Phylogeny of the subfamily Chauliodinae (Megaloptera: Corydalidae), with description of a new genus from the Oriental Realm

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Abstract. A new Oriental fishfly genus, Sinochauliodes gen.n., is described, including four species: S. fujianensis (Yang & Yang, 1999) comb.n., S. griseus (Yang & Yang, 1999) comb.n., S. maculosus sp.n. and S. squalidus sp.n. A cladistic analysis based on adult morphological characters clarified the phylogenetic status of the new genus and allowed the reconstruction of the intergeneric relationships of the subfamily Chauliodinae. Two main clades within Chauliodinae were recognized from the cladistic analysis. The Asian fishflies, together with the two Nearctic genera, Chauliodes and Nigronia, formed a monophyletic lineage, and the new genus was assigned as the sister group to the genus Parachauliodes. The biogeography of the Asian fishflies is discussed.

Introduction

The subfamily Chauliodinae, in Corydalidae, is a very rich group in Megaloptera, comprising fifteen valid genera and more than 110 species from all over the world. By contrast with Corydalinae, the adults of Chauliodinae are characterized by the following features: degenerative postocular plane of the head, usually specialized antennae, three crossveins between R1 and Rs, and reduced male ninth gonocoxite and gonostylus. The larvae of Chauliodinae are distinguished from those of Corydalinae by a lack of ventral gill tufts.

The fauna of Chauliodinae is richest in the New World, with eight genera (Dysmicohermes, Orohermes, Neohermes, Notochauliodes, Protochauliodes, Archichauliodes, Chauliodes and Nigronia), six of which are endemic. In the Afrotropical Realm, three endemic genera (Platychauliodes, Madachauliodes and Taeniochauliodes) are distributed in South Africa and Madagascar. In the Australian Realm, there are only two genera (Archichauliodes and Protochauliodes), both of which have been considered to be ‘relatively primitive’ (van der Weele, 1910). In the Oriental Realm, four endemic genera (Anachauliodes, Ctenochauliodes, Neochauliodes and Parachauliodes) are distributed, with the last two genera extending far into northern China and Japan, also representing Palaeartctic elements.

Davis (1903) divided his Sialididae into two subfamilies, Sialidinae and Corydalinae, and subsequently van der Weele (1909) divided the Corydalinae into two tribes, Neuromini and Chauliodini. Tillyard (1918) elevated Davis’ subfamilies Sialinae and Corydalinae to families and van der Weele’s two tribes to subfamily level as Corydalinae and Chauliodinae. Thus, Neuromini was synonymized with Corydalinae (Lestage, 1927; Glorioso, 1981). This taxonomic scheme was followed by Barnard (1931), and now has been adopted generally, although Theischinger (1983) regarded the tribes as having full family status. Recently, after a cladistic analysis, Contreras-Ramos (2004) noted that the Corydali- dae may be paraphyletic and the relationships between Chauliodinae and Sialidae may be closer.


The intergeneric and interspecific phylogenetic relationships of Chauliodinae are poorly known so far. The latest key to the worldwide Chauliodinae genera (Penny, 1999) implies that the subfamily may consist of two main clades.

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defined by the different antennal morphology. One main clade with subserrate or pectinate antenna comprises all the Asian genera and two Nearctic genera (Chauliodes and Nigronia). The remaining genera form the other main clade with filiform antenna, within which four genera (Protochauliodes, Neohermes, Notochauliodes, and Taeniochauliodes) may be grouped by the first branch of 2A partly fused with 1A. However, no phylogenetic analysis has been undertaken on Chauliodini.

As with all corydalid species, the larvae of Chauliodini are predaceous, living in clean streams of mountainous regions and being sensitive to environmental changes. They may be useful as a biological indicator of water quality (Yang D. & Yang C. K., 1995). The adults emerge from late spring to early autumn, and are always found near clean water. Adults are readily collected at light traps. Detailed studies on the natural history of Chauliodini are mostly restricted to a few species from temperate regions. Contributions to the behaviour have been made by Hayashi (1996, 1999) based on the observation of some Japanese species.

The present paper describes a new Chauliodinae genus, Sinochauliodes, from Oriental China. Four species belonging to the new genus are described and keyed, with two species new to science. The generic status and specific relationships of the new genus are discussed based on a phylogenetic analysis of all five Asian and five New World and Australian genera. The biogeography of the Asian fishflies is also discussed.

Materials and methods

**Taxa and terminology**

Most specimens examined were obtained from the Entomological Museum of China Agricultural University (CAU), Beijing, with one paratype of S. maculosus deposited in the Institute of Zoology, Chinese Academy of Science (IZCAS), Beijing. The Australian and New World fishfly specimens were obtained through the kind exchange by Dr O.S. Flint, Jr. from the National Museum of Natural History (NMNH), Washington DC, U.S.A.

The specimens were collected mostly at light traps in mountainous regions, with some of these collected by the authors. Genitalic preparations were made by macerating the apex of the abdomen in cold 10% KOH for 8–10 h. The apex of the abdomen was then transferred to glycerine for further dissection and examination. After examination, it was moved to fresh glycerine and stored in a microval pinned below the specimen. The habitus photographs of adults were obtained with a digital camera (Coolpix 4500, Nikon, Japan).

The terminology of the adult genitalia generally follows Contreras-Ramos (1998, 2004) in order to unify the terms with Corydalinae.

**Phylogenetic analysis**

Our present phylogenetic analysis aimed to test the monophyly of Sinochauliodes and to establish its generic status and interspecific relationships within Chauliodini. Although the present analysis did not include all sixteen fishfly genera, the sampling involved ten genera, with all five Asian genera and five Australian and New World genera (Archichauliodes, Neohermes, Protochauliodes, Nigronia, and Chauliodes), which represent the main clades of Chauliodini. Because the generic characters are defined clearly for each genus, two species were selected for coding in each genus, except for Chauliodes, Nigronia, and Sinochauliodes with all members included. Two dobsonfly species, Chloroniosa peringueyi Esben-Petersen from South Africa and Neoneuromus ignobilis Navás from China, were selected as the outgroup taxa because Corydalinae is generally considered to be ‘more primitive’ than Chauliodini. A complete list of the taxa used in the phylogenetic analysis is given in Table 1.

**Characters**

Fifty-nine adult morphological characters were selected for coding, with nine cephalic, fourteen thoracic and thirty-six genitalic characters. The data matrix used in the analysis is shown in Table 2 (0, plesiomorphic state; 1–3, apomorphic state; ?, state inapplicable).

