



## New species and new records of *Brueelia* Kéler, 1936 (Phthiraptera: Ischnocera) from South Africa

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### Abstract

Three species of the genus *Brueelia* Kéler, 1936 are reported from South Africa for the first time: *Brueelia cyclothorax* (Burmeister, 1838) ex *Passer domesticus* (Linnaeus, 1758), *Brueelia queleae* Sychra & Barlev [*in Sychra et al.*], 2010a ex *Quelea quelea lathamii* (Smith, 1836), and *Brueelia coryliventer* Gustafsson & Bush, 2015, ex *Creatophora cinerea* (Meuschen, 1787). In addition, two new species of *Brueelia* are described from South African ploceids: *Brueelia oschadlei* n. sp. ex *Ploceus capensis* (Linnaeus, 1766), and *Brueelia inusta* n. sp. ex *Ploceus velatus tahatali* Smith, 1836. Also, we discuss the “African pied *Brueelia*” species-group—to which the two new species belong—in particular the variation in pigmentation patterns on the subgenital plates of both sexes.

**Key words:** *Brueelia*-complex, *Brueelia*, African pied *Brueelia*, Philopteridae, Ploceidae, new species, new records, South Africa

### Introduction

The genus *Brueelia* Kéler, 1936 comprises a large group of morphologically homogeneous lice, separated mainly by characters in the male genitalia and overall chaetotaxy. Species in this genus are mainly parasitic on passeriform birds across the world (Gustafsson & Bush 2017). Currently, about 200 species are in this genus, but Gustafsson *et al.* (2019a) estimated that the diversity of *Brueelia* may exceed 1000 species in Africa alone. They listed 29 species that had been recorded in Africa since 1980, and only a single species of *Brueelia* has been added to the African fauna since 2019: *Brueelia hermetica* Gustafsson *et al.*, 2022, from South Africa.

Most of the species of African *Brueelia* have only been recorded once, and consequently the geographical range of *Brueelia* species parasitising hosts with large ranges is largely unknown. This is potentially important, as at least one African host species is parasitised by different species of *Brueelia* in different parts of its range. Ansari (1956, 1957) described *Brueelia zohrae* Ansari, 1956, and *Brueelia moreli* Ansari, 1957 from the piacpiac, *Ptilostomus afer* (Linnaeus, 1766), from Guinea-Bissau and Senegal, respectively. Gustafsson & Bush (2017) reported *B. zohrae* from Sudan, and *B. moreli* from Uganda. Notably, there are no significant gaps in the distribution of the host (*e.g.*, Borrow & Demey 2014) that could explain having two different species of *Brueelia*; either the two lice may coexist on the same host populations, or their ranges may be determined by yet unknown environmental factors. Therefore, the identity of *Brueelia* species cannot be determined on host associations; specimens from different parts of the host’s range must be compared morphologically.

We have examined a collection of *Brueelia* species collected in South Africa between 2012 and 2015, comprising six different species, including two new species that are described and named in this paper. Samples of three other

already described species expand their geographical ranges, and the last species could not be identified because only a single female was available; however, this female is morphologically unique and likely belongs to an undescribed species which may have been collected from an accidental host species. Four of the six species belong to the “African pied *Brueelia*” species-group erected by Gustafsson *et al.* (2019a), which is discussed more broadly in this paper.

## Material and methods

Specimens were cut half-way through the pterothorax and extracted for DNA using the DNEasy Blood and Tissue Kit (Qiagen, Shanghai, China). Due to the storage of the specimens, no DNA was obtained, but exoskeletons were retrieved and slide-mounted in Canada balsam following Palma (1978) and Gustafsson *et al.* (2019b). Slide-mounted specimens were examined through a Nikon Eclipse Ni (Nikon Corporation, Tokyo, Japan), with a drawing tube attached for making illustrations. Drawings were scanned, then compiled and edited in GIMP (www.gimp.org). Additional illustrations (Figs 1–19) were redrawn from published illustrations when necessary. Specimens were deposited at the Natural History Museum, London (NHML). Measurements were taken from images of the specimens, for the following dimensions: AW = abdominal width (at segment V); HL = head length (at midline); HW = head width (at widest point of temples); PRW = prothoracic width; PTW = pterothoracic width; TL = total length (at midline). Host taxonomy follows Clements *et al.* (2022). Terminology for chaetotaxy and other structures of the lice follows Clay (1951), Mey (1994), and Gustafsson & Bush (2017). An overview of the pigmentation patterns of the male and female subgenital plates of the species in the “African Pied *Brueelia*” species group can be found in Figures 1–10 and 11–19, respectively.

## Systematics

### PHTHIRAPTERA Haeckel, 1896

Phthiraptera Haeckel, 1896: 703.

### Ischnocera Kellogg, 1896

Ischnocera Kellogg, 1896: 63.

### Phloptoridae Burmeister, 1838

Phloptoridae Burmeister, 1838: 422.

### *Brueelia*-complex

#### *Brueelia* Kéler, 1936

*Phlopterus* Nitzsch, 1818: 288 (*in partim*).

*Nirmus* Nitzsch, 1818: 291 (*in partim*).

*Degeeriella* Neumann, 1906 (*in partim*).

*Bruëlia* [sic] Kéler, 1936: 257.

*Painjunirmus* Ansari, 1947: 285.

*Allobrueelia* Eichler, 1951: 36 (*in partim*).

*Nigrionirmus* Złotorzycka, 1964: 248.

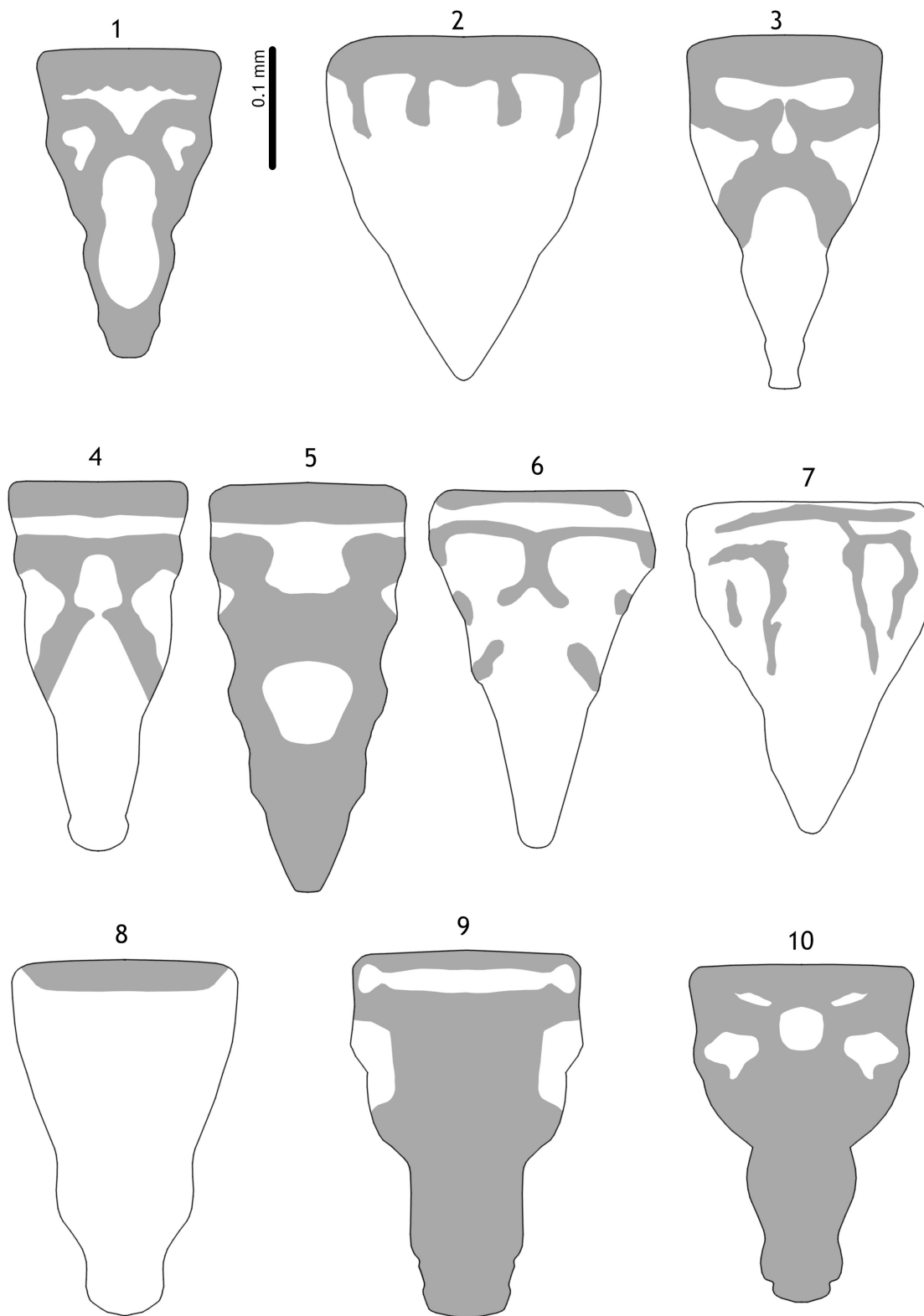
*Spironirmus* Złotorzycka, 1964: 261.

