Ann. Zool. Fennici 16:50—83. 1979

Diptera feeding as larvae on macrofungi in Finland

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Hackman, W. & Meinander, M. 1979: Diptera feeding as larvae on macrofungi in Finland. — Ann. Zool. Fennici 16:50—83.

During the summers of 1974—1977 about 3700 sporophores of 184 species of macrofungi, mainly Agaricales, were examined for infestation with dipterous larvae. Diptera were reared from about one-third of the sporophores and positive results were obtained from 148 fungus species.

The principal families of fungivorous Diptera were Mycetophilidae (53 spp.) and Anthomyiidae (16 spp.). About 120 species of Diptera were recorded. Association with macrofungi has arisen numerous times during evolution in the Diptera; certain fungivorous species are generally saprophagous, others may feed on decomposing matter in the fungus, and among the truly fungivorous species different degrees of specialization are found, in some cases including tendencies towards monophagy. The specialized species belong to Mycetophilidae, Phoridae, Platypezidae, Syrphidae, Anthomyiidae, Fannidae and Muscidae.

Developmental and reproductive strategies of fungivorous Diptera as well as protecting strategies by the fungi against the Diptera are discussed.

Competition between fungus-feeding dipterous species is probably important in some cases; for example from a single sporophore of *Leccinum scabrum* 12 different species of Diptera were reared.

The economic importance of the Diptera as pests of edible fungi in Finland is discussed.

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1. Introduction

Rautavaara (1974) calculated that about 80 000 tons of edible fungi are produced annually in the Finnish forests, only a small part being utilized as food. Often, however, they are unsuitable as human food because of the heavy insect infestation (Fig. 6). Some fungus species are more frequently infested than others (cf. Rautavaara 1947:225) and in the same fungus species infestation may show annual and seasonal variation. The aim of this study is to describe the relative importance of the different species of Diptera as pests of edible, inedible and poisonous fungi in Finland and to give ecological data on the fungivorous Diptera. Some results on the Anthomyiidae have been published earlier (Hackman 1976).

Large-scale studies on fungivorous Diptera have been carried out in Germany (Eisfelder 1954, 1955, 1956, 1961, 1970), England (Buxton 1960), Switzerland (Burla & Bächli 1968), Hungary (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Dely-Draskovits & Babos 1976a, 1976b, Papp 1972) and Siberia (Plotnikova 1962, only a short summary seen). Insects associated with wood-rotting higher fungi in Wisconsin, U.S.A., were studied by Ackerman & Shenefelt (1973). In Germany, Plassman (1969, 1971) reared numerous species of Mycetophilidae from higher fungi.

2. Material and methods

The investigation was started in summer 1974, a favourable year for fungal sporophores in most parts of Finland. In 1975 the summer was dry, and collecting began later than usual, but during September and October we and several cooperators obtained a considerable amount of material. In 1976 and 1977 collecting was done on a smaller scale. In 1976 mushrooms were scarce in SW Finland, and severe night frosts put an end to the season in early October. The rainy summer of 1977 was again favourable for mushrooms.

Table 1. Collecting sites

Locality	Commune	10 × 10 km grid	Collectors
Borgå	Porvoo/Borgå	669:42	O. Biström
Bromarv	Tenala/Tenhola	666:28	K. Pihlström
Dåvits	Kirkkonummi/ Kyrkslätt	667:35	G. Lundqvist
Evo	Evo	678:39	G.-B. Lindholm, R. Tuomikoski
Evitskog	Kirkkonummi/ Kyrkslätt	667:35	H. Harmaja
Framnäs	Tenala/Tenhola	665:27	K. O. Donner
Haapavesi	Haapavesi	711:42	P. Koskela
Helsinki/ Helsingfors	Helsinki/ Helsingfors	667:38, 667:37	W. Hackman, M. Meinander and others
Höstnäs	Ekenäs/ Tammisaari	665:31	W. Hackman
Janakkala	Janakkala	675:36	G.-B. Lindholm
Juuma	Kuusamo	735:60	
Karis	Karis/Karjaa	666:31	M. Meinander
Kauniainen	Kauniainen/ Grankulla	668:37	A. Pekkarinen
Kiikala, Röysy	Kiikala	671:30	A. Albrecht
Kolmperä	Espoo/Esbo and Kirkkonummi/ Kyrkslätt	668:36	W. Hackman
Laitamaa	Kirkkonummi/ Kyrkslätt	668:36	W. Hackman
Lammi Biol. Station	Lammi	677:39	W. Hackman, G.-B. Lindholm, M. Meinander & R. Tuomikoski
Lemsjöholm	Askainen	672:21	L.v. Haartman
Liikasenvaara	Kuusamo	735:61	E. Ohenoja
Luk	Espoo/Esbo	669:37	W. Hackman & M. Meinander
Lovisa	Lovisa/Loviisa	670:45	M. Meinander
Masaby	Kirkkonummi/ Kyrkslätt	666:36	G. Lundqvist
Morby	Espoo/Esbo	668:37	W. Hackman
Närpes	Närpes	694:20	M. Meinander
Odensö	Ekenäs/ Tammisaari	665:29	A. Albrecht
Oulanka Biol. Station	Kuusamo	736:59	W. Hackman & E. Ohenoja
Pellinge	Borgå l.k./ Porvoon mlk.	667:43	Anonymous
Punkasalmi	Punkaharju	685:62	B. Lindeberg
Ruotsinkylä	Tuusula/Tusby	669:38	M. Korhonen
Runsala	Turku/Åbo	671:23	W. Hackman & M. Meinander
Rånäs	Sjundeå/Siuntio	667:30	W. Hackman
Sibbo	Sibbo/Sipoo	668:39	W. Hackman & M. Meinander
Skogby	Tenala/Tenhola	665:29	C. Oker-Blom
Skuru	Pohja/Pojo	667:30	W. Hackman
Söderby	Ekenäs/ Tammisaari	665:30	K. Forssblom
Taivalkoski	Taivalkoski	727:55	E. Ohenoja
Tvärminne Zool. Station	Hangö/Hanko	664:28	W. Hackman, M. M. Meinander & C. Oker-Blom
Tuvkulla	Espoo/Esbo	668:37	U. Cedercreutz
Vaala	Vaala	716:49	L. Saaristo

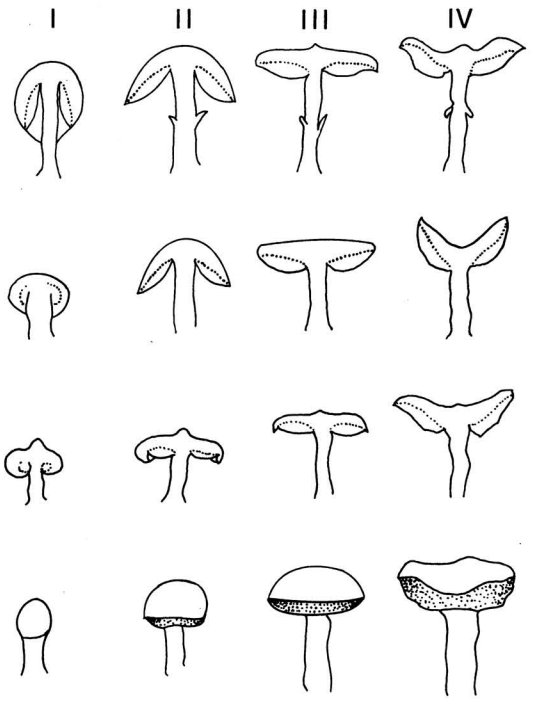

Fig. 1. Sporophores of stages I—IV of *Amanita*, *Russula*, *Lactarius* and *Boletus*.

The sampling localities are listed in Table 1. The bulk of the material was collected at Tvärminne Zoological Station in 1974, in Esbo: Kolmperä in 1974—1977, at Lammi Biological Station in 1975, in Närpes in 1974 and at the Oulanka Biological Station in 1975.

In all, about 3700 sporophores of singly growing fungi or colonies of aggregated fungi were examined. The material comprised 184 species, mainly Agaricales. The sporophores were identified as to species and grouped by age (Fig. 1) into four stages, and the cap diameters measured.

More than 1200 sporophores (or parts of them) representing 179 species were placed in plastic containers on a layer of flower-pot soil. The containers were covered with nylon gauze. Older but not rotting sporophores were chosen if material was plentiful. In some cases the cap and stem were cultured separately. Some 900 cultures of 148 species gave positive results.

For rearing anthomyiid larvae from sporophores of Boletaceae, more special equipment was used to avoid blocking of the maggots' stigmata with the sap of the decaying fungi (Fig. 2). During the summer months the rearing jars were kept outdoors in the shade. The jars were checked frequently. In autumn the cultures were moved to a moist laboratory room with a temperature of +10°C. Towards the end of October the jars were moved to a room at +4°C for a week and then for 2 months at 0°C and finally to room temperature for hatching. In 1974 most of the material was kept in an unheated building until February or March. Before the winter most of the material was searched for puparia,

which were placed in soil in small plastic or glass containers.

In some cases (*Pegomya* spp.) many puparia remained unhatched during the next warm season and during the following winter were again kept cold. Many flies emerged after this second hibernation.

In 1976—1977 some puparia kept in a small outdoor cellar throughout the winter were transferred to an unheated building in the spring to show the normal hatching time of the species.

Traps of the type used by Nuorteva (1959) were used to sample dipterans from growing mushrooms in Tvärminne and Kolmperä. Only a minor part of the trapped material is treated in this paper.

3. The dipterous fauna of the different fungi

The fungus species are listed according to the systematics used by Ulvinen (1976). For each species the list gives collecting sites, and numbers of sporophores (sph) of singly growing fungi and colonies for which the rearing results were positive (e.g. 18 sph cultured). Where necessary the stages (= age classes) of the fungi investigated are indicated with Roman numerals. The Diptera reared from the species are listed and the number of specimens reared/number of sporophores or colonies, and month of infestation are given for each species.

For the fungus species investigated by us all dipterous species reared by previous authors but not by us are also listed.

A sporophore is considered infested when larvae or galleries are found. The infestation percentage is calculated from the sporophores of stages II+III only.

Macrofungi other than Agaricales

Because of their importance as edible mushrooms, eight species of fungi belonging to groups other than Agaricales were studied to a small extent.

Helvellaceae: The two *Gyromitra* species investigated are infested with polyphagous species of Diptera, the infestation in *G. esculenta* being very rare and of no practical importance.

Cantharellaceae: The three species investigated are extremely rarely infested with dipterous larvae, and when they are, it is with polyphagous species, mainly Tipulidae, Limoniinae.

Hydnaceae: As in Cantharellaceae, infestation is very rare; some infestation by polyphagous Limoniinae is recorded.

Poriaceae: Only the soft and edible *Albatrellus ovinus* was investigated. The most important pests are the *Megaselia*. Poriaceae with hard perennial sporophores, which were not investigated, are infested with a number of Diptera not found in fungi with soft short-lived sporophores (see Buxton 1960).

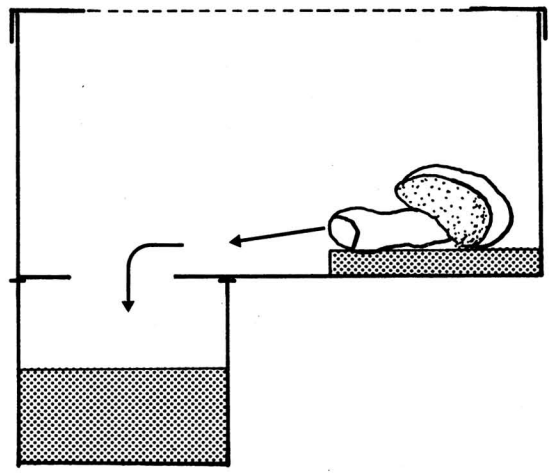

Fig. 2. Rearing box for dipterans infesting large Boletaceae.

1. *Gyromitra infula* (Fr.) Quél. Sibbo 1974, Lammi 1975 (2 sph).

Limonia quadrinotata 16/1 Sept; *L. bifasciata* 2/1 Sept; *Psychoda lobata* 2/1 Sept; *Allodia (Brachycampta)* sp. 1/1 Sept; *Megaselia* sp. (black) 1/1 Sept; *M.* sp. (yellow) 2/1 Sept; *Suillia bicolor* 1/1 Sept; *Suillia atricornis* 1/1 Sept.

2. *G. esculenta* (Pers.) Fr. Haapavesi 1973 (1 sph).

Drosophila transversa 10/1 June, data given by Outi Muona.

3. *Cantharellus cibarius* Fr. Tvärminne 1974, Kolperä 1974—1977 (2 Sph).

Very few of the hundreds of sporophores investigated were infested. Limoniid larvae were found in 3 sph. *Mycetophila fungorum* 1/1 Aug; *Suillia bicolor* 1/1 Aug.

Additional species recorded: (Dely-Draskovits 1972a, 1974, 1977, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Plassmann 1969): *Limonia bifasciata, Ula sylvatica, Sciophila hirta, S. lutea, Leia bimaculata, Drosophila testacea, D. phalerata, D. transversa, Pegomya winthemi, Phaonia populi, Suillia fuscicornis, Tricimba lineella.*

4. *C. tubaeformis* Fr. Kolmperä 1974.

Limoniine larvae were found in a few sporophores. Less than 1 % of the hundreds of sporophores examined were infested.

5. *Craterellus cornucopioides* (Fr.) Pers. (Cantharellaceae) Kolmperä 1977.

A limoniine larva was found in one sporophore. Very few sph infested.

6. *Hydnum rufescens* Fr. Kolmperä 1974—1977.

A limoniine larva was found in one sporophore.

7. *Sarcodon imbricatum* (Fr.) Karst. (Hydnaceae) Karis 1975 (2 sph).

Trichocera hiemalis 2/1 Sept; *Suillia atricornis* 2/1 Sept.

Additional species recorded: (Dely-Draskovits 1972b, Eisfelder 1961): *Mycetophila fungorum, Suillia bicolor, S. flava.*

8. *Albatrellus ovinus* (Fr.) Kotl. & Pouz. Kolmperä 1974—1976 (44 sph examined, 2 cultured).

About 60 % of the sporophores were infested. *Limonia bifasciata* 2/1 Sept; *Allodia lugens* 1/1 Sept; *Megaselia* sp. 1/1 Sept; *Suillia atricornis* 2/1 Sept. This fungus often harbours phorid larvae.

Boletaceae

The Diptera feeding on Boletaceae are frequently oligophagous and even show monophagous tendencies as far as host species groups. There is a very clear difference between the *Boletus edulis* group and *Leccinum* species, on the one hand, and the *Suillus* species, on the other (Table 1). The mild-tasting *Boletus edulis* group and the *Leccinum* species are infested mainly with *Pegomya* flies (Anthomyiidae) and to a lesser extent with fungus gnats. *Pegomya tenera, P. pilosa* and *P. zonata* are characteristic pests of these fungi. Several other *Pegomya* species have been bred exclusively from *Leccinum* (see Table 2 and further p. 78).

Table 2. Diptera characteristic of Boletaceae. Species indicating probable taxonomic relations within the fungus family. The authors' own data ×, from the literature +.

	Leccinum versipelle group	*Leccinum scabrum* group	*Leccinum carpini*	*Boletus edulis* group	"*Boletus satanas* group"	*Boletus piperatus*	*Tylopilus felleus*	"*Xerocomus* group"	*Suillus grevillei* + *flavidus*	*S. luteus* + *granulatus*	*S. variegatus* + *bovinus*	Gomphidiaceae	Paxillaceae
Pegomya incisiva	×	×	–	–	–	–	–	–	–	–	–	–	–
P. tabida	–	×	–	–	–	–	–	–	–	–	–	–	–
P. vittigera	–	×	–	–	–	–	–	–	–	–	–	–	–
P. furva	×	×	–	–	–	–	–	–	–	–	–	–	–
P. fulgens	×	×	×	–	–	–	–	–	–	–	–	–	–
P. flavoscutellata	×	×	×	–	–	–	–	–	–	–	–	–	–
P. tenera	×	×	×	×	–	–	–	–	–	–	–	–	–
P. pilosa	×	×	×	×	–	–	–	–	–	–	–	–	–
P. zonata	×	×	+	×	–	–	–	–	–	–	–	–	–
P. winthemi	+	×	+	+	+	×	–	×	–	–	–	–	–
Cheilosia scutellata													
in Finland	–	×	–	?	–	–	–	–	–	–	–	–	–
in Central Europe	+	+	–	+	–	–	–	+	–	+	+	–	+
C. longula	–	×	–	–	–	–	–	–	×	×	×	–	–
Pegomya deprimata	–	–	–	–	–	–	–	×	–	×	×	–	–
Exechiopsis indecisa	–	–	–	–	–	–	–	+	×	×	×	–	–
Exechia separata	–	–	–	–	–	–	–	+	×	×	×	×	–
Bolitophila rossica	–	–	–	–	–	–	–	–	–	×	×	–	–
Mycetophila signatoides	×	×	×	+	–	–	–	×	–	–	×	–	–
Fannia melania	–	+	+	+	–	–	–	+	×	–	–	–	–
Mydaea discimana	–	×	–	+	–	–	–	–	×	×	×	–	–

Characteristic pests of the *Suillus* species are the fungus gnats *Bolitophila rossica, Exechia separata* (also on Gomphidiaceae, which are actually related to Boletaceae) and *Exechiopsis indecisa.* These three species have never been bred from the *Boletus edulis* group or *Leccinum.* Only one species of *Pegomya, P. deprimata,* feeds on *Suillus* species; it occurs frequently in these but never in the *Boletus edulis* group or in *Leccinum.*

Nowadays the fungi earlier separated as the genus *Xerocomus* and also the former *Suillus piperatus* are placed in *Boletus* (e.g. Kallio in Ulvinen 1976). The dipterous pests of the "*Xerocomus* group" (*B. badius, B. subtomentosus, B. chrysenteron* and *B. versicolor*), however, indicate an intermediate position between *Boletus* and *Suillus* with closer relations to *Suillus*: Three "indicator species" of *Suillus* have been bred a few times from these fungi: *Exechia separata* (from *B. versicolor*, Dely-Draskovits 1974), *Exechiopsis indecisa* ("*Xerocomus* sp." Eisfelder 1956) and *Pegomya deprimata* (*B. subtomentosus*). *Xerocomus* has *Pegomya winthemi* in common with *Boletus* and *Leccinum* species; this fly does not occur in *Suillus.*

Boletus piperatus, like the *Boletus satanas-erythropus-queletii-luridus* group, is mainly inhabited by polyphagous Diptera but sometimes by *Pegomya winthemi* (Buxton 1960, Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Edwards 1925, Eisfelder 1956).

Among the *Leccinum* species the mild-tasting *L. scabrum* group is infested by numerous Diptera. From a single sporophore of *L. scabrum* no less than 12 species were reared. Sporophores of this species are common from S Finland to the high mountain slopes (*regio subarctica*) in Lapland and in rainy years may occur during most of the warm season. A large old sporophore provides several different niches for truly fungivorous, saprophagous and predatory dipterous larvae.

The extremely bitter-tasting *Tylopilus felleus* is obviously well protected against dipterous infestation.

Mycetophila signatoides, Fannia melania and *Mydaea discimana* seem to prefer Boletaceae in general. Among polyphagous species *Pegomya geniculata* seems to avoid the Boletaceae entirely.

9. *Boletus edulis* group. Tvärminne 1974 (*B. edulis* Fr. and possibly *B. pinophilus* Pil. & Dermek), Kolmperä

1974—1977 (*B. edulis* and *B. pinophilus*), Evo 1975 (*B. pinophilus*) and Närpes 1974 (*B. eaulis* and possibly *B. pinophilus*) (12 sph). *B. reticulatus*, also belonging to this group, is treated separately.

Cordyla brevicornis 108/1 Sept; *Mycetophila fungorum* 47/5 Aug—Sept; *Megaselia* sp. 84/1 Aug; *Pegomya tenera* 148/10 July-Sept; *P. pilosa* 3/1 Sept; *P. zonata* 27/4 July—Sept.

Species reared by other authors (Buxton 1960, Canzanelli 1941, Dely-Draskovits 1972a, 1972b, 1974, 1977, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1955, 1956, 1961, Papp 1972, Schmitz 1948: *Trichocera saltator*, *Scatopse fuscipes*, *Docosia gilvipes*, *Mycetophila signatoides*, *M. spectabilis*, *M. alea*, *Exechia fusca*, *Conicera* sp., *Megaselia lata*, *M.* sp. pr. *pulicaria*, *Cheilosia scutellata*, *Drosophila testacea*, *D. funebris*, *D. phalerata*, *D. transversa*, *D. kuntzei*, *Pegohylemyia silvatica*, *Pegomya winthemi*, *Fannia melania*, *Mydaea tincta*, *M. discimana*, *Alloeostylus diaphanus*, *Phaonia variegata*, *Muscina assimilis*, *Suillia fuscicornis*, *S. bicolor*, *Leiomyza dudai*, *Tricimba cincta*.

In Finland the most important pest of this group of edible and commercially important fungus species is *Pegomya tenera*. The fly lays its eggs in the spore layer and some time elapses before the young larvae spread to the inner cap tissue and the stem. Therefore sporophores of stage II, although infested, are still in edible condition. In the present material infestation (larvae found or old galleries, stage II (49 sph examined) and stage III (59) considered) was about 70 % in the summer months, but in the autumn more variable. In 1977 in Kolmperä late sporophores were heavily infested in the stem with *Cordyla* and Phoridae.

9c. *Boletus reticulatus* Boud. Runsala 1977 (1 sph). *Drosophila transversa* 2/1 (III) Aug.

Additional species recorded (Dely-Draskovits 1972a, Dely-Draskovits & Mihályi 1972): *Cheilosia scutellata*, *Pegohylemyia silvatica*, *Pegomya winthemi*, *Muscina assimilis*.

10. *Boletus chrysenteron* St. Am. Runsala 1977 (2 sph). *Mycetophila fungorum* 9/1 (II) Aug; *Drosophila phalerata* 1/1 (II) Aug; *D. transversa* 6/1 (II) Aug.

Additional species recorded (Burla & Bächli 1968, Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Eisfelder 1954, 1956, Plassmann 1969, Schmitz 1948, Shorrocks & Wood 1973): *Scatopse fuscipes*, *Exechia fusca*, *Allodia alternans*, *Mycetophila signatoides*, *M. alea*, *Megaselia flavicans*, *M. lutea*, *M. pygmaeoides*, *Pegomya winthemi*, *Hydrothea* sp., *Mydaea tincta*, *Alloeostylus diaphanus*, *Suillia bicolor*, *S. atricornis*.

11. *Boletus badius* Fr. Framnäs 1975, Åminsby 1977, Borgå 1978, Odensö 1978, Kiikala 1978 (18 sph examined, 1 cultured).

Exechia fusca (1/1). No trace of *Pegomya* larvae were found.

Additional species recorded (Buxton 1960, Eisfelder 1954, 1956, Schmitz 1948): *Mycetophila signatoides*, *Megaselia scutellariformis*, *Pegomya winthemi*.

12. *Boletus subtomentosus* Fr. Tvärminne 1974, Höstnäs 1977, Kolmperä 1974—1977, Tuvkulla 1975, Sibbo 1975, Närpes 1974 (32 sph examined, 8 cultured).

