus herbigradus* (Blackwall) and *M. apertus* (O.P.-Cambridge) in Norway (Araneae).

LARS TVEIT AND ERLING HAUGE

Tveit, L. and Hauge E., 1982. Notes on *Micrargus herbigradus* (Blackwall) and *M. apertus* (O.P.-Cambridge) in Norway. *Fauna Norv. Ser. B. 30*, 34—38.

All available Norwegian material of «*Micrargus herbigradus* (Blackwall)» have been reexamined, showing that in Norway there are two species *M. herbigradus* (Blackwall) and *M. apertus* (O.P.-Cambridge). The present paper gives a brief discussion of the distribution of the species in Norway, their habitat preferences, and an example of the relatively small overlap in cephalothorax length and width within the material examined.

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INTRODUCTION

«*Micrargus herbigradus* (Blackwall)» previously was known from different parts of Southern Norway and found occasionally in Northern Norway. A recent investigation in local habitats in S. Norway has resulted in a number of specimens of that «species». The splitting into three species, *M. herbigradus* (Blackwall), *M. apertus* (O.P.-Cambridge) and *M. georgescuae* Millidge (Millidge 1975, Nellist 1980), forced us to check carefully our own material and consequently the available material from Norwegian museums (i.e. Zoological museum, Bergen, exclusively).

RESULTS

This check revealed that two of the species, *M. herbigradus* and *M. apertus,* both seem quite common in S. Norway, while the North Norwegian individuals registered (Hauge 1977) all belong to *M. herbigradus. M. georgescuae* has not been registered in Norway. A similar distribution has been indicated in Sweden and Finland (Palmgren 1976).

The known distribution of the two species in Norway shown in Fig. 1 gives the false impression that the two species are largely concentrated in the southern part of Western Norway (Vestlandet) and in the southernmost part of Norway (Sørlandet). These areas are, however, concerning spiders the best investigated parts of Norway. It is most likely that at least *M. herbigradus* has a much wider distribution in Norway. The greater parts of Northern Norway, Trøndelag, Møre & Romsdal, and Eastern Norway collecting of spiders have been very sparse and insufficient. Furthermore, we have not been able to trace the material reported in some publications. Thus the genus has been reported from a few more localities than shown in Fig. 1.

In the material examined there is a dominance of *M. apertus* distributed in most parts of S. Norway up to the Hardanger fjord. The species is recorded from the islands of coastal Western Norway to higher altitudes in the central Southern Norway (Buskerud, 700 m a.s.l.). According to Table 1 *M. apertus* is found in very different types of habitats. However, most records are from light and often relatively dry deciduous forests which is somewhat in contrast to Palmgren (1976). Furthermore, in Norway *M. apertus* is found in forests of firs classified as Eu-Piceetum associations with high humidity (Loc. no. 32), and in pine forest and mixed forest with Vaccinio-Pinetum associations (Loc. no. 29, 30, 31, 32). The species also is recorded from humid alder forests and grasslands (Loc. no. 38). The species is absent from bogs, i.e. in accordance with Palmgren's experiences (Palmgren 1976).

M. herbigradus probably is widespread throughout the whole country. The majotiry of records have been from coastal localities and from fjords, but the species also has been found in central inland areas such as Geilo, Setesdalen and mountainous areas in Sør-Trøndelag.

Also *M. herbigradus* has been found in a variety of habitats, but most frequently in areas dominated by ling, and as concerns lights requirments it has been taken in both dense forests of firs and in open heather. According to Palmgren (1976) the species shuns *Calluna vulgaris,* i.e. in

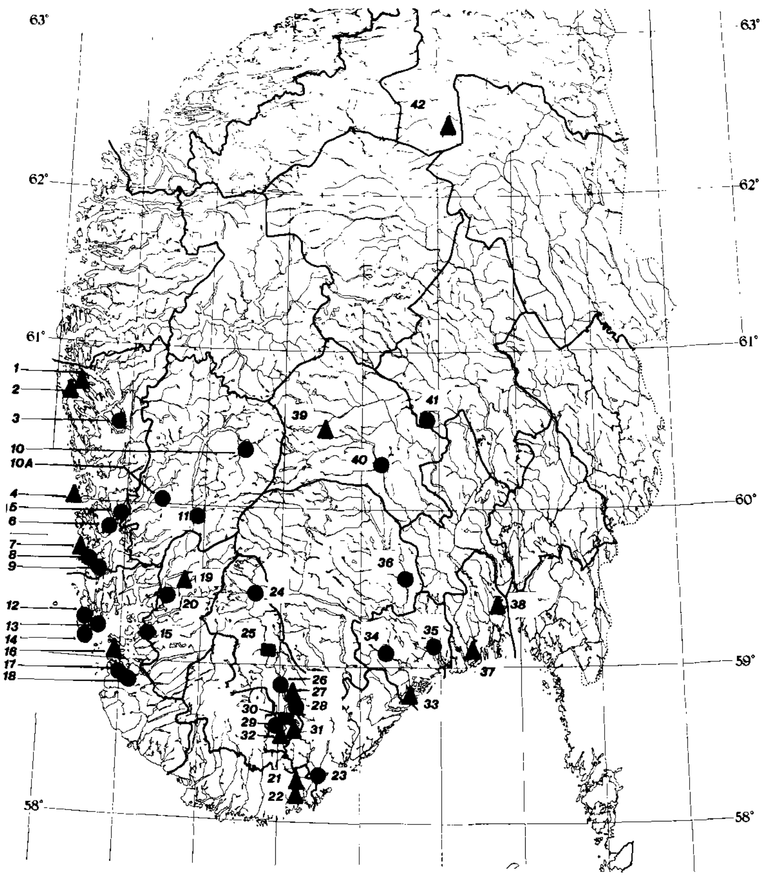

Fig. 1. Distribution of *Micrargus herbigradus* (Blackwall) (▲) and *M. apertus* (O.P.-Cambridge) (●) in Southern Norway. Filled squares (■): both species found. Loc. 43 (Skjomen, N. Norway) not included in this fig.

contrast to our records from the *Calluna* heaths in Lindås, Austrheim and Bømlo (W. Norway). The species also is listed from bogs (not very frequent) but when present obviously at higher densities than elsewhere. This also is supported by reports from Finland (Palmgren 1976).

In the material examined the two species are found together in only two localities both from pitfall traps in Setesdalen in the summer of 1980: A mixed forest with bottom flora of a Vaccinio-Pinetum association (Loc. no. 30), and a pine-dominated Eu-Piceetum association (Loc. no. 25).

Length and width of cephalothorax were measured on males and females of both species. Fig. 2 shows that there are relatively small overlaps between the two species indicating the validity of putting the two «morphs» into two different taxa (as already suggested by Millidge (1975)). We know nothing whether they are reproductively isolated or not. What we know, however, is that they are morphologically different with respect to a number of smaller characters, as demonstrated by Millidge (1975) and Nellist (1980), and now indicated by us (Fig. 2). The registration of both «morphs» on at least two occasions in the same habitat (see above) could be apprehended as an indication of sympatric distribution. Furthermore, this does not immediately exclude the fact that the two «morphs» may be phena of the same population. However, considering the high number of loca-

Tab. 1. List of localities where *Micrargus* spp. is collected in Norway. The data given are: numbers of locality (*cf.* Fig. 1), name of the locality by the system of Strand (1943), period of collection and habitat type.

Locality		Period of collection	Habitat type
1. Mongstad	HOy: Lindås	June-4/10 1979	Calluna-heath
2. Rebnor	HOy: Austrheim	June-4/10 "	Calluna-heath
3. Lono	HOy: Osterøy	Summer 1972 and 1973	Dry meadow
4. Møkster	HOy: Austevoll	18/4-6/12 1972/75	Bog and meadow
5. Ånuglo	HOy: Tysnes	4/6 1976	Calluna-heath
6. Storøy	HOy: Stord	23/2-30/2 1972	Meadow
7. Langevåg	HOy: Bømlo	24/5-18/9 1977	Calluna-heath
8. Amdal	HOy: Bømlo	24/5-18/9 1977	Pinus/Juniperus/Vaccinium
9. Bjelland	HOy: Sveio	25/5-16/9 1977	Pinus/Vaccinium/Calluna
10. Enesdalen	HOi: Kvinnherad	10/5-26/8 1977	Alnus with rich undergrowth
10a. Måbødalen	HOi: Eidfjord	18/5-25/6 1977	Alnus
11. Skare S.	HOi: Odda	9/6-27/6 1977	Pinus/Vaccinium
12. Tjøstheim Ø.	Ry : Strand	27/4-27/9 1977	Betula/Juniperus/Vaccinium
13. Vatnaland N.	Ry : Bokn	29/6-4/9 1977	Calluna/Vaccinium
14. Timmerviken	Ry : Karmøy	25/5-17/9 1977	Corylus/Quercus/Sorbus/Betula
15. Fister N.	Ry : Hjelmeland	26/4-27/9 1977	Ulmus/Tilia/Corylus/Orchidaceae
16. Vaula	Ry : Mosterøy	5/7-29/9 1977	Pinus/Picea/Vaccinium
17. Gausel	Ry : Stavanger	26/6-28/9 1977	Betula/Quercus/Ulmus/Fraxinus
18. Dale	Ry : Sandnes	24/6-28/9 1977	Quercus
19. Suldalsosen	Ri : Suldal	26/4-27/9 1977	Pinus/Vaccinium
20. Lovrafjorden	Ri : Suldal	26/4-27/9 1977	Populus/Corylus/Betula
21. Augland	VAy: Iveland	28/4-25/9 1980	Populus-Quercetum association
22. Strai, Ytre	VAy: Kristiansand	28/4-25/9 1980	Populus-Quercetum ass.
23. Åbel SØ.	AAy: Birkenes	18/7-27/6 1979	Populus-Quercetum ass.
24. Berdals bridge	AAi: Bykle	9/6-26/9 1979	Eu-Piceetum ass.
25. Nomeland	AAi: Valle	30/4-27/9 1980	Melico-Piceetum ass.
26. Urvika	AAi: Bygland	30/4-26/9 1980	Eu-Piceetum ass.
27. Bygland N.	AAi: Bygland	30/4-26/9 1980	Eu-Piceetum ass.
28. Bygland S.	AAi: Bygland	30/4-26/9 1980	Eu-Piceetum ass.
29. Birkelandsfossen	AAi: Evje	29/4-26/9 1980	Vaccinio-Pinetum ass.
30. Bjørnås SV	AAi: Evje	29/4-26/9 1980	Vaccinio-Pinetum ass.
31. Flåt	AAi: Evje	29/4-26/9 1980	Vaccinio-Pinetum ass.
32. Fennefoss	AAi: Evje	29/4-26/9 1980	Vaccinio-Pinetum ass.
33. Tonstøl	TEy: Kragerø	8/6-21/9 1979	Quercus
34. Tørdal N.	TEy: Drangedal	8/6-21/9 1979	Picea
35. Oklungen SV.	TEy: Porsgrunn	7/6-27/9 1979	Picea
36. Helleberg	TEi: Notodden	6/6-19/9 1979	Picea
37. near Hedrum church	Ve : Hedrum	6/6-20/9 1979	Populus/Quercus/Corylus
38. Nykirke N.	Ve : Borre	6/6-20/9 1979	Alnus/Sphagnum
39. Geilo SØ.	Bv : Hol	5/6-19/9 1979	Pinus/Betula/Vaccinium
40. Tunhovddammen SØ.	Bv : Nore og Uvdal	5/6-19/9 1979	Picea
41. Os/Vassfaret	Os : Sør-Aurdal	25/11 1972	Eu-Piceetum ass.
42. Undalen	STi: Oppdal	8/6-26/10 1977/79	Betula/Vaccinium
43. Skjomen	N : Narvik	1/5-10/8 1966/69	Vaccinium/Empetrum/Dryopteris

