

# Revision of the South African leafhopper genus *Hadroca* Theron (Hemiptera, Auchenorrhyncha, Cicadellidae, Bonaspeiini)

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## Abstract

The leafhopper genus *Hadroca* Theron, 1974 with type species *Euscelis ramosa* Naudé, 1926 is re-defined here by examination of long series of specimens with varied color and wing polymorphic males and females. Five new species are added: *Hadroca alacaudella* sp. nov., *H. alavittata* sp. nov., *H. bualacauda* sp. nov., *H. hapsistylis* sp. nov. and *H. treichroa* sp. nov. The genus is known only from South Africa, mostly from the Fynbos Biome. All species have the aedeagus C-shaped and uniformly sclerotized, the shaft gradually tapered, commonly edentate, rarely with single, subapical, anterior process and the style with distal apophysis curved ventrad. A key to species is provided, with discussion on the differentiation from similar genera such as *Bloemia* Theron, 1974, *Basutoia* Linnavuori, 1961 and *Tzitzikamaia* Linnavuori, 1961 and distribution maps.

## Key Words

Afrotropical Region, biodiversity, Cape Floristic Region, herbivore, phytophagous, plant-feeding, shrub-association

## Introduction

The South African leafhopper genus *Hadroca* Theron, 1974 was originally known from *Euscelis ramosa* Naudé. This species was re-examined by Theron (1974) as a subbrachypterous specimen, and now with additional specimens showing brachyptery and macroptery, and a range of colors and up to three shapes of the apex of the aedeagal shaft. Five new species are described and arranged below by numbers of examined specimens. Until the current revision, the genus has included only the type species. The genus is included in the deltocephaline tribe Bonaspeiini, and in a recently phylogenomic study of Deltocephalinae (Cao et al. 2022, supporting information) was recovered in a close relationship to *Bloemia* Theron.

The wide range of colors and shapes of the species included in *Hadroca*, necessitates careful attention to features of the aedeagus and style. In lateral view the aedeagus is C-shaped, uniformly sclerotized, with short, narrow, transverse dorsal apodeme and reduced preatrium. The style has the apex or the whole apophysis curved

ventrally, albeit weakly in *H. alavittata* sp. nov. or excessively in *H. hapsistylis* sp. nov.

Specimens in more than 200 records were examined, with less than half with an associated plant, but few with nymphs and few repeat collections.

## Materials and methods

More than 1000 specimens were examined. Terms and drawings follow Stiller (2020, 2021) and Zahniser (2021). Hind wing lengths are measured from the point of attachment to the apex and widths the greatest perpendicular distance, usually at the jugal lobe. Connective measurements were stem width, usually across the apex, stem length from the apex of the stem to the sclerotized part at the confluence of the arms, arm length from the apex of arm to the sclerotized confluence of the arms and arm width across the widest part of the arms. The desclerotized margin between the arms was considered too variable, as in Figs 5C, D, 8A–D, 13P, 18M, N,

21I, J, 23F, 25G. Due to the vertical orientation of the aedeagal shaft in the pygofer, its anterior and posterior views are used here, and considered equivalent to dorsal and ventral views. Curvature of the shaft is calculated from line drawings as an approximation of an arc most closely following the posterior margin of the shaft to the atrium. It is represented as an angle, using chord length between the apex of the shaft and apex of the atrium (Fig. 7J, dashed line ab) and height of the arc (Fig. 7J, dashed line cd). Area and perimeter of the lateral view of the aedeagus is based on actual greatest length of representative specimens of species treated here, and calculated with ImageJ (Schneider et al. 2012). With the aedeagus in lateral view, the relation of relative size of dorsal apodeme to that of shaft is calculated as a ratio. This is a straight line distance from apex of point of attachment of connective to apex of dorsal apodeme (Fig. 7O, dashed line cd) divided by the straight line distance from apex of point of attachment of the connective to apex of the shaft (Fig. 7O, dashed line ab). The style with two anterior arms, the ventral arm of Blocker and Triplehorn (1985) and the equivalent anterior median lobe of Zahniser (2008) and Zahniser and Dietrich (2008), henceforth termed as medial and lateral arms.

Measurements of drawings of the style were based on the parasagittal line (along medial margin of the apophysis to the medial arm, Fig. 8I dashed line ab) with the length of the apophysis, midsection and base and greatest width at right angles to this parasagittal line (Fig. 8I, dashed lines cd, ef and gh respectively). Micrometers are used for setae length and thickness, and ocellus diameter and interocular distance, and millimeters for all other measurements.

Distribution analysis was done in Diva GIS and Max-Ent (Phillips et al. 2020) with comma separated values of species and their geographical coordinates, 19 bioclimatic worldclim (<https://www.worldclim.org>) variables and 10 percentile training presence. Maps in Figs 26, 30 were compiled with DIVA GIS (methods in Scheldeman and Van Zonneveld 2010).

Original label data with line breaks indicated by a vertical space bar (|), label breaks as ||.

Repositories and institutional acronyms for holotypes are **SANC** (The National Collection of Insects, Pretoria, RSA, same address as author address). Parts of long series of paratypes will be deposited in the **BMNH** (The Natural History Museum, London, UK), **INHS** (Illinois Natural History Survey, Campaign, Illinois, USA) and **SANC**.

### Key to species of *Hadroca* and *Bloemia hieroglyphica*

- 1 Aedeagus, in lateral and dorsal or anterior view, with shaft with regular profile, uniformly tapered; reduced preatrium; aedeagus evenly sclerotized (Fig. 5A, B, G). Apophysis of style, in lateral view, curved ventrad, distinctly (Figs 8F, H, J, 13M, N, 18L, 23H, 25I) or weakly (Figs 5F, 21N). Tegmina polymorphic, submacropters as in Figs 1, 3M, 10, 19A–F, 24A–D, G. *Hadroca* species ..... 2
- Aedeagus, in lateral and dorsal or anterior view, with irregular profile, shaft widest medially, acuminate apex; rounded preatrium; desclerotized apex and medially, sclerotized laterally and basally (Fig. 5H–L). Apophysis of style, in lateral view, straight. Tegmina submacropterous (Fig. 28A–F) ..... *Bloemia hieroglyphica* Naudé
- 2 Apophysis of style, in lateral view, widely arched dorsad, about as long as base of style (Figs 12A, 13A, M, N); male and female length from apex of crown to apex of tegmina 1.97–2.56 mm, length from apex of crown to apex of abdomen 2.33–3.02 mm, pronotum length 0.29–0.37 mm, head width 0.90–1.13 mm, pronotum width 0.90–1.08 mm ..... *H. hapsistylis* sp. nov.
- Apophysis of style with slight ventrad curve, apophysis much shorter than base of style; male and female length from apex of crown to apex of tegmina 2.55–4.98 mm, length from apex of crown to apex of abdomen 3.27–4.53 mm, pronotum length 0.44–0.62 mm, head width 1.28–1.71 mm, pronotum width 1.23–1.69 mm ..... 3
- 3 Tegmina with narrow extension at posterior margin (Figs 15A–C, 22 A–D) ..... 4
- Tegmina with posterior margin rounded or truncate (Figs 1, 3, 4, 19A–F, H, 24A–D, G) ..... 5
- 4 Large species (Fig. 15A, B), length from apex of crown to apex of tegmina 5.02–5.95 mm, greatest width (=pronotum width) 1.63–1.82 mm, aedeagus with short robust shaft, strongly curvate (Fig. 18E, F); female sternite VII with wide, V-shaped notch with medial, ligula wider than long (Fig. 18O, P) ..... *H. bualacauda* sp. nov.
- Smaller species (Fig. 22 A–D), length from apex of crown to apex of tegmina 4.02–4.23 mm, greatest width (=head width) 1.10–1.15 mm; aedeagus with apex wider than width medially, weakly curvate (Fig. 23D); female sternite VII with posterior margin sublinear (Fig. 23I) ..... *H. alacaudella* sp. nov.
- 5 Tegmina with three colors (light brown, dark brown and white cells, veins and reticulation dark brown) (Fig. 24A–D, G), tegmina short, 2–4 abdominal segments exposed; aedeagus in lateral view sublinear to slightly curvate, dorsal apodeme subbasal, preatrium present; female sternite VII with posterior margin shallowly excavated with ligula wider than long (Figs 24I, 25J, K), denticulation of valvula 2 with small rectangular teeth (Fig. 24J); length from apex of crown to apex of abdomen 2.56–3.12 mm ..... *H. treichroa* sp. nov.
- Tegmina at most with two colors or light green to yellow-green, tegmina macropterous, submacropterous (up to 3 abdominal segments exposed) or brachypterous exposing 4–5 abdominal segments; aedeagus in lateral view curvate, dorsal apodeme basal, preatrium reduced; female sternite VII with ligula longer than wide or without ligula and deep,

- narrow parallel-sided notch; denticulation of valvula 2 sinuous with fine denticulation in trough (e.g., Figs 6D, E, 20I) rarely edentate (Fig. 6F) ..... 6
- 6 Tegmina marked with darker V-shaped band, reaching apex of abdomen; crown with 2–3 paired, amorphous to angular light brown marks (Fig. 19A–F, H); subgenital plate produced beyond posterior margin of pygofer lobe, without macrosetae (Fig. 21C, D); male tergite X with paired, ventroposteriad denticles (Fig. 21E, F); shaft in lateral view widely curvate; female sternite VII with posterior margin wide, shallow excavation (Figs 19I, 21Q, R); length from apex of crown to apex of abdomen 2.82–3.24 mm.....*H. alavittata* sp. nov.
- Tegmina with uniform, reticulate brown to light brown marks or unmarked and yellow-green to light green, tegmina brachypterous (Fig. 3A–H), submacropterous (Fig. 1A–O) or macropterous (Fig. 4A–G); crown either unmarked (Fig. 1J, N, O), or with small spots (Figs 1G, H, 3M) or with narrow arcs (Fig. 3A, C, D) or many narrow lines and marks (Figs 1A, E, K, 3E–G); subgenital plate extended posteriad as far as apex of pygofer lobe, with uniseriate, marginal macrosetae (Fig. 7B–H); male tergite X with ventroposterior margin smooth; shaft in lateral view narrowly curvate; female sternite VII with short median ligula longer than wide or wider than long in macropter and submacropter (Fig. 8N–R), or truncated in brachypter (Fig. 8T, U) or with narrow, parallel-sided notch in brachypter (Fig. 8S).....*H. ramosa* (Naudé)

## Type species

### *Hadroca ramosa* (Naudé) Theron, 1974

*Euscelis ramosa* Naudé, 1926: 65–66.

### Redescription of *Hadroca*. Diagnosis.

1. Small (2.2 mm) to moderate (6.5 mm) size.
2. Male and female similar size, color and shape.
3. Ochraceous or light green, dark brown spotted, speckled, reticulate, or unmarked.
4. Tegmina rarely brachypterous or macropterous, commonly submacropterous. Hind wing reduced in brachypter and submacropter, fully developed in macropter. Two species with tegmina with narrow, elongated extension at posterior margin, other species with margin rounded or truncate.
5. Aedeagus C-shaped, uniformly sclerotized, shaft uniformly curved, tapered or subparallel in lateral and posterior or anterior views, dorsal apodeme relatively short, transverse, preatrium reduced or weakly developed, shaft edentate or rarely submacropter of *H. ramosa* with single, subapical, anterior process.
6. Style slightly longer than greatest width, apophysis in dorsal view linear to sublinear, rarely curvate laterad, in lateral view curved ventrad, preapical lobe usually ventrad.
7. Connective Y-shaped, either longer than wide (length greatest/width greatest 1.72–2.52) in four species, or wider than long in *H. hapsistylis* sp. nov. (length greatest/width greatest 0.66–0.90). In anterior view with apices of arms angled or curved dorsad. Narrow in lateral view.
8. Valve obtusely triangular.
9. Pygofer lobe rounded, edentate, scattered macrosetae distally, anal tube incised half way, anterior apodemes absent.
10. Subgenital plate triangular, commonly with uniseriate macrosetae, rarely absent.

**Etymology.** *Hadros*, Greek, well-developed, bulky, stout, large (Brown 1954) for the stout body and pronotum, scutellum and tegmina arched in lateral view, gender feminine.

### Color. Male and female, and nymph.

Four broad patterns recognized:

1. Ochraceous to stramineous with weak or distinct brown reticulations on tegmina and regular to irregular stipples or spotting on the head and pronotum (*H. ramosa* submacropter (Fig. 1A–M) and macropter (Fig. 4A–D), *H. hapsistylis* sp. nov. (Figs 10A–L, 11C, D), *H. bualacauda* sp. nov. (Fig. 15A–C) and *H. alacaudella* sp. nov. (Fig. 22A–D). Nymphs as in Figs 2I–K, 15D, 22E.
2. Light green to yellowish green with feint, brown reticulation sometimes in posterior margin of tegmina or without markings in tegmina. (*H. ramosa* (Fig. 1N, O), *H. hapsistylis* sp. nov. (Figs 10K, 11A, B). Nymph similar color to adult, abdomen marked as in Fig. 2K.
3. Head and pronotum ochraceous to stramineous with head with three pairs of light brown regular to amorphous markings, tegmina with brown reticulations and dark brown, oblique band (*H. alavittata* sp. nov., Figs 19A–F, H, 20A).
4. Head and pronotum ochraceous to stramineous, tegmina with light brown, dark brown and white color pattern (*H. treichroa* sp.n, Fig. 24A–D, G).

**Face.** Brown horizontal arcs on clypeus (Figs 2C, 3K, L, O, 4E, F, 22F), sometimes dark brown with thick arcs and few pale spots (Fig. 2A) or clypeus and clypellus embrowned (Fig. 12B) or half of clypeus with arcs (Figs 19J, 20C) or weakly marked or unmarked (Figs 2B, 12C, 15E, 22G, 24E, F). Arcs sometimes extended dorsally into crown.

**Morphology. Head.** Angle at crown in both sexes 100–113°, broadly rounded to face, disc smooth, anterior margin of head shagreened, *H. ramosa* brachypter with fine or coarsely shagreened margin or finely rugose

in *H. ramosa* macropter, *H. alacaudella* sp. nov. and *H. bualacauda* sp. nov.

**Ocellus and interocular distance.** Ocellus small, distance to eye more than three times its diameter (ocellus diameter/interocular distance 0.16–0.41), ocellus diameter 23–38  $\mu\text{m}$ , interocular distance 77–159  $\mu\text{m}$ .

**Pronotum.** Lateral margin carinate. Narrower or as wide as head.

**Scutellum.** Suture obtusely V-shaped to arcuate in *H. ramosa* macropter, sublinear in *H. alacaudella* sp. nov., *H. bualacauda* sp. nov.; absent in *H. ramosa* submacropter and brachypter, represented by few, fine superficial rugae.

**Tegmina.** Submacropter, 3–4 abdominal segments exposed, brachypter, 4–5 abdominal segments exposed. In brachypter and submacropter with posterior margin broadly rounded, sometimes truncate, appendix absent. Macropter in *H. ramosa* with appendix, four apical cells, three anteapical cells (Fig. 4H). Macropters of *H. bualacauda* sp. nov. (Fig. 15A–C) and *H. alacaudella* sp. nov. (Fig. 22A–D) with acuminate posterior extension, with apex extended well beyond posterior margin of abdomen. Tegmina length/tegmina width in brachypters 1.1–1.3; submacropter 1.5–2.0, macropters with wing extension 2.9–4.3, macropter in *H. ramosa* 3.2–3.5.

**Hind wing.** Reduced in brachypter and submacropter, and macropterous *H. bualacauda* sp. nov. and *H. alacaudella* sp. nov. About half as wide and long as tegmina or much smaller. In macropter of *H. ramosa* well developed with large, folded jugal lobe. In submacropter variable, smaller than tegmina, with narrow, folded jugal lobe (Fig. 3I) or very small scale (*H. hapsistylis* sp. nov., Fig. 11E, F). Hind wing length/width in brachypters 1.4–1.7; submacropter 1.7–2.7; wing extension macropters 3.2–4.1. Macropter in *H. ramosa* with large, folded jugal lobe, when open, wider than tegmina (Fig. 4I).

**Chaetotaxy.** Protibia 1+4, mesotibia 4+4, hind knee 2+2+1. Profemur intercalary (IC) row of 9–11 long, fine setae, distal anteroventral seta ( $AV_1$ ) sometimes slightly longer, thicker, darker than intercalary setae, anteromedial ( $AM_1$ ) one seta, 7–13 anteroventral (AV) setae short, narrowly triangular (profemur in *H. bualacauda* sp. nov. Fig. 15G, H; in *H. ramosa* Fig. 2D).

**Anal tube.** Male tergite X rectangular, wider than long, rarely square or longer than wide; lateral margins variable, parallel, weakly divergent or convergent, sometimes weakly sclerotized; in lateral view anterobasal margin produced anteriorly, in dorsal view paired triangular or rounded profile, sometimes desclerotized, anterior process about as long as distal part, half as wide in lateral view; width in dorsal and lateral view similar. Length/width 0.74–1.10, width greatest/width distal 1.01–1.41. Tergite 11 length/width 2.11–2.86.

**Measurements. Male and female.** Corresponding closely, except length from apex of crown to apex of tegmina or abdomen (370 males, 307 females) Apex of

crown to apex of tegmina 1.9–4.3 mm (smallest male and female in *H. hapsistylis* sp. nov. 1.8 mm, in *H. bualacauda* sp. nov. largest male 6.3 mm, female 7.1 mm), apex of crown to apex of abdomen 2.6–4.2 mm; crown length 0.39–0.57 mm; crown length next to eye 0.28–0.38 mm; pronotum length 0.33–0.58 mm; head width 1.01–1.60 mm; pronotum width 0.97–1.57 mm; ocellus diameter 23–38  $\mu\text{m}$ ; interocular distance 77–159  $\mu\text{m}$ ; crown angle 100–113°; crown length/crown length next to eye 1.34–1.55; head width/pronotum width 1.00–1.05; ocellus diameter/interocular distance 0.16–0.41; crown length/pronotum length 0.94–1.24; pronotum length/pronotum width 0.33–0.38; crown length/head width 0.33–0.42; crown length/pronotum width 0.34–0.43; length from apex of crown to apex of tegmina/length from apex of crown to apex of abdomen 0.73–1.09.

#### Terminalia. Male.

**Aedeagus.** C-shaped, uniformly sclerotized (Figs 5A, B, G, 7J–V, 13D–L, 18E–H, 21K, 23D, E, 25C–E). Dorsal apodeme short, narrow in lateral view, transverse in anterior view, variable in length and orientation of connection with phragma. Shaft strongly (Figs 7J–N, 18E, F, 23D) or weakly curvate (Figs 13D, E, 21K, 25C), variable width, acuminate, subparallel, or apex slightly wider than subbase or medially (Fig. 23D, E), usually edentate, sometimes with single, desclerotized, digitate, narrow, anterior, subapical process (Fig. 7N, R, S, U). Preatrium rarely short or commonly reduced. Gonopore apical to subapical, anterior (Figs 9A–N, 18G, 23D, E, 25F), rarely anterior and posterior (Figs 13I, J, 18I, 21G, H). Orientation vertical in genital capsule (Figs 7B, C, 13A, 18B, 21C, 23B, 25A). Curvature of shaft for all specimens, represented as a segment defined by chord and height 138–178°.

Most curvate: *H. ramosa* 160–184°, *H. bualacauda* sp. nov. 175–189°.

Intermediate curvature: *H. hapsistylis* sp. nov. 139–151°, *H. alacaudella* sp. nov. 140–165°.

Least curvate: *H. alavittata* sp. nov. 127–134°, *H. treichroa* sp. nov. 100–130°.

In posterior or dorsal view width of shaft at subapex/width of shaft medially 0.6–1.3, in lateral view width of shaft at subapex/width of shaft medially 0.7–1.0, two species (*H. alavittata* sp. nov., *H. alacaudella* sp. nov.) with wider subapex than medial width, i.e., width of shaft at subapex/width of shaft medially 1.1–1.5, the other width of shaft at subapex/width of shaft medially 0.5–0.8.

Aedeagus in lateral view relation of relative size of dorsal apodeme to that of shaft, straight line distance from apex of point of attachment of connective, i.e., the atrium, to apex of dorsal apodeme/straight line distance from apex of point of attachment of connective to apex of shaft 0.3–0.5.

Area of the aedeagus in lateral view, 18–38  $\mu\text{m}^2$  in all specimens, smallest area in *H. treichroa* sp. nov. 12–18  $\mu\text{m}^2$ , largest area in *H. alacaudella* sp. nov., 38–44  $\mu\text{m}^2$ ; perimeter in all specimens 1.21–2.35 mm,

**Style.** Distally with narrow, short base, preapical lobe ventral, apophysis commonly short (in *H. hapsistylis*

sp. nov. preapical lobe absent, apophysis very long, Fig. 13M–O) in dorsal view sublinear; medial arm elongate, approximately at mid-length, with base narrow or obtusely triangular; lateral arm elongate, extended anteriad beyond medial arm (Figs 8E, G, I, 13O, 18K, 21M, 23G, 25H); apophysis orientation posteriad or lateroposteriad, commonly short or rarely slightly less than half as long as style (Fig. 13M–O), always curved ventrad or lateroventrad (Figs 8F, H, I, 13M, N, 18L, 23H, 21N, 25I). Preapical lobe rarely reduced, uniformly merged with apophysis (Figs 13M–O, 21M, N, 25H, I) or commonly ventrad to lateroventrad (Figs 5E, F, 8E–J, 18K, L, 23G, H). In anterior view with medial arm curved or angled dorsad (Fig. 18J). Style positioned basally in subgenital plate (Figs 7E–G, 13C, 18C, 21D, 23C, 25B), rarely reaching half way into subgenital plate (Figs 7F, 13B, C). Commonly length greatest/width greatest 1.20–1.80, in *H. hapsistylis* sp. nov. 2.95–3.97; length apophysis/length greatest 0.12–0.19; extension of lateral arm anteriad of medial arm represented as length to apex of medial arm/length greatest 0.14–0.27, this range was the smallest in macropters of *H. ramosa*, i.e., 0.03–0.19.

**Connective.** Y-shaped, commonly longer than wide, stem generally longer than arms, width across stem slightly less than width across arms (Figs 8A–D, 18M, N, 21I, J, 23F, 25G), rarely transverse (Fig. 13P), articulated to aedeagus. Variable extent of desclerotized margins medially between arms. In anterior view with arms angled or curved dorsad (Fig. 18J). Length stem/length greatest 0.41–0.57; length greatest/width greatest 1.15–2.48; wider than long in *H. hapsistylis* sp. nov. (Fig. 13P), length greatest/width greatest 0.66–0.90.