Allodia lugens 1/1 Oct; *Mycetophila fungorum* 87/4 July—Aug; *M. signatoides* 1/1 July; *Drosophila transversa* 11/1 July; *Pegohylemyia silvatica* 4/2 Aug & Oct; *Pegomya deprimata* 6/1 Aug; *Suillia atricornis* 3/1 Oct.

Additional species recorded (Buxton 1960, Barendrecht 1938, Dely-Draskovits 1972a, 1972b, 1974, 1977, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1954, 1965, Laštovka 1971, Plassmann 1969): *Limonia bifasciata*, *Psychoda lobata*, *Scatopse fuscipes*, *Allodia ornaticollis*, *Mycetophila alea*, *Cheilosia scutellata*, *Drosophila funebris*, *D. testacea*, *Fannia melania*, *Mydaea tincta*, *Muscina assimilis*.

Infestation with fungus gnats common (found in 9 sph in the material). Dipterous larvae were found in about 40 % of the sph examined.

13. *Boletus piperatus* Fr. Kolmperä 1974—1976, Lammi 1975 (26 sph examined, 2 cultured).

Pegomya winthemi 1/1 Sept; *Mydaea detrita* 2/1 Sept; *Suillia atricornis* 11/2 Sept; *Suillia bicolor* 1/1 Sept.

Additional species recorded (Dely-Draskovits & Mihályi 1972): *Mydaea tincta*, *Muscina assimilis*.

Seven of the sph investigated were infested with dipterous larvae. Possibly the acrid-tasting substance in this mushroom has a protective effect.

14. *Leccinum versipelle* group. Tvärminne 1974—1975 (*L. versipelle* (Fr. & Hök.) and possibly also *L. aurantiacum* SF. Gray), Kolmperä 1974—1977 (mainly *L. versipelle* but also some *L. vulpinum* Watl.), Lammi 1975 (*L. versipelle*), Närpes 1974 (probably all *L. versipelle*), Vaala 1975 (*L. versipelle*) (164 sph examined, 39 sph cultured). *L. quercinum* and *L. roseotinctum* also belonging to this group are treated separately.

Ula sylvatica 1/1 Aug; *Trichocera hiemalis* 1/1 Sept; *Mycetophila fungorum* 341/3 Aug—Sept; *M. signatoides* 1/1 Sept; *Drosophila busckii* 14/2 July & Sept; *D. funebris* 7/1 Sept; *D. transversa* 24/2 July; *D. phalerata* 14/2 July; *Pegohylemyia silvatica* 3/1 Aug; *Pegomya flavoscutellata* 29/2 July & Aug; *P. incisiva* 808/25 July—Sept; *P. fulgens* 29/1 Sept; *P. furva* 51/2 Sept; *P. tenera* 179/9 July & Sept; *P. pilosa* 14/2 Sept; *P. tenera* + *pilosa* ♀♀ 23; *P. zonata* 160/7 July & Aug; *Fannia canicularis* 40/2 July & Sept; *Mydaea discimana* 3/1 July.

Additional species recorded (Buxton 1960, Dely-Draskovits 1972a, 1974, 1977, Dely-Draskovits & Mihályi 1972, Eisfelder 1955, 1956): *Tipula pabulina*, *Limonia bifasciata*, *Tarnania fenestralis*, *Cheilosia scutellata*, *Pegomya winthemi*, *Suillia bicolor*.

About 70 % of the sporophores of stages II and III were infested with dipterous larvae. One of the most important pests of this edible mushroom is *Pegomya incisiva*, the larvae of which begin their destructive activity from the stem (68 cases = 41 % of the present material). This species infested even small sporophores of stage I (19 cases = 56 % of the present material of stage I). Of the larvae in the spore layer, most are *P. tenera*. Maggots beginning the damage deep in the cap tissue are probably *Pegomya zonata*. Fungus gnat larvae are of minor importance.

14d. *Leccinum quercinum* (Pil.) Green & Watl. Runsala 1977, Framnäs 1976 (3 sph examined, 1 cultured).

Pegomya incisiva 13/1 Sept.

14e. *Leccinum roseotinctum* Watl. Kolmperä 1976—1977. Ruotsinkylä 1976 (9 sph examined, 2 cultured).

Pegomya tenera 2/1 Aug; *P. incisiva* 37/1 July; *P. zonata* 6/2 July—Aug.

15. *Leccinum scabrum* group. Tvärminne 1974—1975 (all probably *L. scabrum* (Fr.) S. F. Gray), Skogby

(*L. scabrum*), Kolmperä 1974—1977 (*L. scabrum*), Sibbo 1975 (*L. scabrum*), Närpes 1974 (*L. scabrum* and possibly *L. variicolor* Watl.). (181 sph examined, 41 cultured). *L. holopus* and *L. carpini* also belonging to this group are treated separately.

Limonia bifasciata 2/1 Aug—Sept; *Ula sylvatica* 1/1 Sept; *Psychoda lobata* 25/4; *Acnemia nitidicollis* 1/1 June; *Mycetophila fungorum* 2/1 July; *M. signatoides* 10/2 July-Aug; *Lycoriella solani* 1/1 Sept; *Megaselia* sp. (yellow) 247/5 June; *Megaselia* sp. (dark) 13/2; *Cheilosia longula* 3/2 July—Aug; *C. scutellata* 108/2 July-Aug; *Drosophila transversa* 62/3 July—Aug; *D. phalerata* 222/4 Aug; *Pegohylemyia silvatica* 2/2 Sept; *Pegomya winthemi* 384/10 June—Sept; *P. flavoscutellata* 82/9 June-Sept; *P. incisiva* 155/5 July-Aug; *P. fulgens* 103/3 Sept; *P. furva* 246/11 July—Sept; *P. tenera* 279/12 July—Sept; *P. pilosa* 46/5 Aug—Sept; *P. tenera* + *pilosa* 156 ♀♀; *P. tabida* 152/5 July; *P. vittigera* 7/4 Aug—Sept; *P. zonata* 288/7 Aug—Sept; *Mydaea tincta* 1/1 Aug; *M. discimana* 8/2 Sept; *Limosina fungicola* 16/1 July; *L. heteroneura* 3/1 Aug; *L. parapusio* 33 ♀♀/1 Aug; *L. luteilabris* 1/1 July; *Meoneura neottiophila* 2/1 July.

Additional species recorded (Burla & Bächli 1968, Canzanelli 1941, Dely-Draskovits 1972a, Dely-Draskovits & Mihályi 1972, Edwards 1925, Eisfelder 1956, Landrock 1940, Plassmann 1971, Schmitz 1948, Winnertz 1863): *Bolitophila cinerea, Sciophila dziedzickii, S. tenius, S. varia, Rondaniella dimidiata, Docosia gilvipes, Exechia fusca, Cordyla brevicornis, Mycetophila alea, Megaselia pygmaeoides, Drosophila funebris, Mydaea electa, Tricimba cincta.*

In June—August infestation was about 70 %. In September the sporophores seem to be less infested with dipterous larvae, below 60 %. The most important pests of this edible fungus are the *Pegomya* species. *P. winthemi* is multivoltine and dominates in early sporophores (June). Very frequently the characteristic galleries of the brachonid wasp *Alysia frigida* are found. The imagines dig galleries and the hosts of this parasite are the *Pegomya* larvae.

15c. *Leccinum holopus* (Rostk.) Watl. Kolmperä 1974, 1975, 1977, Lammi 1975 (8 sph examined, 1 (from Lammi) cultured).

Limonia bifasciata 5/1 Sept; *Ula sylvatica* 8/1 Sept; *Pegomya tenera* 4 ♂♂/1 Sept; *P. pilosa* 17♂♂/1 Sept; *P. tenera* + *pilosa* 32 ♀♀; *P. furva* 1/1 Sept.

15d. *Leccinum carpini* (R. Schulz) Mos. Runsala 1977 (1/III).

Mycetophila signatoides 1/1 Aug; *Drosophila transversa* 1/1 Aug; *Pegomya fulgens* 5/1 Aug; *P. flavoscutellata* 3/1 Aug; *P. tenera* 9/1 Aug; *P. pilosa* 1/1 Aug.

Additional species recorded (Dely-Draskovits 1972a, 1972b, *in litt.*, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973): *Scatopse fuscipes, Mycetophila alea, Drosophila funebris, D. testacea, Pegohylemyia silvatica, Pegomya winthemi, P. zonata, Fannia melania, Muscina stabulans, M. assimilis, Suillia bicolor, S. variegata.*

16. *Suillus grevillei* (Klotzsch) Sing. Lammi 1975 (13 sph, all from the same colony, examined, 12 cultured).

Limonia bifasciata 1/1 Sept; *Exechia separata* 57/9 Sept; *Exechiopsis indecisa* 7/4 Sept; *Mycetophila fungorum* 7/3 Sept; *Corynoptera* sp. 1/1 Sept; *Megaselia* sp. 11/4 Sept; *Cheilosia longula* 9/4 Sept; *Fannia melania* 6/1 Sept; *Mydaea discimana* 22/11 Sept; *M. detrita* 2/2 Sept.

Additional species recorded (Dely-Draskovits 1977, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973): *Drosphila testacea, D. transversa, D. phalerata, Mydaea tincta.*

17. *Suillus luteus* (Fr.) S. F. Gray Runsala 1976, Tvärminne 1974, Kolmperä 1974—1977, Närpes 1974, Oulanka 1975, Juuma 1975 (171 sph examined, 45 cultured).

Limonia bifasciata 1/1 Aug; *Ula sylvatica* 13/1 Sept; *Psychoda lobata* 94/7 Aug—Sept; *Bolitophila rossica* 2/1 Sept; *Exechia separata* 1/1 Sept; *Exechiopsis indecisa* 5/2 Aug—Sept; *Mycetophila fungorum* 1178/35 Aug—Sept; *M. strobli* 5/1 Aug; *Corynoptera* sp. 2/2 Aug; *Cheilosia longula* 6/1 Sept; *Drosophila transversa* 49/5 Aug; *Pegohylemyia silvatica* 98/17 Aug—Sept; *Pegomya deprimata* 87/21 Aug—Sept; *Mydaea discimana* 4/3 Aug-Sept; *M. detrita* 1/1 Aug; *Alloeostylus diaphanus* 1/1 Oct.

Additional species recorded (Canzanelli 1941, Dely-Draskovits 1972b, 1974, 1977, Dely-Draskovits & Mihályi 1972, Eisfelder 1955): *Bolitophila cinerea, Mycetophila alea, Cheilosia scutellata, Drosphila phalerata, Antomyia pluvialis, Mydaea tincta, M. electa, Phaonia populi, Suillia flava.*

The most important pests of this edible mushroom are *Mycetophila fungorum, Pegomya deprimata* and *Pegohylemyia silvatica.* As a result of combined infestation with *Mycetophila* and *Pegomya* in late summer and autumn, sporophores of stages II and III are often inedible. The degree of infestation in the summer months is about 70 %. In September the percentage is still higher, about 95 %, probably owing to increased numbers of ovipositing *Pegohylemyia silvatica* and *Pegomya deprimata.* A more extensive study on the Brachycera feeding on *S. luteus* was made by Christian Oker-Blom at Tvärminne in 1975, the results of which will be published separately and are not included here.

18. *Suillus flavidus* (Fr.) Sing. Kolmperä 1976, Lammi 1975 (8 sph examined, 1 cultured).

Exechia separata 1/1 Sept; *Mycetophila fungorum* 1/1 Sept; *Pegohylemyia silvatica* 1/1 Sept.

Additional species recorded (Landrock 1940): *Exechiopsis indecisa.*

19. *Suillus granulatus* (Fr.) Kuntze Tvärminne 1975, Kolmperä 1977, Lammi 1975 (11 sph examined, 9 cultured).

Bolitophila rossica 2/1 Sept; *Allodia lugens* 1/1 Sept; *A. ornaticollis* 20/1 Sept; *Pegohylemyia silvatica* 2/2 Sept; *Pegomya deprimata* 1/1 Sept; *Mydaea setifemur* 1/1 Sept; *M. discimana* 2/1 Sept; *M. detrita* 1/1 Sept; *Suillia atricornis* 1/1 Sept. Limoniine larvae were found in two sph (Sept.).

Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, 1977, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1956, Schmitz 1948): *Limonia bifasciata, Scatopse fuscipes, Exechia separata, Cordyla* sp., *Mycetophila fungorum, Megaselia lata, M. lutea, M. scutellaris, Cheilosia scutellata, Drosophila phalerata, D. transversa, D. testacea, D. kuntzei, Mydaea electa, M. tincta, Suillia bicolor.*

20. *Suillus bovinus* (Fr.) Kuntze Tvärminne 1974, Kolmperä 1974—1976, Lovisa 1975, Lammi 1975, Oulanka 1975. (82 sph examined, 12 cultured).

Bolitophila rossica 7/2 Sept; *Sciophila varia* 1/1 Sept; *Exechia separata* 6/2 Sept; *Exechiopsis indecisa* 16/3 Sept; *Allodia ornaticollis* 10/1 Sept; *Forcipomyia kaltenbachi* 7/1

Sept; *Mycetophila signatoides* 2/1 Aug; *Megaselia* sp. 1/1 Sept; *Cheilosia longula* 3/2 Sept; *Drosophila transversa* 1/1 Aug; *Pegohylemyia silvatica* 12/5 Sept; *Pegomya deprimata* 5/3 Aug—Sept.

Additional species recorded (Buxton, 1960, Dely-Draskovits 1972a, 1972b, 1974, Eisfelder 1956, Landrock 1927. Matile 1963): *Trichocera saltator, Mycetophila fungorum, M. sigillata, Megaselia lutea, Cheilosia scutellata, Tephrochlamys tarsalis, Suillia bicolor, S. oxyphora.*

The characteristic species feeding on *Suillus, Bolitophila rossica, Exechia separata, Exechiopsis indecisa, Pegomya deprimata* and the polyphagous *Pegohylemyia silvatica* have all been recorded earlier from this fungus. The main damage in the sporophore is done by the fungus gnats, and infestation in the present material was 86 %.

21. *Suillus variegatus* (Fr.) Kuntze Tvärminne 1974, 1977, Kolmperä 1974—1976, Lovisa 1975, Lammi 1975, Närpes 1974, Taivalkoski 1975, Liikasenvaara 1975, Juuma 1975 (81 sph examined, 23 cultured).

Ula sylvatica 19/4 Sept; *Psychoda lobata* 11/1 Sept; *Bolitophila rossica* 13/2 Sept; *Exechia fusca* 6/2 Sept; *E. separata* 42/9 Sept; *Exechiopsis indecisa* 21/5 Sept; *Cordyla* sp. 14/1 Aug; *Mycetophila fungorum* 66/8 Aug—Sept; *Lycoriella solani* 5/1 Aug; *Megaselia* sp. 2/2 Sept; *Cheilosia longula* 1/1 Sept; *Tephrochlamus flavipes* 10/1 Sept; *Pegohylemyia silvatica* 9/1 Sept; *Mydaea tincta* 2/1 Sept; *M. electa* 1/1 Sept; *M. discimana* 9/4 Sept.

Additional records (Dely-Draskovits 1972a, 1974, Eisfelder 1955, 1956): *Trichocera saltator, Megaselia lutea, Cheilosia scutellata, Mydaea urbana.*

Bolitophila rossica and *Exechiopsis indecisa* were previously recorded from this fungus. Infestation in July—August about 50 % in the present material. Late sporophores seem to be infested more often, over 80 % in September—October. In this species also, fungus gnats are of more importance as pests than the Brachycera.

22. *Tylopilus felleus* (Fr.) Karst. Tvärminne 1977, Kolmperä 1974, 1976 (56 sph examined).

No dipterous larvae found. One anthomyiid egg was found in the spore layer of a sporophore, but it did not hatch. Five attempts to transfer small and half-grown *Pegomya* larvae (*P. tenera* and *P. deprimata*) and *Mycetophila fungorum* larvae from other fungi to *Tylopilus* were unsuccessful. Eisfelder (1961) pointed out that she never found any dipterous larvae in *T. felleus*. In North America, however, *Limonia triocellata* has once been reared from this fungus (Alexander 1920).

Paxillaceae

The difference in the dipterous infestation between *Paxillus involutus* and *P. atrotomentosum* has already been pointed out by Eisfelder (1961). *P. involutus* is very often eaten by larvae of fungus gnats, mainly *Bolitophila hybrida*, which is dominant and more or less monophagous. *Cheilosia scutellata*, a *Boletus* inhabitant, has been reported from *Pauxillus* by Eisfelder (1961). The biology of *Exechia* sp. pr. *confinis*, a common species in Finland but still undescribed, is too little known, but it may be specialized on *Pauxillus*. Several polyphagous species feed on *Pauxillus*.

23. *Hygrophoropsis aurantiaca* (Fr.) Schoet. Tvärminne 1975, Kolmperä 1975, Luk 1975, Sibbo 1975, Lovisa 1975 (32 sph examined, 3 cultured).

Exechia fusca 1/1 Sept; *Mycetophila blanda* 4/1 Sept; *Pegohylemyia silvatica* 4/1 Sept.

Additional species recorded (Dely-Draskovits 1974, Eisfelder 1955): *Allodia grata, Mycetophila sigillata, Suillia bicolor.*

Infestation about 50 %.

24. *Paxillus involutus* (Fr.) Fr. Kolmperä 1975—1976, Lammi 1975, Oulanka 1975 (47 sph examined, 13 cultured).

Ula silvatica 11/2 Aug—Sept; *Bolitophila hybrida* 105/7 Aug—Sept; *Sciophila varia* 4/1 Aug; *Exechia* sp. pr. *confinis* 17/2 Sept; *Allodia lugens* 7/1 Sept; *Mydaea tincta* 2/2 Sept; *M. setifemur* 2/2 Sept.

Additional species recorded (Barendrecht 1938, Burla & Bächli 1968, Buxton 1960, Dely-Draskovits 1972b, 1974, Dely-Draskovits & Mihályi 1972, Edwards 1913, 1925, Eisfelder 1955, 1956, 1961, Madwar 1934, Plassmann 1970, Shorrocks & Wood 1973, Tollet 1943): *Limonia bifasciata, Eupterina* sp., *Bolitophila pseudohybrida* (?, det. Barendrecht), *B. scherffi* (det. Plassmann), *Allodia ornaticollis, A. alternans, A. grata, Mycetophila luctuosa*, phorid. sp., *Cheilosia scutellata, Drosophila repleta, D. phalerata, Pegomya geniculata, Suillia fuscicornis, S. bicolor, S. flava.*

In Finland, as elsewhere, *Bolitophila hybrida* is the principal fungus gnat feeding on this mushroom. The degree of dipterous infestation is more than 75 %.

25. *Paxillus atrotomentosum* (Fr.) Fr. Tvärminne 1975, Kolmperä 1975—1976, Lovisa 1975 (21 sph examined, 1 cultured).

Tephrochlamys flavipes 2/1 Aug.

Eisfelder (1961) mentions that she has never found any dipterous infestation in this fungus. Dely-Draskovits (1972b, 1974) records *Leia bimaculata* and *Anthomyza albimana.*

Dipterous larvae or old galleries were found in 4 sph of the present material.

Gomphidiaceae

In the three species investigated, the general features of the dipterous infestation were the same. *Exechia separata* is a characteristic species, as in the Boletaceae. The few other species found are polyphagous. *Cordyla brevicornis*, occurring in various fungi, may sometimes destroy even young sporophores of *Gomphidius glutinosus*, attacking them from the stem. Against ovipositing by other Diptera, a glutinous coat, the cortina, protects the lamellae of the young sporophores.

26. *Chroogomphus rutilus* (Fr.) O. K. Mill. Tvärminne 1975, Kolmperä 1974, 1977, Oulanka 1976 (17 sph examined, 2 cultured).

Exechia separata 29/2 July—Aug; *Cordyla* (?) *bergensis* 5/1 Aug; *C. brevicornis* 3/1 July.

Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Edwards 1925, Eisfelder 1955, 1956): *Trichocera hiemalis, Exechia fusca, E. bicincta, E. separata, Megaselia lutea, Drosophila testacea, D. transversa, Pegohylemyia silvatica, Mydaea electa, Suillia bicolor, S. notata, S. oxyphora.*

Degree of infestation in the present material about 70 %.

27. *Gomphidius glutinosus* (Fr.) Fr. Höstnäs 1977, Kolmperä 1974—1977, Tuvkulla 1975, Lovisa 1975, Lammi 1975, Närpes 1974. (46 sph investigated, 6 sph reared).

Limonia bifasciata 1/1 Sept; *Exechia separata* 18/3 Sept; *Allodia lugens* 29/1 Oct; *A. ornaticollis* 2/1 Sept; *Cordyla brevicornis* 3/2 Sept—Oct; *Pegohylemyia silvatica* 2/1 Oct; *Mydaea discimana* 1/1 Sept.

Additional species recorded (Benick 1952, Dely-Draskovits 1972b, 1974): *Exechia separata, Suillia bicolor.*

Degree of infestation about 35 %. Even in young sporophores (stage I) infestation by *Cordyla* was recorded three times.

28. *Gomphidius roseus* (Fr.) Fr. Kolmperä 1974, 1977 (7 sph examined, 4 cultured).

Ula sylvatica 2/1 Aug; *Rondaniella dimidiata* 1/1 Aug; *Exechia separata* 52/4 Aug & Oct; *Pegohylemyia silvatica* 2/1 Aug. *Limosina parapusio* 2 ♀♀/1 Aug.

Of the 7 sph investigated, 6 were infested.

Hydrophoraceae

The Hygrophoraceae are infested almost only by polyphagous species. Chief among these are the fungus gnats, and *Mycetophila fungorum* is sometimes reared in great numbers. The fungus gnats include *Tarnania tarnani*, which chiefly feeds on Tricholomataceae.

29. *Hygrophorus erubescens* (Fr.) Fr. Runsala 1977, Kolmperä 1977 (Reared from 8 cultures of 1—2 sph each).

Ula sylvatica 10/2 Aug; *Psychoda lobata* 4/1 Sept; *Exechia fusca* 3/2 Aug; *Tarnania tarnani* 3/1 Aug; *Mycetophila fungorum* 1/1 Aug; Cecidomyiidae sp. 2/1 Aug; *Drosophila transversa* 16/2 Aug.

30. *Hygrophorus melizeus* Fr. Tvärminne 1975, Kolmperä 1977 (18 sph examined, 7 cultured).

Exechia fusca 7/3 Sept—Oct; *Mycetophila fungorum* 260/4 Sept; *Pegohylemyia silvatica* 1/1 Sept; *Pegomya geniculata* 22/4 Sept.

Additional species recorded by others from the *H. cossus-melizeus* group (Dely-Draskovits 1972b, *in litt.*, Dely-Draskovits & Mihályi 1972): *Drosophila transversa, Pegohylemyia silvatica, Suillia flava, Suillia bicolor.*

Infestation of *H. melizeus* in Finland near 60 %.

31. *Hygrophorus hypothejus* (Fr.) Fr. Tvärminne 1977, Juuma 1975 (12 sph. cultured).

Exechia fusca 81/11 Oct; *Allodia lugens* 4/1 Sept; *A. ornaticollis* 1/1 Sept; *Mycetophila fungorum* 1/1 Sept.