*Serinirmus* Soler-Cruz, *et al.*, 1987: 244.

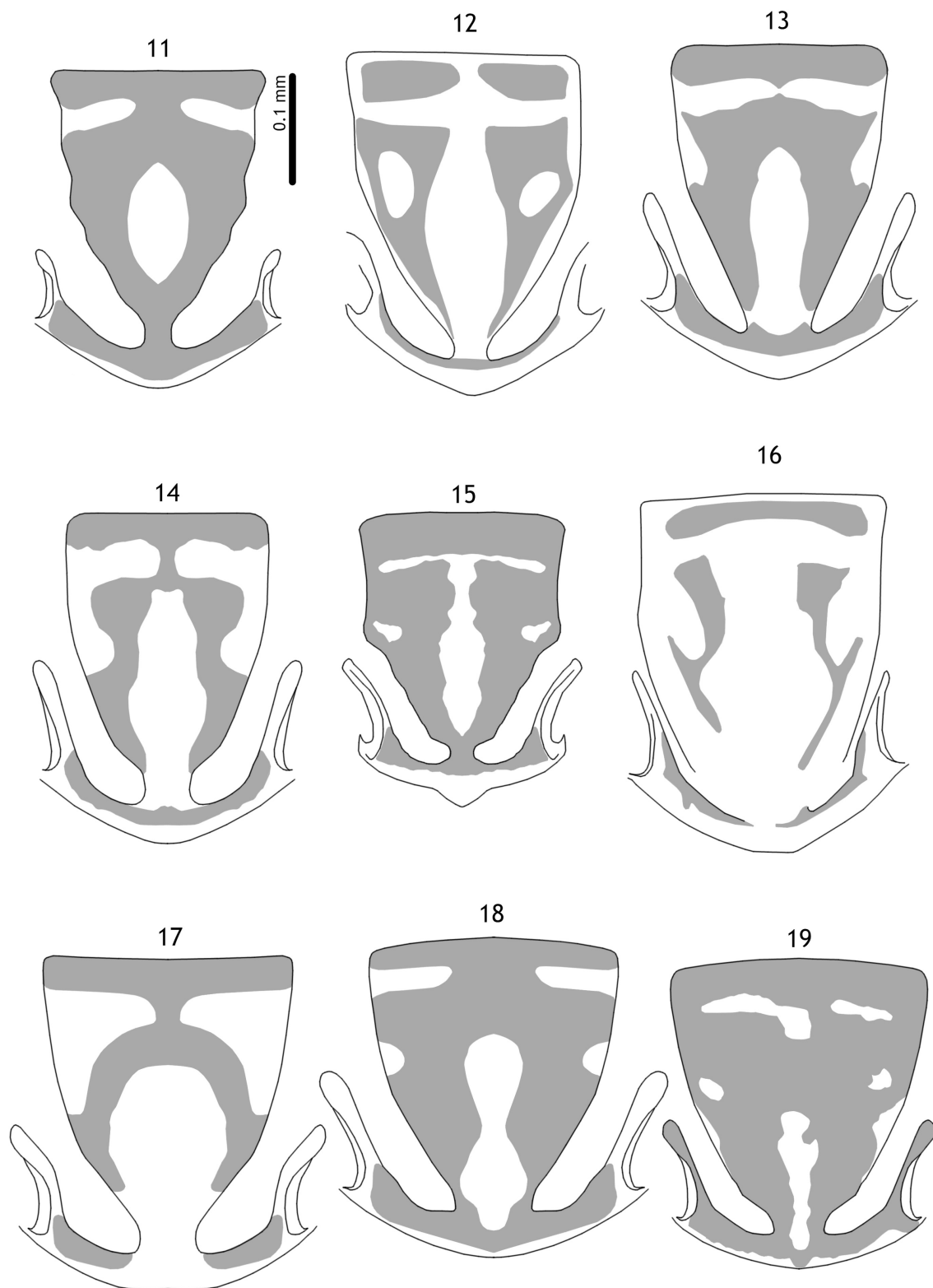
*Plesionirmus* Mey, 2017: 144.

*Neosittiella* Mey, 2017: 149.

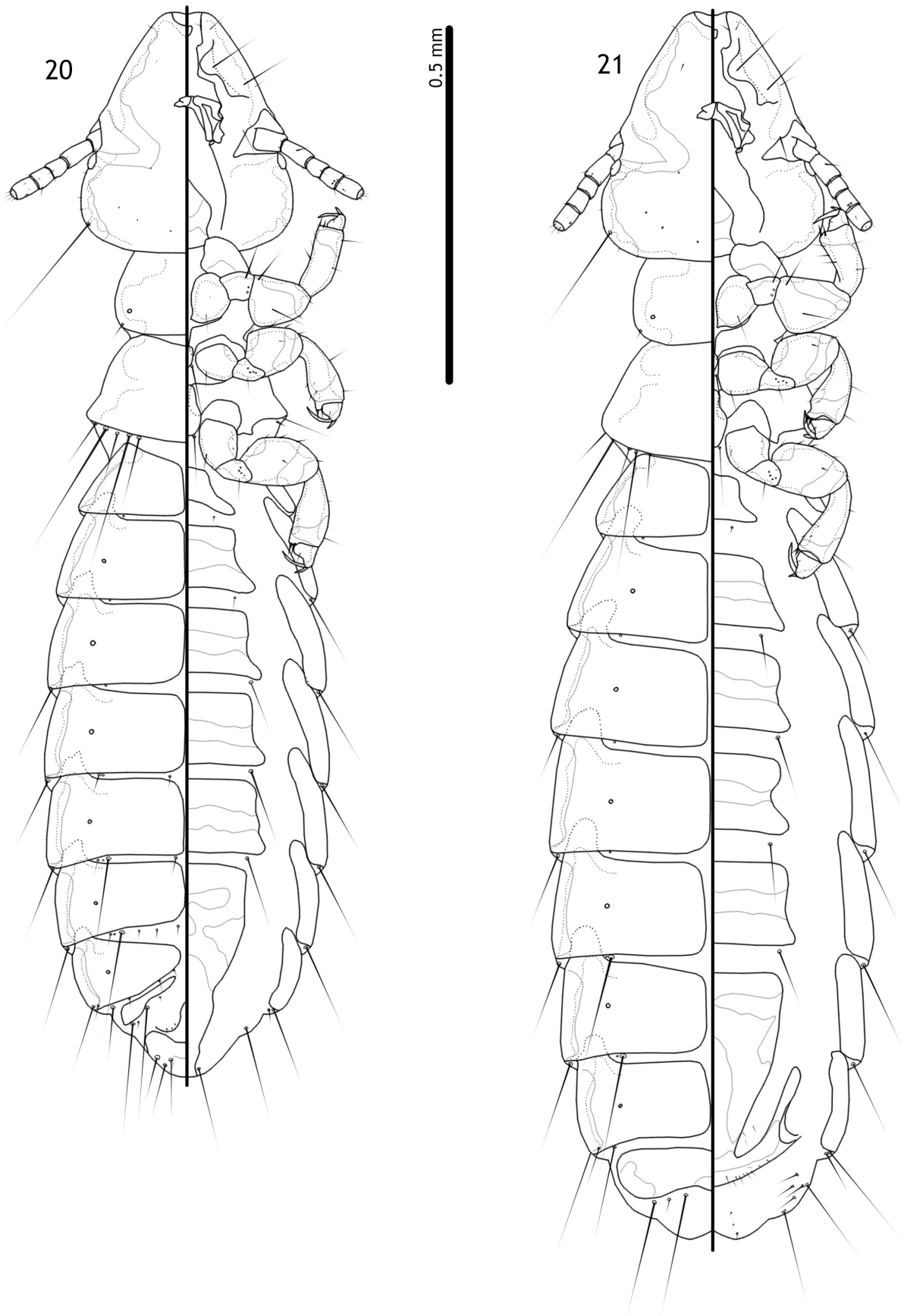
**Type species:** *Bruëlia rossittensis* Kéler, 1936: 257 [= *Nirmus brachythorax* Giebel, 1874: 134], by original designation.