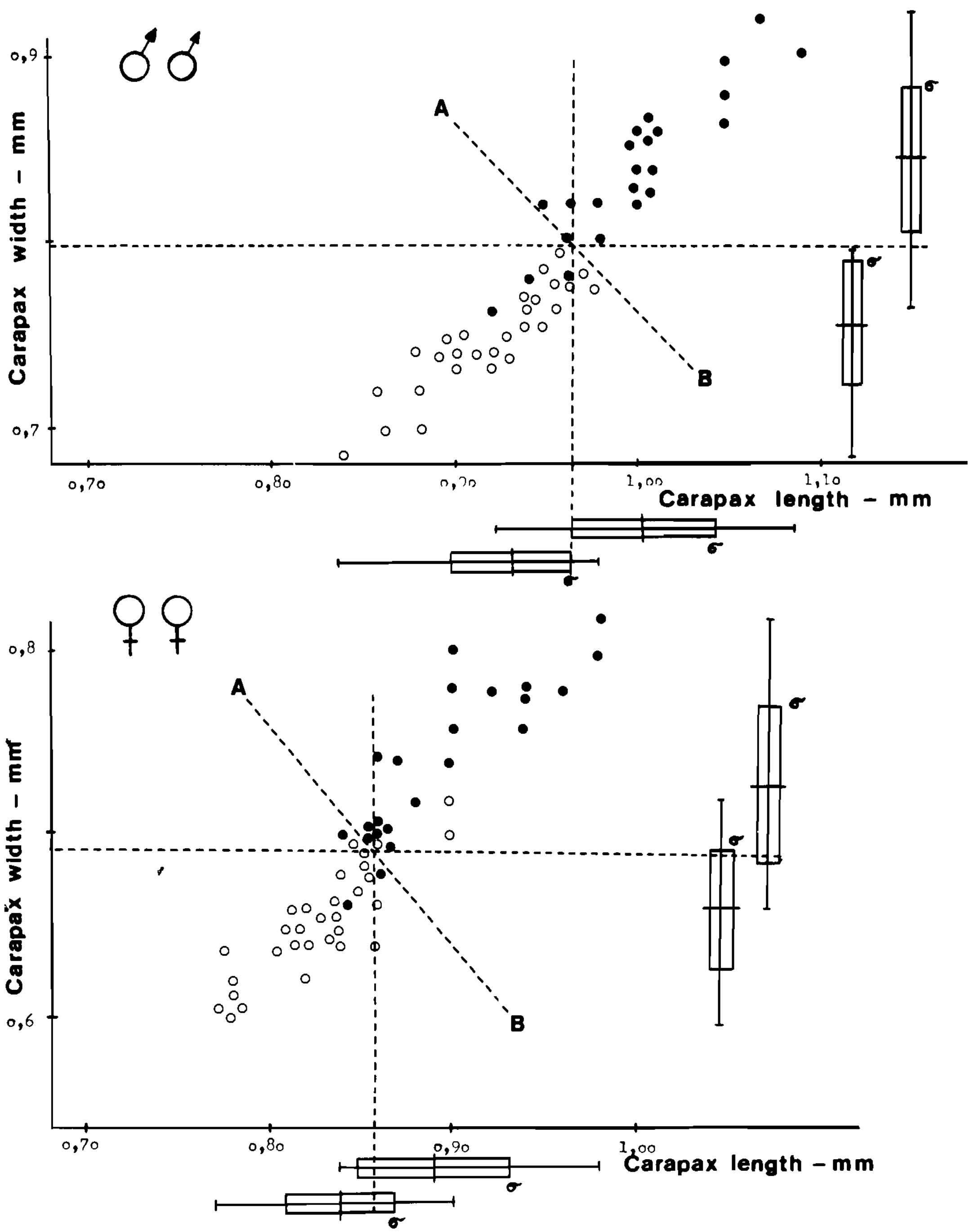

Fig. 2. Carapax length/carapax width (in mm) in adult males and females of *Micrargus herbigradus* (●) and *M. apertus* (●). Range, mean value and standard deviation are given. The dotted line (A-B) makes an hyopthetical separation of the two species.

lities examined in which we have found only one of the «morphs», and knowing that many of these localities are relatively close to each other geographically, it seems obvious that we are dealing with two species with different ecological preferences. In addition comes the fact that most of the specimens capture have been taken in pitfall traps over a long period of time, and that most spiders have a relatively high capacity of spreading (ballooning).

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Spider from forest-fire areas in southeast Norway

ERLING HAUGE AND TORSTEIN KVAMME

Hauge, E. & Kvamme, T. 1983. Spiders from forest-fire areas in southeast Norway. *Fauna norv. Ser. B. 30*, 39—45.

In former forest areas destroyed by forest-fires near Elverum, Heddal and Randal (S. Norway) there was a certain increase in species numbers of spiders during the first years after the fire. There also was a qualitative change during these years as some of the «pioneer species» of Huhta (1971) appeared in the earliest years and then disappeared being replaced by other species, some of which were found also by Huhta (1971). The following species are reported as new to the Norwegian fauna: *Walkenaera mitrata* (Menge), *W. monoceros* (Menge), *Conatium corallipes* (O.P.-Cambridge), *Troxochrus nasutus* Schenkel, *Silometopus incurvatus* (O.P.-Cambridge), *Ceratinopsis stativa* (Simon), *Milleriana inerrans* (O.P.-Cambridge), *Lasiargus hirsutus* (Menge), *Hypsosinga sanguinea* (C.L. Koch), *Pardosa schenkeli* Lessert.

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INTRODUCTION

In 1976 large forest areas in the provinces of Hedmark and Telemark were ruined by fire. Later, in 1980, a new area in Hedmark was burnt down. Investigations on problems concerning artificial regeneration of forest on burnt areas were carried out (Solbraa 1981, 1982). Insects harmful to small plants of Scots pine *(Pinus sylvestris* L.) were sampled during the years 1978 to 1981. A by-product has been a relatively large spider material giving a valuable contribution to the knowledge of the Norwegian spider fauna, and also data concerning the recolonization of spiders in burnt areas.

Dr. Knut Solbraa has been in charge of the investigations. The trapping program was done by Torstein Kvamme in cooperation with professor Alf Bakke. Erling Hauge is responsible for the determination of the species.

THE SAMPLING AREAS

Spiders have been sampled from the following three areas, situated as shown in fig. 1. The faunal codes in front of the locality names are in accordance with Strand (1943). In addition the EIS-grid numbers of the localities are mentioned in parenthesis behind the names.

HEs: Starmoen, Elverum (EIS:55).

A total of 920 hectares pine forest was burnt down in June 30. 1976 in an area situated about 225 meters above sealevel. Three different plots were investigated (Tab. 1).

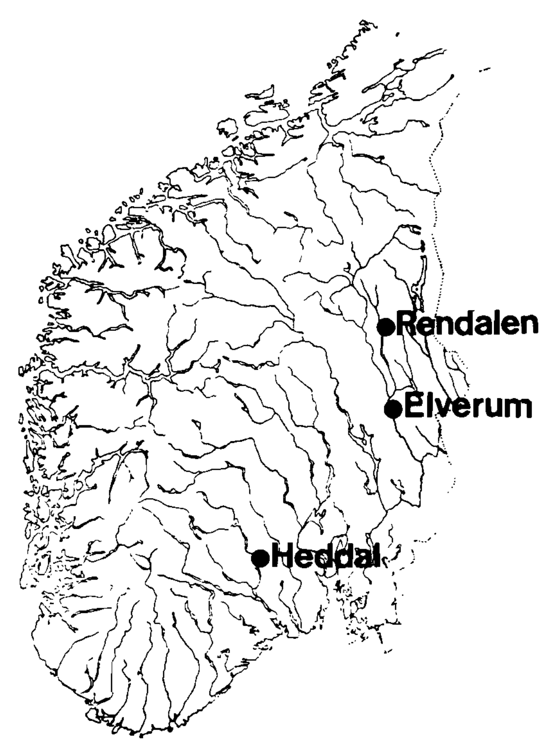

Fig. 1: The location of the sampling areas in South-Norway.

Table 1: Trapping periods at each field. Black star indicate no trapping in the period.

Year	Localites / Trapping periods	I	II	III	IV	V
1978	Elverum, Starmoen : A (Sediment, sand)	21/5–1/6	18/6–25/6	11/7–19/7	9/8–17/8	7/9–17/9
	Elverum, Starmoen : B (Moraine soil)	–"–	–"–	–"–	–"–	–"–
	Heddal, Heståsen : C (Moraine soil)	25/5–1/6	★	3/7–10/7	5/8–10/8	17/9–28/9
1979	Elverum:A	23/5–29/5	19/6–26/6	22/7–29/7	13/8–19/8	15/9–24/9
	Elverum:B	–"–	–"–	14/7–21/7	–"–	–"–
	Heddal:C	9/6–16/6	★	12/7–18/7	9/8–15/8	14/9–22/9
	Elverum:D (Sandy ground, unburned control)	21/5–1/6	18/6–25/6	11/7–19/7	9/8–17/8	7/9–17/9
1980	Elverum:A	28/4–6/5	23/5–30/5	4/7–15/7	★	9/9–17/10
	Elverum:B	–"–	–"–	–"–	★	–"–
	Heddal:C	★	★	24/6 2/7	★	★
	Elverum:D	28/4–6/5	23/5–30/5	4/7–15/7	★	9/9–17/10
1981	Elverum:A	11/5–18/5	10/6–16/6	22/7–29/7	★	16/9–23/9
	Elverum:B	–"–	–"–	–"–	★	–"–
	Heddal:C	6/5–15/5	27/5–4/6	★	30/7–6/8	★
	Rendalen, Kværnnesmoen : E (Coarsegrained moraine soil)	11/5–18/5	10/6–16/6	22/7–29/7	24/8–30/8	★

Elverum A. The ground vegetation was dominated by *Cladonia spp*, *Vaccinium vitis-idae* L., *Calluna vulgaris* (L.) and *Arctostáphylos uva-ursi* (L.). The soil consisted of sand alluvial of poor site quality. *Elverum B* had a ground vegetation which consisted of *Vaccinium myrtillus* L., *V. vitis-idae*, *Calluna vulgaris* and lichens. The soil was moraine of a richer quality than the soil at Elverum A. *Elverum D* is an unburned control area, similar to Elverum A before the fire.

