

RESEARCH ARTICLE

First African and Malagasy records of *Miropotes* (Hymenoptera: Braconidae: Microgastrinae), with three new species and a revised key to all known species

Tomáš HOVORKA^{1,*}, Caroline BOUDREAULT² & Jose FERNANDEZ-TRIANA^{2,3}

¹) Department of Entomology, National Museum of the Czech Republic, Cirkusová 1740, CZ-193 00 Praha-Horní Počernice, Czech Republic; e-mail: tomas.hovorka@nm.cz; ORCID: <https://orcid.org/0000-0002-6887-2644>

²) Agriculture and Agri-Food Canada, Canadian National Collection of Insects, 960 Carling Avenue, Ottawa, Ontario, Canada K1A 0C6; e-mails: caroline.boudreault@agr.gc.ca, jose.fernandez@agr.gc.ca

³) ORCID: <https://orcid.org/0000-0003-0425-0309>

*¹) corresponding author

Accepted:
29th October 2025
Published online:
10th December 2025

Abstract. Three new species of the rarely collected genus *Miropotes* Nixon, 1965 (Hymenoptera: Braconidae: Microgastrinae) are described: *Miropotes klaseriensis* sp. nov. from South Africa, and *Miropotes perditohabitus* sp. nov. and *Miropotes malagasifragilis* sp. nov. from Madagascar. These are the first confirmed records of the genus from sub-Saharan Africa and Madagascar, significantly expanding the known distribution range of *Miropotes* within the Afrotropical Region beyond the single species previously documented in the Arabian Peninsula. An updated key to all currently 18 recognized species of *Miropotes* including those in the Oriental and Australasian Regions is also provided.

Key words. Hymenoptera, Braconidae, Microgastrinae, key, new species, new record, taxonomy, Madagascar, South Africa, Afrotropical Region

Zoobank: <http://zoobank.org/urn:lsid:zoobank.org:pub:D9C3624E-81A6-4559-8193-9BDFE0C45B30>

© 2025 The Authors. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Licence.

Introduction

In his “Reclassification of the tribe Microgasterini”, NIXON (1965) described the genus *Miropotes* Nixon, 1965 (Hymenoptera: Braconidae: Microgastrinae) on the basis of a highly aberrant species from Tasmania, *Miropotes creon* Nixon, 1965. He characterized the genus as extremely unusual within the subfamily Microgastrinae, primarily due to the markedly modified venation of the hind wing. Despite these differences, Nixon tentatively placed *Miropotes* within the tribe Microgastrini Förster (1863), although he was unable to suggest any close affinities with existing genera. A second species, *M. petiolaris* (Szépligeti, 1905), originally described under *Microgaster* Latreille, 1804, was transferred to *Miropotes* by NIXON (1965), bringing the known species count to two (NIXON 1965, AUSTIN 1990).

Until the late 20th century, *Miropotes* was considered a rare and poorly known taxon restricted to Australia and Tasmania. A major revision by AUSTIN (1990) significantly

expanded the genus, describing eight additional species from Australia, along with a tentative host record from the non-native *Samea multiplicalis* (Guenée, 1854) (Lepidoptera: Crambidae), though its relevance as a natural host remains unclear. Subsequently, the genus was recorded from additional Australasian regions such as Papua New Guinea, New Caledonia, and Vanuatu (FERNANDEZ-TRIANA et al. 2014a). The discovery of *Miropotes orientalis* Fernandez-Triana & van Achterberg, 2014 in Thailand and Vietnam represented the first record from the Oriental Region (FERNANDEZ-TRIANA et al. 2014a), and the description of *M. inexpectatus* Fernandez-Triana & van Achterberg, 2017 from Yemen marked the first record from the Afrotropical Region sensu stricto, although still outside sub-Saharan Africa (FERNANDEZ-TRIANA & VAN ACHTERBERG 2017, FERNANDEZ-TRIANA et al. 2020).

The phylogenetic placement of *Miropotes* has been repeatedly investigated using both morphological and mo-



lecular evidence. Some studies have recovered *Miropotes* as the sister group to all other genera of Microgastrinae (WALKER et al. 1990, WHITFIELD et al. 2002), whereas others retained it within the tribe Apantelini Viereck, 1818, although without clearly defined synapomorphies (MASON 1981, AUSTIN 1990). Combined analyses of morphological and genetic data (e.g., COI, 16S, 28S, Ultra-Conserved Elements) tend to support an early divergence of *Miropotes* from other microgastrines (WHITFIELD et al. 2002, JASSO-MARTINEZ et al. 2022).

Currently, *Miropotes* is regarded as a small but morphologically distinct genus within Microgastrinae. It can be readily recognized by its strongly convergent compound eyes with nearly obliterated malar space, slender and elongate body, markedly narrowed radial cell in the hind wing, reduced metatibial spurs, and a short, often sharply curved ovipositor (FERNANDEZ-TRIANA et al. 2014a, 2020). This unique combination of characters is unparalleled within the subfamily and allows for easy identification of the genus.

This study presents the first documented occurrence of *Miropotes* in the Afrotropical Region of sub-Saharan Africa and Madagascar. Based on newly examined material from South Africa and Madagascar, we describe three new species, bringing the total number of described species in the genus to 18. These findings significantly expand the known distribution of *Miropotes* and further support its status as an evolutionarily distinct and geographically widespread but rarely collected lineage within the Microgastrinae.

Materials and methods

The specimens examined for this review came primarily from the collections of the California Academy of Sciences (CAS, voucher codes starting with CASENT) and a few specimens available for study in the Canadian National Collection of insects, arachnids and nematodes, Ottawa, Canada (CNC, voucher codes mostly starting with CNC). In addition to these institutions, some material will also be deposited in the National Museum of the Czech Republic (NMPC).

The material was examined using an Olympus SZX16 and a Leica M205 C stereomicroscope. Photographs of preserved specimens were taken using two different imaging systems: a Keyence VHX-1000 digital microscope with a 13–130× zoom lens, and a Canon EOS 750D camera equipped with a Canon MP-E 65 mm f/2.8 1–5× macro lens. Multiple images were captured at different focal planes and subsequently combined to produce a single image with extended depth of field. Image stacking for photos taken with the Canon EOS 750D was performed using Helicon Focus 8.2.0 software, while images taken with the Keyence VHX-1000 system were processed using the software integrated with the microscope. Final images were corrected by Caroline Boudreault (CB) using GIMP 2.10.12 (GIMP DEVELOPMENT TEAM 2019). All plates were prepared using Microsoft PowerPoint 2021 and saved as .TIF files. Distribution map was created using SimpleMapper web application (SHORTHOUSE 2010).

DNA barcoding data are currently available for more

than 50 specimens of *Miropotes*, representing around 20 different species within 20 BINs (Barcode Index Numbers, a surrogate for species, see RATNASINGHAM & HEBERT 2013). The sequences are available in the Barcode of Life Data System (BOLD) (RATNASINGHAM & HEBERT 2007). However, the vast majority of the sequences and species in BOLD are from Australian specimens, with only 12 sequences (representing the three new species described below) from Africa. Pending a comprehensive molecular analysis of the genus in this paper we only provide the information of the available sequences for the Afrotropical specimens. Photographs of barcoded specimens (Sample IDs: BIOUG43525-G01, BIOUG45505-D03, BIOUG45505-G08, BIOUG45942-F05, BIOUG47065-E07, BIOUG47255-E10, BIOUG47645-H05, BIOUG47661-H04, BIOUG48484-G04) deposited in BOLD were inspected to verify their morphological identity with the examined material.

Specimens were either chemically dried using a modified hexamethyldisilazane (HMDS) protocol (HERATY & HAWKS 1998, RUMPH & TURNER 1998) or critical point dried using a Leica EM CPD300 Critical Point Drier. Specimens were then glued to points using shellac gel or white glue.

For morphological identification we used the keys by AUSTIN (1990) and FERNANDEZ-TRIANA et al. (2014a). Material was also compared to original descriptions and to type material or its photographs if available. For the species description the morphological terms and measurements of structures are mostly as used by FERNANDEZ-TRIANA et al. (2014b). For the wing venation we used SHARKEY & WHARTON (1997). In the key to species, we abbreviate mediotergites 1, 2 and 3 as T1, T2 and T3. In this study, the term Afrotropical Region is used in the sense defined and illustrated by VAN NOORT et al. (2015).

Exact label data are cited and given in quotation marks for the type material. Authors' additional remarks are provided in square brackets; [p] – preceding data are printed; [hw] – preceding data are handwritten. Separate label lines are indicated by a slash (/), separate labels by a double slash (//).

