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## Research article

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# Review of *Narta* Dworakowska, 1979 (Hemiptera: Cicadellidae: Typhlocybinae: Typhlocybini) and description of three new species from Madagascar

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**Abstract.** The Typhlocybinae leafhopper genus *Narta* is reviewed. Three new species, *Narta andasibensis* sp. nov., *Narta irwini* sp. nov., and *Narta septlacus* sp. nov. from Madagascar are described in detail and illustrated. Additionally, a key to the known species of the genus *Narta* is provided.

**Keywords.** Classification, microleafhopper, morphology, taxonomy.

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## Introduction

The subfamily Typhlocybinae Kirschbaum, 1868 is a highly diverse and ecologically important group within the leafhopper family Cicadellidae Latreille, 1825, encompassing approximately 6000 valid species worldwide (Zhou *et al.* 2023). Members of this subfamily are typically small in size and exhibit specialized feeding habits on vascular plants (Chasen *et al.* 2014; Jarrell *et al.* 2020). The genus *Narta* Dworakowska, 1979 was first established by Dworakowska in 1979 and was originally placed in the tribe Zyginellini Dworakowska, 1977 (Dworakowska 1977). Zyginellini and Typhlocybini Kirschbaum, 1868 were distinguished solely by a single hindwing venation character—whether the submarginal vein is directly connected to vein CuA (Dworakowska 1979). However, recent studies have shown that this character alone is insufficient to justify tribal separation, and it is now generally regarded as a junior synonym of Typhlocybini (Lu *et al.* 2021; Yan *et al.* 2022; Cao *et al.* 2023; Zhou *et al.* 2023).

So far, the genus *Narta* included only two known species worldwide, both confined to the Democratic Republic of the Congo (Dworakowska 1979). In the course of examining insect specimens collected from Madagascar, three new species are described and illustrated, with a key to all known species of *Narta*. Meanwhile, we provide an updated review of the genus *Narta*, including detailed redescription of the generic characteristics. The discovery of these new species not only expands the known diversity of *Narta* but also provides insights into the biogeographical patterns of leafhopper distribution in the Afrotropical region.

## Material and methods

The specimens examined in this study were collected using a sweep net from Madagascar: Toamasina Province (botanic garden near entrance to Andasibe National Park) during Oct.–Nov. 2001, Antsiranana Province (Sakalava Beach, dwarf littoral forest) during Jun.–Jul. 2001, Toliara Province (Sept Lacs) during 21–26 Aug. 2002, and Tulear Province (Andohahela Nat'l Park, Tsimelahy, Parcelle II) during 5–15 Feb. 2003, by M. Irwin, F. Parker and R. Harin'Hala. Habitus photographs were taken using a KEYENCE VHX-5000 digital microscope, with multiple images stacked to obtain sharply focused photos. Body length was measured from the apex of the vertex to the tip of the forewings. For male genitalia preparation, the abdomen was removed and soaked in 5–10% sodium hydroxide solution heated in a water bath for 8–15 minutes. After cooling, it was rinsed with pure water to remove residual tissues. Dissection was performed with a dissecting needle under an Olympus SZX16 stereo microscope, and genital structures were preserved in glycerin to prevent desiccation. The male genitalia and wings were observed and illustrated using an Olympus BX53 stereo microscope. All illustrations were created using Procreate software on an iPad, and photographs were edited using Adobe Photoshop CS6 software. Morphological terminology follows the standards of (Dietrich 2005) and (Song & Li 2013). Holotypes are deposited at the collection of the School of Karst Science, Guizhou Normal University, China and additional specimens examined are deposited at the Illinois Natural History Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, USA.

## Results

Class Insecta Linnaeus, 1758  
Order Hemiptera Linnaeus, 1758  
Suborder Auchenorrhyncha Duméril, 1806  
Family Cicadellidae Latreille, 1825  
Subfamily Typhlocybinae Kirschbaum, 1868  
Tribe Typhlocybini Kirschbaum, 1868

Genus *Narta* Dworakowska, 1979

*Narta* Dworakowska, 1979: 311.

### Type species

*Narta waska* Dworakowska, 1979: 312, figs 123–134.

### Diagnosis

Body small, ground color yellowish or brownish. Head with or without ocelli. Morphological characteristics of both forewings and hindwings, together with male genitalia, resemble those of *Muluana* Dworakowska, 1979 (Dworakowska 1979). In both genera, pygofer lobes possess well-developed hind lobes with short, rigid setae clustered on hind margins. However, the genus *Narta* is distinguishable by the following features: 1<sup>st</sup> and 2<sup>nd</sup> apical cells of forewing are smoked while apex of clavus is yellowish;

hindwing with only r+m vein and apical region of Cu<sub>1</sub> vein infuscated; genital capsule symmetrical; pygofer ventral appendage quite long or much exceeding hind margin of lobe; subgenital plates fused at base, rounded at apex; aedeagus with dorsal apodeme short or slender, aedeagal shaft with variable shapes.