**Head**

1. **Head:** (0) flattened; (1) robust.
2. **Head:** (0) without long setae on ventral lateral portion; (1) with long setae on ventral lateral portion.
3. **Postocular plane:** (0) present; (1) absent.
4. **Anteclypeus:** (0) present; (1) absent.
5. **Maxillary palp:** (0) five-segmented; (1) four-segmented.
   - State 1 of the above five characters was considered to be synapomorphic for Chauliodini.
6. **Male antenna:** (0) short, less than one-half of forewing; (1) long, exceeding two-thirds of forewing.
   - The male antenna is less than one-half of the forewing in the basal Corydalinae genera and many Chauliodini genera, whereas it is elongated, exceeding two-thirds of the forewing, in Archichauliodes, Neohermes, and Protochauliodes.
7. **Male antenna:** (0) filiform; (1) moniliform; (2) subserrate; (3) pectinate.
   - The feature of the antenna in Chauliodini is an important diagnostic character at the generic level. In most primitive genera of Chauliodini, the male antenna is filiform or moniliform. However, in the Asian genera and two Nearctic genera (Chauliodes and Nigronia), the male antenna is subserrate or pectinate, which is considered to be apomorphic. The pectinate antenna is considered to be derived from the subserrate form.
8. **Male antenna:** (0) not pectinate; (1) pectinate with branches not distally widened; (2) pectinate with branches slightly widened distally; (3) pectinate with branches strongly widened distally.
Table 1. Taxa studied in the present phylogenetic analysis and their distribution.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Distribution</th>
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<tbody>
<tr>
<td>Corydalinae</td>
<td></td>
</tr>
<tr>
<td><em>Chloroniella</em> Esben-Petersen, 1924</td>
<td></td>
</tr>
<tr>
<td><em>Chloroniella peringueyi</em> Esben-Petersen, 1924</td>
<td></td>
</tr>
<tr>
<td><em>Neoneuromus</em> Weele, 1909</td>
<td></td>
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<tr>
<td><em>Neoneuromus ignobilis</em> Navás, 1932</td>
<td></td>
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<tr>
<td><em>Anachauliodes</em> Kimmins, 1954</td>
<td></td>
</tr>
<tr>
<td><em>Protochauliodes</em></td>
<td></td>
</tr>
<tr>
<td><em>Chauliodes</em> Latreille, 1802</td>
<td></td>
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<tr>
<td><em>Ctenochauliodes</em></td>
<td></td>
</tr>
<tr>
<td><em>Archichauliodes</em> Weele, 1909</td>
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<tr>
<td><em>Archichauliodes</em> chilensis Kimmins, 1954</td>
<td></td>
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<tr>
<td><em>Archichauliodes diversus</em> (Walker, 1853)</td>
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<tr>
<td><em>Chauliodes</em> Lateville, 1802</td>
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<tr>
<td><em>Chauliodes</em> pecticornis (Linnaeus, 1763)</td>
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<tr>
<td><em>Chauliodes</em> rastricornis Ramurb, 1842</td>
<td></td>
</tr>
<tr>
<td><em>Ctenochauliodes</em> freudichi Weele, 1909</td>
<td></td>
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<tr>
<td><em>Ctenochauliodes meridionalis</em> Yang &amp; Yang, 1986</td>
<td></td>
</tr>
<tr>
<td><em>Neochauliodes</em> fraternus (McLachlan, 1869)</td>
<td></td>
</tr>
<tr>
<td><em>Neochauliodes</em> sinensis (Walker, 1853)</td>
<td></td>
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<tr>
<td><em>Neohermes</em> Banks, 1908</td>
<td></td>
</tr>
<tr>
<td><em>Neohermes</em> concolor (Davis, 1903)</td>
<td></td>
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<tr>
<td><em>Neohermes</em> filicornis (Banks, 1903)</td>
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<tr>
<td><em>Nigronia</em> Banks, 1908</td>
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<tr>
<td><em>Nigronia</em> fasciatus (Walker, 1853)</td>
<td></td>
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<tr>
<td><em>Nigronia</em> serricornis (Say, 1824)</td>
<td></td>
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<tr>
<td><em>Parachauliodes</em> Weele, 1909</td>
<td></td>
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<tr>
<td><em>Parachauliodes</em> japonicus (McLachlan, 1867)</td>
<td></td>
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<tr>
<td><em>Parachauliodes</em> nebulosus (Okamoto, 1910)</td>
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<tr>
<td><em>Protochauliodes</em> Weele, 1909</td>
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<tr>
<td><em>Protochauliodes</em> bullocki Flint, 1973</td>
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<tr>
<td><em>Protochauliodes</em> cinerascens (Blanchard, 1851)</td>
<td></td>
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<tr>
<td><em>Sinochauliodes</em> Liu &amp; Yang, gen.n.</td>
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</tbody>
</table>

Table 1. Continued.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Sinochauliodes fujianensis</em> (Yang &amp; Yang, 1999), comb.n.</td>
<td>China (south-eastern)</td>
</tr>
<tr>
<td><em>Sinochauliodes griseus</em> (Yang &amp; Yang, 1999), comb.n.</td>
<td>China (south-eastern)</td>
</tr>
<tr>
<td><em>Sinochauliodes maculosus</em> Liu &amp; Yang, sp.n.</td>
<td>China (southern)</td>
</tr>
<tr>
<td><em>Sinochauliodes squalis</em> Liu &amp; Yang, sp.n.</td>
<td>China (southern)</td>
</tr>
</tbody>
</table>

The branches of the pectinate antenna are not widened distally in *Ctenochauliodes*, but are slightly widened distally in *Anachauliodes*, *Chauliodes*, *Neochauliodes* and *Sinochauliodes*. The branches are strongly shortened and widened distally in *Nigronia fasciatus*.

9. *Female antenna*: (0) filiform; (1) subserrate; (2) pectinate.

In Chauliodinae, the antenna usually shows distinct sexual dimorphism. In most Chauliodinae genera, the female antenna is not strongly modified, either filiform or subserrate. In *Ctenochauliodes* and *Chauliodes pecticornis*, the female antenna is similar to that of the male, also pectinate.

Thorax

10. *Tarsal claw*: (0) simple; (1) with additional subdistal claw.

The tarsal claw is of a similar simple shape in most species of Megaloptera. However, in addition to the distal claw, there is an additional subdistal claw in *Neohermes*.

11. *Pigmentation marks of wing*: (0) dotted in a disperse manner; (1) united into rather distinct transverse band.

In Chauliodinae, the pigmentation marks of the wings are usually small and dotted in a disperse manner, whereas, in *Nigronia* and most species of *Neochauliodes*, the marks are connected into a distinct transverse band in the middle.

12. *Coloration of wing*: (0) hyaline or subhyaline with dark marks; (1) entirely blackish.

In most species of Chauliodinae, the wings are hyaline or subhyaline with several dark marks, whereas they are entirely blackish in *Sinochauliodes fujianensis*.

13. *Coloration of veins*: (0) predominantly brown; (1) alternating dark and pale pattern.

In most genera of Chauliodinae, the veins are mostly brown throughout. In *Anachauliodes* and *Chauliodes*, the veins show a distinct alternating dark and pale pattern (synapomorphy).

