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# Higher-level phylogeny reconstruction of Lower Brachycera

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David Yeates <sup>2</sup> and Keith Bayless <sup>2</sup>

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**PhD thesis**

- Higher-level phylogeny reconstruction of Lower Brachycera
- Phylogeny reconstruction of superfamily Rhagionoidea
- Distribution patterns of genus *Atherimorpha* in Australia



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*Atherimorpha* sp.

## PhD thesis

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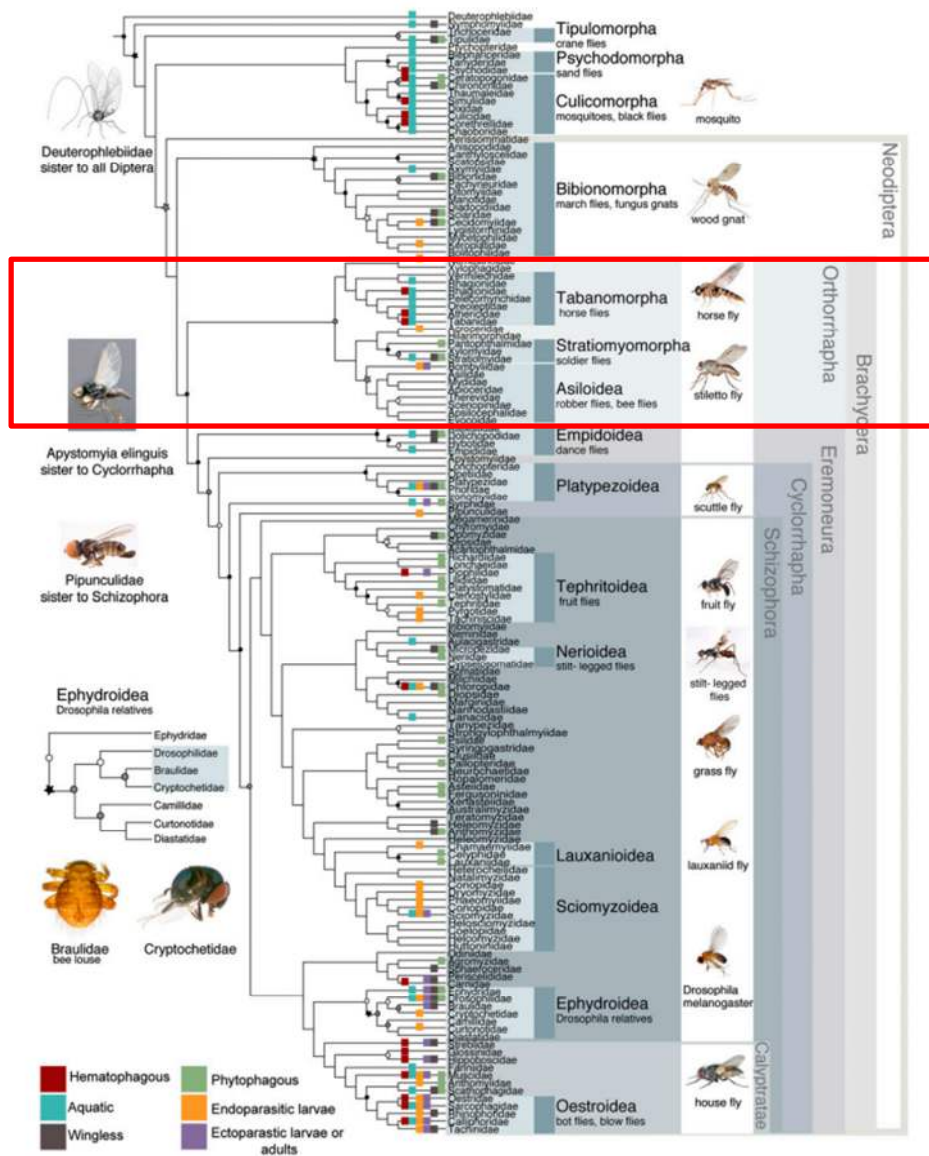


photoed Simon Grove

*Atherimorpha* sp.

## Goals

- reconstruct the higher-level phylogeny of Lower Brachycera
- reveal the phylogenetic positions of controversial groups



## Lower Brachycera

### Episodic radiations in the fly tree of life

Brian M. Wiegmann<sup>a,1</sup>, Michelle D. Trautwein<sup>a</sup>, Isaac S. Winkler<sup>a</sup>, Norman B. Barr<sup>a,b</sup>, Jung-Wook Kim<sup>a</sup>, Christine Lambkin<sup>c,d</sup>, Matthew A. Bertone<sup>a</sup>, Brian K. Cassel<sup>a</sup>, Keith M. Bayless<sup>a</sup>, Alysha M. Heimberg<sup>e</sup>, Benjamin M. Wheeler<sup>f</sup>, Kevin J. Peterson<sup>g</sup>, Thomas Pape<sup>g</sup>, Bradley J. Sinclair<sup>h</sup>, Jeffrey H. Skevington<sup>i</sup>, Vladimir Blagoderov<sup>j</sup>, Jason Caravas<sup>k</sup>, Sujatha Narayanan Kutty<sup>l</sup>, Urs Schmidt-Ott<sup>m</sup>, Gail E. Kampmeier<sup>n</sup>, F. Christian Thompson<sup>o</sup>, David A. Grimaldi<sup>p</sup>, Andrew T. Beckenbach<sup>q</sup>, Gregory W. Courtney<sup>r</sup>, Markus Friedrich<sup>k</sup>, Rudolf Meier<sup>l,s</sup>, and David K. Yeates<sup>d</sup>

