

Article ID: 1000-5692(2003)01-0032-05

Study of systemic status of Mycetophilidae

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Abstract: The actuality of Mycetophilidae family research has been illustrated in detail. The research includes biology, classification and identification, geographical distribution, status of systemic classification and system development. The existed problems and expectation are also explored in the paper. According to the latest information, Mycetophilidae family is composed of 5 subfamilies, i. e., Mycomyinae, Sciophilinae, Gnoristinae, Leiinae and Mycetophilinae. Mycetophilinae includes 2 tribes: Exechiini and Mycetophilini. References 28

Key words: Mycetophilidae; geographical distribution; classification status

CLC Number: Q969.44 **Document Code:** A

The family Mycetophilidae belongs to the superfamily Sciaroidea in the order Diptera, which is the largest family in the superfamily Sciaroidea^[1]. Because of this insects feeding on edible fungi or large fungus body, a lot of scholars have been involved in the research on fungus pest species, and great progress in research on fungus gnats has been made. Based on research results and literature published at home and abroad in the past two decades, the authors make a summarization on the situation of the family Mycetophilidae insect species, including the biology, geography distribution, classification, phylogeny and make a forecast for the existing problems in the hope of providing some fundamental systemic materials for both theoretical research and practical application in the field of control of edible fungus pests^[2~15].

1 The generation

1.1 Biology

Mycetophilidae insects are common in most humids habitats, particularly in woodlands, both in the tropics and in the temperature regions. For the large majority of species their larva are unknown, but numerous species have larvae living in fruiting bodies of various fungi or on mycelium penetrating rotting plant materials. Larvae not spinning a web; usually feeding internally bearing some sort of case of fomed of excrement. Due to their small size and a hidden life, fungus gnats have not caught enough attention of ecologists and systematists.

Received date: 2002-08-31; Revised date: 2002-11-08

Foundation item: project supported by National Natural Science Foundation of China (30070102)

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1.2 Zoogeographic distribution

Mycetophilidae occurs on all continental areas except antractic and on most oceanic islands. However, only a few studies dealing with the biogeography of mycetophilids have been published among them up to now^[16-18]. Gagne^[10] studied the fauna composition in European region, and the result showed that fauna of mycetophilids in Eastern Nearctic is more similar to the European fauna than to the western.

At present, the data on genera and the numbers of species taken from the various regional catalogues are only found in Nearctic fauna^[7, 11-12]. Dimitar discussed the composition of the fungus gnat about fauna of the Palaearctic region, and considered most of the genera to be of boreal (Holarctic) origin^[4].

About 3 500 species have been described in 136 genera so far, but there are undoubtedly much more species that are still undescribed in the world.

1.3 Economic significance

With the rapid development of edible fungus culture, fungus gnats have become to be of the economic importance. Larvae feed on body fungi of all kinds, which damage to various structures and tissues of the fungus. Thus, larvae make on the growth vigor of edible fungus decreased and the yield of the fungus lowered. It's common that all the fungus tissues, spores were eaten up were resulted by fungus gnats pest, and great losses of edible fungus production. Although adults don't feed on edible directly, they can spread all sorts of pathogenic microorganisms, nematodes, mites and so on. Therefore, they have a badly impact on the quality of edible fungus and human being health.

2 Research on classification status of Mycetophilidae

Since the first fungus gnats species in world was described by Decteer, studies on classification of it have been exploited. From then on, there are a lot of scholars involved in the research on the family Mycetophilidae, and several genera and species have been described^[3-14]. Winnertz was first scholar to study the classification system on the family Mycetophilidae, and divided it into seven subfamilies according to wing venation, wing setae and trichia, ocellus number, ocellus position, and so on, and added up to 18 genera one of them included his found 13 genera in the family Mycetophilidae^[11]. The system of classification constructed basical framework on high taxon in the family Mycetophilidae have been adopted by several scholar. Later many new genera were found by some scholar. It is know that there are 27 genera in the family by the ending of 19 century.

In the early 20th century, Johannsen examined the genera of Mycetophilidae, and considered that *Allodia* Winnertz and *Brachycampta* set by Winnertz should not be treated as genera because of the shortage of adequate evidence only based on the final wing fork and length of venation^[11-12]. Meanwhile, he recognized that *Brachycampta* Winnertz should be treated as a subgenus in *Allodia* Winnertz, and proposed that genus *Brevicornu* Marshall should be merged into the genus *Cordyla* Meign. Thus there were 25 genera in Mycetophilidae defined by Johannsen.