14. *R2*: (0) two-branched or more; (1) simple.

The simple R2 is considered to be apomorphic, and is shared by *Protochauliodes*, *Neohermes* and three South African genera which are excluded in the present analysis. In *Archichauliodes*, *Chauliodes*, *Nigronia*, *Nothochauliodes*, *Dysmicothermes*, *Orohermes* and the five Asian genera, R2 is of two branches or more.

15. *R4*: (0) simple; (1) two-branched.

R4 is simple in most genera of Chauliodinae, but it is two-branched in *Protochauliodes* and *Neohermes*.
Table 2. Character matrix.

|                  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Chloroniella peringueyi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Neoneuromus ignobilis   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Anachauliodes sinensis  | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Anachauliodes tonkinesis| 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Archichauliodes chilensis| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| Archichauliodes diversus  | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Chauliodes pecticornis   | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Chauliodes rastricornis  | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| Ctenochauliodes friedrichi| 1 | 1 | 1 | 1 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Ctenochauliodes meridionalis| 1 | 1 | 1 | 1 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Neochauliodes fraternus   | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Neochauliodes sinensis    | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Neohermes concolor       | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Neohermes fimbriatus     | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Nigronia fasciatus       | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Nigronia serricornis     | 1 | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Parachauliodes japonicus| 1 | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Parachauliodes neblisseros| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Protachauliodes bullocki| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Protachauliodes cinerascens| 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sinochauliodes fujianensis| 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sinochauliodes griseus   | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sinochauliodes maculosus | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sinochauliodes squalidus | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
16. $R_c$: (0) branched; (1) simple.
   Branched $R_5$ is considered to be plesiomorphic and shared by the outgroup species and two Nearctic fishfly genera *Dysmicohermes* and *Orohermes*, whereas it is simple in all the present ingroup taxa.
17. 1A of forewing: (0) two-branched; (1) three-branched or more.
   In *Anachauliodes*, 1A of the forewing is three-branched or more (autapomorphy).
18. 2A of forewing with anterior branch: (0) not fused to 1A;
   (1) medially fused to 1A.
   The anterior branch of 2A is not fused to 1A in the forewing in many genera of Carydalidae and is medially fused to the footstalk of 1A in a short distance, which is synapomorphic for grouping *Neohermes*, *Protochauliodes*, *Notochauliodes* and *Taeniochauliodes*.
19. Crossvein between 1A and 2A of forewing: (0) placed between posterior branch of 1A and anterior branch of 2A; (1) placed between footstalks of 1A and 2A.
   In Carydalinae and many genera of Chaulioidinae, the crossvein between 1A and 2A in the forewing is placed between the posterior branch of 1A and the anterior branch of 2A, whereas, in *Nigronia*, *Neochoauliodes*, *Parachauliodes* and *Sinochauliodes*, this crossvein is placed rather basally, connecting the footstalk of 1A and 2A.
20. 2A of forewing: (0) not sinuated; (1) strongly sinuated.
   2A of forewing is strongly sinuated in most Chaulioidinae genera except *Neochoauliodes*.
21. $M_{1+2}$ of hindwing: (0) simple; (1) two-branched.
   In most genera of Chauliodinae, $M_{1+2}$ is simple, whereas, in *Protochauliodes* and *Neohermes*, $M_{1+2}$ is two-branched.
22. Basal r-m crossvein of hindwings: (0) present; (1) absent.
   In most genera of Carydalinae, there is a basal r-m crossvein in the forewing, but this crossvein is absent in *Platychoauliodes*, *Taeniochauliodes*, *Notochauliodes* and *Chauliodes rasricornis*, which may represent parallel loss.
23. Basal r-m crossvein of hindwings: (0) simple; (1) modified.
   In the outgroup species, the basal r-m crossvein of the hindwing is simple, whereas it reconnected to M by an additional short branch or a short fusion in *Nigronia*, *Ctenochauliodes*, *Neochoauliodes*, *Parachauliodes* and *Sinochauliodes*.

**Male genitalia**

24. Ninth tergum in dorsal view: (0) posteriorly incised; (1) posteriorly truncate or arcuately produced.
   In the outgroup species, *Archichauliodes*, *Neohermes* and *Protochauliodes*, the posterior margin of the ninth tergum is incised more or less, whereas it is truncate or arcuately produced in *Anachauliodes*, *Chauliodes*, *Nigronia*, *Ctenochauliodes*, *Neochoauliodes*, *Parachauliodes* and *Sinochauliodes*.
25. Ninth tergum in dorsal view: (0) anteriorly incised; (1) anteriorly truncate.
   In the outgroup species, *Chauliodes*, *Nigronia* and the Asian fishfly genera, the anterior margin of the ninth tergum is incised, whereas it is truncate in *Archichauliodes*, *Neohermes* and *Protochauliodes*.
26. Ninth tergum in dorsal view: (0) wider than long; (1) longer than wide.
   In most genera of Carydalidae, the ninth tergum is wider than long, but longer than wide in *Sinochauliodes*.
27. Ninth tergum in lateral view: (0) with ventral margin obtusely produced; (1) with ventral margin acutely produced.
   In *Ctenochauliodes*, *Neochoauliodes* and *Nigronia*, the ninth tergum is acutely produced at the ventral margin in lateral view (synapomorphy).
28. Ninth sternum: (0) as long as ninth tergum; (1) shorter than ninth tergum.
   In the ‘basal’ genera of Chauliodinae, the male ninth sternum is broad and as long as the male ninth tergum, whereas it is reduced and rather shorter than the ninth tergum in *Chauliodes*, *Nigronia*, *Anachauliodes*, *Neochoauliodes*, *Parachauliodes* and *Sinochauliodes*.
29. Ninth sternum: (0) without membranous apical process; (1) with membranous apical process.
   The male ninth sternum is connected by a membrane to the basal portion of the tenth sternum. In *Nigronia*, *Neochoauliodes*, *Parachauliodes* and *Sinochauliodes*, the membrane is produced backward, forming a small subtriangular process at the tip of the male ninth sternum.
30. Tenth tergum: (0) as long as or longer than ninth tergum; (1) shorter than ninth tergum.
   In *Ctenochauliodes*, *Nigronia*, *Neochoauliodes* and *Sinochauliodes*, the male tenth tergum is much shorter than the male ninth tergum, whereas it is usually as long as or longer than the male ninth tergum in the other ingroup genera and the outgroups.
31. Tenth tergum: (0) not narrowing towards apex; (1) narrowing towards apex.
   In *Anachauliodes*, *Chauliodes* and *Ctenochauliodes*, the tenth tergum is wide at the base and narrows towards the apex, whereas, in the other genera of Chauliodinae, the tenth tergum does not narrow towards the apex and even with the apex inflated.
32. Tenth tergum in lateral view with base: (0) narrower than one-half of ninth tergum; (1) wider than two-thirds of ninth tergum.
   In *Anachauliodes*, *Chauliodes*, *Neochoauliodes*, *Nigronia*, *Parachauliodes* and *Sinochauliodes*, the base of the tenth tergum is wider than two-thirds of the ninth tergum in lateral view, whereas it is narrower than one-half of the ninth tergum in the other Chauliodinae genera.
33. Tenth tergum: (0) without strongly sclerotized distal claws; (1) with a few strongly sclerotized distal claws.
   In *Anachauliodes* and *Chauliodes*, the tenth tergum bears a few strongly sclerotized distal claws (synapomorphy).
34. Tenth tergum with spinous setae: (0) feebly modified; (1) moderately modified; (2) strongly modified.
   In Chauliodinae, there are usually several spinous setae on the distal portion of the tenth tergum. In *Archichauliodes*, *Neohermes* and *Protochauliodes*, the spinous setae are simply slender and dispersed without modified arrangement.
Cercus, Tenth tergum in lateral view with proximal margin