**Subgenital plate.** Generally triangular, lateral margin concave to sinuous (Figs 7G, 18C, D, 21D, 23C, 25B), rarely sublinear (Figs 7H, 21D) or convex (Fig. 13B, C), apex broadly rounded (Figs 9G, H, 13B, 21D) or narrowly rounded (Figs 9G, H, 13C, 18C, D, 23C, 25B), lateral margin sometimes rugulate (Figs 7I, 18C, D), or desclerotized (Fig. 13C). Macrosetae commonly uniseriate, submarginal, basally and apically shorter than medially, length 89–223  $\mu\text{m}$ , basal width 8–11  $\mu\text{m}$ ; absent in *H. alavittata* sp.n, fine short setae present near apex and distal margin, apex dorsally with long, fine setae (Fig. 21C, D). Length/width 1.08–1.69, distal angle by trigonometry 31–43°.

**Valve.** Right to obtusely angled (81–148°), triangular (Figs 7E, F, 18C, D, 21D, 23C, 25B) (length/width 0.36–0.49), *H. hapsistylis* sp. nov. most obtuse (136–159°) and narrowest (Fig. 13B, C) (length/width 0.20–0.29).

**Pygofer.** Length/width 0.88–1.30; anterior apodeme absent; ventrobasal suture sublinear; pygofer lobe rounded, wide, edentate; male tergite X of anal tube incised about half way into pygofer (Figs 7B–D, 13A, 18A, B, 21A, B, 23A, B, 25A). Pygofer length/width <1 commonly in *H. ramosa* brachypters and submacropters and *H. alavittata* sp. nov., length/width >1 in *H. hapsistylis* sp. nov., *H. bualacauda* sp. nov., and most elongate in *H. alacaudella* sp. nov., length/width 1.44–1.70.

**Pygofer lobe.** Edentate, in lateral view with posterior margin broadly rounded, broadly merged with pygofer, scattered long 134–244  $\mu\text{m}$  and short 56–88  $\mu\text{m}$  macrosetae.

#### Female.

**Sternite VII.** Commonly wider than long, rectangular to trapezoid, or almost longer than wide in *H. treichroa* sp. nov. (Fig. 25J, K), posterior margin varied, either sublinear (Figs 8T, 23I), or with wide, deep (Figs 8S, 13Q–S) or wide, shallow excavation (Fig. 21Q, R), or with short, median ligula, either wider than long (Figs 8O, 18O, P, 25J, K) or longer than wide (Fig. 8N, P, Q, R), or without ligula (Figs 8S, 13Q–S, 21Q, R). Length/width 0.36–0.54, *H. treichroa* sp. nov. length/width 0.58–0.65, width across apex/width across base 0.52–0.71, ligula (when present) length/width 0.37–1.11.

**Valvula 3.** Slight protrusion beyond posterior margin of pygofer. Ventral margin with 5–11, short macrosetae, length 17–34  $\mu\text{m}$ .

**Valvula 2.** Distal third to half, forked, dorsally serrate, teeth rounded, small teeth in trough (Figs 6D, E, 14E, F, 16F, 20H, I), rarely uniformly rectangular teeth (Fig. 24J), rarely edentate (Fig. 6F–H).

**Valvula 1.** Lanceolate. Sculpture marginal, at apex imbricate, at base striate, at mid-section intermediate, rarely granulate (Figs 6A–C, 14A–C, 16A, B, 17E, F, L, 20E–G).

**Valvifer 2.** Elongate, length/width 2.50–3.02, sculpture ventrobasally with numerous microtrichia, absent in *H. treichroa* sp. nov. and 4–11 pore-like structures, with *H. treichroa* sp. nov. with 1–2 setae in three out of five specimens (Fig. 25M), one seta in seven specimens of *H. alavittata* sp. nov., setae absent in other species of *Hadroca*. Microtrichia commonly triangular with short point, rarely small, or short lines. Sculpture was most varied in *H. ramosa*, i.e., microtrichia many, few, or short lines, or absent (Fig. 6I, J), most uniform in *H. hapsistylis* sp. nov. (Figs 13U, V, 14I).

**Valvifer 1.** In dorsal view, margins free; in lateral view anterior margin broadly rounded, posterior margin narrowly rounded, apices acute (Figs 8K–M, 25L) or blunt (Fig. 17H), or both states, i.e., *H. hapsistylis* sp. nov., blunt in Fig. 13T, acute in Fig. 14G, *H. alavittata* sp.n, blunt in Fig. 21T, acute in Fig. 20D. Length/width 1.59–2.30.

**Remarks.** The five new species of *Hadroca* and especially *H. ramosa* display a wide range of sizes, wing shapes and forms and color patterns. *Hadroca ramosa* displays brachyptery, submacroptery and macroptery, with three shapes of the posterior margin of the sternite VII in females with associated males. Two species have tegmina extended well beyond the abdomen, thus considered macropters, but with reduced, narrower and shorter hind wings, albeit with jugal lobes, i.e., *H. bualacauda* sp. nov. and *H. alacaudella* sp. nov. Brachypters have 3–5 exposed abdominal segments and 1–3 in submacropters.

However, two important internal features of male terminalia define the genus.

The generic feature of the aedeagus is the strict combination of the C-shape, uniform sclerotization, short

dorsal apodeme and reduced preatrium. Additionally, the aedeagus is considered edentate or rarely with single, desclerotized, subapical, anterior tooth (Figs 5A, G; 7K, N, O, R, S, U; 9C, E, F, G, I–M). The exact dimensions of the dorsal apodeme are subjective due to the nature of the transition and orientation between the union of the phragma and the dorsal apodeme. An approximation of the relation between the length of the dorsal apodeme and the length of the aedeagus, by the use of a straight line distance from the point of attachment of the connective to the apex of the dorsal apodeme divided by the straight line distance from the former point to the apex of the shaft. This relation in *Hadroca* species is 0.35–0.45, and in other Bonaspeiini genera as follows:

*Basutoia brachyptera* Linnavuori, 1961, 0.51–0.58; *Bonaspeia* Linnavuori, 1961, species 0.63–0.79; *Curvostylus* Davies, 1987, species 0.81–0.87; *Flavorubivolutus* Stiller, 2021, species 0.41–0.53, *F. curtiverpus* Stiller, 2021, 0.49–0.60, *F. tensus* Stiller, 2021, 0.45–0.51, *F. glabrus* Stiller, 2021, 0.37–0.49; select species of *Geelus* Stiller, 2020, 0.43–0.64; *Retevolatus* Stiller, 2021, species 0.31–0.54, *R. flexiverpus* Stiller, 2021, 0.41–0.57, *R. semicurvierpus* Stiller, 2021, 0.20–0.25, *R. subspini-verpus* Stiller, 2021, 0.38–0.47; *Tzitzikamaia* Linnavuori, 1961, species 0.55–0.64.

Style metrics vary considerably, not fully resolved and require retrospective evaluation in other members of Bonaspeiini. The generic feature is the ventrad curvature of the apophysis usually visible in situ in the cleared pygofer or whole specimens (Fig. 12A), but sometimes obscured by other structures. The most striking style apophysis is in *H. hapsistylis* sp. nov. with the very long and strongly arched apophysis, and least typical is in *H. alavittata* sp. nov. with the apophysis curvate laterad in dorsal view and its apex with minimal ventrad curvature. The medial arm is curved or angled dorsad, when observed anteriorly.

Theron (1974) stated the connective with elongated stem was diagnostic for the genus, but now found to be longer or shorter than the arms, in approximate equal proportions. Even the width of the stem showed varied degrees of lateral sclerotization. This genus has two types of connective, i.e., longer than wide in four species and wider than long in *H. hapsistylis* sp. nov. and both with medial part of the arms angled dorsad.

The ocellus diameter and interocellar distance in many specimens is poorly defined. Theron (1974) noted the arched pronotum, scutellum and tegmina in lateral view in the submacropterous *H. ramosa* (Figs 1D, L, 3N), that is similar in *H. bualacauda* sp. nov. (Fig. 15C), *H. alavittata* sp. nov. (Fig. 19F) but less distinct in *H. hapsistylis* sp. nov. (Fig. 11C, D), *H. alacaudella* sp. nov. (Fig. 22C, D) and *H. treichroa* sp. nov. (Fig. 24C, G) and additional specimens of *H. ramosa* (Figs 1I, 3B, H, 4B, D).

*Bloemia hieroglyphica* (Naudé, 1926) is similar to *Hadroca* in color, shape and size (Fig. 28A–F), and similar curvature of the aedeagal shaft, but not uniformly sclerotized, i.e., with lateral margins weakly sclerotized,

base strongly sclerotized, apex anteriorly, posteriorly and apex and subapex medially desclerotized (Fig. 5I–L). Additionally, in *Bloemia* the dorsal apodeme is reduced, preatrium short, in dorsal/ventral or anterior/posterior view with the aedeagus at its widest medially, base narrower and apex narrowest. The style in *Bloemia* in dorsal view is curved laterad, in lateral view linear.

*Basutoia brachyptera* Linnavuori, 1961, bears some resemblance to the brachypterous form of *H. ramosa*, but with length from apex of crown to apex of abdomen larger, i.e., males 4.0–4.6 mm. All examined specimens in SANC holdings are brachypterous and have three color forms (Fig. 27A–E). The aedeagus is C-shaped, with a much longer dorsal apodeme, about half as long as the shaft, similar width to the shaft in lateral view, and about three times wider than the shaft in anterior or posterior view. Linnavuori (1961) illustrated a part of the aedeagus in lateral view (Fig. 29L), supplemented with own observations of terminalia in numerous specimens. *Basutoia* is probably grass-feeding and associated with the Grassland Biome of South Africa (Fig. 30A).

*Tzitzikamaia* Linnavuori, 1961 is brachypterous (Fig. 27I–L), similar in some aspects of size (length from apex of crown to apex of tegmina 2.3–2.8 mm, in *Hadroca* 2.8–3.3 mm, length from apex of crown to apex of abdomen 3.5–4.5 mm, in *Hadroca* 3.4–4.2 mm) but head width and pronotum width in *Tzitzikamaia* 1.5–1.8 mm and *Hadroca* 1.3–1.5 mm, and notably with the aedeagus with apical, paired processes. The aedeagus of four species has apical, paired processes, as in Fig. 29G–K. The female sternite VII based on own observations and of two species as in Fig. 29M, N, differs considerably, except in some specimens of *Tzitzikamaia* resembling the narrow incision as in Figs 3J, 8S. Differentiation between *Basutoia brachyptera*, *Tzitzikamaia* species and brachypters of *H. ramosa* in Table 1.

*Goniagnathus brachypterus* Linnavuori, 1978, (Fig. 27M) (in Goniagnathini (Zahniser and Dietrich 2013)) resembles *Hadroca ramosa* in color, shape and size, but has the aedeagus thick and tapered apicad with large, semicircular gonopore, the style apophysis wide and serrate and based on SANC holdings distributed in the northern parts of South Africa, and Linnavuori (1978) described the species from Zaire, now the Democratic Republic of Congo.

*Johanus cypraeus* (Naudé, 1926) bears some resemblance in shape and size, but has a distinct asymmetric aedeagus.

*Teinopterus microphallus* Stiller, 2011, is a grass-feeding leafhopper in Paralimnini, with a narrow tail-like wing extension (Fig. 27F, G) which resembles that of *H. bualacauda* sp. nov. and *H. alacaudella* sp. nov.

### *Hadroca ramosa* (Naudé)

Figs 1–9, 26B

*Euscelis ramosus* Naudé, 1926: 65–66.

*Hadroca ramosa* (Naudé), Theron, 1974: 161–162.

**Table 1.** Morphologic differences and similarities between the brachypterous form of *H. ramosa* (Naudé), *Basutoia brachyptera* Linnavuori and *Tzitzikamaia* species.

	<i>Tzitzikamaia</i> spp	<i>Basutoia brachyptera</i>	<i>Hadroca ramosa</i> brachypter
color	mottled, spotted, speckled	light green, light brown, rarely dark brown	reticulate
exposed abdominal segments	5–6	5–6	3–5
style apophysis laterally	sublinear	sublinear	curvate ventrad
aedeagal shaft	apex with paired process, sublinear, shaft tubular	apex edentate, shaft compressed	apex edentate, shaft tubular
pygofer lobe	long macrosetae seriate	long macrosetae scattered	long macrosetae scattered
dorsal apodeme of aedeagus	about half as long as shaft	about half as long as shaft	about one third as long as shaft
male tergite X	anteroventral process less than one third as long as distal part	anteroventral process less than one third as long as distal part	anteroventral process about half as long as distal part
subgenital plate	triangular, lateral and medial margins convergent; macrosetae long, distal, submarginal; style reaching half way	triangular, lateral and medial margins convergent; macrosetae short, medial, submarginal, style reaching half way	right-angled triangular, lateral margin sinuous or sublinear; macrosetae medial, marginal; style near base
connective length greatest/width greatest	1.10–1.46	1.06–1.62	1.54–2.40 ( <i>Hadroca</i> spp); 1.81–2.27 <i>Hadroca ramosa</i> brachypter
sternite VII	ligula absent, sinuous, wide or narrow V-shaped notch; narrow deep notch similar to that in Fig. 8S.	provisionally considered shallowly bilobate	ligula absent, wide notch, either deep or shallow; rarely narrow, deep notch (Fig. 8S).
habitat	Grassland and Fynbos Biomes	Grassland Biome	Fynbos Biome

### Diagnosis.

1. Stramineous, ochraceous, often with reticulate pattern, light green to yellow green.
2. Tegmina brachypterous, submacropterous, posterior margin broadly rounded or truncate, or macropterous, with appendix and apex narrowly rounded.
3. Aedeagal shaft elongate, strongly curvate, preatrium reduced, sometimes with single, subapical, anterior narrow process.
4. Style apophysis in dorsal view sublinear, in lateral view apophysis short, apex curved ventrad. The apex of the subgenital plate is equidistant to apex of pygofer lobe.
5. Female sternite VII posterior margin with recessed, variable ligula or sublinear, or V-shaped with narrow, parallel-sided notch.

**Etymology.** *Ramosus*, Latin, full of branches (Brown 1954), for the reticulate color pattern of the tegmina, gender feminine.

#### Color. Male, female and nymph.

**Dorsum.** Small circular marks (Fig. 1E, G, H) or transverse narrow marks (Figs 2L, M, 3A–G), or unmarked and light green to yellow-green (Fig. 1C, D, N, O).

**Tegmina.** Brown to dark brown reticulations (e.g., Figs 1K, 2L, 4A, E) or yellow-green (Fig. 1N) to stramineous (Fig. 1C). Veins light brown or dark brown, with cells reticulate, rarely with extensive marking in cells or immaculate, translucent or opaque.

**Face.** Clypeus with brown, horizontal arcs (Figs 2A, C, 3K, L, O), or weakly marked (Fig. 2B). Rarely with facial arcs extending laterodorsally onto crown (Fig. 1K).

**Abdomen.** Heavily marked (Fig. 1A, E), usually with median line and small round marks (Figs 1F–H, 3E–G),

or without median line (Figs 2L, M, 3A–D). Nymph color as in Fig. 2I–K.

#### Morphology. Male and female. Tegmina.

1. Brachypter rare (36 males and 29 females), with tegmina about as long as wide (length/width 1.1–1.2) (Figs 2L, M, 3A–H), hind wing reduced (Fig. 3I), (length/width 0.6, ratio tegmina length/width to hind wing length/width 0.5–0.6).
2. Tegmina submacropterous [see Zahniser (2021) for terms] common (206 males and 96 females), longer than wide (length/width 1.5–1.7) (Figs 1A–O, 3M, N), hind wing reduced (length/width 0.6–0.8, ratio tegmina length/width to hind wing length/width 0.5–0.7).
3. Macropter rare (10 males and 8 females), with tegmina extended beyond apex of abdomen and hind wing well developed with large jugal lobe (Fig. 4A–F).

**Hind wing.** In brachypterous males 1.0 mm long, 0.6–0.7 mm wide and females 1.1 mm long and 0.7–0.8 mm wide. In subbrachypterous males 1.1–1.7 mm long and 0.6–0.7 mm wide, females 1.2–1.8 mm long and 0.6–0.8 mm wide. In macropterous specimens with jugal lobes well developed (Fig. 4I).

**Chaetotaxy.** AV 10–12, IC 9–11 (Fig. 2D).

#### Measurements. Male.

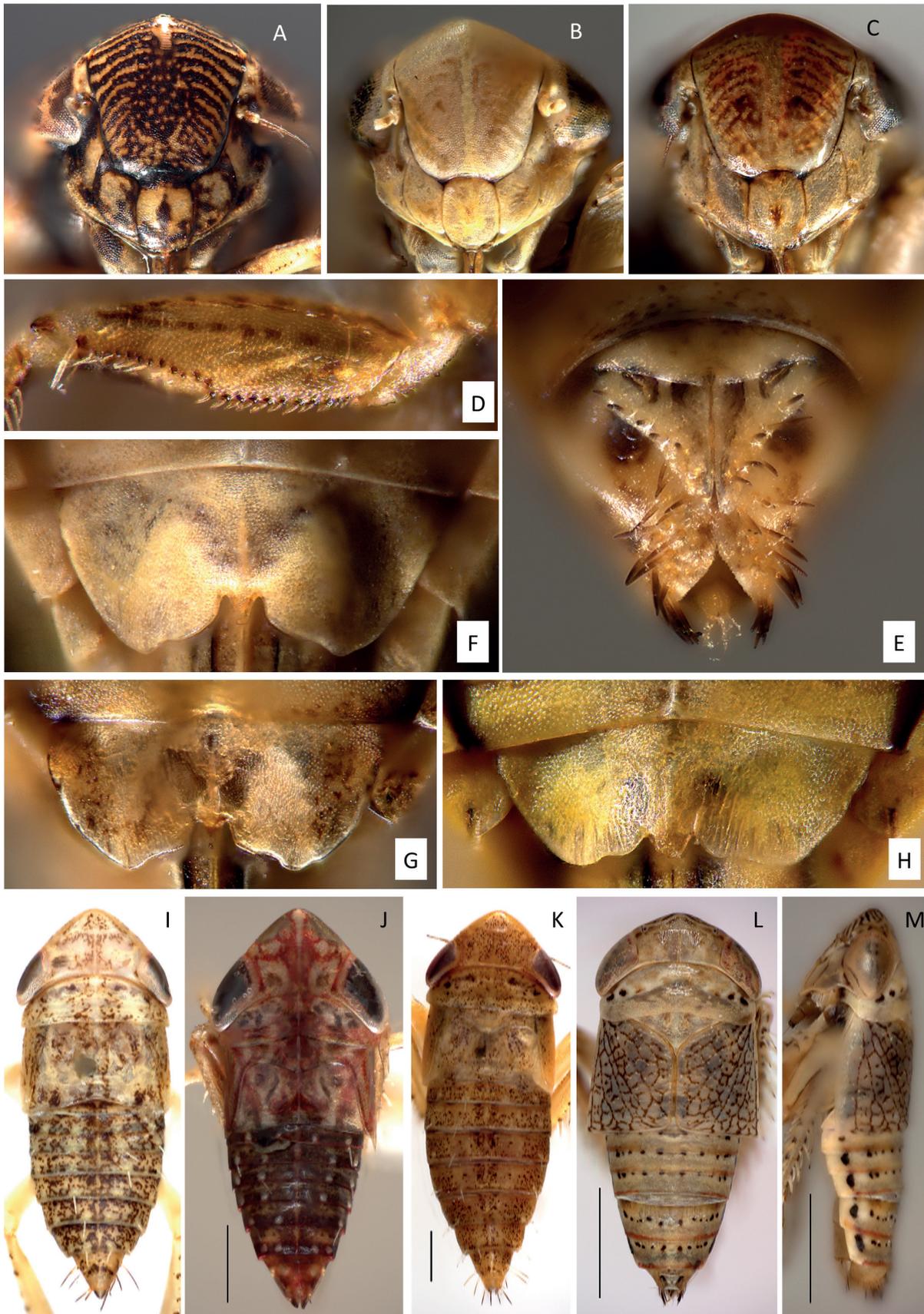
**Brachypter** (n=35). Apex of crown to apex of tegmina 2.46–2.73 mm; apex of crown to apex of abdomen 3.83–4.26 mm; crown length 0.46–0.52 mm; crown length next to eye 0.36–0.42 mm; pronotum length 0.50–0.57 mm; head width 1.59–1.81 mm; pronotum width 1.52–1.75 mm; ocellus diameter 30–45 µm; interocular distance 66–117 µm; crown angle 116–124°; crown length/crown