TEi: Heståsen, Heddal (EIS:27).

Heddal C is about 380 meters above sea-level. The forest was dominated by pine, but spruce and birch were also abundant. The ground vegetation consisted mainly of *Vaccinium myrtillus*, *V. vitis-idae*, *Calluna vulgaris*, mosses and lichens. The site quality varied from low to medium. Moraine soil and rocks dominated the about 150 hectares big area burnt on August 23.—25. 1976. Heddal C and Elverum B are similar.

HEn: Kværnnesmoen, Rendalen (EIS:64).

Rendalen E is the northernmost sampling area and is situated about 300 meters above sea-level. Pine was the dominant tree species, while *Vaccinium vitis-idae* L. and *Cladonia spp* dominated the ground vegetation. The soil consisted of coarsegrained alluvial sand. Approximately 11 hectares of forest was burnt down on May 11. and 12. 1980.

A more detailed description of the areas at Elverum and Heddal is published by Solbraa (1981, 1982).

MATERIAL AND METHODS

Ten pit-fall traps were placed in an irregular pattern at each sampling plot. The traps were 40 cm long and 10 cm broad, and were protected against rainwater by a roof. A solution of 96% water and 4% formaline was used in the traps all years except in 1979 when 75% water and 25% ethyleneglycol was used. The trapping periods are given in Tab. 1.

RESULTS

Only one sampling method has been used and sampling has been done somewhat irregularly (Table 1). On such a biased material a thorough analysis of the recolonizing of spiders in the burned areas is unwarranted. Therefore we choose to present the yearly catches of spiders in Tables 2—5, followed by a few comments.

Table 2 indicates that the numbers of species which have either survived in or recolonized the burned areas, A, B and C, the first year after the fire reached a niveau of 18, 39 and 38 species respectively. During the following years (1979—81) the number of species in the pitfalls at Loc. A increased to 22, 32 and 34 species. The corresponding increase of species at Loc. B is to 44 species in 1979 and to 53 species in 1980 and 1981. Loc. C starts in 1978 at a high species level (38 species). In 1979 and 1981 44 species were found. In 1980 the number of species caught at Loc. C was low, most probably due to a low sampling activity that season (see Table 1). When comparing Loc. A in 1980 (32 species, see Table 4) with its control area (Loc. D) the same year (43 species) many indicate that recolonization at Loc. A was not complete that year. This is not unexpected as, Huhta (1971) shows that the spider fauna in burnt-over areas in Finland went through both quantitative and qualitative changes. He measured the abundance of spiders the first and second year after the fire to be only about 60% and 82% of the original abundance, and found that it took several years before the original fauna was restored. Huhta also showed that there is a period of pioneer species and transitory species before the community is reestablished. In our material the Linyphiidae as a

Table 2. 1978. Numbers of adult specimens (♂♂/♀♀) trapped in period I-V (see Table I) at Loc. A, B and C.

Locality and sampling periode / Species	Elverum A					Elverum B					Heddal C				
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Walkenaera acuminata Blackwall										0/1					
W. antica (Wider)			1/0			5/0					2/0				
W. cucullata (C.L.Koch)											2/1				
W. mitrata (Menge)						1/0									
W. carpinskii (O.P.-Cambridge)						1/0									
W. dysderoides (Wider)						1/0	1/0				1/0				
Pelecopsis elongata (Wider)						0/2				0/1					
Tapinocyba pallens (O.P.-Cambridge)						11/2	2/1			1/2	5/2				1/1
Gongylidiellum murcidum Simon											0/1				
Diplocentria bidentata Emerton						2/0									
Silometopus incurvatus (O.P.-Cambridge)	1/1														
Erigone atra (Blackwall)											1/0		1/2		1/1
Porrhomma pallidum Jackson									2/0	5/2	2/0				1/0
Centromerus arcanus (O.P.-Cambridge)						1/0					5/0				
Meioneta rurestris (C.L.Koch)											1/2				
M. gulosa (L.Koch)	1/1				0/1	1/0	0/1			1/0					
Lepthyphantes pallidus (O.P.-Cambridge)										1/0	1/0				5/1
L. mengei Kulczynski						0/1				2/0					11/2
L. obscurus (Blackwall)						2/0									
Stemonyphantes lineatus (L.)											1/0				
Poeciloneta globosa (Wider)							0/1								
Helophora insignis (Blackwall)										0/2					
Bolyphantes luteolus (Blackwall)															1/0
Phaulothrix hardyi (Blackwall)					1/1					3/1					
Robertus arundineti (O.P.-Cambridge)	3/2	1/1	1/0		1/0		1/0								
R. lividus (Blackwall)											6/0		1/0		
Euryopis flavomaculata (C.L.Koch)								0/1					7/2		
Hypsosinga sanguinea (C.L.Koch)		1/0													
H. albovittata (Westring)		1/0													
Acantholycosa lignaria (Clerck)		6/2	0/2		0/1		46/2	2/5	0/26	0/20			8/0	0/2	2/0
Xerolycosa nemoralis (Westring)	1/0	6/1	1/1			7/2	55/6	19/1	0/1		2/1		16/0		
Pardosa lugubris (Walckenaer)							6/0	0/1		0/2	8/0		7/0	0/2	0/1
P. riparia (C.L.Koch)		0/2					10/1		0/2	0/1					
P. palustris (L.)		7/9	0/1	0/1			17/3		0/1	0/1					
P. pullata (Clerck)													0/1		
P. sphagnicola (Dahl)							0/1						3/1		0/2
P. schenkeli Lessert		2/0	1/3												
Trochosa terricola Thorell											12/5			3/5	1/0
Pirata hygrophilus Thorell															0/1
Alopecosa aculeata (Clerck)		5/1		0/1			8/0	1/0	1/1	0/1	7/0		1/0		
A. pulverulenta (Clerck)		3/0									1/2				0/1
Gnaphosa leporina (L.Koch)						0/1	12/1	4/2					12/0	0/1	
G. bicolor (Hahn)											1/0		1/0		
G. muscorum (L.Koch)		2/3			0/1		18/0	8/0	1/0	0/4					
G. montana (L.Koch)											4/0				
Drassodes lapidosus (Walckenaer)											1/0				
D. pubescens (Thorell)								1/0							
Haplodrassus signifer (C.L.Koch)						6/0	1/1				13/0		3/0		
H. soerenseni (Strand)							0/1								
Zelotes clivicolus (L.Koch)						7/1					12/5			2/2	
Z. latreillei (Simon)											1/1				
Agroeca brunnea (Blackwall)						0/3	0/1						0/2		2/0
A. proxima (O.P.-Cambridge)															0/1
Clubiona frutetorum (L.Koch)							1/1								
Zora spinimana (Sundevall)		1/0													
Z. nemoralis (Blackwall)						0/1									
Aelurillus v-insignitus (Clerck)	1/0										1/0		1/0		
Hahnia pusilla C.L.Koch						1/0					1/0				
H. nava (Blackwall)							0/1								
Xysticus luctuosus (Blackwall)													1/0		
X. cristatus (Clerck)											1/1			0/2	
X. sabulosus (Hahn)				1/0	6/0					12/2					
Oxyptila atomaria (Panzer)										1/0					
Thanatus formicinus (Clerck)						1/0				1/2					
Amaurobius fenestralis (Stroem)															1/0

group (net builders!) seem to have suffered more than the others. This group accounts for the largest increase in species number from 1978 to 1980, while (as also Huhta 1971 indicates) the wandering species (Lycosidae and Gnaphosidae) are more complete at a relatively earlier stage. Among Huhta's pioneer species, *Meioneta rurestris* (C.L. Koch) is present in our material the first year after the fire at Loc. C (Table 2). It increases its number in our pitfalls in 1979 (Table 3) and has disappeared in the third year (Table 4). The species also is present at Loc. B the first year after the fire (Table 2), but in the following years it is totally absent from this locality. Huhta also

Table 3. 1979. Numbers of adult specimens (♂♂/♀♀) trapped in period I-V (see Table I) at Loc. A, B, C and D.

Species \ Locality and sampling periode	Elverum A				Elverum B					Heddal C					Elverum D				
	I	II	IV	V	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Walckenaera antica (Wider)	1/1								0/3	0/1		0/1			2/0		0/1		
W. cucullata (C.L.Koch)						1/0													
W. karpinskii Kulszynski					1/0														
W. nudipalpis (Westring)										0/1									
Gonatium rubens (Blackwall)									0/1										
G. corallipes (O.P.-Cambridge)																			0/1
Cnephalocotes obscurus (Blackwall)										0/1					11/3				
Troxochrus nasutus Schenkel	1/0																		
Silometopus incurvatus (O.P.-Cambridge)															3/21	1/4			0/1
Tapinocyba pallens (O.P.-Cambridge)						2/1	0/1	1/0	1/2				1/0						
Pelecopsis elongata (Wider)				0/1					0/2										
Diplocentria bidentata Emerton					1/0	3/1									7/0				
Erigone atra (Blackwall)										6/1		1/0	1/0						
Ceratinopsis stativa (Simon)																1/0			
Milleriana inerrans (O.P.-Cambridge)													0/1						
Phorrhomma pallidium Jackson						1/2		1/0	1/0					1/0					
Centromerus incilium (L.Koch)	1/1														0/2				
Tallusia experta (O.P.-Cambridge)														0/2					
Macrargus carpenteri (O.P.-Cambridge)				1/1	1/0										0/1				
M. rufus (Wider)							0/1												
Agyneta cauta (O.P.-Cambridge)	1/0														12/4		0/2		
Meioneta gulosa (L.Koch)	0/1	2/0	0/2			3/1	0/1		3/1						1/4	0/1			
M. rurestris (C.L.Koch)										4/1		0/1	4/5	3/2					
M. beata (O.P.-Cambridge)										1/0				0/1					
Oreonetides vaginatus (Thorell)					1/0														
Lepthyphantes pallidus (O.P.-Cambridge)									4/1	2/0				16/1					
L. mengei Kulczynski									2/0			2/2		7/1					0/1
L. cristatus (Menge)						1/0													
L. angulipalpis (Westring)												1/0							
Bolyphantes index (Thorell)									1/1										
Robertus arundineti (O.P.-Cambridge)	2/0	3/0	2/0	1/0											3/0	1/0		1/0	
R. lividus (Blackwall)						4/0				3/0									
Euryopis flavomaculata (C.L.Koch)						2/0				4/0			0/1						
Steatoda phalerata (Panzer)					1/0														
Theridion varians Hahn										1/0									
Hypsosinga albovittata (Westring)	1/0														2/0		0/2		
Acantholycosa lignaria (Clerck)	3/3	2/0			21/5	36/4	0/6	0/6	0/10	9/1		0/2		0/2		3/1	0/2		0/1
Xerolycosa nemoralis (Westring)	0/1	1/1		0/1		7/1	5/3			3/0		4/0	0/1			2/0			
Pardosa lugubris (Walckenaer)	1/0				7/1	22/1		0/4	0/4	30/2		1/3	1/0						0/1
P. riparia (C.L.Koch)	0/3	0/1			7/0	56/7	4/12		0/5	4/1						1/0	0/2		
Pardosa palustris (L.)	4/1	6/0		0/1	1/0	7/1	1/0	0/2	0/1	2/C						5/0	1/0	0/1	
P. pullata (Clerck)	0/1				1/0					2/0		1/1				1/0			
P. sphagnicola (Dahl)										3/0		1/6		0/2					
P. schenkeli Lessert	2/0	0/1			1/0		0/1								14/1	18/1	2/6	0/8	0/4
P. hyperborea Thorell					2/2														
Trochosa terricola Thorell					1/0					0/1		0/3	0/1						
Pirata hygrophilus Thorell														0/1					
Alopecosa aculeata (Clerck)	3/1	2/0		0/2		5/0	0/1			7/0					0/1	3/4	3/2	0/7	0/5
Cheiracanthium virescens (Sundevall)				0/1															
Gnaphosa leporina (L.Koch)	1/0	1/0			2/0	4/1	1/1			14/0		3/6				1/1			
G. bicolor (Hahn)					3/1	0/1				10/1		1/0							
G. muscorum (L.Koch)	1/2			1/0	3/0	7/0	0/1					0/1			0/2	14/5	2/1	2/2	1/7
Drassodes lapidosus (Walckenaer)												1/0							
Haplodrassus signifer (C.L.Koch)					5/2	6/1				3/2		1/0			1/0				
H. soerenseni (Strand)					1/0	1/0													
Zelotes clivicolus (L.Koch)					4/2		2/0					2/1	2/1						
Z. petrensis (C.L.Koch)															0/2		7/1	8/1	
Clubiona trivialis C.L.Koch							1/0							1/0					
Scotina palliardi (L.Koch)										1/0									
Agroeca brunnea (Blackwall)									4/0										
A. proxima (O.P.-Cambridge)														0/1					
Zora spinimana (Sundevall)		1/0			1/1			0/1		0/1						1/0			
Z. nemoralis (Blackwall)										2/0									
Micrommata virescens (Clerck)												1/0							
Aelurillus v-insignatus (Clerck)										1/0									
Neon reticulatus (Blackwall)						1/0											0/1		
Hahnia nava (Blackwall)						1/1				1/0					23/2	1/0		0/1	
Xysticus cristatus (Clerck)					0/2	1/0		0/2							1/0	1/1			
X. sabulosus (Hahn)				2/0				4/0	36/0										1/0
X. lineatus (Westring)										1/0									
Oxyptila atomaria (Panzer)																		0/2	
O. praticola (C.L.Koch)																			1/0
Thanatus formicinus (Clerck)	2/0							1/0				0/1					0/1	0/1	
Tibellus oblongus (Walckenaer)										1/0									
Ero furcata (Villers)									0/1										