Cercus, Ninth gonocoxite and gonostylus

Tenth sternum with lateral margin

Tenth sternum with median plate

Tenth sternum with bifurcation

Ninth gonocoxite and gonostylus

The reduction of the male ninth gonocoxite and gonostylus is a synapomorphic character of Chauliodinae.

Ninth gonocoxite and gonostylus: (0) entire; (1) reduced.

The distinctly bifurcated tenth sternum is considered to be autapomorphic to Ctenochauliodes.

Tenth sternum with distal half in lateral view: (0) feebly widened; (1) strongly widened.

In Ctenochauliodes, the distal half of the tenth sternum is strongly widened in lateral view, as well as in Protochauliodes bullocki, which may be a parallel derived state. However, it is considered to be autapomorphic to Ctenochauliodes.

Lateral lobes: (0) absent; (1) present.

In many genera of Corydalinae, there is a pair of lateral lobes on the posterior margin of the tenth sternum. However, the absence of the lateral lobes is herein considered to be plesiomorphic. In many genera of Chauliodinae, the lateral lobes are absent, but are present in many species of Ctenochauliodes, Nigronia and Chauliodes rastricornis. The reduced ninth gonostylus in Neohermes, which is figured by Contreras-Ramos (2004), is considered herein to be the lateral lobe of the tenth sternum also.

Lateral lobes: (0) fused to lateral arms of tenth sternum; (1) separated from tenth sternum.

In Neohermes, the lateral lobes are fused to the lateral arms of the tenth sternum, whereas, in Ctenochauliodes, Nigronia and Chauliodes rastricornis, the lateral lobes are separated from the tenth sternum.

Lateral lobes: (0) separated from each other; (1) connected by a sclerotized plate.

In Ctenochauliodes and Nigronia, the lateral lobes are connected by a sclerotized plate, which may be a remnant of the paramere.

Plate between lateral lobes: (0) narrow; (1) broad.
In *Ctenochauliodes*, the sclerotized plate connecting the lateral lobes is broad, but it is rather narrow in *Nigronia.*

53. **Plate between lateral lobes:** (0) feebly sclerotized; (1) strongly sclerotized.

In *Ctenochauliodes*, the plate connecting the lateral lobes is generally feebly sclerotized, but it is strongly sclerotized in *Nigronia.*

**Female genitalia**

54. **Eighth sternum with posterior margin:** (0) nearly truncate; (1) produced.

The nearly truncate posterior margin of the female eighth sternum is plesiomorphic and shared by most species of Corydalinae and many genera of Chauliodinae. In *Anachauliodes, Chauliodes, Nigronia, Neoarchichauliodes, Parachauliodes* and *Sinochauliodes*, the female eighth sternum is usually posteriorly produced into a subgenital plate.

55. **Tenth tergum:** (0) thick; (1) slender.

The thick female tenth tergum is plesiomorphic and presented in most genera of Corydalinae, but in *Anachauliodes, Archichauliodes, Chauliodes* and *Ctenochauliodes*, the female tenth tergum is rather slender, much narrower than the diameter of the cercus.

56. **Cercus:** (0) strongly prominent; (1) feebly prominent.

The strongly prominent cercus is considered to be plesiomorphic and is presented in a few Chauliodinae genera, such as *Anachauliodes, Archichauliodes, Chauliodes* and *Ctenochauliodes*.

57. **Gonostylus on gonocoxite:** (0) present; (1) absent.

In Corydalidae, the female gonostylus is placed at the tip of the gonocoxite and plesiomorphically articulated to the gonocoxite. In most genera of Chauliodinae, the female gonostylus is absent, but it remains in *Protochauliodes* and *Neohermes*.

58. **Gonocoxite with apex:** (0) pointed; (1) rounded.

The general form of the gonocoxite is triangular or foliate with a pointed apex; however, a derived form of the gonocoxite with a rounded apex is presented in *Anachauliodes* and *Chauliodes*.

59. **Gonocoxite with lateral sclerotized plate:** (0) subtriangular; (1) subquadrate.

In Corydalidae, there is usually a lateral sclerotized plate on the female gonocoxite, which is generally subtriangular. However, in some genera of Chauliodinae (*Archichauliodes, Neohermes, Protochauliodes*), the lateral sclerotized plate is large and subquadrate.

**Cladistic analysis**

The cladistic analysis was performed in Paup* version 4.0b10 (Swofford, 2002) using heuristic parsimony analysis, with 1000 random stepwise additions of taxa [tree-bisection–reconnection (TBR) branch swapping] under ACCTRAN optimization, characters unordered and of equal weight and MulTrees option in effect. Bootstrap values for clades were calculated in 1000 replicates using a general heuristic search and the branches with bootstrap values of < 50% collapsed. Bremer’s decay index was calculated with Autodecay version 4.0 (Eriksson, 1998) and Paup* version 4.0b10. The unambiguous characters were mapped by MacClade version 4.0 (Maddison & Maddison, 2000).

**Results**

The heuristic analysis resulted in three most parsimonious trees [length = 92, consistency index (CI) = 0.71, retention index (RI) = 0.90, rescaled consistency index (RC) = 0.65]. The three most parsimonious trees only differed in the topology of *Anachauliodes* and *Chauliodes*, with *Chauliodes pecticorns* as the sister group of *Anachauliodes*, with *Chauliodes rastricornis* as the sister group of *Anachauliodes*, or with two *Chauliodes* species to form a monophyletic group. One of the three most parsimonious trees is shown in Fig. 1, and the strict consensus for the three most parsimonious trees is given in Fig. 2. In the latter, the ingroup is divided into two monophyletic clades. Clade 1 contains the five Asian Chauliodinae genera and two Nearctic genera (*Chauliodes* and *Nigronia*). Within clade 1, *Ctenochauliodes* is sister to the remaining clade, which consists of three monophyletic lineages: *Anachauliodes* lineage (*Anachauliodes* + *Chauliodes*), *Neoarchichauliodes* lineage (*Neoarchichauliodes* + *Nigronia*) and *Parachauliodes* lineage (*Parachauliodes* + *Sinochauliodes*). Clade 2 comprises *Archichauliodes, Neohermes* and *Protochauliodes*, with the last two genera as sisters.