Taxonomy

Genus *Miropotes* Nixon, 1965

Miropotes Nixon, 1965: 200–201.

Type species. *Miropotes creon* Nixon, 1965: 200–201, fig. 236, by original designation.

Brief diagnosis. *Miropotes* is characterized by strongly converging compound eyes in females, with malar space nearly absent. Body slender and elongate. First metasomal tergite narrow, with lateral margins subparallel. Hind wing with radial cell distinctly narrowed distally and vein cu-a arising distal to crossvein m-cu. Metatibial spurs reduced, shorter than basal metatarsus. Ovipositor short, often ventrally curved. Ovipositor sheaths narrow and elongate. Hypopygium sharply pointed, weakly sclerotized, longer than broad. This combination of characters distinguishes *Miropotes* from all other genera of Microgastrinae.

Key to females of the world *Miropotes*

Modified from AUSTIN (1990) and FERNANDEZ-TRIANA et al. (2014a) to include all species described till now. For the species not dealt in this paper, we provide their distribution, references to descriptions and illustrations between brackets.

- 1 Margin of pronotum dorso-medially with deep notch (Fig. 1A). 2
- Margin of pronotum dorso-medially straight (Figs 1B; 2E; 3H; 4B). 3
- 2(1) Propodeum mostly sculptured, with strong transverse rugae on area above areola and within area enclosed by areola; face relatively narrow, width below antennal sockets $0.44\times$ head width in anterior view; metacoxa and ovipositor sheath dark brown; body length 3.5 mm (FERNANDEZ-TRIANA et al. 2014a: figs 13–18). *M. neglectus* Fernandez-Triana & Whitfield, 2014 [Papua New Guinea, Vanuatu]
- Propodeum with area above areola smooth, and area enclosed by areola mostly smooth with few transverse rugae; face relatively less narrow, width below antennal sockets $0.54\times$ head width in anterior view; metacoxa and ovipositor sheath black; body length 2.7–3.4 mm (AUSTIN 1990: figs 15, 20–26).
... *M. chookolis* Austin, 1990 [Australia: Queensland]
- 3(1) Tip of ovipositor strongly bent at 50° – 90° (Figs 2D; 4D); distal end of ovipositor sheaths almost always broadened to accommodate shape of ovipositor (Figs 2D; 4D). [Species with ovipositor bent at an angle close to 50° will be keyed out in both halves of this couplet.] 4
- Tip of ovipositor straight or gently curved (Fig. 3J and

- FERNANDEZ-TRIANA et al. 2014a: figs 12, 35, 37, 38, 41); distal end of ovipositor sheaths straight or slightly curved, not broadened distally (FERNANDEZ-TRIANA et al. 2014a: figs 12, 37, 41). 13
- 4(3) Areolet in fore wing reduced to a small spot with virtually no transparent area enclosed within (Figs 3B, D). 5
 - Areolet in fore wing larger, subtriangular or suboval in shape (Figs 2H; 4C). 6
 - 5(4) T1 and T2 with longitudinal striae; legs light brown; face and propleuron brown.
..... *M. creon* Nixon, 1965 [Australia: Tasmania]
 - T1 and T2 without striation, T1 mostly smooth, T2 matt (Fig. 3G); legs yellow to orange-yellow (Fig. 3A); face orange-yellow and propleuron orange-yellow to light brown (Figs 3C, E). *M. malagasifragilis* Hovorka & Fernandez-Triana **sp. nov.** [in part; Madagascar]
 - 6(4) Antenna significantly shorter, its length about $0.60\times$ body length (i.e., length of head + mesosoma + metasoma in lateral view). 7
 - Antenna significantly longer, about same length (0.90 – $1.00\times$) than body length (i.e., length of head + mesosoma + metasoma in lateral view) (FERNANDEZ-TRIANA et al. 2014a: figs 13, 25, 38). 9
 - 7(6) Propodeal areola reduced to multiple carinae diverging from posterior margin of propodeum and open anteriorly (AUSTIN 1990: fig. 28), without carinae near anterior margin of propodeum; body all black; hind legs with femur and distal half of tibia black; body length 2.9 mm.
..... *M. katois* Austin, 1990 [Australia: South Australia]
 - Propodeal areola complete and large, entirely or par-

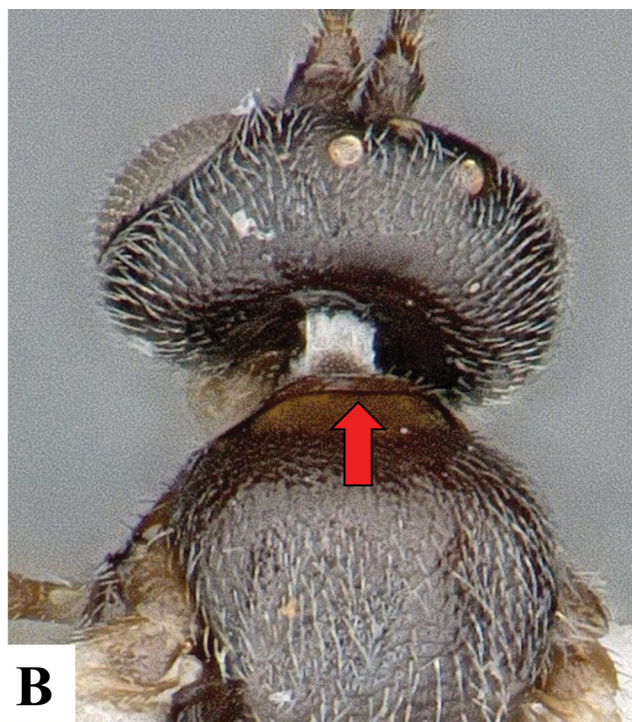
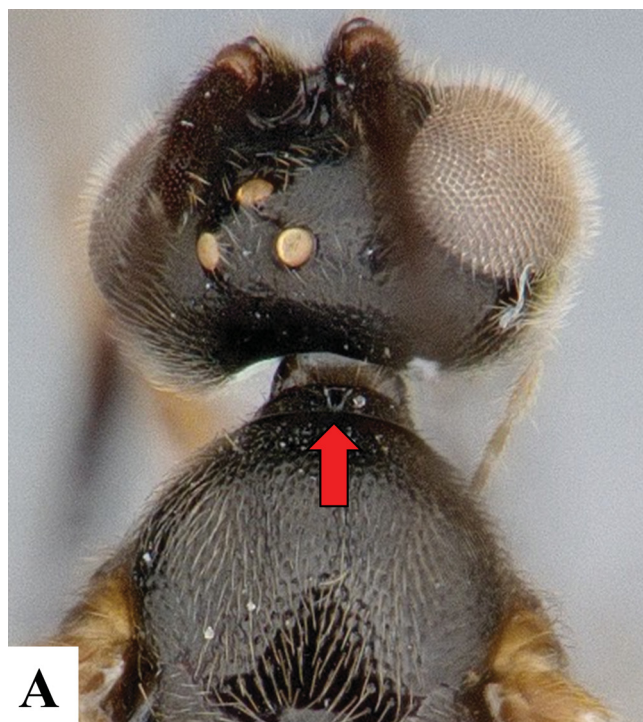


Fig. 1. Diagnostic characters of the pronotum in the genus *Miropotes* indicated by the red line and arrow. A – pronotum dorso-medially with deep notch in *Miropotes neglectus* Fernandez-Triana & Whitfield, 2014; B – pronotum dorso-medially straight in *Miropotes inexpectatus* van Achterberg & Fernandez-Triana, 2017.