Edwards firstly put forward the viewpoint which the texture of thoracic segment sclerite shows decisive significance to generic classification within the subfamily Mycetophilinae, and systematically researched the fauna of fungus gnats species in Enland^[8]. He divided the family Mycetophilidae into 10 subfamilies according to setae of wings, thorax, legs, wing venation, ocellus number, ocellus position as well as ventral distal, namely Bolitophilinae, Keroplatinae, Diadocidinae, Ditomyiinae, Lygistorhininae, Macrocerinae, Manotinae, Mycetophilinae, Sciarinae, Sciophilinae. His classification system appears relatively reasonbale. He also divided the subfamily Mycetophilinae into two tribes namely Exechini and Mycetophilini according to mesepisternum bristle, and amended classification position of the genera in two tribes mentioned above. He thought that genera *Mycothera*, *Opistholoba* and *Plastacephala* should be merged into *Mycetophica*; *Exechia* should be divided into 2 groups basing on changes of venation; *Symplasta* and *Brevicomu* should be merged into *Allodia*; *Pachypalpus* should merged into

Cordyla, and *Telmaphilus* into *Phronia*; raised the genus *Lygistowhina* to the level of the subfamily Lygisterrhininae; raised the genus *Manota* to the level of the subfamily Manotinae. Edwards's divided system is as follows: the tribe Exechiini consists of 5 genera *Anatella* Winnertz 1863, *Allodia* Winnertz 1863, *Brachypeza* Winnertz 1863, *Exachia* Winnertz 1863, *Rhymsoia* Winnertz 1863, the tribe Mycetophilini is composed of 20 genera *Brachydierania* Skuse 1888, *Cordyla* Meigen 1803, *Delopsis* Skuse 1890, *Dynatosoma* Winnertz 1863, *Epicypa* Winnertz 1863, *Macrobrachius* Dziedzicki 1889, *Manota* Williston 1896, *Mycetophila* Meigen 1803, *Mycothera* Meigen 1803, *Lygistorrhina* Skuse 1980, *Opistholoba* Mik 1891, *Pachypalpus* Macquart 1834, *Palaeotrichonta* Meunier 1904, *Parexechia* Becher 1886, *Phronia* Winnertz 1863, *Probolaeus* Williston 1896, *Sceptonia* Winnertz 1863, *Synplasta* Johannsen 1909, *Trichonta* Winnertz 1863, *Zygomysia* Winnertz 1863. At the middle of 20th, Tuomikoski systematically studied the taxonomy of all genera in tribe Exechiini in 1966, recognized previous classification system which didn't conform to natural classification system due to subjective factors; and gave a new classification system, in which *Rymosia* was divided into *Rymosia*, *Tamania*, *Pseudorymosia* and *Allodiopsis*. *Exechia* was considered as a polyphyletic group, and *Exechia* was divided into *Exechia*, *Pseudexechia* and *Exechiaopsis*; *Brocioniu* possesses generic characters which should be taken as a new genus from *Allodia* Winnertz^[19~21]. Tuomikoski moved all species of *Brachypeza* into the new genus *Pseudobrachypela*. Moreover, he suggested the third tribe should be set up in the family Mycetophilidae, but he was short of solid proof^[8].

With development of entomological morphology and many species identified in the Mycetophidae, different authors gave different classification systematics in terms of characters selected and classification standard.

Hennig considered six of the nine subfamilies recognized by Edwards as separate families in his later papers^[15]; the Lygisterrhininae included in the Kertoplatidae; the Manotinae and the Sciophilinae placed in the Mycetophilidae. Madwar treated the Ditomyiidae as a separate family because of the difference between their larvae and those of the Bibionidae. The most recent authors treat the Sciarinae as a family level, so they may ignore it if Sciarinae was treated as subfamily in the Mycetophilidae, and believe the rest of the family into the Mycetophilidae consisting the eight subfamilies, namely Manotinae, Mycomyinae, Sciophilinae, Gnoristinae, Leiinae, Metanepsiinae, Mycetophilinae, Sciarinae. This arrangement is adopted here because of its general acceptance, although the Mycetophilidae in this sense is probably a paraphyletic group. A thorough phylogenetic analysis is necessary to clarify the problem.

The subfamily Mycetophilinae was divided, emerged or raised by authors so that give rise to instability of subgroup in the Mycetophilidae was challenged. For example, Landrock regarded *Allophallus* as synonym of *Delopsis*^[22]; Edwards emerged *Palaevepicypta* into *Khyomzia*^[8]; Coher regarded *Delopsis* as synonym of *Epicypa*, and set a new genus *Nevepicypta*^[3]. Lane merged *platyprosthigyne* into *Zymia*^[5], merged *Platurocypta*, *Plastacephala* and *Nevepicypta* into *Epicypa*^[6], merged *Pwraceomyia* into *Eaechia*^[5], merged *Nevepicypta* into *Platurocypat*^[7].

Positions of some genera in Tuomikoski's classification have been still varying nowadays during development of classification. For example, regarded *Parallodia* as synonym *Allodia*; Vockerth raised the subgenus *Stigmatomeria* in *Brevicomu* to the level of genus^[23]; subgenus *Brachycampta* resumed the level of genus; Matile raised subgenus *Gymnogonia* in the Tuomikoski's classification system to the level of genus^[24]; Gagne emerged *Palaeotrichonta* into *Trichonta* Winnertz in the tribe Mycetophilini^[10].