**Phylogeny**

**Clade 1**

According to the present cladogram, the Asian fishflies were assigned as a corroborated monophyletic group with two Nearctic genera, *Chauliodes* and *Nigronia*, and the monophyly was supported by the pectinate male antenna (character 7:3) and the male ninth tergum with the posterior margin not incised (character 24:1). The modified basal r-m crossvein in the hindwing (character 23:1) also partially supports the monophyly of clade 1, whereas, in *Anachauliodes* and *Chauliodes*, the absence or reduction of the basal r-m crossveins may be lost secondarily.

*Ctenochauliodes* was well supported to be monophyletic by the sparse stout spinous setae on the male tenth tergum (character 34:2) and the broad plate connecting the lateral lobes of the male tenth sternum (character 52:1). The strongly developed pectinate antenna in both sexes may also be synapomorphic to the *Ctenochauliodes* species, and parallel in *Chauliodes pecticorns*. Compared with the other genera within clade 1, *Ctenochauliodes* retains more plesiomorphic characters, such as the totally absent male ninth gonocoxite and gonostylus, the well-developed male ninth sternum without distal membranous process and the...
bifurcated male tenth sternum. Therefore, the origin of *Ctenochauliodes* may be earlier than some ‘younger’ taxa within clade 1, such as the *Neochauliodes* lineage and the *Parachauliodes* lineage.

The monophyly of the *Anachauliodes* lineage + *Neochauliodes* lineage + *Parachauliodes* lineage was well supported by the shortened male ninth sternum (character 28:1), the male tenth tergum with the base wider than two-thirds of the width of the ninth tergum in lateral view (character 32:1), the feebly prominent cercus (character 38:1) and the distinctly produced female eighth sternum (character 54:1).

The grouping of the Nearctic genus *Chauliodes* with the Oriental genus *Anachauliodes* was well supported by the peculiar coloration of the veins (character 13:1), the presence of the distal claws of the male tenth sternum (character 33:1) and the roundly produced female gonocoxite (character 58:1). However, the grouping of the two *Chauliodes* species was not convincing, which may be a result of more plesiomorphic characters retained in *Chauliodes*. The *Anachauliodes* lineage is considered to be more primitive than the group of the *Neochauliodes* lineage and *Parachauliodes* lineage by having some distinguished plesiomorphic characters, such as the bifurcated male tenth sternum and the strongly prominent female cercus.

The monophyletic group of the *Neochauliodes* lineage and *Parachauliodes* lineage was well supported by the position of the crossvein between 1A and 2A (character 19:1), the rows of the spinous setae (character 34:1), the presence of the reduced male ninth gonocoxite and gonostylus (character 40:1) and the feebly prominent male cercus (character 56:1). Kimmins (1954) mentioned that the female genital characters cannot be distinguished from each other between *Neochauliodes* and *Parachauliodes*, and he proposed that these two genera should be considered as synonyms. However, in the present study, the rather different features of the male sternum justify generic status.

The *Neochauliodes* lineage was well supported by the peculiar wing patterns (character 11:1), the male ninth sternum with the ventral margin acutely produced (character 27:1) and the shortened lateral arms of the male tenth sternum (character 41:1). The non-sinuate anal veins are reversed autapomorphic characters of *Neochauliodes*. *Nigronia* appears to be a rather derived genus from the common ancestor with *Neochauliodes* in having many highly modified autapomorphic characters.

The lineage *Parachauliodes* was well supported by the male tenth sternum enveloped in the male ninth tergum (character 44:1). Van der Weele (1910) mentioned that *Parachauliodes* may have close affinities with *Protochauliodes*, which is distributed in the New World and the Australian Realm, and he also noted that *Parachauliodes* may be the precursor of *Neochauliodes*. By contrast with van der Weele’s assumption, the current phylogenetic hypothesis is that *Parachauliodes* belongs to an independent lineage of *Neochauliodes*, and has a rather distant
affinity with *Protochauliodes*. Compared with *Sinochauliodes*, the subserrate male antenna in *Parachauliodes* implies its primitiveness. The monophyly of the new genus *Sinochauliodes* was supported by the elongation of the male ninth tergum (character 26:1). Although the general feature of the genitalia shows the great similarity in *Parachauliodes* and *Sinochauliodes*, the strongly produced male tenth sternum and the elongated male ninth tergum.

Within *Sinochauliodes*, *S. squalidus*, *S. fujianensis* and *S. maculosus* form a monophyletic group supported by the strongly produced male tenth sternum (character 47:1). The sister group relationships between *S. fujianensis* and *S. maculosus* are supported by the male tenth tergum with the rather oblique basal margin in lateral view (character 36:1). Thus, *Sinochauliodes griseus* may be sister to the rest of the genus.

**Clade 2**

The monophyly of *Archichauliodes* + *Neohermes* + *Protochauliodes* was well supported by the long male antenna (character 6:1), the anteriorly truncate male ninth tergum (character 25:1), the male tenth tergum with the inner proximal portion membranous (character 35:1) and the female gonocoxite with the lateral sclerite strongly developed (character 59:1).

As a result of a lack of the three Afrotropical genera (*Platychauliodes*, *Madachauliodes* and *Taeniochauliodes*) and three New World genera (*Dysmicohermes*, *Orohermes* and *Nothochauliodes*), the current hypothesis concerning clade 2 is preliminary. However, some aspects on the generic phylogeny can be inferred on the basis of the current results and previous studies (Barnard, 1931; Paulian, 1951; Chandler, 1954; Flint, 1983; New & Theischinger, 1993; Penny, 1999). Firstly, the nine genera (*Archichauliodes*, *Platychauliodes*, *Madachauliodes*, *Dysmicohermes*, *Orohermes*, *Neohermes*, *Protochauliodes*, *Nothochauliodes* and *Taeniochauliodes*) probably are grouped into a monophyletic clade based on the long filiform antenna and the anteriorly truncate male ninth tergum. Thus, the clade may consist of more primitive genera than clade 1 by having many endemic genera, which retain many plesiomorphic characters (such as the filiform antenna and the presence of the female gonostylus) and are of rather disjunct and limited distributions. Secondly, within the nine genera, *Neohermes*, *Protochauliodes*, *Nothochauliodes* and *Taeniochauliodes* may form a monophyletic subclade, which is supported by the first branch of 2A medially fused with 1A in the forewing (character 18:1). Furthermore, the sister relationships between *Neohermes* and *Protochauliodes* are confirmed by the branched R₄ in the forewing.