- tially closed anteriorly with distinct carina near anterior margin of propodeum (Figs 2C, E; as in 3I; 4F); body mostly brown with light patterns; hind legs with femur and rest of leg yellow to brown. 8
- 8(7) Antennal flagellomeres 10–16 white (Fig. 2G); posterior end of hypopygium white (not translucent; Fig. 2D); T1 with trapezoid-shaped, almost as long as wide, darker central area with two distinct longitudinal carinae in centre (Fig. 2F); yellow margin of T1 rounded (Fig. 2F); T2 with subtriangular darker central area, with carinae in anterior 0.2 (Fig. 2F); yellow marginal part of T2 present and wide (Fig. 2F); basal part of vein 3M distinctly sclerotized (Fig. 2H); scutellar sulcus distinct, deep and high with regular carinae (Fig. 2E); body length 3.2 mm. *M. klaseriensis* Hovorka & Fernandez-Triana **sp. nov.** [South Africa]
- Antennal flagellomeres 9–14 white, 15–16 brown (Fig. 4H); posterior end of hypopygium translucent (Fig. 4D); T1 with rectangular-shaped, longer than wide darker central area without distinct elevated longitudinal carinae in centre (Fig. 4E); yellow margin of T1 straight (Fig. 4E); T2 with triangular darker central area, almost without carinae (Fig. 4E); yellow marginal part of T2 almost not developed (Fig. 4E); vein 3M not distinct or weakly sclerotized (Fig. 4C); scutellar sulcus less distinct, narrow and with irregular carinae (Fig. 4B); body length 2.2–2.5 mm. *M. perditohabitus* Hovorka & Fernandez-Triana **sp. nov.** [Madagascar]
- 9(6) Only posterior part of propodeal areola present and only indicated by indistinct carinae bounded by striations, rest of propodeum with variable number of fine striations and intervening smooth areas (FERNANDEZ-TRIANA et al. 2014a: fig. 36). 10
- Propodeal areola complete and strongly carinate; coarse carinae radiating from areola with rugosity in between; area enclosed by areola with several distinct transverse rugae (as in Figs 2C; 3I; 4F). 12
- 10(9) T1–T3 smooth (AUSTIN 1990: fig. 37); body length 3.0 mm. *M. cadgeis* Austin, 1990 [Australia: New South Wales, Queens-land]
- T1–T2, and usually part or all of T3, mostly sculptured (FERNANDEZ-TRIANA et al. 2014a: figs 3, 5, 9, 20, 23, 31); body length at most 2.6 mm, usually less. 11
- 11(10) Antenna, propleuron, metacoxa, hypopygium and sternites dark brown; hypopygium pointed apically (FERNANDEZ-TRIANA et al. 2014a: figs 1–6); body length 2.6 mm; fore wing length 2.0 mm. *M. austini* Fernandez-Triana & Whitfield, 2014 [Australia: New South Wales]
- Antenna with most flagellomere white (at most with flagellomere 2–6 brown), propleuron, metacoxa and most of sternites yellow, hypopygium partially yellow; hypopygium apically truncated (FERNANDEZ-TRIANA et al. 2014a: figs 19–24); body length 2.1–2.3 mm; fore wing length 1.5–1.6 mm. *M. orientalis* Fernandez-Triana & van Achterberg, 2014 [Thailand, Vietnam]
- 12(9) Antenna uniformly dark brown (FERNANDEZ-TRIANA et al. 2014a: fig. 30). *M. burringbaris* Austin, 1990 [Australia: Capital Territory, Queens-land, New South Wales, Tasmania, Victoria; Papua New Guinea]
- Antenna with apical or subapical flagellomeres white, rest of antenna dark brown (FERNANDEZ-TRIANA et al. 2014a: fig. 25). *M. boothis* Austin, 1990 [Australia: Queensland]
- 13(3) Areolet in fore wing reduced to a small spot with virtually no transparent area enclosed within (Figs 3B, D). 14
- Areolet in fore wing larger, subtriangular in shape (as in Figs 2H; 4C). 17
- 14(13) Eyes not strongly convergent below (AUSTIN 1990: fig. 11); metafemur comparatively stouter, its length less than 3.0× its maximum width; body length 2.0 mm. *M. goobitis* Austin, 1990 [Australia: Northern Territory, Queens-land, Western Australia]
- Eyes strongly convergent (as in Figs 2B; 4G; Fig. 3E); metafemur comparatively less stout, more than 3.0× its maximum width; body length variable. 15
- 15(14) Propodeum with carinae almost entirely absent, only indicated by two short carinae on posterior 0.1 of propodeum (FERNANDEZ-TRIANA & VAN ACHTERBERG 2017: fig. 58); propleuron, pro- and mesocoxae dark brown, comparatively very small size (FERNANDEZ-TRIANA & VAN ACHTERBERG 2017: fig. 54); body length 1.5–1.7 mm. *M. inexpectatus* van Achterberg & Fernandez-Triana, 2017 [Yemen]
- Propodeum with strong carinae defining a complete areola (as in Figs 2C, E; 3I; 4F); propleuron yellow-orange to light brown, pro- and mesocoxae yellow, comparatively larger size (as in Figs 2A, G; 3A, C; 4A); body length 2.3–3.2 mm. 16
- 16(15) Face dark brown; metafemur relatively less stout, its length more than 3.0× its maximum width; T1 and T2 sculptured; scutellar sulcus with more than two developed carinae and clearly separates mesoscutum from scutellum (FERNANDEZ-TRIANA et al. 2014a: figs 7–12); body length 3.2 mm. *M. lordhowensis* Fernandez-Triana & Whitfield, 2014 [Australia: New South Wales (Lord Howe Island)]
- Face orange-yellow (Fig. 3E); metafemur stout, its length less than 3.0× its maximum width; T1 and T2 smooth (Figs 3F, G); scutellar sulcus notch-like, with just few developed carinae in the middle, the separation of mesoscutum from scutellum less distinct (Fig. 3H); body length 2.3 mm. *M. malagasifragilis* Hovorka & Fernandez-Triana **sp. nov.** [in part; Madagascar]
- 17(13) Propodeal areola complete and strongly carinate; coarse carinae radiating from areola with rugosity in between; area enclosed by areola with one to several distinct transverse carinae; T1 longitudinally rugose-striate; T2 longitudinally striate (AUSTIN 1990: fig. 40). *M. thuraris* Austin, 1990 [Australia, New Caledonia, Papua New Guinea, Vanuatu]
- Anterior part of propodeal areola not completed by strongly developed carinae, this area finely striate or nearly smooth (AUSTIN 1990: fig. 37); T1 and T2 usu-

