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叶蝇科昆虫生物学和地理分布分析

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摘要: 概述叶蝇科昆虫的生活史、食性、适蚁性和盗寄生性等生物学特性, 并对叶蝇科、属、种的地理分布进行分析。叶蝇科在世界动物地理区的分布统计结果表明, 叶蝇科 3 亚科均为世界性分布。真叶蝇亚科属级阶元在东洋界丰富度最高, 其次为新热带界; 其种级阶元在东洋界分布最丰富, 其次为古北界, 非洲热带界和澳洲界分布的数量较少。平鬃叶蝇亚科属级阶元在新北界丰富度最高, 其次是古北界和非洲热带界; 其种级阶元在非洲热带界最为丰富, 其次为新热带界和古北界。叶蝇亚科属级阶元在非洲热带界、新北界、新热带界丰富度较高, 古北界和东洋界丰富度较低; 其种级阶元在新热带界最为丰富, 其次为非洲热带界, 分布最少的为古北界。

关键词: 昆虫; 叶蝇科; 生物学; 区系

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Biology and Geographical Distribution Analysis of Milichiidae

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Abstract: The present study summarizes the life history, feeding habits, adaptability to ants and parasitoids of Milichiidae, and analyzes the geographical distribution of genera and species of Milichiidae. The results of statistics from the world fauna show that three subfamilies of Milichiidae all belong to worldwide distribution pattern in the generic level. The Oriental region occupies the first place and the Neotropical region is the second place in the generic and specific levels of the abundances of subfamily Phyllomyzinae, and Afrotropical region and Australian are less abundant in the specific level. The Nearctic region is the richest in the genus level, it is followed by the Palaearctic region and Afrotropical region of the subfamily Madizinae. The Afrotropical region is in the first place, followed by the Neotropical region and the Palaearctic region in the specific level. The genus level of the subfamily Milichiinae is richer in the Afrotropical

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region, the Nearctic region and the Neotropical region, but less abundant in the Palaearctic region and the Oriental region. The specific level are most abundant in the Neotropic region, followed by the Afrotropical region, and least distributed in the Palaearctic region.

Key words: insect; Milichiidae; biology; fauna

叶蝇科 Milichiida 是双翅目 Diptera 环裂亚目 Cyclorrhapha 无瓣类 Acalyptrata 中种类较少的类群之一,全世界已知 3 亚科 21 属 470 种,广泛分布于世界各大动物地理区。

叶蝇科成虫体型较小,体长一般为 1.0~4.0 mm。体色暗黑色、暗棕色、棕色,少数为暗黄色,胸腹部密被短毛,一般具灰白色、银白色的粉被。成虫主要鉴别特征为:单眼后鬃 1 对且较发达,分开、会聚或十字形交叉;髭角一般着生 1 根发达的髭;触角芒常位于第 1 鞭节背面近基部,柄节和梗节通常较短,边缘具或长或短的毛,第 1 鞭节形状多变,差异较大,圆形、球形或方形,下颚须形状多变,或长或短,具毛、鬃或无;新月片具 2 根鬃;脉序简单,翅脉除臀脉外,其余纵脉均达翅缘;前缘脉具 2 缺刻,较粗,延伸至第一中脉或稍延长^[1-4]。

1 生物学

1.1 生活史

目前,国内外关于叶蝇科昆虫生活史的相关研究较少。叶蝇科昆虫属于完全变态类昆虫,一生要经过卵、幼虫、蛹和成虫 4 个阶段。每年发生 1~4 代,主要以老熟幼虫或蛹越冬^[5]。雌成虫一般将卵产在潮湿荫蔽且富含腐殖质的杂草、枯木中^[6],也有部分种类会将卵产于膜翅目巢穴或某些哺乳动物的粪便中,如部分属的一些种类会将卵产在切叶蜂的巢穴内^[7],或将卵产于蚁巢底部,卵孵化后取食蚁巢内的菌圃碎屑^[8-9],也有部分种类将卵产入蝙蝠粪便内^[10-12],或者将卵寄生在蜘蛛(如金蛛属 *Argiope*)的卵中^[13]。雌成虫一生可产卵 80~100 粒,卵前期 7~14 d,孵化期 3~8 d;幼虫期一般 10~50 d,发育历期因环境差异长短不等;幼虫分为 3 个龄期,3 龄老熟幼虫化蛹前行动变缓,离开食物源(不会远离,羽化后要取食补充营养),蛹期一般 7~16 d,羽化后立即取食,1~3 h 之后可飞行^[3,5,10]。

