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Umbelliferous stems as overwintering sites for Mycetophilidae (Diptera) and other invertebrates

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Abstract

VÄISÄNEN, RAUNO: Umbelliferous stems as overwintering sites for Mycetophilidae (Diptera) and other invertebrates. — Notulae Entomologicae 61: 165—170. 1981.

120 broken umbelliferous stems from Helsinki and some from Pyhtää were investigated as overwintering sites of invertebrates. A total of 862 animals were found in Helsinki (Pyhtää: c. 140 exx.). There were an average of about 7 specimens in each stem. Only a quarter of the material contained no arthropods.

The dominant group Mycetophilidae (Diptera) were represented by only two sibling species of *Exechia* (s. str.). *E. parva* Lundström was less abundant (38 %; Pyhtää: 45 %) than *E. repanda,* which is new for Finland.

Springtails were also rather abundant, the dominant species being *Entomobrya nivalis* (L.). Old stems were rich in Ceratopogonidae larvae and Astigmata mites. Clubionid and linyphiid spiders were the main predators in this material. Several other invertebrate groups were found in smaller numbers.

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Introduction

Several groups of arthropods are known to be active in winter in Finland (e.g. FREY 1913, TAHVONEN 1942, HUHTA & VIRAMO 1979). Very little attention has been paid to the importance of hollow plant stems as overwintering and hiding places for insects and other small animals, although some sporadic notes have been published in Central Europe (EDWARDS 1941, TISCHLER 1968, PLASSMANN 1969, CHANDLER 1976, 1977). The only Finnish investigation dealing with this subject is that of PALMÉN (1948) on some shore insects. It contains data about winter fauna in the stubble of *Phragmites australis.* Agricultural works include notes on certain pests in cereal stubble in fields (e.g. RAATIKAINEN 1966).

During several winters in the 1970s, I paid attention to the habits of some Mycetophilidae, as well as Araneae and Collembola, which were hibernating in the hollow stems of umbellifers (Apiaceae). As Mycetophilidae are of special interest to me I decided to study more deeply the winter fauna of these plants and the relative abundances of different insect species.

Material and study area

The material was collected on January 1, 1981 in the centre of Helsinki: Ruskeasuo, Pieni Huopalahti (667:38, UTM grid LG1). The investigation area was a small grassy meadow on a western-facing slope of an old garden with *Malus, Syringa, Prunus* and *Pinus peuce. Urtica dioica, Arctium tomentosum, Euphorbia, Primula veris* etc. grow there in addition to the umbelliferous plants *(Aegopodium podagraria, Anthriscus sylvestris, Angelica sylvestris* and *Heracleum sphondylium).* On one side the meadows is bordered by a mixed forest with *Betula, Picea, Acer, Salix, Prunus padus* and *Alnus glutinosa.*

I gathered all broken umbelliferous stems of different heights (30—160 cm) and ages from a small area (c. 10 m × 20 m), 120 plants in all. Their diameter varied between 0.5 and 2.5 cm. They were cut below the first undamaged node so that the animals had not been able to

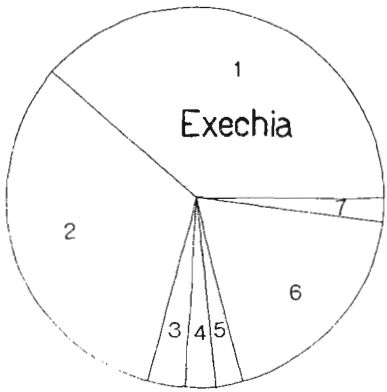

FIG. 1. The proportions of different groups of animals in the umbelliferous stems from Helsinki. 1. *Exechia parva* and *E. repanda* (Mycetophilidae) — 39 %, 2. Ceratopogonidae larvae — 32 %, 3. miscellaneous other Diptera — 3 %, 4. Acarina — 3 %, 5. Heteroptera — 2 %, 6. Collembola — 19 %, 7. other invertebrates — 2 %.

rise into the stems from below. The upper end and any holes were plugged with cotton to prevent the animals from escaping. The material was then put into a plastic container for transport. The stems were split and studied preliminarily in a laboratory at the Lammi Biological Station and later at the Zoological Museum of the University of Helsinki. Most animals were preserved in alcohol and are now deposited in the entomological collection of the Museum.

In addition to the main material from Helsinki, a few stems of *Angelica archangelica* ssp. *litoralis* were investigated. They were collected on January 18. 1981 from a stony sea shore at *N:* Pyhtää, Kiviniemi (670:48, UTM grid MH4).