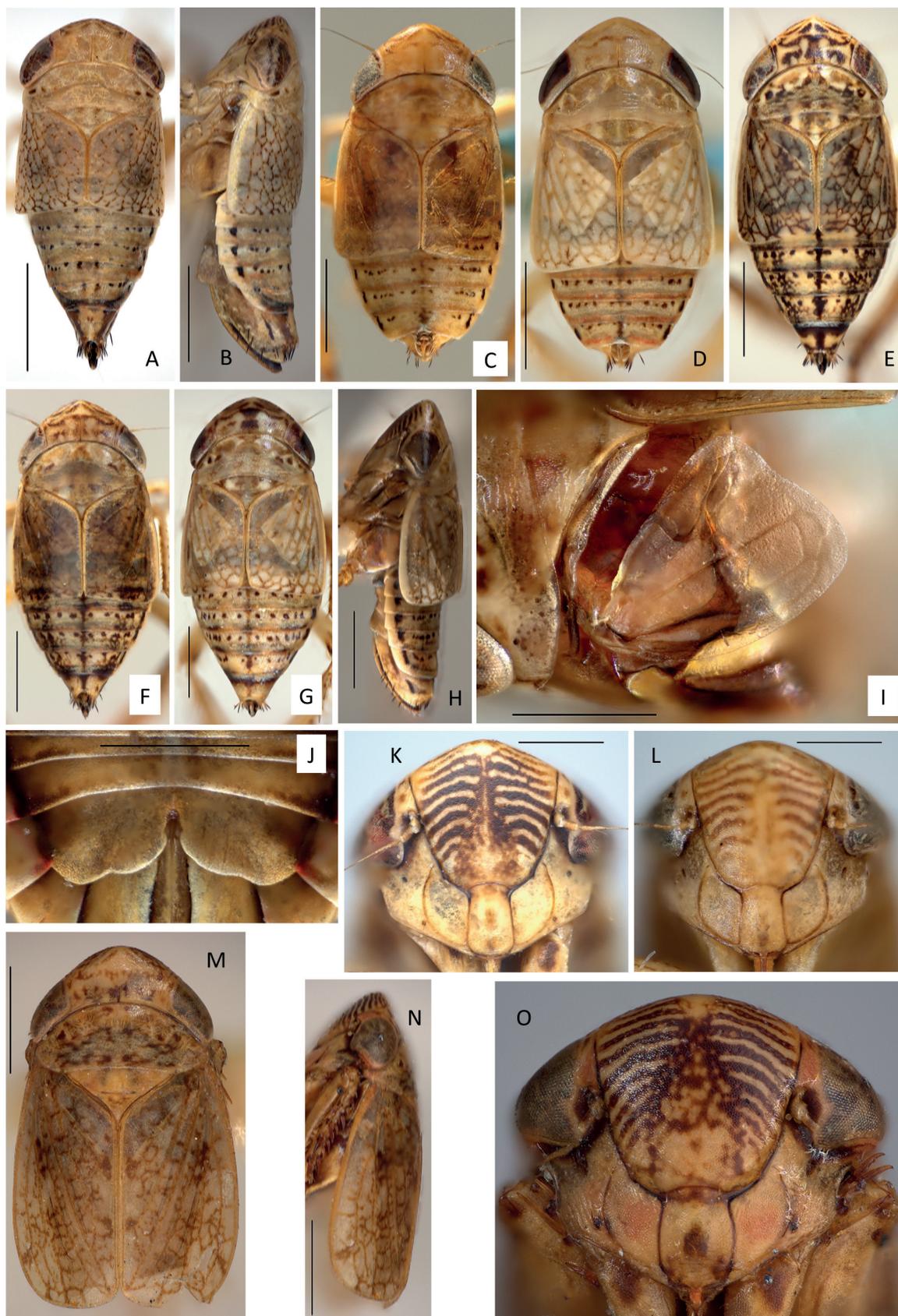
**Figure 1.** A–O *Hadroca ramosa* (Naudé) male and female submacropter, habitus images with specimen localities. **A.** Female, dorsally, Slagboom; **B.** Female, dorsally, Slagboom; **C.** Male, dorsally, Slagboom; **D.** Male, laterally, Ceres; **E.** Male, dorsally, Skurfteberg; **F.** Male, dorsally, Dwarsrivier; **G.** Female, dorsally, Dwarsrivier; **H.** Female, dorsally, Dwarsrivier; **I.** Female, laterally, Dwarsrivier; **J.** Female, dorsally, Cedarberg; **K.** Male, dorsally, Caledon; **L.** Male, laterally, Caledon; **M.** Male, dorsally, Driehoek; **N.** Female, Dwarsrivier, dorsally; **O.** Male, Dwarsrivier, dorsally. A–O. Scale bars: 1 mm.

length next to eye 1.19–1.31; head width/pronotum width 1.03–1.06; ocellus diameter/interocular distance 0.29–0.60; crown length/pronotum length 0.86–0.98; pronotum

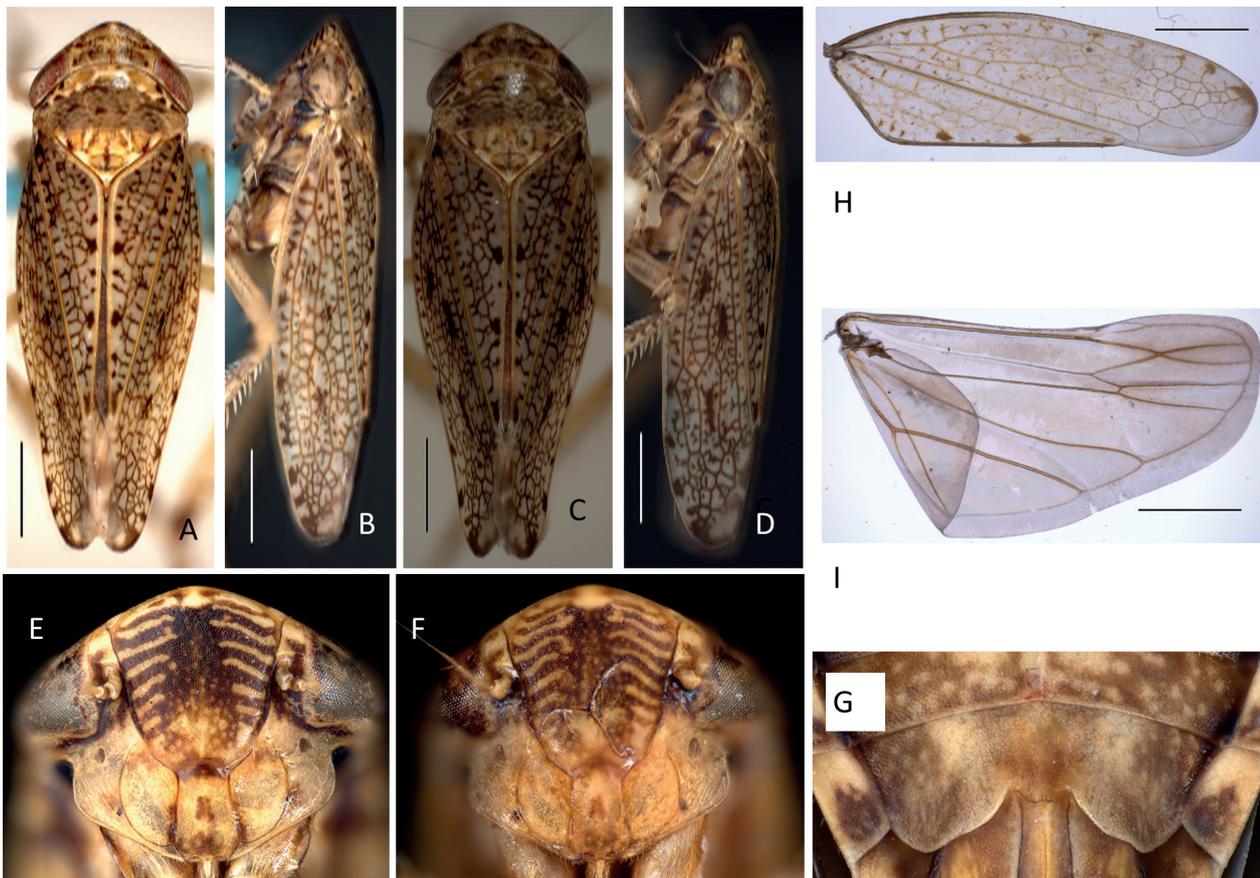
length/pronotum width 0.31–0.34; crown length/head width 0.27–0.31; crown length/pronotum width 0.28–0.32; length to tegmina/length to abdomen 0.62–0.67.



**Figure 2.** A–M *Hadroca ramosa* (Naudé) male, female and nymph submacropter and brachypter, habitus images, profemur and terminalia with specimen localities. A–H, submacropter. A. Face, male, Skurfteberg; B. Face, female, Dwarsrivier; C. Face, male, Fisantekraal; D. Profemur, female, Dwarsrivier; E. Genital capsule, Hottentotsholland; F. Sternite VII, Clanwilliam; G. Sternite VII, Dwarsrivier; H. Sternite VII, Dwarsrivier; I. Nymph, Driehoek; J. Nymph, Fisantekraal; K. Nymph, Driehoek; L–M, brachypter, male, Driftsands. L. Dorsally; M. Laterally. J–M. Scale bars: 1 mm.



**Figure 3.** A–O *Hadroca ramosa* (Naudé) male and female brachypter and submacropter, habitus images, hind wing, face and terminalia with specimen localities. A–L, brachypter. A. Female, dorsally, Driftsands; B. Female, laterally, Driftsands; C. Male, dorsally, Jonkershoek; D. Male, dorsally, Muldersvlei; E. Female, dorsally, Ceres; F. Female, dorsally, Jonkershoek; G. Female, dorsally, Ceres; H. Female, laterally, Jonkershoek; I. Hind wing, male, Swellendam; J. Sternite VII, Jonkershoek; K. Face, male, Ceres; L. Face, male, Jonkershoek. M–O, holotype male. M. Dorsally, Jonkershoek; N. Laterally, Jonkershoek; O. Face, Jonkershoek. A–N. Scale bars: 1 mm.



**Figure 4.** A–I *Hadroca ramosa* (Naudé) male, female macropter, habitus images and wings with specimen localities. **A.** Male, laterally, Clanwilliam; **B.** Male, dorsally, Clanwilliam; **C.** Female, laterally, Clanwilliam; **D.** Female, Clanwilliam; **E.** Face, female, Clanwilliam; **F.** Face, male, Clanwilliam; **G.** Sternite VII, Clanwilliam; **H.** Tegmina, male, Clanwilliam; **I.** Hind wing, male, Clanwilliam. **A–D, H, I.** Scale bars: 1 mm.

**Submacropter** (n=142). Apex of crown to apex of tegmina 2.72–3.43 mm; apex of crown to apex of abdomen 3.32–3.94 mm; crown length 0.47–0.54 mm; crown length next to eye 0.33–0.37 mm; pronotum length 0.45–0.54 mm; head width 1.28–1.56 mm; pronotum width 1.23–1.54 mm; ocellus diameter 25–43  $\mu$ m; interocular distance 69–96  $\mu$ m; crown angle 102–115°; crown length/crown length next to eye 1.36–1.56; head width/pronotum width 1.00–1.05; ocellus diameter/interocular distance 0.32–0.53; crown length/pronotum length 0.90–1.15; pronotum length/pronotum width 0.33–0.39; crown length/head width 0.32–0.40; crown length/pronotum width 0.32–0.42; length to tegmina/length to abdomen 0.79–0.90.

**Macropter** (n=10). Apex of crown to apex of tegmina 5.03–6.14 mm; apex of crown to apex of abdomen 1.10–4.72 mm; length antenna 1.76–2.58 mm; crown length 0.45–0.50 mm; crown length next to eye 0.35–0.39 mm; pronotum length 0.66–0.81 mm; head width 1.67–1.91 mm; pronotum width 1.55–1.82 mm; ocellus diameter 51–68  $\mu$ m; interocular distance 108–122  $\mu$ m; crown angle 119–128°; crown length/crown length next to eye 1.22–1.36; head width/pronotum width 1.05–1.08; ocellus diameter/interocular distance 0.44–0.59; crown length/pronotum length 0.57–0.74; pronotum length/pro-

notum width 0.42–0.45; crown length/head width 0.24–0.29; crown length/pronotum width 0.25–0.32; length to tegmina/length to abdomen 1.17–1.37.

**Female. Brachypter** (n=26). Apex of crown to apex of tegmina 2.44–2.65 mm; apex of crown to apex of abdomen 3.35–3.69 mm; crown length 0.46–0.54 mm; crown length next to eye 0.36–0.41 mm; pronotum length 0.50–0.55 mm; head width 1.56–1.68 mm; pronotum width 1.49–1.63 mm; ocellus diameter 29–43  $\mu$ m; interocular distance 67–105  $\mu$ m; crown angle 112–122°; crown length/crown length next to eye 1.21–1.37; head width/pronotum width 1.02–1.05; ocellus diameter/interocular distance 0.32–0.55; crown length/pronotum length 0.88–1.04; pronotum length/pronotum width 0.32–0.34; crown length/head width 0.28–0.43; crown length/pronotum width 0.29–0.35; length to tegmina/length to abdomen 0.69–0.76.

**Submacropter** (n=78). Apex of crown to apex of tegmina 2.89–3.52 mm; apex of crown to apex of abdomen 3.70–4.51 mm; crown length 0.48–0.56 mm; crown length next to eye 0.33–0.39 mm; pronotum length 0.47–0.55 mm; head width 1.35–1.60 mm; pronotum width 1.31–1.57 mm; ocellus diameter 27–46  $\mu$ m; interocular distance 70–102  $\mu$ m; crown angle 103–116°; crown length/crown length next to eye 1.34–1.55; head width/pro-

pronotum width 1.00–1.04; ocellus diameter/interocular distance 0.32–0.55; crown length/pronotum length 0.91–1.13; pronotum length/pronotum width 0.34–0.38; crown length/head width 0.32–0.40; crown length/pronotum width 0.32–0.41; length to tegmina/length to abdomen 0.72–0.84.

**Macropter** (n=8). Apex of crown to apex of tegmina 4.94–6.10 mm; apex of crown to apex of abdomen 4.04–4.92 mm; length antenna 1.64–2.18 mm; crown length 0.47–0.53 mm; crown length next to eye 0.35–0.39 mm; pronotum length 0.68–0.79 mm; head width 1.70–1.89 mm; pronotum width 1.58–1.90 mm; ocellus diameter 50–66  $\mu\text{m}$ ; interocular distance 107–125  $\mu\text{m}$ ; crown angle 118–125°; crown length/crown length next to eye 1.28–1.44; head width/pronotum width 1.05–1.08; ocellus diameter/interocular distance 0.41–0.60; crown length/pronotum length 0.62–0.76; pronotum length/pronotum width 0.42–0.45; crown length/head width 0.26–0.30; crown length/pronotum width 0.27–0.33; length to tegmina/length to abdomen 1.19–1.27.

#### Terminalia. Male.

**Aedeagus.** Shaft edentate or sometimes with single, narrow, anterior, subapical process at base of gonopore; commonly narrow curvate (Figs 5A, B, G, 7J–L, N, O) segment angle 143–185° (n=37), rarely widely curvate (Fig. 7M), segment angle 136°. In dorsal or posterior view, shaft apically narrower or wider than medially, widest subbasally. Gonopore circular or V-shaped, dorso-antieriad. Process at subapex of shaft commonly acutely angled (Fig. 9D–G) or right angled (Fig. 9H) or without process (Fig. 9A, B, D, N), sometimes deformed or damaged (Fig. 9B, D, J, I, K, L, M); process extended beyond apex of shaft (Fig. 9G, H) or shorter (Fig. 9C, E, I, J). Apex commonly notched in posterior view (Figs 7P, S, 9N), or rarely rounded (Fig. 7Q, R, T–V). Aedeagus in lateral view, area in brachypter 27–28  $\mu\text{m}^2$ , in submacropter 25–35  $\mu\text{m}^2$ , in macropter 24–37  $\mu\text{m}^2$ . perimeter in brachypter 1.389–1.634 mm, in submacropter 1.407–2.212 mm, in macropter 1.038–2.711 mm; greatest straight line length from atrium to apex of dorsal apodeme/greatest length from atrium to apex of shaft, submacropter 0.34–0.43, brachypter 0.35–0.48, macropter 0.55–0.68.

**Style.** Slightly longer than greatest width, length greatest/width greatest 1.12–1.44 in submacropter, 1.62–1.92 in brachypter, 1.16–1.40 in macropter. Apophysis short (all examined specimens, length apophysis/length greatest 0.13–0.19, submacropter 0.13–0.17, brachypter 0.15–0.20, macropter 0.13–0.17); in dorsal view straight (Fig. 8G, I) or rarely somewhat curved laterad (Figs 5E, 8E).

**Connective.** Longer than wide, stem and arms in submacropter and brachypter of variable length, (length stem/length arms submacropter 0.85–1.36, brachypter 0.98–1.33), in macropter stem longer than arms (length stem/length arms 1.29–1.61); length greatest/width greatest in submacropter 1.77–2.56, brachypter 1.81–2.27 (Figs 5C, D, 8A, B, D), macropter 2.13–2.57 (Fig. 8C).

**Subgenital plate.** Apex narrowly rounded (Fig. 7F–H) or rounded (Fig. 7E, I), lateral margin smooth, sometimes rugulate (Fig. 7I). Macrosetae basally and distally short-

er than medially, uniseriate, submarginal. Three states of length/width ratios:

Submacropter: length/width 1.28–1.69, 4–7 macrosetae, length 111–190  $\mu\text{m}$ , angle at apex of subgenital plate, by trigonometry 31–38° (Fig. 7E, H, I).

Brachypter: length/width 0.85–1.12, 2–4 macrosetae, length 71–175  $\mu\text{m}$ , angle at apex of subgenital plate, by trigonometry 42–49° (Fig. 7F).

Macropter: length/width 1.69–2.01, 6–8 macrosetae, length 176–287  $\mu\text{m}$ , angle at apex of subgenital plate, by trigonometry 26–31° (Fig. 7G).

**Valve.** Broadly or narrowly triangular, length/width 0.36–0.46, angle at posterior margin by trigonometry 110–126° (Fig. 7E–I). Submacropter, brachypter and macropter, length/width respectively 0.36–0.45, 0.36–0.49, 0.38–0.46; angle, respectively 111–127°, 100–119°, 105–120°.

**Pygofer lobe.** In lateral view, rarely shorter or commonly longer than greatest width (length/width 1.0–1.3), posterior margin rounded. Macrosetae length in macropter 126–288  $\mu\text{m}$ , submacropter 101–222  $\mu\text{m}$ , brachyptera 68–173  $\mu\text{m}$  (Fig. 7A–D). Shorter macrosetae arbitrarily 65–94  $\mu\text{m}$ .

#### Female.

**Sternite VII.** Variable, either (commonly) with narrow acute (length/width 0.6–1.2), recessed ligula on broadly rounded posterior margin (Figs 2F–H, 4G, 8N–R), or (rarely) with short, parallel-sided notch in wide v-shaped posterior margin (Figs 3J, 8S), or rarely sublinear (Fig. 8T), or wide ligula on sinuous margin (Fig. 8U). Posterior margin straight or slightly recessed (lateral length/medial length 1.0–1.1), wider than long, rectangular (length/width 0.4–0.5), posterior margin with narrow recess (notch width/sternite VII greatest width 0.5–0.6).

**Valvula 3.** Macrosetae 22–44  $\mu\text{m}$ , in Driftsands specimens (n=4) 37–53  $\mu\text{m}$ .

**Valvula 2.** Nine dissected specimens (Caledon, Cedarberg, Dwarsrivier, Fisantekraal, Hottentotsholland, Fisantekraal, Jonkershoek, Ladismith, Stellenbosch) with serrate apex (Fig. 6D, E), six (Cedarberg, Driehoek and Dwarsrivier, Jonkiespoort) edentate, with or without lateral, submarginal circular structures, mediodorsally with fine denticulation (Figs 6F–H).

**Valvula 1.** Sculpture granulose distally (Fig. 6B), strigate medially and basally (Fig. 6A, C).

**Valvifer 2.** Length/width 1.6–2.1. Sculpture with circular structures and microtrichia (Fig. 6I) or circular structures (Fig. 6J).

**Valvifer 1.** Length/width 1.6–2.1. (Fig. 8K–M).

**Material examined. Type locality.** Holotype male, South Africa, Western Cape province, Stellenbosch, Jonkershoek, -33.96, 18.92, 17 Dec. 1922, F.W. Petthey, CCDL01015, SANC.

**Type specimen. Holotype** male, glued to triangle card, pinned, with abdomen missing. Original label unknown, type set label printed by J.G. Theron: “Stellenbosch | Jonkershoek | 17-12-22 | F.W. Petthey || type (red paper) || HOLOTYPE | *Euscelis* | *ramosa* | Naudé 1926 (red paper) | *Hadroca* | *ramosa* | (Naudé) | Det. J.G. Theron”, SANC.

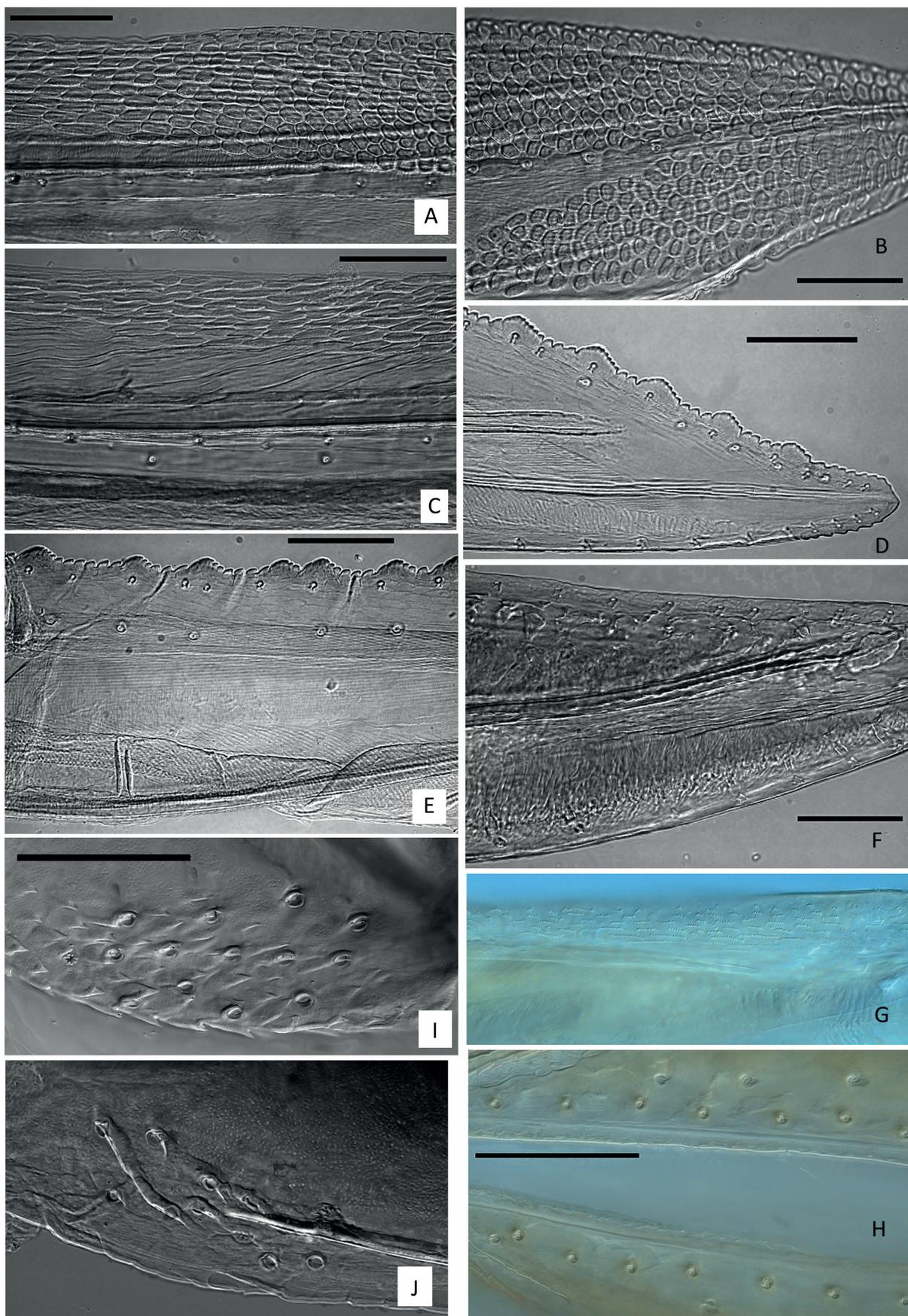


**Figure 5.** A–J *Hadroca ramosa* (Naudé) and *Bloemia hieroglyphica* (Naudé), male genitalia images and line drawings with specimen localities. A–G, *H. ramosa*. A. Aedeagus, Hottentotsholland, laterally; B. Aedeagus, Hottentotsholland, dorsally; C. Connective, Hottentotsholland, dorsally, DIC; D. Connective, Hottentotsholland, dorsally, bright field; E. Style, Hottentotsholland, dorsally; F. Style, Hottentotsholland, laterally; G. Aedeagus & connective, Hottentotsholland, laterally; H–J, *B. hieroglyphica*, aedeagus. H. Apex, dorsally, Bredasdorp; I. Laterally, Bredasdorp; J. Line drawing, laterally, fig. 76 copied from Theron, 1974; K. Anteriorly, Bredasdorp; L. Line drawing, posteriorly, fig. 77 copied from Theron, 1974. A–H. Scale bars: 100µm.