Table 4. 1980. Numbers of adult specimens (♂♂/♀♀) trapped in period I-V (see Table I) at Loc. A, B and C.

Locality and sampling periode / Species	Elverum A					Elverum B					Heddal C	Elverum D			
	I	II	III	IV	V	I	II	III	IV	V	III	I	II	III	V
Ceratinella brevis (Wider)						3/0									
Walckenaera acuminata Blackwall							0/1			0/1					
W. antica (Wider)						0/1	1/0	0/1		4/2					0/1
W. capito (Westring)	1/0				3/0					3/1		2/0			13/6
W. dysderoides (Wider)										1/0					
W. karpinskii (O.P.-Cambridge)	1/0						3/0			0/1					
W. cuspidata (Blackwall)						1/0									
Pelecopsis elongata (Wider)	0/1				0/3	4/1	2/3	0/1		1/6		1/0			
Cnephalocotes obscurus (Blackwall)												0/1	0/2	0/3	3/3
Dicymbium tibiale (Blackwall)											1/0				
Diplocentria bidentata Emerton	4/1					4/7	0/4	0/1				5/3	0/1	1/1	1/2
Ceratinopsis stativa (Simon)													1/0		
Silometopus incurvatus (O.P.-Cambridge)	15/0	0/1			1/1							83/16	6/3	0/1	8/13
Tapinocyba pallens (O.P. Cambridge)						9/4	11/2	0/2		4/6					
Erigone atra (Blackwall)										1/0	2/10				
Typhocrestus tenuis (Holm)	0/1											17/0	1/0	0/1	
Caledonia evansi O.P.-Cambridge						0/1									
Sisicus apertus (Holm)						0/1						0/1			
Porrhomma pallidum Jackson						0/8	1/2	0/3		5/4		0/1			
Centromerus incilium (L.Koch)					1/2	0/1		0/1				7/6	0/3		4/7
C. sylvaticus (Blackwall)					1/0										
Macrargus carpenteri (O.P.-Cambridge)	1/1	0/1			1/6		1/0			2/3		7/8	0/2		9/10
M. rufus (Wider)						0/1									
Agyneta cauta (O.P.-Cambridge)		0/1											9/2	0/5	
A. suecica Holm													1/0		
Meioneta gulosa (L.Koch)	21/23	12/13	1/2		1/0	15/5	7/2	3/2		1/3	2/0	25/10	4/7		1/3
M. rurestris (C.L.Koch)						3/0									
M. beata (O.P.-Cambridge)											0/1				
Microneta viaria (Blackwall)	0/1														
Diplostyla concolor (Wider)	0/1														
Drepanotylus uncatus (O.P.-Cambridge)					0/1										
Oreonetides abnormis (Blackwall)											3/0				
O. vaginatus (Thorell)						2/0	1/0								
Hilaira herniosa (Thorell)										0/1					6/2
Lepthyphantes pallidus (O.P.-Cambridge)										2/2					1/1
L. mengei Kulczynski			0/1		6/1					15/4					13/9
L. angulipalpis (Westring)					2/1	0/1				1/4					2/2
L. angulatus (O.P-Cambridge)												2/0			
L. obscurus (Blackwall)						1/0									
L. antroniensis (Schenkel)										0/1					3/0
Bolyphantes crucifer (Menge)		1/0				1/1						1/0			
B. index (Thorell)					0/3										
B. alticeps (Sundevall)					1/0										0/1
Phaulothrix hardyi (Blackwall)					8/6					17/23					0/2
Poeciloneta globosa (Wider)						0/1	0/1					0/1	0/1		
Robertus arundineti (O.P.-Cambridge)	0/5	1/1	0/1		7/2		4/0			1/0		0/2		2/1	22/3
R. lividus (Blackwall)							3/0				1/0				
R. scoticus Jackson							2/1								
Hypsosinga albovittata (Westring)							1/0								
Acantholycosa lignaria (Clerck)		2/0	1/2		1/0	0/1	3/0	1/5		0/1				0/3	
Xerolycosa nemoralis (Westring)		2/0	6/0				1/3	23/5			2/1				
Pardosa lugubris (Walckenaer)							2/1	0/4			1/2				
P. riparia (C.L.Koch)			0/1				3/1	1/6							
P. palustris (L.)		6/1	1/11				7/0							0/4	0/1
P. sphagnicola (Dahl)											1/0				
P. schenkeli Lessert		1/0					1/0			0/1			11/2	2/5	0/1
Trochosa terricola (Thorell)					1/0										
Alopecosa aculeata (Clerk)			0/1				1/0						1/2		0/4
Gnaphosa leporina (L.Koch)						0/2	0/1	2/1			2/0	0/1	2/1	2/0	0/1
G. bicolor (Hahn)											0/1				
G. muscorum (L.Koch)		2/0	2/1			0/1	6/1	4/1		0/3		3/2			0/13
G. montana (L.Koch)							1/0								
Drassodes pubescens (Thorell)							1/0			0/1					
Haplodrassus signifer (C.L.Koch)							1/1								
Zelotes latreillei (Simon)												2/0			
Z. petrensis (L.Koch)					0/1							0/2		19/0	
Zora spinimana (Sundevall)													0/1	0/1	
Agroeca brunnea (Blackwall)										1/2					0/1
Neon reticulatus (Blackwall)		1/0					0/1						1/1	0/1	
Hahnia nava (Blackwall)							1/0						1/2	1/0	
Xysticus sabulosus (Hahn)	0/2					6/0	0/4			21/0					1/0
Oxyptila atomaria (Panzer)															2/0
Tibellus oblongus (Walckenaer)											0/1				
Thanatus formicinus (Clerck)						0/1	1/1					0/3	0/1		
Dictyna arundinacea (.1)								0/1					1/0		

Table 5. 1981. Numbers of adult specimens (♂♂/♀♀) trapped in period I-V (see Table I) at Loc. A, B, C and E.