Results

The material from Helsinki contained 862 animals (Pyhtää: c. 140 exx.), mostly insects, Mycetophilidae being the dominant group (Fig. 1). There were an average of 7 specimens in each stem. Only 26 % of the stems were completely empty. However, a great proportion of the insects were gathered in a few stems. The different groups of animals are dealt with in detail below.

Araneae

Clubionidae were the most notable spiders in the material. One *Clubiona stagnatilis* Kulczynski female and 4 juvenile *Clubiona* sp. (probably *C. stagnatilis)* had killed several Mycetophilidae. There was usually a large number of life fungus gnats in the lower part of the stem, so a spider would not be able to consume all of them during one winter. The gnats were very active and rapid and were often able to escape, although spiders usually stayed at the upper end of the hollow stem.

Smaller Linyphiidae (Micryphantinae) were represented by *Gongylidium rufipes* (Linné) specimens and some unidentified juveniles. Apparently these species are predators on springtails and other smaller animals. The total number of Araneae in Helsinki was only 10 specimens, i.e. one percent of the total number of individuals.

As far as can be judged from the few stems studied, there were many more spiders on the sea shore at Pyhtää than in the main material. There were 8 spiders (7 Clubionidae, 1 Linyphiidae) in the only *A. archangelica* stem with Mycetophilidae.

Acarina

Some older and wet stems contained many small white Astigmata mites (24 exx.), which apparently used the decaying matter as their feeding ground. Two Trombidiidae (Prostigmata) were also found.

Isopoda

A dead and damaged *Porcellio scaber* (Latreille) was found in an old decaying *Angelica sylvestris.*

Collembola

Springtails were rather abundant (167 exx.), the dominant species being *Entomobrya nivalis* (L.), which is probably the commonest snow springtail in Helsinki (cf. BRUMMER-KORVENKONTIO & BRUMMER-KORVENKONTIO 1980).

Heteroptera

Three species of bugs were observed in this material: *Liocoris tripustulatus* (F.). *Orthops* sp. (Miridae) and *Scolopostethus pilosus* Rt. (Lygaeidae), all few in number (12 exx.).

Homoptera

Only some remains of dead Psyllidae and Aphididae were found in the material. There was also a leafhopper larva in an *A. archangelica* stem from Pyhtää.

Lepidoptera

An empty pupa of *Dasypolia templi* (Thunberg) was found inside a *Heracleum* stem. This noctuid species feeds as larva on flowers, young shoots of umbellifers and finally penetrates the stem. *D. templi* is common in southern Finland and the adult stage, but only females overwinter.

Diptera

Diptera was the most abundant group in this study (639 exx.).

An Anisopodidae pupa was found at the bottom of a stem. When it was kept at room temperature for a few days a female of *Sylvicola ?fenestralis* (Scopoli) hatched. The diverse diet of Anisopodidae generally consists of decaying matter. This specimen had probably also lived as a saprophage in the stem.

In some old decaying plants there were great numbers of nematocerous larvae eating the soft inner wall of the hollow stems. Their light eating routes were easily visible against the brownish background. The abundance of these larvae (279 exx.) agrees well with the figures given for *Forcipomyia* spp. (Ceratopogonidae). *F. radicicola* Edw. is known to live in old tap roots of *Arctium lappa, Pastinaca* and *Angelica* (Edwards 1926, Goetheburger & Lenz 1933—34). In addition, the stems contained several other larvae and pupae of miscellaneous Diptera, mostly Cyclorrhapha.

Mycetophilidae

The most notable group in the present material were fungus gnats (334 exx., plus 119 exx. from Pyhtää), belonging to two sibling species of *Exechia* (s. str., Tuomikoski 1966): *E. parva* Lundström, 1909 and *E. repanda* Johannsen, 1912. *E. parva* (Fig. 2) has been described from Finland by Lundström (1909) and it is known in Central Europe from Britain to Estonia and Latvia (Lackschewitz 1937) and in the east as far as Siberia (Ostroverchova 1979). *E. repanda* (Fig. 3) was not included in Hackman's (1980) list over Finnish Diptera and it is accordingly reported here as new for the Finnish fauna. It is widely distributed from Britain to Siberia and North America (Johannsen 1912).

Probably all *Exechia* (s. str.) species are associated with soft macrofungi. *E. parva* has been reared from Tricholomataceae, Strophariaceae and Russulaceae, *E. repanda* only from Cortinariaceae (Hackman & Meinander 1979).

The male abdomen of these *Exechia* species is almost entirely dark brown, but females have yellow markings on the sides of the abdomen. According to present knowledge (cf. Chandler 1977) the females are indistinguishable in this species group. However, there is considerable variation in their wing length and abdominal colour pattern, but seems to be mainly individual.