At present, there are seven families in the superfamily Sciaroidea, namely Mycetophilidae, Ditomyiidae, Diadocidiidae, Bolitophilidae, Keroplatidae, Lygisterrhinidae and Sciaridae (Lygisterrhinidae had previously been considered as a subfamily of Keroplatidae). Furthermore Edwards subdivided Sciophilidae and Mycetophilidae into tribes: Gnoristini, Leini, Mycomyini and Sciophilini into Sciophilinae; Exechiini and Mycetophilini into Mycetophilinae, the fifth tribe Metanepsiini was added to the Sciophilinae. However, all tribes in Sciophilidae are

raised to the levels of subfamily, and included in the family Mycetophilidae now^[14]. Therefore, now the family Mycetophilidae consists of five subfamilies namely Mycomyinae, Sciophilinae, Gnoristinae, leiinae and Mycetophilinae, and the latter subfamily includes two tribes Exechiini and Mycetophilini.

3 Studies on Mycetophilidae from China

3.1 Studies on classification and phylogeny of Mycetophilidae

After Japanese scholar Okada described 8 species in the Mycetophilinae collected from east-northern China, classification of Mycetophilinae have not been studied until middle of 1980s^[13]. Prof Wu and Yang began to study the taxonomy of Mycetophilidae in China, and have described and recorded about 370 species in 25 genera, which belong to 5 subfamilies^[25].

Wu *et al.* firstly studied phylogenetic relationship of the family Mycetophilidae at the generic level based on species from China with 48 morphological characters^[26]. The cladistic analysis was performed using the Hennig 86 program (version 1.5), the in-group comprised of 28 known genera, *Bolitophila* and *Lygistorrhina* were used as the out-group according to Matile research conclusion. The result of cladistic analysis in Mycetophilidae suggests that Mycetophilinae and Leiinae are sister groups; Sciophilinae is a primitive group in the family Mycetophilidae, and Mycetiphilinae is a revolutionary group. Moreover the research shows that Gnoristinae belongs to paraphyletic groups, while the subfamily Mycomyinae is intermediate between Mycetophilinae and Leiinae.

Generally speaking, the study on classification of Mycetophilidae has been relatively deficient so far, particularly in phylogenetic analysis about Mycetophilidae.

3.2 Studies on zoogeographic distribution

The information of the zoogeographical distribution about Mycetophiledae from China was really scarce^[25-26]. Wu studied the biogeographic distribution of Mycomyinae. According to the earliest fossil material of the subfamily Mycomyinae, he considered that was one of the oldest groups in the family Mycetophilidae^[27]. He also believed the subfamily was a group of tropical region, because seven genera out of the total 10 genera in this subfamily were only found in tropical and subtropical regions. Among the 10 known genera belonging to Mycomyinae only the genera *Mycomya* and *Neoempheria* are discovered throughout the world, but the rest are confined to a certain zoogeographical region. The genus *Echinipodium* can be found in the Neotropical region, *Viricivora*, *Paraemphiella*, *Mycomyiella*, *Moriniola* and *Syndocasia* in the African region. *Vecella* in the Oriental region and *Mycoleia* in the Nearctic region. There are 3 known genera of the subfamily in China, of which *Mycomya* and *Neoempheria* can be found in several zoogeographical regions, while *Vacella* is the endemic genus in China.

4 Problems and prospects

With the efforts of generations of entomologists in China, more than 300 species of fungus gnats have been found and described. On account of the abundance of fungi species, which have a wide distribution and a complicated habitat, lots of insect species that parasitize on edible fungi body are still undescribed. Although some of insects are already known as a fungi pest, their hosts are still not well understood.

In addition, the family Mycetophilidae is low in order Diptera in terms of evolution^[28]. The interaction between the insects that feed on fungi and the fungi species on which these insects parasitize provides a good material for discussion on coevolution between insects and fungi. Therefore, systematic analyses and comparisons between morphology and genetics of the insects that feed on fungi will provide a new theory for coevolution.

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菌蚊科昆虫系统分类地位的研究 (双翅目: 菌蚊科)

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摘要: 对菌蚊科研究现状进行了详细概括, 其中包括其生物学、分类与鉴定、地理分布、分类的系统地位和系统发育等, 同时还提出存在的问题与展望。依据最新的资料, 菌蚊科应由 5 个亚科构成, 即真菌蚊亚科、粘菌蚊亚科、邻菌蚊亚科、滑菌蚊亚科和菌蚊亚科, 其中菌蚊亚科包括 2 个族, 即伊菌蚊族和菌蚊族。

关键词: 菌蚊科; 地理分布; 分类地位