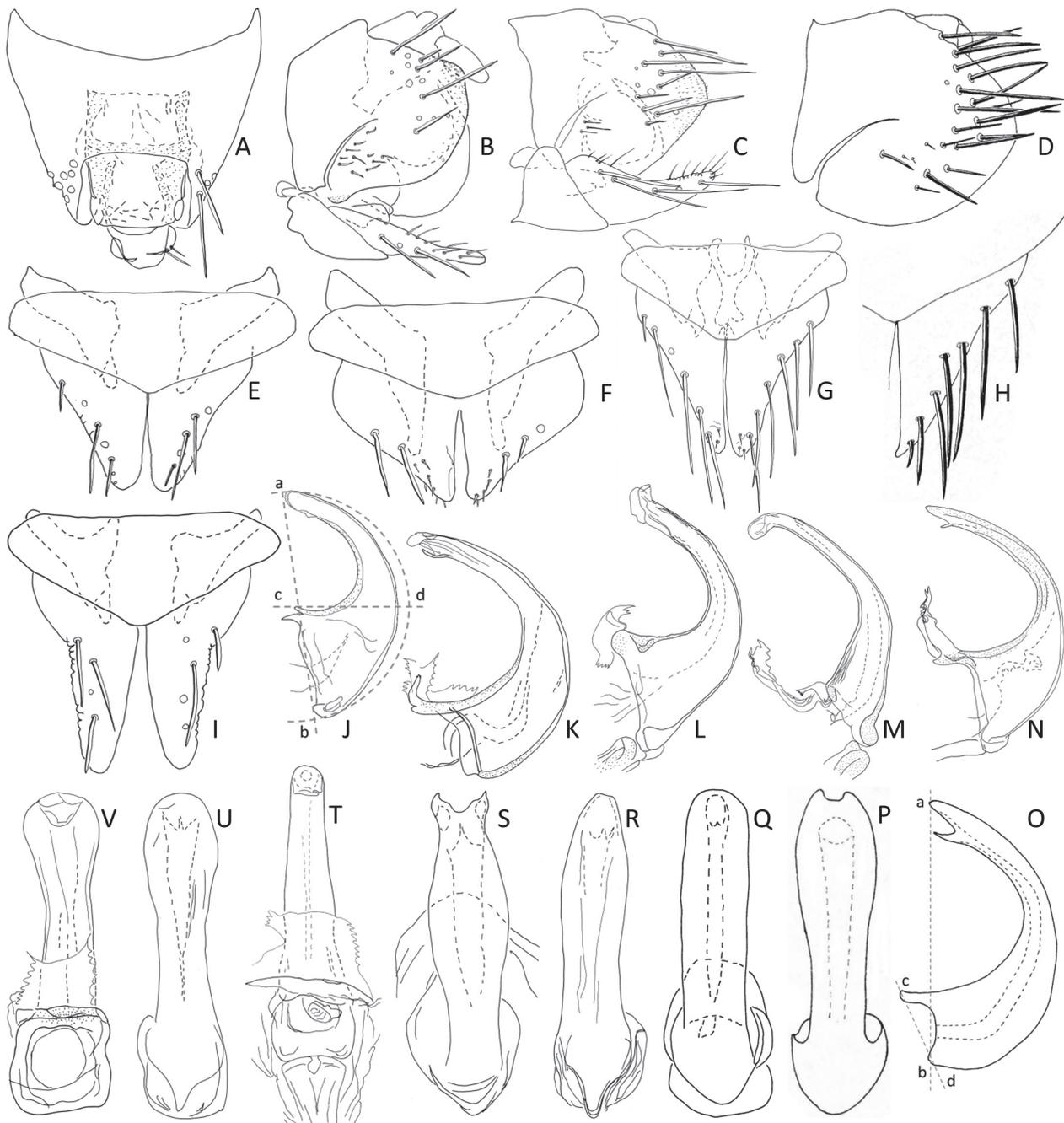
**Remarks.** More than 400 specimens were examined, with the majority submacropters (353 specimens: 204 males, 91 females, 58 nymphs, including 47 dissected males, 31 localities), brachypters were 94 specimens (54 males, 34 females and 6 nymphs, 23 localities) and macropters 19 specimens from 6 localities, with Slag-

boom, near Ceres in the Agterwitsenberg the only locality where all three forms were recorded, i.e., 1967, 1969 and 2004.

Color varied greatly (Figs 1A–O, 3A–H, M, N, 4A–D) with brachypters least typical, especially with the color pattern of the crown as in Figs 2L M, 3A–H.



**Figure 6.** A–J *Hadroca ramosa* (Naudé), ovipositor images with specimen localities. **A.** Valvula 1, medially, Jonkiespoort; **B.** Valvula 1, subapex, Jonkiespoort; **C.** Valvula 1, subbase, Jonkiespoort; **D.** Valvula 2, dentate, apex, Hottentotsholland; **E.** Valvula 2, dentate, subbase, Hottentotsholland; **F.** Valvula 2, edentate, subapex, Jonkiespoort; **G.** Valvula 2, edentate, subapex, Cedarberg; **H.** Valvula 2, edentate, dorsally, Cedarberg; **I.** Valvifer 1, sculpture, Fisantekraal; **J.** Valvifer 1, sculpture, Cedarberg. A–F, H, I. Scale bars: 50µm.



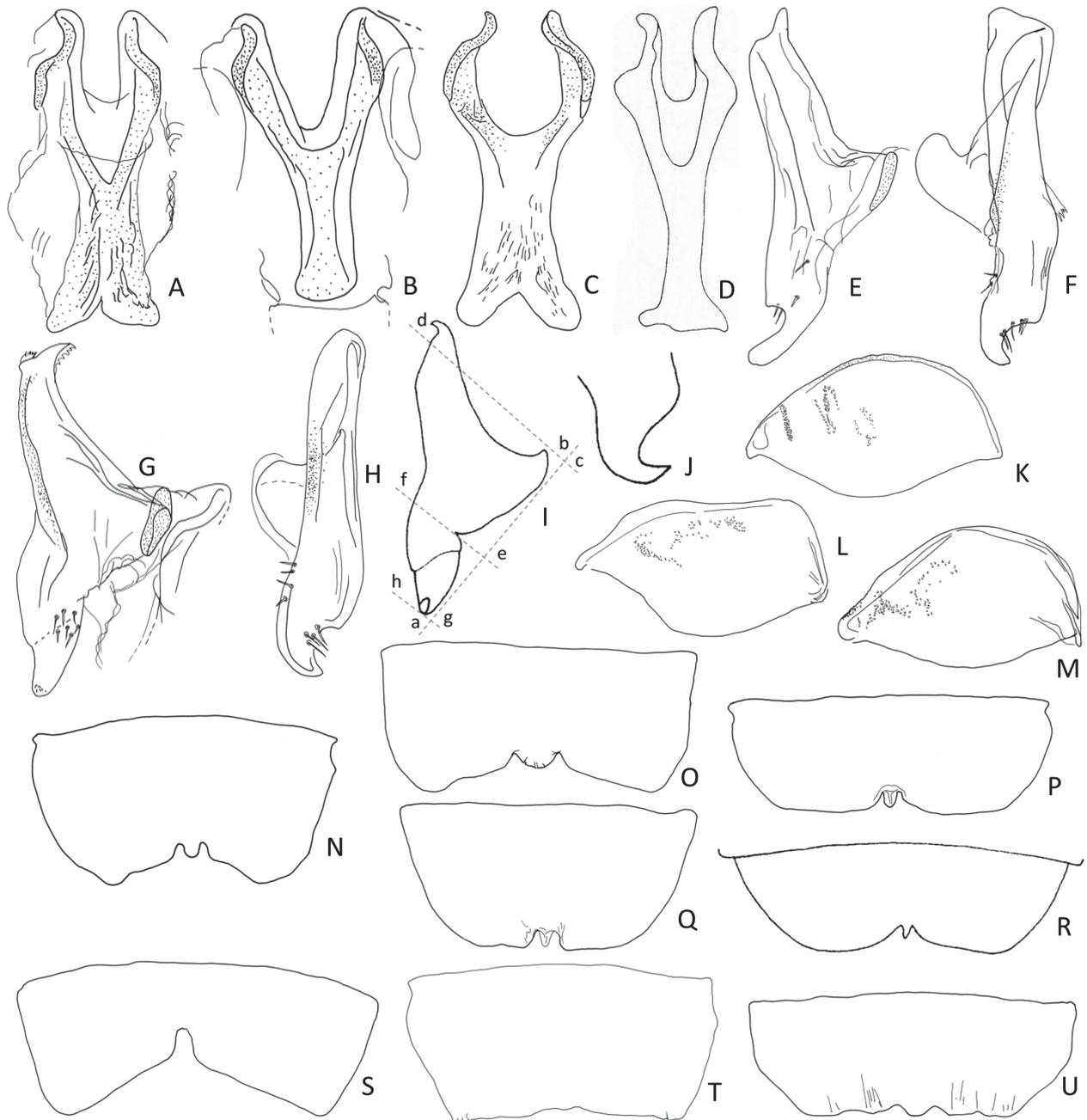
**Figure 7.** A–V *Hadroca ramosa* (Naudé) male terminalia, line drawings with specimen localities. **A.** Genital capsule, dorsally, Dwarsrivier; **B–D,** genital capsule, laterally. **B.** George; **C.** Clanwilliam; **D.** Copied from Theron, 1974; **E–I,** subgenital plate. **E.** Gifberg; **F.** De Hoop; **G.** Clanwilliam; **H.** Copied from Theron, 1974; **I.** Dwarsrivier; **J–O,** aedeagus, laterally. **J.** Driftsands, annotations in material and methods; **K.** Stellenbosch; **L.** Swellendam; **M.** De Hoop; **N.** Clanwilliam; **O.** Copied from Theron, 1974, laterally, annotations in material and methods; **P–S,** aedeagus posteriorly, **T,** aedeagus anteriorly, **U,** aedeagus posteriorly, **V,** aedeagus anteriorly. **P.** Copied from Theron, 1974; **Q.** Clanwilliam; **R.** Cedarberg; **S.** Cedarberg; **T.** Stellenbosch; **U.** De Hoop; **V.** Stellenbosch.

The aedeagal shaft in anterior or dorsal view of 70 examined specimens had 46 with a wide apex, 18 narrow and six parallel. The subapical, anterior process was short in 36 specimens, long in 21 and absent in 10, its position relative to the shaft, 38 acute, 17 subparallel and three right-angled. The distal notch was shallow in 25 specimens, deep in eight and absent in 36. Shaft curvature and shape, especially in the brachypter was variable, but not considered discrete.

Variability in the style was sometimes due to angle of dorsal or lateral observation. In general, lateral view com-

monly clearly depicted ventral curvature of the apophysis. Dorsal view, however, suggested greater variability as in Fig. 8E and the preapical lobe visible in profile, or absent when it was oriented ventrally. This variability in profile was common in undissected, cleared specimens with styles in situ.

Variability in the connective was the degree of the membranous ingression between the arms, and somewhat the lateral margin of the stem, as in Figs 5C, D, 8A–D. For the former condition, the measurement of the stem

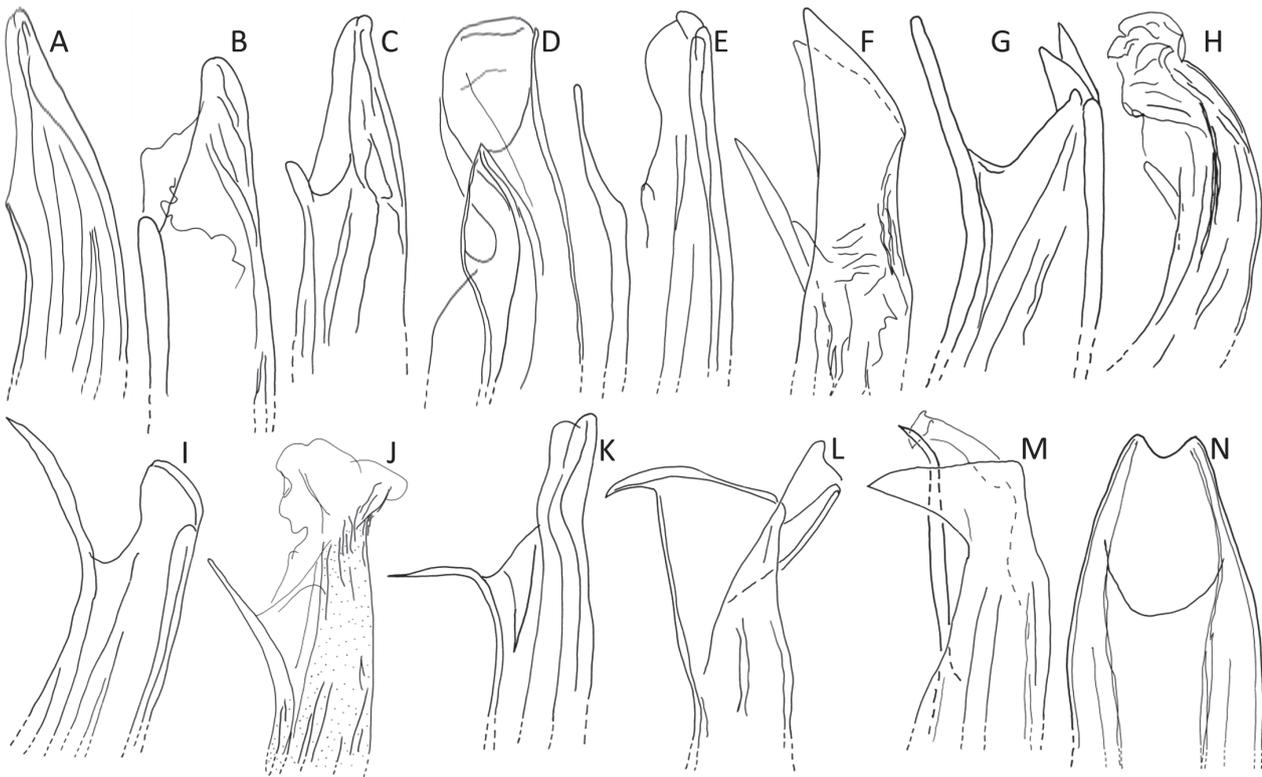


**Figure 8.** A–U *Hadroca ramosa* (Naudé) male and female terminalia, line drawings with specimen localities. A–D, connective; A. Stellenbosch; B. Driftsands; C. Clanwilliam; D. Copied from Theron, 1974; E–J, style. E. Dorsally, Driftsands; F. Laterally, Stellenbosch; G. Dorsally, Stellenbosch; H. Macropter, laterally, Clanwilliam; I. Ventrally, copied from Theron, 1974, annotations in material and methods; J. Apophysis, laterally, copied from Theron, 1974. K–M, Valvifer 1. K. Dwarsrivier; L. Fisantekraal; M. Dwarsrivier; N–U, sternite VII. N. Submacropter Dwarsrivier; O. Macropter Algeria Forestry Station; P. Submacropter Fisantekraal; Q. Driehoek; R. Copied from Theron, 1974; S. Swellendam; T. Driftsands; U. Driehoek.

and arm length was made to the sclerotized part of the Y-shaped frame.

The female sternite VII was ligulate in 21 submacropters and all macropters (Figs 4G, 8O), but truncate or narrowly notched in brachypters. The ligulate sternite VII was in *H. bualacauda* sp. nov. and *H. treichroa* sp. nov. Dissections of the valvula 2 of submacropters were edentate in 9 and dentate in 15 specimens and dentate in 5 brachypters and 2 macropters.

The female sternite VII was least typical in brachypters, and did not resemble that of the submacropter or macropter. Furthermore, examination of specimens of *Tzitzikamaia* revealed some females with the sternite VII with a similar notch as in the specimens from De Hoop, Jonkershoek and Swellendam, as in Fig. 8S. Additionally *Tzitzikamaia* resembled the brachypters of *H. ramosa*. The Driftsands specimens (sternite VII as in Fig. 8T) were collected by vacuum on *Imperata cylindrica* in 2004, but not



**Figure 9.** A–N *Hadroca ramosa* (Naudé) male, aedeagus, apex, laterally or anteriorly with specimen localities. A–M, laterally. A. Gifberg; B. Jonkershoek; C. Slagboom; D. George; E. Hottentotsholland; F. Cedarberg; G. Dwarsrivier; H. Oudekraal; I. Dwarsrivier; J. Swartberg; K. Caledon; L. Dwarsrivier; M. Dwarsrivier; N. Anteriorly Gifberg.

found in 2022 at the same locality on a number of shrubs. *Tzitzikamaia* is well represented in SANC with 246 records with more than 800 brachypterous specimens, half of the records without host or habitat, the rest divided approximately equally between grass and forbs or grass and ten tree or shrub families, with seven records on specific grasses. Distribution models and point distribution for *Tzitzikamaia* show a closer association with the Grassland Biome (Fig. 30A–C). The aedeagal shaft bears paired, apical processes and the dorsal apodeme is considered longer and thicker than in *Hadroca*. The distal configuration of the style in dorsal view has the apophysis longer than in that of *Hadroca*, linear, with the preapical lobe laterad of the apophysis. In *Hadroca* the apophysis shorter, curved ventrad, with the preapical lobe ventrad of the apophysis.

#### *Hadroca hapsistylis* sp. nov.

<https://zoobank.org/8098B568-D5B0-4454-82B9-24263FBC0D4D>  
Figs 10–14, 26C

#### Diagnosis.

1. Tegmina submacropterous, posterior margin rounded, stramineous, ochraceous, or light green to yellow green.
2. Aedeagal shaft elongate, strongly to weakly curvate, preatrium reduced.

3. Style apophysis in dorsal view sublinear, in lateral view apophysis about half as long as base, strongly arched dorsad, apex curved ventrad.
4. Subgenital apex equidistant to apex of pygofer lobe.
5. Female sternite VII posterior margin with wide, rounded, deep or shallow notch.

**Etymology.** Named in Greek for the arched apophysis of the style, arch, *hapsis*, and pillar, for the style, *stylis*, gender feminine.

**Color. Male, female & nymph.** Crown with few, paired small circular or elongate marks (Fig. 10C, D, E, H) or extensively marked (Fig. 10A, B) or unmarked (Fig. 10F, I–K) and light green to yellow-green (Fig. 11A, B) (green color form) or ochraceous to stramineous (Fig. 10F, H–K) (light color form) or dark brown (Fig. 11A–E, G, L) (dark color form). Tegmina with brown (Fig. 10A–C, E, G) to dark brown (Fig. 10D, L) reticulations or light green to yellow green (Fig. 11A, B), sometimes with distal veins embrowned (Fig. 11B). Face with clypeus and clypellus embrowned (Fig. 12B) or ochraceous (Fig. 12C). Nymphs, late instar, Fig. 11G, H, brown, early instar, stramineous (Fig. 11J–L), or dark brown (Fig. 11I).

#### Morphology. Male.

**Tegmina.** Tegmina submacropterous (Figs 10A–F, H, J, 11A–C), brachypterous (Fig. 10G), length/width 1.6–2.0, length 1.3–1.7 mm, width 0.8–0.9 mm; posterior margin broadly rounded.



**Figure 10.** A–L *Hadroca hapsistylis* sp. nov., male and female habitus images with specimen localities. **A.** Male, light brown, Calvinia; **B.** Male, dark brown, Calvinia; **C.** Male, dark head, Oudtshoorn; **D.** Male, light head, Oudtshoorn; **E.** Male, weak marking, Oudtshoorn; **F.** Male, light color, Oudtshoorn; **G.** Male, brown marking, Richmond; **H.** Male, light color, Ceres; **I.** Female, light color, Wiedouw; **J.** Male, brown marking, Nietgenaamd; **K.** Male, light color, Nietgenaamd; **L.** Female, dark brown, Nietgenaamd. A–L. **Scale bars:** 1 mm.



**Figure 11.** A–L *Hadroca hapsistylis* sp. nov., male, female and nymph, habitus images and hind wings with specimen localities. **A.** Male, Ladismith, dorsally; **B.** Male, Oudtshoorn, dorsally; **C.** Male, laterally, Warmwaterberg; **D.** Female, laterally, Wiedouw; **E.** Male, Ceres, hind wing; **F.** Female, Oudtshoorn, hind wing; **G.** Nymph, Oudtshoorn; **H.** Nymph, Wiedouw; **I.** Nymph, Nietge-naamd; **J.** Nymph, Oudtshoorn, large; **K.** Nymph, Oudtshoorn, medium; **L.** Nymph, Oudtshoorn, small. A–L. Scale bars: 1 mm.



**Figure 12.** A–F *Hadroca hapsistylis* sp. nov., male, female and nymph, face and terminalia images with specimen localities. A. Male, genital capsule, laterally, Richmond; B. Male, face, Richmond; C. Male, face, Warmwaterberg; D. Sternite VII, Wiedouw; E. Sternite VII, New Bethesda; F. Sternite VII, Oudtshoorn.

