



中国长翅目昆虫 原色图鉴

(中英文对照)

A Color Atlas of the Chinese Mecoptera (Chinese and English)

王吉申 花保祯 / 著

Jishen Wang & Baozhen Hua



●长翅目 Mecoptera 是全变态类昆虫中的一个小目，全世界已知 700 多种，包括蝎蛉、蚊蝎蛉和拟蝎蛉等。长翅目昆虫对生态环境要求严格，是重要的生态指示昆虫。

●中国是世界上长翅目昆虫最丰富的国家，已知有分布的长翅目昆虫包括 3 科 10 属 300 多种。

●本图鉴是作者在多项国家自然科学基金研究工作的基础上，对中国长翅目昆虫研究进展的系统总结，共收录产自中国的长翅目昆虫 3 科 10 属 170 种。

●本图鉴是世界上第一部长翅目昆虫分类研究的重要著作，全书中英文对照，可作为昆虫学工作者及爱好者的重要参考书。



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内容提要

本图鉴是作者在多项国家自然科学基金(30070101, 30370179, 30670255, 30970386, 31172125, 31301898, 31672341)研究工作的基础上,对中国长翅目昆虫研究进展的系统总结。共收录产自中国的长翅目昆虫3科10属170种;系统编制了本图鉴收录的中国长翅目昆虫分科、分属和分种检索表;概述部分介绍了长翅目昆虫的分类地位、研究简史、分类系统、地理分布、形态特征、生物学和生态学特性等;每种昆虫介绍了中名、拉丁学名、测量数据、形态特征、发生期、地理分布等,并提供有成虫生态照片或标本照片,雄性外生殖器图片以及地理分布图。本图鉴是世界上第一部长翅目昆虫分类研究的重要著作,全图鉴中英文对照,可作为昆虫学工作者及爱好者的重要参考资料。

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序言

谈到昆虫，我们最先想到的往往是蝴蝶、蜻蜓、蜜蜂、蚊蝇、蟑螂等耳熟能详的类群。这些常见的昆虫与人类日常生活最为密切，在影视文化作品中上镜率也最高。但少有人知，在已发现的 100 余万种现生昆虫中，有一类奇特的成员，它们的成虫通常具有延长的喙；一些种类由于雄性的生殖节膨大并向上翘起，形如蝎尾，因此俗称“蝎蛉 scorpionflies”；其外部特征和生物学特性变化多端；它们在昆虫纲 Insecta 的演化及系统发育关系研究中具有十分独特的地位。这类昆虫被昆虫学家归为长翅目 Mecoptera。由于缺少专门的资料，对广大昆虫研究者和爱好者来说，长翅目 Mecoptera 昆虫的鉴定一直以来都较为困难。

现生的长翅目 Mecoptera 是昆虫纲 Insecta 中的一个孑遗小目，全世界已命名的现生种仅超过 700 种，归属于 9 个科近 40 个属。相较之下，已报道的化石类群却约有 620 种，归属于 39 个科、210 个属；大量新分类单元（科、属、种）还在不断被发现，其中 3/4 以上的科在现今已绝灭。长翅目 Mecoptera 昆虫有着漫长的起源和演化历史，它们的化石记录最早出现于早二叠纪，距今约 2.7 亿年。中生代（距今 2.52 亿至 6 500 万年）是长翅目 Mecoptera 昆虫承前启后、发展演化的重要时期。长翅目 Mecoptera 昆虫在这一时期达到了其多样性的顶峰，在中生代全变态昆虫化石中占据着很大比例。现生长翅目 Mecoptera 的 9 个科在侏罗—白垩纪均已出现。许多灭绝的科（如支脉蚊蝎蛉科 Cimbophlebiidae、直脉蝎蛉科 Orthophlebiidae 和蝶蝎蛉科 Choristopsychidae）不仅丰富了人们对长翅目 Mecoptera 多样性的认识，而且为研究长翅目 Mecoptera 的起源与演化提供了宝贵的实证资料。

长翅目 Mecoptera 昆虫的口器、翅、外生殖器等在不同的类群中差异很大，对应着它们丰富多样的生物学特性。将古老绝灭的长翅目 Mecoptera 昆虫与现生类群对比，其生物学特性变化之大，往往超出我们的想象！例如阿纽蝎蛉科 Aneuretopsychidae、中生蝎蛉科 Mesopsychidae 以及长喙蝎蛉科 Pseudopolycentropodidae 昆虫具有特殊的细长虹吸式口器，可以取食裸子植物的传粉滴，是古老的传粉者，与当时的植物之间存在着复杂的协同演化关系；支脉蚊蝎蛉科 Cimbophlebiidae 的银杏侏罗支脉蚊蝎蛉 *Juracimbophlebia ginkgofolia* 与银杏植物之间存在着复杂的拟态和互利共生关系，这种关系在地质历史上共同走过了 1 亿多年；缺脉蝎蛉科 Holcorpidae 一些种类的雄性腹部和生殖器十分夸张地延长，这种特殊结构不仅被用于雄性之间的武力争斗，更是一种对雌性的性

