



## ***Omophorus (Sinomophorus) wallacei*: a new weevil from Borneo highlights the enigmatic Ethiopian-Oriental disjunct distribution (Coleoptera, Curculionidae, Molytinae)**

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### **Abstract**

In the present study we describe a new species of the genus *Omophorus*, *O. (Sinomophorus) wallacei* sp. nov., from Malaysian Borneo. Photographs of habitus and genitalia, a distribution map, and a key for the identification of *Omophorus* species are included. The definition of the subgenus *Sinomophorus* is revised and several new diagnostic characters are added. This is the first documented occurrence of *Omophorus* in Borneo, highlighting its potential diversity in the Oriental region and providing additional evidence of Ethiopian-Oriental disjunction within this genus.

**Key words:** Weevils, Metatygini, new species, Oriental region, disjunction, biogeography

### **Introduction**

The tribe Metatygini was established by Pascoe (1888) under Curculionidae, including the type genus *Metatyges* Pascoe, 1888 (= *Omophorus* Schoenherr, 1835) and *Zantes* Pascoe, 1888. Kuschel (1987) placed Metatygini in Molytinae without a specific statement. Subsequently, Alonso-Zarazaga & Lyal (1999) followed this classification in their checklist of Curculionoidea and placed five genera in this tribe: *Omophorus* Schoenherr, 1835, *Physarchus* Pascoe, 1865, *Sternechosomus* Voss, 1958, *Teluropus* Marshall, 1917 and *Zantes* Pascoe, 1888. Lyal (2014) excluded *Teluropus* and *Zantes* from Metatygini, and Caldara *et al.* (2014) placed *Zantes* in Microstylini and *Teluropus* in Curculioninae *incertae sedis*.

The genus *Omophorus* is characterized by the body covered with light yellow, waxy exudate and hair-like scales on the lateral and ventral surfaces; the absence of paired longitudinal grooves on the rostrum; long prementum, with labial palps absent; pronotum distinctly shorter than elytral length; elytra with large coarse punctures; interstria III strongly protruding over the base of pronotum; and divaricate claws, with ventral surface edentate. It can be distinguished from other genera in this tribe by the smoother humeral calli and the absence of a ventral tooth on the underside of the onychia (Wang *et al.* 2011; Lyal 2014). The genus *Omophorus*, currently comprised of seven species and three subgenera, occurs in Sub-Saharan Africa, Papua New Guinea and Southwest China.

During our study on oriental weevils we discovered an unidentified species of *Omophorus* from Borneo and after careful examination consider it is a new species of the subgenus *Sinomophorus*. The morphological characters seen in this new species provides further data for a subgeneric definition. This is the first record of the subgenus *Sinomophorus* in Borneo, suggesting that there may be a higher potential biodiversity of the group in the Oriental region and providing additional evidence to highlight the Ethiopian-Oriental disjunct distribution within *Omophorus*.

## Material and methods

Material examined in this paper is deposited in the following institutions:

NMNS	National Museum of Natural Science, Taichung, Taiwan
NTU	National Taiwan University Museum, Taipei, Taiwan
TARI	Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan
ZRC	Zoological Reference Collection [= Lee Kong Chian Natural History Museum], National University of Singapore, Singapore

All specimens were collected at an elevation of ca. 1200 m on Mt. Trusmadi at light trap. The majority of the type series were soaked in cold water overnight to soften the body and then glued on the cards after morphological examination. One paratype was preserved in 95% ethyl alcohol and housed in the cryogenic collection of ZRC for future DNA extraction. The habitus photograph was obtained with a digital camera Canon EOS 6D with Canon EF 100mm f/2.8L Macro IS USM and edited with photoshop CS6. Terminology used in the description follows that of Wang *et al.* (2011). The distribution map was prepared using the SimpleMappr program (Shorthouse 2010).

The following measurements are used in this paper and abbreviated as follows: SL—standard length (from midpoint of anterior margin of pronotum to apex of elytra); RL—rostrum length (the apex of rostrum to the base of rostrum), RW—rostrum width (the middle part of rostrum); PL—pronotal length (from the midpoint of anterior margin to the posterior margin), PW—pronotal width (the widest part of pronotum); EL—elytral length (from the humeri to the elytral apex); EW—elytral width (the widest part of elytra); AL—aedeagal length (from the anterior margin to the posterior margin of pedon).