**Hind wing.** Reduced, rectangular (Fig. 11E), length/width 2.1–2.5, length 0.4–0.6 mm long, width 0.2–0.3 mm.

**Female. Tegmina.** Submacropterous, not extended beyond apex of abdomen (Fig. 10I, K), brachypterous in Fig. 10 L, length/width 1.6–2.0, length 1.3–1.9 mm, width 0.8–1.0 mm; posterior margin broadly rounded.

**Hind wing.** Reduced (Fig. 11F), elongate, length/width 2.0–2.7, length 0.4–0.7 mm, width 0.2–0.3 mm.

**Chaetotaxy.** AV 6–8 setae, IC 8–12 setae.

**Measurements. Male.** (n=150). Apex of crown to apex of tegmina 1.95–2.45 mm; apex of crown to apex of abdomen 2.12–2.89 mm; crown length 0.32–0.43 mm; crown length next to eye 0.24–0.31 mm; pronotum length 0.29–0.36 mm; head width 0.90–1.08 mm; pronotum width 0.89–1.03 mm; ocellus diameter 22–29  $\mu$ m; interocular distance 97–122  $\mu$ m; crown angle 101–110°; crown length/crown length next to eye 1.29–1.45; head width/pronotum width 1.00–1.06; ocellus diameter/interocular distance 0.19–0.28; crown length/pronotum length 1.10–1.25; pronotum length/pronotum width 0.32–0.35; crown length/head width 0.35–0.41; crown length/pronotum width 0.36–0.43; length to tegmina/length to abdomen 0.81–0.93.

**Female.** (n=119). Apex of crown to apex of tegmina 2.26–2.80 mm; apex of crown to apex of abdomen 2.68–3.31 mm; crown length 0.37–0.49 mm; crown length next to eye 0.27–0.34 mm; pronotum length 0.31–0.41 mm; head width 0.99–1.22 mm; pronotum width 0.97–1.16 mm; ocellus diameter 22–29  $\mu$ m; interocular distance 104–136  $\mu$ m; crown angle 101–108°; crown length/crown length next to eye 1.31–1.47; head width/pronotum width 1.01–1.07; ocellus diameter/interocular

distance 0.18–0.25; crown length/pronotum length 1.12–1.30; pronotum length/pronotum width 0.31–0.36; crown length/head width 0.36–0.41; crown length/pronotum width 0.37–0.43; length to tegmina/length to abdomen 0.79–0.90.

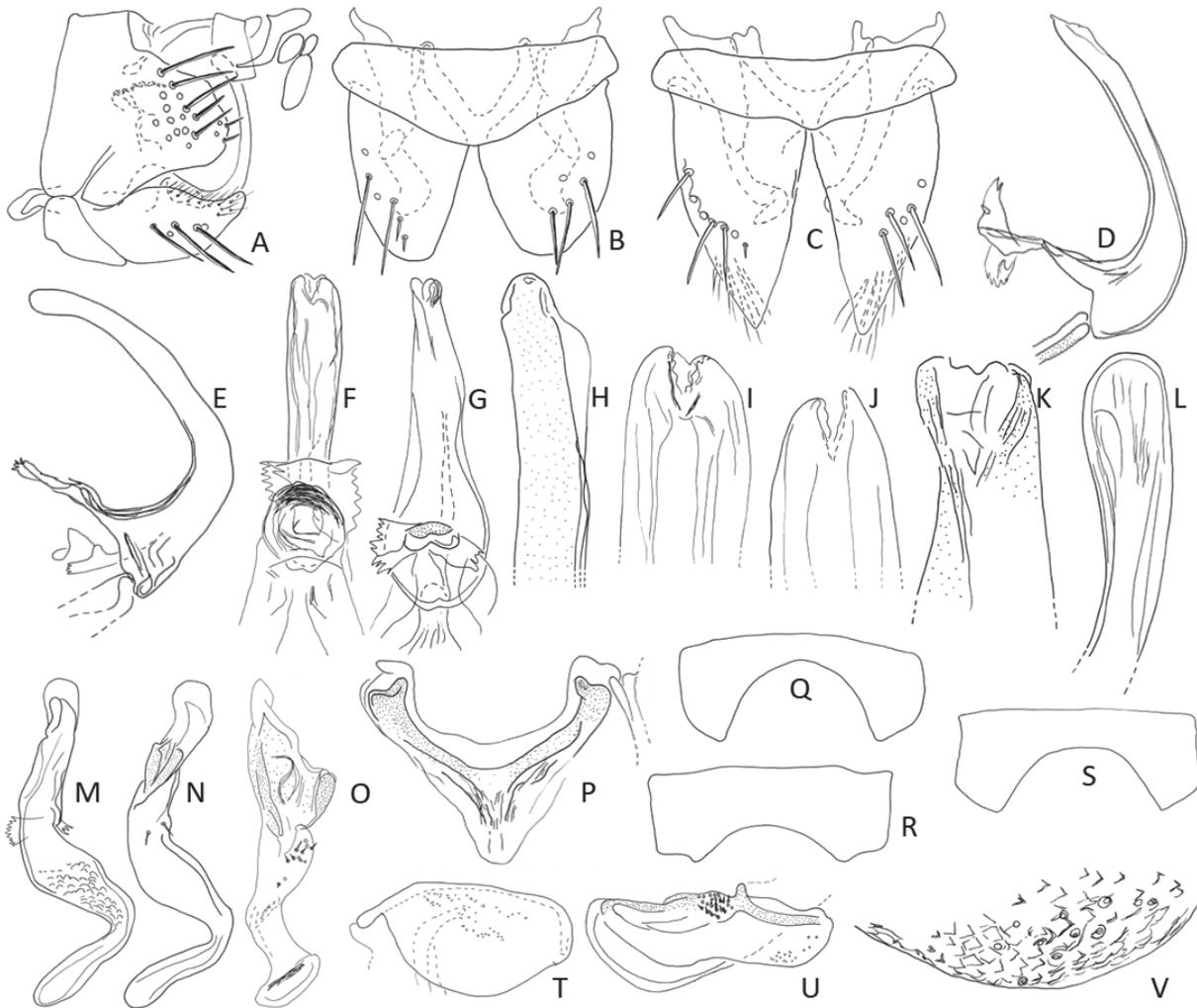
**Terminalia. Male.**

**Aedeagus.** Shaft edentate, widely curvate (Fig. 13D, E), apex wider or narrower than medially (Fig. 13F, G), gonopore narrow, V-shaped (Fig. 13H, I, M, N). Shaft of Graaf Reinet specimens minutely papillose, otherwise glabrous. Curvature depicted by segment defined by chord and height 139–151°. In lateral view, area 13–23  $\mu$ m<sup>2</sup>, perimeter 1.138–1.969 mm; greatest straight line length from atrium to apex of dorsal apodeme/greatest straight line length from atrium to apex of shaft 0.35–0.42.

**Style.** Elongate, narrow, preapical lobe reduced, apophysis elongated, arched dorsad, apex directed posteroventrad, arch in situ vertical or partially lateral, fine denticulation ventrolaterally on base of arch. Length greatest/width greatest 2.96–3.93 (Fig. 13B, C, ventrally, in situ, M, N, laterally, O, dorsally); length apophysis/length to apex medial arm 0.66–1.15. Arched apophysis sometimes visible in open genital capsule (Fig. 12A).

**Connective.** Wider than long, stem very short (length stem/length arms 0.44–0.82), narrow, apex variable, well or poorly sclerotized; arms widely separated, length greatest/width greatest 0.66–0.90 (Fig. 13P). In anterior view with apices of arms angled dorsad.

**Subgenital plate.** Apex variable, either rounded or acute, desclerotized or uniformly sclerotized, sometimes dorsoapical margin with fine, long setae; lateral margin



**Figure 13.** A–V *Hadroca hapsistylis* sp. nov., male and female, terminalia, line drawings with specimen localities. **A.** Genital capsule, laterally, Ladismith; **B.** Subgenital plate, Ladismith; **C.** Subgenital plate, Theronsberg; **D.** Aedeagus, laterally, Brakwater; **E.** Aedeagus, laterally, Ladismith; **F.** Aedeagus, dorsally, Ladismith; **G.** Aedeagus, dorsally, Brakwater; **H.** Aedeagus, apex, dorsally, Ladismith; **I.** Aedeagus, apex, ventrally, Ladismith; **J.** Aedeagus, apex, dorsally, Brakwater; **K.** Aedeagus, apex, dorsally, Ladismith; **L.** Aedeagus, apex, laterally, Ladismith; **M.** Style, laterally, Brakwater; **N.** Style, medially, Brakwater; **O.** Style, dorsally, Ladismith; **P.** Connective, Brakwater; **Q.** Sternite VII, Oudtshoorn; **R.** Sternite VII, Nietgenaamd; **S.** Sternite VII, Brakwater; **T.** Valvifer 1, Warmwaterberg; **U.** Valvifer 2, Wiedouw; **V.** Valvifer 2, sculpture, Wiedouw.

convex. Length to width 1.1–1.6, 4–6 macrosetae, length 84–149  $\mu\text{m}$ ; angle at apex of subgenital plate, by trigonometry 31–42° (Fig. 13B, C).

**Pygofer lobe.** In lateral view about as long as wide (length/width 0.9–1.2), lobe slightly narrower than basal width of pygofer, posterior margin of lobe rounded. Macrosetae 141–205  $\mu\text{m}$  long (Fig. 13A).

#### Female.

**Sternite VII.** Narrow, transversely rectangular, with wide deep or shallow rounded notch (Figs 12D–F, 13Q–S). Posterior margin with lateral length/medial length 1.8–3.6, transversely rectangular (length/width 0.4), posterior margin with wide recess (notch width/sternite VII greatest width 0.6–0.7).

**Valvula 3.** Macrosetae length 16–30  $\mu\text{m}$  (Fig. 14H).

**Valvula 2.** Basally trough and crest denticulate (Fig. 14E, F), apex denticulate dorsally (Fig. 14F).

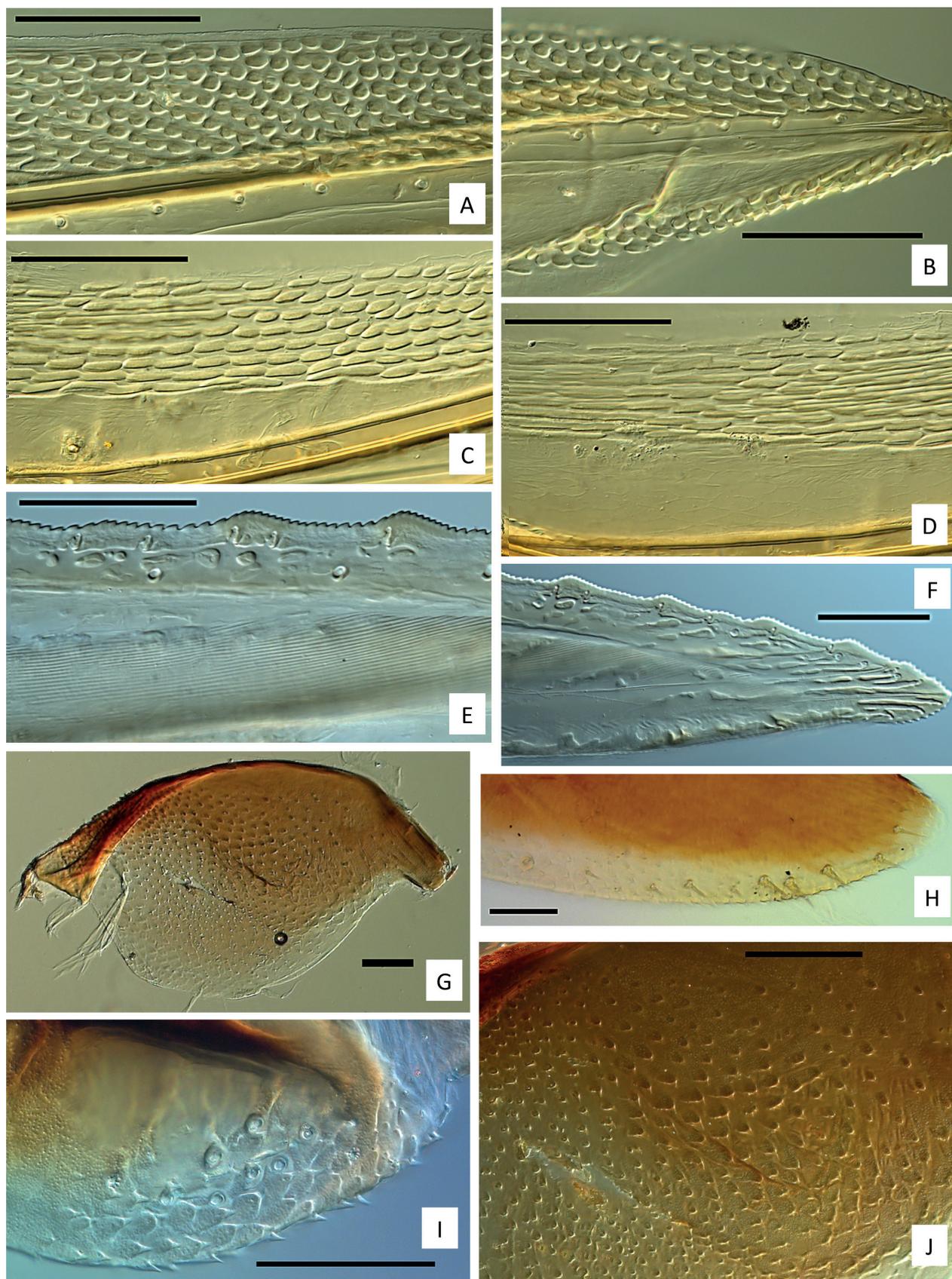
**Valvula 1.** Sculpture granulose distally, strigate basally (Fig. 14A–D).

**Valvifer 2.** Length/width 1.6–2.1 (Fig. 13U). Sculpture as in Figs 13V, 14I.

**Valvifer 1.** Length/width 2.6–2.9 (Figs 13T, 14G), extensively sculptured (Fig. 14J).

**Material examined. Type locality.** Holotype male, South Africa, Western Cape province Oudtshoorn 5 km south, –33.649, 22.222, 5 May 2015, M. Stiller leg., DVac, *Pteronia ?succulenta*, Asteraceae, CCDL26403, SANC, BMNH, INHS.

**Type specimen. Holotype** male, glued to triangle card, pinned, with genitalia in microvial pinned to specimen. Original label “R.S.A. Oudts- | hoorn 5km S | –33.64904 22.22212 | 5.v.2015 | M. Stiller leg. || DVac | *Pteronia* | ?*succulenta* | Asteraceae || SANC Pretoria | Database No. | CCDL26403”.



**Figure 14.** A–J *Hadroca hapsistylis* sp. nov., ovipositor images. **A.** Valvula 1, subapically; **B.** Valvula 1, apically; **C.** Valvula 1, subbasally; **D.** Valvula 1, basally; **E.** Valvula 2, subbasally; **F.** Valvula 2, apically; **G.** Valvifer 1; **H.** Valvula 3, apically; **I.** Valvifer 2, sculpture; **J.** Valvifer 1, texture, medially. A–J. Scale bars: 100  $\mu$ m.

**Paratypes.** 234♂♂, 164♀♀, 92 nymphs, total specimens 491.

**Remarks.** This was the smallest of the known species of *Hadroca*, with similarly wide range of color patterns as in *H. ramosa*, i.e., ochraceous, stramineous, light green to yellow green. Most characteristic was the long and strongly arched apophysis of the style, and orientation medioventrad in 16 dissected specimens and ventrad in 15, possibly due to displacement during maceration. Measurements of parts of the style were complicated by the obscure distinction between the base of the apophysis and medial part of the style and the true width that was influenced by the arch of the apophysis. In other species of *Hadroca* the preapical lobe, whether ventral or lateroventral, marked this intersection. The subgenital plate was more variable than in other species of *Hadroca*. The apex in 69 examined specimens was clearly desclerotized in 12, weakly desclerotized or weakly pigmented in 12 and sclerotized in 45. The apex was acute in 44, broadly rounded in 5, and narrowly rounded in 20. No apparent correlation was recognized between color, subgenital plate, locality or associated plant. Some correlation was present in the rounded apex of the subgenital plate and the longer valve, and the acute apex of the subgenital and the shorter valve. The connective of this species was wider than long with a short, variably sclerotized stem. The aedeagal shaft was commonly smooth, but papillose in Graaf Reinet specimens.

The valvifer I was uniform in all examined specimens. The shape of the posterior margin of the female sternite VII varied in depth of the notch, but consistently wide and rounded, and the sternite wider than long.

Associated plants in 20 out of 50 records, were *Eriocephalus* sp., *Euryops ?oligoglossus*, *Felicia ?filifolia*, *Helichrysum tricostatum*, *Pentzia incana*, *Pentzia* sp., *Pteronia incana*, *P. paniculata*, *Pteronia* sp., *Rosenia* sp., Asteraceae, *Phylica cryptandroides*, *P. oleaefolia*, Rhamnaceae and *Zygophyllum* sp. Zygophyllaceae. Map of potential natural distribution in Fig. 26C with large red circles indicating point distributions.

### *Hadroca bualacauda* sp. nov.

<https://zoobank.org/2D103BDA-95C5-4CBE-ABDE-170CA5F57842>  
Figs 15–18, 26D

### Diagnosis.

1. Tegmina macropterous, posterior margin with narrow, acuminate extension, light brown, oblique band medially.
2. Aedeagal shaft short, strongly curvate, preatrium reduced.
3. Style apophysis in dorsal view sublinear, in lateral view short, apex curved ventrad.
4. Subgenital apex equidistant to apex of pygofer lobe.

5. Female sternite VII posterior margin with short, wide ligula, recessed in deep or shallow V-shaped, wide notch.

**Etymology.** Named in Latin, for the large specimen with the wing tail, *bu-*, prefix meaning large, *ala*, wing, *cauda*, tail, gender feminine.

**Color. Male, female & nymph.** Dorsum usually unmarked. Tegmina with some cells whitish, sometimes with brown reticulation, distally embrowned, veins light brown (Fig. 15A–C). Face unmarked (Fig. 15E). Nymph color as in Fig. 15D with abdomen darker than head, pronotum and thorax.

**Morphology. Male. Tegmina.** Macropterous (Fig. 15A, C), (length/width 2.9–3.2, length 4.1–4.8 mm, width 1.34–1.5 mm); posterior margin narrowly extended with numerous cross veins (Figs 15A, C, 18R).

**Hind wing.** Reduced (Fig. 18O), elongate (length/width 3.4–4.0, male 2.9–3.5 mm long, 0.8–1.0 mm wide).

**Female. Tegmina.** Macropterous (Fig. 15B), length/width 2.9–3.3, length 4.3–5.1 mm, width 1.4–1.6 mm; posterior margin narrowly extended with numerous cross veins (Figs 15B, 18R).

**Hind wing.** Reduced (Fig. 18P), elongate, length/width 3.4–4.0, length 3.2–3.8 mm, width 0.9–1.0 mm.

**Chaetotaxy.** AV 9–14, IC 8–10, single AV<sub>1</sub> seta. (Fig. 15G, H).

**Measurements. Male.** (n=41). Apex of crown to apex of tegmina 5.02–5.95 mm; apex of crown to apex of abdomen 3.87–4.63 mm; crown length 0.52–0.61 mm; crown length next to eye 0.34–0.40 mm; pronotum length 0.58–0.67 mm; head width 1.67–1.81 mm; pronotum width 1.63–1.82 mm; ocellus diameter 24–40 μm; interocular distance 175–207 μm; crown angle 111–117°; crown length/crown length next to eye 1.46–1.62; head width/pronotum width 0.99–1.04; ocellus diameter/interocular distance 0.12–0.21; crown length/pronotum length 0.83–0.97; pronotum length/pronotum width 0.35–0.38; crown length/head width 0.30–0.35; crown length/pronotum width 0.31–0.35; length to tegmina/length to abdomen 1.24–1.35.

**Female.** (n=63). Apex of crown to apex of tegmina 5.51–6.49 mm; apex of crown to apex of abdomen 4.57–5.23 mm; crown length 0.56–0.63 mm; crown length next to eye 0.37–0.41 mm; pronotum length 0.64–0.72 mm; head width 1.76–1.92 mm; pronotum width 1.74–1.93 mm; ocellus diameter 25–36 μm; interocular distance 188–227 μm; crown angle 111–117°; crown length/crown length next to eye 1.44–1.61; head width/pronotum width 0.98–1.02; ocellus diameter/interocular distance 0.12–0.18; crown length/pronotum length 0.82–0.94; pronotum length/pronotum width 0.36–0.38; crown length/head width 0.31–0.34; crown length/pronotum width 0.30–0.35; tegmina/length to abdomen 1.18–1.28.