Species \ Locality and sampling periode	Elverum A				Elverum B				Heddal C			Rendalen E			
	I	II	III	V	I	II	III	V	I	II	IV	I	II	III	IV
Walkenaera acuminata Blackwall								0/2							
W. antica (Wider)	1/0				3/2	0/1		2/4	4/0	4/3	0/2	4/0			
W. capito (Westring)	1/0			1/0											
W. mitrata (Menge)					3/0										
W. dysderoides (Wider)						1/0						4/0			
W. cuspidata (Blackwall)								1/0							
W. clavicornis (Emerton)												1/0			
W. nudipalpis (Westring)								1/0		0/1					
W. monoceros (Wider)												1/0			
Gonatium corallipes (O.P.-Cambridge)								0/1							
Cnephalocotes obscurus (Blackwall)												1/3	0/1		
Pelecopsis elongata (Wider)				1/0		1/2		7/12							
Entelecara erythropus (Westring)													0/1		
Tapinocyba pallens (O.P.-Cambridge)					26/3	0/1		0/1	3/1	7/0		48/1	0/2	2/1	0/1
Silometopus incurvatus (O.P.-Cambridge)	2/0	0/1		0/1	0/1										
Araeoncus crassiceps (Westring)										1/0					
Lasiargus hirsutus (Menge)														1/0	
Savignya frontata (Blackwell)										5/0					
Diplocentria bidentata Emerton	2/0				1/0			0/1							
Microcentria pusilla (Schenkel)												5/2			
Micrargus herbigradus (Blackwall)										0/1					
Caledonia evansi O.P.-Cambridge	0/1							0/1							
Typhocrestus digitatus (O.P.-Cambridge)								1/0							
Thyreosthenius parasiticus (Westring)										0/1					
Erigone atra (Balckwall)								0/1	25/2	10/11	1/4				
E. dentipalpis (Wider)									0/1		0/1				
Sisicus apertus (Holm)								0/1							
Porrhomma pallidum Jackson		0/1			1/4			5/1	0/1			2/0			1/0
Centromerus arcanus (O.P.-Cambridge)		0/1								3/0					
C. incilium (L.Koch)	0/2								1/1			3/5	0/3		0/3
Tallusia experta (O.P.-Cambridge)									4/7	0/2					
Macrargus rufus (Wider)								1/0							
M. carpenteri (O.P.-Cambridge)				0/1	0/1			2/3	1/1			0/1			
Agyneta cauta (O.P.-Cambridge)												9/0			
A. suecica (Holm)						0/1						0/1			
Meioneta gulosa (L.Koch)	14/7	2/2		0/1	11/8	0/5	0/3	2/2	15/7	2/2		1/3			
M. beata (O.P.-Cambridge)									1/0	1/1					
Oreonetides vaginatus (Thorell)					3/0										
Hilaira herniosa (Thorell)				0/2											
Lepthyphantes mengei Kulczynski				6/0	1/1			2/0							
L. angulipalpis (Westring)	0/2				1/1								0/1		
L. antroniensis (Schenkel)				1/0								1/0			0/1
L. pallidus (O.P.-Cambridge)								1/0		0/2		2/1			
L. alacris (Blackwall)												1/0			
Bolyphantes index (Thorell)					0/1							1/0			
B. crucifer (Menge)	0/1	0/1		1/0	1/1							1/0			
Bathyphantes gracilis (Blackwall)		0/1													
Diplostyla concolor (Wider)								1/0		0/1					
Stemonyphantes lineatus (L.)									0/1			0/2			
Poeciloneta globosa (Wider)		1/0						1/0				3/1			
Phaulothrix hardyi (Blackwall)				7/16				25/24							
Robertus arundineti (O.P.-Cambridge)	5/4	2/1	1/1	9/7	2/0										
R. scoticus Jackson					1/0			1/1		1/1			0/1		
R. lividus (Blackwall)								3/1	0/1	9/0	1/0				
Crustulina guttata (Wider)					1/0										
Euryopis flavomaculata (C.L.Koch)										2/0					
Hypsosinga sanguinea (C.L.Koch)												1/0			
Acantholycosa lignaria (Clerck)	0/1	3/1	0/1		3/5	11/0	0/11	0/4		3/0	0/3	1/0	3/0	0/8	0/3
Xerolycosa nemoralis (Westring)		13/2	5/0		8/2	47/6	14/5				0/1		0/1		
Pardosa lugubris (Walckenaer)								0/2	1/1	35/6	0/5				
P. riparia (C.L.Koch)						12/5	0/3	0/3		0/1					
P. palustris (L.)	1/0	6/1	0/1			14/4	0/4					1/0	0/1	0/1	
P. sphagnicola (Dahl)										13/10	0/3				
P. schenkeli Lessert		2/0				1/1							2/1	0/4	0/1
P. hyperborea (Thorell)						1/0							1/0		
P. amentata (Clerck)					0/1										
Trochosa terricola (Thorell)					5/0			0/1	50/7	8/1	0/5	2/1			
Alopecosa aculeata (Clerck)		1/0	0/2			3/0	0/2	0/1		12/1	0/1	4/3	16/8	0/12	0/7
A. pulverulenta (Clerck)										0/1	0/2				
Dolomedes fimbriatus (Clerk)	1 juv.														
Gnaphosa leporina (L.Koch)			1/0		0/3	5/7	2/0	0/2	0/2	5/1	3/0	0/1	4/4		
G. muscorum (L.Koch)					0/2	7/3	1/3	0/3				0/4	23/11	2/2	0/6
G. montana (L.Koch)										4/0	0/2				
Drassodes pubescens (Thorell)										2/0					
Haplodrassus signifer (C.L.Koch)					2/0	0/1			13/1	7/5	1/1	2/0	0/1		
Zelotes petrensis (L.Koch)			1/0									0/2		5/0	
Z. clivicolus (L.Koch)									3/2	17/1	7/1				
Z. latreillei (Simon)										0/1					
Z. subterraneus (C.L.Koch)												2/5	0/1	1/0	
Z. sp.												4/10			
Agroeca brunnea (Blackwall)								1/2		0/1					
Clubiona trivialis (L.Koch)									0/1						
Cheiracanthium virescens (Sundevall)									1/0						
Zora nemoralis (Blackwall)									1/0			4/0			1/0
Aelurillus v-insignatus (Clerck)	1/0				1/2							4/2		1/0	1/0
Neon reticulatus (Blackwall)		0/1										0/1	0/1		
Evarcha falcata (Clerck)										1/0	1/0				
Hahnia nava (Blackwall)	2/0				0/1			1/0							
H. pusilla C.L.Koch										1/0					
Cryhoela silvicola (C.L.Koch)												0/1			
Xyzticus cristatus (Clerck)	2/0				1/0					0/1		1/1			
X. sabulosus (Hahn)				2/0				15/0							
X. bifasciatus C.L.Koch						1/0									
Thanatus formicinus (Clerck)	1/3				4/1					1/0		0/2			

reckons *Erigone atra* (Blackwall) among the pioneer species. This species is present at Loc. C all four years after the fire. Unfortunately we have no control area for Loc. C. *Centromerus incilius* (L. Koch) appears at Loc. A the second year after the fire (Table 3) and at Loc. B the third year (Table 4), while it according to Huhta (1971) appeared in the fifth year. At Loc. E, however, this species is established the first year after the fire (Table 5). Other species deviating from Huhta's findings are *Centromerus arcanus* (O.P.-Cambridge) which appeared in our traps during the first year after the fire at both Loc. B and Loc. C (Table 2). (It is also found at Loc. A and Loc. C in 1981 (Table 5)). It was found by Huhta the 3. or 4. year. *Macrargus rufus* is found in our material as early as the second year (Table 3). A relatively common species, *Diplocentria bidentata* Emerton, is not caught at Loc. A untill 1980 (Table 2—4). Relatively sparse at Loc. A, compared to the control area (D), are *Agyneta cauta* (O.P.-Cambridge), *Silometopus incurvatus* (O.P.-Cambridge) (before 1980!), *Typhocrestus tenuis* (Holm), *Pardosa schenkeli* Lessert, *Zelotes petrensis* and *Hahnia nava* (Blackwall). Also *Macrargus carpenteri* (O.P.-Cambridge) shows a similar trend. The common species *Tapinocyba pallens* (O.P.-Cambridge) was present the first year after the fire, as also found by Huhta (1971), but he shows that this species takes several years to reach its original population density. *Cnephalocotes obscurus* (Blackwall) is not re-established at Loc. A as late as the third year, while several specimens have been found at the control area (Loc. D) in 1979—1980. This species is, however, present at Loc. E the first year after the fire (Table 5).

The following species are recorded for the first time in Norway: *Walckenaera mitrata* (Menge), *W. monoceros* (Menge), *Gonatium corallipes* (O.P.-Cambridge), *Troxochrus nasutus* Schenkel, *Silometopus incurvatus* (O.P.-Cambridge), *Ceratinopsis stativa* (Simon), *Milleriana inerrans* (O.P.-Cambridge), the east-European *Lasiargus hirsutus* (Menge), *Hypsosinga sanguinea* (C.L. Koch), *Pardosa schenkeli* Lessert. *M. inerreans* in particular is interesting since this finding is the most northern of this southern species. Locket & Millidge (1953) report the species from the southernmost part of England and put a question mark to a report from Scotland. Interesting is also *P. schenkeli*, previously reported only from the Alps and from Ural (Maurer 1978). *T. nasutus* is previously known from Switzerland (Wiehle 1963) and from Finland (Palmgren 1976). *Crustulina guttata* (Wider) is in Norway previously reported only from Nordfugløy in Nordland.

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The distribution and host relations of Norwegian ticks (Acari, Ixodides)

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Extensive investigations concerning ectoparasites of many groups of terrestrial vertebrates have been conducted by the author and coworkers during the past 15 years. 900 nests and 7640 host animals consisting of 220 species have been investigated for parasites. This article summarizes the tick species which have been found and gives their geographic distribution (maps) and their host relationships in Norway. The following species of ticks are recorded in Norway: *Ixodes arboricola* Schulze & Slottke, *Ixodes caledonicus* Nuttall, *Ixodes frontalis* (Panzer), *Ixodes hexagonus* Leach, *Ixodes lividus* (C.L. Kock), *Ixodes ricinnus* (L.), *Ixodes trianguliceps* Birula, *Ixodes uriae* White, *Hyalomma marginatum marginatum* C.L. Koch, *Rhipicephalus sanguineus* (Latreille), and *Argas vespertilionis* (Latreille).

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INTRODUCTION

Ticks are important parasites of terrestrial vertebrates. They serve as vectors for diseases of animals and humans and are able to transmit virus, rickettsia, bacteria and protozoa. Therefore, knowledge concerning species distribution and host relations is of great importance for the understanding of the circulation of pathogens in natural foci.

The first survey of ticks in Norway was conducted by Tambs-Lyche (1943 a, b). More recent information concerning new species and revisions of faunistic surveys in this country was published by Mehl (1970a, 1979, 1981). Furthermore, a popular article on ticks in Norway was written by Tambs-Lyche & Mehl (1982). Ten species have been reported on freeliving animals, and in addition one species was imported with dogs and was able to reproduce indoors (Tharaldsen 1973).

During the past 15 years we have conducted an extensive investigation concerning ectoparasites of many groups of terrestrial vertebrates. The results are published in a number of articles treating the parasites of various host species (Mehl 1968, 1972a, b, c, Mehl & Traavik 1983) and in connection with investigations regarding vector-borne diseases (Traavik & Mehl 1977, Traavik, Mehl & Kjeldsberg 1977, Traavik, Mehl & Wiger 1978, Mehl, Traavik & Wiger 1983).

The purpose of this article is to summarize the tick species which have been found, their geographic distributions and their host relationships in Norway.

MATERIALS AND METHODS

The material consists of approximately 8600 ticks. The number of hosts which were examined for ticks totals approximately 7640 animals consisting of 220 species. The number of specimens from each of the following groups are as follows: shrews 350, bats 450, rodents 2100, carnivores 80, domestic animals 50, birds 4600 and reptiles 10. We also examined 700 bird nests and around 200 rodent nests. Furthermore, 40 samples of ticks from humans and domestic animals were mailed to the Entomological Laboratory, National Institute for Public Health in Oslo.

The collection/investigational methods have been described by Mehl (1970b) and Traavik & Mehl (1977).

The works of Haarløv (1962), Arthur (1963) and Filippova (1977) were used for identification and information concerning general geographic distribution. The following publications were used for the geographic distribution in Fennoscandia and Denmark: Schulze (1930), Arthur (1955), Öhman (1961), Ulmanen (1972), Nilsson (1974a, b) and Brinck-Lindroth et al. (1975).

The material of ticks is deposited in the Zoological Museum in Oslo.

RESULTS AND DISCUSSION

Eleven species of ticks were found in the present study. Data concerning the discovery of *Ixodes frontalis* (= *Ixodes pari* Leach, 1815) has not been published previously. However, this species was included in the Norwegian fauna-list (Mehl 1979).