**FIGURES 1–10.** Male subgenital plates of the species in the “African pied *Bruëlia*” group, showing pigmentation patterns. **1**, *Bruëlia aguilarae* Gustafsson & Bush, 2017. **2**, *Bruëlia cantans* Sychra [in Sychra *et al.*], 2010b. **3**, *Bruëlia oschadlei* n. sp. **4**, *Bruëlia inusta* n. sp. **5**, *Bruëlia mpumalangensis* Gustafsson *et al.*, 2018. **6**, *Bruëlia ploceus* (Lakshminarayana, 1968). **7**, *Bruëlia quelea* Sychra & Barlev [in Sychra *et al.*], 2010a. **8**, *Bruëlia semiscalaris* Gustafsson *et al.*, 2019. **9**, *Bruëlia sima* Gustafsson *et al.*, 2019. **10**, *Bruëlia terpsichore* Gustafsson *et al.*, 2019. Note: Pigmentation patterns are variable and often asymmetrical, and the degree of darkness and colour differ among species. All setae have been omitted.



**FIGURES 11–19.** Female subgenital plates of the species in the “African pied *Brueelia*” group, showing pigmentation patterns. **11**, *Brueelia aguilarae* Gustafsson & Bush, 2017. **12**, *Brueelia cantans* Sychra [in Sychra *et al.*], 2010b. **13**, *Brueelia oschadlei* n. sp. **14**, *Brueelia inusta* n. sp. **15**, *Brueelia mpumalangensis* Gustafsson *et al.*, 2018. **16**, *Brueelia quelea* Sychra & Barlev [in Sychra *et al.*], 2010a. **17**, *Brueelia semiscalaris* Gustafsson *et al.*, 2019. **18**, *Brueelia sima* Gustafsson *et al.*, 2019. **19**, *Brueelia terpsichore* Gustafsson *et al.*, 2019. Note: All illustrations are redrawn from their respective original descriptions. The pattern of the female subgenital plate of *Brueelia ploceus* (Lakshminarayana, 1968) is not available. All setae have been omitted.



**FIGURES 20–21.** *Brueelia oschadlei* n. sp. **20**, male habitus, dorsal and ventral views. **21**, female habitus, dorsal and ventral views.

## ***Brueelia oschadlei* new species**

(Figs 3, 13, 20–26, 37–38)

**Type host:** *Ploceus capensis* (Linnaeus, 1766)—Cape weaver.

**Type locality:** Lambert's Bay, Western Cape Province, South Africa.

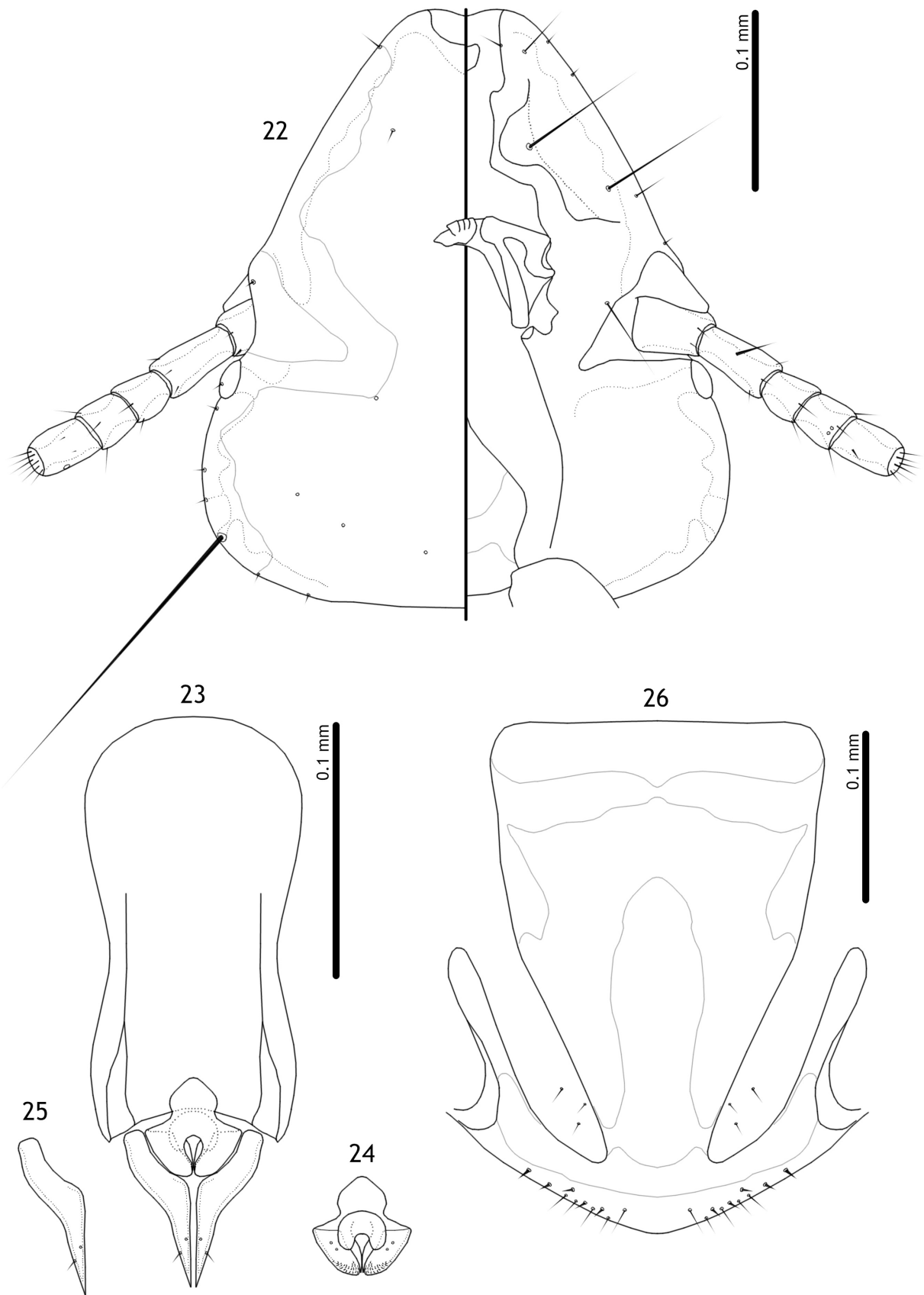
**Diagnosis.** Both sexes of *Brueelia oschadlei* n. sp. key out to *Brueelia semiscalaris* Gustafsson *et al.*, 2019a, in the key of Gustafsson *et al.* (2019a), but they can be separated by the following characters: pigmentation patterns of the male and female subgenital plates (*cf.* Figs 3, 13 with Figs 8, 17); head of *B. oschadlei* (Fig. 22) proportionately shorter and broader than in *B. semiscalaris*; abdominal segment III with *ps* in both sexes in *B. oschadlei*, but without *ps* in *B. semiscalaris*; male parameres slender and elongated, about 2 times as long as mesosome, in *B. oschadlei* (Fig. 23), but stouter, not elongated and less than 1.5 times as long as mesosome in *B. semiscalaris*; proximal mesosome with distal constriction in *B. oschadlei* (Fig. 25), but without such constriction in *B. semiscalaris*; female vulval margin with fewer *vss* (2–4) and fewer *vss* (4–6) in *B. oschadlei* (Fig. 26) than in *B. semiscalaris* (6–7 and 7–8, respectively).