1.2 生活习性和栖居环境

叶蝇科昆虫的幼虫一般为腐食性、粪食性或尸食性。Ferrar^[6]发现成虫从腐烂的鱼、腐烂的植物、动物粪便中孵化,纹额叶蝇属 *Desmometopa* 许多种类是从腐烂蔬菜和水果中孵化出来,为证明叶蝇科昆虫幼虫的生活习性提供了很好的证据,部分叶蝇幼虫与膜翅目物种间存在密切的联系。Melo^[14]在巴西一种麦蜂属昆虫的巢穴内壁潮湿处发现了寄生在其中的叶蝇幼虫及蛹。

叶蝇成虫具有适蚁性,也有部分成虫取食花蜜。叶蝇科昆虫的适蚁性是较为特别的习性,主要表现在叶蝇科昆虫的幼虫寄生在蚁穴中。例如,真叶蝇属 *Phyllomyza* 部分种类的幼虫生长在亮毛蚁 *Lasius fuliginosus* 和红林蚁 *Formica rufa* 的巢穴底部^[15];有些学者在美国得克萨斯州发现了多毛硬叶蝇属 *Pholeomyia* 部分幼虫、蛹和成虫生活在当地一种切叶蚁的巢穴中,幼虫取食菌圃的碎屑^[8]。

叶蝇成虫的另一个特点是盗寄生性,也称共生性或寄生性。部分属的种类喜食或掠夺被捕食性天敌捕获的猎物,例如蜘蛛、猎蝽、食虫虻及蜻蜓等。Sivinsk 等^[16]列出了 5 属(真叶蝇属 *Phyllomyza*,纹额叶蝇属 *Desmometopa*,新叶蝇属 *Neophyllomyza*,并脉叶蝇属 *Paramyia*,凹痕叶蝇属 *Milichiella*)12 种叶蝇科昆虫成虫为捕食性天敌的盗寄生者。Robinson 等^[13]在科罗拉多岛观察到多头真叶蝇的雌虫停留在金线蛛的头胸部,金线蛛捕获猎物并注入消化液后,这些雌虫会离开蜘蛛去吸食被消化的猎物,取食完毕后又回到蜘蛛身体上,通过这些现象可以猜想这些叶蝇和蜘蛛已经相处了很长时间。曾经有报道在蜘蛛上所捕获的具有盗寄生取食行为的叶蝇科昆虫均为雌虫,盗寄生取食行为的主要原因是雌性成虫需要获取额外的

蛋白质供卵发育成熟^[3, 17-18].

不同属的多种叶蝇科成虫有访花习性,具有一定的传粉功能. 在新热带界多种叶蝇科昆虫是马兜铃属植物重要的传粉昆虫,共计 7 属 18 种,在巴拿马为马兜铃属植物传粉^[19-20]. 有些雌性叶蝇成虫会被马兜铃属植物花被上部的纤毛所吸引,从而钻入管状花被,但并不在其中产卵,钻入花被可能是为了获得营养使卵巢发育成熟^[20]. 有的学者认为取食花蜜和盗寄生取食行为均为叶蝇科雌性祖征行为的一部分^[3].

叶蝇科雄性成虫也存在着一些有趣的行为. 凹痕叶蝇属 *Milichiella*、硬叶蝇属 *Phleomyia*、叶蝇属 *Milichia* 和假叶蝇属 *Pseudomilichia* 的部分种类喜群聚,这些种类腹部具灰白色、银白色的粉被,在成群飞行或者交配时能够在很远的距离看到,阳光下泛着银色白光的亮点,即为这些种类^[21-22].

2 区系分析

本文根据已有文献资料并且结合课题组的研究结果,对叶蝇科昆虫属、种阶元在世界动物地理的区系进行分析^[2, 6-9, 11-12, 20-74].

2.1 属、种的区系

真叶蝇亚科世界性分布,世界上已知 11 属,其中 1 属为世界性分布,6 属为单区分布. 该亚科单区分布的属所占比率最高. 根据地理区系分析(图 1),古北界分布 5 属,占该亚科所有属的 45.5%,有 1 个特有属;东洋界分布 8 属(占 72.7%),有 3 个特有属;非洲热带界分布 4 属(占 36.4%);澳洲界分布 2 属(占 18.2%);新北界分布 4 属(占 36.4%);新热带界分布 6 属(占 54.5%),有 2 个特有属. 该亚科属级阶元在东洋界丰富度最高,其次为新热带界.