Ticks were collected from people, 34 species of mammals, 37 species of birds, and one reptile. One species, *Ixodes ricinus,* was found on humans, other mammals, birds and a reptile. *Ixodes uriae* normally occurring on colony-nesting seabird, could also be found on people visiting bird cliffs. It is also possible that this species infests the sheep which graze in and around these bird colonies. Four species were confined to mammals: *Ixodes hexagonus* on carnivores and hedgehogs, *Ixodes trianguliceps* on small rodents and shrews, *Argas vespertilionis* on bats, and *Rhipicephalus sanguineus* on dogs. Three species occurred on birds only: *Ixodes arboricola* from passerines and a woodpecker which nest in hollow trees and bird houses, *Ixodes caledonicus* from starlings, and *Ixodes lividus* from sand martins. Permanent populations of these bird ticks also occur in our neighboring countries. Two species of ticks, *Ixodes frontalis* and *Hyalomma marginatum,* were found on migratory birds and only during spring movements. *H. marginatum* adults parasitize large mammals.

Three species of ticks were quite common on their preferred hosts or within their special ranges: *I. ricinus, I. trianguliceps* and *I. uriae. A. vespertilionis* was common in particular colonies of bats. However, the remaining tick species appear to be relatively rare and were present only on a small percentage of the appropriate host species. *R. sanguineus* was imported with dogs, and although it was observed to reproduce indoors, we have not found permanent populations.

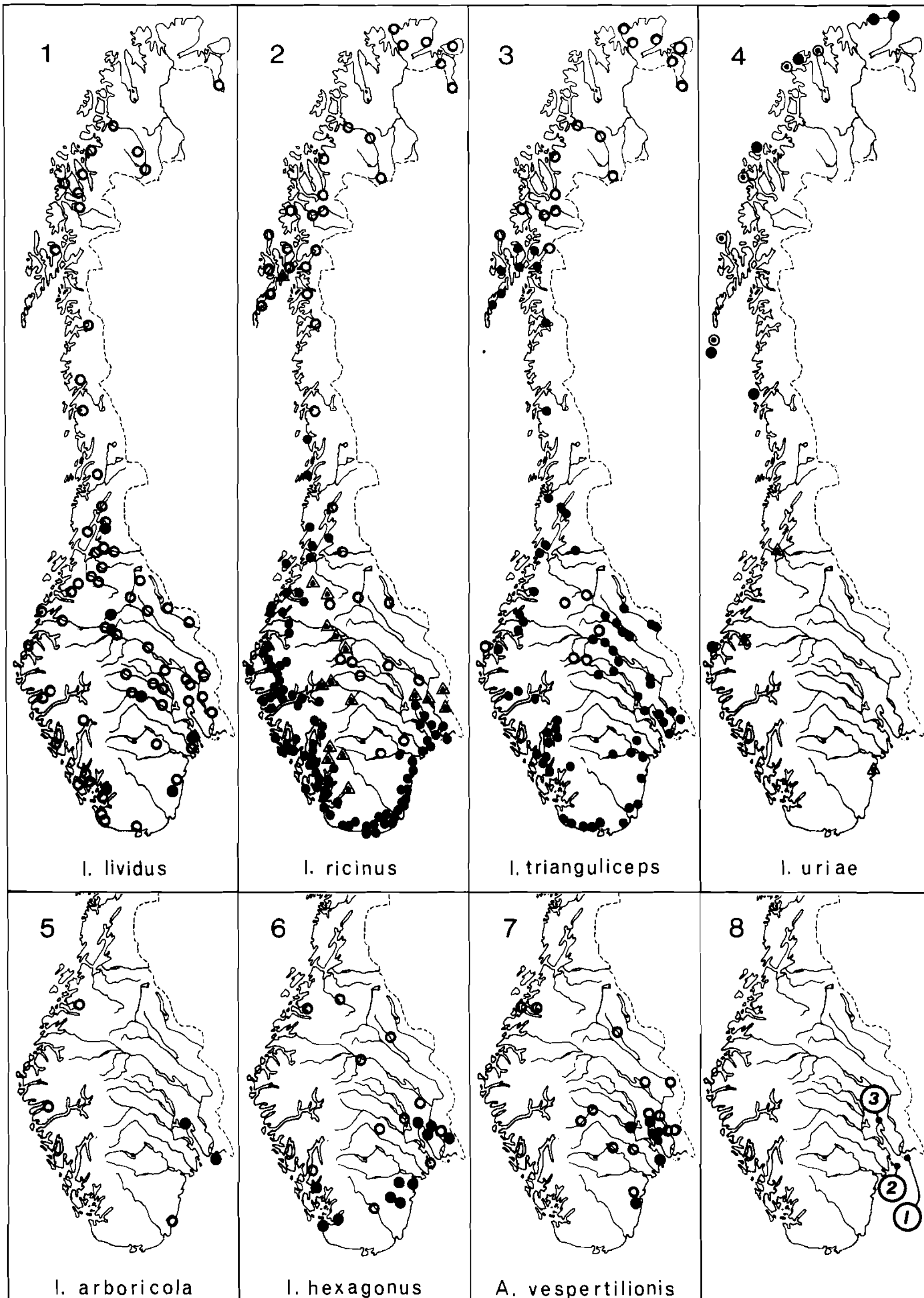
More than 4000 migratory birds have been investigated, thus the transport of ticks with migrating birds to Norway is a well known phenomenon (Mehl, Lid & Michaelsen 1983). A relatively small number of nesting birds have been examined, and consequently our knowledge concerning the distribution and ecology of bird ticks, with the exception of *I. uriae,* is limited (Mehl & Traavik 1983).

The recorded geographic distribution of the individual tick species found in Norway are presented in Figs. 1 — 8.

Certain of the following tick species which have been found in neighbouring countries could also be present in Norway: ***Haemaphysalis punctata*** Canestrini & Fanzango, 1877; ***Ixodes crenulatus*** Koch, 1844; ***Ixodes unicavatus*** Neumann, 1908; ***Ixodes apronophorus*** Schulze, 1924; and ***Argas reflexus*** (Fabricius, 1794).

Family Ixodiade

1. *Ixodes arboricola* Schulze & Schlottke, 1929.
   The first report of this species in Norway was published by Tambs-Lyche (1943b). The present investigation recorded this species three times on two host species from the same locality (Fig. 8, No. 1).
   Recorded hosts in Norway: *Sturnus vulgaris* L., 1758, *Ficedula hypoleuca* (Pallas, 1764) and *Dendrocopos leucotos* (Bechstein, 1803).
   Recorded distribution in Norway: See Fig. 5.
   Range and notes: Europe. Found on birds which nest in hollow trees, bird houses, etc. Variations in anatomical characters of taxonomic importance are discussed by Haarløv (1962).
2. *Ixodes caledonicus* Nuttall, 1910.
   One specimen recorded from *Sturnus vulgaris* L., 1758 on the island Akerøya, Fig. 8, locality No. 1 (Mehl 1970a).
   Range and notes: Northern- and Central Europe. The principal host appears to be the domestic pigeon *Columba livia* Gmelin, 1789, but several other species of birds have been recorded as hosts.
3. *Ixodes frontalis* (Panzer, 1798).
   The only specimen (nymph) from Norway was collected from *Phylloscopus trochilus* (L., 1758) on the island of Akerøya on May 17, 1971 (Leg. G. Lid), Fig. 8, locality No. 1.
   Range and notes: Western and Southern parts of Europe on a number of bird species. One record from Denmark (Arthur 1955). Knowledge of both its distribution and host relations are inadequate.
4. *Ixodes hexagonus* Leach, 1815.
   Tambs-Lyche (1943b) recorded this species from two species of mammals: *Meles meles* and *Martes martes*. Several records and a distribution map have been published by Mehl (1972a, b, c).
   Recorded hosts in Norway: *Vulpes vulpes* (L., 1758), *Mustela vison* Schreber, 1777, *Martes martes* (L., 1758), *Meles meles* (L., 1758), *Lutra lutra* (L., 1758), *Felis catus* L., 1758 and *Erinaceus europaeus* L., 1758.
   Recorded distribution in Norway: See Fig. 6.
   Range and notes: Europe and North-Africa. It is associated with hosts having a «permanent dwelling» (nests, dens, burrows, etc.), such as carnivores and hedgehog, but can occasionally be found on other species.


1
I. lividus
2
I. ricinus
3
I. trianguliceps
4
I. uriae
5
I. arboricola
6
I. hexagonus
7
A. vespertilionis
8
3
2
1

Mustela erminea L., 1758 is an important host for this tick on the British Isles (Arthur 1963). *I. hexagonus* was not found on any of the 15 *M. erminea* or 10 *Mustela nivalis* L., 1766 in the present material.

5. *Ixodes lividus* (C.L. Koch, 1884).
This species was found in seven of the 83 investigated colonies (n = 200 nests) of *Riparia riparia* (L., 1758). More details are given by Mehl (1970a).
Recorded distribution in Norway: See Fig. 1.
Range and notes: Europe and Siberia. Associated with the sand martin *R. riparia* only.
It is possible that the range of *I. lividus* is greater than that shown in Fig. 1, since it appeared to occur more frequently in Northern Sweden and Finland (Ulmanen et al. 1977).

6. *Ixodes ricinus* (L., 1758).
Tambs-Lyche (1943a) conducted an extensive survey of the distribution of this species in Norway based upon collections of ticks from domestic animals and information concerning the distribution of the tick-borne disease, babesiosis of cattle. He published a map based on identified material and gave a more detailed description of the distribution of *I. ricinus* obtained by analyzing questionnaires sent to veterinarians, zoologists etc. Tambs-Lyche recovered *L. ricinus* from 13 host species (humans, 6 domestic animals, 2 other mammals and 4 birds). More recent records of this species have been published by Kohls & Locker (1954), Lund (1964) and Mehl, Traavik & Wiger (1983).
Recorded hosts in Norway: There are 49 recorded host species of *I. ricinus*. The list contains man, domestic animals (6), other mammals (15), bird (27) and reptiles (1). Man and domestic animals — *Homo sapiens* (L., 1758), *Canis familiaris* L., 1758, *Felis catus* L., 1758, *Equus caballus* L., 1758, *Bos taurus* L., 1758, *Capra hircus* L., 1758, *Ovis aries* L., 1758, *Homo sapiens* L., 1758. Other mammals — *Erinaceus europaeus* L., 1758, *Sorex minutus* L., 1758, *Sorex araneus* L., 1758, *Lepus timidus* L., 1758, *Sciurus vulgaris* L., 1758, *Lemmus lemmus* (L., 1758), *Clethrionomys glareolus* (Schreber, 1780), *Clethrionomys rufocanus* (Sundevall, 1846), *Microtus agrestis* (L., 1761), *Apodemus sylvaticus* (L., 1758) *Apodemus flavicollis* (Melchior, 1834), *Mus musculus* L., 1758, *Vulpes vulpes* (L., 1758), *Meles meles* (L., 1758), *Cervus elaphus* L., 1758 Birds-*Bubo bubo* (L., 1758), *Anthus trivialis* (L., 1758), *Motacilla alba* (L., 1758, *Sturnus vulgaris* L., 1758, *Garrulus glandarius* (L., 1758), *Troglodytes troglodytes* (L., 1758), *Prunella modularis* (L., 1758), *Sylvia atricapilla* (L., 1758), *Sylvia communis* Latham, 1787, *Sylvia curruca* (L., 1758), *Phylloscopus trochilus* (L., 1758), *Phylloscopus collybita* (Vieillot, 1817), *Muscicapa striata* (Pallas, 1764), *Phoenicurus phoenicurus* (L., 1758), *Erithacus rubecula* L., 1758, *Luscinia svecica* (L., 1758), *Turdus pilaris* L., 1758, *Turdus torquatus* L., 1758, *Turdus merula* L., 1758, *Turdus iliacus* L., 1766, *Turdus philomelos* Brehm, 1831, *Parus major* L., 1758, *Passer domesticus* (L., 1758), *Fringilla coelebs* L., 1758, *Fringilla montifringilla* L., 1758, *Carduelis chloris* (L., 1758), *Carduelis spinus* (L., 1758), Reptiles-*Lacerta viviparia* Jaquin, 1787.
Recorded distribution in Norway: See Fig. 2. *I. ricinus* is distributed in a narrow zone along the southern coast between the Oslofjord and Jæren where it occurred as high as 50—150 m a.s.l. Along the western coast however, it is generally distributed in a relatively wide zone including the innermost regions of most of the fjords and neighbouring valleys. However it has not been found around the innermost part of the Sognefjord where the climate is drier and warmer than the areas closer to the ocean. In many areas it is common from sea level till 400 m a.s.l., but has also been found as high as 800 m a.s.l.
Both ticks and babesiosis are absent from the treeless Jæren penninsula. However, *I. ricinus* has become established in those areas where trees have been planted. Tambs-Lyche (1944, 1962) analysed the distribution i relation to climate and vegetation. He concluded that *I. ricinus* belongs to the «coast» or «Atlantic» animals whose distributions are governed mainly by the humidity of the environment. He also pointed out that the vegetation is important since it has a modifying effect on the humidity of a habitat. In the periphery of its range in Norway, *I. ricinus* is found in scattered, suitable localities.
I. ricinus (adult females) has occasionally been found on domestic animals outside of its normal range. The source of these infestations are pro-