## Taxonomy

### Subgenus *Sinomophorus* Wang, Alonso-Zarazaga, Ren & Zhang, 2011

**Type species.** *Omophorus rongshu* Wang, Alonso-Zarazaga, Ren & Zhang, 2011: 44.

**Diagnosis** (modified based on Wang *et al.* (2011)). Distinguished from nominal subgenus by the absence of tubercle on pronotal surface; bifid vestiture of the venter; the obtuse humeral angle; extremely small extent of sclerotization in the endophallus; absence of styli in the ovipositor and the absence of a spiculum ventrale on female sternite VIII. It can be separated from the subgenus *Pangomophorus* Voss, 1960 by the bifid vestiture of the venter; the obtuse humeral angle; and the presence of a metatibial uncus. Several diagnostic characters, including longer antennal club; elongate subtrapezoidal scutellum and smaller subhumeral calli, proposed in Wang *et al.* (2011) are considered invalid for a new subgeneric delimitation on the basis of the comparison between *O. (S.) rongshu* and *O. (S.) wallacei* (see details in discussion).

### *Omophorus (Sinomophorus) wallacei* sp. nov.

(Figs. 1–17)

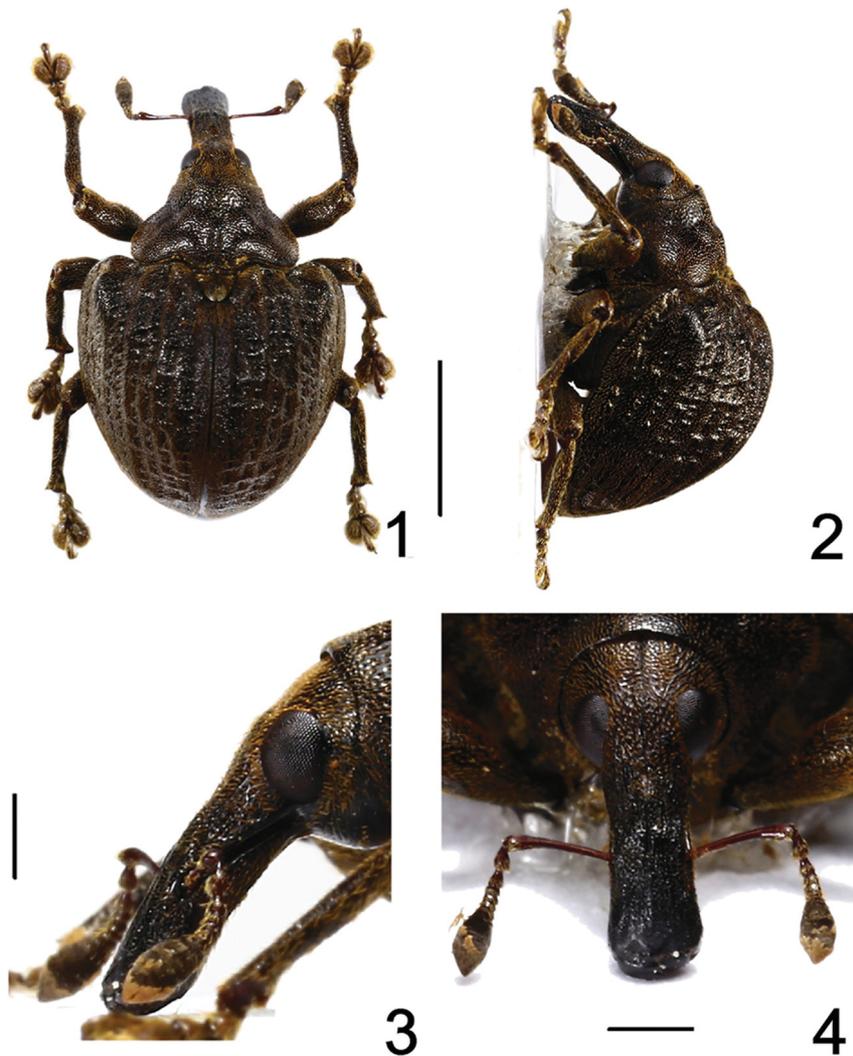
**Type material. Holotype:** ♂, Mt. Trusmadi, Borneo, Malaysia, II. 2016, C.-F. Hsu leg. (ZRC). **Paratypes:** The same data as the holotype (1 ♂ in NMNS; 1 ♂ in NTU; 1 ♂ in TARI; 2 ♂ in ZRC, including one liquid preserved paratype).

