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Is there more than one successional phase in the mycetophilid (Diptera) community feeding on a mushroom?

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The mycetophilid community of *Leccinum scabrum* (Boletaceae) was studied using a new method which allows the sporophores to decay in the field. None of the eight Mycetophilidae species now examined have previously been found feeding on *L. scabrum* in Finland, six species have never been described on this fungus, and the first ecological records are given for four species.

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1. Introduction

The reproductive and developmental strategies of some fungivorous Diptera have been discussed e.g. by Hackman & Meinander (1979) and Hackman (1979) but very little is known about those of Mycetophilidae. Several large-scale studies have been carried out on fungivorous Diptera (see references on p. 50 in Hackman & Meinander), but they have entailed the transfer of the sporophores into laboratories before rotting. They therefore give much information about the egg-laying activity of different species and, for instance, about the primary spoiling of edible mushrooms. However, they do not necessarily give a true impression of all the natural communities utilizing fungal resources, or of the faunal composition of sporophores in nature.

2. Material and methods

The investigation was started on September 6 and 7, 1980, by setting an 18 cm diameter open metal cylinder around every sporophore and to a depth of 10 cm into the soil to prevent pupating larvae from leaving the immediate area of the sporophore. The cylinders were removed on October 11, 1980, and the soil samples containing insects were moved to a temperature of about 0°C until February 1981, when they were transferred to room temperature for hatching. Most insects hatched during March and April and the study was completed in May.

A total of 89 *Leccinum scabrum* (Boletaceae) sporophores were examined in this way at 6 small study areas in the vicinity of the Lammi Biological Station in southern Finland.

The material was collected by Dr. Ilkka Hanski, who is investigating certain synecological problems of the insect communities of *L. scabrum*.

3. Results

A total of 72 mycetophilid specimens belonging to 8 species were found in the sporophore material. 34 sporophores (47 %) were infested by fungus gnats, in 16 cases by only a single specimen. Sciaridae were also numerous but because of the possibility of secondary contamination they have been omitted from this study. The mycetophilids are dealt with in detail below. The following list shows "the number of specimens reared / the number of sporophores infested" for each species.

Mycomya tenuis 2 ♀♀/ 1

M. circumdata 1 ♀/ 1

M. fusca (sensu Mikołajczyk 1967: 22, figs. 4—6) 2 ♂♂1 ♀/ 2

M. trilineata (sensu Mikołajczyk 1967: 22, figs. 7—9) 3♂♂/ 3

These are the first records of the feeding biology of these mycetophilids. Very little is known about the ecology of the whole genus. *Mycomya* larvae have usually been found in rotten wood, under bark or sometimes on Basidiomycete fungi *(Pleurotus, Hypholoma,* Agaricaceae, *Lactarius,*

Ramaria, Clavaria, Coriolus, Polyporus, Poria, Phellinus, Ganoderma, Thelophora, Sparassis, Stereum, Phlebia, Auricularia, Sebacina, ?Phallus) but there are no records from Boletaceae (see Ackerman & Shenefelt 1973, Hackman & Meinander 1979, Ostroverchova 1979, Hutson et al. 1980). According to Laštovka (1972) the larvae of this genus are zoophagous.

Sciophila lutea 21 ♂♂ 14 ♀♀/ 19

This larger species is known from Boletaceae and from a wide variety of other fungi (see Hutson et al. 1980), but not from *Leccinum scabrum* or other *Leccinum* species. On the other hand, *Sciophila dziedzickii, S. tenuis* and *S. varia* have been reared from *L. scabrum* in Central Europe, but not in Finland (cf. Hackman & Meinander 1979).

Coelosia tenella 5 ♂♂ 8 ♀♀/ 6

Very little is known about the biology of the whole genus *Coelosia,* only *C. tenella* has been known to be associated with fungus, i.e. with *Stereum.*

Rondaniella dimidiata 7 ♂♂ 6 ♀♀/ 8

R. dimidiata has been reared from several different fungi including *L. scabrum,* but it was not observed by Hackman and Meinander on this fungus.

