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New species of *Eudiospilus* (Braconidae, Brachistinae) from Madagascar with a review of the genus and key to species

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Abstract

A second species of *Eudiospilus* Szépligeti collected from Madagascar, *E. rubrumbarus* **sp.n.**, is described with an illustrated key to the two known species. *Eudiospilus rubrumbarus* can be distinguished from *E. conradti* Szépligeti by the presence of fore wing vein 2a, hind wing with 2-1A short and not reaching wing margin, propodeum without median furrow, ovipositor longer than total length of body, and differences in the coloration of antennal flagellomeres, head, and metasoma. The evolutionary relationship between *Eudiospilus* and other diospiline genera is discussed.

Key words: Diospilini, Helconinae, Afrotropical, *Diospilus*, description, new species

Introduction

The genus *Eudiospilus* was first described by Szépligeti (1914), which originally included two Afrotropical species found in Cameroon: *E. conradti* Szépligeti 1914 and *E. tricolor* Szépligeti (1914). Both species were redescribed by Papp (2005), and *E. tricolor* was moved to *Diospilus* Haliday, rendering *E. conradti* as the sole species within the genus. *Eudiospilus* can be recognized by the shape of the second submarginal cell of the fore wing (Figs. 1, 7): with 3RSa at least 1.2x longer than 2RS; 2M equal to 2RS; and the *r-m* crossvein is slightly incurved at the posterior end. This combination of characters separates *Eudiospilus* from all other diospiline genera. While some members of Diospilini are recorded as solitary endoparasitoids of phytophagous beetles such as Curculionidae and Nitidulidae (Billqvist & Ekbom 2001; Kuhlmann *et al.* 2001; Sharkey 1997), the biology of *Eudiospilus* is unknown. Diospilini has been moved from Helconinae to the newly elevated subfamily Brachistinae based on molecular evidence by Sharanowski *et al.* (2011), however, the relationships within the tribe and among other Members of the subfamily remains unclear as taxonomic revisions are needed. The objective of this study was to describe and illustrate a new species of *Eudiospilus* from Madagascar, and provide an updated identification key for the two known *Eudiospilus* species.

Material and methods

The holotype of *E. conradti* was borrowed from Museum für Naturkunde der Humboldt Universität, Berlin (MNHU) and compared with newly collected material from recent biodiversity surveys in Madagascar. Morphological terms are based on (Sharkey & Wharton 1997). Measurement data were taken from the average of 3 separate measurements, and are given in millimeters or ratios. Photos were taken with a Nikon 5200 digital camera mounted on an Olympus SZX16 stereomicroscope. Multiple images with different focal planes were combined using the software CombineZP (Hadley 2013), to produce a single, focused image. Adobe Illustrator® was used to create line drawings by tracing the outline of the character on the image. These line drawings were added as insets to some photographic images to clarify character states.

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Key to species of *Eudiospilus* Szépligeti, 1914

1. Fore wing with 2a absent (Fig. 8); hind wing with 2-1A reaching the margin of the wing (Fig. 8); propodeum with median furrow (Fig. 5); median apical margin of clypeus smooth (Fig. 3); antenna brown with apical white band (Fig. 1); head tricolored, frons white, vertex and gena brown, and clypeus yellow (Fig. 3); abdominal tergites largely brown with teardrop shaped brown spot present on the posterior margin of T2; ovipositor shorter than total length of body (0.7x) . . . . . .***Eudiospilus conradti* Szépligeti, 1914**

- Fore wing with 2a present, not reaching wing margin (Fig. 9); hind wing with very short 2-1A , not reaching the margin of the wing (Fig. 10); propodeum without median furrow (Fig. 6); median apical margin of clypeus crenate to smooth (Fig. 4); antenna brown intersected by a band of 12–14 white segments (median white band on antennal segments 13– or 14–26 or 27) (Fig. 2); head largely black, frons black or with white patches, vertex and gena black, clypeus yellow or black (Fig. 4); abdominal tergites yellow, brown band may be present on the posterior margin of T2; ovipositor longer than total length of body (1.1x) . . . . . .***Eudiospilus rubrumbarus* Zhang & Sharanowski sp. nov.**

