



## Three new species of *Epipompilus* Kohl (Hymenoptera, Pompilidae, Pepsinae) from Australia

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### Abstract

Three new species are added to the genus *Epipompilus* (Hymenoptera: Pompilidae) in Australia. *Epipompilus mirabundus* sp. nov., *E. taree* sp. nov., and *E. namadgi* sp. nov. are described and illustrated. A key to males of *Epipompilus* is provided. A novel association of *Epipompilus* and *Sceliphron formosum* (Hymenoptera: Sphecidae) is also documented. The larva of *E. mirabundus* sp. nov. was found sharing single nest cell with a *Sceliphron* larva; this association could be the result of a parasitised spider being brought back to the nest by the *Sceliphron* adult.

**Key words:** Spider wasps, mud dauber wasps, *Epipompilus*, *Sceliphron formosum*

### Introduction

Pompilidae are ectoparasitoid wasps with more than 5,000 species distributed worldwide (Pitts *et al.* 2006). Most species are solitary and known as spider wasps from their diet, where adult females usually use spiders as a food provender for their larvae (Wasbauer 1995).

The genus *Epipompilus* Kohl comprises 52 species of spider wasps, 16 of which are in the Neotropical region, one in the Nearctic region, and 36 in Australia (Roig-Alsina & Barneche 2017). Australian *Epipompilus* are more diverse and have a broader spectrum of morphological variation, especially in male genitalia (Evans 1972).

Knowledge on the biology of this genus is mostly based on Australian species (Villanueva-Bonilla *et al.* 2018). Previous records suggest that these wasps directly deposit eggs on a spider while hunting, making them one of the only known koinobiont pompilids. Their characteristic morphology, with depressed enlarged front femora has been proposed as an adaptation to crawling under bark for spider hunting. During a survey of *Sceliphron formosum* (Smith) prey preference, an *Epipompilus* larva was found sharing a single cell within the *S. formosum* nest, which further supports their koinobiont biology (Yuan & Rodriguez, unpublished data).

Historically there have been some obstacles to the study of taxonomy in this genus. Because they are small and rarely visit flowers, *Epipompilus* are rarely collected. Additionally, association of the sexes is difficult, as there is strong sexual dimorphism (Evans, 1972). Here we describe three new species of *Epipompilus* from the Australian Capital Territory and New South Wales and present a key to identify Australian males of *Epipompilus*.

### Materials and methods

Abbreviations used in the descriptions are the same as those used by Wasbauer and Kimsey (1985): FD, the facial distance; MID, the middle interocular distance; OOL, the ocellocular length; POL, the postocellar length; TFD, the transfacial distance. Measurements of clypeus are as follow: WC, width of clypeus, measured from the widest points; and LC, highest length of clypeus.

Images of specimens were taken with a Leica DFC500 camera mounted on a Leica M205C microscope. Raw images were then aligned and stacked using the Leica Application Suite (LAS) V4.9. and Helicon Focus 5.3. software. Material examined is deposited in Australian Insect Collection (ANIC), CSIRO National Research Collections Australian Canberra.

## Taxonomy

### *Epipompilus mirabundus* Yuan & Rodriguez, sp. nov.

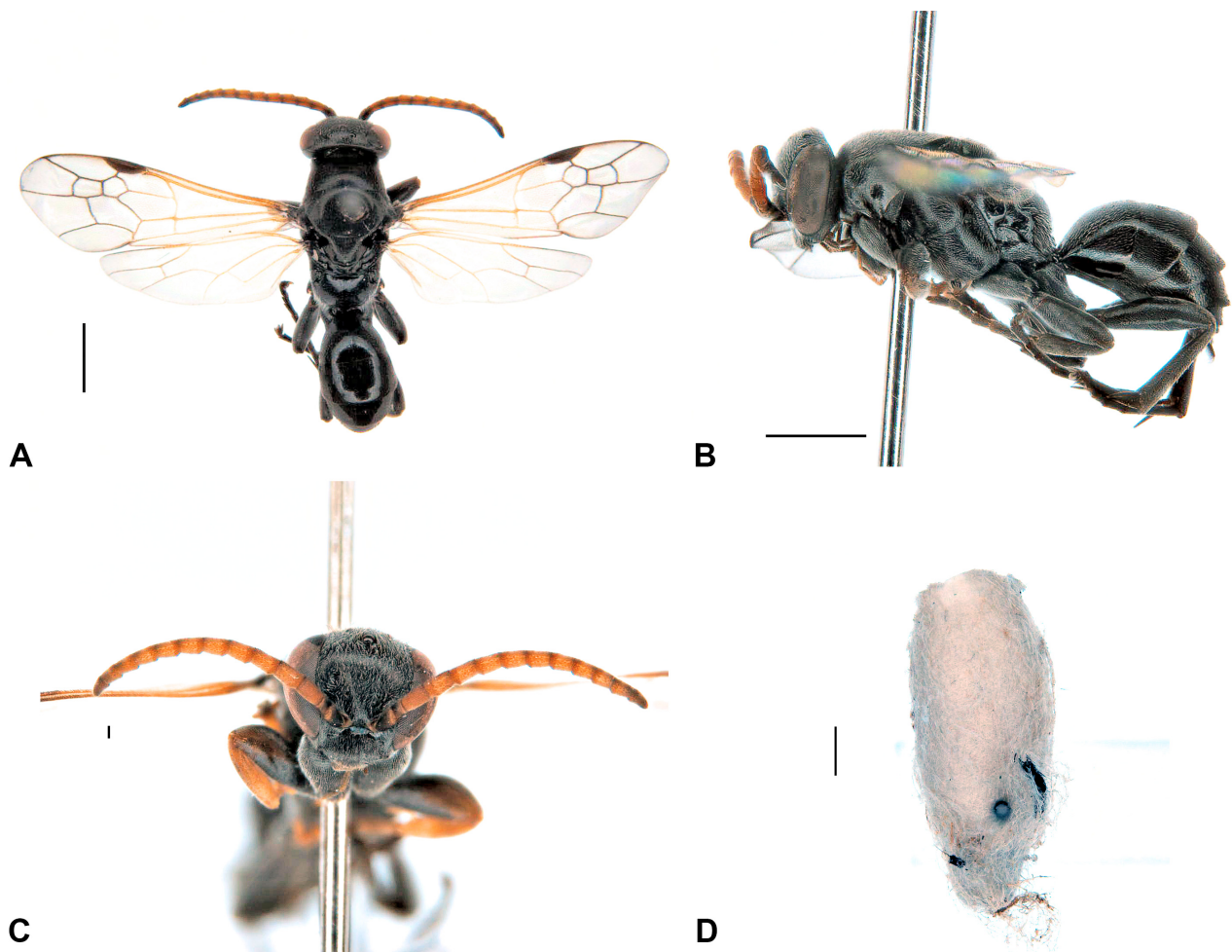
(Figs. 1–3)