**Description. Male** (holotype). Measurements (in mm): SL: 9.6; RL: 2.9; RW: 1.1; PL: 2.5; PW: 4.4; EL: 7.7; EW: 6.9; AL: 2.0. Coloration: mainly dark brown dorsally, sparsely covered with yellowish brown scales; antennae reddish brown; legs dark brown; ventral side dark reddish brown, covered with dense, bifid, yellowish brown scales laterally and ventrally. Antennae and legs covered with hair-like yellow scales.

Head: subspherical in dorsal view, forehead  $0.9 \times$  as wide as RW, somewhat convex laterally; surface densely punctate. Eyes large, broadly ellipsoidal, with length  $1.4 \times$  width. Rostrum straight, subparallel sided, somewhat widened basally and apically, with RL  $1.1 \times$  PL; surface densely punctate, with punctures mainly oblong,

mesorostrum with medial sulcus, extending to occiput. Antennae: Scape inserted at basal half of rostrum, with length  $14.1 \times$  width,  $1.0 \times$  as long as funicle; funicle 7-segmented, I obconical, with length  $1.8 \times$  width, II obconical, somewhat shorter than I, with length  $1.3 \times$  width, III–VI subspherical, with length  $0.5 \times$  width respectively,  $1.3 \times$  as long as I, VII attached to club, with length  $0.4 \times$  width; club 3-segmented, clavate, extremely large, with length  $1.8 \times$  width,  $0.7 \times$  as long as funicle, suture between I and II indistinct while suture between II and III deep and obvious (Figs. 3–4).

Pronotum: subconical in dorsal view, strongly narrowed anteriorly, middle part strangled, with PL  $0.6 \times$  PW, PW  $1.7 \times$  width of anterior margin, side bisinuate, with paired transverse depression medially, surface lustrous metallic, punctate, with numerous spot-like punctures (Fig. 1).



**FIGURES 1–4.** *Omophorus (Sinomophorus) wallacei* sp. nov.: 1. Habitus, dorsal view. 2. Habitus, lateral view. 3. Head, lateral view. 4. Head, dorsal view. Scale bars: 1–2. 5.0 mm; 3–4. 1.0 mm.

Scutellum: subtrapezoidal, rounded apically.

Elytra: moderately convex laterally, ventral side slightly broadened, with obtuse humeral angle (Fig. 5), tubercle developed basally in interstria III, and between interstria VII–IX, with EL  $1.1 \times$  width, EL  $3.0 \times$  PL, with paired indistinct tubercle between interstria IV–VI apically; surface lustrous metallic, densely punctate, punctures in various forms, widely scattered (Figs. 1–2).

Abdomen: ventrite II with length  $0.1 \times$  width,  $1.2 \times$  as long as III; III  $1.1 \times$  as long as IV,  $1.1 \times$  as long as V, width slightly narrowed apically (Fig. 9), ventrite V concave apically. Tergite I–VI weakly sclerotized, tergite VII sclerotized, lateral margin strongly sclerotized, surface covered with dense hair-like scales (Fig. 10), tergite VIII (pygidium) sclerotized, strongly sclerotized and emarginate apically, covered with dense hair-like scales (Fig. 11).