### Description

Body small (2.5–4.3 mm), ground color yellowish or brownish with brown markings or patterns. Head slightly broader than pronotum or subequal in width to pronotum, with or without ocelli. Vertex parallel-sided or slightly produced anteriorly, coronal suture marked by a pigmented line or slightly pale in color. Pronotum pale brownish-yellow, with impressed insertions of thoracic muscles. Scutellum nearly triangular. Face short, with deeply impressed sculptures. Forewing nearly semitransparent, light testaceous, veins slightly yellowish; 1<sup>st</sup> and 2<sup>nd</sup> apical cells smoked; apical half of clavus yellowish. Hindwing with only the r+m vein and the apical region of the Cu<sub>1</sub> vein infuscated.

Abdominal apodemes rudimentary or weakly developed.

### Male genitalia

Pygofer lobe with large hind lobe, provided with several microsetae dorsally and a group of short rigid setae at hind margin. Pygofer ventral appendage quite long or much exceeding hind margin of the lobe. Subgenital plates fused at base, rounded at apex; its apex bent upward and covered with numerous long, thin setae and macrosetae. Style slender and long, apically narrowed and curved dorsad. Aedeagal shaft curved dorsad in lateral view; variable in shape. Connective lamellate, U- or Y-shaped.

### Distribution

Democratic Republic of the Congo, Madagascar (Toamasina, Antsiranana, Toliara, Tulear).

### Remarks

This genus resembles the genus *Muluana*. The main distinguishing features are as follows: pygofer lobe without sclerotized processes of diverse shapes; subgenital plate with long, hair-like setae apically; 1<sup>st</sup> and 2<sup>nd</sup> apical cells of forewing are smoked; only r+m vein and apical region of Cu<sub>1</sub> vein of hindwing are infuscated.

### Key to males of the genus *Narta* Dworakowska, 1979

1. Aedeagus without processes ..... 2  
– Aedeagus with processes ..... 4
2. Dorsal apodeme short, without significant elongation or curvature; head with ocelli .....  
..... *Narta seroka* Dworakowska, 1979  
– Dorsal apodeme significantly elongated and curved; head without ocelli ..... 3
3. Preatrium shorter than aedeagal shaft; dorsal apodeme extremely long and U-shaped curved .....  
..... *Narta irwini* Tan & Song sp. nov.  
– Aedeagal shaft wide and short; dorsal apodeme significantly elongated, V-shaped curved in lateral view .....  
..... *Narta septilacus* Tan & Song sp. nov.
4. Aedeagus with a single process at base; head with ocelli ..... *Narta waska* Dworakowska, 1979  
– Aedeagal shaft with a pair of long finger-like processes arising from ventral base, extending beyond apex of aedeagal shaft; head without ocelli .....  
..... *Narta andasibensis* Tan & Song sp. nov.

*Narta seroka* Dworakowska, 1979

*Narta seroka* Dworakowska, 1979: 312.

**Distribution**

Zaire (Elisabethville).

*Narta waska* Dworakowska, 1979

*Narta waska* Dworakowska, 1979: 312

**Distribution**

Zaire (Elisabethville, Lubumbashi, Kivu).

*Narta andasibensis* Tan & Song sp. nov.

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Figs 1–2

**Diagnosis**

Anterior margin of vertex with two oblong dark brown spots, without ocelli. (Figs 1D–E, 2B). Pygofer lobe broad, apex of pygofer ventral appendage bifurcate (Fig. 2A). Aedeagus with a pair of long finger-like processes, processes longer than aedeagal shaft (Fig. 2E, H).

**Etymology**

The specific epithet ‘*andasibensis*’ is derived from the type locality ‘Andasibe National Park’ (located in Toamasina Province, Madagascar). It forms the specific name with the suffix ‘*-ensis*’, indicating the type locality information of the species.

**Type material**

**Holotype**

MADAGASCAR – **Toamasina Province** • ♂; botanic garden near entrance to Andasibe National Park; 18°55'35" S, 48°24'28" E; 1025 m a.s.l.; 16–24 Oct. 2001; M. Irwin and R. Harin'Hala leg.; MA-01-08B-16.