The distinguished lineage of *Dysmicohermes* + *Orohermes* seems to be highly derived and closely related to the *Protochauliodes* lineage by the branched R₄ in the forewing. The branched R₅ and M₁ + 2 in the hindwing are considered herein to be plesiomorphic, although they may also be
secondarily derived characters for grouping the Dysmico-
hermes lineage and the Protochauliodes lineage. Thus, the
polarization of the states of R₅ and M₁ + 2 requires further
evaluation by adding more outgroups.

Penny (1999) proposed close relationships between
Archichauliodes, Platychauliodes and Madachauliodes based
on the unbranched R₅, 1A not fused to 2A in the forewing
and the filiform antenna. However, all three characters are
probably plesiomorphic. Therefore, any hypothesis on the
relationships between the three genera should be postponed
pending future comprehensive studies.

**Biogeography**

**Distribution patterns of the Asian fishflies**

Compared with the distributions of the other Asian
Chauliodinae genera, the distribution of Neochauliodes is
widest, from south-eastern to far eastern Asia, and most
‘primitive’ Neochauliodes species are restricted to the
Oriental Realm, especially concentrated in south-western
China and north-eastern India (Liu & Yang, 2005a). The
Ctenochauliodes species are restricted to the Oriental Realm
and are richest in China (van der Weele, 1910; Navás, 1932;
1999). The distribution of Anachauliodes is extremely nar-
row, and this genus can be found only in a few mountainous
regions of south-western China and northern Vietnam
(Kimmins, 1954; Yang D. & Yang C. K., 1992). Undoubt-
edly, four Parachauliodes species are distributed in Japan
and Taiwan (Hayashi, 1990b), showing peculiar adaptation
to the island habitats. According to our unpublished studies,
records of the other two species of Parachauliodes from the
Chinese mainland and Vietnam (Navás, 1913, 1924) are
inaccurate, perhaps due to misidentifications. The male
antenna in P. buschi originally was described as pectinate,
and 1A in the forewings of P. laboissierei was illustrated
originally as four-branched, which is the autapomorphic
character of Anachauliodes. Thus, the distribution pattern of
Parachauliodes is confirmed herein, probably along the
West Pacific Island Arc. Interestingly, the genus Sinochauli-
odes, which is the sister to Parachauliodes, occurs only on
the Chinese mainland and is restricted mostly to south-
eastern China, which is close to the West Pacific Island Arc.

**Distribution tracks of the Asian fishflies**

According to the distribution patterns and the present
cladogram, the Asian fishflies reveal north-eastward and
south-eastward distribution tracks. The north-eastward
distribution track can be recognized from south-western
China and north-eastern India, through central China to
south-eastern and northern China. The relatively young
genera of Asian fishflies (Parachauliodes and Sinochauli-
odes) are restricted to south-eastern China, even extending
northwards to Palaearctic Japan. The distribution patterns
of the Neochauliodes species also fit this track, with many
‘younger’ species, such as Neochauliodes sinensis complex,
dominantly occupying northern China (Liu & Yang,
2005b). According to the fossil record of the Chauliodinae
from the Early Cretaceous of Baisa in Siberia (Cretochaulus
lacustris; Ponomarenko, 1976), the north-eastward distribution
track may be at least 140 Myr old. The combination of the
two Nearctic genera, Chauliodes and Nigronia, with the
Asian genera and the Baltic Amber Chauliodes (Pictet, 1854;
Wichard, 2003) also implies that Chauliodinae may have
been widely distributed in Laurasia with some recent genera
originating during the Late Cretaceous or early Eocene. The
distribution areas of Chauliodinae probably decreased and
then increased several times during glacial and postglacial
periods in the Cenozoic until the recent fauna was formed.
The south-eastward distribution track is probably from south-western China and north-eastern India, through southern China, Burma, Thailand and Vietnam, to Malaysia and Indonesia. Part of the Neochauleiodes species may have dispersed along this track.

**Origin of the Asian fishflies**

So far, the biogeography of the Chauliodinae is still poorly known, with a working hypothesis for the origin of the Asian dobsonflies proposed by Penny (1993). As he mentioned, the Asian dobsonfly genera could have been present either in south Asia from a previous vicariant event (perhaps the sundering of Pangea) or may have been introduced as single or multiple ancestors on the Gondwana-derived Indian subcontinent as it drifted northwards. In addition, he pointed out that the biogeographical pattern of Chauliodinae may also fit his theory of Gondwanan distribution. According to the above discussion on the distribution track of the Asian fishflies, the Chauliodinae

![Fig. 4. Habitus photographs of the Sinochauleiodes species. A, S. fujianensis, holotype male; B, S. fujianensis, allotype female; C, S. griseus, paratype male; D, S. griseus, paratype female; E, S. maculosus, holotype male; F, S. squalidus, holotype male; G, S. squalidus, paratype female.](image-url)
may have originated before the Early Cretaceous, at the time of separation of Laurasia and Gondwana. Thus, the hypothesis that the Corydalidae was introduced firstly to Laurasia by the Indian subcontinent is rejected. Considering the current phylogenetic hypothesis, the two main clades of Chaulioidinae may have formed by the splitting of Laurasia from Gondwana.

On the basis of the distribution patterns of Asian fishflies, by harbouring many relatively primitive genera and species, south-western China and north-eastern Asia are considered to be the origin centre of the recent fauna of Chaulioidinae in Asia. The speciation may have been prompted in the diversified mountainous habitats formed by the collision of the Indian subcontinent and Laurasia.

**Biogeography of Parachauliodes and Sinochauliodes**

The Western Pacific Island Arc mainly comprises Taiwan, Ryukyus and Japan, which may have been formed after the Cenozoic. Taiwan has been connected to the Chinese mainland several times since the mid-Pleistocene, offering some direct pathways to introduce species of the mainland into this newly elevated land (Zhang, 1999). Judging from the distribution patterns of *Parachauliodes* and *Sinochauliodes*, the precursor of *Parachauliodes* probably was first introduced to Taiwan by way of south-eastern China, then extending northwards along the Western Pacific Island Arc to Japan. The division of the two sister genera may have taken place as a result of the vicariance between Taiwan and the mainland of Asia during the frequent transgression of the Pacific after the mid-Pleistocene (Fig. 3).

**Taxonomy**

*Genus Sinochauliodes* Liu & Yang, gen.n.

*Etymology.* The new genus is named after the unique distribution in China.

*Type species.* *Sinochauliodes squalidus* sp.n.