Also, *B. oschadlei* can be separated from *B. inusta* n. sp. (Figs 27–33) by the following characters: *aps* present on male tergopleurite V in *B. oschadlei* (Fig. 20), but absent in *B. inusta* (Fig. 27); *ps* present on abdominal segment III, and 2 *ps* present on abdominal segments IV–VI in both sexes in *B. oschadlei* (Figs 20–21), but absent on abdominal segment III and only one *ps* on each of segments IV–VI in *B. inusta* (Figs 27–28); lateral margins of preantennal head more convex in *B. inusta* (Fig. 29) than in *B. oschadlei* (Fig. 22); proximal mesosome more flattened anteriorly in *B. inusta* (Figs 30–31) than in *B. oschadlei* (Figs 23–24); female vulval margin with fewer *vms* and more *vss* in *B. oschadlei* (Fig. 26) than in *B. inusta* (Fig. 33).

**Description.** Head rounded trapezoidal (Fig. 22), lateral margins of preantennal head straight or only barely convex, frons concave. Marginal carina slender, deeply displaced and somewhat widened at osculum. Ventral anterior plate small. Head chaetotaxy and pigmentation patterns as in Fig. 22. Preantennal nodi slender, elongated. Preocular nodi larger than postocular nodi. Marginal temporal carina variable in width, with undulating median margin. Thoracic and abdominal segments, chaetotaxy, and pigmentation patterns as in Figs 20–21. Anterior dark band on subgenital plate of both sexes may be medianly continuous with central dark area, or may be separate. Male abdominal chaetotaxy: *ss* present on tergopleurites V–VIII; *tps* present on tergopleurites VII–VIII; *psps* present on tergopleurites VI–VII; *aps* present on tergopleurites V–VII; *ps* present on segments III–VIII. Female abdominal chaetotaxy: *ss*, *tps*, *aps* absent; *psps* present on tergopleurites VI–VII; *ps* present on segments III–VIII. Basal apodeme broad, with sinuous lateral margins and rounded proximal end (Fig. 23). Proximal mesosome rounded trapezoidal, constricted distally (Fig. 24). Mesosomal lobes convergent distally, with extensive rugose areas. Gonopore large, rounded. Penile arms not extended beyond distal margin of mesosome. Parameres elongated, sinuous, with *pst1*–2 as in Fig. 24. Female subgenital plate trapezoidal, with broad connection to cross-piece (Fig. 26). Vulval margin rounded convergent to median point, with 2–4 short, slender *vms* and 4–6 short, thorn-like *vss* on each side; 2–3 short, slender *vos* on each side of subgenital plate; distal 1 *vos* on each side median to *vss*. Measurements are given in Table 1.

**Etymology:** The species is named after Dr Dieter Oschadleus (Research Associate at the University of Cape Town, and at the University KwaZulu-Natal) in recognition of his work on African birds over many years, and for his assistance to A.H. collecting ectoparasites from South African birds.

**Type material.** Ex *Ploceus capensis*: **Holotype** ♂, Lambert's Bay, Western Cape Province, South Africa, 21 Oct. 2012, coll. A. Halajian, SAFRING CV27592, Plocap16 (NHML). **Paratypes:** 1♂, 1♀, same data as holotype, SAFRING CV27590, Plocap13 (NHML). 1♀, same data as holotype, ring CV27591, Plocap15 (NHML). 1♂, same data as holotype, SAFRING CV27593, Plocap17 (NHML). 1♂, 1♀, Patryskloof farm, Worcester, Western Cape Province, South Africa, 17 Oct. 2012, coll. A. Halajian, SAFRING CV27574, Plocap1 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27575, Plocap2 (NHML). 1♂, 1♀, same locality and collector as previous, 18 Oct. 2012, SAFRING CV27579, Plocap3 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27582, Plocap6 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27580, Plocap7 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27584, Plocap8 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27585, Plocap9 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27586, Plocap10 (NHML). 1♂, 2♀, same data as previous, SAFRING CV27587, Plocap11 (NHML). 1♂, 1♀, same data as previous, SAFRING CV27588, Plocap12 (NHML).



**FIGURES 22–26.** *Brueelia oschadlei* n. sp. **22**, male head, dorsal and ventral views. **23**, male genitalia, dorsal view. **24**, male mesosome, ventral view. **25**, male paramere, dorsal view. **26**, female subgenital plate and vulval margin, ventral view.

**TABLE 1.** Measurements (in mm) of the new species. AW = abdominal width (at segment V); HL = head length (at midline); HW = head width (at widest point of temples); N = number; PRW = prothoracic width; PTW = pterothoracic width; TL = total length (at midline).

Species	Sex	N	TL	HL	HW	PRW	PTW	AW
<i>Brueelia oschadlei</i> n. sp.	M	13 <sup>1</sup>	1.38–1.53	0.30–0.33	0.26–0.29	0.18–0.21	0.25–0.31	0.36–0.43
	F	12 <sup>2</sup>	1.69–1.85	0.34–0.36	0.30–0.32	0.21–0.23	0.28–0.31	0.42–0.48
<i>Brueelia inusta</i> n. sp.	M	6 <sup>3</sup>	1.42–1.45	0.31–0.33	0.25–0.28	0.18–0.19	0.23–0.27	0.36–0.39
	F	11 <sup>4</sup>	1.53–1.73	0.32–0.35	0.27–0.29	0.18–0.21	0.26–0.30	0.38–0.44

<sup>1</sup> N for TL = 10, N for HL and HW = 12.

<sup>2</sup> N for TL = 9.

<sup>3</sup> N for TL = 2, N for AW = 5.

<sup>4</sup> N for TL = 8, N for PTW = 10.

### *Brueelia inusta* new species

(Figs 4, 14, 27–33, 39–40)