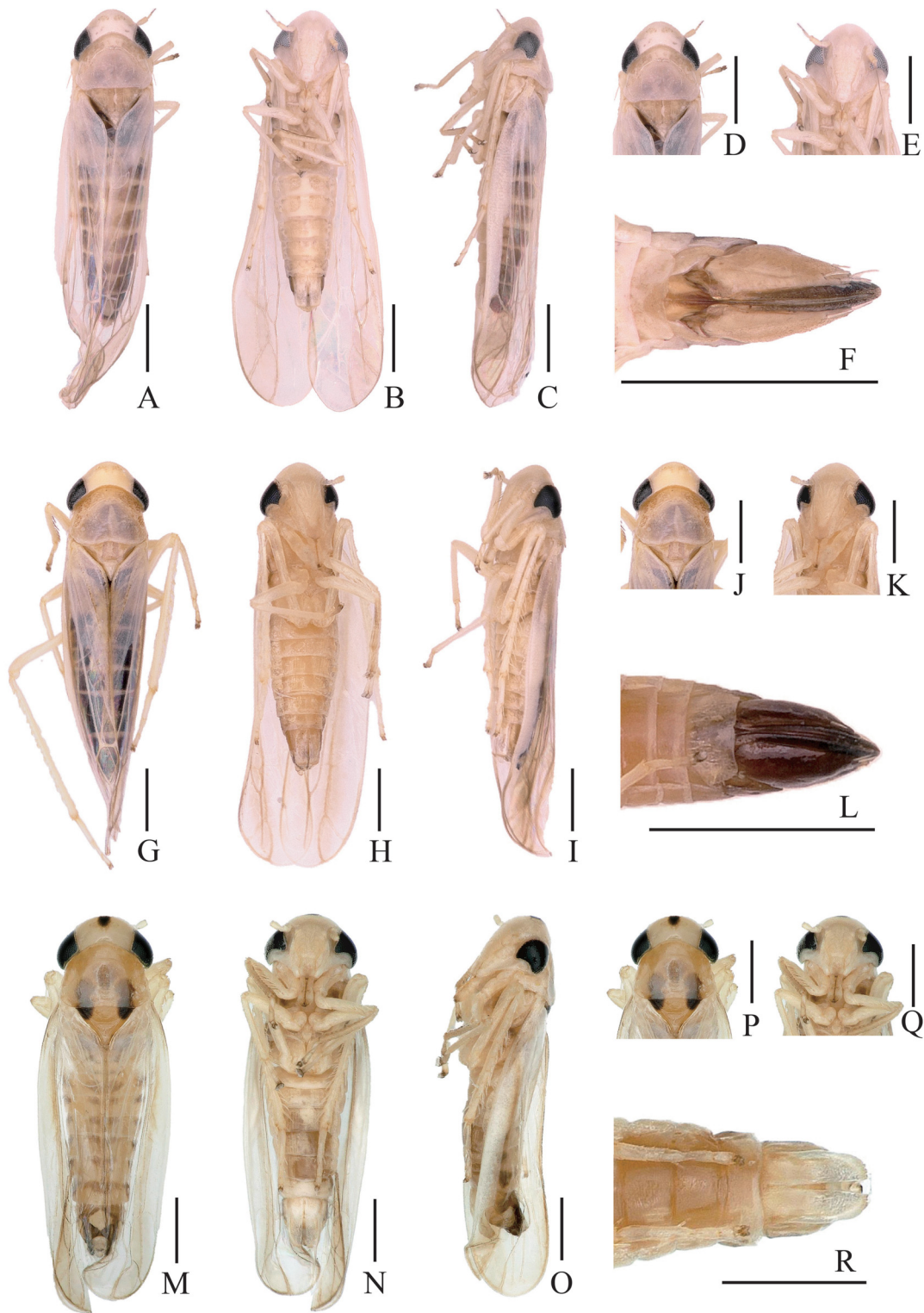
**Paratypes**

MADAGASCAR – **Toamasina Province** • 3 ♀♀; same collection data as for holotype; MA-01-08B-19.  
– **Antsiranana Province** • 1 ♂, 1 ♀; Sakalava Beach, dwarf littoral forest; 12°15'46" S, 49°23'51" E; 10 m a.s.l.; 25 Jun.–6 Jul. 2001; M. Irwin and R. Harin'Hala leg.; MA-01-04B-13.