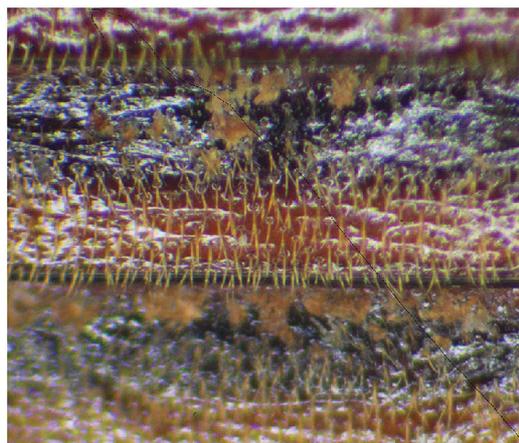
Legs: procoxae contiguous, mesocoxae  $1.3 \times$  as long as the distance between meso- and metacoxae; femora strongly broadened medially, with maximum width  $1.7 \times$  basal width, surface densely covered with hair-like scales; tibiae moderately straight, somewhat widened basally, with metatibial uncus developed; tarsi 5-segmented, tarsomere III rounded apically, tarsomere V divaricate, without paired ventral tooth.



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**FIGURES 5–8.** 5. Humeral angle of *Omophorus (Sinomophorus) wallacei* sp. nov.. 6. Humeral angle of *Omophorus (Pangomophorus) biroi* Voss, 1960, holotype. 7. Vestiture of abdomen of *Omophorus (Sinomophorus) wallacei* sp. nov. 8. Vestiture of abdomen of *Omophorus (Pangomophorus) biroi* Voss, 1960, holotype.

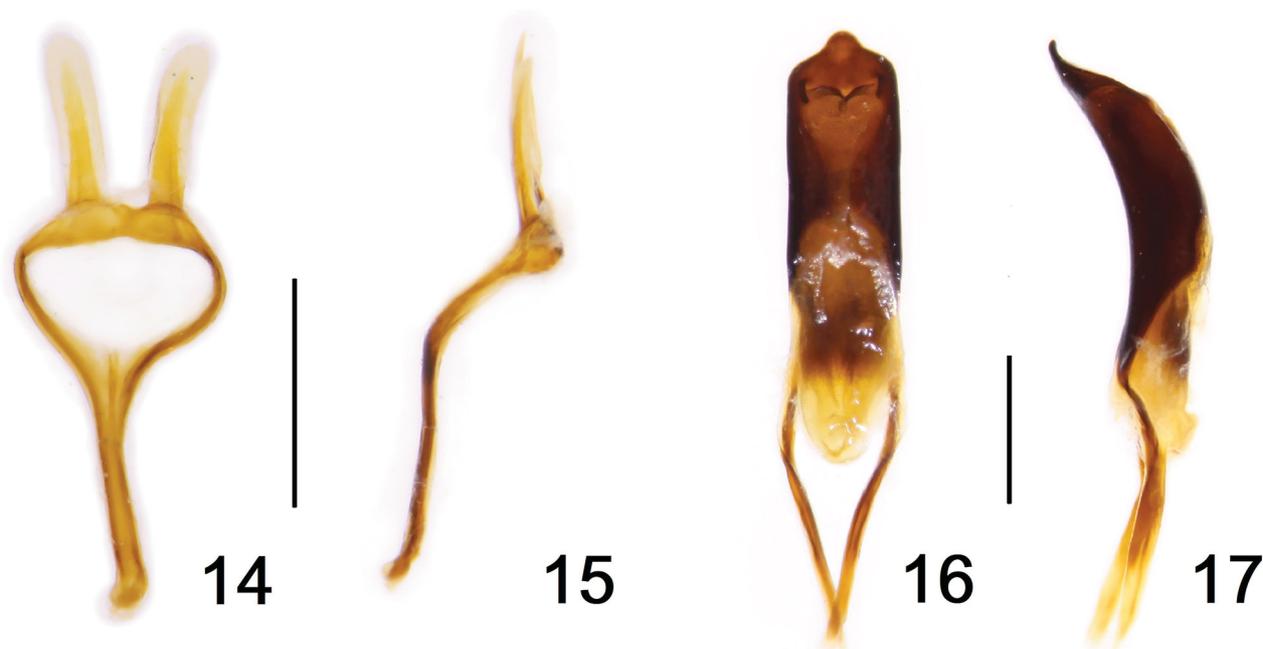
Male genitalia and terminalia: sternite VIII semilunar, sclerotized, basal margin strongly sclerotized (Fig. 13); spiculum gastrale widely emarginate apically, base little sclerotized (Fig. 12). Aedeagus with AL  $3.1 \times$  width in dorsal view, somewhat curved at both sides laterally, lateral margin of pedon slightly recurved apically; endophallus with dense small teeth and very minute sclerotization (Figs. 16–17); tegmen with ring, manubrium as long as parameroid lobes, parameroid lobes sclerotized medially, with sides somewhat sclerotized. (Figs. 14–15).