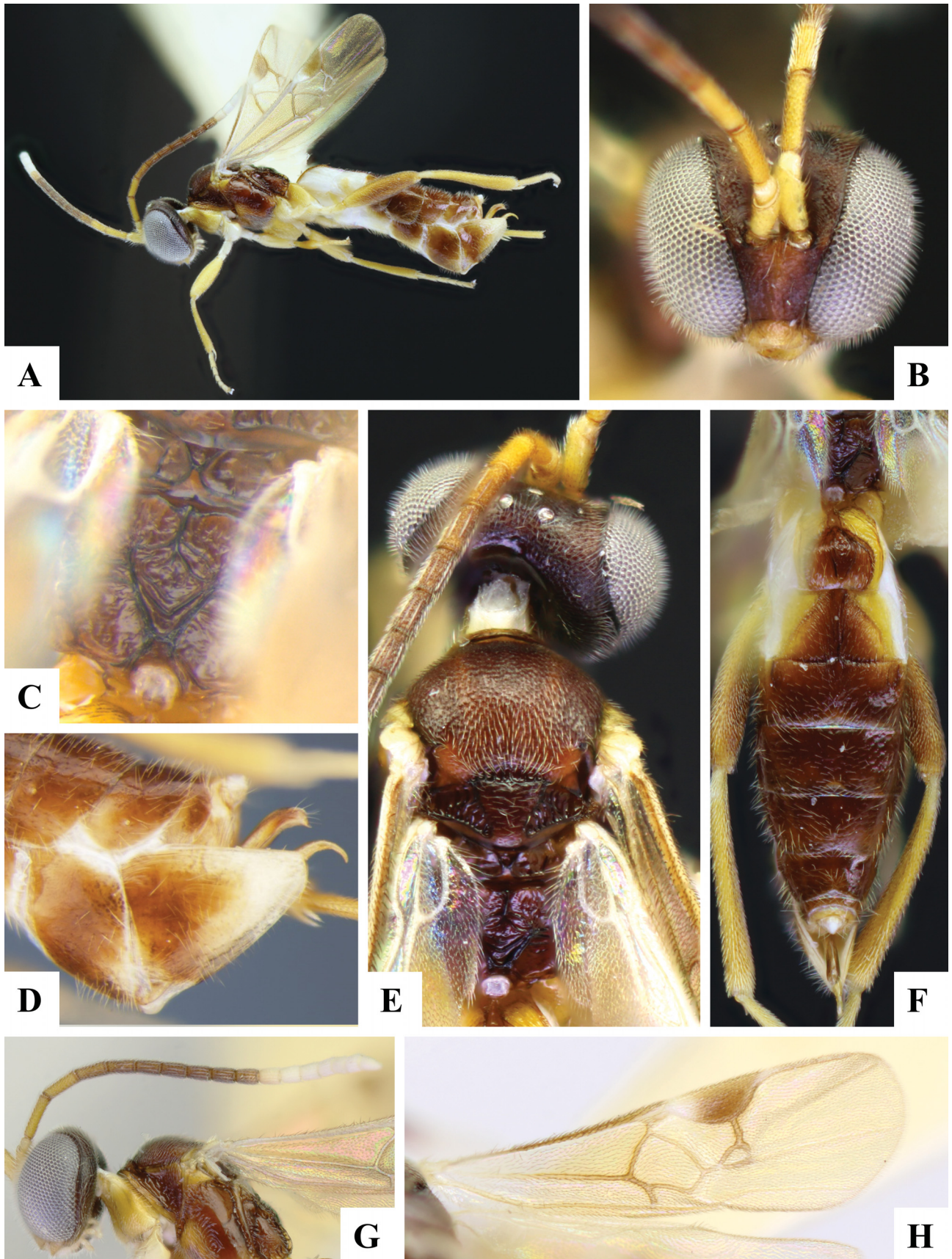


Fig. 2. *Miropotes klasieriensis* Hovorka & Fernández-Triana, sp. nov., female holotype CNC520488. A – habitus, lateral view; B – head, frontal view; C – propodeum, dorsal view; D – hypopygium and ovipositor, lateral view; E – mesosoma, dorsal view; F – metasoma, dorsal view; G – mesosoma and antenna, lateral view; H – fore wing.

- ally smooth, at most with few short anterior striations (as in Figs 3F, G). 18
- 18(17) Posterior part of propodeal areola formed by obvious carinae, anterior part of areola delimited by fine oblique and transverse striations (AUSTIN 1990: fig. 29). *M. kilkulunis* Austin, 1990 [Australia: Northern Territory]
- Posterior part of propodeal areola formed by faint carinae which sometimes merge with surrounding striations, anterior part of propodeum generally smooth, sometimes with indistinct oblique or transverse striations (AUSTIN 1990: fig. 31).
..... *M. petiolaris* (Szépligeti, 1905) [Australia: Capital Territory, New South Wales, Northern Territory, South Australia, Queensland, Western Australia]

Miropotes klaseriensis

Hovorka & Fernandez-Triana sp. nov.

(Fig. 2)

Type locality. South Africa, Mpumalanga province, Klaserie Private Nature Reserve, GPS: ~24°24'30"S, 31°14'58"E.

Type material. HOLOTYPE: ♀, SOUTH AFRICA: "South Africa. Tvl. / Klaserie, 21–27.xii.1985 / MT, WRM Mason, / CNC520488 [p] // Holotype / *Miropotes / klaseriensis / Hovorka & Fernandez-Triana, 2025* [p, red label]". Deposited in CNC.

Additional material examined. Nine specimens from Kruger National Park (Sample IDs: BIOUG43525-G01, BIOUG45505-D03, BIOUG45505-G08, BIOUG45942-F05, BIOUG47065-E07, BIOUG47255-E10, BIOUG47645-H05, BIOUG47661-H04, BIOUG48484-G04). Photographs of these specimens are publicly available in the BOLD database, which allowed us to confirm that they belong to this species. According to the information provided in BOLD, all specimens are deposited in the Centre for Biodiversity Genomics, University of Guelph, Canada.

Diagnosis. Among the species with margin of pronotum straight dorso-medially, tip of ovipositor strongly bent at 50–96°, large areolet in fore wing, antennae short and stout not reaching past T2 with relatively short flagellomeres, *Miropotes klaseriensis* can be recognized by its complete large propodeal areola with distinct carina near anterior margin of propodeum, body mostly brown with light patterns and hind legs with femur brownish and rest of leg yellow.

Description. Female (Fig. 2). *Head.* Antenna short and stout, not reaching past T2. Face width below antennal sockets / head width in anterior view: 0.33× (0.249/0.748). Eyes strongly convergent below.

Mesosoma. Margin of dorsomedial pronotum straight. Scutellar sulcus distinct, deep and high, with regular carinae. Fore wing areolet relatively large and subtriangular in shape; vein 3M basally distinctly sclerotized. Propodeal areola complete and strongly carinate, with coarse carinae radiating from the areola and rugosity in between; area enclosed by the areola with several distinct rugae.

Metasoma. T1 trapezoid-shaped, almost as long as wide, with central area bearing two distinct longitudinal carinae (darker than remainder of tergite). T2 with carinae present only in anterior 0.2. T3 striate in anterior 0.4 and posterior 0.1. T1 0.9× as long as wide; T2 1.7× as wide as long; posterior/anterior width ratio of T2: 1.5×. Hypopygium weakly transversely pleated in the centre. Ovipositor tip

strongly bent.

Legs. Metafemur 3.8× as long as its maximum width.

Measurements. Body length: 3.2 mm; antenna length: 2.0 mm; metafemur length: 0.663 mm; metafemur width: 0.174 mm; T1 length: 0.314 mm, width (posterior): 0.345 mm; T2 length: 0.279 mm, width (posterior): 0.474 mm, width (anterior): 0.320 mm; ovipositor tip bent at 50–80°.

Color. Face brown with yellow pattern in the middle; flagellomeres 1–2 pale yellow, 3–9 brown, 10–16 white; gena with light (white to yellow) spot; propleuron yellow; mesosoma brown; wings hyaline with pale brown wing venation and pterostigma basally and apically with two white spots; legs yellow, only metafemur brownish; T1 with rounded yellow margin; T2 with yellow marginal parts and subtriangular darker central area; lateral tergites of T1 and T2 white; sternum white; posterior end of hypopygium white.

Molecular data. In BOLD there are nine DNA barcodes available for *Miropotes* specimens from South Africa representing BIN BOLD:ADV0951. Although we have not been able to study those specimens, one of them was photographed by the CBG Photography Group and the image is accessible in BOLD (BIOUG43525-G01). The details visible in the photo match closely with those of the holotype, and the locality where the nine specimens were collected, Kruger National Park, is situated in the same habitat and only about 20 km northeast of the type locality. Based on that, we consider those barcodes to represent the new species, *Miropotes klaseriensis* sp. nov.

Differential diagnosis. *Miropotes klaseriensis* can be distinguished from *M. perditohabitus* by having antennal flagellomeres 10–16 white, hypopygium weakly transversely pleated in the centre, posterior end of hypopygium white, not translucent, T1 with trapezoid-shaped, almost as long as wide darker central area with two distinct longitudinal carinae in centre, yellow margin of T1 rounded, T2 with subtriangular darker central area, with carinae in anterior 0.2, yellow marginal part of T2 present, basal part of vein 3M sclerotized and scutellar sulcus distinct, deep and high with regular carinae.

Etymology. Named after the type locality, the Klaserie Nature Reserve; an adjective.

Distribution. South Africa: Mpumalanga. The Klaserie Nature Reserve is one of the largest privately owned reserves in South Africa and also considered as a sanctuary committed to conserving nature and keeping a well-preserved wilderness, as close to untouched by humans as possible (BAOBAB RIDGE 2021).

Miropotes malagasifragilis

Hovorka & Fernandez-Triana sp. nov.

(Fig. 3)

Type locality. Madagascar, Sofia region, Anjamangirana county, Analagnambe forest, GPS: 15°9'25"S 47°44'3.12"E.

Type material. HOLOTYPE: ♀, MADAGASCAR: "CASENT/2164266 [p] // Madagascar. Sofia / District 45 km. S. / Antsohihy, 5 km W of / Anjamangirana, 15.1570°S 47.7342°E, [p] // 97m, 26.v–2.vi.2011, MT / Analagnambe dry / degraded forest, M. Irwin / & R. Harin' Hala, / MG-61–15, / CASENT2164266 [p] // Holotype / *Miropotes / malagasifragilis / Hovorka & Fernandez-Triana, 2025* [p, red label]". Deposited in CAS.