真叶蝇亚科世界已知 173 种,各动物地理区系分布情况为:东洋界分布 101 种,占该亚科所有种的 58.4%;其次为古北界 32 种(占 18.5%);新北界 17 种(占 9.8%);新热带界 13 种(占 7.5%);非洲热带界和澳洲界分布较少,各 5 种(各占 2.9%). 该亚科在东洋界分布最丰富,其次为古北界和新北界的种类分布,非洲热带界和澳洲界分布数量较少.

平鬃叶蝇亚科世界性分布,世界上已知 4 属,其中 2 属为世界性分布,1 属为多区分布,1 属为单区分布. 根据地理区系分析(图 2),古北界分布 3 属;占该亚科所有属的 75%;东洋界分布 2 属(占 50%);非洲热带界分布 3 属(占 75%);澳洲界分布 2 属(占 50%);新北界分布 4 属(占 100%),有 1 个特有属;新热带界分布 2 属(占 50%). 该亚科的属级阶元在新北界丰富度最高;其次是古北界和非洲热带界. 平鬃叶蝇亚科世界已知 81 种(存在跨区分布的物种),各动物地理区系的分布情况为:非洲界分布最丰富 27 种,占该亚科所有种的 33.3%;新热带界 19 种(占 23.5%);古北界 17 种(占 21.0%);新北界 13 种(占 16.9%);澳洲界和东洋界均为 12 种(占 14.8%). 该亚科的种类在非洲界最为丰富,其次为新热带界和古北界.

叶蝇亚科世界性分布,世界上已知 6 属,其中 1 属为世界性分布,1 属为亚世界性分布,2 属为单区分布. 根据地理区系分析(图 3),古北界分布 2 属,占该亚科所有属的 33.3%;东洋界分布 2 属(占 33.3%);非洲热带界分布 4 属(占 66.7%),有 1 个特有属;澳洲界分布 3 属(占 50%);新北界分布 4 属(占 66.7%);新热带界分布 4 属(占 66.7%),有 1 个特有属. 该亚科的属级阶元在非洲热带界、新北界、新热带界丰富度较高;古北界和东洋界丰富度较低. 叶蝇亚科世界已知 216 种,各动物地理区系的分布情况为:新热带界分布最丰富 96 种,占该亚科所有种的 44.4%;非洲界 44 种(占 20.4%);新北界 31 种(占

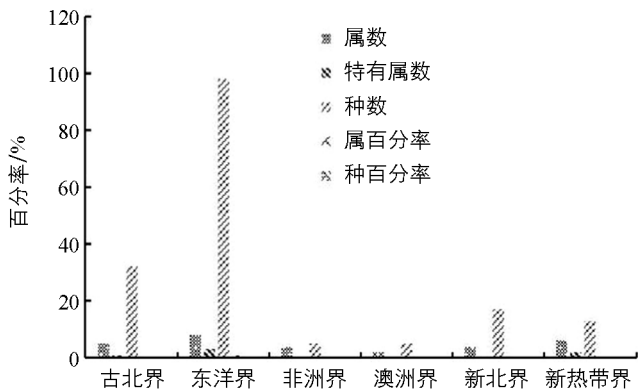


图 1 真叶蝇亚科属、种在各动物地理区系的分布统计

14.4%); 东洋界 20 种(占 9.3%); 古北界 13 种(占 6.0%); 澳洲界 12 种(占 5.6%), 该亚科的种类在新热带界最为丰富, 其次为非洲界, 分布最少的为澳洲界.