展示。长翅目 Mecoptera 昆虫还有大量未知的形态结构、生物学特性以及演化规律在等待着人们发现和研究。

由西北农林科技大学花保祯教授领导的长翅目 Mecoptera 科研团队，长期以来致力于长翅目 Mecoptera 昆虫的形态学、行为学、分类学和系统演化研究，多年来取得了一系列令人瞩目的成果，并在国内外经典学术刊物上发表了一批高水平论文，使得西北农林科技大学成为了国际上现生长翅目 Mecoptera 昆虫的研究中心之一。尤为难得的是，花保祯教授在科学研究的同时，还从事大量的教学工作，培养了一大批优秀的年轻昆虫学者。他开设的科技论文写作、普通昆虫学、昆虫形态学、昆虫分类学等课程深受学生的喜爱。他还因独特的教学理念和严谨的工作态度，获得了“陕西省教学名师”的称号。

《中国长翅目昆虫原色图鉴》是一本难得的昆虫分类图鉴，它用直观精美的画面和科学准确的语言，将长翅目 Mecoptera 各方面的知识呈现出来。这也是一本融科学性、艺术性、趣味性于一体的精彩原创著作，适合广大昆虫学者及爱好者阅读，也可作为第一线农林工作者的实用参考资料。我很荣幸地将这本图鉴推荐给广大读者。同时，我也期待着花保祯教授所领导的长翅目 Mecoptera 科研团队更多优秀著作的诞生。

首都师范大学生命科学学院教授 任东
国际古昆虫学会副主席

2018年9月

Foreword

Speaking of insects, some common groups immediately appear in our minds: butterflies, dragonflies, bees, flies, and cockroaches. These insects are closely related to the daily life of humans, and frequently occur in the screen and other cultural works. Few people know, however, that among the one million species of extant insects, there are a group of peculiar members with elongated rostrum in their adults; some of them have enlarged and recurved male genitalia resembling the tail of scorpions, hence the common name "scorpionflies"; their external morphology and biological characteristics are highly varied; and they play a significant role in the study of the evolution and phylogeny of Insecta. This group of insects have been assigned in the order Mecoptera by entomologists. Because of the lack of specific literatures, the identification of Mecoptera is relatively difficult in a long period of time for the general entomological researchers and hobbyists.

The extant Mecoptera, a small relic order in the class Insecta, consist of over 700 species in nine families and ca. 40 genera. By contrast, the fossil Mecoptera include ca. 620 species in 39 families and 210 genera; a great number of new taxa (families, genera and species) have unceasingly been found. Among them, more than three-fourths of families were extinct. Mecopterans have a long history of origin and evolution, with the earliest fossil records in the Early Permian (ca. 270 mya). The Mesozoic era (252–65 mya) was an important period which links the past with the present days for the evolving Mecoptera. The mecopterans reached their peak of diversity in this era, and held a large proportion in the Mesozoic fossil of Holometabola. Nine extant families in Mecoptera have been found in the Jurassic-Cretaceous period. Many extinct families (*e.g.*, Cimbrophlebiidae, Orthophlebiidae, and Choristopsychidae) not only enrich our knowledge of the diversity of Mecoptera, but also provide precious solid evidence for the study of the origin and evolution of this order.

The Mecoptera have their mouthparts, wings and genitalia highly varied among different groups, corresponding to their diverse biological characteristics. Frequently, by comparing ancient, extinct mecopterans with extant ones, we are so amazed at their highly varied biological characteristics. For instance, members of the families Aneuretopsychidae, Mesopsychidae and Pseudopolycentropodidae were ancient pollinators sharing a complex co-evolution with plants, and their special slender siphoning mouthparts was able to feed

the pollination drops of the gymnosperms; *Juracimbrophlebia ginkgofolia*, belonging to the family Cimbrophlebiidae, have a complex mimicry and symbiotic relationship with the plant *Ginkgo*, the relationship between them lasted over a hundred billion years; some male Holcorpidae have exaggeratedly elongated abdomen and genitalia, special structures not only utilized to forcibly fight with other males, but also an sexual display to the females. There are enormous number of unknown structures, biological characteristics and evolutionary laws await our further discovery and research.

