



学术报告

报告主题：系统发育基因组学揭示有翅昆虫的起源与演化

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主办：古动物室、全重、科技处、人教处、综合处



告简介：

近日，中国科学院南京地质古生物研究所与南京师范大学科研人员联合国内外同行开展了一项综合的昆虫系统发育基因组学研究，采用串联法与溯祖法系统发育分析框架，在同质、异质及多物种溯祖模型下开展分析，系统解析了有翅昆虫早期分化事件，厘清了蜉蝣目、蜻蜓目与新翅类之间的系统发育关系。研究结果支持古翅类（蜉蝣目+蜻蜓目）为单系群。尽管基于溯祖法的方法最初提示“间肌类”（即蜉蝣目+新翅类）假说，但后续信号解析与拓扑检验证实，基因组信号的主流支持古翅类单系。研究进一步识别出不完全谱系分选与基因树估计误差是导致此前拓扑冲突的主要驱动因素。整合化石数据的分子定年结果表明，冠群有翅昆虫起源于早泥盆世，而冠群古翅类则于晚泥盆世首次出现。通过将分子证据与翅基骨片同源性等形态学共有衍征相整合，该研究为有翅昆虫的早期演化提供了连贯的框架，支持翅的单一起源，并将新翅类的翅折叠机制确定为一项独特的演化创新。该成果为厘清昆虫翅的起源与早期辐射、调和分子系统学与形态学证据之间的矛盾提供了重要依据。

Recently, a joint team led by Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, and Nanjing Normal University conducted a comprehensive phylogenomic study of insects. Using concatenation- and coalescent-based phylogenetic analytical frameworks under homogeneous, heterogeneous, and multispecies coalescent models, the study clarified the phylogenetic relationships among Ephemeroptera, Odonata, and Neoptera and resolved the early diversification events of winged insects. The results support Palaeoptera monophyly. Although coalescent-based methods initially suggested the ‘Chiaistomyaria (Ephemeroptera + Neoptera) hypothesis’, subsequent signal dissection and topology tests confirmed that the preponderance of genomic signal favors a monophyletic Palaeoptera. The study further identified incomplete lineage sorting and gene tree estimation error as the primary drivers of previous topological conflicts. Molecular dating results indicate an Early Devonian origin of crown-Pterygota, whereas crown-Palaeoptera first emerged in the Late Devonian. By reconciling molecular evidence with morphological synapomorphies such as wing-base sclerite homologies, this study provides a coherent framework for the early evolution of winged insects, supports a single origin of wings, and identifies the neopteran wing-folding mechanism as a singular evolutionary innovation. These findings provide important evidence for clarifying the origin and early radiation of insect wings and for reconciling conflicts between molecular systematics and morphological evidence.