*General characters.* Fishflies of median size (20–45 mm), with brown to black body. Wings hyaline with dark marks or entirely blackish brown. Head subtriangular and robust with distinctly prominent compound eyes. Antennae pectinate in male and subserate in female. Labrum suboval. Prothorax subcylindrical, not longer than wide. Meso- and metathorax distinctly robust. Legs densely setose, with some long setae. Wings somewhat narrow and elongated, about 4.0× longer than wide, with round or slightly curved tips; Rs four-branched, usually with R2 two-branched, R3 and R4 usually with Z-bend near apices in male; three crossveins between R1 and Rs; M two-branched; 1A two-branched, with posterior branch strongly sinuated; 2A two-branched, with both branches strongly sinuated. Male ninth tergum subquadrate, much longer than wide, usually with V-shaped basal incision; ninth sternum less sclerotized and much shorter than ninth tergum, with one membranous subtriangular apical process; tenth tergum simple and laterally flattened with round apical margin, apical portion somewhat inflated with rows of black spinous setae, ventral portion basally with shallow incision near inner margin; tenth sternum strongly sclerotized and subtriangular, much shorter than ninth tergum, mostly enveloped by ninth tergum, curved upwards. Female eighth sternum subtrapezoidal, usually produced apically as a subgenital plate; ninth tergum deep and pointed downwards; tenth tergum shortly claviform with upper apical corner bluntly produced; gonocoxite subtrapezoidal with pointed tips.

*Remarks.* The genus *Sinochauliodes* comprises four species, with two species described as new to science. The new genus appears to be closely related to the genus *Parachauliodes* in having similar venation and genitalic structures, but can be easily separated from *Parachauliodes* by the sexual dimorphism in the antenna, the elongated male ninth tergum and the strongly produced tenth sternum in the male. In *Parachauliodes*, the distinct sexual dimorphism in the antennae is absent, the male ninth tergum is not elongated and the male tenth sternum is obtuse at the tip. Furthermore, the reduced male ninth gonocoxite is roundly produced in *Parachauliodes*, whereas, in *Sinochauliodes*, this feature is indistinct.

**Key to the adults of Sinochauliodes**

1. Body and wings almost blackish brown throughout ........................................... *S. fujianensis* (Yang & Yang), *comb.n.*
   Body and wings much paler, not blackish brown throughout.................................................. 2

2. Wings without any distinct brownish marks; tenth sternum with tip truncate .......................... 3
   Wings with distinct brownish marks; tenth sternum with tip strongly produced.......................... 3

3. Wings with dense small brownish spots; male tenth tergum with rather oblique proximal margin in lateral view; tenth sternum narrowing at apical portion with tip slightly narrowing again ........................ *S. maculosus* sp.n.
   Wings with several brownish cloudy marks, but with small spots indistinct; male tenth tergum with vertical proximal margin in lateral view; tenth sternum narrowing at apical portion but with tip not narrowing again ........................................... *S. squalidus* sp.n.


*Diagnosis.* Body and wings almost blackish brown; male ninth tergum with oblique apical margin.
Description. Male: body length 23–31 mm; forewing length 28–30 mm; hindwing length 26–27 mm.

Head yellowish brown, with frons, vertex and posterolateral margin entirely black. Compound eyes brown, ocelli yellowish brown with black inner margin. Antenna black. Mouthparts blackish brown.

Thorax entirely blackish brown. Legs brown with dense, yellowish setae. Wings narrowly elongated, entirely blackish brown with tips somewhat paler. Veins blackish brown. Rs four-branched, R\textsubscript{3} distally three-branched, R\textsubscript{4} and R\textsubscript{5} distinctly with Z-bend near apices; three crossoveins between R\textsubscript{4} and R\textsubscript{5}; M two-branched; 1A two-branched, with posterior branch strongly sinuated; 2A two-branched, with both branches strongly sinuated.

Abdomen blackish brown. Ninth tergum (Fig. 5B, D, E) in lateral view subquadrate, dorsal posterior corner strongly and acutely produced, ventral posterior corner bluntly produced. Ninth sternum semicircular, distally with a small membranous

Fig. 5. *Sinochauliodes fujianensis*. A, wings; B, male genitalia, lateral view; C, tenth sternum, ventral view; D, male genitalia, dorsal view; E, male genitalia, ventral view; F, female genitalia, lateral view. Scale bars: A, 5 mm; B–F, 1 mm.
triangular process. Tenth tergum laterally slightly flattened, in lateral view distal half indistinctly narrowing with round distal margin; in ventral view middle portion with a shallow transverse incision on inner margin, and distal half feebly inflated. Tenth sternum (Fig. 5B, C, E) strongly sclerotized, curved dorsad, as long as two-thirds of ninth tergum; proximal margin widely and deeply incised arched; distal half slightly narrowing with tip strongly produced.

**Female:** body length 42 mm; forewing length 37 mm; hindwing length 31 mm. Colour similar to male.

Eighth sternum broad, posterior margin strongly produced. Tenth tergum (Fig. 5F) shortly claviform, slightly narrowing and feebly incised at tip. Gonocoxite (Fig. 5F) subtrapezoidal with pointed tip, posteriorly produced.


**Distribution.** China (Fujian).

**Remarks.** This species is the most distinctive species of *Sinochauliodes* in having a blackish body and wings. All the
adults were collected only on Mt. Wuyishan of Fujian Province, which is located in south-eastern China. During our survey to Mt. Wuyishan in 2004, we found that the adults were very active on sunny days, normally gliding high above the bamboo forest and sometimes nosing down towards an open space within the forest.

*Sinochauliodes griseus* (Yang & Yang, 1999), comb.n. (Figs 4C, D; 6)

*Neochauliodes griseus* Yang & Yang, 1999: 173.

**Diagnosis.** Wings almost pale greyish brown without distinct marks; male ninth tergum with apical margin nearly vertically straight; tenth sternum slightly widened and truncate at tip.

**Description.** Male: body length 28–38 mm; forewing length 37–48 mm; hindwing length 33–42 mm.

Head yellowish brown, with frons, vertex and posterolateral margins entirely blackish brown. Compound eyes brown, ocelli yellow with black inner margin. Antenna blackish brown. Mouthparts pale yellowish brown.

Thorax pale brown. Legs yellowish brown with dense, pale yellow setae; tibiae and tarsi blackish brown, tarsal claws reddish brown. Wings narrowly elongated, pale greyish brown without distinct marks. Veins brown. Rs four-branched, R₂ distally three-branched, R₃ and R₄ distinctly with Z-bend near

![Diagram of Sinochauliodes griseus](image-url)

**Fig. 7.** *Sinochauliodes maculosus*. A, wings; B, male genitalia, lateral view; C, tenth sternum, ventral view; D, male genitalia, dorsal view; E, male genitalia, ventral view. Scale bars: A, 5 mm; B–E, 1 mm.
Fig. 8. *Sinochauliodes squalidus*. A, wings; B, male genitalia, lateral view; C, tenth sternum, ventral view; D, male genitalia, dorsal view; E, male genitalia, ventral view; F, female genitalia, lateral view. Scale bars: A, 5 mm; B–F, 1 mm.
apices; three crossveins between R₁ and Rs; M two-branched; 1A two-branched, with posterior branch strongly sinuated; 2A two-branched, with both branches strongly sinuated.