**Type host:** *Ploceus velatus tahatali* Smith, 1836—Southern masked weaver.

**Type locality:** Old Herbarium, University of Limpopo, Limpopo Province, South Africa.

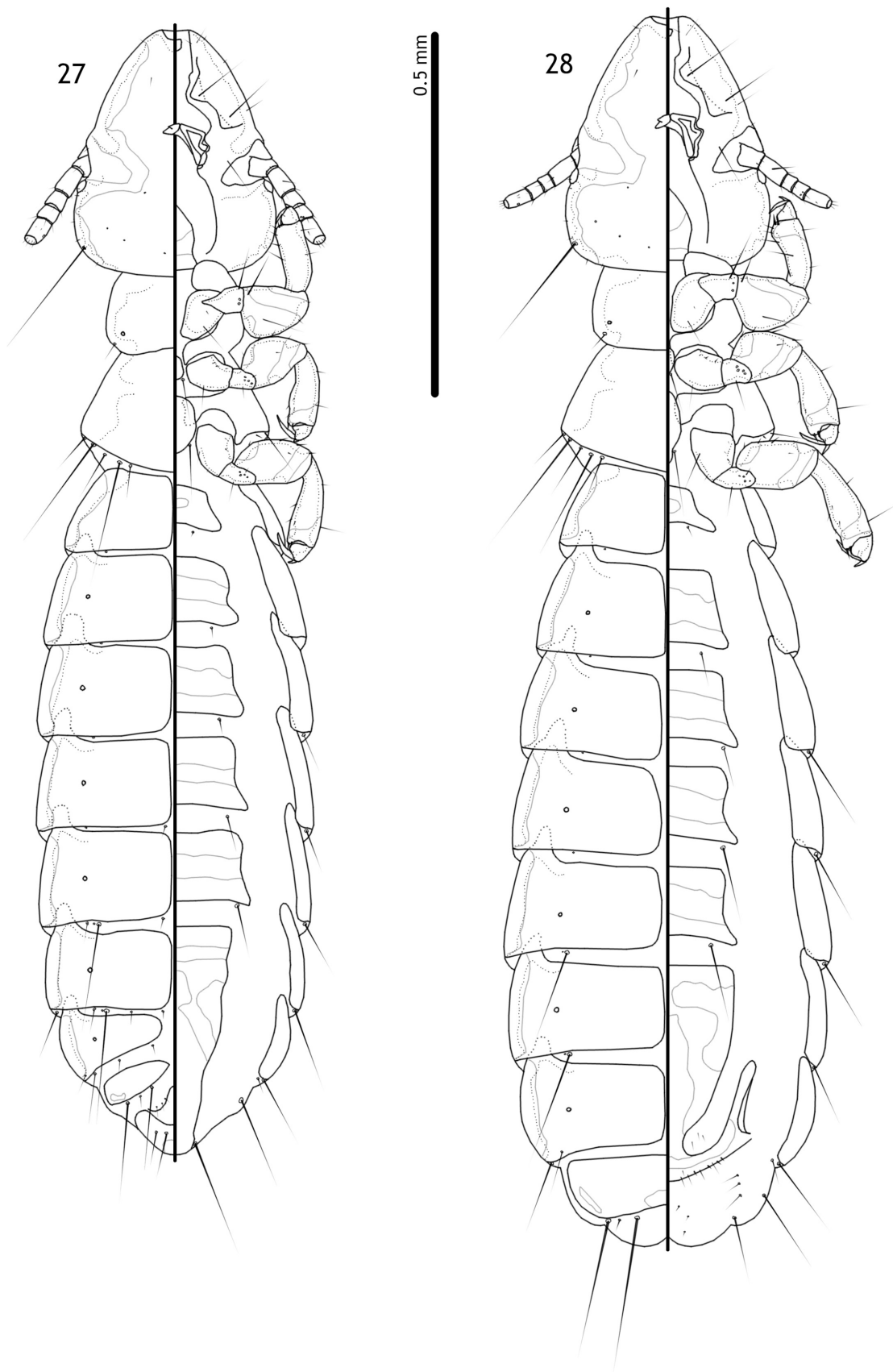
**Diagnosis.** In the key of Gustafsson *et al.* (2019a), males of *B. inusta* n. sp. key out to *Brueelia sima* Gustafsson *et al.*, 2019a, based on the abdominal chaetotaxy, and females key out to *Brueelia semiscalaris*. However, the morphologically most similar species to *B. inusta* is *B. oschadlei* n. sp.; for characters separating these two new species, see above.

*Brueelia inusta* can be separated from *Brueelia sima* by the following characters: lateral margins of preantennal head more convex in *B. inusta* (Fig. 29) than in *B. sima*; proximal mesosome proportionately smaller and gonopore proportionately larger in *B. inusta* (Fig. 31) than in *B. sima*; parameres much elongated in *B. inusta* (Fig. 32) compared to *B. sima*; female vulval margin with only 1 *vms* on each side in *B. sima*, but with 4–6 *vms* on each side in *B. inusta* (Fig. 33).

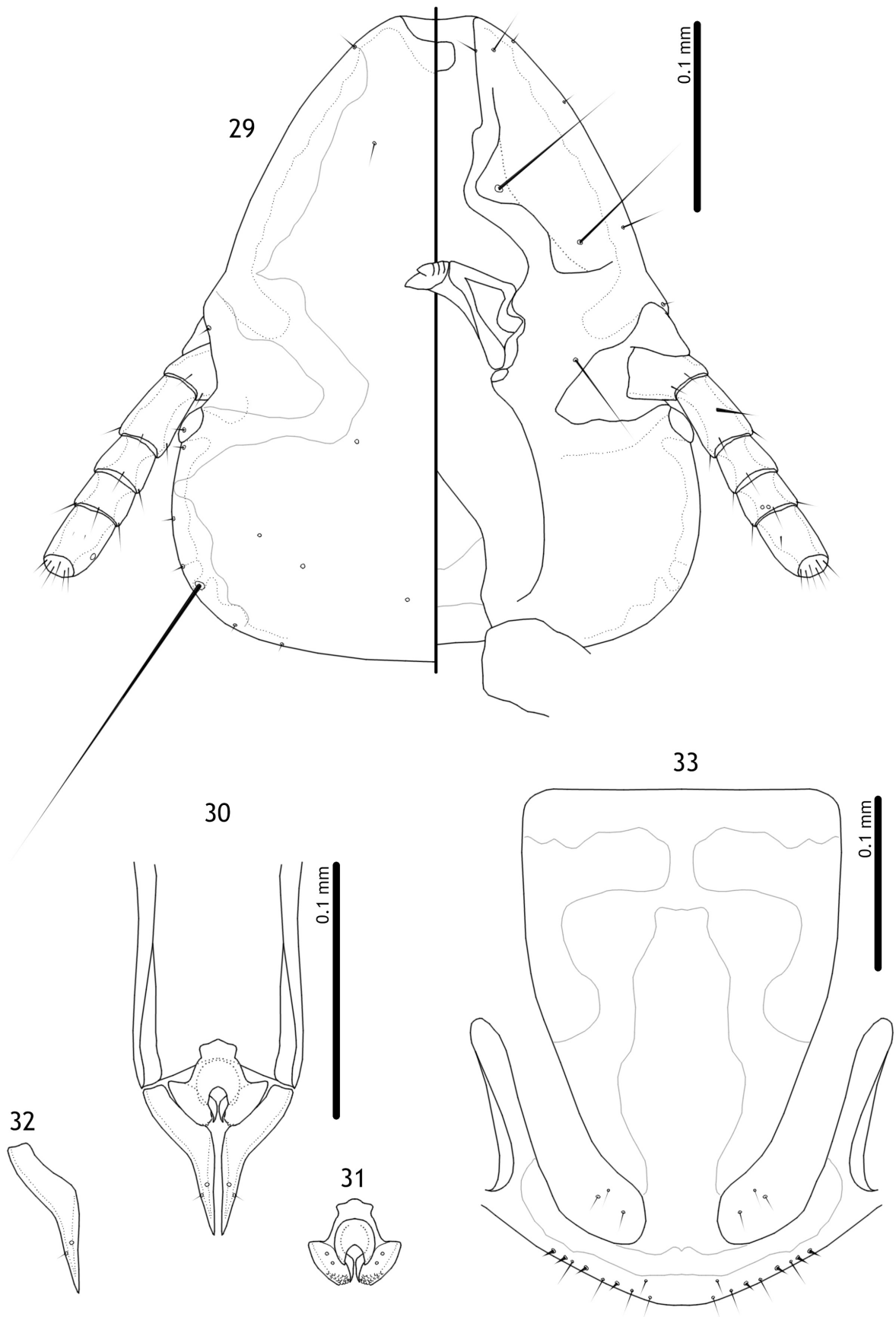
*Brueelia inusta* can be separated from *B. semiscalaris* by the following characters: head proportionately rounder and broader in *B. inusta* (Fig. 29) than in *B. semiscalaris*; female abdominal segments IV–VII with 2 *ps* on each side in *B. semiscalaris*, but with 1 *ps* on each side in *B. inusta* (Fig. 28); dark pigmentation of male subgenital plate more extensive in *B. inusta* (Fig. 4) than in *B. semiscalaris* (Fig. 8); male parameres slender and elongated, about 2 times as long as mesosome, in *B. inusta* (Fig. 30), but stouter, not elongated and less than 1.5 times as long as mesosome in *B. semiscalaris*; proximal mesosome somewhat flattened and irregular in *B. inusta* (Fig. 31), but gently rounded in *B. semiscalaris*; female vulval margin more flattened in *B. semiscalaris* than in *B. inusta* (Fig. 33), and with fewer *vms* (4–6) and *vss* (3–4) in *B. inusta* (Fig. 33) than in *B. semiscalaris* (6–7 and 7–8, respectively).