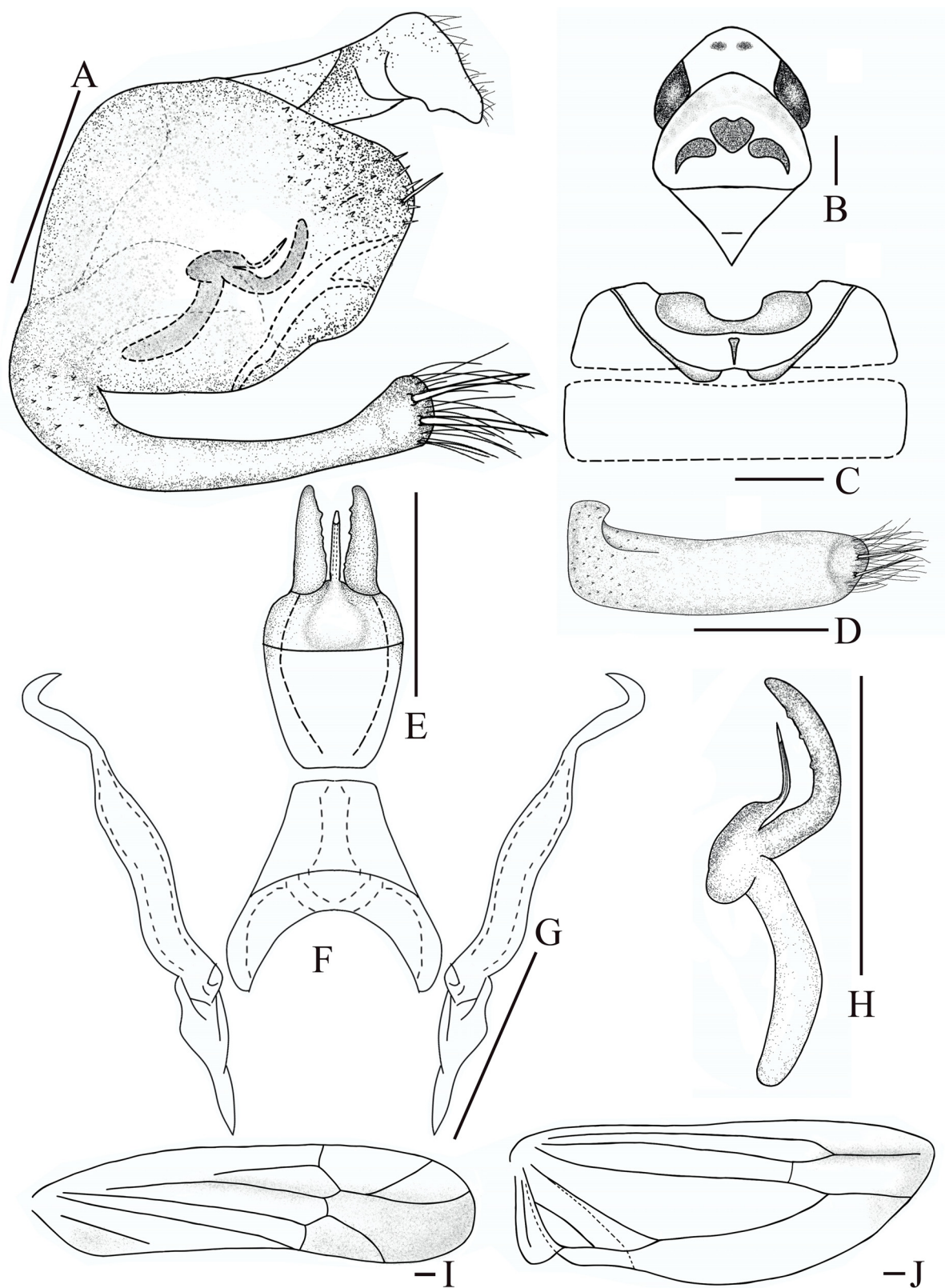
**Description**

MEASUREMENTS. Body length. ♂: 2.9–3.0 mm; ♀: 3.0–3.1 mm.

COLORATION. Ground yellow or ochre-yellow; eyes grayish black (Fig. 1A–E). Vertex with two oblong dark brown spots near anterior margin. Scutellum with basal triangle slightly fumose-brown (Figs 1D, 2B). Face light brown (Fig. 1E). Forewing with apical margin brown, and apex of clavus slightly infuscated (Figs 1A–C, 2I). Hindwing with r+m vein and apical region of Cu<sub>1</sub> vein light brown (Figs 1A–C, 2J).



**Fig. 1.** A–F. *Narta andasibensis* Tan & Song sp. nov. A. Habitus, dorsal view. B. Habitus, ventral view. C. Habitus, lateral view. D. Head and thorax, dorsal view. E. Face. F. Abdomen of female. G–L. *Narta irwini* Tan & Song sp. nov. G. Habitus, dorsal view. H. Habitus, ventral view. I. Habitus, lateral view. J. Head and thorax, dorsal view. K. Face. L. Abdomen of female. M–R. *Narta septilacus* Tan & Song sp. nov. M. Habitus, dorsal view. N. Habitus, ventral view. O. Habitus, lateral view. P. Head and thorax, dorsal view. Q. Face. R. Abdomen of male. Scale bars=0.5 mm.



**Fig. 2.** *Narta andasibensis* Tan & Song, sp. nov. **A.** Pygofer, lateral view. **B.** Head and thorax, dorsal view (showing visible spots/markings on this part). **C.** Abdominal apodemes. **D.** Subgenital plate. **E.** Aedeagus, ventral view. **F.** Connective. **G.** Style. **H.** Aedeagus, lateral view. **I.** Forewing. **J.** Hindwing. Scale bars=0.1 mm.

**STRUCTURE.** Head triangularly produced, subequal in width to pronotum, without ocelli. (Figs 1D–E, 2B). Scutellum with distinct scutellar suture (Figs 1D, 2B). Male abdominal apodemes very small, just extending anterior margin of 3<sup>rd</sup> sternite (Fig. 2C).