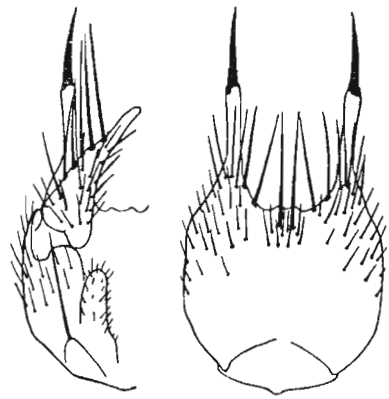

Fig. 2. *Exechia parva* Lundström, 1909, male hypopygium (Barendrecht 1938: Fig. 4).

Exechia specimens were present in 24 samples out of 120 (in Helsinki). The females comprised 53 % (Pyhtää: 54 %) of the whole material. Of the males, *E. repanda* was more numerous (62 %; Pyhtää: 55 %) than *E. parva*. It must be noted that whenever there were more than two males in a sample, it contained both species.

The specimens were usually in groups of 20—30, although in many cases only one specimen occurred in a stem. In the largest sample from one stem in Helsinki there were 86 gnats (Pyhtää: 119 exx.), but during previous winters I have counted more than 200 specimens in a single stem.

Exechia species were often rather densely packed at the bottom of the stem, i.e. near the first undamaged node counted from the top. When the nodes were broken, the gnats were mostly within the lower internodes. In several cases they had moved down through two or three nodes and were near the soil surface, and so were below the snow level where the temperature is usually higher. They can also climb up and fly when there is still snow on the ground, and they can move back into the stems under unfavourable conditions.

Some gnats had been killed by spiders when they were present in the same stem. I have previously occasionally found large numbers of dead, probably frozen *Exechia* specimens. The umbellifers with Mycetophilidae are usually dry, but at Pyhtää the sea had flooded into an *Angelica* stem and there were many frozen dead gnats in an ice cylinder at the bottom of the lowest internode.

The species showed no preferences for different Apiaceae and it must be mentioned that

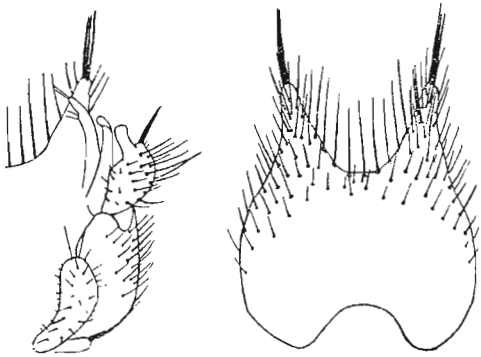

FIG. 3. *Exechia repanda* Johannsen, 1912, male hypopygium (BARENDRECHT 1938: Fig. 5).

I have found *Exechia* gnats within *Peucedanum palustre,* too. I did not observe them in stems of *Urtica* or other plants at the study area (cf. TISCHLER 1968). These *Exechia* species used umbellifers of different height and age, but the oldest decaying stems were not utilised.

Exechia gnats spend their winter very probably in form of quiescence, as do collembolas. They became quite active within a few minutes at room temperature, even after having been kept in the cold. Some specimens even succeeded in escaping during the splitting of the plants.

Coleoptera

Two groups of beetles were observed: Coccinellidae *(Coccinella septempunctata* L.) and Carabidae (a dead and damaged *Harpalus* sp.).

Gastropoda

Two *Trichia hispida* (L.) were overwintering within the stems. In Finland this species is mainly associated with man.

Discussion

Broken umbelliferous stems seem to be more advantageous as overwintering and hiding places than cereal stubble. About 20.000 stalks of cereals contained an average of one specimen of arthropods per 13 stalks (TISCHLER 1968). In the present material there were about 7 specimens per stalk.

In TISCHLER's investigation the faunal structure was quite different, but the *Exechia* species and *Entomobrya nivalis* (L.) belonged to the dominant species in his study, too. He also reported Clubionidae as being dominant spiders in stems of umbelliferous and other plants including cereal stubble and *Phragmites* (see also PALMÉN 1948). Linyphiidae were also numerous. Acarina were represented by more species (Parasitidae, Bdellidae, Trombidiidae, Tyrophagidae and *Ixodes).* The only heteropteran species in common with TISCHLER's study was *Scolopostethus pilosus* Rt. (Lygaeidae), which lives on *Urtica* and was found by him in hollow herb stems but not in cereal stubble. As opposed to the present study, most common beetle families were well represented in the cereal material. It is notable that also TISCHLER found *Trichia hispida* (L.) in his umbellifer material, which was otherwise poor in snails.