**Description.** Head rounded triangular (Fig. 29), lateral margins of preantennal area clearly convex, frons shallowly concave. Marginal carina slender, deeply displaced and somewhat widened at osculum. Ventral anterior plate small. Head chaetotaxy and pigmentation patterns as in Fig. 29. Preantennal nodi broad. Preocular nodi larger than postocular nodi. Marginal temporal carina variable in width, with undulating median margin. Thoracic and abdominal segments, chaetotaxy, and pigmentation patterns as in Figs 27–28. Anterior dark band of female subgenital plate continuous with central dark area. Male abdominal chaetotaxy: *ss* present on tergopleurites V–VIII; *tps* present on tergopleurites VII–VIII; *psps* present on tergopleurites VI–VII; *aps* present on tergopleurites VI–VII; *ps* present on segments IV–VIII. Female abdominal chaetotaxy: *ss*, *tps*, *aps* absent; *psps* present on tergopleurites VI–VII; *ps* present on segments IV–VIII. Proximal section of basal apodeme not clearly delimited and not illustrated; holotype (Fig. 39) with genitalia everted and folded anteriorly, and basal apodeme thus slightly constricted compared to other males (Fig. 30). Proximal mesosome trapezoidal, with irregular somewhat flattened, anterior margin (Fig. 31). Mesosomal lobes convergent distally, with extensive rugose areas. Gonopore large, rounded. Penile arms not extended beyond distal margin of mesosome. Parameres elongated, sinuous, with *pst1*–2 as in Fig. 32. Female subgenital plate rounded trapezoidal, with broad connection to cross-piece (Fig. 33). Vulval margin rounded convergent to median point, with 4–6 short, slender *vms* and 3–4 short, thorn-like *vss* on each side; 2–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* on each side median to *vss*. Measurements are given in Table 1.





**FIGURES 27–28.** *Brueelia inusta* n. sp. **27**, male habitus, dorsal and ventral views. **28**, female habitus, dorsal and ventral views.



**FIGURES 29–33.** *Brueelia inusta* n. sp. **29**, male head, dorsal and ventral views. **30**, male genitalia, dorsal view. **31**, male mesosome, ventral view. **32**, male paramere, dorsal view. **33**, female subgenital plate and vulval margin, ventral view.

**Etymology:** The species epithet derives from “*inustus*”, Latin for “burnt”, referring to the pigmentation patterns.

**Type material.** Ex *Ploceus velatus tahatali*: **Holotype** ♂, Old Herbarium, University of Limpopo, Limpopo Province, South Africa, 11 Sep. 2014, coll. A. Halajian, SAFRING BC09995 (NHML). **Paratypes:** 1 ♀, same data as holotype (NHML). 1 ♂, 1 ♀, same data as holotype, SAFRING BB72401 (NHML). 1 ♂, 1 ♀, same data as holotype, SAFRING BB72402 (NHML). 1 ♂, 1 ♀, Polokwane Game Reserve, Polokwane, Limpopo Province, South Africa, 11 Feb. 2012, coll. A. Halajian, Pve-PGR2 (NHML). 1 ♀, same data as previous, Pve-PGR3 (NHML). 1 ♂, 1 ♀, same data as previous, SAFRING CV27561, Pve-PGR4 (NHML). 1 ♀, University of Limpopo, Limpopo Province, South Africa, 28 Sep. 2012, coll. A. Halajian, SAFRING CV27571, Pve-PGR11 (NHML). 1 ♂, 1 ♀, same data as previous, SAFRING CV27573, Pve-PGR12 (NHML). 1 ♀, De Loskop, Limpopo Province, South Africa, 7 Dec. 2012, coll. A. Halajian, SAFRING CV27598, Pve-PGR17 (NHML). 1 ♂, 1 ♀, same data as previous, SAFRING CV65202, Pve-PGR20 (NHML).

### *Brueelia queleae* Sychra & Barlev [in Sychra *et al.*], 2010

(Figs 34–36)

*Brueelia queleae* Sychra & Barlev [in Sychra *et al.*], 2010a: 18.

**Type host:** *Quelea quelea quelea* (Linnaeus, 1758)—red-billed quelea.

**Type locality:** Matam, Senegal.

**Other host:** *Quelea quelea lathami* (Smith, 1836).

**Description of male genitalia.** Basal apodeme with unclear anterior end, lateral margins slightly sinuous (Fig. 34). Proximal mesosome broader than long, margins irregular, constricted distally (Fig. 35). Mesosomal lobes with slightly concave lateral margins and extensive rugose areas distally. Gonopore bell-shaped, with distal ends curved and extended slightly laterally. Penile arms short and stubby, not reaching beyond distal margin of mesosome. Slight ridges present in anterior end of mesosomal lobes, but visible only in some examined specimens. Parameres bulky proximally, but distal elongations slender, with *pst1*–2 as in Fig. 36.

**Remarks:** Besides the type host, *Brueelia queleae* was reported from *Q. quelea lathami* in Malawi by Bush *et al.* (2016) and Gustafsson & Bush (2017), but our record is the first from South Africa. No significant differences in head shape, chaetotaxy, or pigmentation patterns have been found between our specimens and those examined by Sychra *et al.* (2010a), except that the pigmented areas of the male and female subgenital plates are slightly more extensive in our specimens. We do not consider this difference significant, and there are no other characters to separate the three known populations of *B. queleae*.

In the original description of *B. queleae*, the male genitalia are not illustrated fully, lacking the proximal mesosome. For this reason, we here provide a description and illustrations of the male genitalia based on the South African material.

**Material examined (non-types).** Ex *Quelea quelea lathami*: 1 ♂, 1 ♀, Polokwane Game Reserve, Polokwane, Limpopo Province, South Africa, 4 Apr. 2015, coll. A. Halajian, BiRBQPGR1 (NHML). 1 ♂, 1 ♀, same data as previous, BiRBQPGR2 (NHML). 1 ♂, 1 ♀, same data as previous, BiRBQPGR4 (NHML). 1 ♂, same data as previous, BiRBQPGR11 (NHML). 1 ♀, same data as previous, BiRBQPGR12 (NHML). 1 ♂, same data as previous, BiRBQPGR13 (NHML). 1 ♀, same data as previous, BiRBQPGR14 (NHML). 1 ♂, 1 ♀, same data as previous, BiRBQPGR17 (NHML). 1 ♀, same data as previous, BiRBQPGR20 (NHML).

### *Brueelia coryliventer* Gustafsson & Bush, 2015

*Brueelia coryliventer* Gustafsson & Bush, 2015: 513.

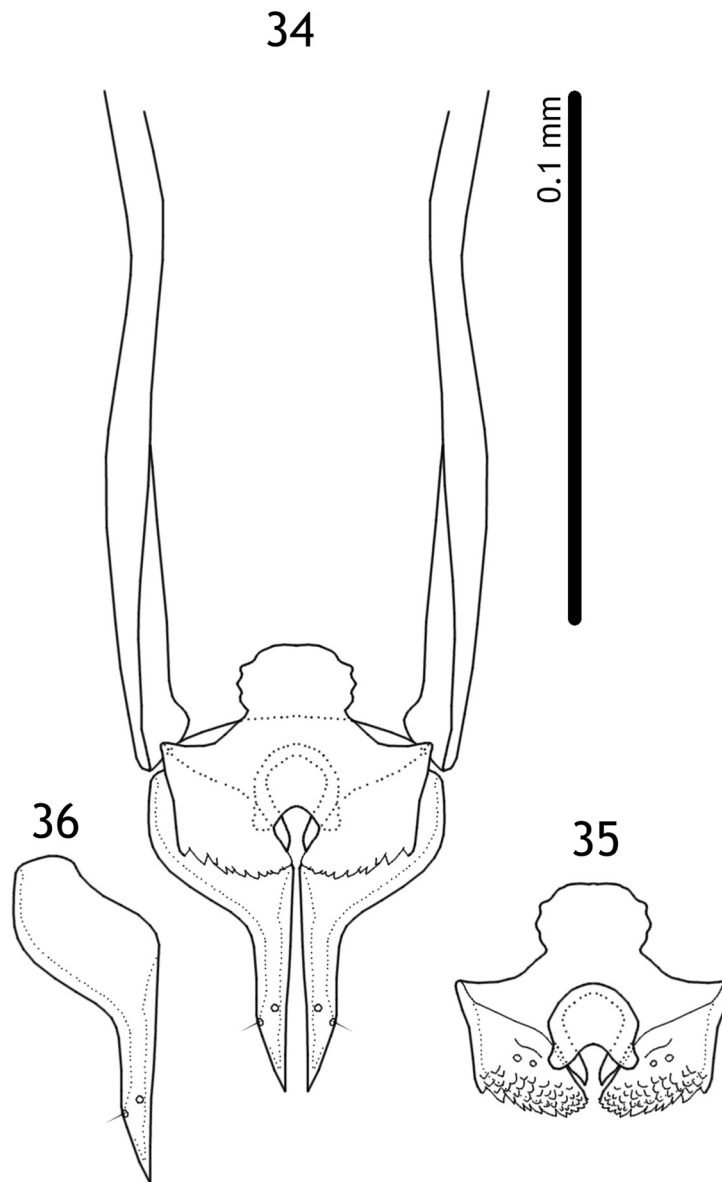
**Type host:** *Creatophora cinerea* (Meuschen, 1787)—wattled starling.