**MALE GENITALIA.** Pygofer ventral appendage swollen at midlength, tapering distally, apex bifurcate (Fig. 2A). Subgenital plate little broadened at base, with some microtrichia on outer surface; two large macrosetae and multiple long hair-like setae at apex (Fig. 2A, D). Style slender, and with elongated and hook-like apex (Fig. 2G). Aedeagus with a well-developed, inflated preatrium; one pair of long finger-like processes arising from base of aedeagal shaft ventrally, each one with fine denticles on inner margin, and extending beyond aedeagal shaft apex; shaft slender and abbreviated (Fig. 2E, H). Connective with well-developed arms, and strong stem (Fig. 2F).

### Distribution

Madagascar (Toamasina, Antsiranana).

### Remarks

This species resembles *Narta waska* Dworakowska, 1979, but differs in having two long and strong processes arising from the base of the aedeagal shaft and exceeding the length of the shaft; the apex of the ventral pygofer appendage bifurcate. It was co-discovered by Weiwei Ran and Professor Yuehua Song; morphological description and illustration by Yusha Tan.

*Narta irwini* Tan & Song sp. nov.

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Figs 1, 3

### Diagnosis

Head without ocelli (Fig. 1K). Pronotum yellow or light brown, posterior margin concave inward (Figs 1J, 3B). Pygofer lobe with numerous microtrichia on caudal part, two large setae near caudal part. (Fig. 3A) Aedeagus without distinct processes; dorsal apodeme long and curved in U-shape (Fig. 3D, G).

### Etymology

The specific epithet '*irwini*' is derived from the surname of Michael Irwin, one of the collectors of the type specimens, hence the name is given after his surname in commemoration.

### Type material

#### Holotype

MADAGASCAR – **Toamasina Province** • ♂; botanic garden near entrance to Andasibe National Park; 18°55'35" S, 48°24'28" E; 1025 m a.s.l.; 8–16 Oct. 2001; M. Irwin and R. Harin'Hala leg.; MA-01-08B-15.