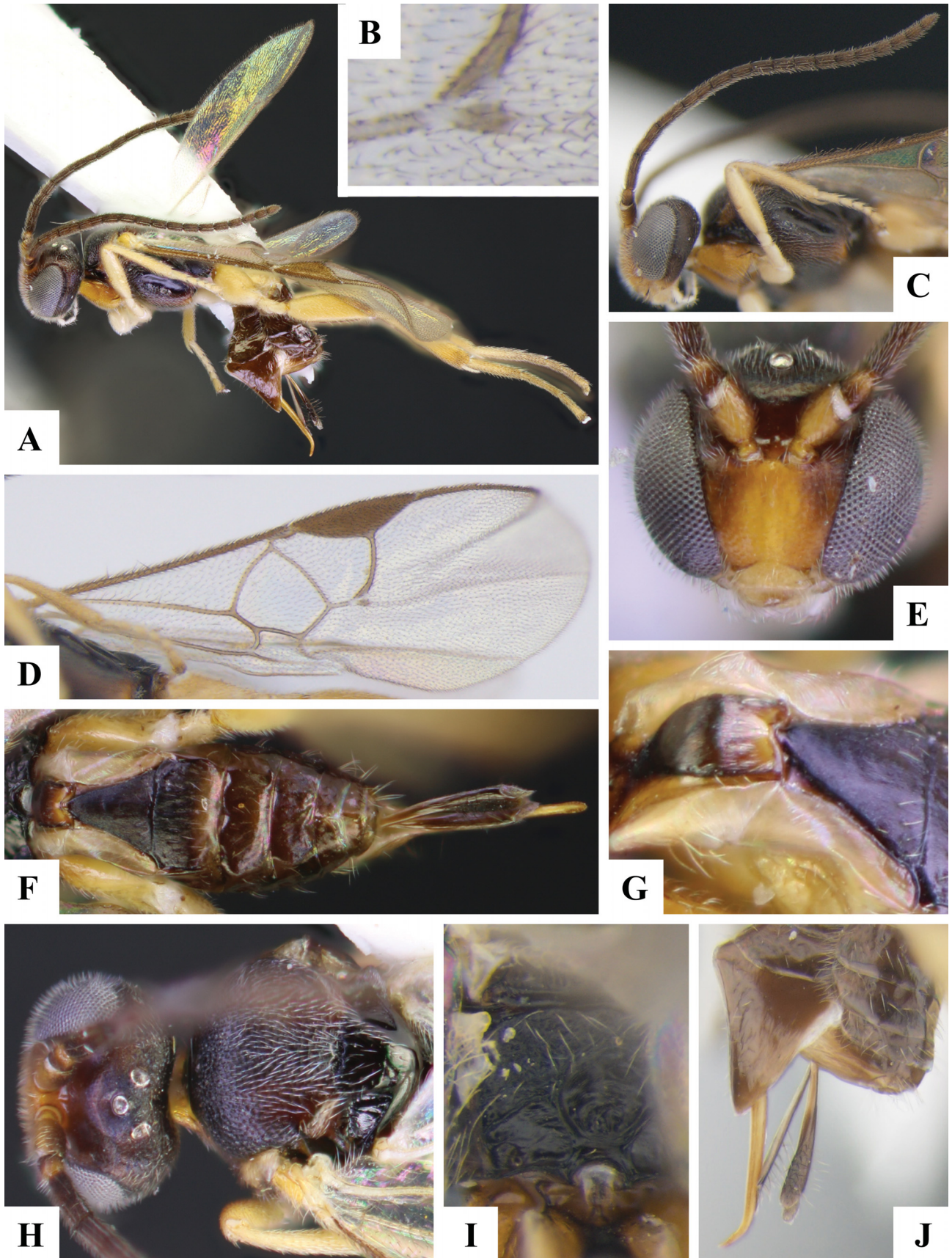


Fig. 3. *Miropotes malagasifragilis* Hovorka & Fernández-Triana, sp. nov., female holotype CASENT2164266. A – habitus, lateral view; B – detail of fore wing areola; C – mesosoma and antenna, lateral view; D – fore wing; E – head, frontal view; F – metasoma, dorsal view; G – metasomal tergites T1 and T2; H – mesosoma, dorsal view; I – propodeum, dorsal view; J – hypopygium and ovipositor, lateral view.

PARATYPES: **MADAGASCAR:** 1 ♀, same label data as holotype except for institutional code and paratype label “CASENT / 2164657 [p] // Paratype / *Miropotes* / malagasifragilis / Hovorka & Fernandez-Triana, 2025 [p, yellow label]”; 1 ♀, same label data as holotype except for institutional code “CASENT / 2164274 [p]” and last three labels “*Miropotes* // *Miropotes* / Not in Tree [hw] // Paratype / *Miropotes* / malagasifragilis / Hovorka & Fernandez-Triana, 2025 [p, yellow label]”, (damaged, head with incomplete antennae mounted separately at the base of the card). Paratype CASENT2164657 is deposited in CAS, CASENT 2164274 in NMPC.

Diagnosis. Among the species with margin of pronotum straight dorso-medially, tip of ovipositor straight or gently curved and areolet in fore wing reduced to a small spot with virtually no transparent area enclosed within, *Miropotes malagasifragilis* can be recognized by its eyes strongly convergent, propleuron orange-yellow to light brown, pro- and mesocoxae yellow and protibiae yellow.

Description. Female (Fig. 3). *Head.* Antenna reaching at least to T3. Face width below antennal sockets / head width in anterior view: 0.5×. Eyes strongly convergent below.

Mesosoma. Margin of dorsomedial pronotum straight. Scutellar sulcus notch-like, with only a few developed carinae medially, making the separation between mesoscutum and scutellum less distinct. Lunulae deep, with distinct median carinae. Fore wing areolet reduced to a small spot with virtually no transparent area enclosed; vein 3M not distinct. Propodeal areola complete and strongly carinate, with coarse carinae radiating from the areola and rugosity in between; area enclosed by the areola with several distinct transverse rugae.

Metasoma. T1 with central area longitudinally aciculate. T2 in its centre smooth, marginal area of T2 aciculate. T3 smooth. T1 2.3× as long as wide; T2 1.1× as wide as long; posterior/anterior width ratio of T2: 2.0×. Hypopygium almost smooth or slightly longitudinally pleated. Ovipositor tip gently curved.

Legs. Metafemur 2.8× as long as its maximum width.

Measurements. Body length: 2.3 mm; antenna length: 1.8 mm; ovipositor tip curved at approximately 145°.

Color. Face orange-yellow; antenna uniformly dark brown; gena with light spot next to the base of mandible and lower margin of eye; propleuron orange-yellow to light brown; mesosoma dark brown; wings hyaline with brownish venation and pterostigma uniformly brown; legs yellow; T1 with darker central area, lateral parts whitish to hyaline; T2 with triangular darker central area, pale margin of T2 aciculate; T3 entirely smooth; lateral tergites of T1 and T2 whitish to hyaline; sternum whitish; posterior end of hypopygium brown.

Molecular data. A partial sequence (422 base pairs) is available from the holotype; however, the sequence (Process ID: MADMI329-23) does not appear close to any other *Miropotes* sequence in BOLD.

Differential diagnosis. *Miropotes malagasifragilis* can be distinguished from *M. lordhowensis* (an Australian species), in addition to its significant geographical separation, by having face orange-yellow, metafemur stout, its length less than 3.0× its maximum width, T1 and T2 smooth, lunulae deep with distinct median carinae, scutellar sulcus notch-like, with just a few developed carinae in the middle,

thus the separation of mesoscutum from scutellum being less distinct and body in average much smaller (3.2 mm in *M. lordhowensis*, 2.3 mm in *M. malagasifragilis*).

Etymology. The species epithet *malagasifragilis* combines the words *Malagasy*, referring to the island of Madagascar, with the Latin adjective *fragilis*, meaning “fragile”. The name alludes not only to the species’ endemic origin but also to the delicate and irreplaceable natural heritage of Madagascar, the land of immense biodiversity under increasing pressure from environmental degradation.

Distribution. North-west Madagascar.

Miropotes perditohabitus
Hovorka & Fernandez-Triana sp. nov.

(Fig. 4)

Type locality: Madagascar, Boeny region, Majunga [= Mahajanga] county, Analamanitra Forest, GPS: 15°54′59.976″S 45°57′0″E.

Type material. HOLOTYPE: ♀, **MADAGASCAR:** “Madagascar. Majunga / Analamanitra Forest / 14km NE of Misinjo / 15.91666°S, 45.95000°E, [p] // 19m, 2–9.x.2007, MT / dense dry forest, M. Irwin, / CASENT2247327 [p] // *Miropotes* / sp. [hw] / Det. C. Boudreault, 2018 [p] // Holotype / *Miropotes* / perditohabitus / Hovorka & Fernandez-Triana, 2025 [p, red label]”. Deposited in CAS. PARATYPES: **MADAGASCAR:** 1 ♀, same label data as holotype except for institutional code, collecting date and paratype label “19m, 20.xi–4.xii.2007, MT / dense dry forest, M. Irwin, / CASENT2167888 [p] // Paratype / *Miropotes* / perditohabitus / Hovorka & Fernandez-Triana, 2025 [p, yellow label]”; 1 ♀ “19m, 23–30.x.2007, MT / dense dry forest, M. Irwin, / CASENT2167586 [p] // Paratype / *Miropotes* / perditohabitus / Hovorka & Fernandez-Triana, 2025 [p, yellow label]”. Paratype CASENT2167888 is deposited in CAS, CASENT2167586 in NMPC.