**Female.** Unknown.

**Diagnosis.** This new species is similar to *Omophorus (Sinomophorus) rongshu* Wang, Alonso-Zarazaga, Ren & Zhang, 2011, but can be easily distinguished by larger body size; distant eyes; shorter antennal club; rostrum somewhat broadened basally and apically; strongly bisinuate pronotal base; tubercle between interstria VII–IX present; aedeagus: larger in size ( $>1.5$  mm), with broader, rounded apex, slightly recurved apically; tegmen with manubrium distinctly longer than parameroid lobes.



**FIGURES 9–13.** *Omophorus (Sinomophorus) wallacei* sp. nov.: 9. Ventrites, ventral view. 10. Tergite VII, dorsal view. 11. Tergite VIII, dorsal view. 12. Spiculum gastrale, dorsal view. 13. Sternite VIII, dorsal view. Scale bars: 9. 5.0 mm; 10–13. 1.0 mm.



**FIGURES 14–17.** *Omophorus (Sinomophorus) wallacei* sp. nov.: 14. Tegmen ring, dorsal view. 15. Lateral view. 16. Penis, dorsal view. 17. Lateral view. Scale bar: 1.0 mm.

**Etymology.** The specific name is in honor of the renowned British naturalist, Alfred Russel Wallace, who is famous for his remarkable contributions on the theory of evolution and biogeography.

**Distribution.** Malaysian Borneo.

### Key to species of genus *Omophorus* Schoenherr, 1835

1. Vestiture of ventral part bifid; humeral angle obtuse, almost absent ..... 7
- Vestiture of ventral part simple; humeral angle present ..... 2
2. Pronotum with paired tubercle dorsally; metatibial uncus present ..... 3
- Pronotal tubercle absent; metatibial uncus absent. .... *O. (Pangomophorus) bironi* Voss, 1960
3. Body length less than 7 mm ..... 4
- Body length more than 7 mm ..... 5
4. The tubercle of pronotum strongly protruding, with sharp summit; interstria I strongly protruding basally; stria X complete. . . . . *O. (Omophorus) indispositus* Boheman, 1845
- The tubercle of pronotum moderately protruding, with obtuse and rounded summit; interstria I weakly protruding medially; stria X almost disappear behind the metacoxae ..... *O. (O.) boxi* Marshall, 1944
5. Antennae and head reddish brown; scutellum triangular, rounded apically ..... 6
- Antennae and head black; scutellum cordiform ..... *O. (O.) hacquardi* (Chevrolat, 1881)
6. Apical angle of elytra rounded; integument without metallic luster. .... *O. (O.) stomachosus* Boheman, 1881
- Apical angle of elytra with sharp angle; integument with metallic luster. .... *O. (O.) cupreus* (Pascoe, 1870)
7. Body length less than 6 mm; forehead  $0.5 \times$  as wide as rostral apex; rostrum subparallel-sided; antennal club  $1.5 \times$  as long as funicle; pronotum conical, slightly bisinuate of lateral margin; tubercle between interstria VII–IX absent; aedeagus length less than 1.5 mm, with sharp apex, pedon straight apically; tegmen with manubrium length equal with parameroid lobes length; body covered with fine grey scales. .... *O. (Sinomophorus) rongshu* Wang *et al.*, 2011
- Body length more than 7 mm; forehead  $0.8 \times$  as wide as rostral apex; rostrum somewhat broadened basally and apically; shorter antennal club; pronotum subconical, strangled medially, lateral margin strongly bisinuate; tubercle between interstria VII–IX present; aedeagus length more than 1.5 mm, with broader, rounded apex, pedon recurved apically; tegmen with manubrium distinctively longer than parameroid lobes; body covered with fine yellowish brown scales. . . . . *O. (S.) wallacei* **sp. nov.**