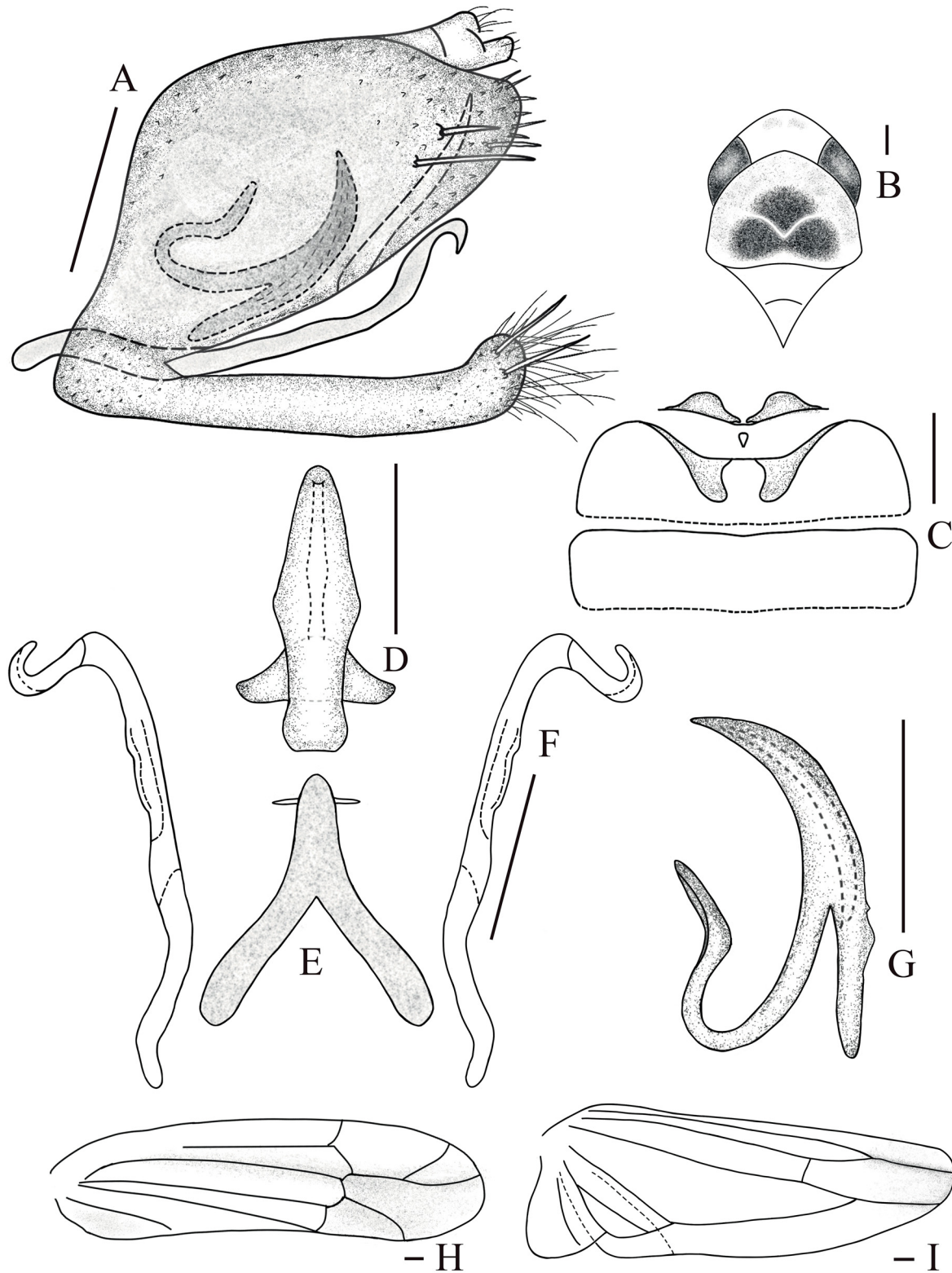
#### Paratypes

MADAGASCAR – **Toamasina Province** • 1 ♂, 3 ♀♀; 7–16 Nov. 2001; same collection data as for holotype; MA-01-08B-19.

### Description

**MEASUREMENTS.** Body length. ♂: 3.1–3.2 mm; ♀: 3.2–3.4 mm.

**COLORATION.** Body yellowish to brownish (Fig. 1G–L). Vertex creamy yellow, with two indistinct oblong light spots near anterior margin; pronotum yellow or light brown, with scattered irregular small brownish



**Fig. 3.** *Narta irwini* Tan & Song, sp. nov. **A.** Pygofer, lateral view. **B.** Head and thorax, dorsal view (showing visible spots/markings on this part). **C.** Abdominal apodemes. **D.** Aedeagus, ventral view. **E.** Connective. **F.** Style. **G.** Aedeagus, lateral view. **H.** Forewing. **I.** Hindwing. Scale bars=0.1 mm.

spots (Fig. 1J). Face creamy yellow; postclypeus with several transverse striae along lateral margins; anteclypeus slightly darker than postclypeus (Fig. 1K). Forewing with 1<sup>st</sup> and 2<sup>nd</sup> apical cells darker (Figs 1G–I, 3H). Hindwing characters conform to the generic diagnosis. (Figs 1G–I, 3I).

**STRUCTURE.** Head without ocelli. Vertex subequal in width to pronotum, with median area of anterior margin produced slightly; posterior margin parallel to anterior margin (Figs 1J–K, 3B). Pronotum with posterior margin slightly concave. Scutellum with distinct transverse impression (Figs 1J, 3B). Male abdominal apodemes relatively small, slightly curved, located in the 3rd sternite (Fig. 3C).

**MALE GENITALIA.** Pygofer lobe broad, dorsal margin and caudal part with numerous scattered microtrichia, two large setae near caudal tip; pygofer ventral appendage slender, extending to distal margin of pygofer lobe (Fig. 3A). Subgenital plate slender, subequal in width; two macrosetae at apex, outer surface densely covered with long hair-like setae (Fig. 3A). Style slender, with hook-like apex (Fig. 3F). Aedeagus with preatrium shorter than shaft; dorsal apodeme extremely long and U-shaped curved; aedeagal shaft curved dorsad and devoid of processes; gonopore subapical, ventrad (Fig. 3D, G). Connective with long and narrow lateral arms; central lobe absent (Fig. 3E).

### Distribution

Madagascar (Toamasina).

### Remarks

This genus resembles *Narta seroka* Dworakowska, 1979, but differs by having the dorsal apodeme extremely long and U-shaped curved; the preatrium slender and the aedeagal shaft not expanded strongly.

*Narta septlacus* Tan & Song sp. nov.

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Figs 1, 4

### Diagnosis

Vertex rounded, anterior margin with an inverted triangular spot, without ocelli. (Figs 1P–Q, 4B). Subgenital plate expanded at apex, slightly curved upward (Fig. 4A). Aedeagal shaft broad and lamellate in ventral view; dorsal apodeme extremely long and curved in V-shape (Fig. 4D, G).

### Etymology

The specific epithet ‘*septlacus*’ is a noun in apposition, derived from the type locality ‘Sept Lacs’ (the Seven Lakes region, located in Toliara Province, Madagascar). The name is a contracted combination of the Latin prefix ‘*sept-*’ (abbreviation of *septem*, meaning ‘seven’) and the Latin noun ‘*lacus*’ (meaning ‘lake’), referring to the type locality of the new species.