**Type material.** Holotype, ♂ (Figs. 1, 2), pinned, with genitalia and genital plate in a separate vial, labelled “Tuggeranong, ACT (-35.4588023, 149.0913374), underpass of Tharwa Drive”, “ANIC Database No. 32\_151566”.

**Diagnosis.** This species can be recognized by the following combination of characters: flagellum, profemur, protibia and protarsus brown (Figs. 1A, 1B, 1C); genitalia with gonostylus and parapenial lobe exceeding aedeagus by over one third; gonostylus slender, long, loosely setose with longer setae on the apex; parapenial lobe broad, long, invaginated and constricted at base, outer apex higher than inner apex; digitus about the same height as aedeagus, bent inward, constricted and slender at the base, rounded and short setae on outer margin; subgenital plate elongate, concave in the middle and broad at apex, long setae at apex, setae bent apically (Fig. 2).

**Description.** Body length 5 mm; fore wing 4 mm; maximum wing width 1.5 mm.

**Coloration.** Integument black; body covered with white, minute pubescence; clypeus and scape, pedicel black; mandible and remaining antennal articles brown; wings transparent; more than one half of the veins brown at base; legs with profemur, protibia and protarsus brown, otherwise black.



**FIGURE 1.** *Epipompilus mirabundus* sp. nov., holotype, male. A. Habitus, dorsal view. B. Habitus, lateral view. C. Head, frontal view. D. Cocoon. Scale bar: 1mm for A, B and D; 0.1 mm for C.



**FIGURE 2.** Male genitalia of *Epipompilus mirabundus* sp. nov., holotype. A. Genitalia, ventral view. B. Subgenital plate, ventral view. Scale bar: 0.1 mm



**FIGURE 3.** Cocoon of *Epipompilus mirabundus* sp. nov., arrow pointed at the cocoon of *E. mirabundus* found sharing the mud nest of *Sceliphron formosum*, both cocoons emerged in the laboratory.

*Head.* Head wide, covered with white minute pubescence; TFD  $1.1 \times$  FD; MID  $0.7 \times$  FD; punctation conspicuous, small, shallow; front ocellus in obtuse angle; lateral ocelli closer to compound eyes than to each other; POL  $1.3 \times$  OOL; head apex protruding in between lateral ocelli; clypeus lower than frons, flat broad, bilobed, WC  $2 \times$  LC; labrum partially exposed; flagellomeres roughly the same size, each article basally enlarged.

*Mesosoma*. Pronotum broad, trapezoid, elongated, visible dorsally, with shallow punctation, width  $2 \times$  length; lateral pronotum concave; scutum broad, shape similar to pronotum rotated 180 degrees, with shallow punctation; notauli present, distance equal to the posterior of scutum and separating scutum into 3 sections; scutellum and metanotum square-shaped, lateral side concave, smooth and shining laterally, with shallow punctation and pubescence covering the apex; propodeum smooth and shiny at base, remaining surface covered with pubescence, antero-laterally with longer setae; wing with maximum length  $3 \times$  width, third submarginal cell about as long as the second submarginal cell, second recurrent vein meeting third submarginal cell half distance from base to apex of cell; coxa enlarged, rounded at base, about two thirds as long as femur, protibia with short spines, protibial spur curved, tarsal claws bifid, metatibial spur heavily setose.

*Metasoma*. Terga and sterna covered with short pubescence except first sternum, laterally smooth without any pubescence, terga largely covering sterna.

*Genitalia*. Gonostylus and parapenial lobe exceeding aedeagus over one third; gonostylus slender, long, loosely setose with longer setae on the apex; parapenial lobe broad, long, invaginated and constricted at the base, outer apex higher than inner apex; digitus slender, about the same height as aedeagus, bend inward, constricted and slender at the base, short setae on the outer margin of the lobe; aedeagus broad in the middle, constricted at the apex; subgenital plate elongate, concave in the middle and broad at apex, long setae at apex and upper side of the plate, setae bent apically.