**Type locality:** Isiolo, Kenya.

*Brueelia coryliventer* was described by Gustafsson & Bush (2015) based on specimens from Kenya and Ethiopia, and the present report constitutes the first report of this species from South Africa. There are no significant

morphological differences between these specimens and those reported by Gustafsson & Bush (2015), except that the lateral folds of the mesosome of the two specimens examined from South Africa extend further distally than the median fold in both males, but the genitalia are somewhat distorted, and this could be artifactual. We therefore do not consider this slight difference significant and consider these specimens to be conspecific with *B. coryliventer*.

**Material examined (non-types).** Ex *Creatophora cinerea*: 1♂, 1♀, De Loskop, Limpopo Province, South Africa, 20 Apr. 2015, coll. A. Halajian, WStaDLap15 (NHML). 1♂, same locality, 7 Dec 2014, coll. A. Halajian, Crecin2 (NHML). 1♀, Welgelegen, Polokwane, Limpopo Province, South Africa, 25 May 2015, coll. A. Halajian, WaStDerMey15 (NHML).



**FIGURES 34–36.** *Brueelia queleae* Sychra & Barlev [in Sychra *et al.*], 2010a. **34**, male genitalia, dorsal view. **35**, male mesosome, ventral view. **36**, male paramere, dorsal view.

### ***Brueelia cyclothorax* (Burmeister, 1838)**

*Nirmus cyclothorax* Burmeister, 1838: 429.

*Nirmus subtilis* Nitzsch [in Giebel], 1874: 137.

*Bruëlia subtilis obligata* Eichler, 1954: 63.

**Type host:** *Passer montanus montanus* (Linnaeus, 1758)—tree sparrow.

**Type locality:** None given, probably Germany, given that Nitzsch's collection was from Germany.

**Other hosts:** *Passer domesticus domesticus* (Linnaeus, 1758)—house sparrow. *Passer hispaniolensis hispaniolensis* (Temminck, 1820)—Spanish sparrow. *Passer montanus saturatus* Stejneger, 1885.

Our South African samples have been compared with other specimens of *Brueelia cyclothorax* from Europe, North America, and Asia and found to be conspecific. This is the first record of *B. cyclothorax* from South Africa (Gustafsson *et al.* 2019a); *Brueelia cyclothorax* will be redescribed elsewhere (D.R.G. *in prep.*).

**Material examined (non-types).** Ex *Passer domesticus*: 1♂, 1♀, Sappi Trust Farm, KwaMbonambi, KwaZulu-Natal Province, South Africa, 28 Apr. 2015, coll. A. Halajian, 2.38838 (NHML). 1♂, same data, 2.38842 (NHML). 1♂, 1♀, Old Herbarium, University of Limpopo, Limpopo Province, South Africa, 11 Sep. 2014, coll. A. Halajian, ring FB06249 (NHML).

### ***Brueelia* sp.**

**Host:** *Bradornis mariquensis mariquensis* Smith, 1847—Mariqua flycatcher. Straggler?

A single female from this host was examined, which keys out to *Brueelia sima* in the key of Gustafsson *et al.* (2019a). However, based on the pigmentation patterns of the subgenital plate, it is more closely related to some *Brueelia* species from *Ploceus* spp. Considering that some characters, such as abdominal and vulval chaetotaxy, are largely conserved throughout most species of *Brueelia*, we are unable to identify or describe this specimen further. More louse collections from *Bradornis mariquensis* are needed to identify this species, and confirm that this is the natural host of our specimen. Notably, most other flycatchers are parasitized by species of *Guimaraesiella* Eichler, 1949 rather than *Brueelia* (see Gustafsson & Bush 2017), but few records of *Brueelia* have been published from flycatchers, and host associations may be influenced by environmental factors (Takano *et al.* 2019).

**Material examined.** Ex *Bradornis mariquensis mariquensis*: 1♀, Polokwane Game Reserve, Polokwane, Limpopo Province, South Africa, 17 Mar. 2013, coll. A. Halajian, SAFRING AR30085, Bi-Bramar7 (NHML).

## **Discussion**

Except for *Brueelia coryliventer*, which belongs to the *Brueelia clara* species-group, and *Brueelia cyclothorax*, the other species reported in this paper belong to the “African pied *Brueelia*” species-group. Whereas the *B. clara* species-group is a monophyletic clade sharing unique male genitalia, the “African pied *Brueelia*” species-group is an informal group sharing similar pigmentation patterns only. The “African pied *Brueelia*” species-group was proposed by Gustafsson *et al.* (2019a) to facilitate the identification of species in the key, given that the vast majority of *Brueelia* species are unknown, and many species have been poorly described.

The variation in pigmentation patterns of the male and female subgenital plates in species of the “African pied *Brueelia*” species-group is shown in Figs 1–10 and Figs 11–19 respectively. In addition to these patterns of dark pigmentation, species in this group have the following features darkly pigmented: (1) anterior and posterior margins of sternites III–VI, (2) parts of female tergopleurite IX+X, (3) lateral margins of the tergopleurites in both sexes, (4) distal ends of femora I–III, (5) flagellomeres II–III, (6) distal ends of tibiae I–III, (7) and to various degrees the head in both sexes (Figs 37–40). Notably, the variation in pigmentation patterns among species is more marked on the subgenital plates than on other features.

Among males, the pigmentation patterns of the subgenital plate appear to fall into three categories: (1) pigmentation limited to the anterior margin of the plate (Figs 2, 8), (2) pigmentation forming a more extensive, roughly X-shaped pattern on the anterior half of the plate, which may be continuous with the dark anterior margin, but the distal half of the plate is unpigmented (Figs 3–4, 6, probably 7), and (3) pigmentation on most of the plate, including the distal half, with smaller translucent fenestra either only on the anterior end (Figs 9–10) or on both anterior and posterior ends (Figs 1, 5).

Among females, the pigmentation patterns of the subgenital plate show a more gradual variation, but two groups can be delimited: (1) pigmentation on anterior margin and on lateral bands that may be continuous anteriorly but do not meet posteriorly, and not continuous with the dark markings of the cross-piece (Figs 12–14, 16–17), (2) pigmentation on lateral bands merge distally and also merge with the pigmented cross-piece, forming a central,

elongated, translucent fenestra on the distal end of the subgenital plate (Figs 11, 15, 18–19). Notably, the pigmentation patterns may vary among conspecific specimens, and may even be asymmetrical in the same specimen (e.g., Figs 7, 16, 19).

The “African pied *Brueelia*” species-group may not be monophyletic. For instance, considering the presence of pigmentation as described above, *Brueelia* species parasitizing *Euplectes* spp. would fall in the same group as the species from *Melaniparus* Vieillot, 1818, but lice from *Euplectes* spp. were placed in two different clades in the phylogeny of Bush *et al.* (2016), and their specimens from *Melaniparus niger* (Vieillot, 1818) were not placed close to either of these clades. *Brueelia* species from *Euplectes* spp. are the most pigmented of all *Brueelia* species (see figs 41–42 in Gustafsson *et al.* 2019a), yet in the phylogeny of Bush *et al.* (2016), *Brueelia queleae* is among the least pigmented in the “African pied *Brueelia*” species-group.