- Position between Lower Diptera and Eremoneura
- 23 extant families, 1800 genus, over 25000 described species

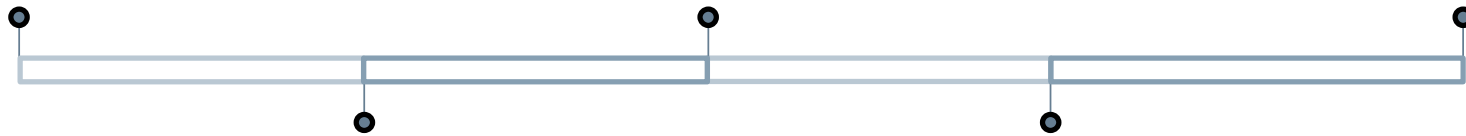


## Recent works of Lower Brachycera

101 morphological  
characters  
Yeates (2002)

male terminalia  
characters  
Sinclair et al. (2013)

20 genes  
Shin et al. (2018)



CAD, 28S  
Trautwein et al.  
(2010)

12 PCGs, 18S, 28S,  
mt genomes  
Wiegmann et al.  
(2011)



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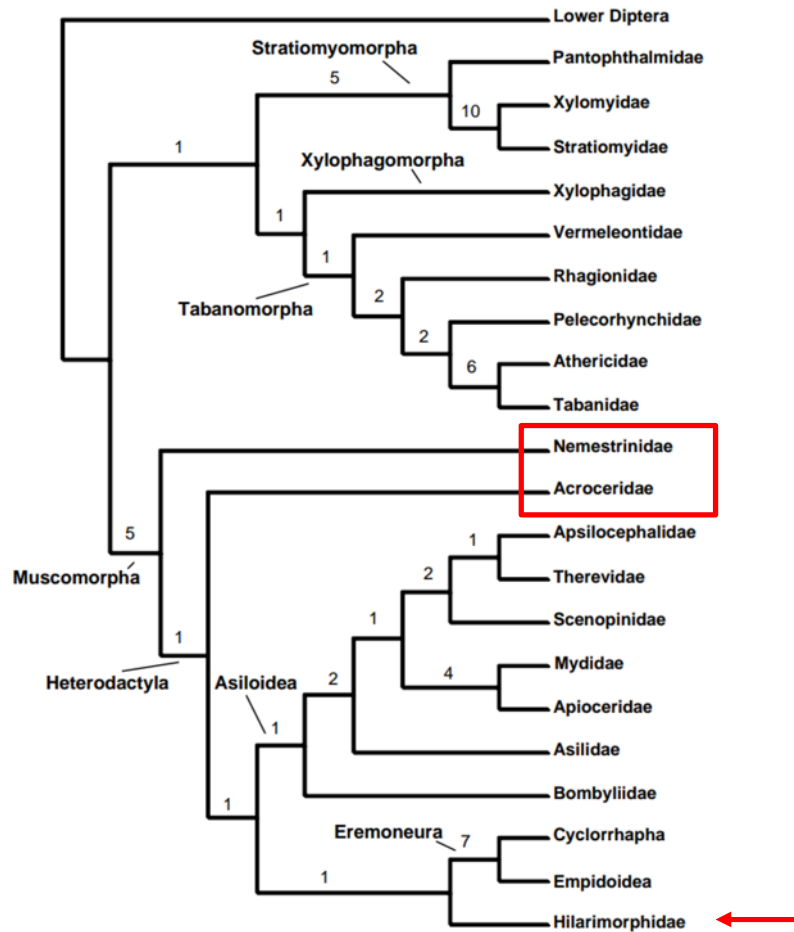


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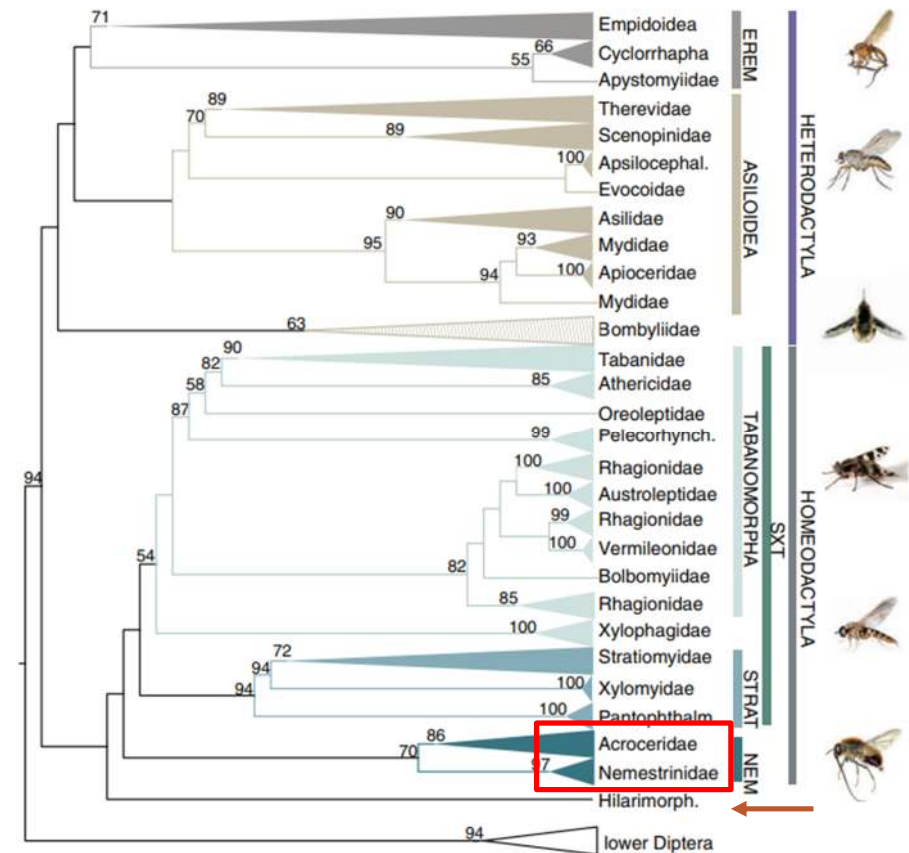