*Cocoon*. Cocoon oval, silky and white.

**Distribution.** Australia: Australian Capital Territory.

**Etymology.** The epithet originates from the Latin *mirabundus*, which means astonishment, and is based on the unusual way the specimen was found in its larval stage developing and sharing a cell with a *Sceliphron formosum* larva.

**Remarks.** The cocoon was found in the nest of *Sceliphron formosum* (Hymenoptera: Sphecidae) (Figs. 1D, 3). A male adult was reared and emerged in the lab.

### ***Epipompilus namadgi* Yuan & Rodriguez, sp. nov.**

(Fig. 4)

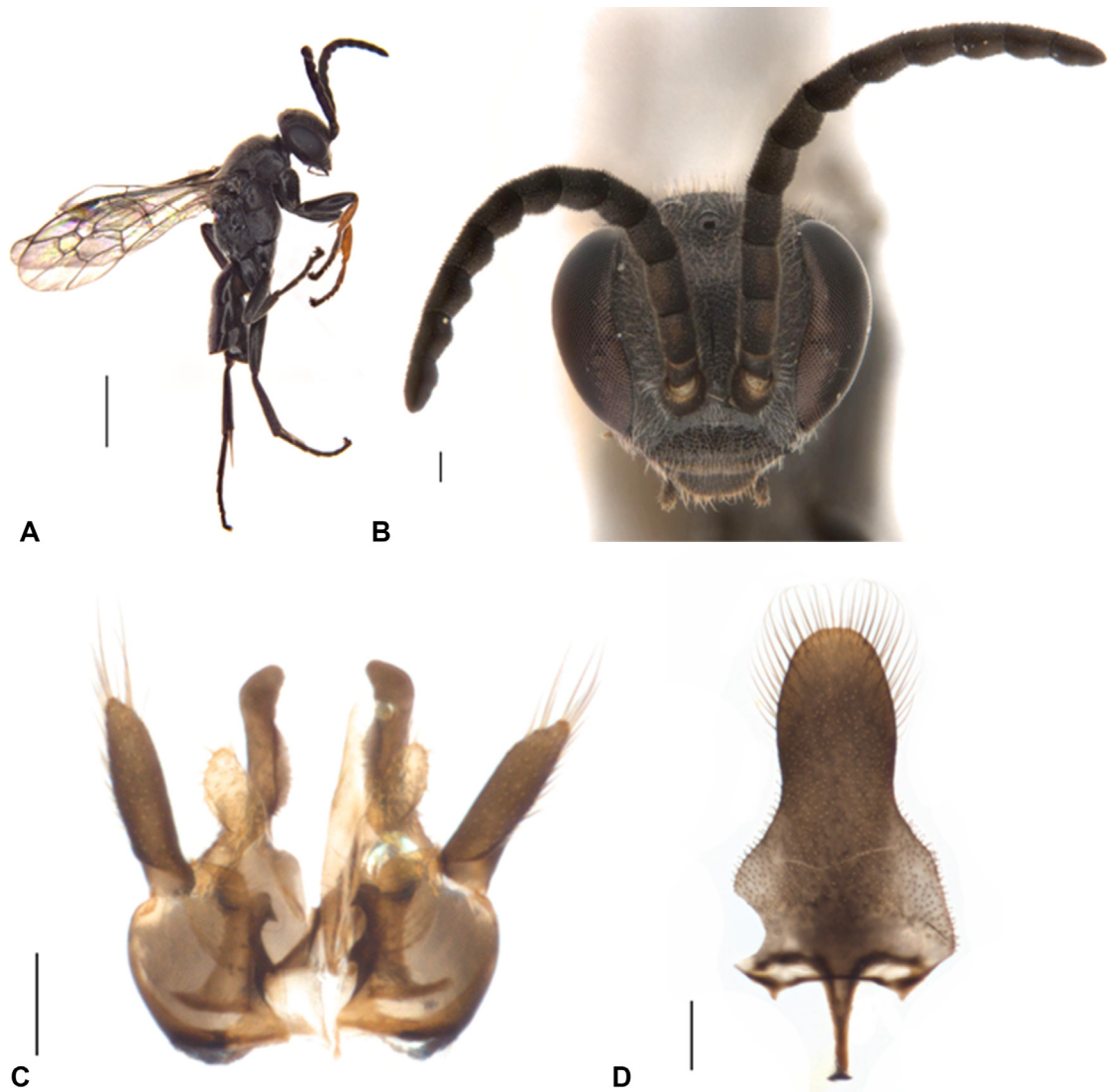
**Type material.** Holotype, ♂ (Fig. 4), pinned, with genitalia and genital plate in a separate vial, labelled "AUS: ACT, Namadgi National Park, near Naas Creek, -35.79629003, 148.91472, 1165m, Nov 29–Dec 4, Malaise, ACT Bush Blitz, Evangelista, Florez and Rodriguez col.", "ANIC Database No. 32\_151567".