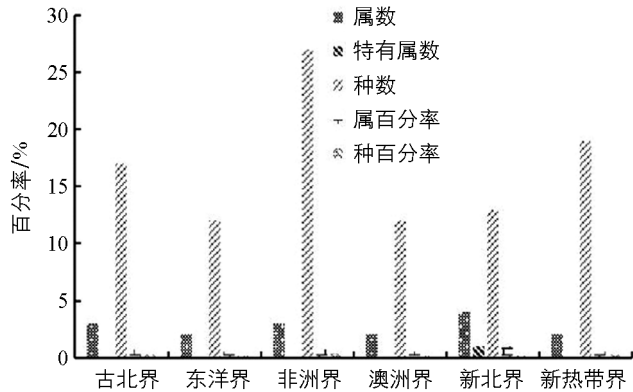


图 2 平鬃叶蝇亚科属、种在各动物地理区的分布统计

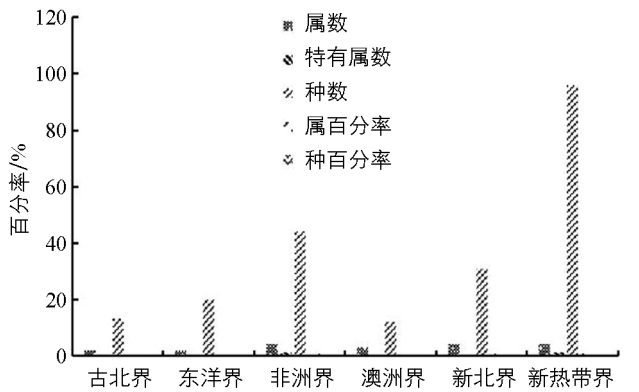


图 3 叶蝇亚科属、种在各动物地理区的分布统计

2.2 属级阶元区系组成特点

叶蝇科昆虫已记述 21 属, 其属的区系分布共 6 型 14 分布式(表 1). 以东洋界、新北界、新热带界分布的属最多, 均共有 12 属, 占叶蝇科属级阶元的 57.14%, 其中东洋界和新热带界各有特有属 3 个, 新北界特有属 1 个; 其次是非洲热带界, 共有 11 属, 其中特有属 1 个; 再次是古北界, 共有 10 属, 特有属 1 个; 澳洲界分布的属较少, 共有 7 属, 无特有属. 跨区分布的属以四区型和六区型居多, 各有 4 属, 均占叶蝇科属级阶元的 19.05%, 其中六区型(世界性分布)的属所占比例最高, 占叶蝇科的 19.05%; 五区型共有 2 属, 占叶蝇科的 9.52%; 双区型和三区型均只有 1 属, 均占叶蝇科的 4.76%. 结果表明, 叶蝇科属级阶元在各个动物地理区均有分布, 且分布数量没有太大的差异; 从区域的属级相关性来看, 古北界和东洋界的相似度较高, 新热带界和新北界相似度也较高.

表 1 叶蝇科属级阶元在世界动物地理区中的区系类型和比例

序号	区系型	分布式	属数/个	占比/%
1	单区型	古北界	1	4.76
2		东洋界	3	14.29
3		非洲热带界	1	4.76
4		新北界	1	4.76
5		新热带界	3	14.29
6	双区型	新北界-新热带界	1	4.76
7	三区型	古北界-非洲热带界-新北界	1	4.76
8	四区型	古北界-东洋界-非洲热带界-新北界	1	4.76
9		古北界-东洋界-非洲热带界-新热带界	1	4.76
10		东洋界-澳洲界-新北界-新热带界	1	4.76
11		非洲热带界-澳洲界-新北界-新热带界	1	4.76
12	五区型	古北界-东洋界-非洲热带界-新北界-新热带界	1	4.76
13		古北界-东洋界-非洲热带界-澳洲界-新北界	1	4.76
14	六区型	古北界-东洋界-非洲热带界-澳洲界-新北界-新热带界	4	19.05

3 结语

就目前叶蝇科世界区系研究水平来看,叶蝇科昆虫各亚科广泛分布于世界六大动物地理区系,但各亚科在世界动物地理区系中的分布各有特点.真叶蝇亚科其属、种级阶元均在东洋界丰富度最高,其次为古北界;平鬃叶蝇亚科属级阶元在新北界丰富度最高,其次是古北界和非洲热带界,其种级阶元在非洲界最为丰富,其次为新热带界和古北界;叶蝇亚科属级阶元在非洲热带、新北界、新热带界丰富度较高,该亚科种类在新热带界最为丰富,其次为非洲界.叶蝇科属级阶元在各个动物地理区均有分布,且分布数量没有太大差异;从区域的属级相关性来看,古北界和东洋界的相似度较高,新热带界和新北界相似度也较高.跨区分布的属以六区型(世界性分布)所占比例最高,占叶蝇科属级阶元的 19.05%.

叶蝇科物种多样性丰富,广泛分布于各大动物地理区.叶蝇科昆虫常在落叶、稻草、腐烂的树桩或鸟巢中活动,主要以腐食性和菌食性为生.因此,深入开展叶蝇科系统分类和进化研究,发掘其生物学及生态学意义,在保护生态环境、降解有机质、维持生态平衡、保护昆虫资源等方面均有十分重要的作用.

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