Additional species recorded (Dely-Draskovits & Mihályi 1972): *Mycetophila fungorum, Pegohylemyia silvatica.*

32. *Hygrophorus olivaceoalbus* (Fr.) Fr. Kolmperä 1976—1977, (13 sph examined, 4 cultured).

Coelosia truncata 1/1 Sept; *Exechia fusca* 7/2 Aug—Sept; *Tarnania tarnanii* 4/2 Sept; *Pegomya geniculata* 6/3 Sept.

33. *Hygrophorus camarophyllus* (Fr.) Dumée, Grandj. & Maire Tvärminne 1974, Kolmperä 1977 (16 sph examined; dipterans reared from 6 cultures of 1—3 sph each).

Psychoda lobata 28/1 Aug; *Smittia bicolorata* 5/1 Aug; *Exechia dorsalis* 1/1 Sept; *E. pallida* 1/1 Aug; *Tarnania tarnanii* 8/4 Aug—Sept; *Mycetophila fungorum* 213/1 Aug; *M. ichneumonea* 3/1 Sept; *Lycoriella solani* 2/2 Aug; *Drosophila transversa* 3/1 Aug.

Additional species recorded (Lastovka 1970): *Mycetophila alea.*

34. *Hygrocybe conica* (Fr.) Kumm. Kolmperä 1975 (6 sph investigated, 1 reared).

Pegomya geniculata 1/1 Sept. Larvae of fungus gnats were found in the same sporophore.

35. *Hygrocybe punicea* (Fr.) Kumm. Runsala 1977 (Reared from 1 culture of 2 sph).

Allodia ornaticollis 3/1 Aug; *Drosophila transversa* 10/1 Aug; *D. phalerata* 1/1 Aug.

Tricholomataceae

This large family contains very different types of fungi with different dipterous communities. The small-sized fungi of the *Omphalina* group and the *Mycena* species have at most a few quickly developing polyphagous species such as *Exechia fusca* or *Drosophila*. Often only a single larva is found in the sporophore. In *Mycena pura* the anthomyid *Pegomya geniculata* is able to develop. Very small species like *Micromphale perforans* hardly support any Diptera.

Laccaria and *Collybia* species seem to be infested only with polyphagous Diptera, mainly fungus gnats and *Drosophila*.

Clitocybe and *Lepista* species are of more interest. A characteristic feature is the occurrence of *Bolitophila*, *Allodiopsis* and *Tarnania* species among the fungus gnats. *Lepista odora*, earlier placed in *Clitocybe*, is, like *Lepista nuda*, a host of *Bolitophila pseudohybrida*. The pests also include polyphagous Diptera, but these two genera are rarely attacked by the commonest pest of fungi in general, *Mycetophila fungorum*. However, another polyphagous species, *Mycetophila ichneumonea*, is found in many sporophores.

Armillaria mellea is a host of many Diptera, mainly polyphagous species, and here *Mycetophila fungorum* shows a strong dominance.

Tricholoma, *Tricholomopsis* and *Melanoleca* species show a variable mixture of specialized elements (some also attacking the *Clitocybe* group) and polyphagous Diptera. The fungus gnats dominate. *Bolitophila modesta* was reared from *Tricholoma imbricatum* and *Melanoleuca* species and it also attacks *Clitocybe* species. *Tarnania tarnanii* occurs in both groups. Another pest of interest is *Pegomya atricauda*, which infests several species of the *Tricholoma* complex and further is known from *Oudemansiella* of the same family and from two species of Cortinariaceae, thus showing systematic oligophagy. Polyphagous species may occur in great numbers in *Tricholoma flavovirens* but are absent from other *Tricholoma* species.

The group of *Pleurotus*, *Pleurocybella* and *Lentinus* is infested with *Mycetophila* species that are rarely if ever found in other Tricholomataceae.

36. *Omphalina ericetorum* (Fr.) M. Lange Kolmperä 1977.
In July 35 sph of stage III were examined and no dipterous larvae were found. The sporophore is probably too small for Diptera.

37. *Omphalina sphagnicola* (Berk.) Mos. Kolmperä 1974, 1976 (62 sph examined, 2 cultured).
Exechia spinigera 1/1 Oct; *E. fusca* 1/1 Oct.
Degree of infestation below 20 %.

38. *Xeromphalina campanella* (Fr.) Kühn. & Maire (1 colony of 41 sph on a tree stump).
Drosophila phalerata 1/1 July.
Of the 41 sph investigated, 3 were infested with 1 fungus gnat larva each.

39. *Laccaria laccata* (Fr.) Berk & Br. Höstnäs 1977, Kolmperä 1975—1977, Sibbo 1975, Lammi 1975 (114 sph examined, 13 cultured).
Fungus gnat larvae were found in about 10 % of the sph of stages II—III but attempts at rearing were unsuccessful.
Species recorded in earlier papers (Buxton 1960, Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Papp 1973): *Ula sylvatica*, *Sciophila lutea*, *Exechia dorsalis*, *E. lucidula*, *Allodia ornaticollis*, *Mycetophila luctuosa*, *Drosophila kuntzei*, *Suillia bicolor*, *S. flava*.

40. *Clitocybe clavipes* (Fr.) Kumm. Kolmperä 1976, 1977 (21 sph investigated).
Infestation by fungus gnat or limoniine larvae were found in 6 of the 18 sph of stages II—III examined.
Species recorded by Benick 1952: *Docosia gilvipes*.

41. *Clitocybe squamulosa* (Fr.) Kumm. Kolmperä 1975—1977 (25 sph examined, 4 sph cultured).
Exechia fusca 4/1 July, *Allodia ornaticollis* 1/1 July; *Allodiopsis domestica* 1/1 Aug; *Mycetophila ichneumonea* 4/2 Aug.
Infestation about 45 %.

42. *Clitocybe gibba* (Fr.) Kumm. Kolmperä 1974—1975, 1977 (48 sph examined, 7 sph cultured).
Bolitophila modesta 42/3 Aug—Sept; *Exechia fusca* 1/1 Aug; *Allodiopsis domestica* 5/4 July—Aug; *Mycetophila ichneumonea* 3/1 Aug; *Mydaea tincta* 1/1 Aug.
A limoniine larva was found in one sporophore.
Additional species recorded (Burla & Bächli 1968, Dely-Draskovits 1972b, Edwards 1925): *Tarnania fenestralis*, *Mycetophila fungorum*, *M. luctuosa*, *Drosophila phalerata*, *Suillia flava*.

43. *Clitocybe* sp. (? *harperii* Murr.). Laitamaa 1977 (2 sph examined, 1 cultured).
Allodiopsis domestica 1/1 Aug.

44. *Clitocybe* sp. Kolmperä 1977 (1 sph cultured).
Mycetophila ichneumonea 2/1 Aug.

45. *Lepista odora* (Fr.) Kumm. Kolmperä 1975, 1977 (16 sph examined, 4 cultured).
Bolitophila pseudohybrida 31/4 Sept.
Additional species recorded (Barendrecht 1938, Benick 1952, Burla & Bächli 1968, Dely-Draskovits 1972b, 1974, Papp 1972): *Ditomyia fasciata*, *Leia bimaculata*, *Docosia gilvipes*, *Allodiopsis domestica*, *Mycetophila idonea*, *Drosophila busckii*, *D. transversa*, *Suillia bicolor*, *Leiomyza dudai*.

46. *Lepista nuda* (Fr.) Cooke Kolmperä 1974 (10 sph examined, 2 cultured) *Bolitophila pseudohybrida* 8/1 Oct; *Tarnania fenestralis* 4/2 Oct.
Of the 10 sph examined, 3 were infested with fungus gnat larvae.
Additional species recorded (Audcent 1949, Buxton 1960, Dely-Draskovits 1972b, 1974, *in litt.*, Edwards 1925, Matile 1964, Plassmann 1969): *Bolitophila saundersi*, *B. rossica* (?), *Rondaniella dimidiata*, *Leia bicamulata*, *Docosia gilvipes*, *Exechia fusca*, *Allodiopsis domestica*, *A. rustica*, *Drosophila phalerata*, *D. transversa*, *Tephroclamys tarsalis*, *Suillia bicolor*, *S. flava*, *S. oxyophora*.

47. *Lepista nebularis* (Fr.) Harmaja Kolmperä 1974, 1975, Punkasalmi 1974 (25 sph examined, 6 cultured).
Bolitophila modesta 1/1 Oct; *Docosia gilvipes* 10/3 Oct; *Allodiopsis domestica* 11/5 Oct; *Tarnania fenestralis* 37/4 Oct.
Additional species recorded (Buxton 1960, Canzanelli 1941, Dely-Draskovits 1972b, 1974, *in litt.*, Edwards 1925, Matile 1964, Plassmann 1969): *Limonia nubeculosa*, *Trichocera hiemalis*, *T. saltator*, *Scatopse fuscipes*, *Bolitophila glabrata*, *Sciophila hirta*, *Leia bimaculata*, *Exechia fusca*, *Allodia grata*, *A. ornaticollis*, *Mycetophila fungorum*, *M. idonea*, *Phaonia variegata*, *Suillia fuscicornis*, *A. oxyophora*, *Allophyla atricornis*.
Infestation about 60 %. Important pests of this edible mushroom are *Allodiopsis domestica* and *Tarnania fenestralis*.

48. *Leucopaxillus giganteus* Fr. (Sing.) Lemsjöholm 1977 (10 sph examined, 2 cultured).
Pegomya pallidoscutellata 38/2 Aug.
All the 10 sph examined were infested with *Pegomya larvae*.
Additional species recorded (Dely-Draskovits *in litt.*): *Drosophila transversa*.

49. *Cantharellula umbonata* (Fr.) Sing. Kolmperä 1975, Dåvits 1976 (12 sph examined).

Fungus gnat larvae found in one sporophore.

50. *Armillaria mellea* (Fr.) Karst. Tvärminne 1974, Kolmperä 1974– 1976, Helsingfors 1975—1976, Lammi 1975, Evo 1975, Janakkala 1975, Vaala 1975. (10 colonies with numerous sph in each; several sph from each colony cultured).

Exechia fusca 2/1 Oct; *E. separata* 2/1 Sept; *Allodia lugens* 3/1 Oct; *Mycetophila fungorum* 131/7 Aug—Sept; *Drosophila transversa* 3/1 Aug; *D. phalearata* 42/1 Aug; *Pegohylemyia silvatica* 6/1 Sept; *Pegomya geniculata* 2/1 Sept; *Suillia atricornis* 2/2 Sept.

Additional species recorded (Barendrecht 1938, Burla & Bächli 1968, Canzanelli 1941, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1954, 1955, Keilin 1917, Plassmann 1969, Winnertz 1863): *Ula sylvatica, Bolitophila tenella, B. cinerea, Docosia gilvipes, Allodia ornaticollis, A. grata, Tarnania fenestralis, Mycetophila idonea, M. spectabilis, M. luctuosa, Clythia agarici, Platypeza consobrina, Drosophila testacea, D. cameraria, Tephroclamys rufiventris, T. tarsalis, Pegomya transversa, Mydaea tincta, Phaonia variegata, Alloeostylus diaphanus, Suillia bicolor, S. oxyophora.*

In most of the colonies investigated at least some sph were infested with fungus gnat larvae and the most important pest of this edible fungus is undoubtedly *Mycetophila fungorum.*

51. *Tricholoma flavobrunneum* (Fr.) Kumm. Runsala 1977 (3 cultures, nothing reared).

Record by Dely-Draskovits 1974: *Rhymosia* sp. pr. *fovea.*

52. *Tricholoma imbricatum* (Fr.) Kumm. Evo 1975 (1 sph cultured).

Trichocera 4/1 Sept; *Bolitophila modesta* 23/1 Sept; *Megaselia* sp. 2/1 Sept; *Pegomya geniculata* 1/1 Sept; *P. atricauda* 1/1 Sept; *Suillia atricornis* 2/1 Sept.

53. *Tricholoma portentosum* (Fr.) Quél. Masaby 1975 (1 sph cultured). *Tarnania fenestralis* 131/1 Sept.

Additional species recorded (Canzanelli 1941, Eisfelder 1956): *Docosia gilvipes, Exechia fusca, Mycetophila marginata, M. spectabilis, Tephroclamys tarsalis.*

54. *Tricholoma flavovirens* (Fr.) Lund Tvärminne 1974, 1975, Kolmperä 1976, Oulanka 1975 (18 sph examined, 14 cultured).

Psychoda lobata 2/1 Sept; *Docosia gilvipes* 10/2 Sept; *Exechia fusca* 1/1 *Rhymosia affinis* 7/1 Sept; *Tarnania tarnanii* 10/5 Sept; *Mycetophila fungorum* 140/10 Sept; *M. ichneumonea* 1/1 Sept; *M. luctuosa* 1/1 Sept; *Lycoriella splani* 3/1 Sept; *Pegohylemyia silvatica* 169/9 Sept.

Additional species recorded (Dely-Draskovits & Mihályi 1972): *Mydaea tincta.*

More than 90 % of the sph examined were infested with dipterous larvae. Important pests are *Mycetophila fungorum* and *Pegohylemyia silvatica.*

55. *Tricholoma album* (Fr.) Kumm. Tvärminne 1974, Kolmperä 1974—1975, 1977 (32 sph examined, 15 cultured).

Drosophila transversa 1/1 Sept; *Pegomya atricauda* 37/13 Sept—Oct; *Suillia atricornis* 1/1 Sept; *Limosina parapusio* 3 ♀♀/1 Sept.

Additional species recorded (Audcent 1949, Bonnamour 1925, Dely-Draskovits 1974, Papp 1972): *Ula sylvatica, Leia* sp., *Drosophila phalerata, Suillia bicolor, S. oxyophora, Leiomyza dudai.*

Fungus gnat larvae were found in 11 sph but we did not succeed in rearing any.

56. *Tricholoma terreum* (Fr.) Kumm. Söderby 1975 (1 sph examined).

The sporophore was infested with fungus gnat larvae but nothing was reared.

Species reared by previous authors (Dely-Draskovits 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Edwards 1925, Eisfelder 1956, Schmitz 1948): *Ula sylvatica, Trichocera hiemalis, Exechia fusca, Tarnania fenestralis, Mycetophila fungorum, Megaselia flavicans, M. scutellaris, Mydaea tincta, Suillia bicolor, S. oxyophora.*

57. *Tricholoma saponaceum* (Fr.) Kumm. Kolmperä 1975 (5 sph examined, 3 cultured).

Tarnania tarnanii 3/1 Sept; *T. fenestralis* 18/2 Sept; *Corynoptera* sp. 3/1 Sept; *Pegomya geniculata* 3/2 Sept; *P. atricauda* 10/1 Sept.

Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972): *Ula sylvatica, Culicoides scoticus, Docosia gilvipes, Allodia lugens, A. ornaticollis, Tarnania fenestralis, Alloeostylus diaphanus, Suillia fuscicornis, S. atricornis.*

58. *Tricholoma virgatum* (Fr.) Kumm. Kolmperä 1977, Lammi 1975 (7 sph examined, 1 cultured).

Tarnania tarnanii 9/1 Aug.

Fungus gnat larvae were found in 5 sph and phorid and muscoid (*Pegomya?*) species in one sph.

59. *Tricholomopsis decora* (Fr.) Sing. Kolmperä 1976—1977 (7 sph examined).

Fungus gnat larvae or empty galleries were found in 6 sph.

60. *Tricholomopsis rutilans* (Fr.) Sing. Framnäs 1975, Kolmperä 1975, 1977, Liikasenvaara 1975. (4 colonies à 4—6 sph investigated, samples from 2 colonies cultured)

Exechia sp. (♀) 1/1 Sept; *Allodia lugens* 1/1 Sept; *Mycetophila finlandica* 5/1 Sept; *Suillia atricornis* 1/1 Sept.

Additional species recorded (Benick 1952, Buxton 1960, Dely-Draskovits 1974, *in litt.*, Kidd 1962): *Ula sylvatica, Culicoides scoticus, Allodia alternans, Tarnania fenestralis, Phaonia populi.*

61. *Melanoleuca cognata* (Fr.) Konr. & Mubl. Kolmperä 1977, Lammi 1975 (5 sph examined, 2 cultured).

Pegomya atricauda 3/1 Sept.

Fungus gnat larvae were found in 2 sph.

62. *Melanoleuca melaleuca* (Fr.) Murr. Laitamaa 1974 (4 sph examined, 2 cultured).

Bolitophila modesta 48/2 Oct.

63. *Melanoleuca* sp. Juuma 1975 (1 sph cultured).

Bolitophila modesta 3/1 Sept.

64. *Lyophyllum fumosus* (Fr.) Kühn. & Romagn. Pellinge 1974 (1 colony investigated).

Limonia bifasciata 2/1 Aug; *Psychoda lobata* 3/1 Aug; *Drosophila buscki* 2/1 Aug; *Tephrochlamys flavipes* 2/1 Aug; *Limosina fungicola* 3/1 Aug; *L. claviventris* 5/1 Aug.

Additional species recorded (Dely-Draskovits 1972b, 1974, Dely-Draskovits & Mihályi 1972): *Tarnania fenestralis, Pegomya geniculata, Suillia bicolor, S. fuscicornis, S. notata.*

65. *Micromphale perforans* (Fr.) Sing. Kolmperä 1975. In a rearing experiment 20 sph were cultured, but without results. The fungus is probably too small and short-lived to be attacked by Diptera.

66a. *Collybia dryophila* (Fr.) Kumm. Tvärminne 1975, Kolmperä 1975, Luk 1975 (25 sph investigated).
Fungus gnat larvae were found in 2 sph.
Species recorded (Burla & Bächli 1968, Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Eisfelder 1955, Papp 1972): *Exechia fusca, E. lucidula, Allodia ornaticollis, A. grata, Cordyla fasciata, Mycetophila fungorum, M. idonea, Drosophila phalerata, D. transversa, D. testacea, D. histrio, D. kuntzei, Anthomyia pluvialis, Suillia bicolor, S. variegata, Leiomyza dudai, Tricimba lineella.*

66b. *Collybia* sp. (pr. *dryophila* but larger and aggregated) Kolmperä 1975, Luk 1975 (2 colonies of numerous sph each; cultures from both).
Mydaea tincta 4/1 Sept; *M. setifemur* 1/1 Sept. Fungus gnat larvae were present but may have been eaten by the predaceous *Mydaea* larvae.

67. *Collybia maculata* (Fr.) Quél. Kolmperä 1975, Lammi 1975 (3 sph examined, 1 sph cultured).
Mycetophila strobli 1/1 Sept.
Additional species recorded (Buxton 1960, Eisfelder 1955, Falcoz 1930): *Exechia lundstroemi, E. dorsalis, Suillia bicolor.*

68. *Oudemansiella platyphylla* (Fr.) Moser Kolmperä 1975—1977, Sibbo 1975 (24 sph examined, 6 cultured).
Limonia bifasciata 1/1 Aug; *Psychoda lobata* 1/1 Sept; *Mycetophila fungorum* 2/2 Aug—Sept; *M. ichneumonea* 14/2 Aud—Sept; *Drosophila phalearata* 1/1 Sept; *Pegohylemyia silvatica* 1/1 Sept; *Pegomyia geniculata* 1/1 Sept; *P. atricauda* 8/1 Sept; *Mydaea setifemur* 2/1 Aug.
Additonal species recorded (Burla & Bächli 1968, Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Shorrocks & Wood 1973): *Scatopse fuscipes, Exechia bicincta, Allodia grata, Mycetophila idonea,* Phoridae sp., *Drosophila busckii, D. cameararia, Pegomya transversa, P. winthemi, Mydaea tincta.*
More than 60 % of the sporophores examined were infested with dipterous larvae.

69. *Mycena pura* (Fr.) Kumm. Lammi 1975 (1 culture).
Pegomya geniculata 2/1 Sept.
Additional species recorded (Dely-Draskovits 1974): *Exechia fusca, E. dorsalis, Allodia ornaticollis, A. alternans, A. grata, Mycetophila fungorum, Suillia bicolor.*

70. *Mycena inclinata* (Fr.) Quél. Runsala 1976 (1 colony of 5 sph, nothing was reared).
Species reared by other authors (Buxton 1960, Dely-Draskovits 1972b, 1974): *Exechia bicincta, Suillia bicolor.*

71. *Mycena galericulata* (Fr.) S. F. Gray Sibbo 1975, Liikasenvaara 1975 (2 sph examined, nothing reared).
Species reared by other authors (Barendrecht 1938, Buxton 1960, Dely-Draskovits 1972b, 1974, Dely-Draskovits & Papp 1973): *Exechia bicincta, E. fusca, Allodia lugens, A. ornaticollis, Drosophila phalerata, D. kuntzei, Suillia bicolor, S. atricornis.*

72. *Pleurotus ostreatus* (Fr. & Jacq.) Quél. Kolmperä 1976 (1 colony investigated).
Limoniine larvae were found in 3 sporophores but nothing was reared.
Species reared by other authors (Dely-Draskovits 1972b, 1974, Edwards 1925, Séguy 1940): *Trichocera hiemalis, Sciophila hirta, Exechia bicincta, Tarnania fenestralis, Mycetophila ocellus, M. ornata, M. spectabilis.*

73. *Pleurocybella porrigens* (Fr.) Sing. Kolmperä 1977 (1 colony investigated, 2 sph cultured).
Smittia bicolorata 2/1 Aug; *Mycetophila ocellus* 21/1 Aug; *Scaptomyza pallida* 7/1 Aug.

74. *Lentinus lepideus* Fr. Kolmperä 1975 (1 sph cultured).
Mycetophila flava 48/1 Aug.

Rhodophyllaceae

The species reared from the two species of *Rhodophyllus* were mainly polyphagous Diptera. The two *Tarnania* species often occurring in Tricholomataceae were reared from *R. lividus*. The dominant species were fungus gnats, particularly *Mycetophila fungorum*. Among the anthomyiid flies *Pegomya geniculata* was reared in numbers from *R. clypeatus* and, as in many other poisonous fungi, the *Drosophila* species and the limoniine *Ula sylvatica* were found.

75. *Rhodophyllus lividus* (Fr.) Quél. Runsala 1977 (1 colony of 5 sph and one single sph examined; both cultured).
Exechia fusca 1/1 Aug; *Tarnania fenestralis* 19/1 Aug; *T. tarnanii* 2/1 Aug; *Mycetophila fungorum* 5/2 Aug; *M. ichneumonea* 1/1 Aug; *Drosophila transversa* 1/1 Aug; *D. phalerata* 1/1 Aug.