**Diagnosis.** This species can be recognized by the following combination of characters: coloration of protibia and partial tarsus brown, else black (Figs. 4A, 4B); genitalia with gonostylus and parapenial lobe slightly exceeding aedeagus; gonostylus slightly broader than parapenial lobe, loosely setose on the outer margin and with longer setae on the apex; parapenial lobe slender, bent at apex, inner apex higher than outer apex, setose in inner middle margin; digitus lower than aedeagus, broad, setose with slightly longer setae on apex, bent inward, stem without any setae; aedeagus constricted at base; subgenital plate elongate, concave in the middle and broad at base, long setae at apex and upper side of the plate, setae bent apically (Figs. 4C, 4D).

**Description.** Body length 4.5 mm; fore wing 4 mm; maximum wing width 1.2 mm.

**Coloration.** Integument black; body covered with white, minute pubescence; clypeus, mandible, scape, pedicel and flagellum black, one fifth of margin brown; wings transparent; wing veins dark brown; legs with protibia and tibial spur brown, protarsus slightly brown, else black.

**Head.** Head wide, covered with white minute pubescence; TFD  $1.1 \times$  FD; MID  $0.7 \times$  FD; punctation conspicuous, small, shallow; front ocellus in obtuse angle; lateral ocelli closer to compound eyes than to each other; POL  $1.3 \times$  OOL; head apex protruding in between lateral ocelli; clypeus lower than frons, flat broaden on bottom and narrow on top with upper sutures meeting between antennae forming a triangle, WC  $1.4 \times$  LC; labrum partially exposed; flagellomeres roughly the same size, dorsal side flat and ventral side bulging at each of the articles; short, dense setae evenly distributed throughout the antenna.



**FIGURE 4.** *Epipompilus namadgi* sp. nov., holotype, male. A. Habitus, lateral view. B. Head, frontal view. C. Genitalia, ventral view. D. Subgenital plate, ventral view. Scale bar: 1 mm for A; 0.1 mm for B, C and D.

*Mesosoma.* Pronotum broad, trapezoid-shaped with short side protruding in the middle, elongated, visible dorsally, white minute setae covering dorsally, width  $2.6 \times$  length; lateral pronotum concave, covered and ridged with white setae; scutum broad, shape similar to pronotum rotated 180 degrees, covered with white minute setae and shallow punctation; notauli present, distance equal to the posterior of scutum and separating scutum into three segments; scutellum and metanotum upside down bell-shaped, lateral side concave and loosely covered with white setae; propodeum ridged, loosely covered with minute white setae, longer white setae antero-laterally; maximum wing length  $2.91 \times$  width, third submarginal cell about as long as the second submarginal cell, second recurrent vein meeting the third submarginal cell at half distance from base to apex; coxa enlarged, rounded at base, about two thirds as long as femur, protibial spur curved, tarsal claws bifid, metatibial spur heavily setose.

*Metasoma.* Terga evenly covered with short white setae, sterna loosely covered with short white setae except first sternum.

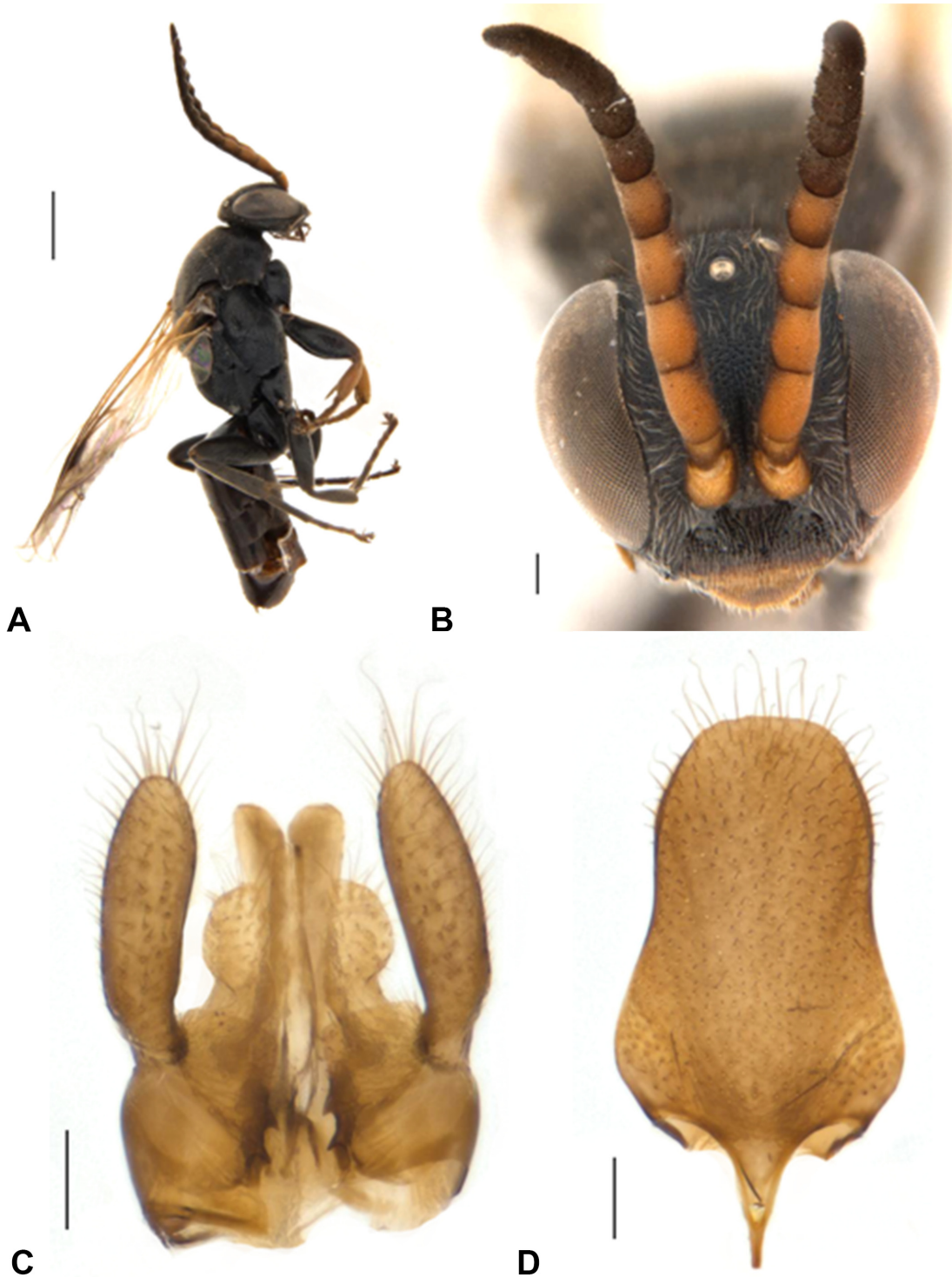
*Genitalia.* Gonostylus, parapenial lobe slightly exceeding aedeagus; gonostylus slightly broader than parapenial lobe, loosely setose on the outer margin and with longer setae on the apex; parapenial lobe slender, bent at apex, inner apex higher than outer apex, setose in the inner middle margin; digitus lower than aedeagus, broad, setose with slightly longer setae on the apex, bent inward, stem devoid of setae; aedeagus constricted at the base; subgenital plate elongate, concave in the middle and broad at base, long setae at apex and upper side of the plate, setae bent apically.