Entomobrya nivalis (L.) was one of the two dominant collembolan species in cereal stubble and it was also found inside stems of umbellifers *(Anthriscus, Heracleum), Cirsium* and *Urtica* (TISCHLER 1968). It is apparent that the few springtails active in winter regularly use hollow plant stems as their hiding places at low temperatures. BRUMMER-KORVENKONTIO & BRUMMER-KORVENKONTIO (1980) report that the springtails in snow actively seek the warmest habitat: ground-snow-tree.

The habit of some *Exechia* species of overwintering in hollow herb stems has been reported by several authors (EDWARDS 1941, TISCHLER 1968, PLASSMANN 1969, CHANDLER 1976, 1977, Tuomikoski unpubl.). TISCHLER found *E. repanda, E. parva* and *Exechia* sp. (Peder Nielsen det.) imagines in large numbers in the stalks of cereals in Germany and he also observed them in stems of Apiaceae. *Exechia* comprised 30 % of the total number of individuals in his study, i.e. 454 exx. He supposed that these *Exechia* species lived saprophagously in the field, but in my opinion it is quite apparent that they had flown to their wintering places, even to the *A. archangelica*

stems near the sea shore, from the nearby forests, where they had lived on macrofungi as larvae.

In addition to *E. parva* specimens from stems of umbellifers and thistles, PLASSMANN (1969) reported one *E. pseudocincta* Strobl, 1910 larva from an umbellifer and he managed to rear it. However, HACKMAN & MEINANDER (1979) consider this species to be very specialized in its larval nourishment, being almost monophagous on the *Lactarius deliciosus* group.

It is notable that there were only two *Exechia* species represented in the present study, although several other common species of this genus occur in the area, besides a great many other fungus gnats. Apparently these two species do not only occasionally overwinter in broken umbelliferous stems, but show also a real specialization to this habit. It can be mentioned that *E. fusca* (Meigen, 1804) males and females have been found overwintering in leaf-sheaths of *Typha* sp. during February and March in England on several occasions (KIDD & BRINDLE 1959).

E. parva and *E. repanda* usually occurred simultaneously in the same stems. It is clear that these two species do not compete for their hibernation places — there is enough room for both of them. Their host preferences, although still quite unclear, show specializations to different groups of fungi. In my opinion this might be the main resource they share.

How do the gnats orientate to the broken and usually high stems? Are there any aggregation feromones? This would serve as an interesting object for ethological investigations. In any case, the method of searching for hollow plants seem to be similar in these two closely related *Exechia* species. This specialization could be used as an easy method for biogeographical studies of these Mycetophilidae. The presence of the *Exechia* species can be checked in winter, when entomologists usually have little work in the field.

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Selostus

Sarjakukkaisten varret sienisääskien ja muiden selkärangattomien talvehtimissijoina

Tutkimuksessa on selvitetty lähinnä Helsingistä kerättyjen putkikasvien varsien — talventörröttäjien — merkitystä erityisesti sienisääskille. Kaksi läheistä *Exechia*-lajia, *E. parva* Lundström ja *E. repanda* Johannsen (uusi Suomelle) ovat erikoistuneet käyttämään niitä talvehtimispaikkoinaan. Sienisääskiä käyttävät ravinnokseen erityisesti *Clubiona*-suvun hämähäkit. Eräitä hyppyhäntäisiä, erityisesti lumihyppiäistä *Entomobrya nivalis* (L.), tavattiin myös runsaana. Vanhoissa mätänevissä varsissa oli polttiaistoukkia ja eräitä punkkeja. Lukuisia muitakin, pääasiassa satunnaisesti putkissa talvehtivia eläimiä löydettiin vähäisempiä määriä. Yhteensä Helsingistä kerätyssä aineistossa oli 862 eläintä eli noin 7 yksilöä keskimäärin varressa ja vain neljännes putkista oli aivan tyhjiä.

Referat

Apiaceae-stänglar som övervintringsplatser för svampmyggor och andra evertebrater

Artikeln behandlar Apiaceae-stänglarnas betydelse på vintern för små djur, speciellt svampmyggor. Materialet samlades mestadels i Helsingfors. Två *Exechia*-arter, *E. parva* Lundström och *E. repanda* Johannsen (ny för Finlands fauna) har specialiserat sig att använda stänglar som sina övervintringsplatser. I synnerhet *Clubiona*-spindlar utnyttjar myggor som näring. Också hoppstjärtar med *Entomobrya nivalis* (L.) dominerande, var ganska talrika. I gamla växter finns det Ceratopogonidae larver och kvalster. Många andra djur, som vanligen bara sporadiskt övervintrar i stänglar, påträffades i mindre antal. Materialet från Helsingfors omfattade tillsammans 862 små djur, ungefär 7 exemplar per stängel i genomsnitt. Bara en fjärdedel av växterna var alldeles tomma.