76. *Rhodophyllus clypeatus* (Fr.) Quél. Lammi 1975 (10 cultures of 2 sph each).
Ula sylvatica 1/1 Sept; *Psychoda lobata* 35/4 Sept; *Mycetophila fungorum* 113/8 Sept; *M. ichneumonea* 12/3 Sept; *Pegomya geniculata* 25/3 Sept.
Additional species recorded (Dely-Draskovits 1972a, 1974, *in litt.*, Plassmann 1969): *Limonia bifasciata, Scatopse fuscipes, Allodia grata, Mycetophila sp.* (*M. ruficolle* group), *Drosophila phalerata, D. transversa, Suillia variegata.*

77. *Clitopilus prunulus* (Fr.) Quél. Tvärminne 1975, Tuvkulla 1975, Kolmperä 1975 (5 sph examined).
Fungus gnat larvae were found in one sph but nothing was reared.
Species reared by other authors (Burla & Bäckli 1968, Papp 1972): *Drosophila phalerata, D. cameraria, Leiomyza laevigata, L. dudai.*

Amanitaceae

This family comprises both edible and strongly poisonous species. The degree of infestation

varies but a general feature is that the dipterous pests are all polyphagous. In the infestation percentage there is no significant difference between the edible *Amanita rubescens* and the poisonous *A. muscaria*, in both cases near 70 %. The non-poisonous *A. vaginata* group and the poisonous *A. porphyria* are less frequently infested, 20—25 %. In *A. virosa* two *Mydaea* larvae were found in one sph, but having no prey of fungus gnat larvae they died in the last larval instar. From *Amanita phalloides*, which contains amanitine in almost the same concentration as *A. virosa*, 13 species of Diptera are known (Buxton 1960, Dely-Draskovits 1972b, 1974, Dely-Draskovits & Mihályi 1972, Eisfelder 1956, Papp 1972, Plassmann 1969, Riel 1920).

78. *Amanita rubescens* (Fr.) S.F.Gray Tvärminne 1974 – 1975, Höstnäs 1977, Kolmperä 1975– 1977, Loppi 1975, Närpes 1975 (24 sph examined, 6 cultured).

Psychoda lobata 94/2 Aug—Sept; *Allodia ornaticollis* 1/1 Sept; *Mycetophila fungorum* 75/5 Aug—Sept; *Megaselia* sp. 149/1 Aug; *Pegomya geniculata* 3/1 Sept; *Mydaea discimana* 1/1 Sept; *M. setifemur* 2/1 Sept; *Limosina parapusio* 21 ♀♀/1 Sept.

Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Edwards 1925, Eisfelder 1956, Hennig 1964, Plassmann 1969, Riel 1920): *Trichocera hiemalis, Scatopse fuscipes, Bolitophila cinerea, Leia bimaculata, Docosia gilvipes, Exechia fusca, Allodia alternans, A. grata, Cordyla brevicornis, Mycetophila idonea, Megaselia lata, M.* sp. pr. *pulicaria, M. scutellariformis, Drosophila phalerata, D. transversa, D. testacea, Anthomyia pluvialis, Pegohylemyia silvatica, Pegomya deprimata, P. zonata, Mydaea tincta, Phaonia pallida, Muscina assimilis, Suillia bicolor, Tricimba cincta.*

About 70 % of the sph of stages II—III were infested with dipterous larvae.

79. *Amanita porphyria* (Fr.) Secr. Tvärminne 1974, Kolmperä 1975—1976, Lammi 1975 (27 sph examined, 4 cultured).

Psychoda lobata 26/2 Sept; *Docosia gilvipes* 6/1 Sept; *Mycetophila fungorum* 43/2 Sept; *Pegohylemyia silvatica* 20/2 Sept; *Mycetophila fungorum* 43/2 Sept; *Pegohylemyia silvatica* 20/2 Sept; *Pegomya geniculata* 19/2 Sept; *Suillia atricornis* 3/2 Sept.

About 20 % of the sph were infested with dipterous larvae.

80. *Amanita citrina* S. F. Gray Tvärminne 1975 (1 sph examined, nothing found).

Species record by other authors (Bonnamour 1925, Brauer 1883, Dely-Draskovits 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Eisfelder 1961, Falcoz 1930, Hennig 1964, Papp 1972): *Docosia gilvipes, Exechia fusca, Cordyla fusca, Mycetophila fungorum, Drosophila phalerata, D. transversa, Pegohylemyia silvatica, Mydaea detrita, M. tincta, Suillia bicolor, S. fuscicornis, S. notata, S. flava, Leiomyza dudai.*

81. *Amanita virosa* (Fr.) Bert. Kolmperä 1976—1977, Laitamaa 1977, Sibbo 1975, Evo 1975 (16 sph examined).

One sporophore contained 2 muscoid larvae, probably 2nd instar *Mydaea* sp. Eisfelder (1961) had not seen a single infested sporophore of this poisonous fungus.

82. *Amanita regalis*. Kolmperä 1976 (9 sph examined, 2 cultured).

Psychoda lobata 4/1 Aug; *Drosphila phalerata* 1/1; *D. testacea* 13/2 Aug; *Mydaea setifemur* 1/1 Aug.

Additional species recorded (Henning 1964): *Mydaea tincta.*

83. *Amanita muscaria* (Fr.) Hook. Tvärminne 1974, Skuru 1976, Kolmperä 1975—1976 (21 sph examined, 6 cultured).

Mycetophila fungorum 31/3 Aug—Sept; *Megaselia* sp. 3/1 Sept; *Drosophila phalerata* 1/1 Aug; *Tephroclamus flavipes* 2/1 Aug; *Pegohylemyia silvatica* 165/3 Sept; *Pegomya geniculata* 1/1 Sept; *Mydaea setifemur* 1/1 Sept; *Alloeostylus diaphanus* 1/1 Sept; *Suillia atricornis* 1/1 Sept.

Additional species recorded (Buxton 1960, Dely-Draskovits 1972b, 1974, Eisfelder 1960): *Limosina bifasciata, Ula sylvatica, Trichocera hiemalis, Docosia gilvipes, Exechia spinigera, Cordyla brevicornis, Megaselia lata, Tephrochlamys tarsalis, Drosophila transversa, Suillia bicolor, Neoleria ruficeps.*

More than 60 % of the sph were infested.

84. *Amanita vaginata* group (including *A. vaginata* (Fr.) Vitt and *A. crocea* (Quél.) Sing.) Tvärminne 1975, Kolmperä 1975—1976, Sibbo 1974—1975, Lammi 1975 (29 sph examined, 4 cultured).

Psychoda lobata hundreds/3 Sept; *Allodia* sp. (*A. lugens* group) 1/1 Aug; *Mycetophila fungorum* 10/2 Aug; *Drosophila phalerata* 8/1 Aug; *Mydaea detrita* 1/1 Sept.

Additional species recorded (Barendrecht 1938, Dely-Draskovits 1972a, 1972b, Dely-Draskovits & Mihályi 1972, Eisfelder 1956, Plassmann 1969): *Scatopse fuscipes, Allodia lugens, Cordyla brevicornis, Mycetophila luctuosa, Megaselia lata, Drosophila transversa, Pegohylemyia silvatica, Mydaea tincta, Muscina assimilis, Suillia affinis, Tricimba cincta.*

Infestation about 25 %.

Pluteaceae

Rather few species of Diptera have been reared from these fungi and the Phoridae present have not been identified. Most of the dipterous species reared are polyphagous.

85. *Pluteus cervinus* (Fr.) Quél. Luk 1975 (2 sph examined, 1 cultured).

Megaselia sp. 1/1 Aug; *Mydaea tincta* 3/1 Aug; *M. setifemur* 1/1 Aug.

Additional species recorded (Burla & Bächli 1968, Plassmann 1969): *Mycetophila fungorum, Conicera pauxilla,* Platypezidae sp., *Drosophila phalerata, D. kuntzei.*

86. *Pluteus atromarginatus* Sing. Luk 1975 (2 sph cultured).

Allodia grata 34/2 Aug; *Megaselia* sp. 16/1 Aug; *Limosina parapusio* 1 ♀/1 Aug.

Lepiotaceae

From the larger species several polyphagous species have been bred, but special interest

attaches to the presence of *Pegomya rufina* in *Macrolepiota rhacodes*, suggesting a relationship with the Agaricaceae. Probably the only species able to live in the small *Cystoderma* species is the small, rapidly developing, polyphagous *Exechia fusca*.

87. *Macrolepiota procera* (Fr.) Sing. Tvärminne 1974, Lammi 1975 (4 sph examined, 3 cultured).
Psychoda lobata 1/1 Aug; *Megaselia* sp. 8/1 Aug; *Drosophila phalerata* 2/1 Aug; *D. transversa* 3/2 Aug—Sept; *D. funebris* 3/2 Aug; *Pegohylemyia silvatica* 2/1 Sept; *Pegomya geniculata* 4/2 Aug—Sept; *Mydaea electa* 1/1 Sept.
Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Matile 1964, Plassmann 1969): *Ula sylvatica, Scatopse fuscipes, Leia bimaculata, Docosia gilvipes, Exechia fusca, Allodia alternans, Rhymosia affinis, Tarnania fenestralis, Mycetophila fungorum, Platypeza consobrina, Anthomyia pluvialis, Muscina assimilis, Anthymyza albimana, Suillia bicolor, S. oxyphora.*

88. *Macrolepiota rhacodes* (Vitt.) Sing. Tvärminne 1974, Kolmperä 1974—1975 (21 sph examined, 6 cultured).
Exechia fusca 5/2 Sept—Oct; *Mycetophila fungorum* 178/2 Sept; *Megaselia* sp. 1/1 Aug; *Pegomya rufina* 2/1 Aug; *Mydaea* sp. 1/1 Aug.
Additional species reared (Dely-Draskovits 1972a, *in litt.*, Dely-Draskovits & Mihályi 1972): *Platypeza dorsalis, Drosophila phalerata, D. transversa, Muscina assimilis.*
Over 50 % of the sporophores infested.

89. *Macrolepiota puellaris* (Fr.) Kumm. Lovisa 1975 (3 sph exammed, 1 cultured).
Megaselia sp. 13/1 Sept.

90. *Lepiota clypeolaria* (Fr.) Kumm. Kolmperä 1975 (2 sph examined, 1 cultured).
Mycetophila fungorum 1/1 Sept; *Pegomya geniculata* 2/1 Sept.
Additional species recorded (Dely-Draskovits 1974, *in litt.*): *Docosia gilvipes, Exechia fusca, E. dorsalis, Allodia grata.*
91. *Cystoderma carcharias* (Secr.) Fay Kolmperä 1974 (3 sph examined).
The sph examined were each infested with one fungus gnat larva, possibly *Exechia fusca*, which is able to develop in small fungi.

92. *Cystoderma amianthinum* (Fr.) Fay (coll.) Kolmperä 1976, Oulanka 1975 (45 sph examined, 15 cultured together).
Exechia fusca 4 exx Sept.

Agaricaceae

The *Agaricus* species are rarely infested with fungus gnats and their important pests are found among the Phoridae and Anthomyiidae. Phorids were identified by Eisfelder (1956) and possibly two of the *Megaselia* species may be monophagous. *Pegomya calyptrata* and *P. rufina* are characteristic monophagous or oligophagous species and both may occur in great numbers as larvae in the sporophores. *Platypeza dorsalis* has been reared from two species of *Agaricus* by Dely-Draskovits (1972a).

93. *Agarius abruptibulbus* Peck. Kolmperä 1974 (1 sph examined, none cultured).
Species reared by other authors (Dely-Draskovits 1972a, *in litt.*, Dely-Draskovits & Mihályi 1972, Papp 1972): *Platypeza dorsalis, Drosophila transversa, Pegomya rufina, Muscina assimilis, Leiomyza dudai.*

94. *Agarius campestris* Fr. Helsingfors 1975, Lammi 1975 (4 sph examined, 3 cultured).
Pegomya rufina 314/3 Sept; *Limosina parapusio* 2 ♀♀/1 Sept.
Additional species recorded (Czerny 1930, Dely-Draskovits 1972a, 1974, Dely-Draskovits & Mihályi 1972, Eisfelder 1956, Engel 1916, Hennig 1964, Keilin 1917): *Limonia bifasciata, Docosia gilvipes, Allodia ornaticollis, Mycetophila punctata, M. blanda, Megaselia nigra, M. rufipes, M. hirtiventris, Platypeza dorsalis, P. subfasciata, Anthomyia pluvialis, Pegohylemyia silvatica, Pegomya calyptrata, Muscina assimilis, Leiomyza dudai, L. laevigata.*

95. *Agaricus edulis* Vitt. Helsingfors 197 (3 sph examined, cultured together).
Megaselia sp. 3 exx Sept; *Pegomya calyptrata* 120 exx Sept.
Additional species recorded (Dely-Draskovits 1972a, 1972b, *in litt.*, Dely-Draskovits & Mihályi 1972: *Scatopse fuscipes, Platypeza dorsalis, Drosophila phalerata, Fannia canicularis, Muscina assimilis, Piophila casei.*

96. *Agaricus silvaticus* Secr. Tvärminne 1974, Kolmperä 1974 (2 sph examined, 1 cultured).
Pegomya rufina 9/1 Aug.

97. *Agaricus bisporus* (Lange) Sing. Piikkiö 1976 (2 cultivated sph examined)
Megaselia sp. observed.
Species reared by other authors (Brauns 1950, Dely-Draskovits & Mihályi 1972, Wyatt 1964): *Henria psalliotae, Heteropeza pygmaea, Lestramia cinerea, Mycophila barnesi, M. speyeri, Megaselia nigra, Pegomya rufina.*

Bolbitiaceae

Of the dipterans constituting the present material, only *Mycetophila fungorum* has been reared from a fungus of Bolbitiaceae. *Leiomyza dudai* (Asteidae) is known from two *Agrocybe* species (Papp 1972) and the only host fungus known for *Pegomya ulmaria* is *Agrocybe aegeritia* (Buxton 1960).

98. *Agrocybe praecox* (Fr.) Fag. Kolmperä 1976 (2 sph cultured).
Mycetophila fungorum 75/2 June.
Several other dipterous species were trapped on the fungus, e.g. *Exechia fusca* 4 ♂♂, 5 ♀♀; *Drosophila transversa* 1 ♀ and *Pegohylemyia silvatica* 1 ♀, all between 6 and 11 June.

Additional species recorded (Dely-Draskovits *in litt.*, Papp 1972): *Drosophila phalerata, D. transversa, Leiomyza dudai.*

Strophariaceae

The *Psatyrella* and *Stropharia* species examined have harboured only polyphagous species, except for the unidentified phorids, which may represent some more specialized species. On the HCN-producing *Phaeolepiota aurea*, we have found *Exechia fusca* and Edwards (1925) reported *Tarnania fenestralis*, usually found on the Tricholomataceae.

On *Pholiota* and *Nematoloma* species, which grow mainly on tree stumps or old trees, certain fungus gnats of the genus *Bolitophila* occur (as also pointed out by Eisfelder 1955). From *Kuehneromyces mutabilis* of the same ecological type, *Bolitophila* species have not been reported. It is rarely infested with Diptera.

99. *Psatyrella candolleana* (Fr.) Maire Kolmperä 1975 (5 sph examined, 3 cultured).
Allodia grata 10/2 June; *Megaselia* sp. 3/1 July; *M.* sp. 1/1 July; *Drosophila transversa* 25/3 July; *D. phalerata* 39/3 July.
Additional species recorded (Dely-Draskovits *in litt.*, Dely-Draskovits & Mihályi 1972, Eisfelder 1956, Papp 1972, Schmitz 1948): *Psychoda lobata, Megaselia rufipes, M. spinicincta, M.* sp. pr. *vernalis, Platycoenosia miki, Muscina assimilis, Leiomyza dudai.*

100. *Psatyrella velutina* (Fr.) Sing. Lammi 1975 (6 sph examined, 3 cultured).
Exechia fusca 1/1 Sept; *Allodia lugens* 1/1 Sept; *Pegomya geniculata* 4/2 Sept; *Suillia atricornis* 1/1 Sept.
Additional species recorded (Burla & Bächli 1968, Edwards 1913): *Bolitophila cinerea, Drosophila phalerata.*

101. *Stropharia hornemanni* (Fr.) Lund & Neuf. Sjundeå 1977, Kolmperä 1974—1975, Liikasenvaara 1975 (sph examined, 3 cultured).
Ula sylvatica 1/1 Sept; *Trichocera saltator* 1/1 Sept; *Exechia fusca* 2/1 Oct; *Mycetophila fungorum* 5/2 Sept-Oct; *Allodia lugens* 1/1 Sept; *Pegomya geniculata* 5/1 Sept.

102. *Stropharia semiglobata* (Fr.) Quél. Liikasenvaara 1975 (1 sph examined, none cultured).
Species reared by Eisfelder 1956: *Megaselia berndseni.*

103. *Phaeolepiota aurea* (Fr.) Maire Helsingfors 1974, 1976 (15 sph examined, 4 cultured).
Exechia fusca 45/4 Sept. Ovipositing *E. fusca* females were observed on two additional sph.
Additional species recorded (Edwards 1925): *Tarnania fenestralis.*

104. *Pholiota squarrosa* (Fr.) Kumm. Runsala 1976 (1 colony investigated, several sph from this colony cultured).
Lycoriella solani 45 exx Sept.
Additional species recorded (Benick 1952, Buxton 1960, Eisfelder 1956, Falcoz 1930, Plassmann 1969): *Bolitophila cinerea, Alloeostylus diaphanus, Suillia bicolor.*

105. *Pholiota flammans* (Fr.) Kumm. Skuru 1976, Kolmperä 1976 (2 colonies investigated and sph cultured from both).
Trichocera hiemalis 1/1 Sept; *Bolitophila cinerea* 18/1 Sept.

106. *Pholiota lenta* (Fr.) Sing. Laitamaa 1974 (1 sph cultured).
Bolitophila tarsata 9/1 Oct; *B. tenella* 129/1 Oct.
Additional species recorded (Dely-Draskovits 1972b, 1974, Dely-Draskovits & Mihályi 1972): *Exechia dorsalis, Pegomya geniculata, Suillia bicolor.*

107. *Kuehneromyces mutabilis* (Fr.) Sing & A. H. Smith Bromarv 1975, Komperä 1975—1976, Sibbo 1974, Lammi 1975. (8 colonies investigated, 4 cultures of several sph each).
Psychoda lobata 28/3 Sept; *Mycetophila fungorum* 11/1 Sept.
Additional species recorded (Grämer 1965): *Trichonta melanura.*
The dipterous infestation is rather low; in one big colony less than 10 % of the sporophores were infested with fungus gnat larvae.

108. *Nematoloma capnoides* (Fr.) Karts. Kolmperä 1974, Juuma 1975 (2 colonies of together 72 sph investigated; 3 cultures of several sph each).
Bolitophila aperta 1/1 Oct; *B. cinerea* 10/2 Oct.
Additional species recorded (Eisfelder 1954, 1960, Plassmann 1969): *Bolitophila cinerea, Mycetophila fungorum.*
Less than 10 % of the sporophores were infested with fungus gnat larvae.

109. *Nematoloma sublateritium* (Fr.) Karst. Runsala 1976, Kolmperä 1976 (12 sph of 2 colonies investigated; sph of both colonies reared).
Bolitophila cinerea 198/2 Oct.
Additional species recorded (Burla & Bächli 1968, Buxton 1960, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Eisfelder 1954, 1955): *Ula sylvatica, Trichocera hiemalis, T. rufescens, T. saltator, Bolitophila cinerea, Mycomyia wancowsiczii, Docosia gilvipes, Allodia ornaticollis, Mycetophila fungorum, Drosophila funebris, Suillia bicolor, S. flava, Tricimba cincta.*

110. *Nematoloma fasciculare* (Fr.) Karst. Kolmperä 1975, 1977 (5 sph of one colony and 2 sph of another cultured).
Bolitophila cinerea 19/1 Sept; *Tarnania fenestralis* 2/1 Sept; *Mycetophila fungorum* 4/1 Sept.
Additional species recorded (Audcent 1949, Buxton 1960, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Edwards 1925, Eisfelder 1954, 1956, Falcoz 1921, Grämer 1965, Plassmann 1969, Shorrocks & Wood 1973): *Limonia bifasciata, Ula sylvatica, Bolitophila saundersi, Rondaniella dimidiata, Docosia gilvipes, Cordyla fusca, Mycetophila idonea, Drosophila cameraria, D. testacea, D. transversa, Anthomyia pluvialis, Pegohylemyia silvatica, Fannia canicularis, Mydaea tincta, Muscina assimilis, Suillia bicolor, S. flava, Limosina parapusio. Bolitophila cinerea* is recorded by three of the above authors.

111. *Nematoloma* sp. [? *udum* (Fr.) Karst.] Kolmperä (1 sph cultured).

Exechia frigida 4/1 July; *E. parva* 2/1 July; *Drosophila transversa* 2/1 July.

Coprinaceae

The Coprinaceae have very short-lived sporophores and even in those of the bigger species, the lamellae soon break down into a dense black liquid. Of the true fungivores *Exechia fusca*, *Mycetophila fungorum* and some *Drosophila* species are able to develop in these fungi. Larvae of *Fannia canicularis*, *Muscina assimilis* and some sphaerocerids can continue feeding in the rotting sap.

112. *Coprinus comatus* (Fr.) S. F. Gray Helsinki: Lauttasaari 1976 (2 sph examined, nothing cultured).
This fungus was investigated by Buxton (1960), who found no dipterous infestation.

113. *Coprinus atramentarius* (Fr.) Fr. Helsingfors 1974, 1976 (18 sph examined, 4 cultured).
Exechia fusca 5/2 Sept; *Mycetophila fungorum* 4/3 Sept; *Drosophila transversa* 2/1 Sept.
Additional species recorded (Papp 1972): *Limosina flavipes*.

114. *Coprinus fuscescens* Fr. Kauniainen 1977 (1 dense colony with some sph already decomposing investigated; the entire colony cultured).
Drosophila transversa 60 exx July; *Fannia canicularis* 15 exx July; *Muscina assimilis* 2 exx July.

Cortinariaceae

More than 20 dipterous species are recorded as feeding on the edible *Rozites caperata*. Most of them, e.g. the dominant *Mycetophila fungorum*, are common polyphages. It is of interest, however, that *Pegomya atricauda* was also reared from *Cortinarius triumphans*; it is typical of some Tricholomataceae.

In the large *Cortinarius* complex the genus *Dermocybe* is attacked by several polyphagous dipterans, but some *Dermocybe* species seem to be very little infested (e.g. *D. semisanguinea*). The extremely poisonous fungi of the subgenus *Leprocybe* are not uncommonly infested with more or less polyphagous fungus gnats or Limoniinae. In *Phlegmacium* species the dominant pests are polyphagous fungus gnats, but more specialized species are *Bolitophila basicornis*, *Tarnania tarnanii* (in many species of fungi, but not entirely polyphagous) and, as already mentioned, *Pegomya atricauda*.

The *Sericeocybe* species have mainly polyphagous pests and common fungus gnats dominate. Their strong smell does not protect *S. camphoratus* and *S. traganus* from the fungus gnats or *Limonia*. The *Myxacium* and *Telamonium* species seem to be infested mainly with common polyphages.

In our material the poisonous and rather small *Inocybe* species were inhabited by *Exechia fusca* or *Drosophila transversa*. From *Inocybe dulcamarae* Barendrecht (1938) recorded *Rhymosia batava*. *Tarnania tarnanii* occurs in some of the *Inocybe* species.

The genus *Hebeloma* has many polyphagous pests but in one species Eisfelder (1955) found *Allodiopsis domestica*, a fungus gnat typical of the Tricholomataceae. Eisfelder (1955) also recorded *Rymosia fasciata* from *Galerina marginata*. These and other features of the composition of the dipterous fauna of Cortinariaceae indicate a systematic relationship with the Tricholomataceae.