**Distribution.** Australia: Australian Capital Territory.

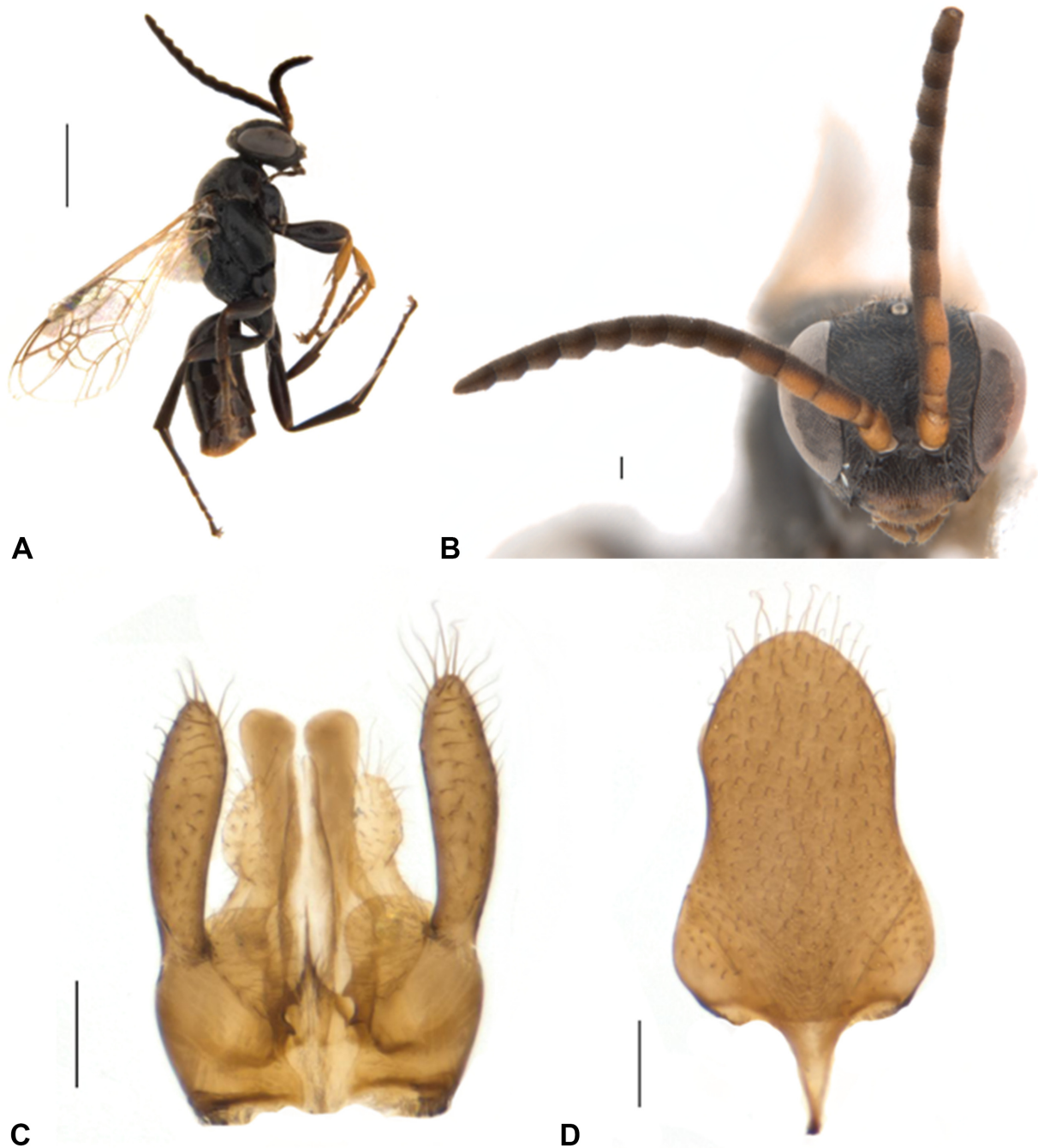
**Etymology.** The epithet, placed as a noun in apposition, comes from the National Park where the type specimen was collected.