### Discussion

This new Molytinae can be placed within the Trigonocolini tribe-group by its interstria III with strong convex projection extended over base of pronotum; large coarse punctures on elytral surface; body irregularly covered with light yellow, waxy exudate and piliform scales laterally and ventrally; and, divaricate tarsomere V. Further, it can be placed in Metatygini based on the combination of the following characters: smooth surface of rostrum, without groove; and, pronotal length shorter than half elytral length (Lyal 2014). It is confirmed to belong to the genus *Omophorus* by its diagnostic convex humeral calli and simple claws, without a ventral tooth on the apex of tarsomere V (Wang 2011; Lyal 2014). The subgeneric attribution of this species is somewhat more confusing. Based on the subgeneric classification proposed in Wang *et al.* (2011), this species should not be attributed to the subgenus *Omophorus* because of the bifid vestiture of the venter; and the extremely small extent of sclerotization in the endophallus, nor *Pangomophorus* Voss, 1960 by the smaller subhumeral calli; and the presence of a metatibial uncus. It does, however, share enough characteristics with *Sinomophorus* Wang, Alonso-Zarazaga, Ren & Zhang, 2011 to warrant its plausible placement in this subgenus. However, the diagnostic “elongate subtrapezoidal scutellum” is a somewhat vague term, the scutellum is elongate in some species of the nominal subgenus and the term “subtrapezoidal” is hard to define, additionally, its antennal club length and subhumeral calli disagrees with the subgeneric concept in Wang *et al.* (2011), which resembles *Omophorus* s. str. In view of its monotypy, which could include some autapomorphies in the subgeneric diagnoses, together with the overall similarities compared to *O. (S.) rongshu* and the zoogeographic distribution, we herein suggest that the elongate subtrapezoidal scutellum, subhumeral calli and the longer antennal club should be eliminated from the diagnoses for subgeneric identification for *Sinomophorus*. Additionally, we propose several new diagnostic characters for improving the subgeneric classification (see details in the diagnosis of *Sinomophorus*).

Disjunction is defined as phylogenetically related organisms with widely separated distributions (Brown & Lomolino 1998). This phenomenon occurs in many groups of insects, for example, the transoceanic disjunction in *Limnogonus* water striders (Hemiptera: Gerridae; Ye *et al.* 2016); Eastern Asia–North American disjunction in

Hormaphidini and Melaphidina aphids (Hemiptera: Aphididae; von Dohlen *et al.* 2002; Ren *et al.* 2013) and swallowtail butterflies of *Papilio elwesi* species-group (Lepidoptera: Papilionidae; Wu *et al.* 2015); Mediterranean-southern African disjunction in *Longitarsus* flea beetles (Coleoptera: Chrysomelidae; Biondi & D'Alessandro 2008) and *Scarabaeus* scarab beetles (Coleoptera: Scarabaeidae; Carpaneto 2008); continental European-Central America disjunction in *Eubria* water penny beetles (Coleoptera: Psephenidae; Barr & Shepard 2017); Ethiopian-Oriental distribution in *Eupetersia* parasitic bees (Hymenoptera: Halictidae; Pauly 2012).

The genus *Omophorus* also exhibits an Ethiopian-Oriental disjunct distribution (Fig. 18). The discovery of *O.* (*S.*) *wallacei* not only highlights the potential species diversity of this group in the Oriental region but also adds a new example to demonstrate this enigmatic biogeographic distribution. It is plausible that the transoceanic disjunction of *Omophorus* in Sub-Saharan Africa (Ethiopian region), tropical Asia (Oriental region), and Papua New Guinea (Australian region) could be linked to a Gondwanan distribution. Like previous studies (e.g., stoneflies, apple snails, and parrots; Wright *et al.* 2008; Hayes *et al.* 2009; McCulloch *et al.* 2016), this distribution, together with having the highest species diversity in Africa, also lends credence to a Gondwanan origin. However, the causes of disjunction are varied, including vicariance by continental drift, long-distance dispersal or the extinction of intervening populations in a once broadly distributed species can also contribute to the disjunct distribution (Brown & Lomolino 1998; Barden & Ware 2017). Moreover, it is worth noting that the present-day distributions of *Omophorus* may be caused by insufficient taxonomic work and underestimated species diversity. Therefore, further work on the taxonomy and geographic ranges of this group may challenge this assumption in the future. It is not currently possible to pinpoint the evolutionary path of this group but with more biogeographic studies along with molecular phylogenetics and a better understanding of the associated historical biogeography, a clearer picture with surely come to light.