***Eudiospilus* Szépligeti**

Diagnosis. *Eudiospilus* is distinguished from all other diospiline genera by fore wing veins 3RSa at least 1.2x the length of 2RS, 2M equal to or 0.9x the length of 2RS, and the slightly incurved *r-m* crossvein at the posterior end of the vein (Fig. 7). Superficially, *Eudiospilus* and *Schauinslandia* Ashmead are similar in general appearance as members of both genera have large subquadrate heads, thickened antennae, and are similar in general coloration. The latter, however, is restricted to Australasia (Ashmead 1900) and the rectangular shape of the second submarginal cell in *Eudiospilus* is synapomorphic for the genus and different from the upside-down trapezoid (2M 0.8x shorter than 2RS) shape found in species of *Schauinslandia.* The geographic separation, morphological differences, and molecular results from Sharanowski *et al.* (2011) justify the retention of *Eudiospilus* as a distinct genus rather than a junior synonym of *Schauinslandia*.

***Eudiospilus conradti* Szépligeti, 1914**
(Figs. 1, 3, 5, 7, 8)

***Eudiospilus conradti* Szépligeti, 1914**: 225. Type Locality: Cameroon: Joh-Albrechtshohe, Lectotype (selected by van Achterberg in 1980), female (MNHU); **Papp 2005**: 232 [redescription, illustration].

Additional specimen examined: female, Angola, Roça Canzele, 30 km nördl/ Quiculungo II-III-55. Heimrich, MNHU.

***Eudiospilus rubrumbarus* Zhang & Sharanowski, n. sp.**
(Figs. 2, 4, 6, 9,10)

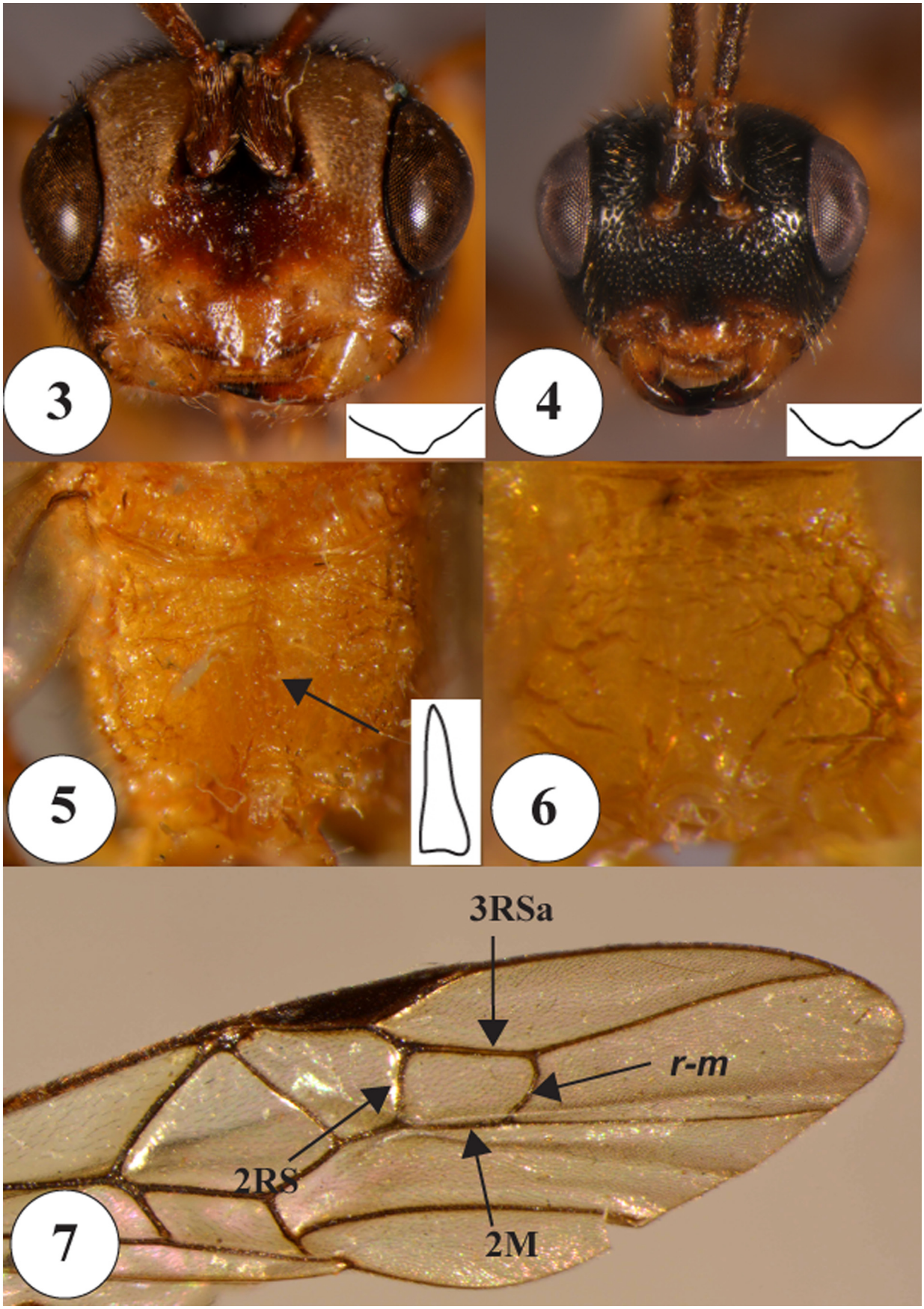
Type locality. Madagascar: Ranomafana National Park