Docosia gilvipes 1 ♂/ 1

This species was not included in the *L. scabrum* material of Hackman and Meinander, but is also known to feed on this fungus in Central Europe. In addition to having been found in a wide variety of fungi, *D. gilvipes* has been found in a vole nest *(Microtus agrestis)* (Hackman 1963), indicating saprophagous habits. *D. fumosa,* which is known to live as larvae in disused birds' nests *(Corvus,* "finch", *Prunella, Turdus),* is also believed to be saprophagous.

Laboratory studies (Hackman & Meinander 1979) have shown that although most mycetophilids emerge before winter and do not require any cold treatment, some specimens of *D. gilvipes* require a diapause.

This species may be a complex of several taxa and the present specimen (with two combs in each paramere) does not quite agree with the figures given by Hutson et al. (1980), but agrees better with figure 25.6 of Ostroverchova (1979) for *Docosia laminosa,* which was described as having been reared from *Lactarius deliciosus* at Tomsk, USSR. Apparently the forthcoming revision by Dr. P. Laštovka (Prague) and Dr. L. Matile (Paris) will solve these taxonomic difficulties.

Usually only one species was found in a sporophore, but the coexistence of two species was observed in seven cases: *S. lutea* with *M. tenuis, M. fusca, C. tenella* or *R. dimidiata,* and *C. tenella* with *M. trilineata* or *R. dimidiata.* In the sporophores with more than one mycetophilid specimen there were two species in 39 % of cases. There were no distinct differences between the small subareas.

4. Discussion

The present composition of the mycetophilid material from *L. scabrum* differs totally from that described in the study of Hackman and Meinander, which was also carried out in southern Finland, as well as differing distinctly from the published Central European investigations. Hackman and Meinander found only three species: *Acnemia nitidicollis, Mycetophila fungorum* and *M. signatoides,* none of which was represented in this study. In their material there were no Mycetophilidae in *L. scabrum* sporophores collected in September. In addition to *R. dimidiata, D. gilvipes* and the *Sciophila* species mentioned above, *Bolitophila cinerea, Exechia fusca, Cordyla brevicornis* and *Mycetophila alae* have been listed in association with *L. scabrum* in Central Europe.

The differences in the faunal composition cannot be explained simply by phenological or biogeographical reasons or by the differences between summers. Furthermore, contamination from the small soil sample below the sporophore could probably not give as regular and distinct results as these. The only possible significant difference from the earlier investigations is in the rearing method.

The present material indicates a possible later successional phase in the mycetophilid community feeding on a mushroom. This phase would differ significantly from the material found in fungi transferred to the laboratory before rotting. If this is true, it can be expected that many more Mycetophilidae species than those assumed by or observed in traditional studies are in fact associated with soft macrofungi. All fungus gnats of this study belong to Sciophilinae, which are usually believed to be associated with mycelia in the soil, decaying wood or woodrotting fungi other than Agaricales. Some of the present species may, at least as young larvae, also feed on aggregated mycelia under sporophores. Only later, if at all, do they attack the sporophores themselves. It can be mentioned that in more

detailed studies it has been noticed that a number of species previously considered to be saprophagous, coprophagous or xylophagous are in fact mycophagous (Laštovka 1972).

Zoophagy may partially explain the absence of some previously observed species in rotting sporophores, but this remains unclear.

According to Hackman & Meinander (1979) only 57 of the more than 450 Finnish mycetophilid species have been reared from Agaricales and the other investigations in Europe add only about 30 species. Practically nothing is known of the living habits and larval nourishment of the majority of Mycetophilidae species. Perhaps some of them belong to a possibly overlooked later phase in large Agaricales sporophores.

There are also opposing views about the evolutionary trends in the nutritional strategies of mycetophilid larvae. Hackman & Meinander (1979: 77) believe that the larvae developed from saprophagy through feeding on decomposing tissue in fungi to feeding on both fresh and decaying fungus tissue and finally to mycophagy with several species tending to monophagy. According to Laštovka mycophagy is the most original and widespread type of feeding in this family (and zoophagy is the second most frequently occurring type). He considers saprophagy and phytophagy derived, facultative feeding habits in Mycetophilidae. A more detailed study of a possible later phase may also throw light on this matter, because these species, e.g. Sciophilinae, may have feeding habits intermediate between saprophagy and mycophagy. In connection with phylogenetic studies the direction of evolution may also be better understood.

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