Additional material examined. **MADAGASCAR:** 6 ♂♂, same label data as holotype except for institutional codes and collecting dates: CASENT2167883; CASENT2167884; CASENT2167885; CASENT2167887; CASENT2167890; CASENT2167891 (all collected 20.xi–4.xii.2007); 1 ♂, “Madagascar Majunga, / Besalamy District / Marofototra dry forest 17 / km W of Besalamy, / 16.721667°S [p] // 44.423667°E, 51m, / 11–18.vii.2008, MT, dry / wash in forest, M Irwin, / R. Harin’Hala, / CASENT8402123 [p]. All specimens are deposited in CAS, except one male (CASENT2167885) deposited in NMPC.

Diagnosis. Among the species with margin of pronotum straight dorso-medially, tip of ovipositor strongly bent at 50–96°, large areolet in fore wing, antennae short and stout not reaching past T2 with relatively short flagellomeres, *Miropotes perditohabitus* can be recognized by complete large propodeal areola with distinct carina near anterior margin of propodeum, body mostly brown with light patterns and hind legs with femur and rest of leg yellow to brown.

Description. Female (Fig. 4). *Head.* Antenna short and stout, not reaching past T2. Face width below antennal sockets / head width in anterior view: 0.3×. Eyes strongly convergent below.

Mesosoma. Margin of dorsomedial pronotum straight. Scutellar sulcus less distinct, narrow, with irregular carinae. Fore wing areolet relatively large and triangular; vein 3M not distinctly sclerotized. Propodeal areola complete and strongly carinate; coarse carinae radiating from areola, with rugosity in between only in anterior half; area enclosed by areola with indistinct rugae.

Metasoma. T1 rectangular, longer than wide, with central area lacking distinct elevated longitudinal carinae,

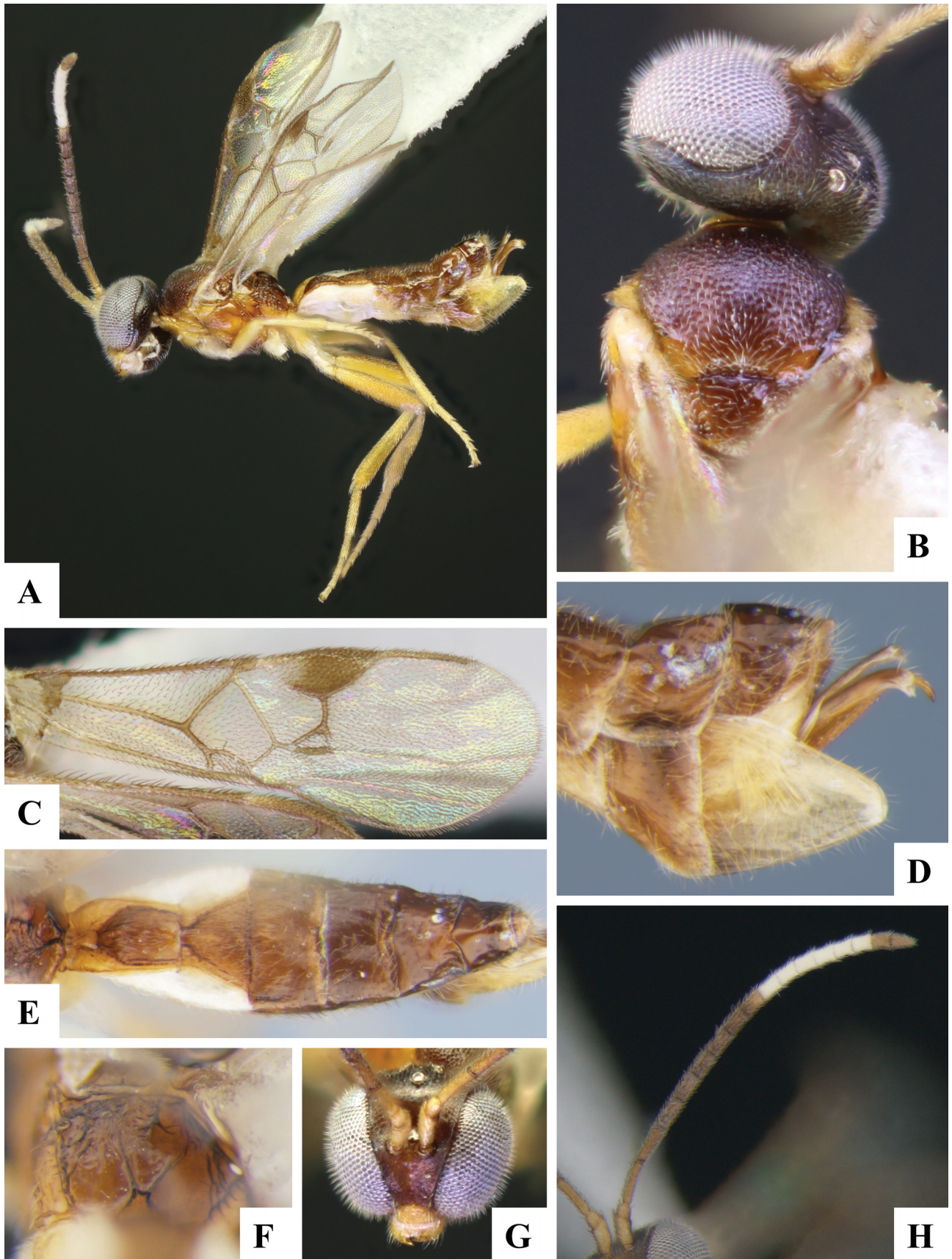


Fig. 4. *Miropotes perditohabitus* Hovorka & Fernández-Triana, sp. nov., female holotype CASENT2247327. A – habitus, lateral view; B – mesosoma, dorsal view; C – fore wing; D – hypopygium and ovipositor, lateral view; E – metasoma, dorsal view; F – propodeum, dorsal view; G – head, frontal view; H – antenna, detail.

margins straight. T2 almost without carinae. T3 striate in anterior 0.1. T1 1.5× as long as wide. T2 1.5× as wide as long and posterior/anterior width ratio of T2 1.5×. Hypopygium strongly transversely pleated in the centre. Ovipositor tip strongly bent.

Legs. Metafemur 3× as long as its maximum width.

Measurements. Body length: 2.2–2.5 mm; antenna length: 1.6–1.7 mm; ovipositor tip bent at more than 80° (average 96°).

Color. Face dark brown; flagellomere 1 together with scape and pedicel yellow; flagellomeres 2–8 brown, 9–14 white, 15–16 brown; gena with light (white or yellow) spot next to base of mandible and lower margin of eye not distinct; propleuron yellow; mesosoma dark brown; wings hyaline with brownish venation and pterostigma basally and apically with pale/hyaline spots; legs yellow to brown; T1 and T2 with dark central areas, yellow margins reduced or straight; lateral tergites white; sternum white; posterior end of hypopygium translucent.

Molecular data. DNA barcodes are available for the holotype and one paratype (CASENT2167586); they represent in BOLD the BIN BOLD:AEH7693, which is very distinctive, as it is separated by 9.29% of base pairs difference from the closest BIN BOLD:ADV0951 (BIOUG45505-D03).

Differential diagnosis. *Miropotes perditohabitatus* can be distinguished from *M. klaseriensis* by having antennal flagellomeres 9–14 white, 15–16 brown, hypopygium strongly transversely pleated in the centre, posterior end of hypopygium translucent, T1 with rectangular-shaped, longer than wide darker central area without distinct elevated longitudinal carinae in centre, yellow margin of T1 straight, T2 with triangular darker central area, without carinae, yellow marginal part of T2 almost not developed, vein 3M not distinct and scutellar sulcus less distinct, narrow and with irregular carinae.

Etymology. The species epithet *perditohabitatus* is a Latin adjective composed of the words *perditus* (= ruined, destroyed, lost) and *habitatus* (= adjective perfect participle of *habito* = to inhabit, to dwell), meaning “inhabitant of lost habitat”. It refers to the ongoing degradation and loss of natural ecosystems in Madagascar, where this species was discovered and it hopes to bring more attention to the irreplaceable natural heritage of Madagascar and the dangers of losing its habitats.