Holotype. f, deposited at California Academy of Sciences (CAS). Holotype labels: 1. Fianarantsoa Parc Nat. Ranomafana, radio twr @ Forest edge: 21°15.05”S 47° 25.43”E 1130 m, 27.ii-9.iii.2003; MA-2-9B-54 R. Harin’Hala; CAS; MT, trop forest. 2. DNA Voucher #BJS014S Secondary Voucher Hymenoptera Institute University of Kentucky. The left fore leg is missing, and the left fore wing is separated from the body and glued onto the point.

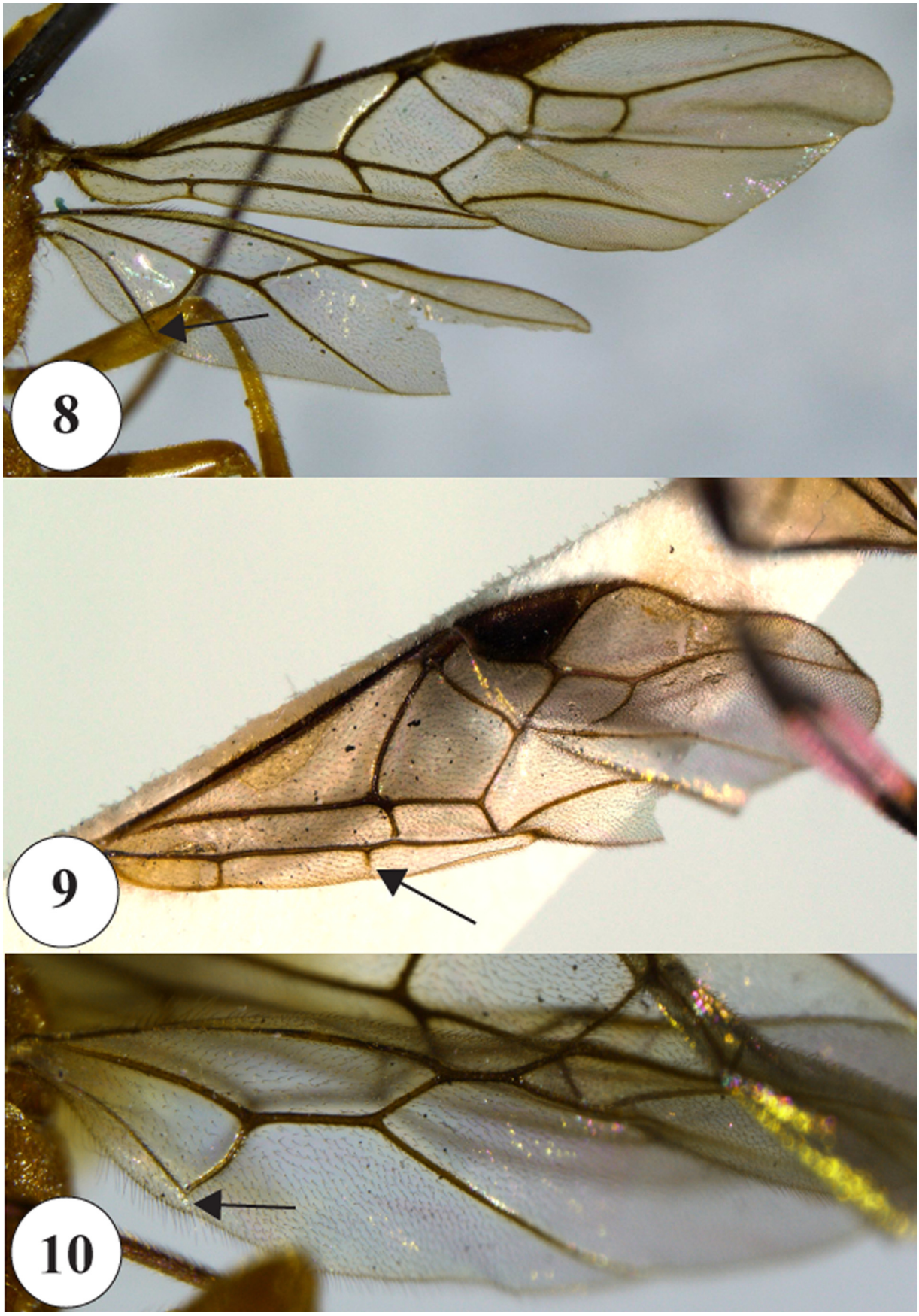
Paratype. f, deposited at Parc Botanique et Zoologique de Tsimbazaza, Antananarivo, Madagascar. Same locality label as holotype. DNA Voucher #BJS014 (Genbank Accession as “*Diospilus* sp. 5” # ACC JF979961.1; 28S JF979827.1; 28S JF979690.1; 18S JF979552.1 Hymenoptera Institute University of Kentucky.)

Diagnosis. This species can be distinguished from *E. conradti* using the following combination of characters: head largely black (Figs. 2, 4), antennal segments brown basally and apically, intersected by a band of 11 white segments; propodeum rugose-rugulose without median furrow (Fig. 6); fore wing 2a present, not reaching the margin of the wing (Fig. 9); hind wing 2-1A very short, not reaching the margin of the wing (Fig. 10); tergite 2 with brown band on posterior margin; and ovipositor 1.1x longer than the total length of body (Fig. 2). *Eudiospilus rubrumbarus* is restricted to Madagascar, while *E. conradti* is found in Cameroon and Angola.

FIGURES 1–2. 1. Lateral habitus of ***Eudiospilus conradti*** holotype. **2.** Lateral habitus of ***Eudiospilus rubrumbarus*** holotype.



FIGURES 3–7. ***Eudiospilus conradti*****: 3.** Frontal view of head. Inset: Line drawing of clypeal margin. **5.** Propodeum. Arrow: median furrow. Inset: Median furrow shape. **7.** Fore wing. ***E. rubrumbarus*****: 4.** Frontal view of head. Inset: Line drawing of clypeal margin. **6.** Propodeum (paratype).