115. *Rozites caperata* (Fr.) Karst. Tvärminne 1974, Kolmperä 1974—1976, Närpes 1974 (137 sph examined, 27 cultured).
Ula sylvatica 2/1 Aug; *Psychoda lobata* 10/1 Aug; *Exechia fusca* 1/1 Aug; *Allodia ornaticollis* 1/1 Aug; *Tarnania tarnanii* 1/1 Aug; *Cordyla brevicorne* 37/1 Aug; *Mycetophila fungorum* 408/20 Aug—Sept; *M. ichneumonea* 4/2 Aug; *Cirynoptera* sp. 1/1 Aug; *Megaselia* sp. 1/1 Aug; *Drosophila transversa* 97/9 Aug; *D. phalerata* 6/1 Aug; *Tephrochlamys flavipes* 2/2 Aug; *Pegohylemyia silvatica* 1/1 Sept; *Pegomya geniculata* 6/3 Sept; *P. atricauda* 1/1 Aug.
Additional species recorded (Dely-Draskovits 1972a, 1972b, Dely-Draskovits & Mihályi 1972, Eisfelder 1954, 1956, Grämer 1965, Papp 1972, Schmitz 1948): *Trichocera hiemalis*, *Bolitophila hybrida*(?), *Megaselia lata*, *M. nigrescens*, *M. pygmaea*, *M. scutellariformis*, *Anthomyia pluvialis*, *Suillia bicolor*, *Leiomyza dudai*.
The most important pest of this edible fungus is *Mycetophila fungorum*, but *Cordyla brevicornis*, which was reared by us from a single sample, has been reared by Eisfelder (1954) 25 times. In August infestation with dipterous larvae about 80 %.

116. *Dermocybe semisanguinea* (Fr.) Wünsche Kolmperä 1975, 1977 (14 sph examined).
Small galleries, probably caused by fungus gnat larvae, were found in one sporophore. The *Dermocybe* species seem to be very little infested with dipterous larvae (cf. Eisfelder 1954).

117. *Cortinarius (Leprocybe) speciosissimus* Kühn & Romagn. Evo 1975 (11 sph examined, 2 cultured).
Mycetophila uninotata 8/2 Sept.
Of the sprophores investigated, four had fungus gnat larvae.

118. *Cortinarius (Leprocybe) gentilis* (Fr.) Fr. Kolmperä 1976, Evitskog 1976, Evo 1975, Liikasenvaara 1975, Juuma 1975 (13 sph examined, 1 cultured).
Ula sylvatica 2/1 Sept; *Tarnania tarnanii* 1/1 Sept.

119. *Cortinarius (Phlegmacium) multiformis* (Secr.) Fr. group. Kolmperä 1974—1976 (10 sph examined, 3 cultured).
Docosia gilvipes 1/1 Oct; *Exechia fusca* 1/1 Oct; *Allodia lugens* 1/1 Oct; *Pegomya geniculata* 3/2 Sept.

120. *Cortinarius (Phelegmacium) triumphans* Fr. Tvärminne 1974, Snappertuna 1975, Kolmperä 1975—1976, Lammi 1975 (15 sph examined, 7 cultured).
Ula sylvatica 1/1 Sept; *Trichocera saltator* 5/1 Sept; *Psychoda lobata* 9/1 *Smittia bicolorata* 1/1 Sept; *Bolitophila basicornis* 2/1 Sept; *Tarnania tarnanii* 8/2 Sept; *Mycetophila fungorum* 332/3 Sept; *M. ichneumonea* 4/1 Sept; *Pegomya geniculata* 1/1 Sept; *P. atricauda* 1/1 Sept; *Limosina parapusio* 2 ♀♀/1 Sept.
Mycetophila fungorum seems to be the most important pest of this edible fungus.

121. *Cortinarius (Sericeocybe) traganus* (Fr.) Fr. Kolmperä 1976 (4 sph examined, 1 cultured).
Limonia bifasciata 5/1 Sept.

122. *Cortinarius (Sericeocybe) camphoratus* Fr. Kolmperä 1975—1976 (31 sph examined, 1 cultured).
Limonia bifasciata 4/1 Sept.
About 30 % of the sporophores examined were infested, the pests being fungus gnat larvae.

123. *Cortinarius (Sericeocybe)* sp. pr. *alboviolaceus* (Fr.) Fr. Lammi 1975 (13 sph examined, 5 cultured).
Exechia cincta 1/1 Sept; *Tarnania tarnanii* 3/1 Sept; *Mycetophila fungorum* 46/3 Sept; *M. ichneumonea* 8/1 Sept; *Suillia atricornis* 3/1 Sept.

124. *Cortinarius (Myxacium) trivialis* J. Lange Tvärminne 1974 (31 sph examined, 3 cultured).
Psychoda lobata 66/1 Aug; *Allodia ornaticollis* 1/1 Aug; *Mycetophila fungorum* 17/3 Aug; *Drosophila phalerata* 40/1 Aug; *D. transversa* 22/1 Aug; *Limosina parapusio* 1 ♀/1 Aug.
Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972): *Limonia bifasciata, L. tripunctata, Ula sylvatica, Exechia fusca, Mydaea tincta, Alloeostylus diaphanus, Suillia bicolor, S. oxyophora.*
About 70 % of the sporophores examined were infested.

125. *Cortinarius (Myxacium) collinitus* (Fr.) Fr. Kolmperä 1976—1977, Evo 1975, Liikasenvaara 1975 (10 sph examined, 3 cultured).
Psychoda lobata 50/2 Sept; *Exechia fusca* 1/1 Sept; *E. separata* 1/1 Sept; *Corynoptera* sp. 1/1 Sept; *Pegomya geniculata* 21/1 Sept; *Suillia atricornis* 3/2 Sept.
Additional species recorded (Riel 1920): *Drosophila phalerata.*

126. *Cortinarius (Telamonium) armillatum* (Fr.) Fr. Tvärminne 1974, Kolmperä 1974—1976, Lammi 1975, Oulanka 1975 (64 sph examined, 5 cultured).
Limonia bifasciata 2/1 Sept; *Ula sylvatica* 17/1 Sept; *Psychoda lobata* 2/1 Sept; *Exechia dorsalis* 6/3 Sept; *Mydaea* sp. 1 puparium/1 Sept.
About 30 % of the sporophores examined were infested with dipterous larvae.

127. *Cortinarius (Telamonium) brunneus* (Fr.) Fr. Kolmperä 1974, Liikasenvaara 1975 (3 sph examined, 2 cultured).
Ula sylvatica 3/1 Sept; *Tarnania tarnanii* 2/1 Sept.
Additional species recorded (Dely-Draskovits 1972b, 1974): 1974): *Rondaniella diminata, Suillia bicolor.*

128. *Gymnopilus penetrans* (Fr.) Murr. Luk 1975 (4 sph examined).
Dipterous eggs on the lamellae of 1 sph and on the stem of another (probably *Mydaea* sp.).
Species recorded by Dely-Draskovits (1972b): *Suillia bicolor.*

129. *Inocybe lacera* (Fr.) Kumm. Kolmperä 1975— 1976 (46 sph examined, 2 cultured).
Exechia fusca 1/1 June; *Drosophila transversa* 1/1 Aug.
Of the sporophores examined 17 % were infested with dipterous larvae.

130. *Inocybe* sp. (? *mixtilis* Britz.) Kolmperä 1977 (8 sph examined, 1 cultured).
Drosophila transversa 1/1 July.

131. *Hebeloma* sp. Lammi 1975 (5 sph examined, 2 cultured).
Exechia fusca 6/2 Sept.

132. *Tubaria* sp. Juuma 1975 (1 sph cultured).
Allodia lugens 1/1 Sept.

133. *Galerina marginata* (Fr.) Kühn. Kolmperä 1976 (1 colony with some sph investigated).
Some sporophores were infested with fungus gnat larvae.
Eisfelder (1955) reared *Rhymosia fasciata.*

Russulaceae

The edible, rather soft-stemmed *Russula* species are mostly (often more than 80 % of the sporophores (II+III) examined) infested by Diptera. The most important pest is *Mycetophila fungorum*, but *Cordyla* species are also frequent, attacking the sporophores from the lower parts of the stem. Another characteristic species is *Exechia pallida*, which was sometimes reared in great numbers. *Pegomya geniculata* occurs frequently but in small numbers in the sporophore.

The acrid-tasting species are generally less infested (Eisfelder 1961), but are attacked by the same species as are the edible species of *Russula.*

The *Russula adusta* group has a characteristic fungus gnat species sometimes occurring in great numbers, — namely, *Mycetophila alea*, which is only occasionally found in other fungi. Various polyphagous species are also reared from the *R. adusta* group.

Russula delica is a transitional species to the white *Lactarius* species of the *L. vellerus-piperatus-pergamenus* group. Numerous dipterans, of which

the dominant ones are polyphagous, are bred from this species.

The white *Lactarius* species are comparatively rarely infested. From *L. resimus* the oligophagous species *Mycetophila strobli* and *Exechia nigroscutellata* are reared. In the present material the latter was otherwise found only in *Lactarius torminosus* and *L. pyrogalus*.

The very rich milky sap in *L. representaneus* and *L. volemus* probably largely protects these fungi against dipterous infestation.

Exechia nigroscutellata has already been mentioned as a specialized fungus gnat of the *Lactarius* fungi. In *Lactarius necator* and *L. trivialis Exechia contaminata* seems to be a characteristic dominant oligophagous species. *Exechia pseudocincta* is another species feeding on *Lactarius*, which was reared by us only from the *L. deliciosus* group, of which the most important pest is *Mycetophila blanda*, a species rarely found in other fungi. The polyphagous *Mycetophila ichneumonea*, *M. strobli* and *M. uninotata* seem to be more common in the *Lactarius* species than in other fungi. Some phorids also appear to be characteristic of *Lactarius*. Although numerous polyphagous Diptera occur in various combinations in the different *Lactarius* species, *Mycetophila fungorum* is not common.

Fannia difficilis seems to favour both *Russula* and at least some *Lactarius* species (see also Dely-Draskovits 1976a).

Thus the dipterous fauna of Russulaceae shows several cases of oligophagy, but further rearing experiments are needed to answer some questions concerning the *Lactarius* species.

134. *Russula delica* Fr. Tvärminne 1974—1975, Kolmperä 1974, Tuvkulla 1975 (16 sph examined, 7 cultured).

Limonia bifasciata 1/1 Aug; *Psychoda lobata* 5/1 Aug; *Smittia bicolorata* 31/1 Aug; *Allodia lugens* 3/2 Sept; *Cordyla fusca* 1/1 Sept; *Mycetophila fungorum* 8/2 Sept; *M. strobli* 57/4 Aug—Sept; *M. ichneumonea* 1/1 Sept; *M. alea* 9/1 Aug; *Drosophila transversa* 5/1 Aug; *Tephrochlamys flavipes* 1/1 Sept; *Pegohylemyia silvatica* 4/1 Sept; *Suillia atricornis* 2/1 Sept.

Additional species recorded (Buxton 1960, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Edwards 1925, Eisfelder 1954, Hennig 1964, Laštovka 1971, Matile 1963, Mikołajczyk 1967): *Ula sylvatica, Culicoides scoticus, Scatopse fuscipes, Sciophila lutea, S. cliftoni, Leia bimaculata, Docosia gilvipes, Exechia fusca, Cordyla brevicornis, C. nitidula, Mycetophila idonea, M. blanda, M. conformis, M. sigillata, Drosophila busckii, D. testacea, D. phalerata, D. kuntzei, D. trivittata, Pegomya rufina, Fannia difficilis, Mydaea tincta, Phaonia populi, P. variegata, Tricimba cincta.*

135. *Russula nigricans* (Mérat) Fr. Tvärminne 1974 (1 sph cultured).

Smittia bicolorata 1/1 Sept; *Mycetophila ichneumonea* 1/1 Sept; *M. alea* 32/1 Sept.

Additional species recorded (Benick 1952, Buxton 1960, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Papp 1973, Edwards 1925, Eisfelder 1954, 1956, Hennig 1964, Kidd 1962, Riel 1920, Schmitz 1948): *Ula sylvatica, Trichocera saltator, Leia bimaculata, Docosia gilvipes, Cordyla fasciata, C. fusca, Mycetophila alea* (recorded by several authors), *Megaselia nigrescens, M. pygmaeoides, Drosophila testacea, D. phalerata, D. transversa, Mydaea tincta, Suillia bicolor, Tricimba cincta.*

136. *Russula adusta* (Fr.) Fr. Tvärminne 1974, Kolmperä 1976—1977, Oulanka 1975 (12 sph examined, 8 cultured).

Smittia bicolorata 1/1 Aug; *Cordyla fusca* 1/1 Aug; *Mycetophila fungorum* 1/1 Aug; *M. ichneumonea* 1/1 Sept; *M. alea* 463/6 Aug—Sept; *Scaptomyza pallida* 6/1 Aug; *Tephroclamys flavipes* 1/1 Aug; *Pegohylemyia silvatica* 8/2 Aug; *Suillia bicolor* 1/1 Aug; *S. atricornis* 1/1 Sept; *Copromyza* sp. (immature ♀) 1/1 Sept.

Additional species record (Bonnamour 1926, Eisfelder 1954, 1956, Riel 1920): *Ula sylvatica, Cordyla fasciata, Mycetophila alea (M. signata* of Bonnamour 1926 is probably this species), *Megaselia nigrescens, Drosophila phalerata.*

The saprophagous species *Smittia bicolorata, Scaptomyza pallida* and *Copromyza* (s.str.) sp. may have been feeding on decomposing substances in the galleries of *Mycetophila alea*, the characteristic fungus gnat of the *Russula adusta* group.

137. *Russula decolorans* (Fr.) Fr. Tvärminne 1974, Kolmperä 1974—1976, Sibbo 1975, Lammi 1975, Närpes 1974 (121 sph examined, 17 cultured).

Ula sylvatica 38/2 Sept; *Psychoda lobata* 280/2 Sept; *Smittia bicolorata* 14/1 Sept; *Culicoides chiopterus* 2/1 Sept; *C. scoticus* 20/1 Sept; *Allodia ornaticollis* 6/2 Aug; *Cordyla fasciata* 13/2 July; *C. brevicornis* 18/3 Aug; *C. flaviceps* 2/1 Aug; *Mycetophila fungorum* 164/10 July-Aug; *M. strobli* 1/1 Sept; *Megaselia* sp. 1/2 Aug; *Tephrochlamys flavipes* 1/1 Aug; *Pegohylemyia silvatica* 1/1 Aug; *Pegomya geniculata* 3/1 Aug; *Fannia difficilis* 2/1 Aug; *Mydaea tincta* 2/2 Aug; *M. setifemur* 5/3 Aug—Sept.

Additional species recorded (Eisfelder 1954, 1956, Schmitz 1948): *Cordyla brevicornis* (10 times), *Megaselia lata, M. lutea, M. nigrescens, M. scutellariformis.*

Of the sporophores examined (age class IV excluded), 78 % were infested with dipterous larvae, *Mycetophila fungorum* being the dominant pest. The larvae of *Cordyla* feed in the stem and damage the sporophore severely as early as stage II.

138. *Russula vinosa* Lindbl. Tvärminne 1974, Kolmperä 1974—1975, Närpes 1974 (36 sph examined, 13 cultured).

Exechia pallida 11/1 Aug; *E. fusca* 2/2 Aug; *Allodia ornaticollis* 10/1 Sept; *Cordyla brevicornis* 5/2 Aug—Sept; *Mycetophila fungorum* 164/10 Aug-Sept; *M. luctuosa* 1/1 Aug; *Drosophila transversa* 4/3 Aug; *D. phalerata* 4/1 Aug; *Tephrochlamys flavipes* 5/1 Aug; *Pegohylemyia silvatica* 7/1 Aug; *Pegomya geniculata* 9/2 Aug; *Fannia difficilis* 7/2 Aug; *Mydaea tincta* 1/1 Aug; *Limosina claviventris* 1/1 Aug.

Additional species recorded (Buxton 1960); *Megaselia scutellariformis.*

More than 85 % of the sporophores (stages II—III) were infested with dipterous larvae. The dominant pest is *Mycetophila fungorum.*

139. *Russula flava* (Rom.) Rom. Tvärminne 1974, Kolmperä 1974, 1976 (131 sph examined, 33 cultured).
Psychoda lobata 366/7 Aug—Sept; *Smittia bicolorata* 3/1 Aug; *Culicoides scoticus* 1/1 Sept; *Exechia pallida* 10/1 Aug; *E. fusca* 5/2 Aug—Sept; *Mycetophila fungorum* 961/32 Aug—Sept; *Lycoriella solani* 3/2 Aug—Sept; *Megaselia* sp. 1/1 Aug; *Drosophila phalerata* 30/7 Aug—Sept; D. *transversa* 87/7 Aug-Sept; *Pegomya geniculata* 29/5 Aug—Sept; *Limosina parapusio* 4 ♀♀/2 Aug.
About 85 % of the sporophores were infested, the commonest pest being *Mycetophila fungorum.*

140. *Russula consobrina* (Fr.) Fr. Kolmperä 1976, Ruotsinkylä 1976 (2 sph examined, 1 cultured).
Ula sylvatica 5/1 Sept.

141. *Russula foetens* (Fr.) Fr. Bromarv 1975, Tvärminne 1974, Höstnäs 1977, Kolmperä 1974, 1976, Morby 1976, Lammi 1975 (32 sph examined, 9 cultured).
Ula sylvatica 3/1 Sept; *Psychoda lobata* 7/1 July; *Smittia bicolorata* 42/2 July, Sept; *Cordyla flaviceps* 4/1 Sept; *Mycetophila fungorum* 198/5 July, Sept; *M. strobli* 3/1 Sept; *Drosophila transversa* 17/1 July.
Additional species recorded (Bonnamour 1926, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1954, 1956, Schmitz 1948): *Limonia bifasciata, Sylvicola cincta, Scatopse fuscipes, Sciophila lutea, Rondaniella dimidiata, Exechia fusca, Cordyla fasciata, C. fusca, Mycetophila idonea, M. alea, Megaselia lata, M. lutescens, M. nigrescens, Drosophila confusa, D. testacea, D. phalerata, Anthomyia pluvialis, Fannia difficilis, Mydaea tincta, M. electa, Muscina assimilis, Suillia affinis, S. bicolor, S. atricornis, Anthomyza albimana, Tricimba cincta.*
Infestation about 60 %.

142. *Russula xerampelina* (Secr.) Fr. Bromarv 1975, Tvärminne 1974, Kolmperä 1976, (27 sph examined, 14 cultured).
Psychoda lobata 15/1 Aug; *Smittia bicolorata* 1/1 Aug; *Exechia pallida* 212/4 Aug—Sept; *Cordyla fasciata* 9/2 Aug; *Mycetophila fungorum* 182/10 Aug—Sept; *Drosophila transversa* 4/2 Aug; *Pegomya geniculata* 14/2 Aug– Sept.
Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973- Eisfelder 1956, Papp 1972, Schmitz 1948): *Scatopse fuscipes, Leia bimaculata, Allodia ornaticollis, Mycetophila idonea, Megaselia eisfelderae, M. flavicans, M. lutea, M. nigrescens, Drosophila testacea, Pegohylemyia silvatica, Fannia difficilis, Mydaea tincta, Suillia fuscicornis, S. flava, S. bicolor, S. notata, S. variegata, Leiomyza dudai, Tricimba cincta.*

143. *Russula vesca* Fr. Kolmperä 1975, Sibbo 1974, Lammi 1975 (8 sph examined, 2 cultured).
Pegomya geniculata 1/1 Sept; *Mydaea setifemur* 1/1 Aug.
Additional species reared (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Eisfelder 1955, 1956, Schmitz 1948): *Scatopse fuscipes, Exechia pallida Cordyla brevicornis, Mycetophila fungorum, M. idonea, Megaselia berndseni, M. flavicans, M. lutea, M. lata, M. nigrescens, M. pygameoides, M. scutellariformis, Cheilosia scutellata, Drosophila testacea, D. phalerata, D. transversa, Pegohylemyia silvatica, Pegomya deprimata, Fannia difficilis, Mydaea tincta, Muscina assimilis, Suillia bicolor, S. flava.*

144. *Russula paludosa* Britz. Tvärminne 1974, Kolmperä 1974– 1976, Lammi 1975 (88 sph examined, 21 cultured).
Limonia bifasciata 3/1 Sept; *Ula sylvatica* 1/1 Sept; *Psychoda lobata* 24/3 Sept; *Smittia bicolorata* 6/1 Sept; *Culicoides chiopterus* 1/1 Sept; *C. scotius* 4/1 Sept; *Exechia pallida* 4/2 Aug– Sept; *Allodia ornaticollis* 1/1 Aug; *Brevicornu* sp. 1 ♀/1 Aug; *Cordyla fusca* 65/2 July; *C. nitida*? 1/1 Aug; *Mycetophila fungorum* 597/16 July-Aug; *M. strobli* 9/3 Aug—Sept; *Lycoriella solani* 5/1 Aug; *Megaselia* sp. 11/1 Aug; *Drosophila transversa* 12/2 Aug; *D. phalerata* 6/1 Aug; *Pegomya geniculata* 10/1 Sept; *Suillia flava* 2/1 Sept.
Additional species recorded (Eisfelder 1954, 1956, Schmitz 1948): *Cordyla brevicornis, Megaselia eisfelderae, M. lutea, M. flavicans, M. nigrescens, M. scutellaris, M. scutellariformis.*
About 90 % of the sporophores of stages II—III were infested. *Mycetophila fungorum* is more important than any other dipterous species. The badly eaten sporophores of stage III serve as a suitable substrate for saprophagous species.

145. *Russula nitida* (Fr.) Fr. Kolmperä 1975– 1976 (6 sph examined, 1 cultured).
Allodia ornaticollis 1/1 Aug; *Drosophila transversa* 4/1 Aug.
Fungus gnat larvae were found in 5 sph.

146. *Russula puellaris* Fr. Kolmperä 1974– 1975, Lammi 1975 (5 sph examined, 3 cultured).
Allodia ornaticollis 2/1 Sept; *Mycetophila fungorum* 4/2 Sept; *Megaselia* sp. 1/1 Sept; *Pegomya geniculatu* 3/3 Sept.
Additional species recorded (Eisfelder 1956, Schmitz 1948): *Megaselia lutea M. pygmaeoides, M. scutellariformis.*

147. Russula sp. (a small species with a violet cap) Kolmperä 1974 (1 sph cultured).
Exechia pallida 24/1 Sept.

148. *Russula lundelli* Sing. Kolmperä 1974, 1976 (3 sph cultured).
Psychoda lobata 2/1 Aug; *Mycetophila fungorum* 13/2 Aug; *M. strobli* 3/1 Aug; *Lycoriella solani* 8/1 Aua; *Pegomya geniculata* 2/1 Aug; *Mydaea setifemur* 3/1 Aug; *Suillia atricornis* 1/1 Aug.

149. *Russula emetica* (Fr.) S. F. Gray Kolmperä 1975—1977, Sibbo 1975 (9 sph examined, 1 cultured).
Scaptomyza pallida 1/1 Aug.
Additional species recorded (Eisfelder 1956, Plassmann 1969): *Allodia ornaticollis, Cordyla crassicornis, Mycetophila fungorum, Megaselia lutea.*
Dipterous larvae were found in 2 sph.