Distribution. North-west Madagascar.

Discussion

Historically, *Miropotes* was considered an Australasian endemic, with known species primarily from Australia, Tasmania, New Caledonia, and Papua New Guinea (AUSTIN 1990, AUSTIN & DANGERFIELD 1992). The genus remained extremely rare in collections with only two species known until the 1990s. Subsequent surveys extended its range slightly into the Oriental Region (Thailand, Vietnam) (FERNANDEZ-TRIANA et al. 2014a) and later to Yemen (FERNANDEZ-TRIANA & VAN ACHTERBERG 2017), but these records were considered marginal.

The new records from Madagascar and mainland sub-Saharan Africa reported in this study represent the first confirmed presence of *Miropotes* in the Afrotropical Region. This discovery significantly expands the known distribution of the genus and suggests a broader biogeographic presence than previously assumed (see Table 1; Fig. 5).

These findings further support the hypothesis that *Miropotes* represents an ancient and early-diverging clade within Microgastrinae (WHITFIELD et al. 2002, JASSO-MARTINEZ et al. 2022), with a wide but patchily documented distribution across the Old World tropics. *Miropotes* remains rare in collections, likely due to a combination of genuine scarcity and persistent sampling gaps. This is particularly plausible

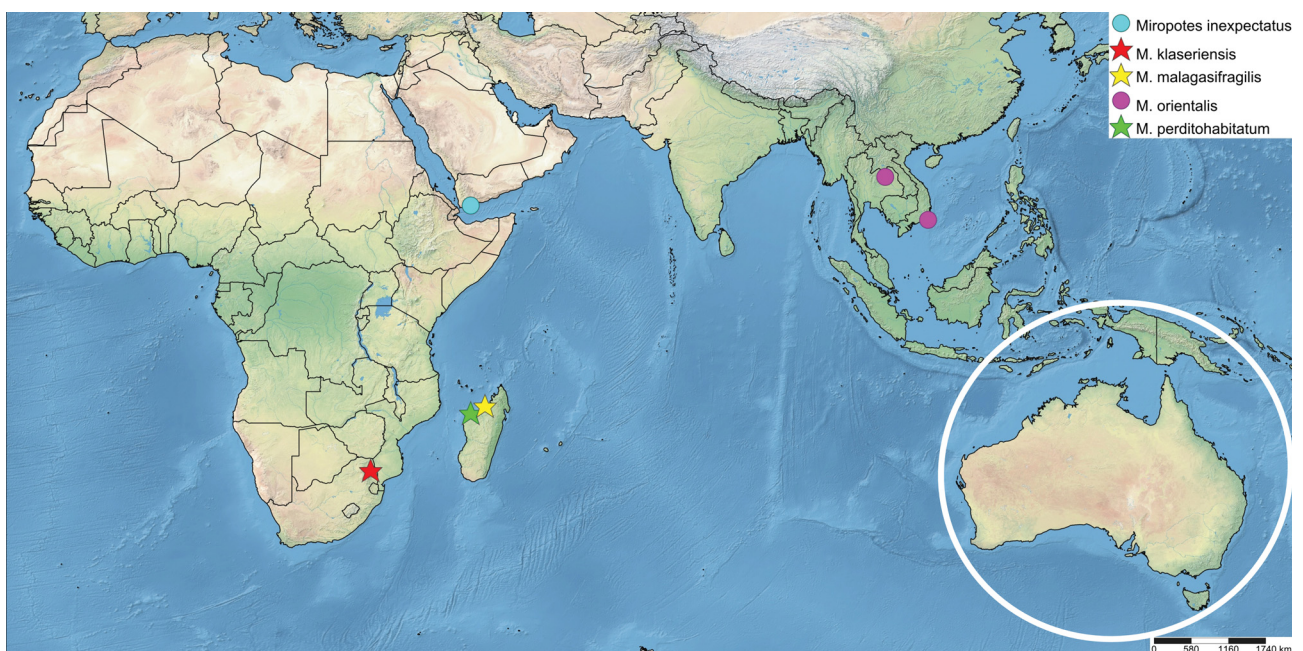


Fig. 5. Distribution map of known and newly described *Miropotes* species outside the Australasian diversity hotspot, highlighted with a white circle.

given the historical under-collection of parasitoid wasps in key habitats across Africa and Madagascar. The presence of several additional undescribed, morphologically divergent Afrotropical species suggests that *Miropotes* may be more widespread in the Old World tropics than currently recognized. It is likely that additional taxa could be uncovered through focused surveys in other underexplored tropical regions. In fact, DNA barcoding data (see comments in the Methods section above) indicate that *Miropotes* diversity in Australia is at least 50% higher than currently documented in that country. This contrast between relatively well-sampled areas and newly explored regions such as Madagascar and southern Africa highlights how much of the genus diversity may remain undocumented. These findings underscore how incomplete our understanding of parasitoid wasp distributions remains. They also highlight the importance of continued investigation, particularly in regions undergoing rapid ecological change.

This concern is especially relevant in Madagascar, which alone lost approximately 44% of its natural forest cover between the 1950s and 2000 (HARPER et al. 2007). Deforestation has continued at an alarming pace, with an additional 10% loss between 2000 and 2014 (VIEILLEDENT et al. 2018). As a result, not only charismatic flagship species such as mammals or birds are disappearing, but also the vast array of less conspicuous organisms, including insects and the many tropically associated taxa such as predators and parasitoids (KREUSS & TSCHARNTKE 1994, DIRZO et al. 2014, VAN KLINCK et al. 2020). Among these, Hymenoptera constitute one of the most diverse animal

orders globally, yet their richness remains vastly underestimated and understudied, especially in biodiversity hotspots (FORBES et al. 2018, WAGNER et al. 2021).

Although raising awareness of this biodiversity crisis is not the primary aim of our taxonomic work, we deliberately chose the species names *M. perditohabitatus* and *M. malagasifragilis* to draw attention to it, underscoring the vulnerability of Madagascar's ecosystems and the rapid pace at which they are being altered. Despite awareness of this issue has grown in recent years, effective mitigation remains elusive, particularly in regions facing intense anthropogenic pressure and limited conservation capacity (HARPER et al. 2007, VIEILLEDENT et al. 2018).

In contrast, *M. klaseriensis* was discovered in the Klaserie Private Nature Reserve (South Africa), and its name highlights the locality of its origin. While primarily a taxonomic finding, this example underscores that both public and privately managed areas may serve as valuable sources of biodiversity knowledge, particularly in regions where conservation resources are limited. At the same time, the discovery reminds us that new species of parasitoid wasps can be encountered in a wide variety of habitats, even outside formally designated reserves.

Acknowledgements

This research was supported by the Ministry of Culture of the Czech Republic (DKRVO 2024–2028/5.I.b, National Museum of the Czech Republic, 00023272) and Internal Grant of the National Museum of the Czech Republic

Table 1. Distribution of known species of the genus *Miropotes* Nixon, 1965 as summarized in FERNANDEZ-TRIANA et al. (2020). Abbreviations of biogeographical regions are as follows: AFR – Afrotropical Region; AUS – Australasian Region; OTL – Oriental Region.

Species	Biogeographical region	Country
<i>Miropotes austini</i> Fernandez-Triana & Whitfield, 2014	AUS	Australia
<i>Miropotes boothis</i> Austin, 1990	AUS	Australia
<i>Miropotes burringbaris</i> Austin, 1990	AUS	Australia, Papua New Guinea, Indonesia
<i>Miropotes cadgeis</i> Austin, 1990	AUS	Australia
<i>Miropotes chookolis</i> Austin, 1990	AUS	Australia
<i>Miropotes creon</i> Nixon, 1965	AUS	Australia
<i>Miropotes goobitis</i> Austin, 1990	AUS	Australia
<i>Miropotes inexpectatus</i> van Achterberg & Fernandez-Triana, 2017	AFR	Yemen
<i>Miropotes katois</i> Austin, 1990	AUS	Australia
<i>Miropotes kilkulunis</i> Austin, 1990	AUS	Australia
<i>Miropotes klaseriensis</i> Hovorka & Fernandez-Triana sp. nov.	AFR	South Africa
<i>Miropotes lordhowensis</i> Fernandez-Triana & Whitfield, 2014	AUS	Australia
<i>Miropotes malagasifragilis</i> Hovorka & Fernandez-Triana sp. nov.	AFR	Madagascar
<i>Miropotes neglectus</i> Fernandez-Triana & Whitfield, 2014	AUS	Papua New Guinea
<i>Miropotes orientalis</i> Fernandez-Triana & Whitfield, 2014	OTL	Thailand, Vietnam
<i>Miropotes perditohabitatus</i> Hovorka & Fernandez-Triana sp. nov.	AFR	Madagascar
<i>Miropotes petiolaris</i> (Szépligeti, 1905)	AUS	Australia
<i>Miropotes thuraris</i> Austin, 1990	AUS	Australia, New Caledonia, Papua New Guinea, Vanuatu

(P25/01IG-HO 5/5100). JFT and CB were supported by Agriculture and Agri-Food Canada Project J-002276 (Systematics of beneficial arthropods in support of resilient agroecosystems). We are grateful to Robert Zuparko and Brian Fisher for providing access to the Madagascar material, which was particularly valuable given the relevance of Malagasy taxa discussed in the present work. We also thank to Erinn Fagan-Jeffries for providing us with information about her sequences of Australian *Miropotes*.