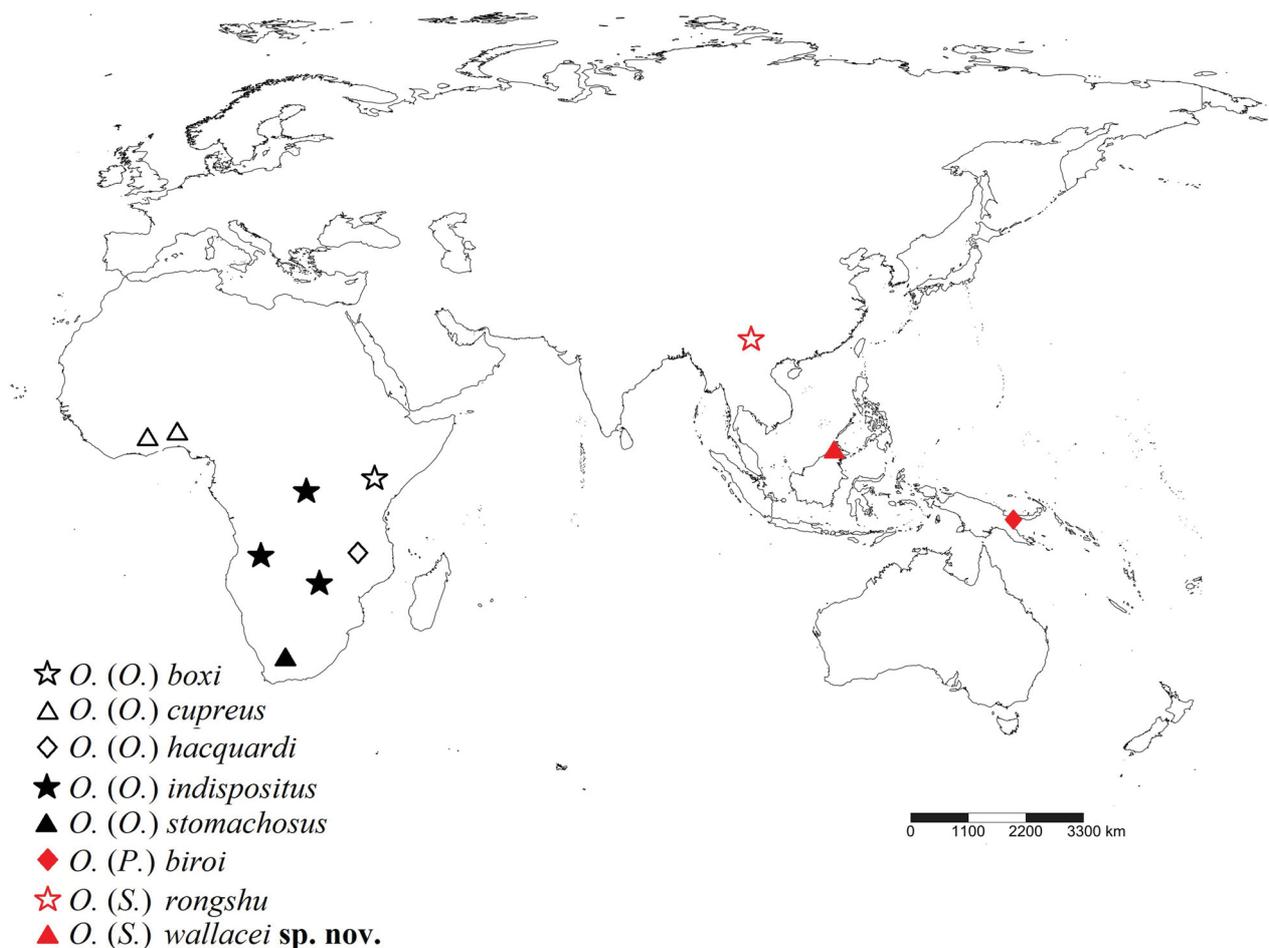


FIGURE 18. The distribution map of genus *Omophorus* Schoenherr, 1835.

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