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## Recent works of Lower Brachycera

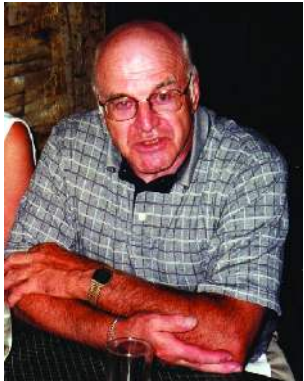


Yeates, 2002



Shin *et al.*, 2018

- Small-sized, 1.8–7.2 mm
- Adults occur near streams and ponds
- 34 species
- Nearctic, Palearctic, Oriental regions
- The genus was erected by Schiner (1860), has been variously placed in the families Empididae, Rhagionidae, Therevidae, Bombyliidae, and Hilarimorphidae.



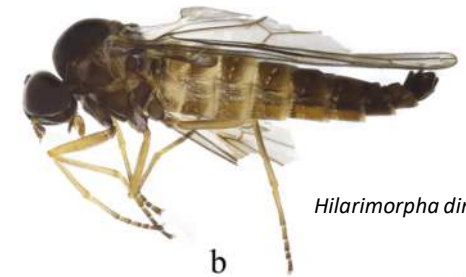
Donald W. Webb

1974, Dr. Webb only suggested a greater similarity to Rhagionidae than to Bombyliidae

## Hilarimorphidae



*Hilarimorpha tibetensis*



*Hilarimorpha dingae*



*Hilarimorpha elongata*

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Full length article

Family Hilarimorphidae (Diptera) newly recorded from China with descriptions of three new species

Yue Liu, Shang Gao, Ding Yang\*

Department of Entomology, College of Plant Protection, China Agricultural University, Beijing 100193, China



## Nemestrinidae



- Tangle vein flies
  - 300 species
  - Adults – no feeding or pollinators; some larvae are known as internal parasitoids of nymphs, adults of Orthoptera.
- 



- Woodley (1989) placed it in the Nemestrinoidea, based on the shared endoparasitic lifestyle with Acroceridae
- 1994, Yeates, found the superfamily to be paraphyletic; 2002, again showed that Nemestrinoidea to be paraphyletic
- Nagatomi (1992) and Griffiths (1994) suggest it's better placed in Tabanomorpha

## Acroceridae

- Small-headed flies
- 400 species
- Adults - no feeding or flower visitors
- Some larvae are endoparasitoids of spiders



- Traditionally, it has been placed with Nemestrinidae in Nemestrinoidea.