150. *Russula fragilis* (Fr.) F. Kolmperä 1976—1977 (19 sph examined).
Fungus gnat larvae were found in one sporophore.
Species reared by other authors (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1954): *Forcipomyia ciliata, Dicranomyia decemmaculata, Ula sylvatica, Trichocera saltator, Scatopse fuscipes, Cordyla fasciata, Exechia fusca, E. pallida, Bolitophila pseudohybrida, Docosia gilvipes, Allodia ornaticollis, Mycetophila fungorum, M. idonea, M.*

spectabilis, Drosophila testacea, D. phalerata, D. transversa, Pegomya geniculata, Suillia bicolor, S. flava, S. notata, Tricimba cincta.

The infestation percentage is obviously low in this acrid-tasting fungus (cf. Eisfelder 1961).

151: *Russula rhodopoda* Zvára Kolmperä 1974, 1976 (11 sph examined, 1 cultured).

Mycetophila fungorum 4/1 Sept; *Pegomya geniculata* 3/1 Sept.

In 6 of the 11 sph examined, eggs or larvae of Diptera were found.

152. *Russula sardonia* Fr. Tvärminne 1974 (1 sph cultured).

Mycetophila ichneumonea 7/1 Sept; *M. strobli* 14/1 Sept.

Additional species recorded (Audcent 1949, Burla & Bächli 1968, Eisfelder 1956, Plassmann 1971): *Allodia ornaticollis, A. lugens, Megaselia lutea, M. nigrescens, Drosophila buscki.*

153. *Russula olivacea* (Secr.) Fr. Runsala 1977 (1 sph cultured).

Mycetophila fungorum 10/1 Aug; *Drosophila funebris* 1/1 Aug; *D. transversa* 34/1 Aug; *D. phalearta* 22/1 Aug.

Additional species recorded (Burla & Bächli 1968, Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Papp 1973, Shorrocks & Wood 1973): *Ula sylvatica, Scatopse fuscipes, Exechia pallida, Allodia grata, A. ornaticollis, Drosophila testacea, D. buscki, D. cameraria, Fannia difficilis, Suillia bicolor.*

154. *Russula aeruginea* Lindbl. Tvärminne 1974, Kolmperä 1974—1976, Lovisa 1975, Lammi 1975, Närpes 1975, Oulanka 1975 (37 sph examined, 18 cultured).

Psychoda lobata 143/8 July-Sept; *Exechia fusca* 1/1 July; *E. pallida* 15/1 *Allodia ornaticollis* 16/3 July; *Cordyla* sp. 1/1 Aug; *Mycetophila fungorum* 384/14 July-Sept; *M. strobli* 1/1 Sept; *Lycoriella solani* 3/3 Sept; *Megaselia* sp. 1/1 Sept; *Drosophila testacea* 1/1 Aug; *D. transversa* 12/4 July-Aug; *Tephrochlamys flavipes* 1/1 Sept; *Pegohylemyia silvatica* 1/1 Sept; *Pegomya geniculata* 2/1 Sept; *Fannia difficilis* 1/1 Sept; *Mydaea tincta* 5/2 Aug; *M. setifemur* 2/1 Aug.

Additional species recorded (Eisfelder 1956): *Megaselia flava, M. flavicans.* The *Megaselia* sp. listed above may be one of these.

About 95 % of the sporophores of stages II—III were infested with dipterous larvae. The most important pest is *Mycetophila fungorum.*

155. *Lactarius vellereus* (Fr.) Fr. Runsala 1977 (1 sph examined, nothing found).

Earlier records (Benick 1952, Burla & Bächli 1968, Buxton 1960, Dely-Draskovits 1872a, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Edwards 1925, Eisfelder 1954): *Limonia bifasciata, Ula sylvatica, Rondaniella dimidiata, Neoclastobasis sibirica, Exechia fusca, Cordyla fasciata, Mycetophila alea, M.* sp. (*ruficollis* group), *M. idonea, M. luctuosa, Drosophila confusa, D. repleta, D. testaceae, D. phalerata, D. histro, Pegohylemyia silvatica, Fannia difficilis, Mydaea tincta, Phaonia populi.*

156. *Lactarius piperatus* (Fr.) S. F. Gray Runsala 1977 (1 sph cultured).

Drosophila transversa 2/1 Aug.

157. *Lactarius pergamenus* (Fr.) Fr. Runsala 1977 (1 sph cultured).

Psychoda lobata 6/1 Aug.

There were fungus gnat larvae in the lower part of the stem but they did not develop.

158. *Lactarius resimus* (Fr.) Fr. Tvärminne 1975, Kolmperä 1974, 1976—1977 (14 sph examined, 3 cultured).

Exechia nigroscutellata 1/1 Aug; *Mycetophila strobli* 2/1 Aug; *Lycoriella solani* 29/1 Sept; *Megaselia* sp. (puparia) Sept; *Pegohylemyia silvatica* 1/1 Aug; *Mydaea* sp. (?) puparium Aug.

Additional species record (Disney & Evans 1978): *Megaselia lutea.*

Of the 14 sph examined, 10 were infested with fungus gnat larvae.

159. *Lactarius repraesentaneus* Britz. Kolmperä 1975—1977 (6 sph examined, nothing found).

The very thick "milk sap" of this mushroom may be a good protection against dipterous infestation.

160. *Lactarius necator* (Fr.) Karst. Tvärminne 1954, Kolmperä 1974—1977, Lammi 1975, Närpes 1974 (64 sph examined, 16 cultured).

Ula sylvatica 2/2 Aug—Sept; *Psychoda lobata* 4/1 Sept; *Smittia bicolorata* 7/1 Sept; *Sciophila lutea* 5/1 Sept; *Exechia contaminata* 53/9 Aug—Sept; *Allodia lugens* 2/1 Sept; *Mycetophila strobli* 2/2 Sept; *Megaselia* sp. 3/1 Aug; *Drosophila transversa* 1/1 Aug; *Tephrochlamys flavipes* 2/1 Aug; *Pegomya geniculata* 3/1 Sept; *Fannia* sp. (larva) Aug; *Mydaea setifemur* 3/3 Aug—Sept; *Suillia flavifrons* 1/1 Sept; *S. atricornis* 7/2 Sept.

About 45 % of the sph of stages II—III were infested. *Exechia contaminata* seems to be a regular pest of this mushroom.

161. *Lactarius torminosus* (Fr.) S. F. Gray Tvärminne 1974—1975, Kolmperä 1974—1976, Oulanka 1975 (85 sph examined, 18 cultured).

Psychoda lobata 3/2 Sept; *Smittia bicolorata* 4/1 Sept; *Exechia nigroscutellata* 44/6 Aug—Sept; *E. spinigera* 1/1 Sept; *A. pallida* 1/1 Aug; *Cordyla flaviceps* 4/1 Sept; *Mycetophila fungorum* 33/2 Aug—Sept; *M. ichneumonea* 26/3 Sept; *M. strobli* 42/6 Aug—Sept; *M. uninotata* 2/1 Sept; *Lycoriella solani* 1/1 Aug; *Megaselia* sp. 1/1 Sept; *Pegohylemyia silvatica* 2/2 Sept—Oct; *Mydaea tincta* 1/1 Sept; *M. setifemur* 1/1 Sept; *Suillia atricornis* 1/1 Oct.

Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Eisfelder 1954); *Ula sylvatica, Trichocera saltator, Exechia fusca, Allodia lugens, A. ornaticollis, Cordyla murina, C. fasciata, Suillia bicolor, S. notata.*

About 40 % of the sporophores of stages II—III were infested with dipterous larvae. *Exechia nigroscutellata* seems to be a regular specialized pest.

162. *Lactarius pubescens* (Krombh.) Fr. Kolmperä 1975, Janakkala 1975 (4 sph examined, 1 cultured).

Mycetophila ichneumonea 1/1 Sept; *M. strobli* 2/1 Sept; *Pegomya geniculata* 2/1 Sept; *Suillia atricornis* 1/1 Sept.

Probably this mushroom, which is very close to *L. torminosus,* has the same dipterous inhabitants.

163. *Lactarius fuliginosus* (Fr.) Fr. Ruotsinkylä 1976 (1 sph examined).

The sporophore was infested with phorid (*Megaselia*?) larvae.

Earlier records (Burla & Bächli 1968, Bely-Draskovits 1974): *Sciophila lutea*, Cecidomyiidae sp., *Drosophila busckii*, *D. testacea*, *D. phalerata*, *D. kuntzei*, *D. histrio*.

164. *Lactarius deliciosus* group (*L. deterrimus* Gröger & *L. deliciosus* (Fr.) S. F. Gray These two close species have been separated only in part of the material and earlier authors do not indicate any significant difference in their dipterous pests. Framnäs 1975, Tvärminne 1974, Kolmperä 1974—1976, Lovisa 1974, Närpes 1974 (42 sph examined, 18 cultured).

Trichocera hiemalis 3/3 Sept; *Psychoda lobata* 23/2 Aug—Sept; *Exechia pseudocincta* 20/5 Aug—Sept; *Mycetophila strobli* 2/1 Sept; *M. uninotata* 4/1 Sept; *M. blanda* 113/11 Aug—Sept; *Megaselia* sp. 1/1 Sept; *Drosophila transversa* 2/1 Aug; *Tephrochlamys flavipes* 6/3 Sept; *Pegohylemyia silvatica* 11/4 Sept; *Pegomya geniculata* 20/4 Sept; *Mydaea setifemur* 3/3 Sept; *M. electa* 1/1 Sept; *Suillia bicolor* 1/1 Sept; *S. atricornis* 11/3 Sept; *Limosina claviventris* 1/1 Sept.

Additional species reared (Dely-Draskovits 1972a, 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972, Henning 1964, Lundbeck 1922, Plassmann 1969): *Limonia bifasciata*, *Ula sylvatica*, *Rondaniella dimidiata*, *Allodia ornaticollis*, *Cordyla fasciata*, *Mycetophila alea*, *M. idonea*, *M. signatoides*, *Megaselia rufipes*, *Drosophila phalerata*, *Pegomya maculata*, *Mydaea tincta*, *Phaonia populi*, *Suillia flava*, *S. oxyphora*.

Mycetophila blanda is undoubtedly the most important pest. More details about its habits are given by Eisfelder (1954) and Luterek (1967). *Exechia pseudocincta* also occurs regularly on the *L. deliciosus* group (Eisfelder 1954 and Dely-Draskovits 1974). More than 80 % of the sporophores examined were infested with larvae. Rautavaara (1947) mentions that sporophores found later in the autumn are less infested.

165. *Lactarius uvidus* (Fr.) Fr. Lammi 1975 (1 sph cultured).

Pegomya geniculata 1/1 Sept; *Suillus atricornis* 1/1 Sept.

Additional species recorded (Dely-Draskovits 1972a, 1972b, 1974, *in litt.*): *Ula sylvatica*, *Leia bimaculata*, *Mycetophila fungorum*, *Suillia bicolor*, *S. flava*.

166. *Lactarius flexuosus* (Fr.) S. F. Gray Höstnäs 1977 (12 sph examined, 3 cultured).

Smittia bicolorata 55/1 July; *Mycetophila strobli* 1/1 July; *Drosophila transversa* 41/3 July; *Limosina claviventris* 1/1 July.

8 sph were infested with larvae.

167. *Lactarius vietus* (Fr.) Fr. Tvärminne 1974, Kolmperä 1975, Lammi 1975, Juuma 1975 (22 sph examined, 2 cultured).

Mydaea tincta 1/1 Sept; *Suillia atricornis* 6/1 Sept.

Earlier records (Buxton 1960, Dely-Draskovits 1972a, 1974): *Trichocera saltator*, *Mycetophila luctuosa*, *Suillia atricornis*, *S. bicolor*.

168. *Lactarius pyrogalus* (Fr.) Fr. Runsala 1977 (27 sph examined, 1 cultured).

Exechia nigroscutellata 1/1 Aug.

Additional species recorded (Dely-Draskovits 1972b, 1974): *Exechia fusca*, *Suillia bicolor*.

The other 26 sporophores examined were uninfested.

169. *Lactarius trivialis* (Fr.) Fr. Tvärminne 1974, Kolmperä 1974—1976, Lammi 1975, Janakkala 1975 (33 sph examined, 6 cultured).

Ula sylvatica 1/1 Sept; *Psychoda lobata* 8/2 Sept; *Exechia contaminata* 10/3 Sept; *Mycetophila luctuosa* 1/1 Sept; *Megaselia* sp. 2/1 Sept; *Mydaea setifemur* 1/1 Sept; *M. detrita* 2/1 Sept; *Alloeostylus diaphanus* 2/1 Sept; *Suillia atricornis* 10/3 Sept; *Limosina claviventris* 1/1 Sept; *Limosina parapusio* 3 ♀♀/1 Sept.

About 20 % of the sph of stages II—III were infested.

170. *Lactarius glyciosmus* (Fr.) Fr. Lammi 1975 (13 sph examined, 2 cultured).

Pegomya geniculata 2/1 Sept; *Suillia atricornis* 1/1 Sept.

Additional species recorded (Dely-Draskovits 1974, Eisfelder 1954, 1956): *Allodia lugens*, *Mycetophila blanda*, *Megaselia lutea*.

Of the 13 sph examined only 3 were infested.

171. *Lactarius helvus* (Fr.) Fr. Tvärminne 1974, Kolmperä 1975—1976, Lammi 1975, Evo 1975 (57 sph examined, 15 cultured).

Limonia bifasciata 1/1 Sept; *Ula sylvatica* 11/3 Sept; *Mycetophila fungorum* 27/2 Sept; *M. ichneumonea* 80/10 Sept; *M. luctuosa* 266/3 Sept; *Mydaea setifemur* 1/1 Sept; *Suillia atricornis* 9/3 Sept.

Additional species recorded (Eisfelder 1954, 1956): *Mycetophila czizecki*, *M. blanda*, Cecidomyiidae sp., *Megaselia lata*, *M. nigrescens*.

In August about 35 % of the sph of stages II+III were infested; in September 9 of the 10 sph investigated were infested with dipterous larvae.

172. *Lactarius lilacinus* (Lasch) Fr. Lammi 1975 (10 sph investigated).

Fungus gnat larvae were found in 3 sph.

173. *Lactarius volemus* (Fr.) Fr. Runsala 1977, Kolmperä 1974 (15 sph examined, no eggs or larvae found).

Earlier records (Burla & Bächli 1968, Buxton 1960, Dely-Draskovits 1972b, *in litt.*, Dely-Draskovits & Mihályi 1972, Plassmann 1969): *Scatopse fuscipes*, *Sciophila* sp., *Drosophila phalerata*, *D. transversa*, *Fannia difficilis*.

Probably the very rich milky sap protects at least the younger sph against attack.

174. *Lactarius quietus* (Fr.) Fr. Runsala 1977 (6 sph examined, nothing found).

Earlier records (Dely-Draskovits 1972a, 1972b, 1974, Dely-Draskovits & Mihályi 1972, Dely-Draskovits & Papp 1973, Eisfelder 1956, Papp 1972): *Limonia bifasciata*, *Ula sylvatica*, *Mycetophila idonea*, *Megaselia lutea*, *Drosophila testacea*, *D. transversa*, *Pegonhylemyia silvatica*, *Phaonia variegata*, *Suillia bicolor*, *S. flava*, *S. notata*, *S. oxyophora*, *Limosina parapusio*.

175. *Lactarius rufus* (Fr.) Fr. Tvärminne 1974, Kolmperä 1974—1977, Närpes 1974, Oulanka 1975 (289 sph examined, 24 cultured).

Ula sylvatica 9/2 Sept; *Psychoda lobata* 23/1 Sept; *Smittia bicolorata* 11/1 Sept; *Sciophila lutea* 8/2 Aug—Sept; *Allodia lugens* 1/1 Sept; *Mycetophila ichneumonea* 191/12 July & Sept; *M. strobli* 17/6 July & Sept; *M. uninotata* 9/3 Sept; *M. luctuosa* 39/7 Sept; *Lycoriella solani* 9/4 Sept; *Megaselia* sp. (*lutea*?) 68/5 July; *Pegohylemyia silvatica* 11/3 Sept; *Mydaea tincta* 2/2 July & Sept; *Limosina parapusio* 1♀/1 Aug.

Additional species recorded (Eisfelder 1954, 1956, Laštovka 1971): *Cordyla fasciata*, *M. fungorum*, *M. blanda*, *Megaselia lutea*, *M. eisfelderae*, *M. pygmaeoides*.

In July and August 46 % of sph were infested, in the autumn only 24 %. Phorids are important pests during the summer months.

176. *Lactarius sphagneti* (Fr.) Neuh. Kolmperä 1975 (14 sph examined, 1 cultured).
Allodia (Brachycampta) sp. 1/1 Aug.

177. *Lactarius thejogalus* (Fr.) S. F. Gray Kolmperä 1975—1976, Janakkala 1975 (11 sph examined, 1 cultured).
Pegomya geniculata 1/1 Sept.
Additional species recorded (Dely-Draskovits 1972b, 1974, *in litt.*, Dely-Draskovits & Mihályi 1972): *Leia bimaculata, Mycetophila fungorum, Suillia bicolor.*
Infestation with fungus gnat larvae was recorded in 4 of the 10 sph of stages II+III investigated.

4. The dipterous pests of fungi

Here are included only the species that were reared by us, and for each species the numbers of the fungus species from which they are bred are listed. The families Scatopsidae, Platypezidae, Anthomyzidae, Asteidae and Chloropidae are not dealt with, as no species was reared by us from soft macrofungi. The literature, however, contains data about species bred from Agaricales (Buxton 1960, Dely-Draskovits 1972a, 1972b, Papp 1972).

Tipulidae

The family is represented by two polyphagous species of the subfamily Limoniinae. They are true fungus feeders, feeding on the sporophores in August—September and emerging in culture before the winter.

Limonia quadrinotata Meigen, 1.
L. bifasciata (Schrank), 1, 8, 15, 16, 17, 27, 64, 68, 121, 122, 126, 134, 144, 171.
Ula sylvatica Meigen, 12, 15c, 17, 21, 24, 28, 29, 76, 101, 115, 118, 120, 127, 137, 140, 141, 144, 160, 169, 171, 175.

Trichoceridae

The larvae of the Trichoceridae are said to be saprophages, but two species are bred from fungi. Whether the larvae feed on fresh fungus tissue or decaying matter in the fungus is not clear. Clearly, however, the two commonest *Trichocera* species in Finland, *T. hiemalis* and *T. regelationis*, fill different niches. *T. regelationis* has not been reared by us or by Dely-Draskovits (Hungary) from fungi and seems to be associated with subsoil habitats (Hackman 1963).

Trichocera hiemalis (DeGeer) 7, 14, 105, 164.
T. saltator Harrison, 52, 101, 120.

Psychodidae

All specimens reared by us and also by Dely-Draskovits (*in litt.*) belong to *Psychoda lobata*, which is a true fungivore. A larva was observed in fresh tissue of a *Russula* sp. We have reared *P. lobata* from 73 sporophores of 31 different fungus species and Dely-Draskovits obtained the species from 11 sporophores of 10 fungus species and also as the only representative of the Psychodidae. The related *Psychoda* species are saprophagous. Riel (1920) recorded *P. phalaenoides* from two species of fungi, but this species is a common saprobiont and his records probably refer to *P. lobata*, which had not been described at that time.

Psychoda lobata Tonnoir, 1, 15, 17, 21, 33, 54, 64, 68, 76, 78, 79, 82, 84, 87, 107, 115, 124, 125, 126, 134, 137, 141, 142, 144, 148, 154, 157, 160, 169, 171, 175.

Chironomidae

Smittia bicolorata, which has been reared from various fungi, is closely related to the common saprophagous *S. aterrima* Meigen. Strenzke (1950) recorded *S. foliata* Kieffer from fungi; the species is now considered a synonym of *S. aterrima*. Possibly *Smittia* larvae feed on decomposing matter in the fungus.

Smittia bicolorata Goetghehuer, 33, 73, 120, 134, 135, 136, 137, 139, 142, 144, 159, 161, 175.

Ceratopogonidae

The two species of *Culicoides* that were reared from fungi, together with *C. dwulfi* and *C. obsoletus* (Meigen), form a subgenus. *C. chiopterus* and *C. dwulfi* are bred from cow dung and *C. obsoletus* from horse dung, and it thus seems likely that the *Culicoides* species are not true fungus feeders but feed on decaying matter in the sporophore. *C. scoticus* was also reared by Dely-Draskovits (*in litt.*) from fungi.

Forcipomyia kaltenbachi Winnertz, 20.
Culicoides scoticus Downes & Kettle, 137, 139, 144.
C. chiopterus (Meigen), 137, 144.

Mycetophilidae

In this large family the association with fungi is obviously a primary feature. It is surprising

Table 3. The host preferences of the *Bolitophila, Rymosia* complex, and *Cardyla* species reared from Agaricales. Numbers signify number of host species from which fungus gnats have been reared by us. Records from the literature are denoted with +. Asterisks signify regular host fungi.

	Boletaceae	Gomphidiaceae	Paxillaceae	Hygrophoraceae	Tricholomataceae	Rhodophyllaceae	Amanitaceae	Pluteaceae	Lepiotaceae	Agaricaceae	Bolbitiaceae	Strophariaceae	Coprinaceae	Cortinariaceae	Russulaceae
Numbers of fungus species studied here	20	3	3	6	38	3	7	2	6	5	1	13	3	26	41
Bolitophila aperta	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
B. basicornis	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
B. cinerea	–	–	–	–	+	–	–	–	–	+	–	3*	–	–	–
B. glabrata	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–
B. hybrida	–	–	1*	–	–	–	–	–	–	–	–	–	–	–	–
B. maculipennis	+	–	–	–	+	–	–	–	–	–	–	–	–	–	–
B. modesta	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–
B. pseudohybrida	–	–	+?	–	2*	–	–	–	–	–	–	–	–	–	–
B. rossica	4*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
B. saundersi	–	–	–	–	+	–	–	–	–	–	–	+	–	–	–
B. scherffi	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–
B. tarsata	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
B. tenella	–	–	–	–	+*	–	–	–	–	–	–	1*	+	–	–
Rymosia affinis	–	–	–	+	1	+	–	–	+	–	–	–	–	+	–
R. batava	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Pseudorymosia sp. pr. *fovea*	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–
Tarnania fenestralis	+	–	–	+	5*	–	–	–	+	–	–	1	–	+*	–
T. tarnanii	–	–	–	3	4*	–	–	–	–	–	–	–	–	5*	–
Allodiopsis domestica	–	–	–	+	4*	–	–	–	–	–	–	–	–	+	–
A. maculosa	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
A. rustica	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–
Cordyla bergensis	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
C. brevicornis	1	2	–	–	–	–	+	–	+	–	–	–	–	1	2*
C. crassicornis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
C. fasciata	–	–	–	–	+	–	–	–	–	–	–	–	–	–	2*
C. flaviceps	–	–	–	+	–	–	–	–	–	–	–	–	–	–	3*
C. fusca	–	–	–	–	–	–	–	–	–	–	–	–	–	+	3*
C. murina	+	–	–	–	+	–	–	–	–	–	–	–	–	–	–
C. nitidula	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
C. sp.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–

however, that only 57 of the more than 450 Finnish species have been reared by us from Agaricales. The other investigations in Europe add only about 30 species from soft mushrooms. The larvae of the Ceroplatinae, including *Macrocera*, are mainly predacious and are not found on Agaricales. Most Sciophilinae and for example the Mycetophilinae genus *Phronia* are associated with mycelia in the soil or in decaying wood. Some Sciophilinae and Mycetophilinae feed as larvae in wood-rotting fungi other than Agaricales.

