

A STUDY ON THE PHYLOGENY OF DOLICHOPODINAE FROM THE PALAEARCTIC AND ORIENTAL REALMS, WITH DESCRIPTIONS OF THREE NEW GENERA (DIPTERA, DOLICHOPODIDAE)

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Abstract The phylogenetic relationships among genera of Dolichopodinae from the Palaearctic and Oriental Realm are analyzed for the first time. The subfamily Dolichopodinae is confirmed to be a monophyly. A monophyletic clade including the genera *Ahercostomus*, *Allohercostomus*, *Tachytrechus* and *Aphalacrosona* is suggested, and a sister group relationship of *Tachytrechus* and *Aphalacrosona* is indicated. *Gymnopternus*, which is originally a subgenus of *Hercostomus*, is suggested to be a valid genus and has close relationship with *Setihercostomus* gen. nov. The genera *Ludovicius* and *Sybiostroma* resemble each other and should be put together as a single genus. And the genus *Paraclius* Coquillett might be the synonym of *Pelastoneurus*.

Three new genera, *Ahypophyllus* gen. nov., *Aphalacrosona* gen. nov., and *Setihercostomus* gen. nov. are erected, and the subgenus *Ahercostomus* Yang et Saigusa of the genus *Hercostomus* is elevated to the generic level. The following new combinations are erected: *Ahypophyllus sinensis* (Yang, 1996) comb. nov., *Aphalacrosona hubeiense* (Yang, 1998) comb. nov., *A. postiseta* (Yang et Saigusa, 2001) comb. nov., *A. sichuanense* (Yang et Saigusa, 1999) comb. nov., *Setihercostomus setifacies* (Stackelberg, 1934) comb. nov., *S. zonalis* (Yang, Yang et Li, 1998) comb. nov., *S. wuyangensis* (Wei, 1997) comb. nov., *S. huangi* (Zhang, Yang et Masunaga, 2004) and *Ahercostomus jiangchenganus* (Yang et Saigusa, 2001) comb. nov.

Key words Dolichopodidae, Dolichopodinae, new genera, new combinations, phylogeny.

1 Introduction

The Dolichopodinae is one of the most diverse and widespread subfamilies within Dolichopodidae with 33 genera and over 1 300 described species. Most species of Dolichopodinae are from the Holarctic realm with about 900 known species. The fauna of the southern hemisphere is less diverse and includes about 190 species in the Neotropics, 120 in the Afrotropics, 90 in the Oriental realm, and 30 in Australasia and Oceania (Brooks, 2002). The subfamily Dolichopodinae is often well identified by the antennal scape haired dorsally, and male tergite and sternite 7 forming the well developed hypopygial peduncle. Adults are usually middle to large sized and seen running on foliage in sunny moist habitat.

China covers two important zoogeographical realms: the Palaearctic Realm and the Oriental Realm. The Chinese fauna of Dolichopodinae is rich and comprises 13 genera that including 374 known species. The genera *Hercostomus* and *Dolichopus* are dominant with 246 species and 49 species respectively to comprise

about 79% of the species. The *Ludovicius*, *Paraclius* and *Tachytrechus* each have over 10 species and cover 15% of the species.

In the present paper, the cladistic relationships among 27 genera (subgenera) of Dolichopodinae, which selected from the Palaearctic and Oriental Realm are undertaken for the first time. Three new genera, *Ahypophyllus* gen. nov., *Aphalacrosona* gen. nov., and *Setihercostomus* gen. nov. are erected, and the subgenus *Ahercostomus* Yang et Saigusa of the genus *Hercostomus* is elevated to the generic level. And new combinations are created accordingly.

The following abbreviations are used: acr acrostichal, ad anterodorsal, d dorsal, dc dorsocentral, hr humeral, prsr presutural, npl notopleural, oc ocellar, pa postalar, plr posthumeral, sa supraalar, sr sutural, vt vertical, pvt postvertical.

2 Taxonomy

Ahypophyllus gen. nov. (Figs. 1-7)

Diagnosis. Arista with long hairs. Femora slender; hind femur with 2 preapical bristles; hind tar-

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somere 1 as long as tarsomere 2. Abdominal tergite 6 large and distinctly elongated, subquadrate in lateral view; peduncle located under middle of tergite 6.

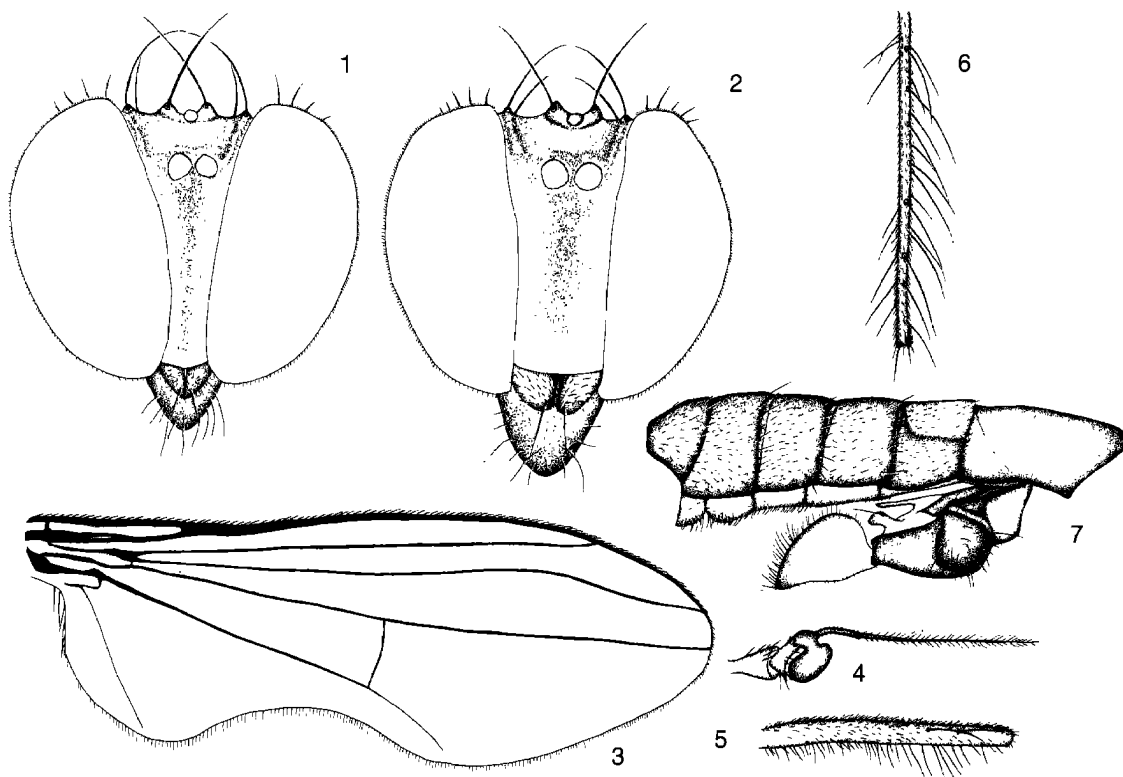
Description. Body large sized (body length 7.0-7.7 mm, wing length 7.7-8.0 mm) with slender abdomen (nearly 2 times as long as thorax) somewhat compressed laterally. Eyes separated. Vertex slightly excavated. Ocellar tubercle with 2 long strong oc and 4 short posterior hairs; vt nearly as long as oc; pvt distinctly shorter than vt. Male face (Fig. 1) broad basally and narrowing towards clypeus, female face (Fig. 2) wide, nearly parallel sided. Clypeus short and small (1/6 as long as total length of face and clypeus), distinctly not reaching lower margin of eyes. Antenna (Fig. 4) with scape haired dorsally and distinctly longer than pedicel; first flagellomere small and short; arista subapical with longer hairs, shorter than width of head. Antennal sockets closely setted and their outer margin close to inner margin of eyes. 6 strong dc (the last 2nd slightly divergent from the dc row), acr biseriate. Scutellum with 2 pairs of bristles (basal pair short and hair-like, apical pair long and strong), marginal hairs longer and distinct, but without discal hairs. 1 h