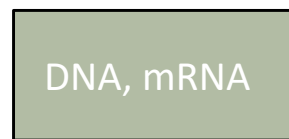


Yuan *et al.* 2020

## Materials and Method

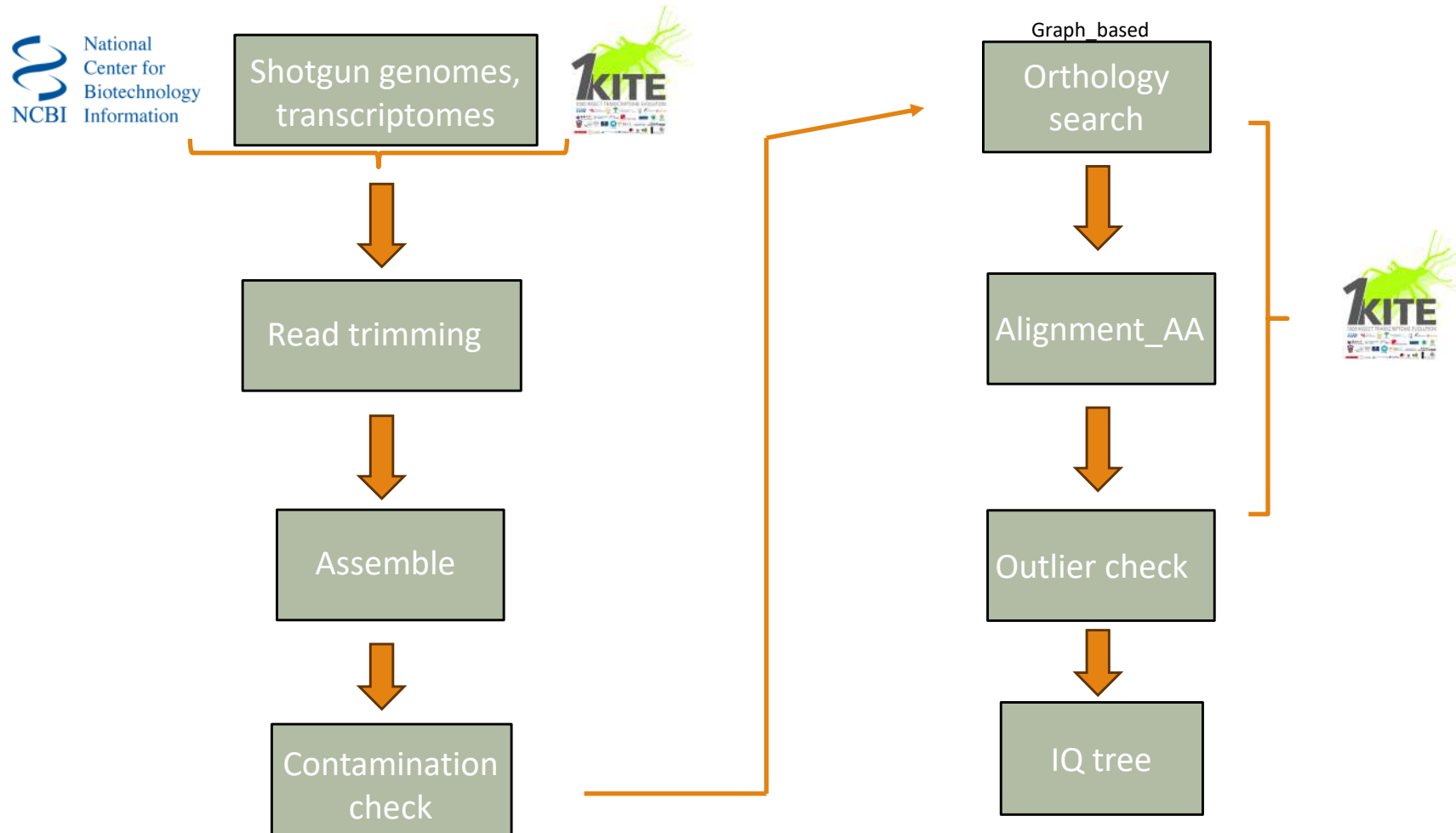


Identify species

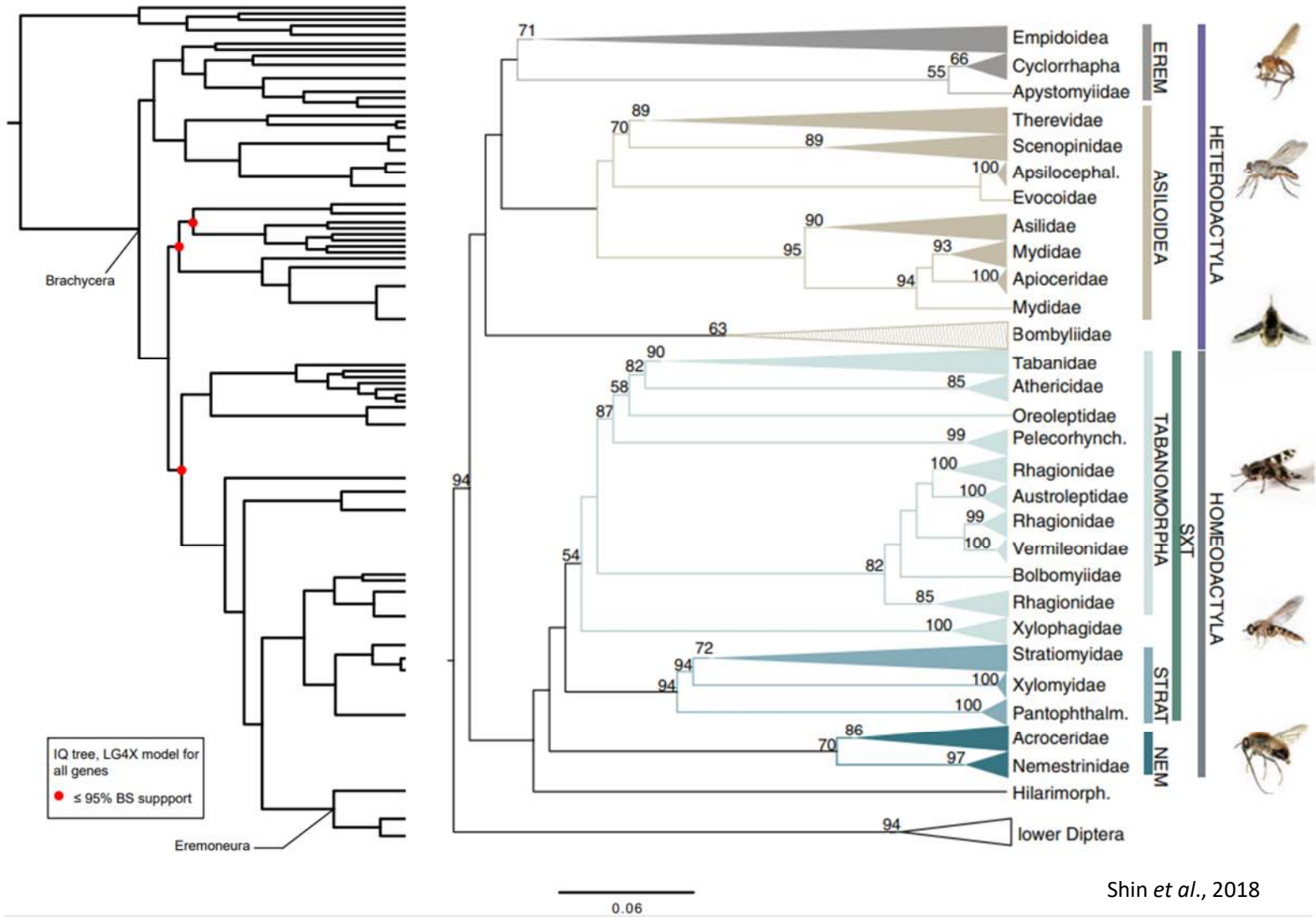


- 41 ingroup species from 16 families were sequenced including Evocoidae, Apsilocephalidae, Hilarimorphidae
- 31 genus were sequenced first time