A typical fungivorous genus feeding on Agaricales is *Bolitophila*, which shows various degrees of specialization towards monophagy (see Table 3). These fungus gnats are taxonomically difficult, and possible misidentifications (*B. hybrida- pseudohybrida* group) make the picture of host preference less clear. Two related species, *B. cinerea* and *B. tenella*, seem to prefer wood-rotting fungi of Tricholomataceae and Strophariaceae (mainly *Nematoloma*).

Sciophilinae: Leiini includes some polyphagous species on Agaricales, but one of them,

Table 4. The host preferences of the *Exechia* (*s.lat.*) species reared from Agaricales. For explanations see Table 3. Eisfelder (1955) recorded *Exechia dorsalis* 21 times from 14 species of macrofungi, *E. fusca* 284 times from 128 species, and *E. spinigera* 37 times from 27 species, but gave no further details.

	Boletaceae	Gomphidiaceae	Paxillaceae	Hygrophoraceae	Tricholomataceae	Rhodophyllaceae	Amanitaceae	Pluteaceae	Lepiotaceae	Agaricaceae	Bolbitiaceae	Strophariaceae	Coprinaceae	Cortinariaceae	Russulaceae
Numbers of fungus species studied here	20	3	3	6	38	3	7	2	6	5	1	13	3	26	41
Polyphagous species															
Exechia dorsalis	+	–	–	+	1	–	+	–	+	–	–	–	–	1	–
E. fusca	1	+	1	4	5	1	1	–	3	–	–	2	1	4	1
E. spinigera	–	–	–	1	+	–	+	–	–	–	–	–	–	–	1
Specialized															
Exechia bicincta	–	+	+	–	+*	–	–	–	–	–	–	–	–	–	–
E. sp. *pr. confinis*	–	–	1*	–	–	–	–	–	–	–	–	–	–	–	–
E. contaminata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2*
E. nigroscutellata	–	–	–	+	–	–	–	–	–	–	–	–	–	+	2*
E. pallida	–	–	–	+	+	–	–	–	–	–	–	–	–	–	5*
E. pseudocincta	–	–	–	–	–	–	–	–	–	–	–	–	–	+	2*
E. separata	5*	3*	–	–	1	–	–	–	–	–	–	–	–	1	–
Exechiopsis indecisa	4*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Host preference unclear															
Exechia cincta	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
E. confinis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
E. frigida	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
E. lucidula	–	–	–	–	+	–	–	–	–	–	–	–	–	+	–
E. lundstroemi	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–
E. maculipennis	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
E. nigrofusca	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
E. parva	–	–	–	–	+	–	–	–	–	–	–	1	–	–	+
E. repanda	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
E. tenella	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Exechiopsis fimbriata	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–

Docosia gilvipes, has also been bred from a cheese bait (Hackman 1963), which indicates saprophagous habits.

The genus *Exechia* (s.str.) among the Mycetophilinae seems to be mainly, if not entirely, associated with soft macrofungi. Of the other genera of the *Exechia* complex, only two species of *Exechiopsis* have been reared from Agaricales. The *Exechia* species include both polyphagous and specialized fungivores (see Table 4).

The *Rymosia* complex (Table 3) shows a clear tendency to prefer Tricholomataceae and Cortinariaceae. As mentioned by Eisfelder (1975), they never infest Russulaceae.

Cordyla species, the larvae of which infest the mushrooms from below in the stipe (Fig. 3), are mainly reared from *Russula* species (see Table 3) and only *C. brevicornis* is more polyphagous.

The large genus *Mycetophila* includes the most frequent and most abundant dipteran of our material and of similar collections from Europe, *Mycetophila fungorum*, a highly polyphagous fungus gnat. The *M. ruficollis* group and several other species of the genus feed on Agaricales. Different degrees of specialization occur, from polyphagy to a preference for certain fungi (see p. 77).

Bolitophila (Bolitophila) basicornis (Mayer), 120.
B. (B.) cinerea Meigen, 108, 109, 110.
B. (B.) tenella (Winnertz), 106.
B. (Cliopisa) aperta Lundström, 108.

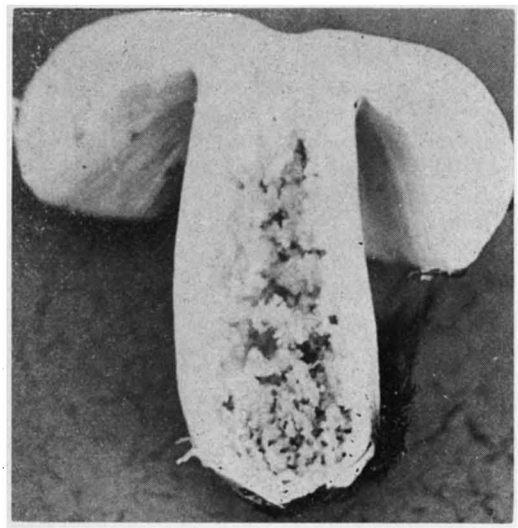

Fig. 3. *Russula decolorans* with *Cordyla* infestation starting from the base of the stipe.

B. (C.) hybrida (Meigen), 24.
B. (C.) modesta Lackschewitz, 42, 47, 62, 63.
B. (C.) pseudohybrida Landrock, 45, 46.
B. (C.) rossica Landrock, 17, 19, 20, 21.
B. (C.) tarsata Mayer, 106.
Sciophila lutea Macquart, 160, 175.
S. varia (Winnertz), 20, 23.
Acnemia nitidicollis (Meigen), 15.
Coelosia truncata Lundström, 32.
Rondaniella dimidiata (Meigen), 28.
Docosia gilvipes (Walker), 47, 54, 79, 119.
Rymosia affinis Winnertz, 54 .
Tarnania fenestralis (Meigen), 46, 47, 53, 57, 75, 110.
T. tarnanii (Dziedzicki), 29, 32, 33, 54, 57, 58, 75, 115, 118, 120, 123, 127.
Allodiopsis domestica (Meigen), 41, 42, 43, 47.
Exechia cincta Winnertz, 23.
E. sp. pr. *confinis* Winnertz, 24.
E. contaminata Winnertz, 160, 169.
E. dorsalis (Staeger), 33, 126.
E. frigida (Holmgren), 111.
E. fusca (Meigen), 21, 23, 29, 30, 31, 32, 37, 41, 42, 50, 54, 75, 88, 92, 100, 101, 103, 113, 115, 119, 125, 129, 138, 139, 154.
E. nigroscutellata Landrock, 158, 161, 168.
E. pallida (Stannius), 33, 138, 139, 142, 144, 146, 154, 161.
E. parva Lundström, 111.
E. pseudocincta Strobl, 164.
E. separata Lundström, 16, 17, 18, 20, 21, 26, 27, 28, 50, 125.
E. spinigera Winnertz, 36, 161.
Exechiopsis indecisa (Walker), 16, 17, 20, 21.
Allodia (Allodia) lugens (Wiedemann), 8, 12, 19, 24, 27, 31, 50, 60, 100, 101, 119, 132, 134, 160, 175.
A. (A.) ornaticollis (Meigen) 19, 20, 27, 31, 41, 78, 115, 124, 137, 138, 144, 145, 146, 154.
A. (Brachycampta) barbata (Lundström), 1.
A. (B.) grata (Meigen), 86, 99.
Brevicornu sp., 144.
Cordyla bergensis (Barendrecht), 26.
C. fasciata Meigen, 137, 142.
C. flaviceps (Staeger), 137, 141, 161.
Mycetophila alea Laffoon, 134, 135, 136.
M. blanda Winnertz, 23, 164.
M. finlandica Edwards, 60.
M. flava Winnertz, 74.
M. fungorum (De Geer), 3, 9, 10, 12, 14, 15, 16, 17, 18, 21, 29, 30, 31, 33, 50, 54, 68, 75, 76, 78, 79, 83, 84, 88, 90, 98, 101, 107, 110, 113, 115, 120, 123, 124, 134, 136, 137, 138, 139, 141, 142, 144, 146, 148, 151, 153, 154, 161, 171.
M. ichneumonea Say, 33, 41, 43, 44, 54, 68, 75, 76, 115, 120, 123, 135, 136, 152, 161, 162, 171, 175.
M. luctuosa Meigen, 54, 38, 169, 171, 175.
M. ocellus Walker, 73.
M. signatoides Dziedzicki, 12, 14, 15, 20.
M. strobli (Lastowka), 17, 67, 134, 137, 141, 144, 148, 152, 154, 158, 160, 161, 162, 164, 166, 175.
M. uninotata Zetterstedt, 117, 164, 175.

Sciaridae

The few Sciaridae found are probably not true fungus feeders. The larvae may be predacious or saprophagous. The occurrence of the common indoor sciarid *Bradysia amoena* in some samples has been regarded as a secondary contamination and the species has been omitted from the list. One outdoor species reared on several occasions is listed here:

Lycoriella solani (Winnertz), 15, 21, 33, 54, 104, 139, 144, 148, 154, 158, 161, 175.

Cecidomyiidae

The rather few specimens reared from various fungi have not yet been identified. Five species of Cecidomyiidae are known from cultivated mushrooms (Wyatt 1964) and some other species have been reared from fungi other than Agaricales (Buxton 1960). At least some of the species (*Heteropeza pygmaea*, *Lestremia cinerea* and the *Mycophila* spp.) are found in various habitats and occasionally, as pests in mushroom houses.

Phoridae

This is an important family among fungivorous Diptera. All the specimens reared by us belong to the genus *Megaselia* and mainly to the subgenus *Megaselia*. They have not yet been identified to species level but the material includes at least 7 species. The host preferences of a number of *Megaselia* species among Agaricales is known (Buxton 1960, Eisfelder 1956, Schmitz 1948).

Syrphidae

As far as is known, the only species of European Syrphidae feeding on Agaricales are *Cheilosia scutellata* and *C. longula*, two closely related species, both found in Boletaceae.

Eisfelder (1956) and Dely-Draskovits (1972a) list only *C. scutellata* from *Boletus*, *Leccinum* and *Suillus* of Boletaceae and from *Paxillus* of Paxillaceae. *Cheilosia longula* is rare or lacking in various parts of Central and SE Europe but from England Buxton (1960) mentions the species from *Suillus*. In Finland both *Cheilosia* species are common and *C. scutellata* has been bred by us from *Leccinum* and probably also feeds on *Boletus edulis* (an ovipositing female observed), but *C. longula* was bred twice from *Leccinum scabrum* and 8 times from *Suillus* species (see also Table 2).

Cheilosia scutellata (Fallén), 15.
C. longula Zetterstedt, 15, 16, 17, 20, 21.

Drosophilidae

Some mainly saprophagous species, e.g. *Drosophila busckii*, *D. funebris* and *Scaptomyza pallida*, have been bred by us from fungi. On the other hand, the material also includes clearly fungivorous species. *D. phalerata*, *D. transversa*, and *D. testacea*, common polyphagous pests of soft macrofungi. Although these species possibly prefer sporophores already damaged by other dipterans, they undoubtedly also occur in fresh fungus tissue (cf. Shorrocks & Wood 1973 and Dely-Draskovits & Papp 1973).

Drosophila busckii Coquilett, 14, 64.
D. funebris (Fabricous), 14, 87, 153.
D. testacea v. Roser, 82, 154.
D. phalerata Meigen, 10, 14, 15, 35, 38, 50, 68, 75, 82, 83, 84, 87, 99, 115, 124, 129, 139, 144, 153.
D. transversa Fallén, 2, 10, 12, 14, 15, 17, 20, 29, 33, 35, 50, 55, 75, 87, 99, 113, 114, 115, 124, 129, 130, 134, 139, 141, 142, 144, 145, 153, 154, 160, 164, 166.
Scaptomyza pallida (Zetterstedt), 73, 136, 149.

Heteromyzidae

This small family was separated from Heleomyzidae by Griffiths (1972). *Tephrochlamys flavipes*, recorded by us from mushrooms, is mainly saprophagous and it is doubtful whether the larva feeds on fresh fungus tissue. In England the species is replaced by *T. tarsalis* in the mushroom niche (Buxton 1960). Both species occur in Finland as well as in England.

Tephrochlamys flavipes (Zetterstedt), 21, 25, 64, 83, 115, 134, 137, 138, 154, 160, 164.

Anthomyiidae

The life habits of the Finnish fungivorous Anthomyiidae have already been described (Hackman 1976). Most of them belong to the *Pegomya geniculata* species group (Hennig 1966—1976). The fungivorous Anthomyiidae include both polyphagous species like *Pegomya geniculata* and *Pegohylemyia silvatica* and specialized species, which will be dealt with in detail in connection with evolutionary aspects (p. 77). Some of the *Pegomya* species are the most important pests of edible *Boletus* and *Leccinum* species.

Pegohylemyia silvatica (Robineau-Desvoidy), 12, 14, 15, 17, 18, 19, 20, 21, 23, 27, 30, 50, 54, 68, 79, 83, 87, 115, 134, 137, 138, 154, 161, 164, 175.
Pegomya geniculata (Bouché), 30, 32, 34, 50, 52, 57, 68, 69, 76, 78, 79, 83, 87, 90, 100, 101, 115, 119, 120, 125, 137, 138, 139, 142. 143, 144, 146, 148, 151, 154, 160, 161, 162, 164, 165, 170, 177.
P. rufina (Fallén), 88, 94, 96.
P. calyptrata (Zetterstedt), 95.
P. atricauda Ringdahl, 52, 55, 57, 61, 68, 115, 120.
P. pallidoscutellata (Zetterstedt), 48.
P. deprimata (Zetterstedt), 12, 17, 19, 20.
P. winthemi (Meigen), 13, 15.
P. fulgens (Meigen), 14, 15.
P. furva Ringdahl, 14, 15.
P. flavoscutellata (Zetterstedt), 14, 15.
P. incisiva Stein, 14, 15.
P. tenera (Zetterstedt), 9, 14, 16.
P. pilosa Stein, 9, 14, 15.
P. tabida (Meigen) 15.
P. vitttgera (Zetterstedt), 15.
P. zonata (Zetterstedt), 9, 14, 15.

Fanniidae

Only two species are true fungivores, *Fannia melania* which prefers Boletaceae, and *F. difficilis*, which is fairly polyphagous but shows a certain preference for Russulaceae (cf. Dely-Draskovits & Babos 1976a). *Fannia canicularis* occurs in cultures with already partly decomposing fungi and secondary infection of cultures may also be possible.

Fannia canicularis (Linnaeus) 14, 114.
F. difficilis (Stein), 137, 138, 154.
F. melania Dufour, 16.

Muscidae

Several species of the genus *Mydaea* occur regularly or probably exclusively as larvae in Agaricales. It is clear, however, that at least

the last (? third) larval instar is obligatorily predacious. We have tried to rear *Mydaea* larvae from eggs on an agar medium with mycelium of *Marasmius scorodonius*, but the larvae died when half grown. In one case fungus gnat larvae were added as prey and then at least one larva pupated (but unfortunately died as a puparium). The *Mydaea* species are polyphagous but at least *M. discimana* shows a preference for Boletaceae. *Mydaea* species lay their eggs on the lamellae (or in the pores of the Boletaceae) or on the cap surface.

Among Phaoninae *Alloeostylus diaphanus* is a polyphagous fungivore. The characteristic yellowish larva hibernates before pupation. *Muscina assimilis* (Muscinae) sometimes occurs in fungi but the larva has saprophagous and predacious habits and is more common in other habitats.

Mydaea tincta (Zetterstedt), 15, 21, 24, 42, 66b, 85, 137, 138, 154, 161, 167, 175.
M. setifemur Ringdahl, 19, 24, 66b, 78, 82, 83, 85, 137, 143, 148, 154, 160, 161, 164, 169, 171.
M. detrita (Zetterstedt), 13, 16, 17, 19, 84, 169.
M. discimana Malloch, 14, 15, 16, 17, 19, 21, 27, 78.
M. electa (Zetterstedt), 21, 87, 164.
Alloeostylus diaphanus (Wiedemann), 17, 83, 169.
Muscina assimilis (Fallén), 114.

Heleomyzidae

The genus *Suillia* is known to be fungivorous and several species have been bred from Agaricales by us. They all seem to be polyphagous without host preference and sometimes they occur in fungi avoided by other Diptera.

Suillia flava (Meigen), 144.
S. flavifrons Zetterstedt, 160.
S. bicolor Zetterstedt, 1, 3, 13, 164, 169.
S. fuscifrons Zetterstedt, 169.
S. atricornis Meigen, 1, 8, 12, 13, 19, 50, 52, 60, 79, 83, 100, 123, 125, 134, 136, 148, 160, 161, 162, 164, 165, 167, 169, 170, 171.

Sphaeroceridae

Among the rather few species bred from comparatively fresh mushrooms only *Limosina parapusio* seems to be a true fungivore; the other species are known to be saprophagous and their larvae probably feed on decomposing fungus tissue. *Limosina parapusio* is thought to be parthenogenetic (Papp 1972) and there are only females in our material.

Copromyza (Copromyza) sp. ,136.
Limosina fungicola Haliday, 15, 64.
L. claviventris Strobl, 64, 138, 164, 166, 169.
L. parapusio Dahl, 15, 28, 55, 78, 94, 120, 139, 169, 175.
L. luteilabris Rondani, 15.
L. heteroneura Haliday, 15.

Carnidae

Two specimens of *Meoneura neottiophila* were reared by us from *Leccinum scabrum*. This fly, known to have a saprophagous larva, has not previously been bred from fungi.

Meoneura neottiophila Collin, 15.

5. The association of Diptera with fungi

A. General aspects

Compared with the interaction between phytophagous insects and vascular plants, the interaction between fungivorous dipterans and macrofungi is basically different. The phytophagous insects may injure their host plants to a degree that has given various protective properties a selective value and led to certain types of co-evolution, and to a trend towards monophagy for the insect. For example, the poisonous plant *Daphne mezerum* is attacked by a monophagous insect, the moth *Anchinia daphnella*, but is immune to polyphagous phytophages. For the soft macrofungi it does not greatly matter whether the soon decomposing sporophore is eaten by larvae in the cap tissues or in the stipe provided spore formation and dispersal are secured; even larval damage to lamellae or to the spores is rarely serious. Egg-laying Diptera visiting ripe sporophores may actually contribute to the spread of spores. Fungi filled with larval galleries do not usually collapse until stage IV. In young sporophores (stage I) of certain groups protective properties against too early dipterous attack can be observed:

1. The sporophore only emerges from the soil at a stage close to stage II. An example is *Lactarius necator*.

2. The unripe basidia (on lamellae or in pores) are protected by a volva or cortina, sometimes mucous and sticky, or by fringes of an inwardly bent cap edge. This prevents oviposition on the basidial layer in stage I. There are numerous examples among our commonest mushrooms.

Cordyla species and *Pegomya incisiva* deposit their eggs in the stipes of sporophores, even young ones, and against these pests a volva,

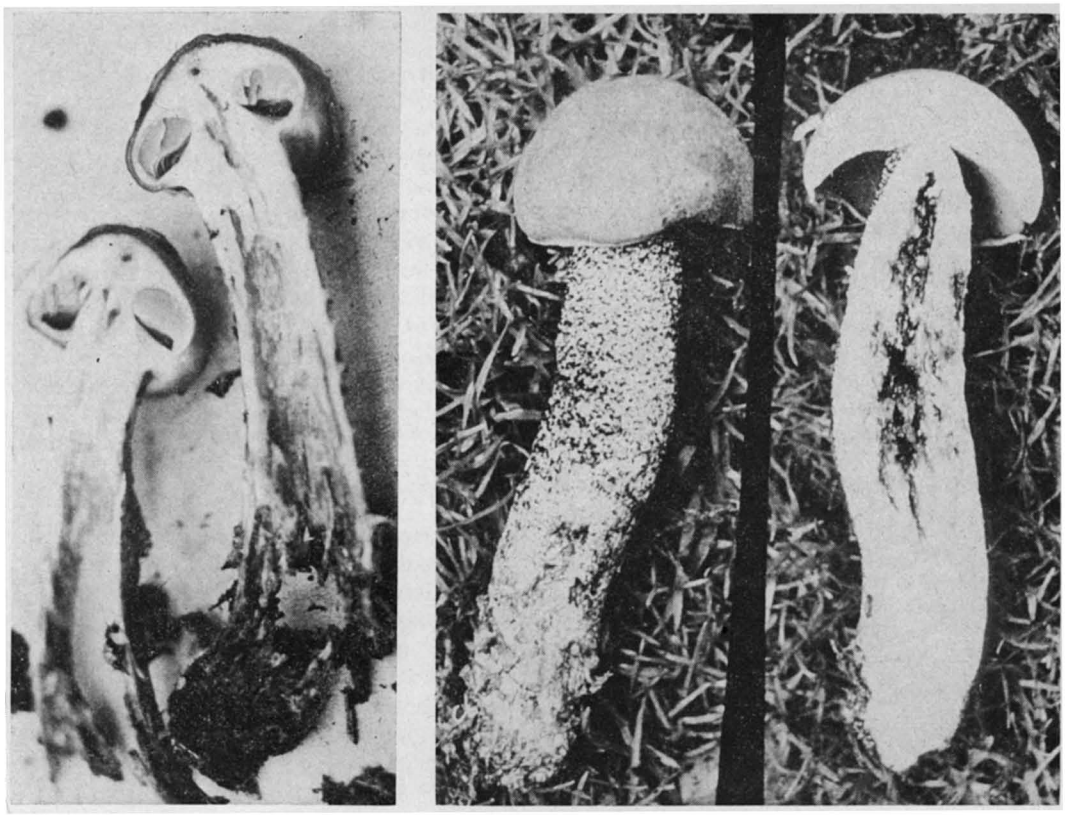

Fig. 4. Young *Gomphidius* sporophore badly damaged by *Cordyla*. Spore formation endangered.

Fig. 5. *Leccinum versipelle* superficially in good condition, but with *Pegomya incisiva* infestation in the stipe. Spore formation not endangered.

cortina or inwardly bent fringed cap edge affords no protection. Young sporophores of the generally well-protected *Gomphidius glutinosus* are sometimes eaten by *Cordyla* larvae to an extent which endangers spore formation (Fig. 4). Young *Leccinum versipelle* are often badly damaged in the stipe by *Pegomya incisiva* (Fig. 5), but in spite of this the sporophores probably develop more or less normally.

3. Rich milky sap, especially in young instars (most *Lactarius* species). In *Lactarius volemus* the sap probably continues to protect the sporophore in stages II and III.

4. The sporophore contains poisonous or repellent substances by which dipterous attack is prevented entirely or to a high degree, and not only in the young instars, (examples *Tylopilus felleus*, *Paxillus atrotomentosus*).

It must be pointed out that fungi which are poisonous to human beings or mammals in general are not necessarily protected against dipterans. On the contrary, the deadly poisonous *Amanita phalloides* is eaten by larvae of several common polyphagous species like *Docosia gilvipes*, *Exechia dorsalis*, *Drosophila phalerata*, *Pegohylemyia silvatica*, *Suillia flava* and *S. atricornis* (Buxton 1960, Dely-Draskovits 1972b, 1974, Dely-Draskovits & Mihályi 1972, Riel 1920). The highly dangerous species of the *Cortinarius speciosissimus* group are eaten by and not rarely infested with polyphagous tipulids and fungus gnats.