and 1 short humeral hair, 1 ph, 1 prsu, 1 su, 2 npl, 2 sa and 1 pa. Propleuron haired, with 1 black bristle on lower portion; pteropleuron without hair in front of postspiracle. Mid coxa with 1 outer bristle, hind coxa with 1 outer bristle at middle. Femora slender (9-10 times longer than width of femur); mid femur with 1 preapical bristle, hind femur (Fig. 5) with 2 preapical bristles. Hind tibia (Fig. 6) with long and many bristles. Hind tarsomere 1 as long as tarsomere 2. Wing (Fig. 3) with narrow anal lobe, R₄₊₅ curved upward, M nearly straight, nearly parallel to R₄₊₅ apically, M ended at wing tip. CuAx ratio distinctly less than 1. Male tergite 6 (Fig. 7) large and distinctly elongated, nearly quadrate in lateral view; peduncle located under middle of tergite 6. Male genitalia large, curved forward to sternum 2; cercus large like *Dolichopus*-style.

Type species. *Hypophyllus sinensis* Yang, 1996.

Etymology. The Greek prefix a is combined with the generic name *Hypophyllus*.

Distribution. The genus is known only from China (Gansu, Henan, Hubei, Shaanxi) with only 1 species, *Ahypophyllus sinensis* (Yang, 1996) comb. nov., which was originally included in *Hypophyllus*.



Figs 1-7. *Ahypophyllus sinensis* (Yang). 1. Male head, anterior view. 2. Female head, anterior view. 3. Wing. 4. Antenna, lateral view. 5. Hind femur, lateral view. 6. Hind tibia. 7. Abdomen, lateral view.

Remarks. The new genus is similar to *Hypophyllus* in the face narrowing downward, clypeus distinctly

not reaching the lower margin of eyes, outer margin of antennal sockets close to the inner margin of eyes, and

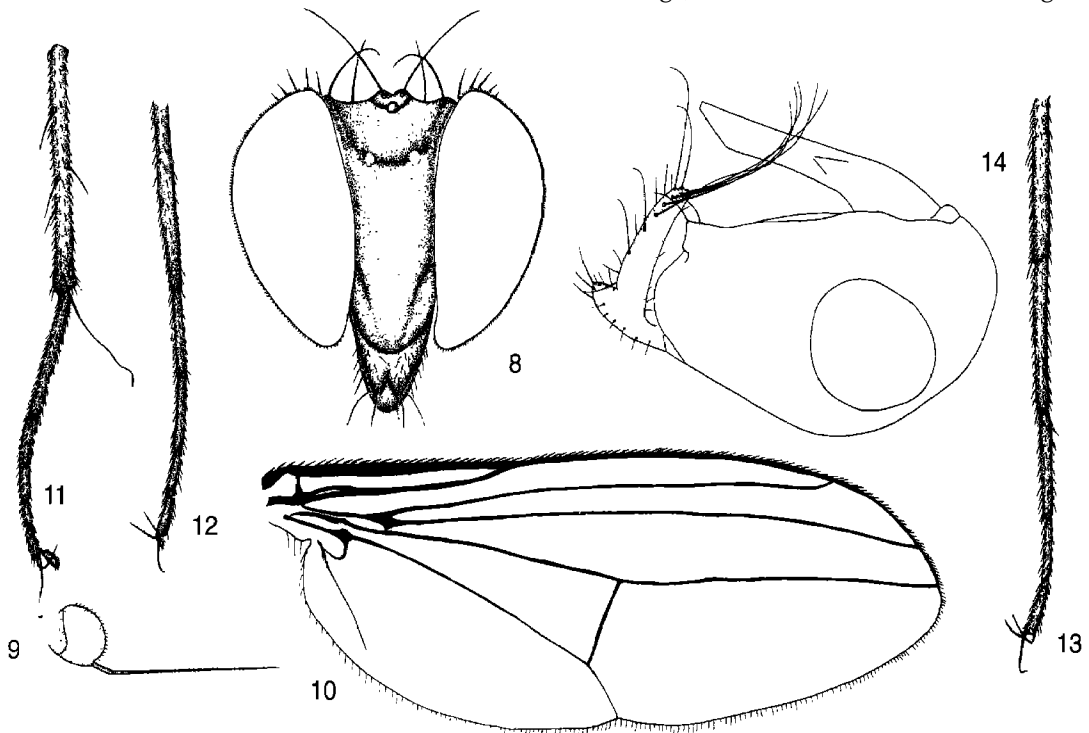
slender femora. But it may be separated from *Hypophyllus* with the following apomorphic characters: hind femur with 2 preapical bristles; hind tarsomere 1 as long as tarsomere 2, and the abdominal tergite 6 large, distinctly elongated, nearly quadrate in lateral view. In *Hypophyllus*, the hind femur has 1 preapical bristle, the hind tarsomere 1 is distinctly shorter than tarsomere 2, and tergite 6 is small and triangular in lateral view as in other genera of Dolichopodinae.

Aphalacrosona **gen. nov.** (Figs. 8-14)

Diagnosis. Male face wide, nearly parallel sided; clypeus long and wide ($1/2-1/3$ as long as total length of face and clypeus), convex apically and nearly reaching lower margin of eyes. Antennae widely separated at base. Femora slender. Claws elongated, mid and hind pulvilli reduced. CuAx ratio distinctly more than 1.