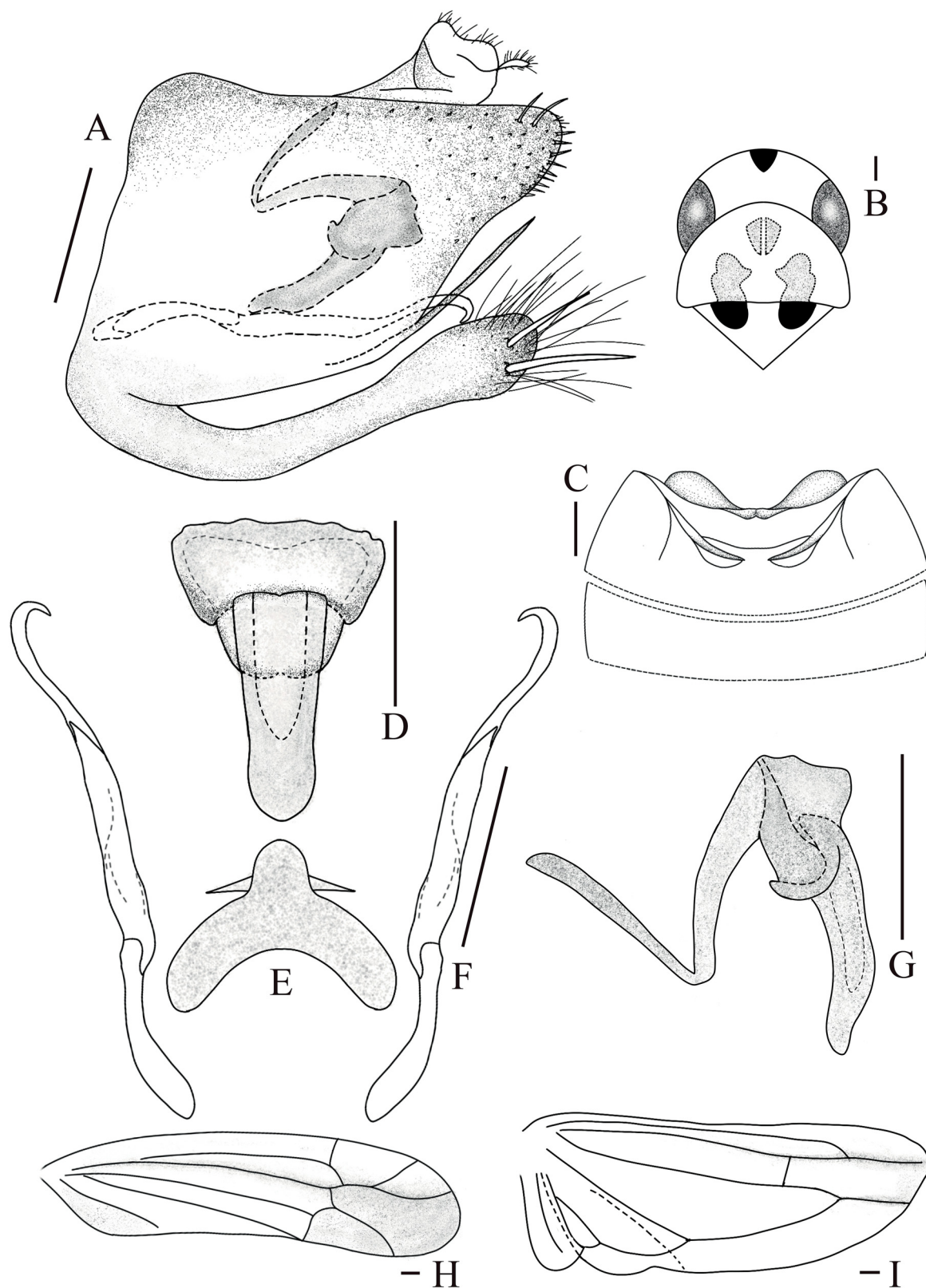
### Type material

#### Holotype

MADAGASCAR – **Toliara Province** • ♂; Sept Lacs; 23°31'15" S, 44° 9'35" E; 120 m a.s.l.; 21–26 Aug. 2002; M. Irwin, F. Parker and R. Harin'Hala leg.; MGF038.

#### Paratypes

MADAGASCAR – **Tulear Province** • 1 ♂, 1 ♀; Andohahela Nat'l Park, Tsimelahy, Parcelle II; 24°56'12.6" S, 46°37'36" E; 180 m a.s.l.; 5–15 Feb. 2003; M. Irwin, F. Parker and R. Harin'Hala leg.; MA-02-20-15.



**Fig. 4.** *Narta septilacus* Tan & Song, sp. nov. **A.** Pygofer, lateral view. **B.** Head and thorax, dorsal view (showing visible spots/markings on this part). **C.** Abdominal apodemes. **D.** Aedeagus, ventral view. **E.** Connective. **F.** Style. **G.** Aedeagus, lateral view. **H.** Forewing. **I.** Hindwing. Scale bars=0.1 mm.

## Description

MEASUREMENTS. Body length. ♂: 3.0–3.2 mm; ♀: 3.2 mm.

COLORATION. Body yellowish-brown or light brown (Fig. 1M–R). Vertex creamy yellow, with an inverted triangular dark brown spot on anterior margin medially; eyes black; pronotum yellowish-brown, without distinct markings, transparent or semitransparent; scutellum with basal triangles dark brown, transverse impression deeply concave (Fig. 1P). Face creamy yellow, postclypeus slightly darker than anteclypeus (Fig. 1Q). Forewing with apical cells smoked (Figs 1M–O, 4H). Hindwing characters conform to the generic diagnosis. (Figs 1M–O, 4I).