**Terminalia. Male.**

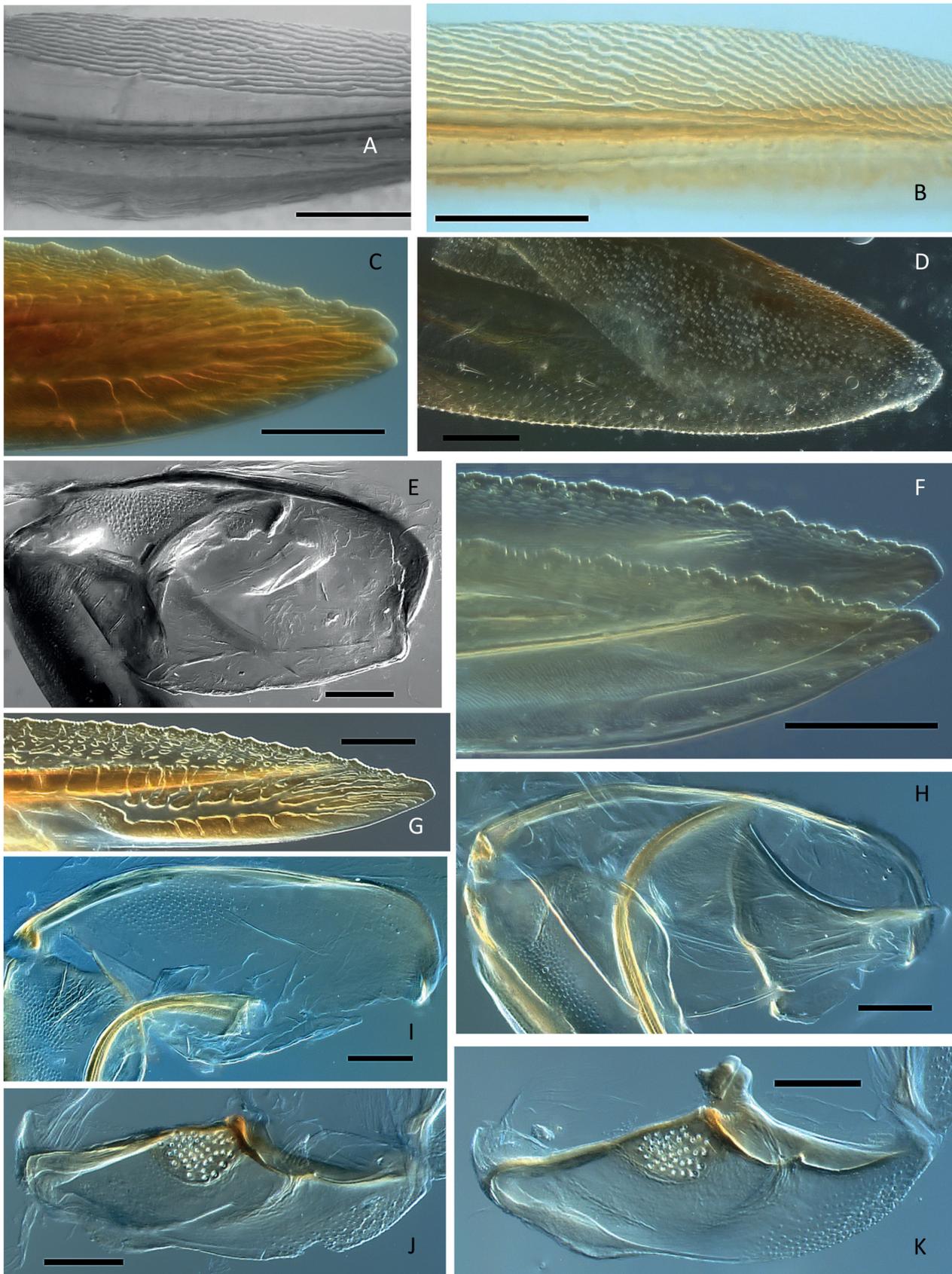


**Figure 15.** A–H *Hadroca bualacauda* sp. nov., male, female and nymph, habitus images, face, terminalia and profemur. **A.** Male, dorsally, Dwarsrivier; **B.** Male, dorsally, Biesiesfontein; **C.** Male, laterally, Gifberg; **D.** Nymph, dorsally, Dwarsrivier; **E.** Face, Biesiesfontein; **F.** Sternite VII, Garies; **G.** Profemur, Tulbagh; **H.** Caps, i.e., Profumur, Gifberg. A–D. Scale bars: 1 mm.

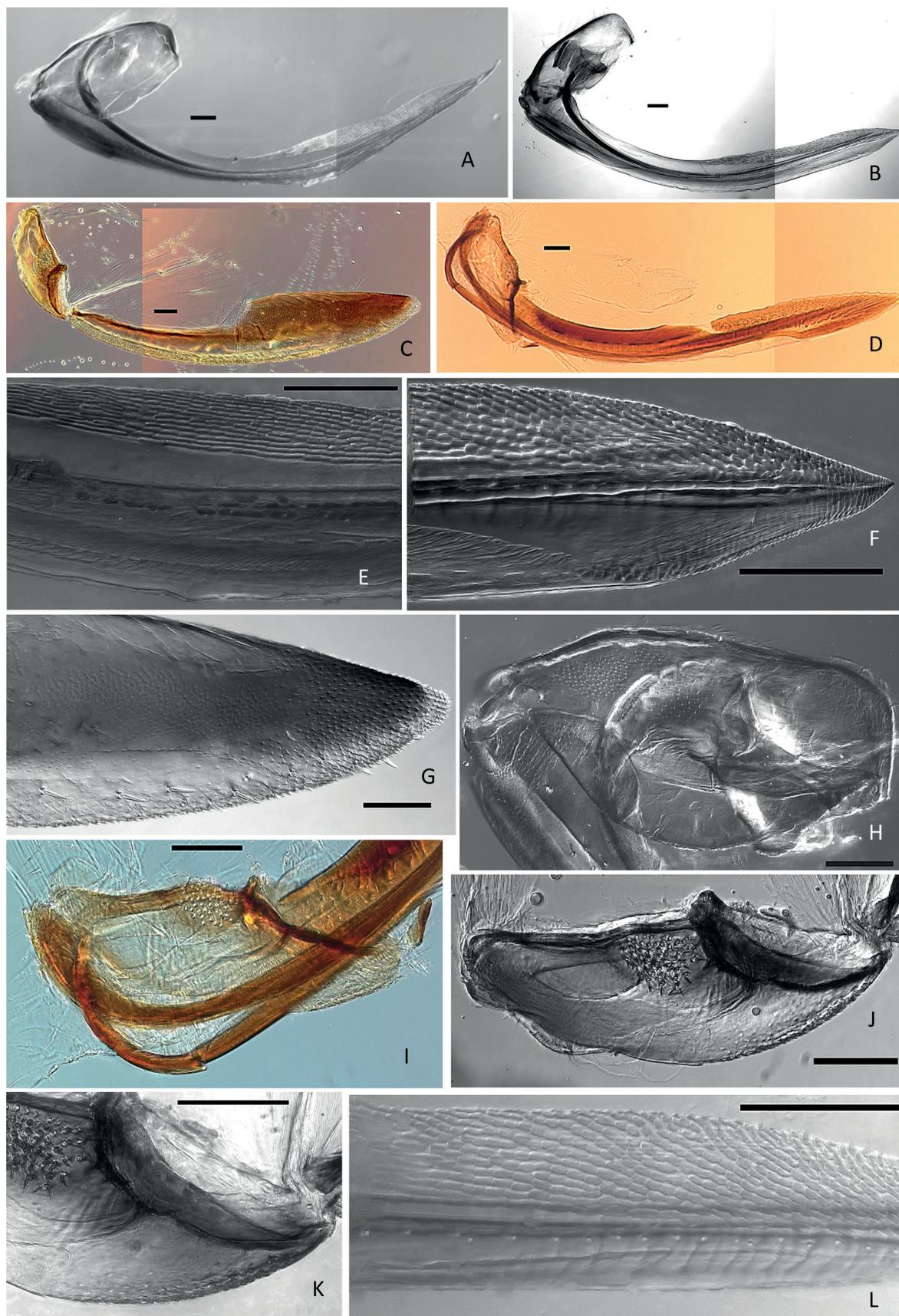
**Aedeagus.** Shaft edentate, narrowly curvate (Fig. 18E, F), segment angle  $175\text{--}189^\circ$ , short, apically narrower than medially, gonopore circular, anteriad (Fig. 18G), rarely extended posteriad, shallow in Van Rhynsdorp specimen, deeply in Dwarsrivier specimen (Fig. 18I). Curvature depicted by segment defined by chord and height  $167\text{--}181^\circ$ . In lateral view, area  $28\text{--}44$

$\mu\text{m}^2$ , perimeter  $1.142\text{--}1.742$  mm; greatest straight line length from atrium to apex of dorsal apodeme/greatest straight line length from atrium to apex of shaft  $0.39\text{--}0.50$ .

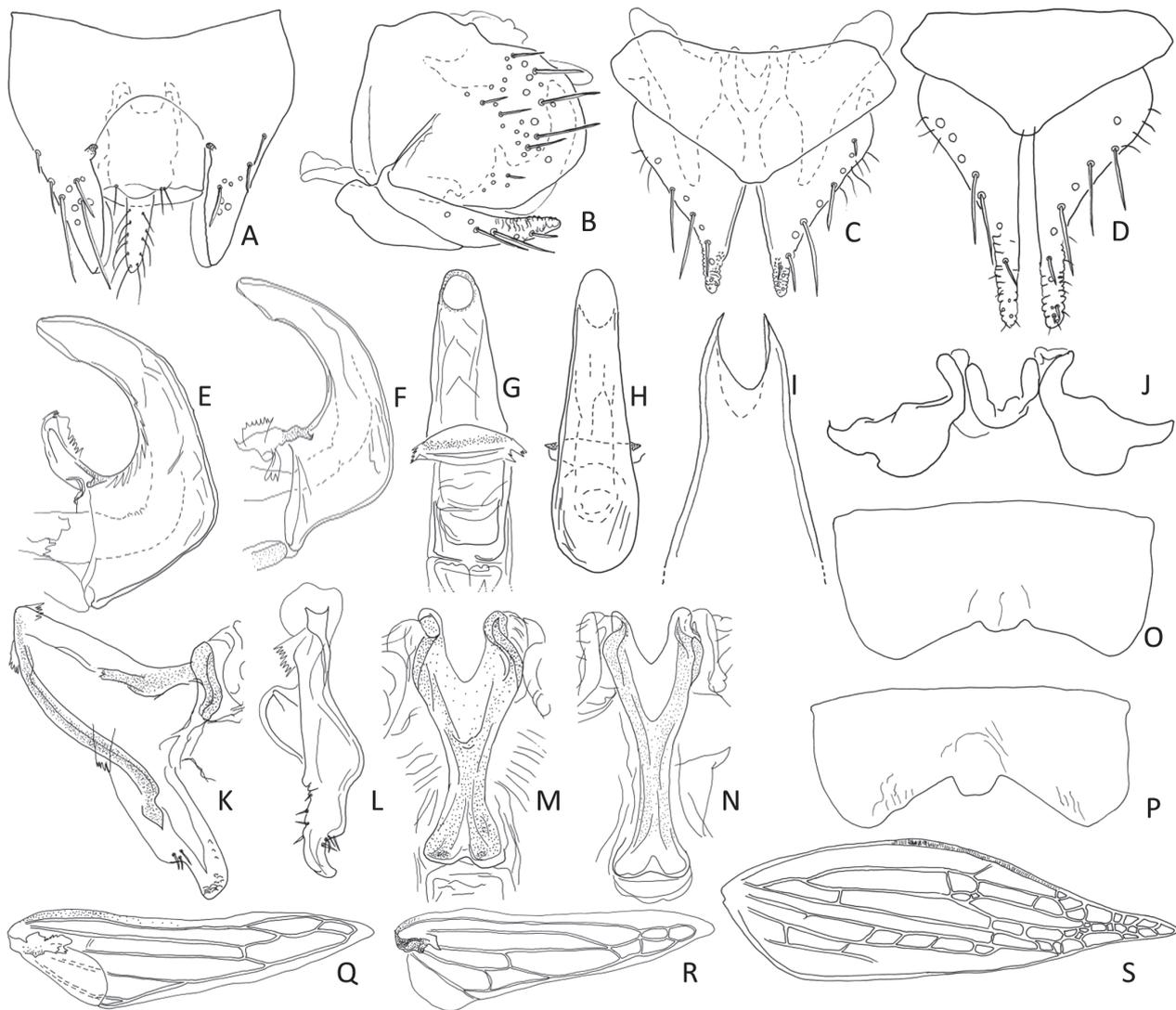
**Style.** Apophysis short (length apophysis/length greatest  $0.1\text{--}0.2$ ), straight, length greatest/width greatest  $1.5\text{--}1.9$  (Fig. 18K, L).



**Figure 16.** A–K *Hadroca bualacauda* sp. nov., ovipositor images with specimen localities. **A.** Valvula 1, subbasally, Biesiesfontein; **B.** Valvula 1, subapically, Biesiesfontein; **C.** Valvula 2, apically, Biesiesfontein; **D.** Valvula 3, apically, Garies; **E.** Valvifer 1, Biesiesfontein; **F.** Valvula 2, immaculate, apically, Garies; **G.** Valvula 2, sculptured, apically, Garies; **H.** Valvifer 1, left, Garies; **I.** Valvifer 1, right, Garies; **J.** Valvifer 2, left, Garies; **K.** Valvifer 2, right, Garies. A–K. Scale bars: 100 µm.



**Figure 17.** A–L *Hadroca bualacauda* sp. nov., ovipositor images with specimen localities. **A.** Valvula 1, narrow apex, Biesiesfontein; **B.** Valvula 1, wide apex, Biesiesfontein; **C.** Valvula 3 with valvifer 2, Biesiesfontein; **D.** Valvula 2 with valvifer 2, Biesiesfontein; **E.** Valvula 1, sculpture, medially, Biesiesfontein; **F.** Valvula 1, sculpture, apically, Biesiesfontein; **G.** Valvula 3, apically, Biesiesfontein; **H.** Valvifer 1, Biesiesfontein; **I.** Valvifer 2, Biesiesfontein; **J.** Valvifer 2, Biesiesfontein; **K.** Valvifer 2, sculpture, Biesiesfontein; **L.** Valvula 1, sculpture, subapically, Biesiesfontein. A–L. Scale bars: 100 µm.



**Figure 18.** A–S *Hadroca bualacauda* sp. nov., male and female terminalia, line drawings with specimen localities. **A.** Genital capsule, dorsally, Hermon; **B.** Genital capsule, laterally, Hermon; **C.** Subgenital plate, Hermon; **D.** Subgenital plate, Dwarsrivier; **E.** Aedeagus, laterally, Piketberg; **F.** Aedeagus, laterally, Faure; **G.** Aedeagus, dorsally, Faure; **H.** Aedeagus, posteriorly, Dwarsrivier; **I.** Aedeagus, apex, posteriorly, Dwarsrivier; **J.** Styles and connective, anteriorly, Dwarsrivier; **K.** Style, dorsally, Cape Flats; **L.** Style, laterally, Biesiesfontein; **M.** Connective, Wolseley; **N.** Connective, Tulbagh; **O.** Sternite VII, Biesiesfontein; **P.** Sternite VII, Garies; **Q.** Hind wing, female, Biesiesfontein; **R.** Hind wing, male, Biesiesfontein; **S.** Tegmina, female, Biesiesfontein.

**Connective.** Longer than wide, stem longer or shorter than arms (length stem/length arms 1.0–1.5), length greatest/width greatest 2.0–2.7 (Fig. 18M, N).

**Subgenital plate.** Lateral margin concave, apex narrow, variably elongated, densely rugulose; length/width 1.3–1.9, 4–8 macrosetae, length 44–183  $\mu\text{m}$ ; angle at apex of subgenital plate, by trigonometry 29–37° (Fig. 18C, D).

**Pygofer lobe.** In lateral view longer than greatest width (length/width 1.1–1.4), posterior margin rounded. Macrosetae 44–178  $\mu\text{m}$  long (Fig. 18B).

#### Female.

**Sternite VII.** Rectangular, with short, narrow ligula (length/width 0.2–0.6), recessed in deep or shallow, wide, V-shaped posterior margin (Figs 15F, 18O, P). Posterior margin slightly recessed (lateral length/medial length 1.1–1.2), transversely rectangular (length/width 0.4–0.5),

posterior margin with wide recess (notch width/sternite VII greatest width 0.6–0.7).

**Valvula 3.** Whole part in Fig. 17C. Macrosetae length 22–38  $\mu\text{m}$ , 1–2 irregular rows (Figs 16D, 17G).

**Valvula 2.** Whole part in Fig. 17D. Distally serrate (Fig. 16C, F, G), base sclerotized, desclerotized area medially between apex and base.

**Valvula 1.** Whole part in Fig. 17A, B. Sculpture apically granulose (Fig. 17F) and basally strigate (Figs 16A, B, 17E, L).

**Valvifer 2.** Length/width 2.5–2.9, sculpture small triangular scales (Figs 16J, K, 17I–K).

**Valvifer 1.** Length/width 1.8–2.2, distal margin blunt (Figs 16E, H, I, 17H).

**Material examined. Type locality.** Holotype male. South Africa, Northern Cape province, Biesiesfontein Farm south Springbok, –29.75, 17.93, 29 Sep.–3 Oct.

2002, 710 m, M. Stiller leg., sweeping, *Pteronia divariculata*, Asteraceae, CCDL18292, SANC.

**Type specimen.** *Holotype* male, glued to triangle card, pinned, with genitalia in microvial pinned to specimen. Original label “South Africa | Northern Cape | Province | Biesiesfontein | Farm S Springbok | 29°45’S, 17°56’E | 29.ix.–3.x.2002 | 710 m M. Stiller | swept off | *Pteronia* | *divariculata* | Asteraceae | SANC – Pretoria | Database No. | CCDL18292”.

**Paratypes.** 59♂♂, 84♀♀, 39 nymphs, 183 total specimens.

**Remarks.** This species was larger than the other species of *Hadroca*, and with an acuminate extension at the posterior margin of the tegmina. *Hadroca alacaudella* sp. nov. also had a similar extension of the tegmina, but was much narrower and shorter. Differences are elucidated under the remarks section of *H. alacaudella* sp. nov. Variability in the aedeagus of *H. bualacauda* sp. nov. was confined to the degree of taper of the shaft in lateral view, and generally appeared to be thicker than in other species of *Hadroca*. The subgenital plate was more variable in the length of the apex, as in Fig. 18C, D. The depth of the notch in the female sternite was variable, as in Fig. 18O, P. The acuminate extension of the tegmina had more cross veins (Fig. 18S) than in *H. alacaudella* sp. nov. (Fig. 23P). Point distribution and potential natural distribution are in Fig. 26D. Twenty two records were without an associated plant, and 17 records had the following plant associations (family, genus, species):

Anacardiaceae, *Searsia undulata*; Asteraceae: *Berkheya canescens*, *Dimorphotheca cuneata*, *Eriocephalus africanus*, *E. punctulatus*, *E. racemosus*, *E. umbellulatus*, *Euryops multifidus*, *Gorteria personata*, *Pentzia* sp., *Pteronia divariculata*; Aizoaceae, *Galenia africana*; Ebenaceae, *Diospyros ramulosa*; Fabaceae, *Wiborgia mucronata* Menispermaceae, *Antizoma miersiana*. However, the only record with some adults and numerous nymphs was on *Dimorphotheca cuneata* which is widely distributed in drier parts of southern Africa (<https://posa.sanbi.org.Explore>, accessed 16 Jun. 2022).

### *Hadroca alavittata* sp. nov.

<https://zoobank.org/4AC8DDF1-ADB2-4A95-92F2-25B8C5E28F0C>  
Figs 19–21, 26E

### Diagnosis.

1. Tegmina submacropterous, posterior margin rounded, light brown, oblique band medially.
2. Aedeagal shaft elongate, curvate, preatrium reduced.
3. Style apophysis in dorsal view curvate laterad, in lateral view short, apex with slight ventral curvature.
4. Subgenital apex extended beyond posterior margin of pygofer lobe.
5. Female sternite VII posterior margin sinuous.

**Etymology.** Named in Latin for the brown V-shaped band across the tegmina, *ala*, wing, *vittata*, ribbon, band, gender feminine.

**Color. Male & female.** Crown with paired, transverse, light brown marks apically, medially and subbasally, pronotum with some marks (Fig. 19A–E, H). Face in male (Fig. 20C) and female (Fig. 19J) with 3–4 wide, dark brown arcs distally, face basally pale ochraceous, with amorphous small spots in clypellus and genae. Tegmina with brown veins and reticulation within cells, medially with oblique V-shaped, dark brown band across both tegmina (Figs 19A–F, H, 20A, B).

**Morphology. Male. Tegmina.** Submacropterous (Fig. 19B, D, E), about as long as abdomen, (length/width 1.5–1.7, length 1.7–2.0 mm, width 1.1–1.2 mm); posterior margin broadly rounded (Fig. 19B, D, E).

**Hind wing.** Reduced (Fig. 21P), elongate (length/width 3.4–4.0, length 2.9–3.5 mm, width 0.8–1.0 mm).

**Female. Tegmina.** Submacropterous (Figs 18A, C, F, H, 20, A, B), about as long as abdomen, (length/width 1.6–1.7, length 2.0–2.2 mm, width 1.2–1.3 mm); posterior margin broadly rounded (Fig. 19A, C, H).

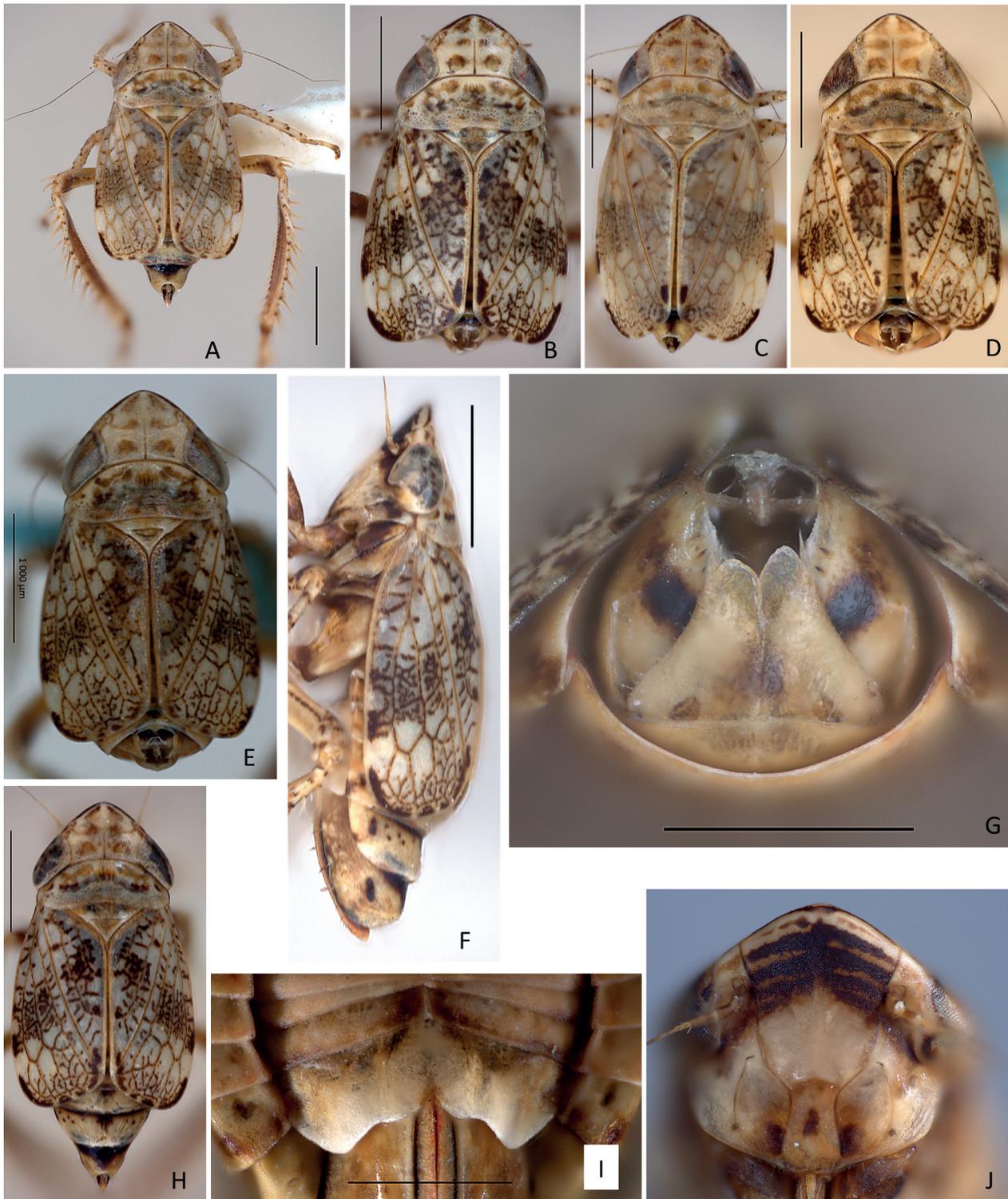
**Hind wing.** Reduced (Fig. 21P), elongate (length/width 3.4–4.0, length 3.2–3.8 mm, width 0.9–1.0 mm).