Description. Body middle to large-sized (body length 4.5-6.8 mm, wing length 4.3-6.8 mm) with abdomen 1.0-1.5 times as long as thorax. Eyes separated. Vertex slightly excavated. Ocellar tubercle weak, with 2 long strong oc and 6 short posterior hairs; vt shorter than oc; pvt slightly shorter than vt ($2/3$ as long as vt). Male face (Fig. 8) wide, nearly parallel sided. Clypeus long and wide ($1/2-1/3$ as long as total length of face and clypeus), convex apically

and nearly reaching lower margin of eyes, visible in lateral view. Antenna (Fig. 9) with scape haired dorsally and distinctly longer than pedicel; first flagellomere small and short, rounded apically; arista subapical, nearly bare, shorter than width of head, with very short basal segment. Antennal sockets (Fig. 8) widely separated (wider than ocellar tubercle) and their outer margin close to inner margin of eyes. 5 strong dc (the last 2nd not or slightly divergent from the dc row), acr irregularly uniseriate or biseriate. Scutellum with 2 pairs of bristles (basal pair short and hair-like, apical pair long and strong), without marginal hairs and discal hairs. 1 h and 2 short humeral hairs, 1 ph, 1 prsu, 1 su, 2 npl, 2 sa and 1 pa. Propleuron haired, with 1 black bristle on lower portion; pteropleuron without hair in front of postspiracle. Mid coxa with 1 outer bristle, hind coxa with 1 outer bristle at middle. Femora slender (7-8 times longer than width of femur); mid and hind femora each with 1 preapical bristle. Hind tarsomere 1 slightly shorter than or as long as tarsomere 2. Claws (Figs. 11-13) elongated, mid and hind pulvilli reduced. Wing (Fig. 10) with narrow anal lobe; first costal section thickened medially; R_4+5 and M convergent apically, M ended just before wing tip. CuAx ratio distinctly more than 1. Tergite 6 bare. Male genitalia large, curved forward and reaching sternum 2.



Figs 8-14. *Aphalacrosona positseta* (Yang et Saigusa). 8. Male head, anterior view. 9. Antenna, lateral view. 10. Wing. 11. Fore tibia and coxa. 12. Mid tarsus. 13. Hind tarsus. 14. Male genitalia, lateral view.

Male genitalia (Fig. 14): epandrial lateral lobe indistinctly separated from epandrium, hypandrium simple, not furcated; cercus furcated basally, with long bristles.

Type species. *Phalacrosoma postiseta* Yang et Saigusa, 2001.

Etymology. The Greek prefix a is combined with the generic name *Phalacrosoma*.

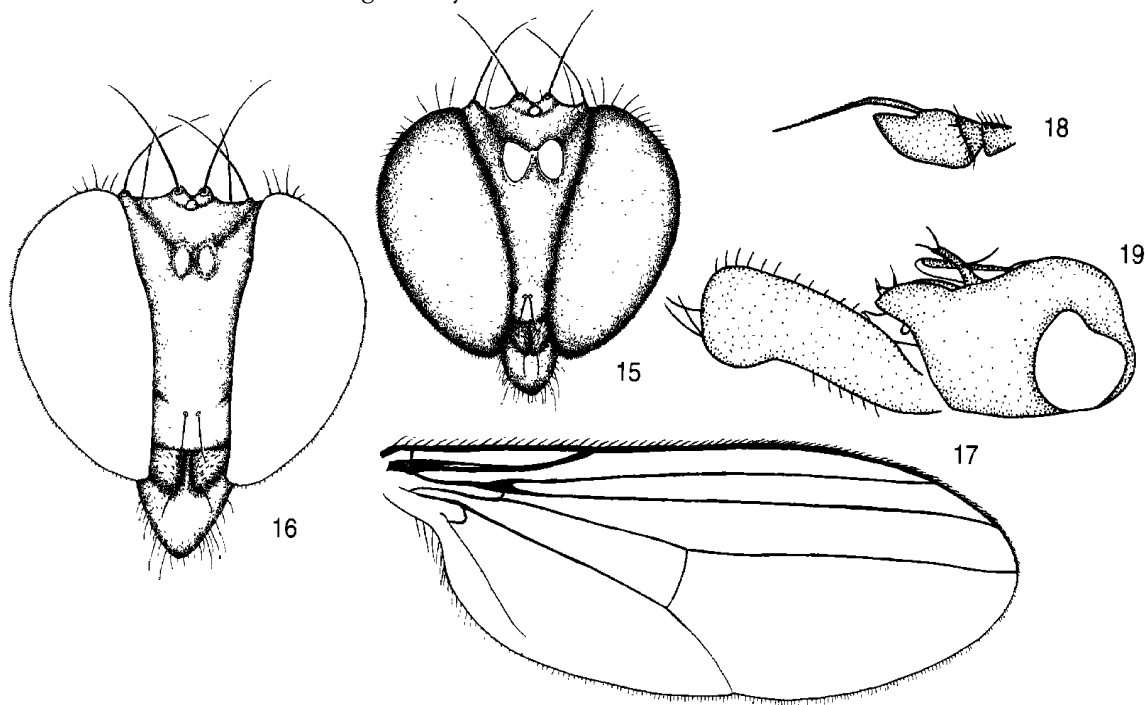
Distribution. The genus is known only from China (Hubei, Sichuan, Yunnan) with the following 3 species which were originally included in the genus *Phalacrosoma*: *Aphalacrosoma hubeiense* (Yang, 1998) comb. nov., *A. postiseta* (Yang et Saigusa, 2001) comb. nov., *A. sichuanense* (Yang et Saigusa, 1999) comb. nov.

Remarks. The new genus is similar to *Tachytrechus* in the face rather wide, outer margin of antennal sockets close to the inner margin of eyes and

CuAx ratio ≥ 1 . But it may be separated from *Tachytrechus* by the distance between antennal sockets wider than the ocellar tubercle, hind femur with 1 preapical bristle, claws elongated, mid and hind pulvilli reduced. In *Tachytrechus*, the antennal sockets are rather close to each other; claws are normal or if elongated but without reduced pulvilli; the hind femur has several anterior dorsal bristles except the true preapical bristle.

Setihercostomus **gen. nov.** (Figs. 15-19)

Diagnosis. Clypeus short and narrow (1/5 as long as total length of face and clypeus), distinctly not reaching lower margin of eyes, bearing one pair of strong bristles in both sexes. Pteropleuron with group of fine hairs in front of postspiracle. Male cercus large and thick, nearly as long as epandrium.



Figs. 15-19. *Setihercostomus zonalis* (Yang, Yang et Li). 15. Male head, anterior view. 16. Female head, anterior view. 17. Wing. 18. Antenna, lateral view. 19. Male genitalia, lateral view.