## Materials and Method

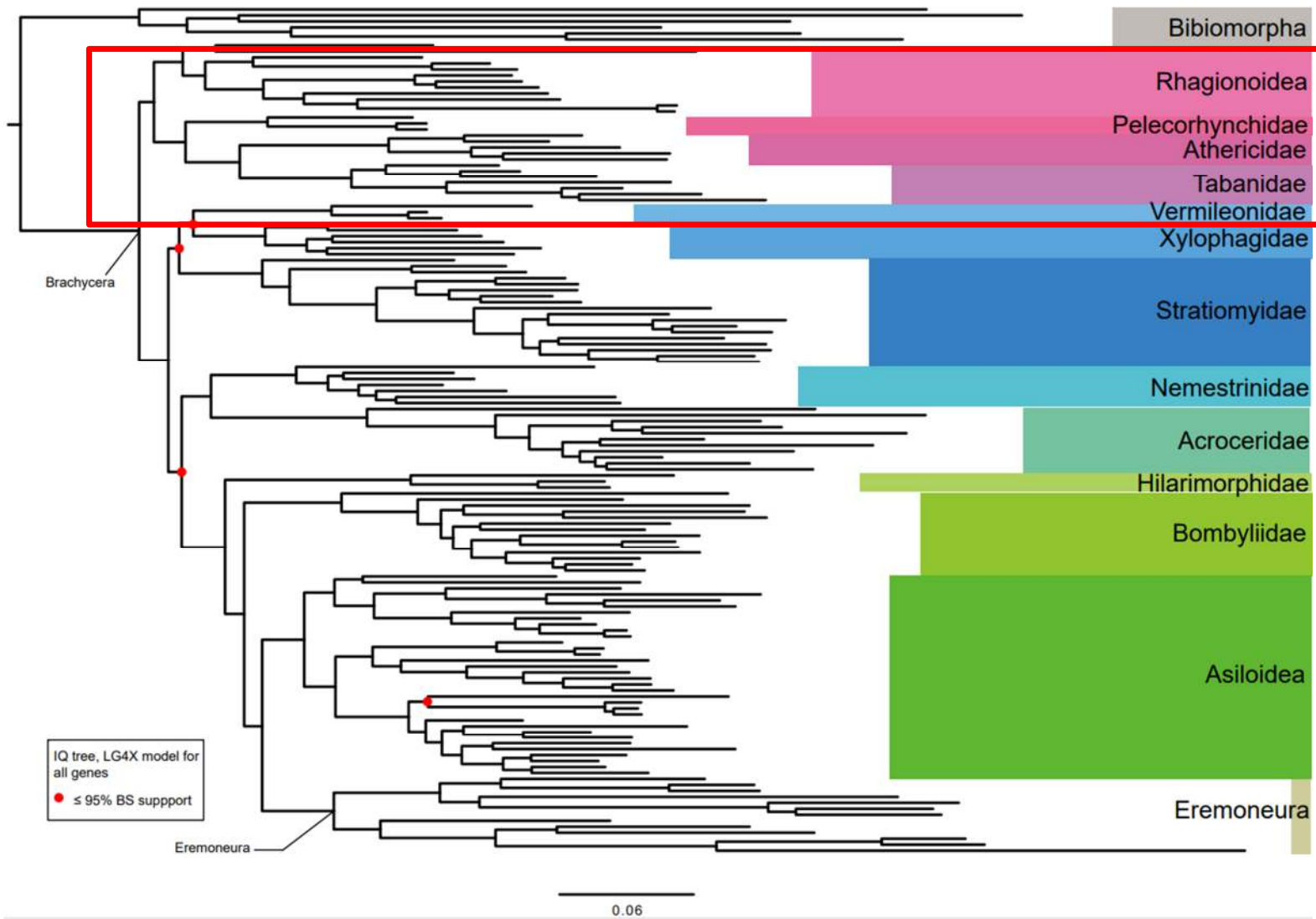


# Preliminary results



142 taxa, 2000 genes

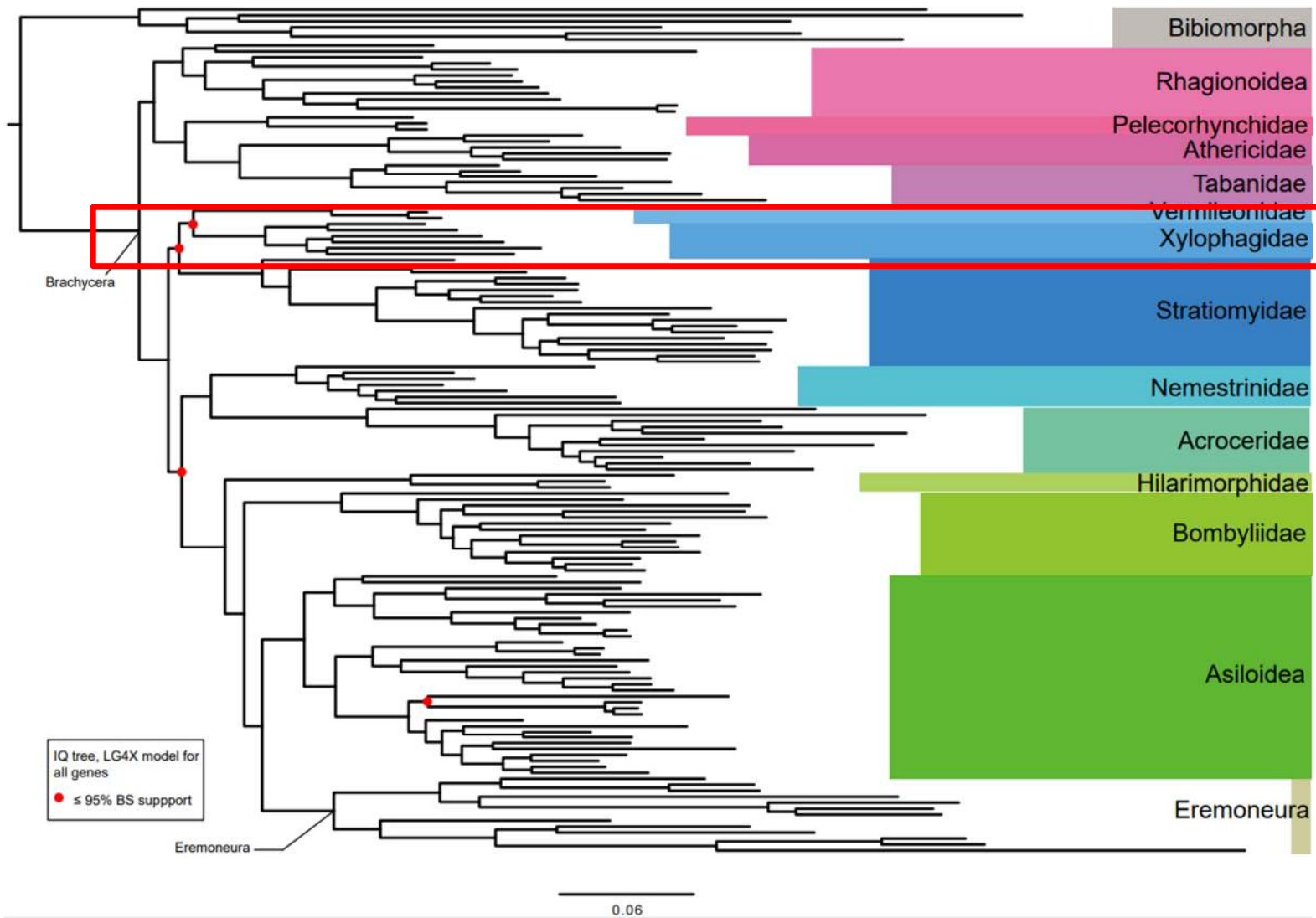
## Preliminary results



➤ Tabanomorpha not monophyletic