**Chaetotaxy.** AV 7–9, IC 9–11.

**Measurements. Male.** (n=39) Apex of crown to apex of tegmina 2.70–2.98 mm; apex of crown to apex of abdomen 2.82–3.24 mm; crown length 0.52–0.56 mm; crown length next to eye 0.35–0.38 mm; pronotum length 0.42–0.45 mm; head width 1.28–1.34 mm; pronotum width 1.23–1.30 mm; ocellus diameter 26–39 µm; interocular distance 98–121 µm; crown angle 99–103°; crown length/crown length next to eye 1.43–1.51; head width/pronotum width 1.02–1.05; ocellus diameter/interocular distance 0.23–0.36; crown length/pronotum length 1.19–1.29; pronotum length/pronotum width 0.33–0.35; crown length/head width 0.40–0.43; crown length/pronotum width 0.41–0.44; length to tegmina/length to abdomen 0.89–0.98.

**Female.** (n=32) Apex of crown to apex of tegmina 3.08–3.34 mm; apex of crown to apex of abdomen 3.53–4.08 mm; crown length 0.56–0.60 mm; crown length next to eye 0.38–0.41 mm; pronotum length 0.45–0.48 mm; head width 1.38–1.44 mm; pronotum width 1.33–1.40 mm; ocellus diameter 28–42 µm; interocular distance 110–130 µm; crown angle 99–103°; crown length/crown length next to eye 1.43–1.51; head width/pronotum width 1.02–1.05; ocellus diameter/interocular distance 0.23–0.36; crown length/pronotum length 1.21–1.29; pronotum length/pronotum width 0.33–0.35; crown length/head width 0.40–0.42; crown length/pronotum width 0.41–0.44; length to tegmina/length to abdomen 0.78–0.91.

**Terminalia. Male. Aedeagus.** Shaft widely curvate, segment angle 127–134°, apically wider than medially, gonopore v-shaped anteropostriad (Fig. 21G, H). Curvature depicted by segment defined by chord and height 127–134°. In lateral view, area 31–36 µm<sup>2</sup>, perimeter 1.863–2.771 mm (Fig. 21K, L); greatest straight line length from atrium to apex of dorsal apodeme/greatest straight line length from atrium to apex of shaft 0.31–0.46.

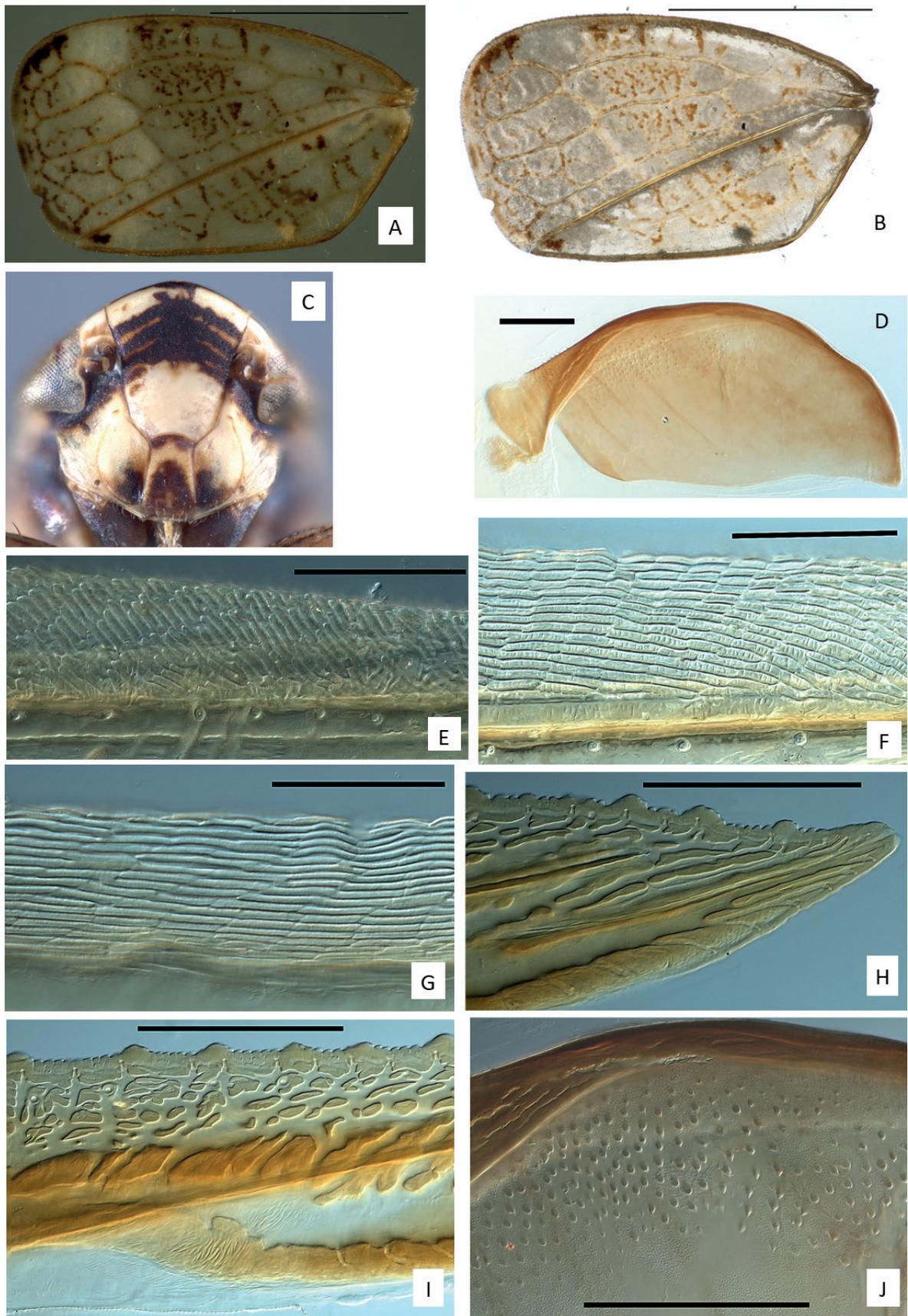


**Figure 19.** A–J *Hadroca alavittata* sp. nov., male and female, habitus images and terminalia with specimen localities. **A.** Female, dorsally, Swellendam; **B.** Male, dorsally, Graaf Reinet; **C.** Female, dorsally, Graaf Reinet; **D.** Male, dorsally, Swellendam; **E.** Male, dorsally, Swellendam; **F.** Female, laterally, Swellendam; **G.** Genital capsule, posteriorly, Graaf Reinet; **H.** Female, Swellendam; **I.** Sternite VII, Swellendam; **J.** Face, female, Swellendam. A–I. Scale bars: 1 mm.

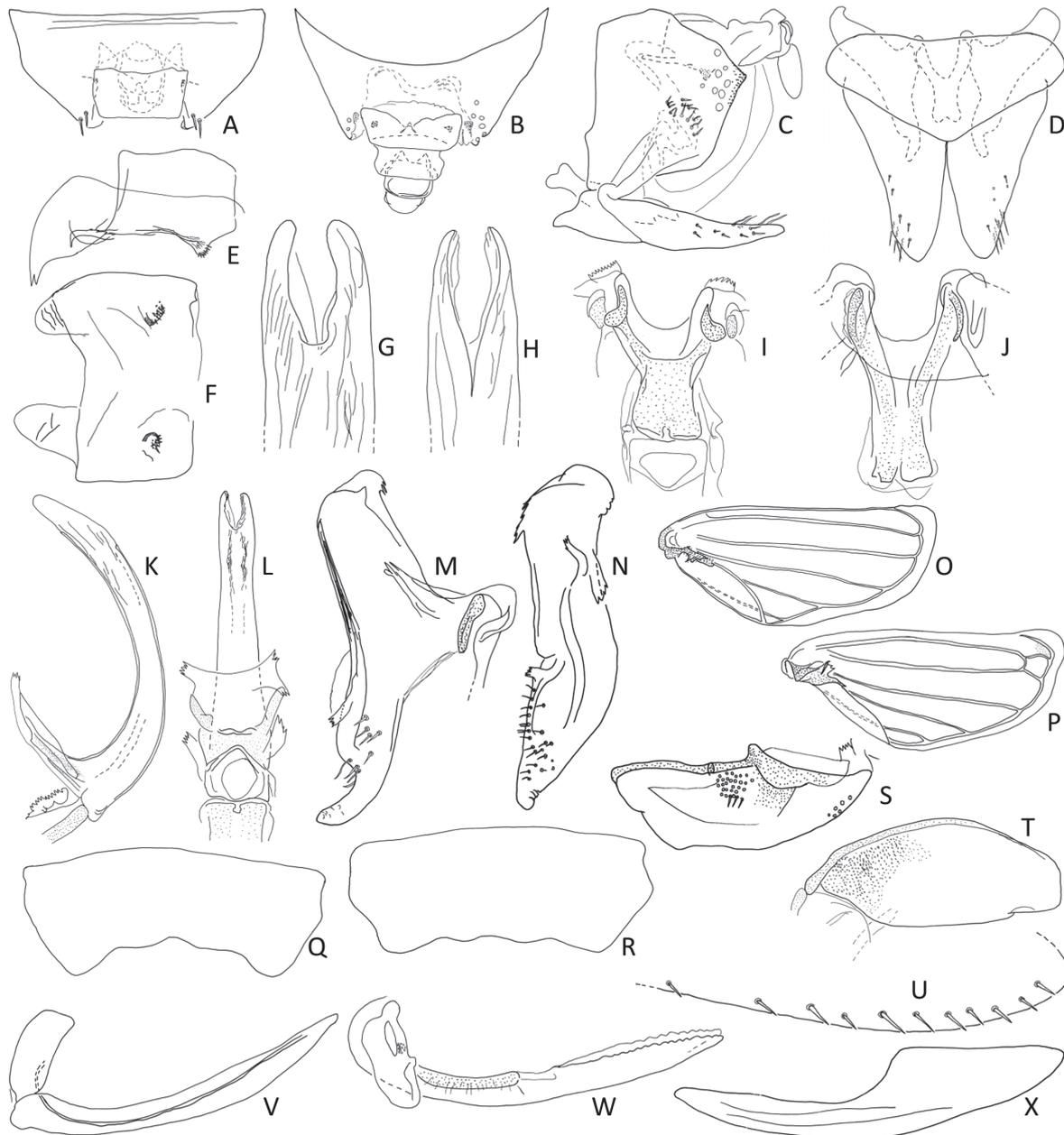
**Style.** Apophysis short (length apophysis/length greatest 0.1–0.2), curved or angled posterolaterad (Fig. 21M, N), in lateral or dorsolateral or ventrolateral view (Fig. 21N), required to distinguish ventrad curvature (as in Figs 8F, H, I 18L, 23H), length greatest/width greatest 1.7–1.9.

**Connective.** Longer than wide, stem longer or shorter than arms, (length stem/length arms 0.79–1.20), length greatest/width greatest 1.33–1.70 (Fig. 21I, J).

**Subgenital plate.** Triangular, apex narrowly rounded, length/width 1.4–1.6, macrosetae absent, fine, narrow setae subapically dorsally and on ventrolateral margin; apex



**Figure 20.** A–J *Hadroca alavittata* sp. nov., male and female, images, tegmina, face and ovipositor with specimen localities. **A.** Tegmina, reflected light, female, Swellendam; **B.** Tegmina, transmitted light, female, Swellendam; **C.** Face, male, Swellendam; **D.** Valvifer 1, Cradock; **E.** Valvula 1, subapically, Cradock; **F.** Valvula 1, medially, Cradock; **G.** Valvula 1, subbasally, Cradock; **H.** Valvula 2, apically, Cradock; **I.** Valvula 2, medially, Cradock; **J.** Valvifer 1, sculpture, Cradock. Scale bars: 1 mm (A, B), 100  $\mu$ m (D–J).



**Figure 21.** A–X *Hadroca alavittata* sp. nov., male and female terminalia, line drawings with specimen localities. **A.** Genital capsule, dorsally, Cradock; **B.** Genital capsule, dorsally, Swellendam; **C.** Genital capsule, laterally, Swellendam; **D.** Subgenital plate, ventrally, Graaf Reinet; **E.** Male tergite X, laterally, Swellendam; **F.** Male tergite X, ventrally, Swellendam; **G.** Aedeagus, apex, dorsally, Graaf Reinet; **H.** Aedeagus, apex, posteriorly, Graaf Reinet; **I.** Connective, Swellendam; **J.** Connective, Swellendam; **K.** Aedeagus, laterally, Swellendam; **L.** Aedeagus, dorsally, Swellendam; **M.** Style, dorsally, Swellendam; **N.** Style, laterodorsally, Swellendam; **O.** Hind wing, female, Swellendam; **P.** Hind wing, male, Swellendam; **Q.** Sternite VII, Graaf Reinet; **R.** Sternite VII, Swellendam; **S.** Valvifer 2, Graaf Reinet; **T.** Valvifer 1, Swellendam; **U.** Valvula 3, apex, Graaf Reinet; **V.** Valvula 1, Swellendam; **W.** Valvula 2, Graaf Reinet; **X.** Valvula 3, Graaf Reinet.

of subgenital plate extended beyond posterior margin of pygofer lobe, angle at apex of by trigonometry  $31\text{--}36^\circ$  (Figs 19G, 21D).

**Pygofer lobe.** In lateral view shorter than greatest width (length/width 0.6–0.8), posterior margin acute. Macrosetae 46–86  $\mu\text{m}$  long (Fig. 21C).

**Female.**

**Sternite VII.** Transversely rectangular, posterior margin sinuous with wide, shallow notch (Figs 19I,

21Q, R). Posterior margin sinuous with wide shallow or deep recess (lateral length/medial length 1.1–1.3), length/width 0.6–0.7, notch width/sternite VII greatest width 0.6–0.7.

**Valvula 3.** Macrosetae length 23–41  $\mu\text{m}$  (Fig. 21U, X).

**Valvula 2.** Apex serrate, fine teeth in trough, rounded teeth as in Figs 20H, I, 21W.

**Valvula 1.** Lanceolate (Fig. 21V), sculpture strigate (Fig. 20E–G).

**Valvifer 2.** Length/width 2.3–2.9 (Fig. 21S). Sculpture as in other species, e.g., Figs 13V, 14I.

**Valvifer 1.** Length/width 2.2–2.8 (Figs 20D, 21T), sculpture with microtrichia basally (Fig. 20J).

**Material examined. Type locality.** Holotype male, South Africa, Eastern Cape province, Cradock, –32.166, 25.616, 19 Jan. 1984, J.G. Theron leg., sweeping, *Asparagus* sp., Asparagaceae CCDL28305, SANC, BMNH, INHS.

**Type specimen. Holotype** male, glued to triangle card, pinned, with genitalia in microvial pinned to specimen. Original label “South Africa | Cradock | 19.i.1984 | J.G. Theron || *Asparagus* sp., Asparagaceae || SANC Pretoria | Database No. | CCDL28305”.

**Paratypes.** 39♂♂, 29♀♀, total specimens 68.

**Remarks.** The color pattern, especially of the head and tegmina, differentiated this species from the other species of *Hadroca*, although not always well developed. The face was also distinct. The male tergite X with the ventral paired process and the glabrous subgenital plate were unique. Least typical was the style with the compressed, laterally curved apophysis in dorsal view (Fig. 21M), and the apex with minimal ventral curvature in lateral view (Fig. 21N). The configuration of the aedeagus and its uniform sclerotization conforms to that of the species of *Hadroca*. It also appeared to be associated with wild asparagus. Modelled potential natural distribution is in Fig. 26E from eight records indicated by yellow squares.

#### *Hadroca alacaudella* sp. nov.

<https://zoobank.org/7B616E81-5391-46DF-885B-6069AF5AB8D9>

Figs 22, 23, 26E

#### Diagnosis.

1. Tegmina macropterous, posterior margin with narrow, dark brown, acuminate extension. Hind wing reduced.
2. Aedeagal shaft elongate, widely curvate, parallel-sided in lateral view, preatrium reduced.
3. Style apophysis in dorsal view sublinear, in lateral view short, apex curved ventrad.
4. Subgenital apex equidistant to apex of pygofer lobe.
5. Female sternite VII posterior margin sublinear.

**Etymology.** Named in Latin, for the small specimen with the wing tail, *ala*, wing, *cauda*, tail, diminutive suffix *-ella*, gender feminine.

**Color. Male, female & nymph.** Dorsum usually unmarked, ground color light brown. Tegmina smoky translucent, apex embrowned with numerous light brown veins (Fig. 22A–D). Nymph light brown, ochraceous narrow median line (Fig. 22E).

**Morphology. Male. Tegmina.** Macropterous (Figs 22A–D, L, K, 23P), (length/width 3.7–4.0, length 3.2–3.4 mm, width 0.8–0.9 mm); posterior margin narrowly extended with numerous cross veins (Fig. 22J, K).

**Hind wing.** Reduced (Fig. 21L), elongate (length/width 3.1–3.7, length 1.7–1.9 mm, width 0.5 mm).

**Female. Tegmina.** Macropterous, length/width 3.9–4.3, length 4.0–4.4 mm, width 1.0–1.1 mm; posterior margin narrowly extended with numerous cross veins (as in male, Fig. 22J, K).

**Hind wing.** Reduced, elongate, length/width 3.7–4.0, length 2.5–2.8 mm, width 0.7 mm (as in male, Fig. 22L).

**Chaetotaxy.** Male AV 7–9 setae, female AV 8–9 setae, male and female, IC 7–10 setae.

**Measurements. Male.** (n=8) Apex of crown to apex of tegmina 4.02–4.23 mm; apex of crown to apex of abdomen 2.80–2.94 mm; crown length 0.46–0.52 mm; crown length next to eye 0.30–0.32 mm; pronotum length 0.41–0.43 mm; head width 1.10–1.15 mm; pronotum width 1.05–1.09 mm; ocellus diameter 25–30 µm; interocular distance 116–132 µm; crown angle 95–101°; crown length/crown length next to eye 1.49–1.63; head width/pronotum width 1.04–1.06; ocellus diameter/interocular distance 0.19–0.24; crown length/pronotum length 1.09–1.23; pronotum length/pronotum width 0.38–0.40; crown length/head width 0.41–0.45; crown length/pronotum width 0.43–0.47; length to tegmina/length to abdomen 1.39–1.47.

**Female.** (n=20) Apex of crown to apex of tegmina 4.99–5.33 mm; apex of crown to apex of abdomen 3.71–4.01 mm; crown length 0.52–0.58 mm; crown length next to eye 0.34–0.38 mm; pronotum length 0.48–0.51 mm; head width 1.29–1.33 mm; pronotum width 1.23–1.28 mm; ocellus diameter 23–34 µm; interocular distance 140–153 µm; crown angle 97–103°; crown length/crown length next to eye 1.45–1.61; head width/pronotum width 1.03–1.06; ocellus diameter/interocular distance 0.16–0.24; crown length/pronotum length 1.06–1.17; pronotum length/pronotum width 0.38–0.40; crown length/head width 0.40–0.44; crown length/pronotum width 0.42–0.46; length to tegmina/length to abdomen 1.28–1.40.

#### Terminalia. Male.

**Aedeagus.** Shaft narrowly curvate, segment angle 144–157°, apically wider than medially, dorsal apodeme angled anteriorly, gonopore convoluted to V-shaped, subapically between anterior and posterior margin. In lateral view, area 38–44 µm<sup>2</sup>, perimeter 1.494–2.325 mm (Fig. 23D, E); greatest straight line length from atrium to apex of dorsal apodeme/greatest straight line length from atrium to apex of shaft 0.38–0.49.

**Style.** Apophysis short (length apophysis/length greatest 0.1–0.2), straight, length greatest/width greatest 2.4–2.7 (Fig. 23G, H).

**Connective.** Longer than wide, stem longer than arms (length stem/length arms 1.6–2.0), length greatest/width greatest 2.3–2.9 (Fig. 23F).

**Subgenital plate.** Lateral margin concave; length/width 1.5–1.8, 5–7 macrosetae, length 60–98 µm; angle at apex of subgenital plate, by trigonometry 29–33° (Fig. 23C).



**Figure 22.** A–L *Hadroca alacaudella* sp. nov., male, female and nymph, habitus images, face, sternite VII, tegmina, hind wing with specimen locality, Klondyke farm. **A.** Male, dorsally; **B.** Female, dorsally; **C.** Male, laterally; **D.** Female, laterally; **E.** Nymph, dorsally; **F.** Face, female; **G.** Face, male; **H.** Sternite VII; **I.** Sternite VII; **J.** Tegmina, transmitted light; **K.** Tegmina, reflected light; **L.** Hind wing. A–E, I–L. Scale bars: 1 mm.

**Pygofer lobe.** In lateral view longer than greatest width (length/width 1.4–1.6), posterior margin rounded. Macrosetae, short setae length 42–62  $\mu\text{m}$ , long setae length 83–134  $\mu\text{m}$ , longest seta 165  $\mu\text{m}$ , apices of long setae damaged by KOH (Fig. 23B).