Description. Body small to middle-sized (body length 2.8-3.6 mm, wing length 2.5-3.1 mm) with abdomen 1.5 times as long as thorax. Eyes separated. Vertex not excavated. Ocellar tubercle weak, with 2 long strong α and 6 short posterior hairs; vt nearly as long as α ; pvt distinctly shorter than vt. Male face (Fig. 15) narrowing towards clypeus, female face (Fig. 16) wide and nearly parallel-sided. Clypeus short and narrow (1/5 as long as total length of face and clypeus), distinctly not reaching lower margin of eyes,

bearing one pair of strong bristles in both sexes (Figs. 15-16). Antenna (Fig. 18) with scape haired dorsally and distinctly longer than pedicel; first flagellomere distinctly longer than wide; arista dorsal with short hairs. Antennal socket narrowly separated (close to each other) and their outer margin close to inner margin of eyes. 6 strong dc (the last 2nd distinctly divergent from the dc row, nearly reaching the acrow), acrow biseriate. Scutellum with 2 pairs of bristles (basal pair short and hair-like, apical pair long and

strong), without marginal hairs and discal hairs. 1 h and 2 short humeral hairs, 1 ph, 1 prsu, 1 su, 2 npl, 2 sa and 1 pa. Propleuron haired, with 1 black bristle on lower portion; pteropleuron with several hairs in front of postspiracle. Mid coxa with 1 outer bristle, hind coxa with 1 outer bristle at middle. Femora thick (5-6 times longer than width of femur), mid and hind femora each with 1 preapical bristle. Hind tarsomere 1 shorter than tarsomere 2. Wing (Fig. 17) with narrow anal lobe, R_{4+5} and M parallel apically. M ended at wing tip. CuAx ratio less than 1. Tergite 6 bare. Male genitalia (Fig. 19) rather large, curved forward to sternum 2; cercus large and thick, nearly as long as epandrium.

Type species. *Hercostomus zonalis* Yang, Yang et Li, 1998.

Etymology. The Greek prefix seti is combined with the generic name *Hercostomus*.

Distribution. The genus is known only from Far East and China (Henan, Shaanxi, Sichuan, Guangxi, Guizhou) with the following 3 species which were originally included in *Hercostomus*: *Setihercostomus setifacies* (Stackelberg, 1934) comb. nov., *S. zonalis* (Yang, Yang et Li, 1998) comb. nov., *S. wuyangensis* (Wei, 1997) comb. nov., *S. huangi* (Zhang, Yang et Masunaga, 2004).

Remarks. The new genus is very similar to *Gymnopternus* in the pteropleuron with one group of fine hairs in front of postspiracle, but may be separated from the latter by the clypeus with one pair of strong bristles in both sexes and male cercus rather large and thick (nearly as long as epandrium).

Ahercostomus Yang et Saigusa, stat. nov.

Ahercostomus Yang et Saigusa, 2001. Bull. Inst. R. Sci. Nat. Belg. Ent., 71: 239 (as a subgenus of *Hercostomus*).

Type species. *Hercostomus* (*Ahercostomus*) *jiangchenganus* Yang et Saigusa, 2001.

Diagnosis. Face narrowing downward. Antenna rather widely separated from inner margin of eyes. Clypeus projecting beyond lower margin of eyes. First flagellomere rather short, as long as wide, rounded apically; arista subapical, nearly bare and with very short basal segment. 6 strong dc, 5th pair of dc strongly convergent. Cercus rather large, nearly as long as epandrium, furcated and with distinct marginal denticles.

Remarks. Here the subgenus *Ahercostomus* of *Hercostomus* is raised to the generic level with only 1 known species, *Ahercostomus jiangchenganus* (Yang et Saigusa, 2001) comb. nov. It is similar to *Hercosto-*

mus, but may be separated from the latter by the clypeus projecting beyond the lower margin of eyes and antenna rather widely separated from inner margin of eyes. In *Hercostomus*, the clypeus is not reaching the lower margin of eyes, and the outer margin of antennal sockets is close to the inner margin of eyes.

3 Cladistic Analysis

3.1 Material and Methods

Representative species of 24 genera and 3 subgenera from Dolichopodinae from the Palearctic and Oriental Realms are selected as ingroup members. The genus *Pterostylus* Mik is not included because the type species is not accessible. Thirty-nine adult characters from head, thorax and abdomen are used in the phylogenetic study of Dolichopodinae after closely examined. The genus *Sciapus* of Sciapodinae, which is thought to be one of the most primitive groups is selected as the rooted outgroup. *Hydrophorus* from Hydrophorinae is chosen as another outgroup because this subfamily is somewhat related to Dolichopodinae.

Examined representative species for this study are listed as follows (* type specimens):

Sciapus sp., *Hydrophorus qinghaiensis* Yang, 1998*, *H. praecox* (Lehmann, 1822), *Ahypophyllus sinensis* (Yang, 1996)*, *Ahercostomus jiangchenganus* (Yang et Saigusa, 2001)*, *Allohercostomus chinensis* Yang, Saigusa et Grootaert, 2001*, *Aphalacrosona postiseta* (Yang et Saigusa, 2001)*, *A. sichuanense* (Yang et Saigusa, 1999)*, *A. zhejiangense* (Yang, 1997)*, *Argrochlamys decolor* (Parent, 1930), *Dolichopus* (*Dolichopus*) *simulator* Parent, 1926, *D. (D.) brigeniculatus* Parent, 1926, *D. (D.) marynovi* Stackelberg, 1930, *Dolichopus* (*Hygrocleathus*) *brweifacies* Stackelberg, 1925, *D. (H.) rotundipennis* Loew, 1848., *Dolichopus* (*Macrodolichopus*) *diadema* Haliday, 1832, *Halaiba carvicola* Parent, 1929, *Ahercostomus jiangchenganus* Yang et Saigusa, 2001*, *Hercostomus* (*Hercostomus*) *beijingensis* Yang, 1996*, *H. (H.) acutatus* Yang et Yang, 1995*, *H. (H.) gansuensis* Yang, 1996*, *H. (H.) ulrichi* Yang, 1996*, *Hercostomus* (*Gymnopternus*) *congruens* Becker, 1922, *Hypophyllus obscurulus* (Fallén, 1823), *Ludovicus acutatus* Yang, 1996*, *L. curvatus* Yang, 1998*, *L. incisus* Yang, 1999*, *Lichtwardtia ziczac* (Wiedemann, 1824), *Muscidideicus praetextatus* (Haliday, 1855), *Orthochile nigrocoerulea* Latreille, 1809, *Paraclius acutatus* Yang et Li, 1998*, *P. adligatus* Becker, 1922, *P. longicornutus* Yang et Saigusa, 1999*, *Paraahercostomus orientalis* Yang, Saigusa et Masunaga, 2001*, *P. tristeta* Yang, Saigusa et Masunaga, 2001*, *Pelastoneurus bifarius* Becker, 1922, *Phalacrosona amoenum* Becker, 1922, *Poecilobothrus principalis* Loew, *P. fumipennis* (Stamius, 1831), *P. regalis* (Meigen, 1824), *P. nobilitatus* (Linné, 1767), *Polymedon inopinatus* Parent, 1934, *Pseudohercostomus sinensis* Yang et Grootaert, 1999*, *Setihercostomus zonalis* (Yang, Yang et Li, 1998)*, *Stelopyga* sp., *Sybistroma nordicornis*

Meigen, 1824, *Tachytrechus genualis* Loew, 1857, *T. notatus* (Stamius, 1831), *T. consobrinus* Walker, 1851.