For the past many years, the research team of Mecoptera, Northwest A&F University, leading by professor Baozhen Hua, dedicated to the study of morphology, behaviors, taxonomy and phylogeny of Mecoptera, and made a lot of remarkable achievements. They published some excellent works in many Chinese and abroad journals, making Northwest A&F University one of the global research center of Mecoptera. Meanwhile, professor Bao-Zhen Hua also dedicated to teaching works and trained a group of young entomologists. His college courses are popular among students, such as scientific writing, general entomology, insect morphology, and insect taxonomy are popular among students. A title of "Prominent Educator of Shaanxi" was granted for his unique teaching idea and rigorous working attitude.

A Color Atlas of the Chinese Mecoptera is a valuable and unmatched atlas, in which all the aspects of knowledge of Mecoptera are shown by distinct elegant pictures and accurate scientific texts. It is a great original work that gathered scientific, artistic, and enjoyable qualities, suitable for the general entomological researchers and hobbyists, and also a practical reference for the forefront workers in agriculture and forestry. I am honored to recommend this atlas to the readers. Meanwhile, I also expect more excellent works from the research team of Mecoptera leading by professor Baozhen Hua.

Professor of the College of Life Sciences, Capital University
Vice-President of the International Palaeoentomological Society

Dong Ren

September 2018

前言

长翅目 Mecoptera 是全变态类昆虫中的一个小目,全世界已知 700 多种,包括蝎蛉、蚊蝎蛉等。长翅目昆虫对生态环境要求严格,是重要的生态指示昆虫。它们常常表现出复杂的求偶和交配行为,是研究昆虫行为学的绝佳材料。长翅目昆虫是全变态类昆虫中较古老的成员,在昆虫纲的系统演化研究中占据重要地位。

中国是世界上长翅目昆虫最丰富的国家,已知有分布的长翅目昆虫包括 3 科 10 属 300 多种。然而,目前国内长翅目昆虫鉴定方面的资料十分匮乏。依托西北农林科技大学昆虫博物馆丰富的标本收藏和近几年来野外考察的积累,我们历时 3 年编写了《中国长翅目昆虫原色图鉴》一书。

本图鉴收录了 170 种产自中国的长翅目昆虫。仅凭生态照片,多数长翅目昆虫难以鉴定到种,因此我们也选用了大量针插或酒精浸泡标本的照片。书中的大多数物种,我们都提供了成虫和雄性外生殖器特征图。另外,为了方便了解分布情况,我们还为每个种配上了地理分布图。

本图鉴中用到的标本,主要保存于西北农林科技大学(NWAFU)昆虫博物馆,也有一些借阅或交换自澳大利亚国家昆虫标本馆(ANIC)、中国农业大学(CAU)、中国科学院动物研究所(IZAS)、南开大学(NKU)、华南农业大学(SCAU)、中山大学(SYSU)、天津自然博物馆(TJNHM)以及堪萨斯大学自然历史博物馆(KUNHM)等单位。除注明拍摄者的外,所有图片皆为第一作者拍摄。

本图鉴的编写工作,离开了许多朋友和同事的无私帮助是难以完成的。对长翅目昆虫物种的鉴定,首先得益于西北农林科技大学已故周尧教授几十年来对中国长翅目昆虫标本、资料的积累以及开创性的研究;也与西北农林科技大学长翅目昆虫研究团队的研究生们,尤其是黄蓬英、谭江丽、陈静、蔡立君、马娜、钟问、姜碌、高琼华、王萌、胡桂林、苗颖、谢莎、彭韬、侯小燕、刘书宇、颜刚、徐颢、李雪、付强、张俊霞、高超、杜薇、高凯等的工作分不开。感谢董志巍、高凯文、何力、黄贵强、黄思遥、姜日新、蒋世翔、蒋卓衡、李泽建、林业杰、吕林、邱见玥、邱鹭、王洪建、王勇、吴超、许浩、杨峤志、余锟、詹程辉、张杰、赵明智、郑昱辰、周超、周德尧、周文一(中国台湾)等对珍贵标本的采集,使它们能够呈现在读者面前。感谢首都师范大学任东教授、华南农业大学王敏教授、中南林业科技大学魏美才教授捐赠标本。感谢中国科学院动物研究所陈军和刘虹为我们安排检视和借阅标本。作者历年的野外考察,得到了胡彦卿、薛爽、花远、Flinks A. Bakrie(印度尼西亚)和 Sepni Juhansah(印度尼西亚)等的大力支持。感谢 Dalton S. Amorim

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由于我们水平有限, 书中遗漏和不妥之处, 敬请专家学者和广大读者批评指正。

王吉申 花保楨
2018 年 9 月于杨凌

Preface

Mecoptera is an small order of holometabolous insects, and consists of over 700 known species worldwide, including scorpionflies and hangingflies, *etc.* They are important indicators of ecological environments, and are often ideal materials for behavioral studies due to their interesting courtship and mating behaviors. They are ancient members in Holometabola, and play a significant role in the evolutionary research of Insecta.