Abdomen brown. Ninth tergum (Fig. 6B, D, E) in lateral view subquadrate, posterior margin nearly vertical, with round ventral posterior corner. Ninth sternum semicircular distally with small membranous triangular process. Tenth tergum laterally flattened, in lateral view distal half distinctly narrowing with round posterior margin; in ventral view middle portion with shallow longitudinal incision on inner margin, and distal half inflated, globose. Tenth sternum (Fig. 6B, C, E) strongly sclerotized, curved dorsad, as long as two-thirds of ninth tergum; in lateral view its tip acutely pointed; in ventral view its proximal margin widely incised trapezoidal; distal half slightly narrowing, but tip somewhat widened and truncate.

Female: body length 38–43 mm; forewing length 41–50 mm; hindwing length 38–45 mm. Colour similar to male.

Eighth sternum subtrapezoidal with posterior margin distinctly produced. Tenth tergum (Fig. 6F) short claviform, ventrally with tip slightly incised. Gonocoxite (Fig. 6F) broad with tip distinctly narrowing and curved inwards.


Distribution. China (Zhejiang).

Remarks. This species seems to be closely related to the following new species, S. squalidus, in having the male tenth tergum with a vertical proximal margin in lateral view, but it is easily separated from S. squalidus by the wings lacking distinct marks and the tenth sternum with the tip somewhat widened and truncate. In S. squalidus, the wings are tinged with brownish cloudy marks and the tenth sternum is strongly tapered distally.

Sinochauliodes maculosus Liu & Yang, sp.n.
(Figs 4D; 7)


Etymology. The specific epithet ‘maculosus’ refers to the forewings with a large number of small brownish spots.

Diagnosis. Forewings with a large number of small brownish spots; male tenth tergum with rather oblique proximal margin in lateral view; distal half of tenth sternum strongly narrowing with blunt narrowed tip.

Description. Male: body length 40–45 mm; forewing length 40–43 mm; hindwing length 36–39 mm.

Head yellowish brown, with blackish marks on ocellar triangle area and radiating towards vertex. Compound eyes brown, ocelli pale yellow with black inner margin. Antenna blackish brown. Mouthparts yellowish brown, with distal half of mandibles, maxillary palpi and labial palpi brown.

Prothorax greyish brown, middle portion dorsally with a pair of pale yellow marks near lateral margin; meso- and metathorax yellowish brown, dorsally with brownish marks on lateral sides. Legs yellow with dense, brownish setae; tibiae and tarsi brown, tarsal claws reddish brown. Wings hyaline with many small brownish spots; pterostigma indistinct. Forewing tinged with brown at basal costal area, and with 7–8 small blackish brown spots before pterostigma; small brownish spots densely dispersed throughout along longitudinal veins, medi- ally with one subtriangular hyaline area near Rs; anal area also nearly without any marks. Hindwing mostly hyaline, with sparse small brownish spots at tip. Veins blackish brown, with most veins on hindwings pale brown. Rs four-branched, R₂ distally two-branched, R₁ and R₄ distinctly with Z-bend near apices; three crossveins between R₁ and Rs; M two-branched; 1A two-branched, with posterior branch strongly sinuated; 2A two-branched, with both branches strongly sinuated.

Abdomen greyish brown. Ninth tergum (Fig. 7B, D, E) in lateral view subquadrate, with straight dorsal margin and arched ventral margin. Ninth sternum semicircular, distally with a small membranous triangular process. Tenth tergum laterally flattened, in lateral view with proximal margin rather oblique, its distal portion slightly narrowing with round distal margin; in ventral view proximal portion with subsinuate incision on inner margin, and distal portion slightly inflated. Tenth sternum (Fig. 7B, C, E) strongly sclerotized, curved dorsad, as long as two-thirds of ninth tergum; proximal margin widely and deeply incised trapezoidal; distal half strongly narrowed, with tip bluntly narrowed again.

Female: unknown.

Distribution. China (Guangxi, Guizhou).

Remarks. The new species is distinguished from other Sinochauliodes species by the wing pattern of dense brownish spots. The unique feature of the male genitalia is that the distal portion of the tenth sternum is distinctly narrowed with the tip slightly narrowed again.

Sinochauliodes squalidus Liu & Yang, sp.n.
(Figs 4F; 8)


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**Etymology.** The specific epithet 'squalidus' refers to the cloudy brownish marks on the forewings.

**Diagnosis.** Forewings with several cloudy brownish marks; male tenth sternum with proximal margin nearly vertical; tenth sternum with proximal margin widely and deeply incised V-shaped, and with distal half slightly narrowing towards tip.

**Description.** Male: body length 30–38 mm; forewing length 36–43 mm; hindwing length 31–39 mm.

Head yellowish brown, with blackish brown marks on ocellar triangle area and radiating towards vertex. Compound eyes brown, ocelli pale yellow with black inner margin. Antenna black. Clypeal area brown. Mouthparts blackish brown.

Thorax pale brown with meso- and metanotum blackish brown on lateral sides. Legs pale brown with dense, brownish setae; tibiae and tarsi blackish brown, tarsal claws pale red. Wings hyaline with pale brown cloudy marks; pterostigma indistinct. Forewing tinged with brown on lateral sides, and with a brown stripe before pterostigma and with sparse small brownish spots on apical half. Veins pale yellow except blackish brown cross-veins on costal area and brownish marks. Rs four-branched, R₂ distally three-branched, R₃ and R₄ indistinctly with Z-bend near apices; three crossveins between R₁ and Rs; M two-branched; 1A two-branched, with posterior branch strongly sinuated; 2A two-branched, with both branches strongly sinuated.

Abdomen brown. Ninth tergum (Fig. 8B, D, E) in lateral view subquadrate, apical margin nearly vertically straight, with ventral posterior corner roundly produced. Ninth sternum semicircular, distally with a small membranous triangular process. Tenth tergum laterally flattened, in lateral view proximal margin nearly vertical, its distal half distinctly narrowing with round distal margin; in ventral view middle portion with shallow transverse incision on inner margin, and distal half flattened, globose. Tenth sternum (Fig. 8B, C, E) strongly sclerotized, curved dorsad, as long as two-thirds of ninth tergum; proximal margin widely and deeply incised V-shaped; distal half slightly narrowing with round tip.

**Female:** body length 40–45 mm; forewing length 36–43 mm; hindwing length 31–39 mm. Colour similar to male, but ventral surface of head tinged with blackish brown on posterolateral margin.

Eighth sternum broad, posterior margin slightly produced. Tenth tergum (Fig. 8F) short claviform with pointed tip. Gonocoxite (Fig. 8F) subtrapezoidal with pointed tip, posteriorly produced.

**Distribution.** China (Guangdong).

**Remarks.** See the remarks on *S. griseus*.

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