◀ Figs. 1—8. The maps show the recorded distribution of ticks in Norway. *Solid circles* = localities where ticks have been collected and identified. *Open circles* = localities where hosts for the individual tick species were examined without finding ticks. *Triangles* = observations which originate from localities outside of the species «normal» range. Such observations are ascribed to transportation with birds or domestic animals. *Open circle containing a dot* = samples which were not identified, but which are considered positive finds.

Fig. 1, *Ixodes lividus*.
Fig. 2, *Ixodes ricinus*.
Fig. 3, *Ixodes trianguliceps*.
Fig. 4, *Ixodes uriae*.
Fig. 5, *Ixodes arboricola*.
Fig. 6, *Ixodes hexagonus*.
Fig. 7, *Argas vespertilionis*.
Fig. 8, shows the localities Nos. 1, 2 and 3. 1 = Akerøya, 2 = Store Færder, 3 = Oslo. *Ixodes caledonicus* and *Ixodes frontalis* were recorded from locality No. 1. *Hyalomma marginatum* from Nos. 1 and 2. *Rhipicephalus sanguineus* from No. 3.

bably nymphs which were transported by migratory birds during spring. Previous records of ticks on domestic animals outside of its normal range have been attributed to the transportation of cattle from the coastal to inland areas (Tambs-Lyche 1962).

Range and notes: *I. ricinus* is recorded from Europe and North-Africa. It parasitizes mammals, birds and reptiles.

Tambs-Lyche (1959) published a review of the diseases which can be transmitted by *I. ricinus* in Norway.

7. *Ixodes trianguliceps* Birula, 1895.

Tambs-Lyche (1943b) found this species on three host species from two localities. Records from Norway are also published by Swedish investigators (Nilsson 1974a, b, and Brinck-Lindroth et al. 1975).

Recorded hosts in Norway: *Sorex minutus* L., 1758, *Sorex araneus* L., 1758, *Neomys fodiens* (Pennant, 1771), *Myopus schisticolor* (Lilljeborg, 1844), *Lemmus lemmus* (L., 1758), *Clethrionomys rutilus* (Pallas, 1779), *Clethrionomys glareolus* (Schreber, 1780), *Clethrionomys rufocanus* (Sundevall, 1846), *Arvicola terrestris* (L., 1758), *Microtus agrestis* (L., 1758), *Microtus oeconomus* (Pallas, 1776), *Apodemus flavicollis* (Melchior, 1834), *Apodemus sylvaticus* (L., 1758) and *Mus musculus* L., 1758.

Recorded distribution in Norway: See Fig. 3. There are no records of *I. trianguliceps* in North-Norway northeast of the Ofoten area or in the alpine region in South-Norway. This distributional pattern appears to be based on climatic conditions.

Range and notes: Europe and Siberia. The principal hosts are small rodents and shrews.

8. *Ixodes uriae* White, 1852.

The first records in Norway are given by Schulze (1938) and Tambs-Lyche (1943b). A more detailed study of the distribution, host relationship and ecology of *I. uriae* has been conducted by Mehl (1968) and Mehl & Traavik (1983).

Recorded hosts in Norway: *Phalacrocorax aristotelis* (L., 1761), *Rissa tridactyla* (L., 1758), *Uria aalge* (Pontoppidan, 1763), *Cepphus grylle* (L., 1758), *Fratercula arctica* (L., 1758) and *Homo sapiens* (L., 1758).

Recorded distribution in Norway: See Fig. 4. Its distribution is confined to seabird colonies in typical birdcliffs. However, it is also recorded on birds outside their colonies.

Range and notes: *I. uriae* has a bipolar distribution including North Atlantic, North Pacific, Australia, New Zealand and Antarctic islands. It is associated with colony-nesting seabirds. It also infests people visiting the bird cliffs.

9. *Hyalomma marginatum marginatum* C.L. Koch, 1844.

Specimens previously published as *Hyalomma* sp. (Mehl 1970a), have been identified by Kaiser and Hoogstraal as *Hyalomma marginatum* (nymphs) and *H. m. marginatum* (one female). Under laboratory conditions, one adult tick developed from a nymph taken from a bird.

Recorded hosts in Norway: *Phoenicurus phoenicurus* (L., 1758), *Achrocephalus scirpaceus* (Hermann, 1804) and *Lanius collurio* L., 1758.

Recorded distribution in Norway: This species is regularly transported to Norway by migrating birds during the last part of May. It has been collected on the ornithological stations on the islands Akerøya and Store Færder, Fig. 8, localities Nos. 1 and 2.

Range and hosts: This sub-species is normally found in Southern Europe and Northern Africa. The sub-species *H. marginatum rufipes* C.L. Koch, 1844 occurs normally in Africa, south of the Sahara Desert. Both subspecies have been found on migrating birds in Finland (Saikku et al. 1971).

10. *Rhipicephalus sanguineus* (Latreille, 1806).

This tropical species is transported to Northern Europe with dogs and commercial goods. It has managed to survive and reproduce indoors and attacks both dogs and humans (Haarløv 1981).

Recorded hosts in Norway: *Canis familiaris* L., 1758.

Recorded distribution in Norway: Oslo, Fig. 8, locality No. 3. Specimens of *R. sanguineus* have been found on dogs which have passed through quarantine stations. It has reproduced at the quarantine station in Oslo, and consequently control measures were carried out at the station (Tharaldsen 1973, Mehl unpublished).

Range and notes: Originates in Africa, but with the help of man has spread over great parts of the earth, especially in warmer countries.

Family Argasidae

11. *Argas vespertilionis* (Latreille, 1802).

This is the only tick found on bats in Norway. The first records were given by Mehl (1970a).

Recorded hosts in Norway: *Myotis daubentoni* (Leisler, 1819), *Myotis mystacinus* (Kuhl, 1819), *Eptesicus nilssonii* (Keyserling & Blasius, 1839), and *Pipistrellus pipistrellus* (Schreber, 1774).

Recorded distribution in Norway: See Fig. 7.

Range and notes: This species has a wide distribution on many species of bats in Europe, Asia and Africa.

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Short communications

THE FIRST RECORD OF THE NYMPH OF *XANTHOPERLA APICALIS* (NEWMAN) (PLECOPTERA: CHLOROPERLIDAE) FROM SCANDINAVIA, WITH A KEY TO THE MATURE NYMPHS OF THE SCANDINAVIAN CHLOROPERLIDAE

JOHN E. BRITTAIN

The nymph of *Xanthoperla apicalis* has been recorded in the River Namsen, Nord-Trøndelag and in the River Glomma, Hedmark, Norway. Only adults have previously been recorded from Scandinavia. The salient characters of the Norwegian material of *X. apicalis* are described and a key is given to distinguish between the mature nymphs of *X. apicalis* and the other two Scandinavian Chloroperlidae, *Siphonoperla burmeisteri* and *Isoptena serricornis*.

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Xanthoperla apicalis (Newman), formerly *Chloroperla apicalis* Newman, is a lotic species which has been recorded in large rivers throughout much of Europe (Illies 1978). Although the nymph was first described by Aubert (1953) from northern Italy, only the adults have been recorded from Scandinavia (Brinck 1949, Lillehammer 1974). However, in samples from the River Namsen in the county of Nord-Trøndelag, central Norway, several chloroperlid nymphs were present which clearly differed from the only other chloroperlid recorded from Norway, *Siphonoperla burmeisteri* (Pictet). The nymphs agree with the description of *X. apicalis* given by Aubert (1953). Subsequently nymphs of *X. apicalis* have been found in benthic samples from the River Glomma in southern Norway (Brittain et al. — in press). It is therefore the intention of this paper to point out the salient characters of the nymph of *X. apicalis*, based on Norwegian material, and at the same time provide a key to the mature nymphs of the Scandinavian Chloroperlidae.

Nymphal material of *X. apicalis* has been studied from the following Norwegian locations: 1. The River Namsen at Kjelmoen (UTM UM947789): 17 nymphs, 2. The River Namsen above Grong (UTM UM711528): 5 nymphs, 3. The River Sanddøla, below Tømmeråshølen (UTM UM717512): 4 nymphs. 4. The River Glomma at Bellingmo, in Hedmark county (UTM NP915797): 68 nymphs, 5. The River Glomma at Hanestad (UTM NP992579): 11 nymphs. At the first location *X. apicalis* occurred together with *S. burmeisteri*. Mature nymphs of *X. apicalis* were found during May and June. The nymphs occurred on stony substratum in forest rivers where the current speed was moderate.

The nymphs of *Xanthoperla apicalis* agree with most of the characters given by Aubert (1953) and later quoted by Hynes (1977). The mature nymph of *X. apicalis* is smaller (5—8 mm), slimmer and much paler coloured than *Siphonoperla burmeisteri*. The area between the ocelli, which is brown in *S. burmeisteri*, is pale yellow in *X. apicalis*. In *S. burmeisteri* the pronotal bristles are more or less evenly distributed along the whole of the lateral edge, while in *X. apicalis* they are arranged in anterior and posterior groups. The anterior group is especially noticeable. A similar difference is present between *Chloroperla torrentium* (Pictet) and *Chloroperla tripunctata* (Scopoli) (Hynes 1977). The banding of the abdominal terga is often more apparent in *X. apicalis*, but this is not a reliable character to separate the two species.