China is rich in Mecoptera all over the world. Almost 300 species in 10 genera of three families have been recorded in China hitherto. However, literature regarding the identification of the Chinese Mecoptera is very scarce. Hence, we spent three years to compile this color atlas based on the abundant collections from the Entomological Museum, Northwest A&F University, and our intensive field investigations in recent years, to introduce the common species of the Chinese Mecoptera.

In this atlas, we list and illustrate 170 species of the Chinese Mecoptera concisely. It is often difficult to identify to the species-level based exclusively on live photographs without careful examinations under a microscope. Therefore we also provide lots of pictures of pinned or alcohol-preserved specimens. For most species, we present pictures of the adults and the male genitalia. A geographical distribution map is also provided for each species.

The examined specimens are mainly deposited in the Entomological Museum, Northwest A&F University (NWAUFU). Others were loaned or interchanged with the Australian National Insect Collections (ANIC), the Entomological Museum, China Agricultural University (CAU), the Institute of Zoology, Chinese Academy of Sciences (IZAS), Nankai University (NKU), South China Agricultural University (SCAU), Sun Yat Sen University (SYSU), Tianjin Natural History Museum (TJNHM) and the Natural History Museum, University of Kansas (KUNHM). All the photographs in this atlas were taken by the first author except those specified.

This work cannot be finished without the generous helps from numerous friends and colleagues during our writing and editing courses. For the identifications of species, we mostly benefit from the late Professor Io Chou, who had collected specimens and literature, and initiated the studies of the Chinese fauna of Mecoptera for decades. We also profited from the postgraduate students of the research team of Mecoptera, Northwest A&F University, including Pengying Huang, Jiangli Tan, Jing Chen, Lijun Cai, Na Ma, Wen

Zhong, Lu Jiang, Qionghua Gao, Meng Wang, Guilin Hu, Ying Miao, Sha Xie, Tao Peng, Xiaoyan Hou, Shuyu Liu, Gang Yan, Hao Xu, Xue Li, Qiang Fu, Junxia Zhang, Chao Gao, Wei Du and Kai Gao. Our sincere thanks also go to Zhiwei Dong, Kaiwen Gao, Li He, Guiqiang Huang, Siyao Huang, Rixin Jiang, Shixiang Jiang, Zhuoheng Jiang, Zejian Li, Yejie Lin, Lin Lyu, Jianyue Qiu, Lu Qiu, Hongjian Wang, Yong Wang, Chao Wu, Hao Xu, Qiaozhi Yang, Kun Yu, Chenghui Zhan, Jie Zhang, Mingzhi Zhao, Yuchen Zheng, Chao Zhou, Deyao Zhou, and Wen-i Chou (Taiwan). They collected many valuable specimens and made it feasible to show those species to readers. We thank Professor Dong Ren from the Capital Normal University, Professor Min Wang from the South China Agricultural University, and Professor Meicai Wei from the Central South University of Forestry and Technology for donating specimens. We also appreciate Jun Chen and Hong Liu of the Institute of Zoology, Chinese Academy of Sciences (Beijing) for arranging the access to examine and loan of the specimens. Our recent field works were greatly supported by Yanqing Hu, Shuang Xue, Yuan Hua, Flinks A. Bakrie (Indonesia) and Sepni Juhansah (Indonesia). We would also express our thanks to Dalton S. Amorim (Brasil), Cristiano Lopes-Andrade (Brasil), Tomoya Suzuki (Japan), and Jason G.H. Londt (South Africa) for fervidly sending precious literatures. We also thank Yijun Chai, Lu Jiang, Bo Lei, Yechan Lin (Taiwan), Han Xu, Weiwei Zhang and Wen Zhong for providing photographs. A special thank is due to Mr. Benqing Zhou from the Henan Science and Technology Press. Under his encouragement and agitation, this atlas began to compile. The publication of the current form is also due to his excellent editorial work. Our works were financially supported by the National Natural Science Foundation of China (30070101, 30370179, 30670255, 30970386, 31172125, 31301898, 31672341) and the 2018 National Publication Foundation.

Due to our limited knowledge, there might be some mistakes and flaws in this atlas. We expect criticism and correction from experts and readers.

Jishen Wang & Baozhen Hua

at Yangling

September 2018

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