The cladistic analysis was conducted using Hennig 86 (Version 1.5; Farris, 1988) by successive weighting of characters. Each morphological character is numerically coded and stated for all the representative species of the Dolichopodinae. The taxon character states matrix subjected to cladistic analysis is given in Table 1. 0 = plesiomorphic state, 1-2 = apomorphic state, ? = state inapplicable.

Morphological terminology for adult structures mainly follows McAlpine (1981).

3.2 Characters Used in the Analysis (Table 1)

Head

0) Eyes: separated (0); contiguous on lower margin of the clypeus (1). $0 \rightarrow 1$

Eyes are separated in most genera of Dolichopodidae and also Dolichopodinae except *Allohercostomus* with the eyes contiguous at the lower margin of the clypeus.

1) Vt bristles: long and strong, longer than pvt (0); weak, distinctly shorter than pvt (1). $0 \rightarrow 1$

The vt bristles are distinctly longer than pvt bristles in most genera of Dolichopodinae except *Allohercostomus* with weak vt distinctly shorter than pvt.

2) Face: narrowing downward (0); wide, nearly parallel sided (1); narrow basally then widened downward (2). $1 \leftarrow 0 \rightarrow 2$

The outgroup and most genera of Dolichopodinae have the face narrowing downward. In *Tachytrechus*, male and female has the face narrow basally and then widened towards the clypeus while *Aphalacrosona* and *Lichtwardtia* has the face wide and parallel sided.

3) Clypeus: bare (0); with one pair of bristles (1). $0 \rightarrow 1$

In *Setihercostomus*, the clypeus bears one pair of strong bristles in both sexes.

4) Clypeus: reaching or beyond lower margin of eyes (0); distinctly not reaching lower margin of eyes (1). $0 \rightarrow 1$

In *Sciapus* and *Hydrophorus*, the clypeus reaches or extends beyond the lower margin of eyes. So, clypeus reaching or beyond the lower margin of eyes is considered as plesiomorphic.

5) Proboscis and palpus: short, normal (0); distinctly elongated (1). $0 \rightarrow 1$

Proboscis and palpus are distinctly elongated in *Orthochile* and considered as apomorphic state.

6) Scape of antenna: bare dorsally (0); haired dorsally (1). $0 \rightarrow 1$

The outgroup and the genus *Pseudohercostomus* in Dolichopodinae with the scape of antenna bare dorsally. Most genera of Dolichopodinae have the scape haired dorsally.

7) Scape of antenna: short, nearly conical (0); elongated (1). $0 \rightarrow 1$

In most genera of Dolichopodinae, the antennal scape is short, nearly conical except the subgenus *Hygroceleuthus* of *Dolichopus* with the thick and elongated scape.

8) Pedicel of antenna: short, nearly conical (0); elongated (1). $0 \rightarrow 1$

In most genera of Dolichopodinae, pedicel is shorter than scape, but the subgenus *Hygroceleuthus* of *Dolichopus* has the elongated pedicel.

9) Antenna: normal (0); scape swollen with reduced pedicel (1). $0 \rightarrow 1$

In *Ludovicus* and *Sybiptroma*, the antenna has the scape remarkably swollen, vase like at apex and embracing the rudimentary pedicel, which hardly visible in outer view.

10) Antenna: first flagellomere longer than wide, subquadrate (0); first flagellomere short, as long as wide, oval (1); $0 \rightarrow 1$

Most genera of Dolichopodinae have the first flagellomere longer than wide and quadrate, except *Tachytrechus*, *Phalacrosona*, *Aphalacrosona*, *Pseudohercostomus* and *Ahercostomus* with the first flagellomere usually short, as long as wide, rounded apically and related with very short basal segment.

11) Arista: shorter than width of head (0); longer than width of head (1). $0 \rightarrow 1$

The arista is distinctly shorter than the width of the head in the outgroup and most genera of Dolichopodinae, except the genera *Ludovicus* and *Sybiptroma* with the arista distinctly longer than width of head.

12) Arista: dorsal (0); subapical to apical (1). $0 \rightarrow 1$

In *Sciapus*, *Hydrophorus* and most genera of Dolichopodinae, the arista is dorsal.

13) Arista: minutely pubescent (0); with long hairs (1); nearly bare (0). $1 \leftarrow 0 \rightarrow 2$

In outgroup and most genera of Dolichopodinae, the arista is bare or minutely pubescent. In *Lichtwardtia* and *Ahyphophyllus*, the arista has very long hairs.

14) Arista: without swollen part at middle or apex (0); with swollen part at middle or apex (1). $0 \rightarrow 1$

In *Ludovicus* and *Sybiptroma*, the arista is usually swollen at middle or apex, which is one of the generic characters.

15) Antenna: distance between antennal sockets shorter than width of ocellar tubercle (0); distance between antennal socket wider than width of ocellar tubercle (1). $0 \rightarrow 1$

The distance between antennal sockets is very closely located and distinctly shorter than ocellar width in outgroup and most genera of Dolichopodinae, except the genus *Aphalacrosona* has the antennal sockets widely separated and the distance between antennal sockets wider than ocellar tubercle.

16) Antenna: the outer margin of antennal sockets is distant from the inner margin of eyes (0); the outer margin of antennal sockets close to inner margin of eyes (1). $0 \rightarrow 1$

In *Sciapus* and *Hydrophorus*, the outer margin of antennal sockets is far away from the inner margin of eyes. The genera *Ahercostomus*, *Allohercostomus*, *Halaiba*, *Argyrochlamys*, *Phalacrosona* and *Polymedon* in Dolichopodinae also have the plesiomorphic state of antennal sockets.

Thorax

17) Scutellum: without distinct marginal hairs (0); with marginal hairs (several to many) (1). $0 \rightarrow 1$

In *Sciapus* and *Hydrophorus*, the scutellum has no distinct

marginal hairs. Thus, the scutellum without distinct marginal hairs is considered to be plesiomorphic.