FIGURES 8–10. ***E. conradti*: 8.** Fore and hindwing. Arrows: 2-1A reaching margin of hindwing. ***E. rubrumbarus*: 9.** Forewing. Arrow: Presence of 2a. **10.** Hindwing. Arrow: 2-1A not reaching margin of hindwing.

Description. Female. Body length 6.5mm.

Color. Head black except clypeus and proximal half of mandible yellow; scape, pedicel, and flagellomeres 1–14 and 27–34 brown, flagellomeres 14–26 white (dyed pink in holotype due to red label leaching); body testaceous; tergite 2 with a brown band dorsally; fore and hind wings subhyaline, pterostigma dark brown and veins brown.

Head. Head width 1.6x as long in dorsal view, umbilicate punctured; OOL (the shortest distance between the edge of posterior ocellus to the margin of the compound eye) 5.3x as long as POL (the shortest distance between the edges of both posterior ocelli); 34 antennal segments, antennal keel present; first flagellomere 2.5x as long as broad apically; clypeus 3.8x as wide as high, anterior margin crenate with two small teeth (Fig. 4).

Mesosoma. Mesosoma length 1.8x its height in lateral view; pronope present and deep; notauli evenly deep, crenulate; pronotum, mesoscutum, scutellum, and mesopleuron smooth, shiny; sternaulus present, crenulate; propodeum rugose-rugulose anteriorly, carinae obliterated, posterior areola present (Fig 6). **Wings**: Fore wing 4.5 mm in length, shorter than body; 3RSa 1.2x as long as 2RS; pterostigma 3.4x as long as wide (Fig. 9); 1a and 2a present (Fig. 9). Hind wing with 2-1A not reaching margin of the wing (Fig. 10). **Legs**: Hind femur 4.3x long as broad medially; basitarsus long, 3.3x longer than tarsomere 2; claws simple.

Metasoma. Length of first tergite 1.5x its apical width in dorsal view, rugose; tergite 2 slightly raised anteromedially, with a brown band on the posterior edge; ovipositor longer than body (1.1x).

Male. Unknown.

Variations. Paratype with 39 antennal segments (1–13 brown, 14–27 white, 28–39 brown); frons white (possible result of DNA extraction process), clypeus black; tergite 2 without brown band.

Biology. Unknown.

Distribution. Madagascar.

Etymology. In honor of Baron Manfred von Richthofen, the "Red Baron", as the coloration on the head of this species resembles that of a leather aviator helmet.

Discussion

Eudiospilus has been rarely collected and all known specimens were examined for this study. The male of both *E. conradti* and *E. rubrumbarus*, as well as the biology of both species remains unknown (Papp 2005). The afrotropical fauna is grossly understudied, particularly with respect to Diospilini taxa, and the diversity and distribution of *Eudiospilus* is likely far greater than currently known.

The phylogenetic relationships between *Eudiospilus* and the other members of Diospilini remains unclear, as the monophyly of this group is not supported by current generic concepts, thus rendering the diagnosis difficult (Sharkey 1997). The paratype of *E. rubrumbarus* was used in the multigene phylogenetic analysis under the name "*Diospilus* sp. 5" in Sharanowski *et al.* (2011), and the resulting clade contained some other diospiline members such as *Baeacis* Foerster, *Schauinslandia*, and *Diospilus*. However, not all the diospiline genera were sampled in Sharanowski *et al.* (2011), thus the clade is poorly resolved and relationships cannot be inferred until more data are added.

In addition, while Diospilini, Brachistini, and Brulleiinii have all been moved to Brachistinae based on recent molecular evidence (Sharanowski *et al.* 2011), the relationships between these three tribes remains unclear. Additional sampling across a broader geographical range, combined with molecular phylogenetic analysis of brachistine tribes are needed in order to fully understand the higher-level evolutionary relationships among members of Brachistine.

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