*Epipompilus taree* Yuan & Rodriguez, sp. nov.

(Figs. 5, 6)



**FIGURE 5.** *Epipompilus taree* sp. nov., holotype, male. A. Habitus, lateral view. B. Head, frontal view. C. Genitalia, ventral view. D. Subgenital plate, ventral view. Scale bar: 1 mm for A; 0.1 mm for B, C and D.



**FIGURE 6.** *Epipompilus taree* sp. nov., paratype, male. A. Habitus, lateral view. B. Head, frontal view. C. Genitalia, ventral view. D. Subgenital plate, ventral view. Scale bar: 1 mm for A; 0.1 mm for B, C and D.

**Type material.** Holotype, ♂ (Fig. 5), pinned, with genitalia and genital plate in a separate vial, labelled “3 km N Lansdowne nr. Taree20-27. Dec.1990. G. Williams. Malaise. Rainf./wet sclerophyll. Paratype 1♂. AUS: NWS, 3 km N Lansdowne nr. Taree20-27. Dec.1990. G. Williams. Malaise. Rainf./wet sclerophyll”, “ANIC Database No. 32\_112552”.

**Diagnosis.** This species can be recognized by the following combination of characters: protibia, tarsus and first three articles of flagellum brown ventrally, (Figs. 5A, 5B); genitalia with gonostylus and parapenial lobe slightly exceeding aedeagus; gonostylus swollen, loosely setose with longer setae on apex; parapenial lobe broad, swollen at apex, invaginated, bent inward and constricted at the base, outer apex higher than inner apex; digitus slightly lower than aedeagus, broad, setose on top with longer setae on apex, bent inward, stem broad and without any setae;

aedeagus broad in the middle, constricted at apex; subgenital plate broad, slightly concave in the middle, long setae at apex, setae bent apically (Figs. 5C, 5D).

**Description.** Body length 6.5 mm; fore wing 5 mm; maximum wing width 1.9 mm.

**Coloration.** Integument black; body loosely covered with brown, minute setae; clypeus black, with one fifth brown on the margin; scape, pedicel and the first three articles of flagellum brown ventrally; mandible and remaining antennal articles brown; wings transparent with brown veins; protibia, tarsus and tarsal claw brown; legs with metatibial spur white on tip, else black.

**Head.** Head wide, brown minute setae covering the apex, white setae covering the rest of the head; TFD  $1.3 \times$  FD; MID  $0.7 \times$  FD; punctation conspicuous, small, shallow; front ocellus in obtuse angle; lateral ocelli closer to compound eyes than to each other; POL  $1.6 \times$  OOL; head apex protruding in between lateral ocelli; clypeus lower than frons, flat, broaden on bottom and narrow on top with upper sutures meeting in between antennae forming a triangle, WC  $1.6 \times$  LC; labrum partially exposed; flagellomeres roughly the same size, dorsal side flat and ventrally bulging; short, dense brown setae evenly distributed throughout the antenna.

**Mesosoma.** Pronotum broad, wide-based pentagon-shaped, elongated, visible dorsally, with shallow punctation, brown, minute setae covering dorsum, width  $2 \times$  length; lateral pronotum concave, shiny and ridged; scutum broad, shape similar to pronotum rotated 180 degrees, with shallow punctation; notauli present, distance equal to the posterior of scutum and separating scutum into 3 segments; scutellum and metanotum upside down bell-shaped, lateral side concave, loosely covered with minute brown setae and shallow punctation, ridged anteriorly; propodeum ridged, loosely covered with minute brown setae, longer brown setae appearing at antero-laterally; wing elongate, maximum length  $2.56 \times$  width, third submarginal cell about as long as the second submarginal cell, second recurrent vein meeting third submarginal cell half distance from base to apex of cell; coxa enlarged, rounded at base, about two thirds as long as femur, protibial spur curved, tarsal claws bifid, metatibial spur heavily setose.

**Metasoma.** Terga and sterna evenly covered with short brown setae except the first sternum.

**Genitalia.** Gonostylus, parapenial lobe slightly exceeding aedeagus; gonostylus swollen, loosely setose with longer setae on the apex; parapenial lobe broad, swollen on the apex, invaginated, bent inward and constricted at the base, outer apex higher than inner apex; digitus slightly lower than aedeagus, broad, setose distally with longer setae on the apex, bent inward, stem broad and without any setae; aedeagus broad in the middle, constricted at apex; subgenital plate broad, slightly concave in the middle and sharp at apex, long setae at apex, setae bent apically.

**Distribution.** Australia: New South Wales.

**Variation.** Two males were collected in the same locality, the paratype (Fig. 6) having a slightly more pointed subgenital plate (Fig. 6D) than the holotype.

**Etymology.** The epithet, placed as a noun in apposition, comes from the city close to where the specimens were collected.