B. Monophagous and polyphagous Diptera

There is no known case where a relation of monophagy can be assumed to have developed as a result of co-evolution between dipterans

and soft macrofungi. A dipterous species feeding on a single fungus species or species group is a rare phenomenon (cf. Buxton 1960) and some recorded cases are dubious because of incomplete knowledge of the habitats of the species. Where something near monophagy has been recorded, some dipterous species feeding on one fungus species or species group may occasionally be found on one or more other fungus species that are not even related. Together with the almost monophagous species several highly polyphagous dipterans may occur in the same fungus, e.g. in *Pauxillus involutus* the larvae of the monophagous *Bolitophila hybrida* may occur together with the polyphagous *Ula sylvatica*, *Allodia lugens* and *Mydaea tincta*.

C. Evolutionary trends

The association with macrofungi has arisen many times during the evolution of Diptera. The first step towards fungivorous habits may be when a saprophagous species begins to feed on decomposing tissue in the fungus. The present material includes several examples of saprophagous species that occur as larvae in decomposing matter but also in macrofungi, e.g. *Drosophila busckii*, *D. funebris*, *Tephrochlamys flavipes*, *Fannia canicularis*, *Muscina assimilis* and *Limosina claviventris*.

The next step will be a specialization to feed in fungi, although possibly still only on decomposing matter in the fungi. *Forcipomyia kaltenbachi*, *Culicoides chiopterus*, *C. scoticus* and *Smittia bicolorata* probably represent this stage in evolution.

Docosia gilvipes probably and *Drosophila phalerata*, *D. transversa* and *D. testacea* certainly feed on both fresh and decaying fungus tissue. They are all polyphagous as far as fungi are concerned and so also are some species of true fungivorous species belonging to dipterous genera of which the other species are saprophagous: *Limonia bifasciata*, *Psychoda lobata*, *Limosina parapusio* and *Pegohylemyia silvatica*.

In the families Mycetophilidae, Phoridae, Platypezidae, Syrphidae, Anthomyiidae, Fanniidae and Muscidae we find among the fungivorous species different degrees of food specialization and in some cases examples of trends towards monophagy.

Among the Mycetophilidae the Bolitophilinae probably all feed on higher fungi. *Bolitophila modesta* and *B. pseudohybrida* feed on certain Tricholomataceae, and *B. rossica* on certain Boletaceae, while *B. hybrida* is still further specialized, and was bred only from *Paxillus involutus*. Of the genus *Exechia* (Mycetophilinae) the present material includes three species bred only from *Lactarius* spp.: *E. contaminata*, *E. pseudocincta* and *E. nigroscutellata* (cf. p. 66). The systematic oligophagy of *E. separata* has already been mentioned (p. 56). *E. fusca* is polyphagous with a very wide range of host fungi. The species of the *Rhymosia* complex have a distinct preference for the Tricholomataceae and the Cortinariaceae.

In the large genus *Mycetophila*, the very common and extremely polyphagous *M. fungorum* is obviously a very successful species as a fungivore. More specialized species, such as *M. alea* and *M. blanda*, were mentioned on p. 65. The phylogeny of this large genus has not been worked out, but it seems that there are several separate evolutionary lineages towards host preference.

The fungivorous Phoridae, belonging mainly to the subgenus *Megaselia*, are still too little known to permit conclusions about evolutionary trends.

Among the European Anthomyiidae, all the fungivores (with the exception of two polyphagous species in *Anthomyia* and *Pegohylemyia*) form a monophyletic group in the genus *Pegomya*. Henning (1966—1976) divided the *P. geniculata-hyoscyami* section into two groups based on morphological characters, the *P. geniculata* group and the *P. hyoscyami* group. All the *Pegomya* species known to be fungivorous belong to two subgroups (the *P. geniculata* "Reihe" and the *P. tabida* "Reihe") of the *P. geniculata* group. There are two other subgroups, the *P. ruficeps* "Reihe" of which the biology is unknown, and the *P. rubivora* "Reihe" with phytophagous species like those in the *P. hyoscyami* group. Thus it can be assumed that the fungivorous habit evolved once in the *P. geniculata* group.

The *P. geniculata* subgroup shows examples of various degrees of fungivorous specialization. *P. geniculata* is polyphagous but avoids the Boletaceae, *P. winthemi* lives mainly on large Boletaceae but avoids the *Suillus* species, *P. deprimata* lives mainly on *Suillus*, *P. fulgens* and *P. furva* only on *Leccinum* species (Table 2 and Hackman 1976: Tables 1—2). In the *P. tabida* subgroup, all the species whose biology is known feed on *Leccinum* species or species of the *Boletus edulis* group.

A niche differentiation can also be noted in this subgroup, *P. incisiva* and *P. zonata* having different ovipositing sites in the sporophore. In *Leccinum* species, in contrast, several species of both subgroups seem to occupy the same niche; the eggs are laid in the pores and the larvae spread from there into the cap tissue and further into the stipe. Such species include at least *P. fulgens*, *P. furva*, *P. tenera*, *P. pilosa* and *P. winthemi*, in which the female has a short, blunt ovipositor.

The concentration of ten very oligophagous *Pegomya* species on the *Leccinum scabrum* group is interesting. Apart from *P. winthemi* and *P. zonata* these species are mainly boreal, some of them with a wide Holarctic distribution. In subarctic forests, at least in Fennoscandia, sporophores of the genus *Leccinum* are common and dominant, especially those of the *L. scabrum* group. Presumably the *Pegomya* species developed allopatrically in subarctic areas with *Leccinum* species as their host fungi, and then spread out to their present ranges.

D. Phenological aspects, developmental and reproductive strategies of fungivorous Diptera

Dely-Draskovits & Babos (1976b) suggest that in several cases an apparent preference for or avoidance of a fungus species by a dipterous species may have phenological reasons. The occurrence of ovipositing females may or may not coincide in biotope and time with growing sporophores of the fungus. This is perhaps true in some cases; *Drosophila* species and phorids are rare or absent in late autumn fungi. The apparent preference of the *Mycetophila ruficollis* group of Russulaceae may be explained by the high frequency of these fungi in early autumn. On the other hand, there are numerous cases of preference and avoidance which cannot be explained in this way. For example, *Pegomya geniculata*, though in general entirely polyphagous, avoids the Boletaceae as host fungi, but the females of the species can be seen sitting on a *Leccinum* sporophore.

The phenology of the fungivorous Diptera in southern Finland agrees in general with the features mentioned from England (Buxton 1960), Switzerland (Burla & Bächli 1968) and Germany (Eisfelder 1954). The phorids and drosophilids are summer insects, while the tipulids (Limoniinae), some fungus gnats and the heleomyzids occur towards the end of the warm season.

In the laboratory the mycetophilids almost all emerged before the winter without any cold treatment. The only exception was *Docosia gilvipes* of which some of the specimens required a diapause. Several polyphagous fungus gnats, such as *Exechia fusca*, *Mycetophila fungorum* and *M. ichneumonea*, take only 2—3 weeks to develop from egg to imago and may have several generations during the warm season.

Among the antomyiids, different types of reproductive and developmental strategies exist. *Pegomya winthemi*, which in Finland feeds on *Leccinum* species, is multivoltine with univoltine strains. In favourable weather conditions sporophores of *Leccinum* species may appear from June to October, and early sporophores in June are often infested with *P. winthemi*. After a couple of weeks the larvae pupate in the soil, and the bulk of the imagines emerge within a month, the rest hibernating as puparia. Larvae feeding in July may also develop into imagines the same year. Fertile egg-laying females are thus present during most of the warm season.

Pegomya furva represents another type. This species attacks *Leccinum* species, mainly of the *L. scabrum* group, from July on into the autumn, but no imagines emerge without hibernation, and some puparia regularly hibernate a second winter before emerging. This is a good adaptation, because unfavourable weather conditions cause scarcity of host sporophores in some years.

In several *Pegomya* species (*P. calyptrata*, *P. rufina*, *P. tenera*, *P. pilosa* and *P. zonata*) numerous specimens emerged in the laboratory 1 to 2 months (at room temperature) after a 2-month exposure of the puparia (during the winter) to a temperature near 0 °C. When kept out-of-doors, *P. tenera* and *P. furva* emerged during the first warm weeks of June. All these *Pegomya* are specialized in their egg-laying and choice of host fungus and can hardly be supposed to subsist as larvae on mycelia in the soil in the absence of early host sporophytes. *P. calyptrata*, for example, is reared exclusively from *Agaricus* species, which seldom appear before August. The thin abdomens of bred specimens indicate that they have to eat before reaching fertility. In fact some *Pegomya* species have been observed feeding on aphid honey dew, on leaves of bushes and on apple baits for moths (Tiensuu 1935) The *Pegomya* specimens trapped on fungi in August and September are all females.

Obviously mating occurs earlier, during the warm season, and females may live for several months. With few exceptions the larvae of the highly polyphagous *Pegohylemyia silvatica* are found only in the end of August and in the autumn (see also Eisfelder 1956). Males of the species have been caught in the open as early as June.

Even in the laboratory *Pegomya deprimata* hatches about 2 months later than the first specimens of *P. tenera*, *P. zonata*, *P. furva* and other species that feed on *Leccinum*. The *Suillus* species which are the hosts of *P. deprimata* usually produce sporophores from mid-August to September. Exceptionally early sporophores of *Suillus luteus* are free from maggots.

E. Orientation of Diptera to the host sporophores

Trapping experiments made in 1974 and 1975 at Tvärminne by C. Oker-Blom and at Kolmperä by the author Hackman show that fungal sporophores attract both males and females of fungus gnats, drosophilids and heleomyzids, but only females of anthomyiids and muscids. It is clear that the stimuli are olfactory and not visual. Aromatic substances of a few fungi (*Gyromitra esculenta*, *Boletus edulis* and some *Lactarius* species) have been analysed by Pyysalo (1975), who kindly made us an artificial mixture corresponding to the scent produced by *Boletus edulis*. The dominant component was 1-octene-3-ol and a glycol was used as solvent. The mixture was tried as a bait in Nuorteva traps at Tvärminne and Kolmperä, but the results were unclear.

The stinkhorn (*Phallus impudicus*) and other Phallaceae attract numerous species of Diptera to the gleba of the sporophore by its strong smell of carrion (Luther 1947, Smith 1956, Overgaard Nielsen 1963, Kühlhorn 1974). Most of these Diptera are necrophagous and do not oviposit on the sporophore, but contribute to the spread of the spores. The few species bred from stinkhorns are species known from various other fungi.

6. Interaction between insects living in soft macrofungi

Whether competition occurs between different species of Diptera in soft macrofungi has already been discussed by Burla & Bächli (1968). They concluded that there is no sign of food competition between the *Drosophila* spp. often occurring together in the same sporophore. We also observed that *Drosophila transversa* and *D. phalerata* occur together and probably feed in the same way in the same parts of the sporophore. The difference in habitat preference between these two species and the differences in their distribution (*D. transversa* is found much farther north in Finland than *D. phalerata*) suggest that they fill overlapping but different ecological niches. Further the food supply is usually sufficient and the association of larvae of different species temporary.

Among the *Pegomya* species *P. winthemi*, *P. fulgens*, *P. furva*, *P. pilosa* and *P. tenera* probably feed on a *Leccinum* sporophore in the same way at the larval stage, beginning from the spore layer. The five species are found as larvae in the same sporophores in various combinations, in one case four species in the same sporophore. In developmental and reproductive strategies some differences exist, *P. winthemi* and *P. furva* *P. winthemi* being partly multivoltine, the other species being univoltine. No observation indicating competition between these species has been observed. At the larval stage *P. zonata* and *P. incisiva* fill different niches in *Leccinum* sporophores from the above-mentioned species. About the remaining *Pegomya* species feeding on *Leccimum* too little is known.

The two species of syrphids feeding on Boletaceae, *Cheilosia acutellata* and *C. longula*, have not been found together in the same sporophore. In Central Europe *C. scutellata* attacks a wider range of host fungi than in Finland (cf. p. 74). *C. longula* has been reared by us and by Oker-Blom from *Suillus* species (unpublished). No details of the mode of feeding of the *Cheilosia* larvae are known and possibly they are partly predators.

It is possible that competition has led the heteromyzid *Tephrochlamys flavipes* to extend its wide niche to feed in mushrooms in Finland but not in England, whereas in England the sympatric species *T. tarsalis* feeds in fungi but *T. flavipes* does not.

Burla & Bächli (1968) mention the possibility of competition between mycetophilids and drosophilids. In our material, however, the combination of *Mycetophila fungorum* and *Drosophila transversa* or *D. phalerata* or both is common in the *Russula* species.

Important predators of dipterous larvae in soft fungi are certain beetles, especially staphylinids (cf. Benick 1952). It seems, however, that the staphylinids invade sporophores at a rather late stage (IV). The late-instar larvae of the muscids of the genus *Mydaea* are also predatory.

Numerous parasitic Hymenoptera were reared in the cultures. Most were brachonids of the subfamily Alysiinae parasiting *Pegomya* species, but there were also ichneumonids and cynipids. Much of the material was identified by Mr. Matti Viitasaari and a list will be published separately. The commonest parasite of the *Pegomya* species (*P. fulgens*, *P. furva*, *P. pilosa*, *P. tenera*) is *Alysia frigida* Haliday. This digs characteristic broad, flat galleries in *Leccinum* sporophores between the spore layer and the cap tissue, the female having outward-moving mandibles adapted for digging.

7. Economic importance of Diptera as pests of edible fungi

The importance of insects as pests of edible fungi was briefly discussed by Rautavaara (1947) For each fungus species we have calculated the infestation percentage of sporophores, considering a sporophore as infested when larvae or galleries are found. If dipterous eggs had also been considered, the infestation percentage would have been much higher. Larvae may hatch in 1—2 days and dipterous larvae are active in the autumn even at +5°C, the average temperature of a refrigerator. If sporophores of stage I had been included in the calculation, this would in many cases have lowered the infestation percentage, but this stage is less usually collected for food and in some species is difficult to find.

Some notes on dipterous infestation in the 30 saleable (according to Pohjola & Korhonen 1976) fungi in Finland:

Gyromitra esculenta, *Morchella esculenta* group, *Ramaria flava*, *Hydnum repandum* group, *Cantharellus cibarius*, *C. tubaeformis*, *Craterellus cornucopioides*. As far as information is available, infestation is very low, below 1 %.

Albatrellus ovinus. Infestation about 60 % in medium-sized sporophores. The main pests are phorids (*Megaselia* spp.)

Boletus edulis group. Table 5 shows that a high percentage of sporophores of age classes I—III can be used as food if the spore layer is removed when infested with larvae. In young sporophores *Cordyla* species may damage the bases of the stipe. In older sporophores important pests are *Pegomya tenera* and. *P. zonata*.

Table 5. Damage (% of sph) by dipterous larvae to different species of fungi.

Stage	I	II	III	IV
Boletus edulis group				
Number of sph. investigated	5	49	59	14
No eggs or larvae	80	22	3	—
Only eggs or, if larvae, only in the spore layer	—	50	41	—
Minor damage to cap stem tissue, edible after removing spore layer	20	18	32	—
Heavy infestation, at most small portions edible	—	10	24	100
Leccinum versipelle group (summer)				
Number of sph. investigated	38	88	74	6
No eggs or larvae found	29	18	4	—
Only eggs or, if larvae, only in the spore layer	13	25	38	—
Minor damage to cap and stem tissue, edible	3	8	8	—
Heavy infestation, at most small portions edible	55	49	60	100
Suillus luteus (August)				
Number of sph. investigated	36	42	59	3
No larva found	89	50	7	—
Few galleries, still edible	3	24	36	—
Coarse or dense galleries, not edible	—	—	22	100
Suillus bovinus				
Number of sph. investigated	10	18	47	6
No larvae found	10	24	6	—
Few galleries, still edible	30	35	26	—
Coarse or dense galleries, not edible	60	35	47	—
Most inner parts eaten by larvae	—	6	21	100
Suillus variegatus	I	II	III	IV
Number of sph. investigated	2	18	57	—
No larvae found	100	72	19	—
Few galleries, still edible	—	22	33	—
Coarse or dense galleries, not edible	—	6	39	—
Most inner parts eaten by larvae	—	—	9	—
Rozites caperata				
Number of sph. investigated	13	32	81	10
No larvae found	38	16	15	20
Few galleries, still edible	16	38	24	—
Coarse or dense galleries, not edible	38	28	36	40
Most inner parts eaten by larvae	8	18	25	40
Russula decolorans				
Number of sph. investigated	15	22	51	29
No larvae found	53	46	10	—
Few galleries, still edible	47	36	37	—
Coarse or dense galleries, not edible	—	18	29	59
Most inner parts eaten by larvae	—	—	24	41
Lactarius rufus (Kolmperä, summer 1975)				
Number of investigated sph.	38	36	50	8
No larvae found	63	19	6	—
Eggs or larvae on the lamellae	32	55	32	—
Few galleries, still edible	5	17	36	13
Coarse or dense galleries, not edible	—	6	18	50
Most inner parts eaten by larvae	—	3	10	37

Leccinium versipelle group. Only about half the younger sporophores (I—II) can be used (Table 5). *Pegomya incisiva* frequently damages the stipe of sporophores as early as stage I (p. 54). The most important pests are the *Pegomya* species.

Suillus luteus. A fairly high percentage of young sporophores (I—II) can be used if those with a few galleries are tolerated (Table 5). About 40 % of sporophores of stage III can be used. The main pests are fungus gnats (*Exechia, Mycetophila fungorum*), *Pegomya deprimata* and *Pegohylemyia silvatica*.

Suillus bovinus. It is more heavily infested in the young stage than *S. luteus* (Table 5). Pests the same as in *S. luteus*.

Suillus variegatus. Much less frequently infested than *S. bovinus* (Table 5). The most important pests are fungus gnats.

Hygrophorus camarophyllus. The important species seem to be *Mycetophila fungorum* and *Tarnaria tarnanii*.

Lepista nuda. Insufficient material.

Lepista nebularis. Infestation about 60 %, but most infested sporophores of stages II and III can still be used. The main pests are fungus gnats of the *Rhymosia* complex.

Armillaria mellea. Usually most of the numerous sporophores in the colonies can be used as food. *Mycetophila fungorum* often feeds on this fungus but is of little importance as a pest.

Tricholoma flavovirens. Infestation is high, about 90 %, but the damage is usually small and even sporophores of stage III can often be used as food. The main pests are *Mycetophila fungorum* and *Pegohylemyia silvatica*.

Macrolepiota procera. Insufficient material. In the few sporophores studied, the damage caused by dipterous larvae was small.

Kueneromyces mutabilis. Few sporophores in the colonies are infested.

Naematoloma capnoides. Few sporophores in the colonies are infested. The characteristic pest is *Bolitophila*.

Coprinus comatus. Sporophores are edible only when young, and no dipterous larvae have been found in young sporophores.

Rozites caperata: Infestation is high, about 80 %, but more than 50 % of sporophores of stages I and II can be used as food (Table 5). The important pest is *Mycetophila fungorum*.

Russula decolorans and *R. paludosa*. Infestation of sporophores (II+III) is 80—90 %. In *R. decolorans* (Table 5), if sporophores with a few galleries are tolerated, the percentage of edible sporophores in stages I—III is fairly high. The important pests are *Mycetophila fungorum* (Fig. 6) and *Cordyla* spp.

Lactarius necator. Infestation of sporophores (II+III) is about 45 %. Those of stage II are usually still edible. Pests are various fungus gnats, frequently *Exechia contaminata*.

Lactarius torminosus. Infestation of sporophores (II+III) is nearly 40 % but in stage II the damage is often slight. Common pests are *Exechia nigroscutellata* and *Mycetophila strobli*.

Lactarius deliciosus group. Infestation of sporophores (II+III) is about 80 %. Most of the sporophores of stages II-IV are full of larvae and their galleries. The most important pest is *Mycetophila blanda*.

Lactarius trivialis. Infestation about 20 %. The pests are various fungus gnats and some flies.

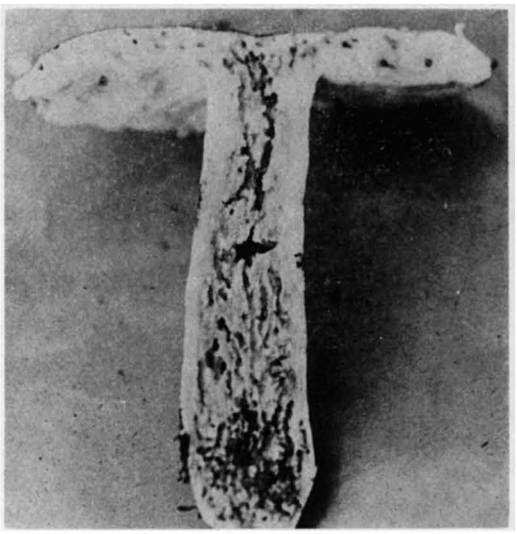

Fig. 6. *Russula decolorans* damaged by *Mycetophila fungorum*.

Lactarius rufus. During the summer infestation may be more than 40 %, in the autumn less. Even in the summer months a considerable percentage of the sporophores of stages I and III can be used (Table 5). The most important pests are *Megaselia* spp.

Acknowledgements. The study was supported by grants from Suomen Luonnonvarain Tutkimussäätiö (The Foundation for the Investigation of Natural Resources in Finland) and from Societas Scientiarum Fennica.

The following colleagues and friends assisted in collecting the fungi: Mr. Anders Albrecht, Mrs. Ulla Cedercreutz, Prof. Kai Otto Donner, Prof. Lars von Haartman, Dr. Harri Harmaja, Mr. Larry Huldén, Mrs. Gun-Britt (Lindholm) Husberg, Mr. Bernhard Lindeberg, Mr. Gunnar Lundqvist, Mrs. Kerstin Meinander, Mrs. Esteri Ohenoja, Mr. Christian Oker-Blom, Dr. Samuel Panelius, Mr. Antti Pekkarinen, Miss Margareta Sjöblom, Mr. Ilkka Teräs, Prof. Risto Tuomikoski and Dr. Kari Vepsäläinen.

Mr. Anders Albrecht and Mr. Christian Oker-Blom assisted with the breeding and their help is gratefully acknowledged. Prof. Veronica Sundman provided us with laboratory cultures of some fungi.

Dr. Agnes Dely-Draskovits (Budapest) gave us unpublished lists of Diptera reared from Hungarian fungi.

The following persons helped with the identification of the fungi: Dr. Harri Harmaja, Prof. Veikko Hintikka, Prof. Paavo Kallio, Mr. Mauri Korhonen, Mrs. Esteri Ohenoja, Prof. Risto Tuomikoski and Dr. Kari Vepsäläinen.

In the identification of the Chironomidae we were helped by Prof. Mauri Hirvenoja and Mr. Bernhard Lindeberg.

Dr. Heikki Pyysalo kindly made us a mixture of chemicals corresponding to the aromatic substances of a fungus.

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Received 2. XII. 1978
Printed 25. V. 1979