142 taxa, 2000 genes

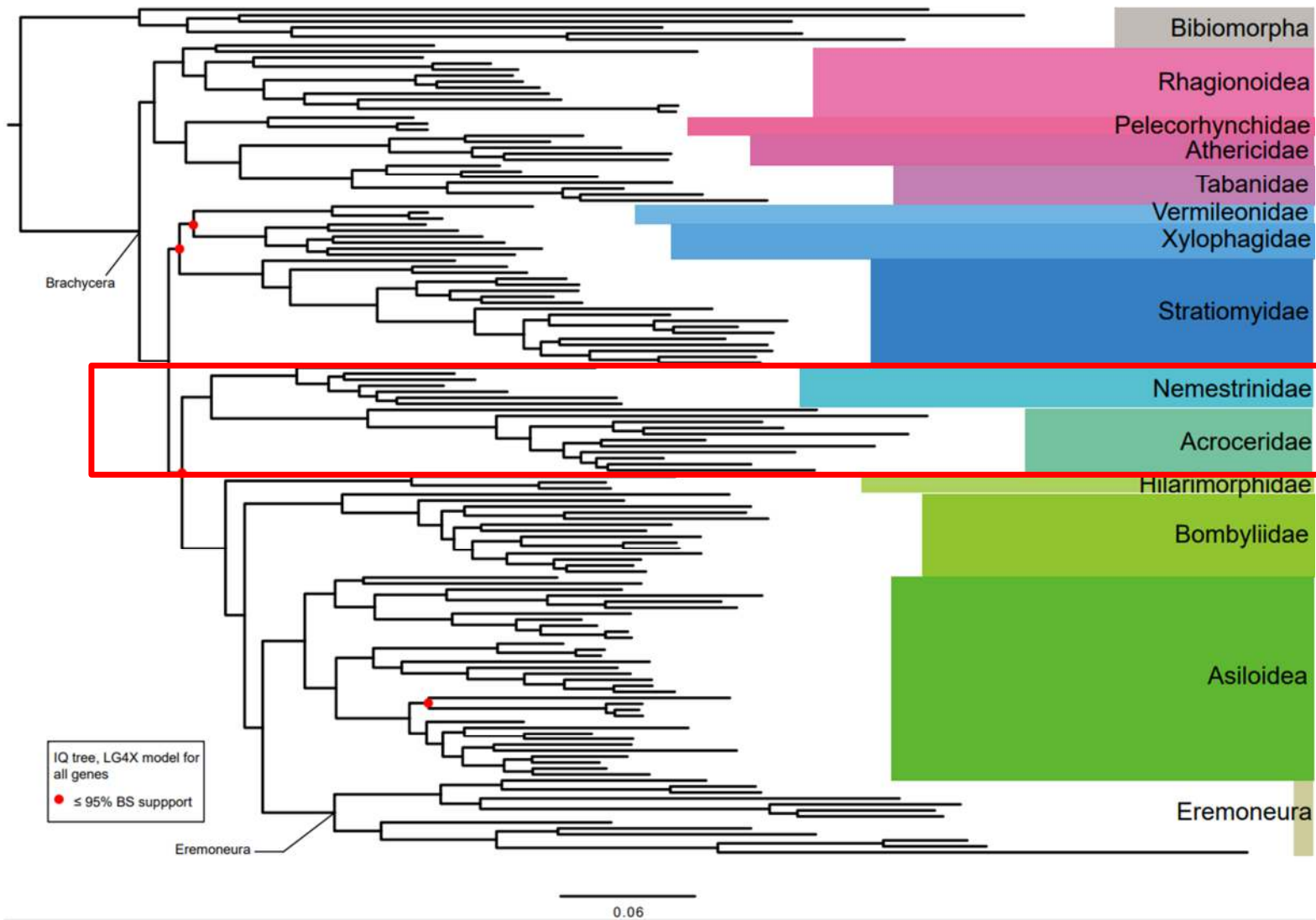
## Preliminary results



- Vermileonidae is sister to Xylophagomorpha, but with weak support

142 taxa, 2000 genes

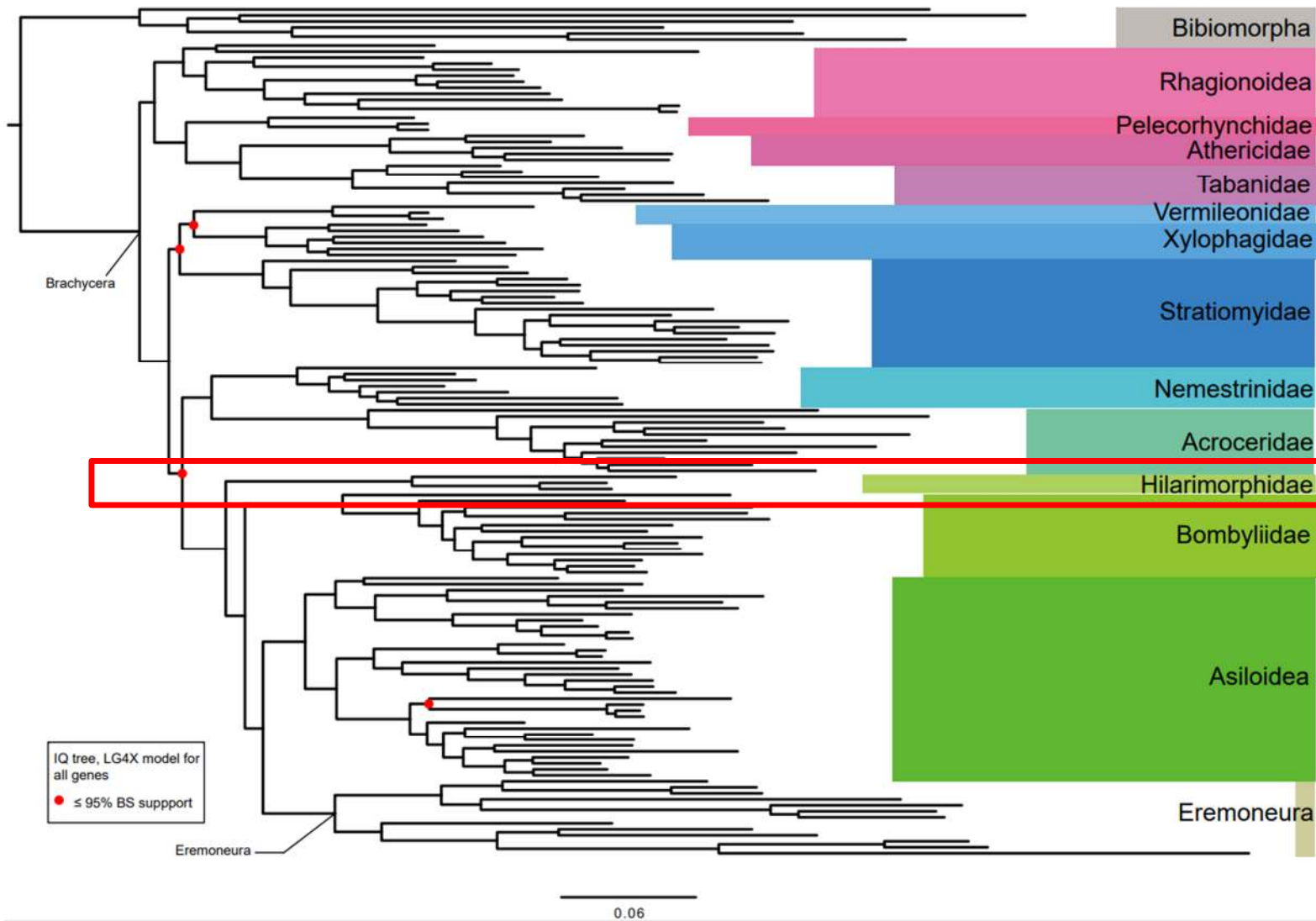