18) Scutellum: without hairs on disc (0); with distinct hairs on disc (1). $0 \rightarrow 1$

In outgroup and most genera of Dolichopodinae, the scutellum has no distinct hairs on the disc except *Syblstroma* and *Poecilobothrus*.

19) Prsu: present (0); absent (1). $0 \rightarrow 1$

The prsu bristle is usually present in Dolichopodinae but absent only in *Parahercostrum*.

20) Su: present (0); absent (1). $0 \rightarrow 1$

The su bristle is present in Dolichopodinae but only absent in *Parahercostrum*.

21) Pteropleuron: without group of hairs in front of postspiracle (0); with group of hairs in front of postspiracle (1). $0 \rightarrow 1$

The pteropleuron with group of fine hairs is a character shared only by *Dolichopus*, *Gymnopternus*, *Lichtwardtia* and *Setihercostrum*.

22) Hind coxa: with outer bristle at middle (0); with outer bristle at apical 1/3 (1). $0 \rightarrow 1$

In outgroup and most genera, the hind coxa has 1 outer bristle at middle. And in the genera *Dolichopus*, *Lichtwardtia*, *Paracilius*, *Parahercostrum*, *Pelastoneurus*, *Polymedon* and *Pseudohercostrum*, the coxa has 1 outer bristle located at apical 1/3.

23) Hind femur: slender (0); short and thick (1). $0 \rightarrow 1$

In the genera *Sciapus*, *Hydrophorus*, *Phalacrosona*, *Aphalacrosona*, *Ludovicius*, *Ahyphophyllus*, *Parahercostrum* and *Ahercostrum*, the hind femur is slender and thought to be plesiomorphic.

24) Hind femur: with one preapical bristle (0); with several preapical bristles (1). $0 \rightarrow 1$

In outgroup and most genera of Dolichopodinae, the hind femur has only 1 preapical bristle except *Tachytrechus* and *Ahyphophyllus* has at least 2 preapical bristles.

25) Hind tarsomere 1: without dorsal bristle (0); with distinct dorsal bristle (1). $0 \rightarrow 1$

In *Sciapus* and *Hydrophorus*, including most genera in Dolichopodinae, the hind tarsomere 1 has no dorsal bristle. In *Lichtwardtia* and *Dolichopus*, the hind tarsomere 1 has strong and distinct dorsal bristles, and the species of *Parahercostrum* also has somewhat weak dorsal bristles.

26) Legs: with small claws (0); claws elongated (1). $0 \rightarrow 1$

The claws are small in *Sciapus*, *Hydrophorus* and other genera of Dolichopodinae except the genus *Aphalacrosona*.

27) Hind tarsomere 1: distinctly longer than tarsomere 2 (0); as long as tarsomere 2 (1); distinctly shorter than tarsomere 2. $1 \leftarrow 0 \rightarrow 2$

In *Sciapus* and *Hydrophorus*, the hind tarsomere 1 is distinctly longer than tarsomere 2 and regarded as plesiomorphic.

28) Wing: bristles on C well developed (0); bristles on C

very small and short (1). $0 \rightarrow 1$

Bristles on vein C are usually well developed except *Aphalacrosona* with bristles very weak and short.

29) Wing: C normal, without thickened part (0); C wholly or mostly thickened (1). $0 \rightarrow 1$

In *Sciapus* and *Hydrophorus*, vein C simple and not thickened. *Phalacrosona* has the costal vein thickened and reaching tip of M.

30) Wing: with curved M like Sciapodinae (0); M not curved like Sciapodinae (1). $0 \rightarrow 1$

The genera *Halaiba* and *Argyrochlamys* have the M curved like Sciapodinae and is considered to be plesiomorphic.

31) Wing: M without "Z" bend (0); with "Z" bend (1). $0 \rightarrow 1$

The genera *Lichtwardtia* and *Dolichopus* has the M with "Z" bend and with or without rudimentary M₂, indicating the ancestral divergence of M₂. So, this is considered to be plesiomorphic.

32) Wing: M strongly curved to R₄₊₅ (0); M slightly curved to R₄₊₅ (1); M nearly straight (2). $0 \rightarrow 1 \rightarrow 2$

M furcate with M₁ strongly curved to R₄₊₅ is the most distinct feature of Sciapodinae and regarded as a plesiomorphic character.

33) Wing: M ended at or just before the tip of wing (0); M distinctly ended before the tip of wing (1). $0 \rightarrow 1$

In *Sciapus*, *Hydrophorus* and most genera of Dolichopodinae, M ended at or just before the tip of wing.

34) Wing: cell R₄₊₅ normal (0); cell R₄₊₅ rather wide (1). $0 \rightarrow 1$

In most genera of Dolichopodidae, the cell R₄₊₅ is not so wide as that in the genus *Phalacrosona*.

35) CuAx ratio: < 1 (0); ≥ 1 (1). $0 \rightarrow 1$

Most genera of Dolichopodinae with m cu far away from the wing margin results in the small CuAx ratio.

36) Wing: without costal callus (0); with costal callus (1). $0 \rightarrow 1$

The vein C with the costal callus is a derived character present in the genera *Lichtwardtia* and *Dolichopus*.

Abdomen

37) Tergite 6: reduced, triangular in lateral view (0); distinctly elongated, subquadrate (1). $0 \rightarrow 1$

In *Sciapus*, *Hydrophorus* and most genera of Dolichopodinae, tergite 6 is reduced and triangular in lateral view, while *Ahyphophyllus* has tergite 6 distinctly elongated and subquadrate.

38) Male genitalia: smaller, at most curved forward to sternite 4 (0); larger, at least curved forward to sternite 2-3 (1). $0 \rightarrow 1$

In *Sciapus*, *Hydrophorus* and other subfamilies, the male genitalia is usually small enclosed in the tip of the preabdomen. If not enclosed, the male genitalia never extend forward to the base of abdomen.

Table 1. Characters state distribution of characters used in cladistic analysis of Dolichopodinae.