References

- AUSTIN A. D. 1990: Revision of the enigmatic Australasian genus *Miropotes* Nixon (Hymenoptera: Braconidae: Microgastrinae), with comments on the phylogenetic importance of the female ovipositor system. *Systematic Entomology* **15**: 43–68.
- AUSTIN A. D. & DANGERFIELD P. C. 1992: Synopsis of Australasian Microgastrinae (Hymenoptera: Braconidae), with a key to genera and description of new taxa. *Invertebrate Systematics* **6**: 1–76.
- BAOBAB RIDGE 2021: The Klaserie – a conservation success story. available from: <https://baobabridge.com/the-klaserie-a-conservation-success-story/>
- BIOUG43525-G01: Centre for Biodiversity Genomics. available from: https://bench.boldsystems.org/index.php/MAS_DataRetrieval_OpenSpecimen/picPopUp?processid=KMPVB064=18-&objectid-caos-cloud.linode-us-east.25_129.ece3a134-1943-4825-9f86-5ad241f566f4.jpg&extension=jpg
- BIOUG45505-D03: Centre for Biodiversity Genomics. available from: https://v3.boldsystems.org/index.php/Public_BarcodeCluster?clusteruri=BOLD:ADV0951
- DIRZO R., YOUNG H. S., GALETTI M., CEBALLOS G., ISAAC N. J. B. & COLLEN B. 2014: Defaunation in the Anthropocene. *Science* **345**: 401–406.
- FERNÁNDEZ-TRIANA J., SHAW M. R., BOUDREAULT C., BEAUDIN M. & BROAD G. R. 2020: Annotated and illustrated world checklist of Microgastrinae parasitoid wasps (Hymenoptera, Braconidae). *ZooKeys* **920**: 1–1089.
- FERNÁNDEZ-TRIANA J. & VAN ACHTERBERG C. 2017: Order Hymenoptera, family Braconidae Subfamily Microgastrinae from the Arabian Peninsula. Pp. 275–321. In: HARTEN A. VAN (ed.): *Arthropod fauna of the United Arab Emirates. Vol. 6*. Department of the President's Affairs, Abu Dhabi, 775 pp.
- FERNÁNDEZ-TRIANA J., VAN ACHTERBERG C. & WHITFIELD J. B. 2014a: Australasian endemic no more: four new species of *Miropotes* Nixon (Hymenoptera, Braconidae, Microgastrinae), with the first record from the Oriental region. *Tijdschrift voor Entomologie* **157**: 59–77.
- FERNÁNDEZ-TRIANA J., WHITFIELD J. B., RODRIGUEZ J. J., SMITH M. A., JANZEN D. H., HALLWACHS W., HAJIBABAEI M., BURNS J. M., SOLIS M. A., BROWN J., CARDINAL S., GOULET H. & HEBERT P. D. N. 2014b: Review of *Apanteles sensu stricto* (Hymenoptera, Braconidae, Microgastrinae) from Area de Conservación Guanacaste, northwestern Costa Rica, with keys to all described species from Mesoamerica. *ZooKeys* **383**: 1–565.
- FORBES A. A., BAGLEY R. K., BEER M. A., HIPPEE A. C. & WIDMAYER H. A. 2018: Quantifying the unquantifiable: why Hymenoptera, not Coleoptera, is the most speciose animal order. *BMC Ecology* **18** (21): 1–11.
- GIMP DEVELOPMENT TEAM 2019: *GIMP*. Retrieved from <https://www.gimp.org>. (Last accessed 2025-06-15.)
- HARPER G. J., STEININGER M. K., TUCKER C. J., JUHN D. & HAWKINS F. 2007: Fifty years of deforestation and forest fragmentation in Madagascar. *Environmental Conservation* **34**: 325–333.
- HERATY J. & HAWKS D. 1998: Hexamethyldisilazane – A chemical alternative for drying insects. *Entomological News* **109**: 1–4.
- JASSO-MARTINEZ J. M., SANTOS B. F., ZALDIVAR-RIVERON A., FERNÁNDEZ-TRIANA J. L., SHARANOWSKI B. J., RICHTER R., DETTMAN J. R., BLAIMER B. B., BRADY S. G. & KULAR R. 2022: Phylogenomics of braconid wasps (Hymenoptera, Braconidae) sheds light on classification and the evolution of parasitoid life history traits. *Molecular Phylogenetics and Evolution* **173** (107452): 1–23.
- KLINK R. VAN, BOWLER D. E., GONGALSKY K. B., SWENGEL A. B., GENTILE A. & CHASE J. M. 2020: Meta-analysis reveals declines in terrestrial but increases in freshwater insect abundances. *Science* **368**: 417–420.
- KREUSS A. & TSCHARNTKE T. 1994: Habitat fragmentation, species loss, and biological control. *Science* **264**: 1581–1584.
- MASON W. R. M. 1981: The polyphyletic nature of *Apanteles* Foerster (Hymenoptera: Braconidae): A phylogeny and reclassification of Microgastrinae. *Memoirs of the Entomological Society of Canada* **113** (115): 1–147.
- NIXON G. E. J. 1965: A reclassification of the tribe Microgasterini (Hymenoptera: Braconidae). *Bulletin of the British Natural History Museum, Entomology, Supplement* **2**: 1–284.
- NOORT S. VAN, BUFFINGTON M. L. & FORSAGE M. 2015: Afrotropical Cynipoidea (Hymenoptera). *ZooKeys* **493**: 1–176.
- RATNASINGHAM S. & HEBERT P. D. N. 2013: ADNA-Based Registry for All Animal Species: The Barcode Index Number (BIN) System. *PLoS ONE* **8** (8) (e66213): 1–16.
- RATNASINGHAM S. & HEBERT P. D. N. 2007: BOLD: The Barcode of Life Data System (<http://www.barcodinglife.org>). *Molecular Ecology Notes* **7**: 355–364.
- RUMPH J. A. & TURNER W. J. 1998: Alternative to critical point drying for soft-bodied insect larvae. *Annals of the Entomological Society of America* **91**: 693–699.
- SHARKEY M. J. & WHARTON R. A. 1997: Morphology and terminology. Pp. 19–37. In: WHARTON R. A. MARSH P. M. & SHARKEY M. J. (eds.): *Identification Manual to the New World Genera of Braconidae*. The International Society of Hymenopterist, Washington DC, 476 pp.
- SHORTHOUSE D. P. 2010: *SimpleMappr, an online tool to produce publication-quality point maps*. <https://www.simplemappr.net>.
- VIEILLEDENT G., GRINAND C., RAKOTOMALALA F. A., RANAIVOSOA R., RAKOTOARIJONA J. R., ALLNUTT T. F. & ACHARD F. 2018: Combining global tree cover loss data with historical national forest cover maps to look at six decades of deforestation and forest fragmentation in Madagascar. *Biological Conservation* **222**: 189–197.
- WAGNER D. L., GRAMES E. M., FORISTER M. L., BERENBAUM M. R. & STOPAK D. 2021: Insect decline in the Anthropocene: Death by a thousand cuts. *Proceedings of the National Academy of Sciences* **118** (e2023989118): 1–27.
- WALKER A. K., KITCHING I. J. & AUSTIN A. D. 1990: A reassessment of the phylogenetic relationships within the Microgastrinae (Hymenoptera: Braconidae). *Cladistics* **6**: 291–306.
- WHITFIELD J. B., MARDULYN P., AUSTIN A. D. & DOWTON M. 2002: Phylogenetic relationships among microgastrine braconid wasp genera based on data from the 16S, COI and 28S genes and morphology. *Systematic Entomology* **27**: 337–359.