The only other chloroperlid recorded from Scandinavia is *Isoptena serricornis* Pictet where its known distribution includes Denmark (Kaiser 1977) and Sweden (Illies 1953, Benedetto 1973). It has not so far been recorded from Norway. The nymph of *I. serricornis* which has been illustrated by Illies (1953) and Kittel (1976), is morphologically adapted to a burrowing life in the substratum and therefore differs markedly from other Scandinavian stoneflies. However, as in the other chloroperlids the last segment of the maxillary palp is reduced in width. Apart from this character, there is little morphological similarity between *I. serricornis* and the other two Scandinavian chloroperlids. The mature nymphs of the Scandinavian Chloroperlidae can be distinguished as follows:

1. Covered in long hairs especially around the eyes and on the thoracic terga. Legs with a fringe of long hairs. Antennae reduced. Cercal bristles short, less than 1/3 segmental length. Smooth profile
   . . . . *I. serricornis*.
   Only scattered hairs on the head. Antennae not reduced. Cercal bristles longer
   . . . . 2.
2. Nymph, especially the head and thorax, pale yellow. Pale area between ocelli. Pronotal bristles arranged in anterior and posterior groups
   . . . . *X. apicalis*.

Nymph darker; area between the ocelli brown. Pronotal bristles forming a more or less continuous fringe
.... *S. burmeisteri.*

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PSEUDOVESPULA OMISSA (BISCHOFF) (HYM. VESPIDAE)

STIG LUNDMO & PER STRAUMFORS

One specimen of *Pseudovespula omissa* (Bischoff) is recorded from Buskerud, Southern Norway.

Stig Lundmo & Per Straumfors, Rana museum, Naturhistorisk avd. 8600 Mo.

The cuckoo — wasp, *Pseudovespula omissa* (Bischoff 1931) was first published from Sandnes, South-western Norway (Rognes and Mohn 1981).

Later the species has been recorded from the vicinity of Trondheim. (Eriksen 1982). In the collection of Rana Museum, Dept. of Natural History we found one specimen of *P. omissa* collected by one of us (P.S.) in Hole community, Buskerud county, EIS 36, 1 ♀ 12. July 1977.

The specimen was identified by Stig Lundmo. Knut Rognes has kindly verified the identification.

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ADDITIONS TO THE LIST OF CADDIS FLIES (TRICHOPTERA) FROM VESTFOLD, SOUTH-EASTERN NORWAY

TROND ANDERSEN

Five Trichoptera, *Beraea pullata* (Curtis, 1834), *Hydatophylax infumatus* McLachlan, 1865, *Oligotricha lapponica* (Hagen, 1864), *O. striata* (L., 1758), and *Hagenella clathrata* (Kolenati, 1848), are recorded for the first time in Vestfold. The number of Trichoptera now recorded from Vestfold amounts to 102 species.

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A total of 97 species of Trichoptera have previously been recorded from Vestfold (Andersen 1975). The number of species from this province have now reached 102 as five more species have been collected by Geir Ellefsen (GE), Arne Fjellberg (AF), and the author (TA).

The species

Beraeidae

Beraea pullata (Curtis, 1834) Eidene, Tjøme (UTM:32VNL8051) 19 June 1965, 1 ♀, at an excavated pond (AF). Kjæretangen, Tjøme (UTM:32VNL8052) 12 June 1967, 1 ♀, marsh

(AF). Sandø, Tjøme (UTM:32VNL8449) 13 June 1967, 1 ♀, marsh (AF).

In Norway *B. pullata* has previously been recorded from On, Bø, HOy, HOi, STy, Nsi, TRy (Brekke 1946, Solem 1967).

Limnephilidae

Hydatophylax infumatus McLachlan, 1865 Bergandammen, Lardal (UTM: 32VNL483917) 3 Aug. 1979, 1 ♂; 18 June 1980, 3 ♂, light trap at small river (GE).

In Norway *H. infumatus* has previously only been recorded from HEn and Fø (Forsslund 1935, Solem 1970).

Phryganeidae

Oligotricha lapponica (Hagen, 1864) Bergandammen, Lardal (UTM: 32VNL483917) 18 June 1980, 1 ♂, light trap at small river (GE).

In Norway *O. lapponica* has previously been recorded from HEs, Os, Bø, Ry, MRi, Nnø, Fi, Fn-ø (Brekke 1946).

O. striata (L., 1758) syn. *ruficurus* (Scopoli, 1763) Sandø, Tjøme (UTM:32VNL8449) 2 June 1965, 1 ♀ (AF).

In Norway *O. striata* has previously been recorded from AK, HEs, Bø, NTi (Brekke, 1946).

Hagenella clathrata (Kolenati, 1848) Kjæreskogen, Tjøme (UTM: 32VNL8052) 12 June 1967, 1 ♂, marsh (AF). Bjørnum, Sandefjord (UTM: 32VNL691631) 3 July 1977, 1 ♂, *Sphagnum*-bog (TA).

In Norway *H. clathrata* has previously been recorded from Nsi and Fø (Brekke 1946).

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CADDIS FLIES (TRICHOPTERA) ON SUGAR BAITS

TROND ANDERSEN

Several Trichoptera species, mainly limnephilids and phryganids, but also the polycentropodid *Plectrocnemia conspersa* (Curtis, 1834), have been collected on sugar baits in Southern Norway.

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Trichoptera imagines have reduced mouth parts, the mandibles are vestigal and the maxillae are small and closely associated with the labium. However, a protrusible haustellum, which is derived from the hypopharynx, is well developed and adapted for sucking liquid (Crichton 1957). In captivity Trichoptera readily take solutions of glucose or honey (e.g. Novák & Sehnal 1963). But Trichoptera have seldom been observed feeding in the wild, although some species, mainly limnephilids, have been recorded to suck on flowers (e.g. Mosely 1939).

The sugaring mixtures used to collect nocturnal Lepidoptera often attract Trichoptera (Crichton 1957). During a few nights in early July 1981 I collected Lepidoptera on sugar baits in a hardwood shrub near Mostranda (UTM: 32VNL8049), VE:Tjøme, and Trichoptera were regularly feeding on the baits. The locality is situated near the coast. In the area there are a few more or less ephemeral ponds with rich vegetation, the nearest situated some 200 m from the trapping site.

Five Trichoptera species, viz.: *Limnephilus affinis* Curtis, 1834, *L. flavicornis* (Fabricius, 1787), *L. stigma* Curtis, 1834, *Grammotaulius nigropunctatus* (Retzius, 1783) (Limnephilidae) and *Agrypnia varia* (Fabricius, 1793) (Phryganeidae), were taken on the baits. Both sexes were represented. Considering the species flying in the area in early July (Andersen 1975), this is a rather representative selection of the two families.

Later in the summer 1981 I collected with sugar bait- traps in the Grenland area in Telemark, and caught two more species, viz.: *Plectrocnemia conspersa* (Curtis, 1834) (Polycentropodidae) and *Phryganea grandis* L., 1758 (Phryganeidae). I have previously also observed *Micropterna lateralis* (Stephens, 1837) (Limnephilidae) frequently on sugar baits on Osterøy in outer Hordaland.

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CLUSIODES VERTICALIS (COLLYER, 1912) AND *HENDELIA BECKERI* CZERNY, 1903 (DIPT., CLUSIIDAE) FOUND IN NORWAY

LITA GREVE

Clusiodes verticalis (Collyer, 1912) and *Hendelia beckeri* Czerny, 1903 are reported new to Norway. One female of *C. verticalis* was found at Kårstø, Tysvær, Rogaland province on 14. July 1981, another female of the same species at Bergsberget, Kvam, Hordaland province on 2. July 1971. One female of *Hendelia beckeri* was caught near Nordheimsund, Kvam, Hordaland province on 18. July 1981 UTM: 32 VLM 4591.

Clusiodes verticalis is in Scandinavia known from southern Sweden; and also in England. *Hendelia beckeri* is in Scandinavia known from Finland.

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The family Clusiidae is a small group numbering of about ten species in Scandinavia, estimated from the list given by Hackman (1980). Czerny (1930) adds only a few additional species from elsewhere in Europe. Czerny also notes the fact that most of the species are very rare.

The Clusiidae often have clouded wingtips, and the body coloured yellow, or yellow and dark. Between the antenna and the ocelli there is a pair of bristles near the midline. Prominent vibrissa usually present. The larvae are found in places of high humidity.

One specimen of *Clusiodes verticalis* (Collyer), a female, was netted by the author in a mixed wood of decidious trees with dominant birch, oak and hazel at Kårstø, Tysvær county, Rogaland province on 14. July 1981. The wood was open with small patches of meadow in between the trees. Repeated showers made the ground and foliage very wet. A second female was caught at Bergsberget, Kvam county, Hordaland province by Hein Rune Skjoldal on 2. July 1971.

One specimen of *Hendelia beckeri* Czerny, 1903, a female, was found between Tørrvikbygd and Nordheimsund, Kvam county, Hordaland province on 18. July 1981 UTM: 32 VLM 4591. The locality was near the main road, somewhere while netting in grass or on herbage.

Both species are new to Norway. *C. verticalis* has been recorded from southern Sweden by Andersson (1971). The species also is listed from England (Kloet & Hincks, 1976). *Hendelia beckeri* is listed by Hackman (1980), but not known from Sweden (H. Andersson pers.comm.).

I am indepted to Dr. Á. Soós, Budapest, who has verified the determinations, and to Dr. H. Andersson for information on the distribution of the two species in Sweden.

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Bokanmeldelser

A.C. NILSSEN, 1982. *ZOOLOGISKE PREPA-RERINGSTEKNIKKER. Universitetsforlaget. 68 pp. Pris kr. 49,—*

I forordet sier forfatteren at hovedhensikten med denne trykksaken er å gi veiledning for lærere i å ta vare på materiale for å skaffe skolen et representativt utvalg av våre vanligste dyregrupper. Dette må man selvfølgelig ha for øye når boka leses. Inntrykket er behagelig — sidene lettleste, tegningene kvikker opp og figurene og fotografiene er illustrative.

I tur og orden blir bedøving, avliving, fiksering, konservatering, montering og etikkering kort, men klart og greit behandlet. Forfatteren synes å ha fått med det viktigste. Særlig verdifullt er det at ulempene ved formalin, som er farlig ved uforsiktig bruk, blir nevnt. Formalin er en utmerket fikserings- og konserveringsvæske, men må behandles med forsiktighet.

De vanligste dyregrupper som en lærer kan ha interesse av å ta vare på er nevnt. Selv for ukyndige personer skulle det å ivareta et materiale kunne gjøres nå når denne trykksaken foreligger. Jeg vil anbefale at boka blir innkjøpt til alle skoler som har biologiundervisning. Den er videre også svært praktisk å ha for naturvitenskapelige muséer eller andre institusjoner som får forespørsler om preparering. Den er hendig å slå opp i.

John O. Solem
førstekonservator
DKNVS, Muséet

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Content

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Short communications

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