STRUCTURE. Vertex with anterior and posterior margins nearly parallel, median area of anterior margin slightly produced anteriorly, without ocelli (Figs 1P–Q, 4B). Pronotum broad, with indistinct impression on median area of anterior margin; scutellum triangular (Figs 1P, 4B). Male abdominal apodemes very small, confined to the 3<sup>rd</sup> sternite (Fig. 4C).

MALE GENITALIA. Pygofer lobe broad, posterior part densely covered with short stout setae, microtrichia, and two long setae; pygofer ventral appendage arising from posterior margin, long and slender (Figs 1R, 4A). Subgenital plate expanded at base, little narrowed medially, inflated and slightly curved at apex; with two macrosetae and dense long hair-like setae on outer surface of apex (Fig. 4A). Style slender, with apex hook-like curved (Fig. 4F). Aedeagus robust, its shape quite unique; aedeagal shaft wide and short; dorsal apodeme significantly elongated, appearing V-shaped curved in lateral view (Fig. 4D, G). Connective with two well-developed arms; stem short and thick, without central lobe (Fig. 4E).

## Distribution

Madagascar (Toliara, Tuléar).

## Remarks

This species can be distinguished from other species in the genus by its unique aedeagus.

## Discussion

This study reviews the genus *Narta* and describes three new species from Madagascar: *N. andasibensis* sp. nov., *N. irwini* sp. nov., and *N. septlacus* sp. nov. Prior to this work, only two species had been recorded in this genus, both of which are endemic to the Democratic Republic of the Congo (Dworakowska 1979). In the study, techniques such as the KEYENCE VHX-5000 digital microscope and Procreate software were employed to improve the accuracy of morphological character documentation. This addressed a limitation of earlier research on *Narta*, which struggled to capture fine diagnostic traits. Previously, there was no dedicated identification key for *Narta*, complicating species recognition. The key developed in this study is intended to facilitate future research on *Narta* in Africa and Madagascar.

*Narta* possesses several unique features that confirm its generic distinctiveness. All five species share characteristics not observed in other genera of the same family, including “fusion of the subgenital plate base”, “well-developed pygofer ventral appendage extending beyond the margin of the pygofer lobe”, and “aedeagal shafts with diverse shapes”. It should be specifically noted, however, that all the new species lack ocelli, which represents a remarkable discrepancy from the original description of the two known species (*N. seroka* and *N. waska*) that bear a pair of ocelli on the vertex. Dworakowska previously noted similarities in wing shape and male genitalia between *Narta* and *Muluana*; however, distinct differences exist between the two genera: *Narta* has smoky brown 1<sup>st</sup> and 2<sup>nd</sup> apical cells on the forewing and long microsetae at the apex of the subgenital plate, while *Muluana* has an asymmetrical genital capsule and plate-like, nearly triangular subgenital plates. These features, combined with the unique

male genitalic traits of the new species (e.g., the bifurcated apex of the pygofer ventral appendage in *N. andasibensis* sp. nov. and the U-shaped curved dorsal apodeme in *N. irwini* sp. nov.), provide reliable diagnostic criteria for *Narta* and its constituent species.

The presence or absence of ocelli is a key trait in insect taxonomy, and the pattern of its differentiation within the genus *Narta* merits in-depth investigation. The presence or absence of distinct visual organs in insects is often associated with the environmental and life habits of species, indicating that ocelli may become dispensable and thus degenerate under certain ecological conditions (Guignard *et al.* 2022). The loss of ocelli in the three new species is likely directly related to Madagascar's unique insular ecological environment and long-term geographic isolation. This island has been isolated from continental Africa for approximately 160 million years (Antonelli *et al.* 2022). Such an isolated environment has driven adaptive evolution in species, and ocelli, as photoreceptors, might have gradually disappeared through natural selection as compound eyes evolved. The discovery of three species in Madagascar represents the first record of this genus outside continental Africa. As a biodiversity hotspot, Madagascar has an extremely endemic insect fauna (Goodman 2022). The distribution and evolution of *Narta* on this island further confirm the key role of insular isolation in shaping species morphological traits. This study provides a reference for future research that integrates morphology and molecular phylogenetics to explore the evolutionary relationships between insect groups from Madagascar and continental Africa.

## Acknowledgements

We thank Ms Weiwei Ran for her valuable contributions to the discovery of the new species *Narta andasibensis* sp. nov. This work was partly supported by the National Natural Science Foundation of China (32260120), the Natural Science Foundation of Guizhou Province (Qiankehejichu-ZK [2023] General 257), the Training Program for High-level Innovative Talents of Guizhou Province (Qiankehepingtairencai-GCC [2023]032) and the Science and Technology Innovation Talent Team Building Project of Guizhou Province (Qiankehepingtairencai-CXTD [2023]010).

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