	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3				
<i>Sciapus</i>	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8						
<i>Hydrophorus</i>	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	0				
<i>Ahercostomus</i>	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	1	1	?			
<i>Ahypophyllus</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	1	1	2	0	0	0		
<i>Allohercostomus</i>	1	1	0	0	0	0	1	0	0	0	1	0	?	2	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	2	0	0	0		
<i>Aphalacrosona</i>	0	0	1	0	0	0	1	0	0	0	0	1	2	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	2	0	0	
<i>Argyrochlamys</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	?	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0		
<i>Dolichopus</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	1	1	0	1	0	1	0	0	1	0	?	0	0	0	
<i>Gymnopternus</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	2	0	0	1	1	2	0	0	0
<i>Halaiba</i>	0	0	1	0	0	0	1	0	0	0	1	0	1	?	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	1	0	0
<i>Hercostomus</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2	0	0	1	1	2	0	0	0
<i>Hygroceutusus</i>	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	1	0	0	0	1	1	1	0	1	0	1	0	0	1	0	?	0	0	1
<i>Hypophyllus</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	2	0	0	1	1	1	0	0	0	0
<i>Luovicius</i>	0	0	0	0	1	0	1	0	0	1	1	1	0	2	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	1	1	2	0	0	0
<i>Lichtwardtia</i>	0	0	1	0	?	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	1	1	0	1	0	2	0	0	1	0	?	0	0	1
<i>Macrodolichopus</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	1	0	0	1	0	?	0	0	0
<i>Muscidiacus</i>	0	0	?	0	1	0	1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	1	0	0	2	0	0	1	1	?	0	0	0
<i>Orthodile</i>	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	?	0	0	1	1	1	1	0	0
<i>Paradius</i>	0	0	0	0	?	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	2	0	0	1	1	0	1	1	0
<i>Parahercostomus</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0	0	0	1	1	2	0	0	0
<i>Pelastoneurus</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	2	0	0	1	1	0	1	1	0
<i>Phalacrosona</i>	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	1	0	0	1	0
<i>Poelobothrus</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	1	0	0	1	1	1	1	0	0
<i>Polymedon</i>	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	0	0	1	1	0	0	1	0
<i>Pseudohercostomus</i>	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0	2	0	0	1	1	2	0	0	0
<i>Setihercostomus</i>	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	2	0	0	1	1	2	0	0	0
<i>Steleopyga</i>	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2	0	0	1	1	1	0	0	0
<i>Sybiroma</i>	0	0	0	0	1	0	1	0	0	1	1	1	0	2	1	0	1	1	1	0	0	0	0	1	0	0	2	0	0	1	1	1	1	0	0
<i>Tachytrachus</i>	0	0	2	0	0	0	1	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	1	1	1	1	0

4 Results and Discussion (Fig. 20)

A strict consensus tree is produced from 4 equally most parsimonious trees (L= 99, Ci= 43, Ri= 61). As indicated in the cladogram, the subfamily Dolichopodinae is a monophyletic group supported by characters 6, 35 and 38. Within this subfamily two main clades were obtained. The genera *Ahercostomus*, *Allohercostomus*, *Tachytrachus* and *Aphalacrosona* form the basal monophyletic clade supported by character 12 (state 1), with the sister relationships between *Tachytrachus* and *Aphalacrosona*. The rest genera of the subfamily comprise another main clade supported by characters 4 (state 1) and 16 (state 1).

The monophyly of the Dolichopodinae is supported mainly by the antennal scape haired dorsally (character 6), CuAx ratio < 1 (character 35) and the male hypopygium very large, extending forward toward the base of the abdomen (character 38). All genera of Dolichopodinae share the dorsally haired scape excluding *Pseudohercostomus*. Though species of the subgenus *Argyra* of *Agyra* in Rhaphinae also have the scape with

dorsal hairs, the hypopygium relatively small and enclosed in the tip of the preabdomen. Therefore, the haired dorsally scape, large and distinctly curved forward hypopygium are the synapomorphic characters of Dolichopodinae.

The basal clade: *Ahercostomus*-*Allohercostomus*-*Tachytrachus*-*Aphalacrosona* is supported by the arista nearly apical related with very short basal segment. Although the apomorphic character 12 shows parallel derivation, which also present in *Pseudohercostomus* and *Halaiba*, it is still a good character to support the monophyly of the basal clade because of its steady exhibition in these genera. But more informative characters are still needed to confirm the monophyly of the basal clade in further study.

Another main clade is comprised of three paraphyletic subclades and supported by the clypeus distinctly not reaching the lower margin of the eyes (character 4, state 1) and the outer margin of the antennal sockets close to the inner margin of the eyes (character 16, state 1).