## Key to species of *Epipompilus* occurring in Australia and New Guinea (modified from Evans, 1972)

### Male

1. Fore wing with 3 submarginal cells (Fig. 1A) ..... 2
- Fore wing with 2 submarginal cells (Evans 1972: figs. 4, 5) ..... 12
2. Subgenital plate tapering to acute or narrowly rounded apex (Evans 1972: figs. 9–12) ..... 3
- Subgenital plate relatively broad, apex truncate, broadly rounded or subangulate, or weakly emarginate (Figs. 2B, 5D) ..... 7
3. Subgenital plate slender and acuminate (Evans 1972: fig. 9); gonostylus slender, much exceeding parapenial lobe (Evans 1972: figs. 21, 22) ..... 4
- Subgenital plate more gradually tapered or narrowly rounded apically (Evans 1972: figs. 10–12); gonostylus relatively broad, not or barely exceeding parapenial lobe (Evans 1972: figs. 18, 23, 24) ..... 5
4. Antennae and coxae black; gonostylus moderately slender, strongly setose (Evans 1972: fig. 21); tibial spurs stramineous, paler than legs ..... *E. collessi* Evans
- Antennae and meso- and metacoxae ferruginous; gonostylus very slender, sparsely setose (Evans 1972: fig. 22); tibial spurs ferruginous like legs ..... *E. ferrugineipes* Evans
5. Subgenital plate slender apically, tip narrowly rounded (Evans 1972: fig. 12); parapenial lobe unusually broad (Evans 1972: fig. 18); wing veins nearly colorless, but stigma dark brown ..... *E. eyreanus* Evans
- Subgenital plate tapering gradually to a subacute apex (Evans 1972: figs. 10, 11); parapenial lobe slender, wing veins ..... 6
6. Third submarginal cell as wide as or slightly wider than second; digitus elongate, parapenial lobe simple (Evans 1972: fig. 23) ..... *E. bushi* Evans



- Third submarginal cell as wide as second or only 2/3 as wide as second; digitus shorter and broader, parapenial lobe with roughened area on inner margin (Evans 1972: fig. 24) ..... *E. semitinctus* Evans
- 7. Surface of propodeum smooth with only weak surface sculpturing or weakly rugose; subgenital plate either broad and flat or broad apically but slender medially (Figs. 2B, 5D), truncate or broadly rounded apically (Fig. 3D) ..... 8
- Surface of propodeum rough, coarsely rugose, foveolate or irregularly carinate; subgenital plate somewhat slender, slightly emarginate apically (Evans 1972: fig. 8) or broad, tapered, margined with strongly bent setae (Evans 1972: fig. 20) ..... 9
- 8. Subgenital plate simple (Figs. 2B, 4D, 5D); digitus simple, much exceeded by parapenial lobe (Figs. 2A, 4C, 5C); length of fore wing 2.8-4.5 mm. .... 13
- Subgenital plate with lateral angulations (Evans 1972: fig. 7); digitus large, hook-like, parapenial lobe reduced to small flaps (Evans 1972: fig. 17); length of fore wing 5.5 mm ..... *E. elongatus* Evans
- 9. Subgenital plate somewhat narrow, weakly emarginate apically (Evans 1972: fig. 8); propodeum with strong median longitudinal ridge ..... *E. rieki* Evans
- Subgenital plate broad, tapering to a broadly rounded or subangulate apex, margined with strongly bent setae; propodeum without strong median longitudinal ridge (Evans 1972: fig. 20) ..... 10
- 10. Legs entirely black; subgenital plate broad, tapering to broadly subangulate apex (Evans 1972: fig. 20) ..... *E. carbonarius* Evans
- Legs partly ferruginous or castaneous; subgenital plate tapering to narrower apex ..... 11
- 11. Wings tinged with yellow, with broad dark band subapically; aedeagus unusually short, much shorter than other genitalic appendages ..... *E. pictipennis* Evans
- Wings clear hyaline; aedeagus elongate, exceeding digitus and approximately as long as gonostylus. . . *E. hyalinipennis* Evans
- 12. First transverse cubital vein absent (Evans 1972: fig. 4); wing veins colorless, except stigma dark brown, forewing 2.8 mm . . . *E. stigmaticus* Evans
- Third transverse cubital vein absent (Evans 1972: fig. 5); wing veins brown; minute species, fore wing 1.8-2.4 mm ..... *E. reductus* Evans
- 13. Subgenital plate broad and flat (Fig. 5D); gonostylus broader apically than basally (Fig. 5C) ..... 14
- Subgenital plate broad apically, slender medially (Figs. 2B, 4D); gonostylus slender or straight and somewhat restricted apically (Figs. 2A, 4C) ..... 15
- 14. Subgenital plate round apically; parapenial lobe higher on inner side; digitus round with longer setae apically ..... *E. turneri* Evans
- Subgenital plate somewhat truncate, flat apically; parapenial lobe higher on outer side; digitus tapering apically ..... *E. taree* **sp. nov.**
- 15. Subgenital plate elongate, broad apically and basally but slender medially, without basal setae; gonostylus slender, much exceeding parapenial lobe; parapenial lobe truncate, higher on outer side; digitus slightly exceeded by aedeagus, thinner than gonostylus width gonostylus ..... *E. mirabundus* **sp. nov.**
- Subgenital plate broad apically and basally but slender medially, with short setae basally; gonostylus relatively short, much exceeded by parapenial lobe, straight and somewhat constricted apically; parapenial lobe somewhat bending inwards with roughened area on inner margin; digitus short, much exceeded by aedeagus ..... *E. namadgi* **sp. nov.**