Notably, the clades of the “African pied *Brueelia*” species-group included in the phylogeny of Bush *et al.* (2016) are not closely related to the *Brueelia ornatissima* species-group parasitising New World Icterinae; however, both groups have strikingly similar pigmentation patterns (cf. Figs 37–40 with figs 125–129 in Cicchino & Castro 1996). Presumably, pigmentation patterns shared by the “African pied *Brueelia*” species-group have evolved by convergence due to the largely black plumage of most of their hosts (Bush *et al.* 2010). Interestingly, the hosts of *B. oschadlei* and *B. inusta* are both predominantly yellow or brownish yellow depending on their breeding cycle, and the hosts of e.g., *Brueelia cantans* Sychra [in Sychra *et al.*], 2010b is largely brown. Hence, surface-level plumage colouration does not always predict whether the lice are cryptically coloured; presumably, in these cases the lice are adapted to the colour of the proximal part of the body feathers, which are black in many songbirds, including a great number of host species that are parasitised by non-pied *Brueelia* species.

The presence of darkly pigmented *Brueelia* species on weavers is difficult to explain, especially since so many other *Brueelia* species are not. The hypothesis of cryptic colouration as described by Bush *et al.* (2010) is not satisfactory, considering that weavers appear to spend very little time preening (Khan *et al.* 2019), and allopreening is almost unknown among ploceid birds (Harrison 1965; MacLean 1973). As discussed by Bush *et al.* (2010), dark pigmentation in lice may have other functions beyond camouflage, for instance for UV resistance. Most *Brueelia* species known from the northern hemisphere have more uniform and paler pigmentation patterns, and possibly solar radiation may have influenced the development of dark pigmentation patterns in different lineages of *Brueelia* on African hosts. More data from other *Brueelia* populations in the southern hemisphere are needed to evaluate this hypothesis.

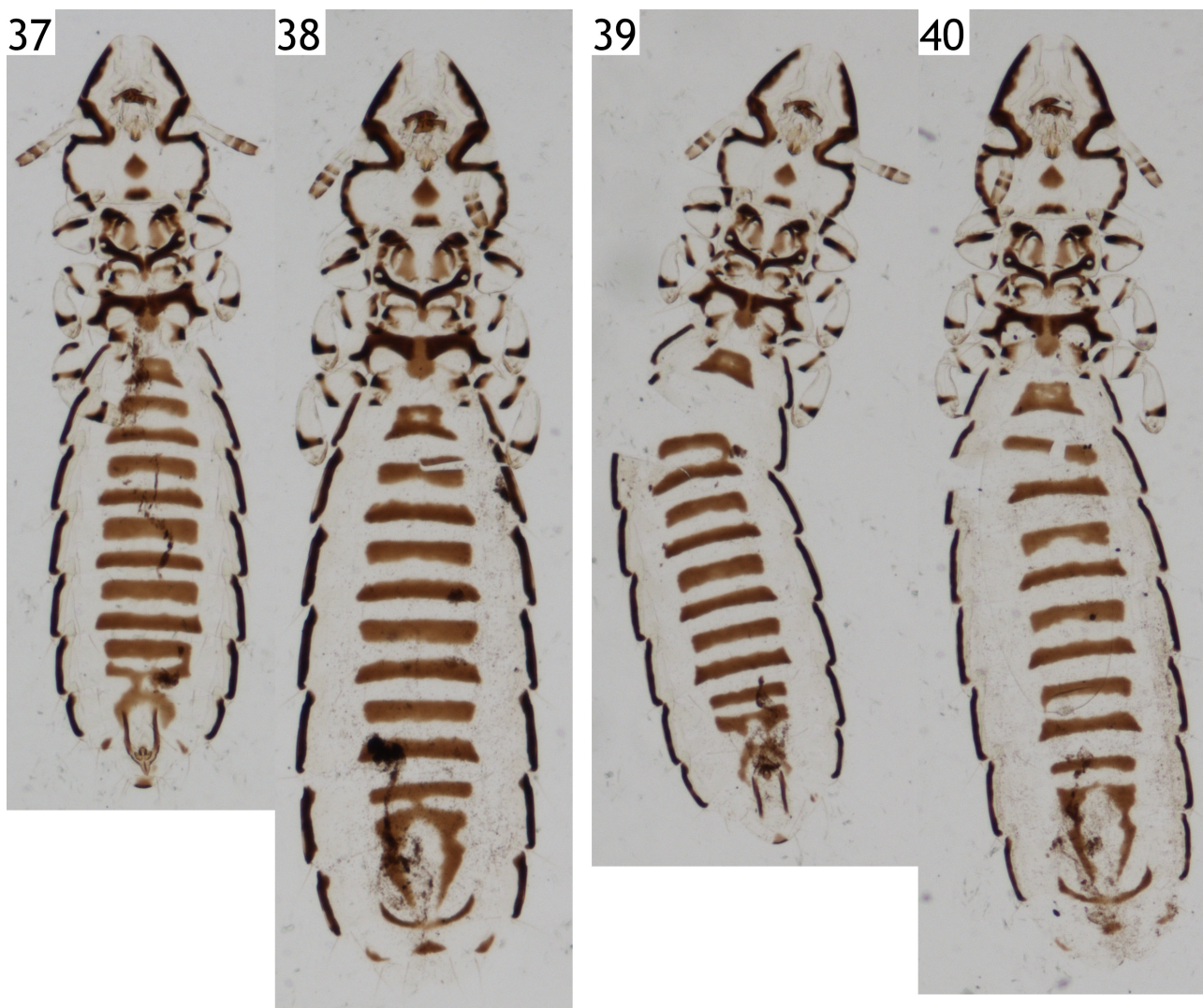
In any case, among the few species of *Brueelia* known from African hosts, pigmentation patterns appear to be a good first step towards identifying the species. In particular, the pigmentation patterns on subgenital plates of males (Figs 1–10) and females (Figs 11–19) appear to be useful for at least an initial identification but, due to their variability (e.g., Fig. 19), other characters must be used to confirm the species identity. Furthermore, the two species described here from closely related hosts have similar pigmentation patterns (cf. Figs 37–38 with 39–40) and, as more species of *Brueelia* from ploceid hosts are described, the usefulness of this character may be lessened.

In contrast, *Brueelia coryliventer* is readily identified as a member of the *Brueelia clara* species-group by the unique shape of the male genitalia in this group (Gustafsson & Bush 2015). No member of this group has been analysed genetically, but their distinct genitalia are reminiscent of those of some *Brueelia* species parasitizing starlings in the Australo-Papuan region (D.R.G. *in prep.*).

Given our patchy knowledge of the chewing louse fauna of African songbirds, more collections are needed to understand the overall biodiversity, their biogeographical ranges, and any environmental or historical factors that may have produced such ranges. Few species of the *Brueelia*-complex had been described based on African material prior to the checklist of Ledger (1980). However, in recent decades the number of publications based on African material has increased significantly, including studies of the louse fauna of Benin (Takano *et al.* 2017), Cameroon (Balakrishnan & Sorenson 2006; Gajdosova *et al.* 2020), the Democratic Republic of Congo (Light *et al.* 2016), Malawi (Bush *et al.* 2016), Senegal (Sychra *et al.* 2010a,b; Najer *et al.* 2012), South Africa (Takano *et al.* 2019), and across the continent (e.g., Gustafsson & Bush 2015, 2017; Gustafsson *et al.* 2018, 2019a).

Although this renewed interest is encouraging, most louse species treated in these publications are identified to genus level, with some still undescribed and unnamed. The lack of morphological descriptions also limits the value of surveys when genetic data can easily be obtained. This is not the case when working with historical collections important for studying range shifts or host switches, or for studies conducted in economically poorer regions. The lack of species identifications is not surprising, given that less than 3% of the estimated diversity has been identified (Gustafsson *et al.* 2019a). Most louse species known from African songbirds have been recorded from only a few

localities. We urge any louse researchers working with African material to describe any new lineages or species they encounter, so that a combined database of molecular and morphological data can be built up for African songbird lice.



**FIGURES 37–40.** Male and female habitus showing pigmentation patterns. **37**, *Brueelia oschadlei* **n. sp.** holotype male. **38**, *Brueelia oschadlei* **n. sp.** paratype female. **39**, *Brueelia inusta* **n. sp.** holotype male. **40**, *Brueelia inusta* **n. sp.** paratype female.

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