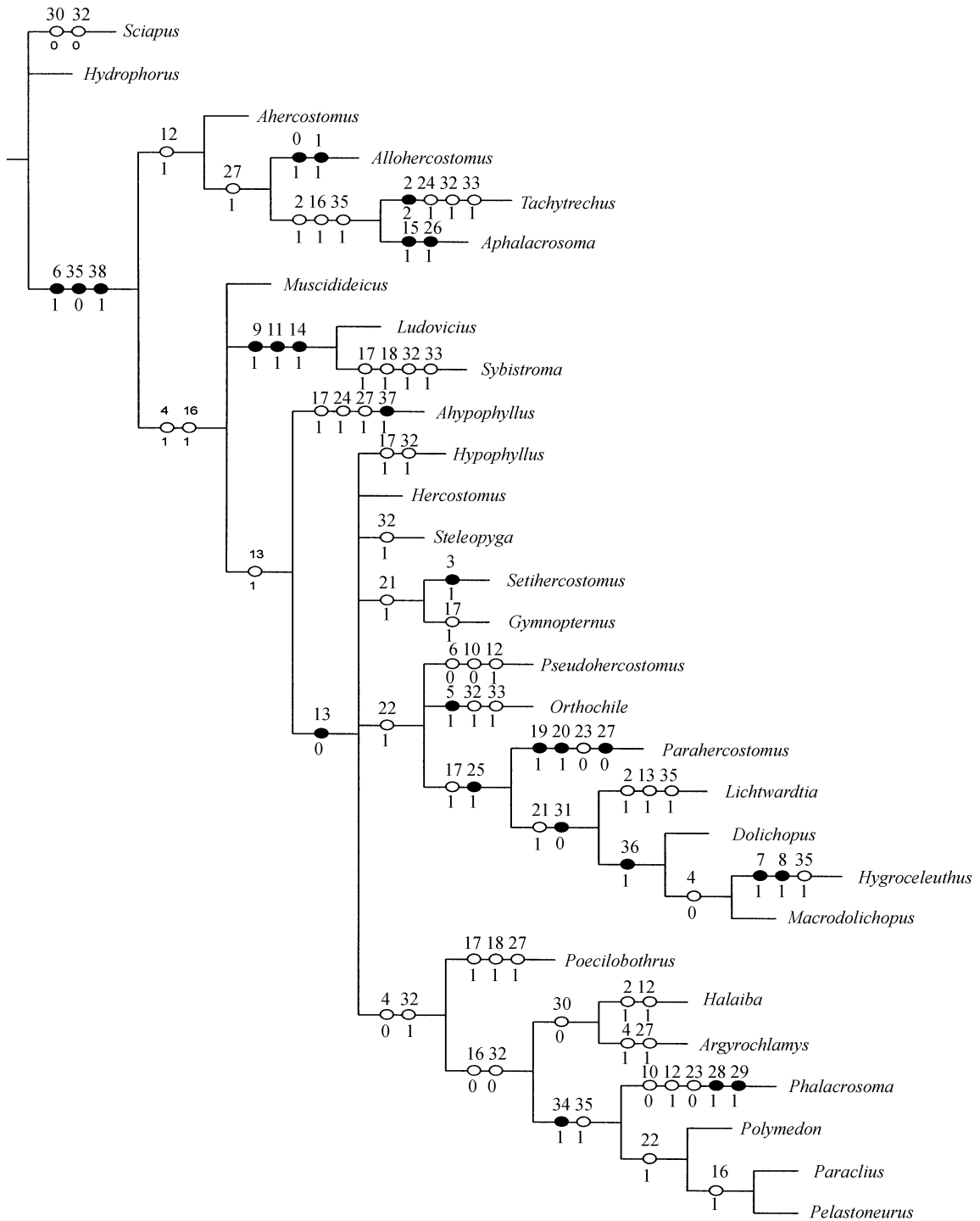


Fig. 20. Strict consensus of four most parsimonious trees of genera in Dolichopodinae from the Palaearctic and Oriental Realm (L = 99, Ci= 43, Ri= 61). Numbers above hashmarks correspond to characters as described in the text: numbers below hashmarks correspond to states. Black hashmarks represent synapomorphies, white hashmarks parallelism.

Within the paraphyletic subclades, the genera *Ludovicius* and *Sybistroma* were assigned as a monophyletic group, supported by the following synapomorphy: antenna with scape swollen while pedicel reduced and hardly visible in outer view (character 9), and arista usually with swollen part at middle or (and)

apex (character 14); and arista thin and long, longer than width of head (character 11). *Sybistroma* differs from *Ludovicius* in the scutellum with distinct discal and marginal hairs, and M distinctly ended before the tip of the wing. However, there are many species showing intermediate character states. *Ludovicius* with

some species that have M distinctly (such as *Ludovicus golanicus* Grichanov) ended before the tip of the wing, and *Sybistroma* also have some species with M indistinctly ended before the tip of the wing. Based on this consideration, the genus *Ludovicus* and *Sybistroma* should be put together as a single genus.

The relationships between *Hercostomus* and *Gymnopternus* has still been argued so far. The Dipterists from North American regard *Hercostomus* and *Gymnopternus* as two separated genera, while researchers from Asia and European accept *Gymnopternus* as a subgenus of the genus *Hercostomus*. According to the present cladogram, *Gymnopternus* is more close to the genus *Setihercostomus* supported by the pteropleuron with one group of fine hairs in front of the postspiracle (character 21). The wing with "Z" bend (character 31) is only shared by *Dolichopus* and *Lichtwardtia* in Dolichopodinae, which well supports their monophyly together with the character pteropleuron with one group of fine hairs in front of postspiracle. The sister group *Setihercostomus-Gymnopternus* was assigned to be paraphyletic with the genus *Hercostomus*. Herein, as the comparative morphological study carried out by Pollet (2004), *Gymnopternus* is a valid genus.

The generic limits between *Hercostomus* and *Hypophyllus* are not clear yet in the present cladogram. While considering the long lateral lobe of the male genitalia bearing group of long hairs *Hypophyllus* may be a monophyletic genus.

The *Poecilobothrus* is probably an intermedial group in having M slightly curved to R_{4+5} , while M distinctly ended before the tip of the wing. The *Halaiiba* and *Argyrochlamys* form a sister group supported by the wing with curved M like Sciapodinae type and M distinctly ended before the tip of the wing. Though *Halaiiba* and *Argyrochlamys* are similar to each other, they are different in the shape of the face and the arising position of arista.

The genera *Polymedon*, *Paradius*, and *Pelastoneurus* show the monophyly by sharing the hind coxa with outer bristle at apical 1/3 (character 22, state 1). In fact, the genus *Paradius* is identical with *Pelastoneurus* in M strongly curved to R_{4+5} and distinctly ended before the tip of wing, and there is no more forceful characters to distinguish them very well. Becker (1921, 1922) distinguished *Pelastoneurus* from *Paradius* by the plumose rather than short pubescent arista and bulging rather than flat clypeus, but he also noted that many species possess intermediate charac-

ters. So, *Paradius* Coquillet might be the synonym of *Pelastoneurus*.

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长足虻亚科系统发育研究及三新属记述 (双翅目, 长足虻科)

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摘 要 采用支序分析的方法首次对古北和东洋区长足虻亚科的 24 属 3 亚属之间的系统发育关系进行了分析。结果表明, 长足虻亚科为一严格的单系群, 其中 *Ahercostomus*、*Allohercostomus*、*Tachytrechus* 和 *Aphalacrosona* 为一单系群, *Tachytrechus* 和 *Aphalacrosona* 为姐妹群。原为寡长足虻属 *Hercostomus* 亚属之一的 *Gymnopternus* 与新属 *Setihercostomus* 的亲缘关系较近, 为有效属。粗柄长足虻属 *Ludovicicus* 与 *Sybistroma* 为一严格单系群, 建议合并为一属。弓脉长足虻属 *Paraclius* Coquillett 应为 *Pelastoneurus* 的异名。建立 3 新属, 即准长毛长足虻属 *Ahyphophyllus* gen. nov., 模式种 *Ahyphophyllus sinensis* (Yang, 1996); 准白长足虻属 *Aphalacrosona* gen. nov., 模式种 *Aphalacrosona postiseta* (Yang et Saigusa, 2001); 毛颜寡长足虻属 *Setihercostomus* gen. nov., 模

关键词 双翅目, 长足虻科, 长足虻亚科, 系统发育, 新属。
中图分类号 Q969.451.3

式种 *Setihercostomus zonalis* (Yang, Yang et Li, 1998)。原为寡长足虻属的亚属 *Ahercostomus* 提升为属, 模式种 *Hercostomus (Ahercostomus) jiangchenganus* (Yang et Saigusa, 2001)。

建立的新组合为: *Ahyphophyllus sinensis* (Yang, 1996) comb. nov., *Aphalacrosona hubeiense* (Yang, 1998) comb. nov., *A. postiseta* (Yang et Saigusa, 2001) comb. nov., *A. sichuanense* (Yang et Saigusa, 1999) comb. nov., *Setihercostomus setifacies* (Stackelberg, 1934) comb. nov., *S. zonalis* (Yang, Yang et Li, 1998) comb. nov., *S. wuyangensis* (Wei, 1997) comb. nov., *S. huangi* (Zhang, Yang et Masunaga, 2004) and *Ahercostomus jiangchenganus* (Yang et Saigusa, 2001) comb. nov.。