## Discussion

*Epipompilus* are rarely collected and are uncommon in museum collections (Roig-Alsina & Barneche 2017). There are hardly any recent records of *Epipompilus* in Australia and the latest revision for the genus was in 1972 by Evans. All three new species are similar morphologically, except for colour variations of the antenna and proleg. *Epipompilus mirabundus* **sp. nov.** has brown flagellum, profemur, protibia and protarsus, while *E. taree* **sp. nov.** has brown ventral flagellum on the first three articles and brown protibia and protarsus, and *E. namadgi* **sp. nov.** only has brown protibia and partially brown protarsus. Despite the similarities of these three *Epipompilus*, males can be diagnosed using the genitalia and genital plates. *Epipompilus mirabundus* **sp. nov.** has 1) long, slender gonostylus with long, loosely setose and longer setae on the apex; 2) broad and long parapenial lobe which is invaginated and constricted at the base, with outer apex higher than inner apex; 3) digitus bent inward, constricted and slender at the base, with rounded and short setae on the outer margin of the lobes; 4) elongate subgenital plate, concave in the middle, with long setae and broad apex bending apically. *Epipompilus taree* **sp. nov.** has 1) swollen gonostylus that is loosely setose with longer setae on the apex; 2) parapenial lobe that is broad and swollen on the apex but invaginated, bent inward and constricted at the base with its outer apex higher than inner apex; 3) broad digitus that are setose distally with longer setae on the apex and bent inward, and broad stem devoid of setae; 4) broad subgenital plate that is slightly concave in the middle and has long setae at apex which bend apically. *Epipompilus namadgi* **sp. nov.** has 1) gonostylus that are loosely setose on the outer margin, with longer setae on the apex; 2) slender parapenial lobe that bend at apex and are setose in the inner middle margin; 3) broad, setose digitus that bend inward and have slightly longer setae on the apex; 4) elongate subgenital which is concave in the middle but broad at base, having long setae at apex and ventral side of the plate that bend apically.

For *E. mirabundus* **sp. nov.** and *E. namadgi* **sp. nov.**, we only obtained one male specimen during this study, whereas for *E. taree*, we have identified two specimens and the other specimen is almost identical to the holotype, except the subgenital plate, which has the apex tapering instead of truncate (Fig. 6D). Despite this minute variation, we still diagnosed them as conspecific, since the morphology of the adult males, including their genitalia, is identical.

The life history of *Epipompilus* has always been difficult to observe in the field, because the nesting sequence is shortened, and females are therefore never seen carrying the spider or opening a burrow. Interestingly, one of the new species, *E. mirabundus* **sp. nov.**, was found living inside the *Sceliphron formosum* nest. Presumably it is the koinobiont parasitoid behaviour of *Epipompilus* that results in them inhabiting the same mud nest with *S. formosum*. There are two possible scenarios, first that a female *Epipompilus* found the wasp nest while it was still under the process of being provisioned by *S. formosum*, and opportunistically laid an egg on one of the prey items inside the nest. The second is a by-catch hypothesis, which suggests that a *S. formosum* female captured a spider that had already been parasitised by *Epipompilus*. Because *Epipompilus* have been documented to be one of the only pompilid koinobionts (allows host to continue development) (Villanueva-Bonilla *et al.* 2018), the by-catch scenario likely explains the presence of *Epipompilus* in the *Sceliphron* nest.

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## Reference

- Evans, H.E. (1972) Revision of the Australian and New Guinean species of *Epipompilus* (Hymenoptera: Pompilidae). *Pacific Insects*, 1144, 101–131.
- Pitts, J.P., Wasbauer, M.S. & Von Ohlen, C.D. (2006) Preliminary morphological analysis of relationships between the spider wasp subfamilies (Hymenoptera: Pompilidae): revisiting an old problem. *Zoologica Scripta*, 35 (1), 63–84.  
<https://doi.org/10.1111/j.1463-6409.2005.00217.x>
- Roig-Alsina, A. & Barneche, J. (2017) The genus *Epipompilus* in Argentina (Hymenoptera: Pompilidae). *Revista de la Sociedad Entomológica Argentina*, 76 (3–4), 33–38.  
<https://doi.org/10.25085/rsea.763405>
- Villanueva-Bonilla, G.A., Brescovit, A.D., dos Santos, E.F. & Vasconcellos-Neto, J. (2018) First record of *Epipompilus excelsus* (Bradley, 1944) (Hymenoptera, Pompilidae) as a koinobiont ectoparasitoid of *Ariadna mollis* (Holmberg, 1876) (Araneae, Segestriidae). *Journal of Hymenoptera Research*, 66, 15–21.  
<https://doi.org/10.3897/jhr.66.28915>
- Wasbauer, M.S. & Kimsey, L.S. (1985) California spider wasps of the subfamily Pompilinae. *Bulletin of the California Insect Survey*, 26, 1–130.
- Wasbauer, M.S. (1995) Pompilidae. In: Hanson, P.E. & Gauld, I.D. (Eds.), *The Hymenoptera of Costa Rica*. Oxford University Press, Oxford, pp. 522–539.