## Preliminary results



➤ Nemestrinoidea is supported weakly

142 taxa, 2000 genes

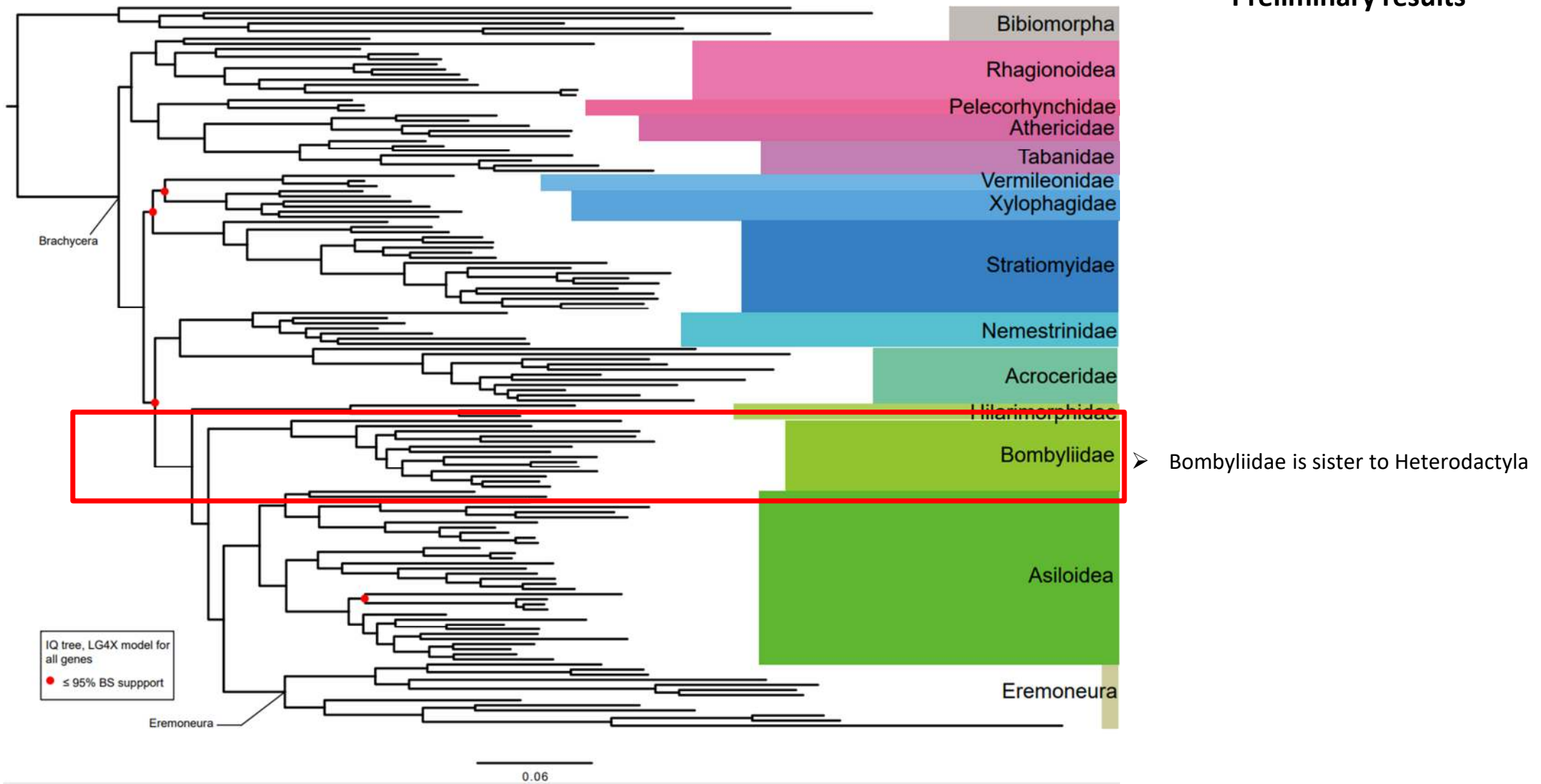
## Preliminary results



➤ Hilarimorphidae is sister to Bombyliidae and Heterodactyla

142 taxa, 2000 genes

## Preliminary results





## Acknowledgement

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Thank you!



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