**Female.**

**Sternite VII.** Rectangular, posterior margin straight to slightly sinuous (Figs 22H, I, 23I). Posterior margin laterally and medially similar length (lateral length/medial length 1.0), length/width 0.6, posterior margin wide, width across posterior margin/sternite VII greatest width 0.6–0.7.

**Valvula 3.** Macrosetae length 23–41  $\mu\text{m}$  (Fig. 23J).

**Valvula 2.** Apex serrate (Fig. 23K), fine teeth in trough, rounded teeth as in Fig. 20H, I.

**Valvula 1.** Lanceolate (resembling Fig. 21V), sculpture strigate (as in Fig. 20E–G).

**Valvifer 2.** Length/width 2.3–2.9 (Fig. 23N), sculpture in Fig. 23O.

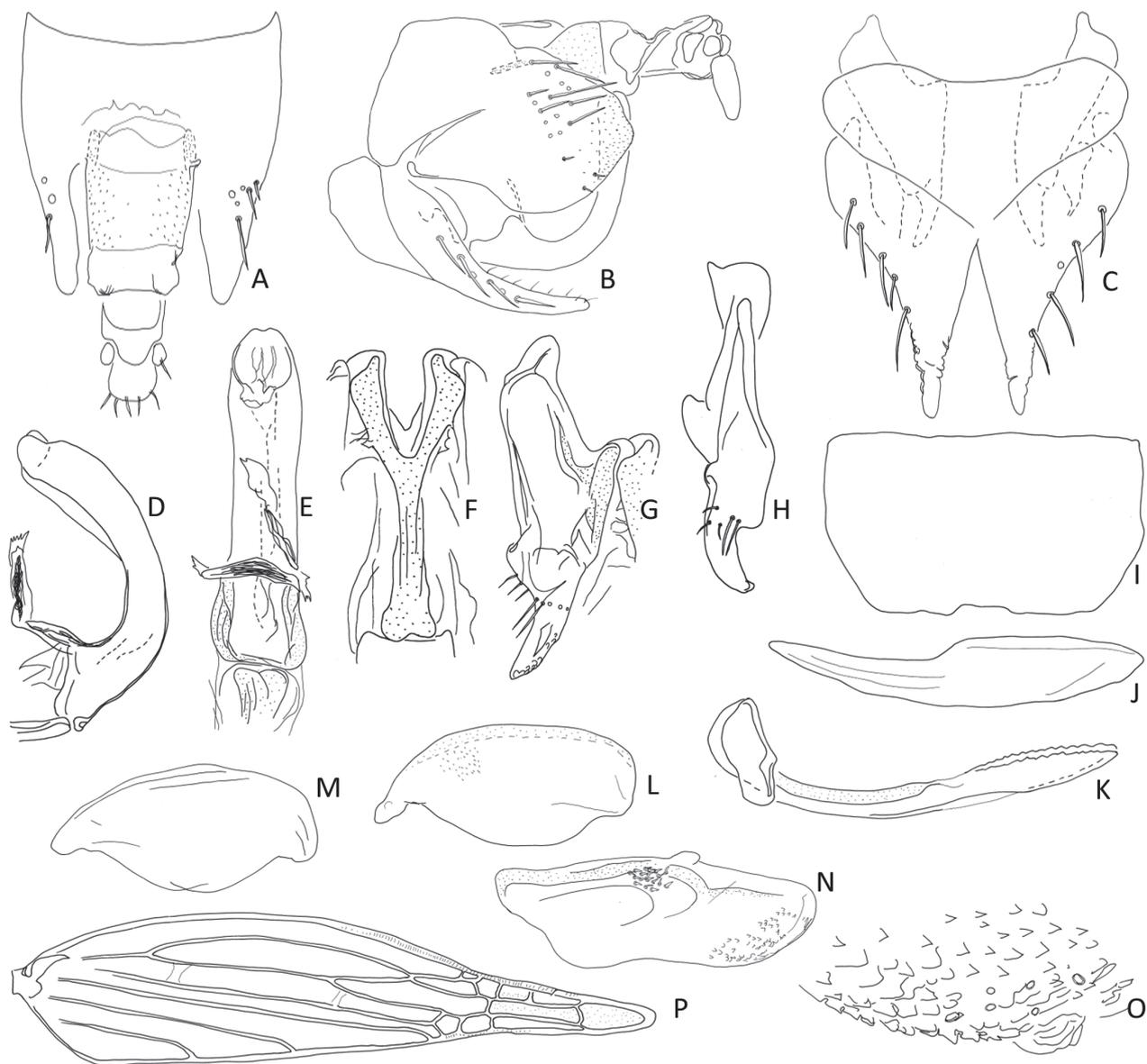
**Valvifer 1.** Length/width 2.2–2.8 (Fig. 23M, L).

**Material examined. Type locality.** Holotype male, South Africa, Western Cape province, Klondyke farm, near Ceres, –33.308, 19.577, 28 Jan. 2022, M. Stiller leg., sweeping, *Senecio* sp., Asteraceae, CCDL28915, SANC;

**Type specimen. Holotype** male, glued to triangle card, pinned, with genitalia in microvial pinned to specimen. Original label “R.S.A. Klondyke | farm Bo Swaar- | moed, –33.308 | 19.577, 28.i. | 2022, M. Stiller || sweep | *Senecio* sp. | Asteraceae || SANC Pretoria | Database# CCDL / 28915”.

**Paratypes.** 14♂♂, 47♀♀, 7 nymphs, total specimens 68.

**Remarks.** *Hadroca alacaudella* sp. nov. and *H. bualacauda* sp. nov. had the acuminate extension of the posterior margin of the tegmina, but specimens of the former were much narrower, the crown angle more acute and shorter than the latter, and listed in Table 2.



**Figure 23.** A–P *Hadroca alacaudella* sp. nov., male and female, terminalia, line drawings with specimen locality, Klondyke farm. A. Genital capsule, dorsally; B. Genital capsule, laterally; C. Subgenital plate; D. Aedeagus, laterally; E. Aedeagus, dorsally; F. Connective; G. Style; H. Style; I. Sternite VII; J. Valvula 3; K. Valvula 2; L. Valvifer 1; M. Valvifer 1; N. Valvifer 2; O. Valvifer 2, sculpture; P. Tegmina.

**Table 2.** Measurements for comparison of *Hadroca alacaudella* sp. nov. and *Hadroca bualacauda* sp. nov.

Measurements	<i>Hadroca alacaudella</i> sp. nov.	<i>Hadroca bualacauda</i> sp. nov.
male apex of crown to apex of tegmina	4.02–4.23 mm	5.02–5.95 mm
male head width	1.10–1.15 mm	1.67–1.81 mm
male pronotum width	1.05–1.09 mm	1.63–1.82 mm
male crown angle	95–101°	111–117°
female apex of crown to apex of tegmina	4.99–5.33 mm	5.51–6.49 mm
female head width	1.29–1.33 mm	1.76–1.92 mm
female pronotum width	1.23–1.28 mm	1.74–1.93 mm
female crown angle	97–103°	111–117°

Male genitalia differed distinctly between these two species. In *H. alacaudella* sp. nov. the aedeagus was widely curvate, and wider distally than medially in lateral view (Fig. 23D). In *H. bualacauda* sp. nov. the aedeagus was narrowly curvate and narrower distally than medially

in lateral view (Fig. 18E, F). The sternite VII of the female in *H. alacaudella* sp. nov. had the posterior margin sublinate, and in *H. bualacauda* sp. nov. it was ligulate with a wide, V-shaped notch. Distribution on the map in Fig. 26E from one locality indicated by a red circle.

***Hadroca treichroa* sp. nov.**

<https://zoobank.org/375ED020-3347-4363-8864-1834481E1698>

Figs 24, 25, 26E

**Diagnosis.**

1. Tegmina submacropterous, rounded posterior margin, with whitish, light brown and dark brown markings.
2. Aedeagal shaft elongate, sublinear, preatrium produced, about as long as dorsal apodeme.
3. Style apophysis in dorsal view sublinear, in lateral view short, apex curved ventrad.
4. Subgenital plate apex equidistant to apex of pygofer lobe.
5. Female sternite VII posterior margin with short, wide, recessed ligula.
6. Valvula 2 with short, square teeth.

**Etymology.** Named in Greek, for the three colors on the tegmina, *treis*, three; *chroa*, color, gender feminine.

**Color. Male & Female.** Crown unmarked or with small red dots, pronotum unmarked or with light brown marks (Fig. 24A–D). Tegmina with three colors: brown to dark brown reticulations, interspersed with whitish opaque, light brown and dark brown cells (Fig. 24A–D, G).

**Morphology. Male. Tegmina.** Submacropterous (Fig. 24A–C), about half as long as abdomen, 3–4 abdominal segments exposed, length/width 1.5–1.7, length 1.2–1.4 mm, width 0.8–0.9 mm; posterior margin broadly rounded.

**Hind wing.** Reduced (slightly larger than in Fig. 11E), elongate, length/width 0.8–2.3, length 0.4–0.8 mm, width 0.4 mm.

**Female. Tegmina.** Submacropterous (Fig. 24D, G), length/width 1.2–1.9, length 1.4–1.5 mm, width 0.6–1.1 mm.

**Hind wing.** Reduced (slightly larger than in Fig. 11F), elongate, length/width 0.8–2.3, length 0.8 mm, width 0.4 mm.

**Chaetotaxy.** AV 6–8, IC 7–9.

**Measurements. Male.** (n=6). Apex of crown to apex of tegmina 1.98–2.22 mm; apex of crown to apex of abdomen 2.56–3.12 mm; crown length 0.38–0.43 mm; crown length next to eye 0.30–0.33 mm; pronotum length 0.35–0.38 mm; head width 1.10–1.13 mm; pronotum width 1.02–1.06 mm; ocellus diameter 14 µm; interocular distance 104–115 µm; crown angle 105–111°; crown length/crown length next to eye 1.26–1.34; head width/pronotum width 1.06–1.09; ocellus diameter/interocular distance 0.12–0.14; crown length/pronotum length 1.07–1.15; pronotum length/pronotum width 0.34–0.36; crown length/head width 0.34–0.39; crown length/pronotum width 0.37–0.41; length to tegmina/length to abdomen 0.74.

**Female.** (n=25). Apex of crown to apex of tegmina 2.34–2.34 mm; apex of crown to apex of abdomen 3.47–3.61 mm; crown length 0.41–0.43 mm; crown length next to eye 0.31–0.34 mm; pronotum length 0.38–0.40 mm; head width 1.17–1.21 mm; pronotum width

1.10–1.14 mm; ocellus diameter 13–21 µm; interocular distance 111–125 µm; crown angle 107–112°; crown length/crown length next to eye 1.22–1.30; head width/pronotum width 1.05–1.08; ocellus diameter/interocular distance 0.11–0.18; crown length/pronotum length 1.03–1.11; pronotum length/pronotum width 0.34–0.36; crown length/head width 0.34–0.37; crown length/pronotum width 0.36–0.39; length to tegmina/length to abdomen 0.63–0.66.

**Terminalia. Male.**

**Aedeagus.** Shaft sublinear, slightly curvate, segment angle 100–130°, shaft with apical and medial width similar, dorsal apodeme subbasal, preatrium produced, gonopore subapical, V-shaped (Fig. 25F). In lateral view, area 13–17 µm<sup>2</sup>, perimeter 1.138–1.969 mm; greatest straight line length from atrium to apex of dorsal apodeme/greatest straight line length from atrium to apex of shaft 0.42–0.51 (Fig. 25C–E).

**Style.** Apophysis short, length apophysis/length greatest 0.1–0.2, straight; length greatest/width greatest 1.5–1.8 (Fig. 25H, I).

**Connective.** Longer than wide, stem and arms about equidistant, length stem/length arms 0.84–1.02; length greatest/width greatest 2.40–2.88 (Fig. 25G).

**Subgenital plate.** Triangular, length/width 1.26–1.62, macrosetae length 57–77 µm; angle at apex of subgenital plate, by trigonometry 32–38° (Fig. 25B); 2–3 macrosetae, length 55–57 µm; apex rugose.

**Pygofer lobe.** In lateral view longer than greatest width (length/width 1.1–1.4), posterior margin rounded. Macrosetae length 59–110 µm (Fig. 25A), 6–12 short macrosetae 53–80 µm, 5–8 long macrosetae 99–123 µm usually uniseriate.

**Female.**

**Sternite VII.** Variably rectangular, posterior margin with short, wide, shallowly recessed ligula, lateral margins rounded (Figs 24I, 25J, K), ligula length/width 0.24–0.48. Lateral length/medial length 1.07–1.14, greatest length/greatest width 0.59–0.69, notch width/sternite VII greatest width 0.34–0.45.

**Valvula 3.** Macrosetae length 21–34 µm.

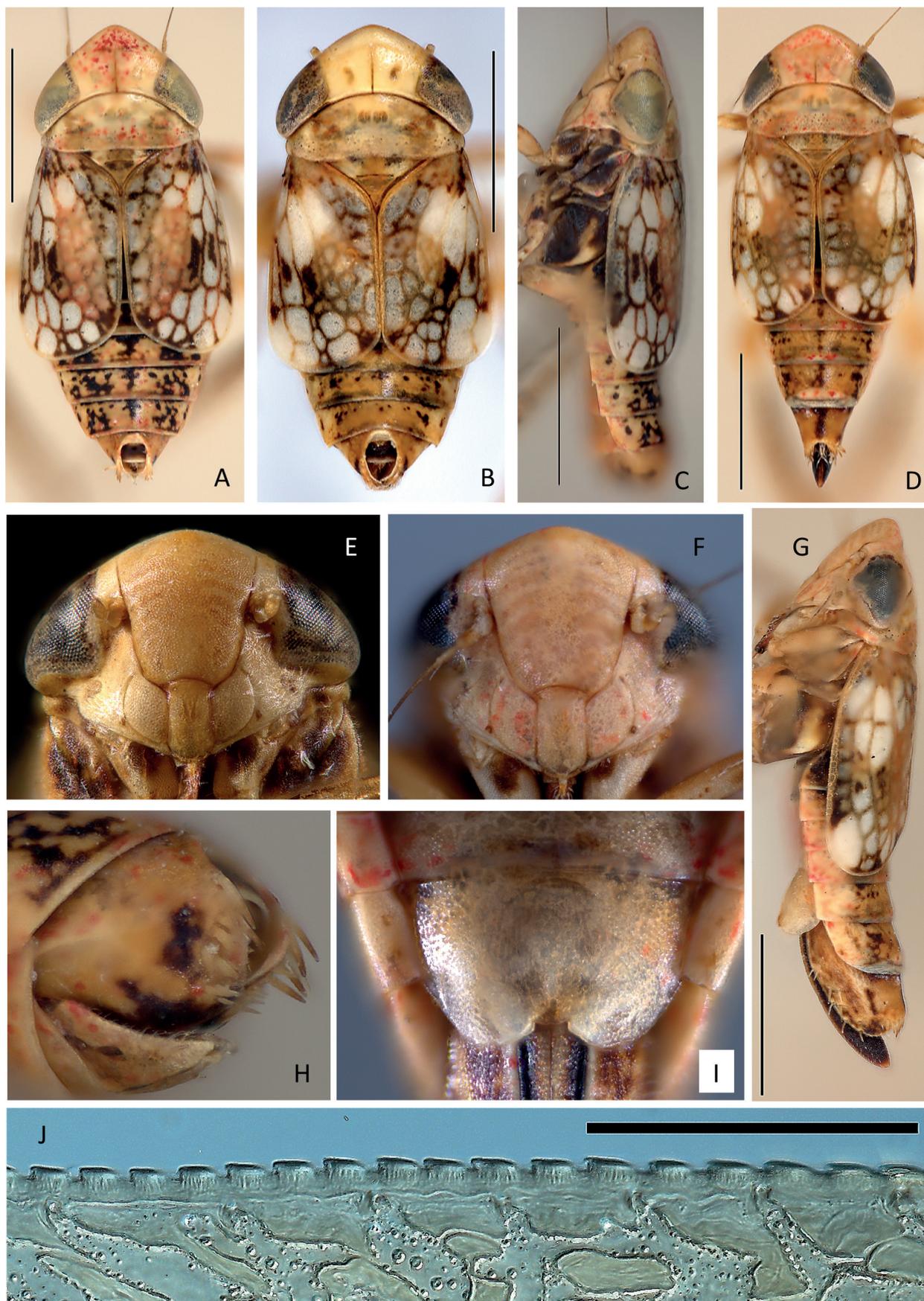
**Valvula 2.** Serrate distally, with teeth square, close-set, fine sculpture at base of tooth (Fig. 24J), sometimes teeth weakly developed.

**Valvula 1.** Sculpture granulose apically and ovoid basally.

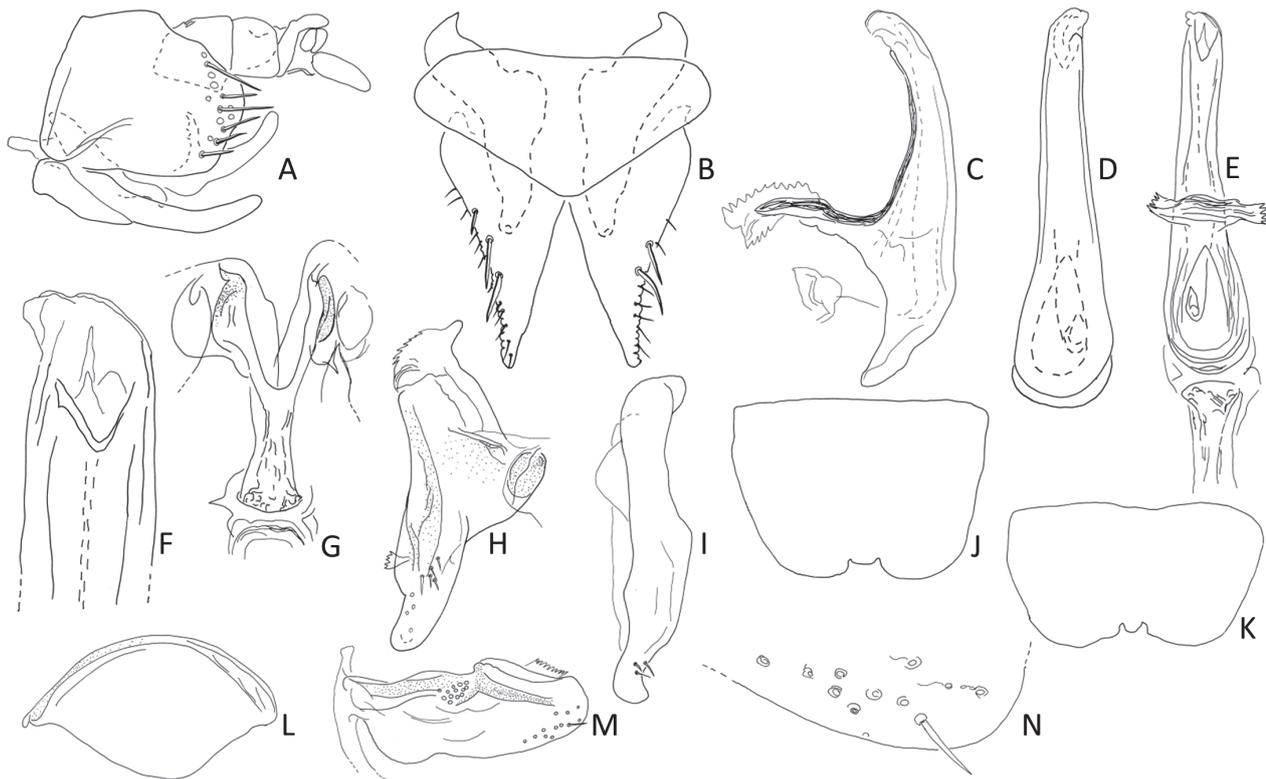
**Valvifer 2.** Length/width 2.46–2.97, sculptured area with 7–10 circular pore-like structures (Fig. 25M, N), sometimes with 1–2 setae.

**Valvifer 1.** Length/width 1.83–2.05, rounding dorsally and ventrally similar, anterior and posterior margin acute (Fig. 25L).

**Material examined. Type locality.** Holotype male, South Africa, Western Cape province, Wiedouw Farm base of Gifberg Pass, south east of Van Rhynsdorp, –31.733, 18.766, 3–10 Oct 2002, M. Stiller leg., sweeping, *Passerina truncata* subsp. *truncata*, Thymelaeaceae, CCDL18930, SANC.



**Figure 24.** A–J *Hadroca treichroa* sp. nov., male and female, habitus images with specimen localities. **A.** Male, dorsally, Wiedouw; **B.** Male, dorsally, Wiedouw; **C.** Male, laterally, Wiedouw; **D.** Female, dorsally, Wiedouw; **E.** Face, male, Wiedouw; **F.** Face, female, Wiedouw; **G.** Female, laterally, Wiedouw; **H.** Genital capsule, laterally, Wiedouw; **I.** Sternite VII, Wiedouw; **J.** Valvula 2, denticulation, Wiedouw. A–D, G, scale 1 mm, J. Scale bars: 50 μm.



**Figure 25.** A–N *Hadroca treichroa* sp. nov., male and female, terminalia, line drawings with specimen localities. **A.** Genital capsule, laterally, Wiedouw; **B.** Subgenital plate, Wiedouw; **C.** Aedeagus, laterally, Wiedouw; **D.** Aedeagus, posteriorly, Wiedouw; **E.** Aedeagus, dorsally, Wiedouw; **F.** Aedeagus, apex, dorsally, Wiedouw; **G.** Connective, Wiedouw; **H.** Style, dorsally, Wiedouw; **I.** Style, laterally, Wiedouw; **J.** Sternite VII, Wiedouw; **K.** Sternite VII, Clanwilliam; **L.** Valvifer 1, Wiedouw; **M.** Valvifer 2, Wiedouw; **N.** Valvifer 2, sculpture, Wiedouw.

**Type specimen.** *Holotype* male, glued to triangle card, pinned, with genitalia in microvial pinned to specimen. Original label “South Africa | Western Cape | Prov. Wiedouw | Farm foot | Gifberg Pass | SE Van Rhynsdorp | 31°44’S, 18°46’E | 3-10.x.2002 120 m | M. Stiller leg. || swept off | *Passerina* | *truncata* | subsp. *truncata* | Thymelaeaceae || SANC Pretoria | Database No. | CCDL18930”.

**Paratypes.** 5♂♂, 24♀♀.

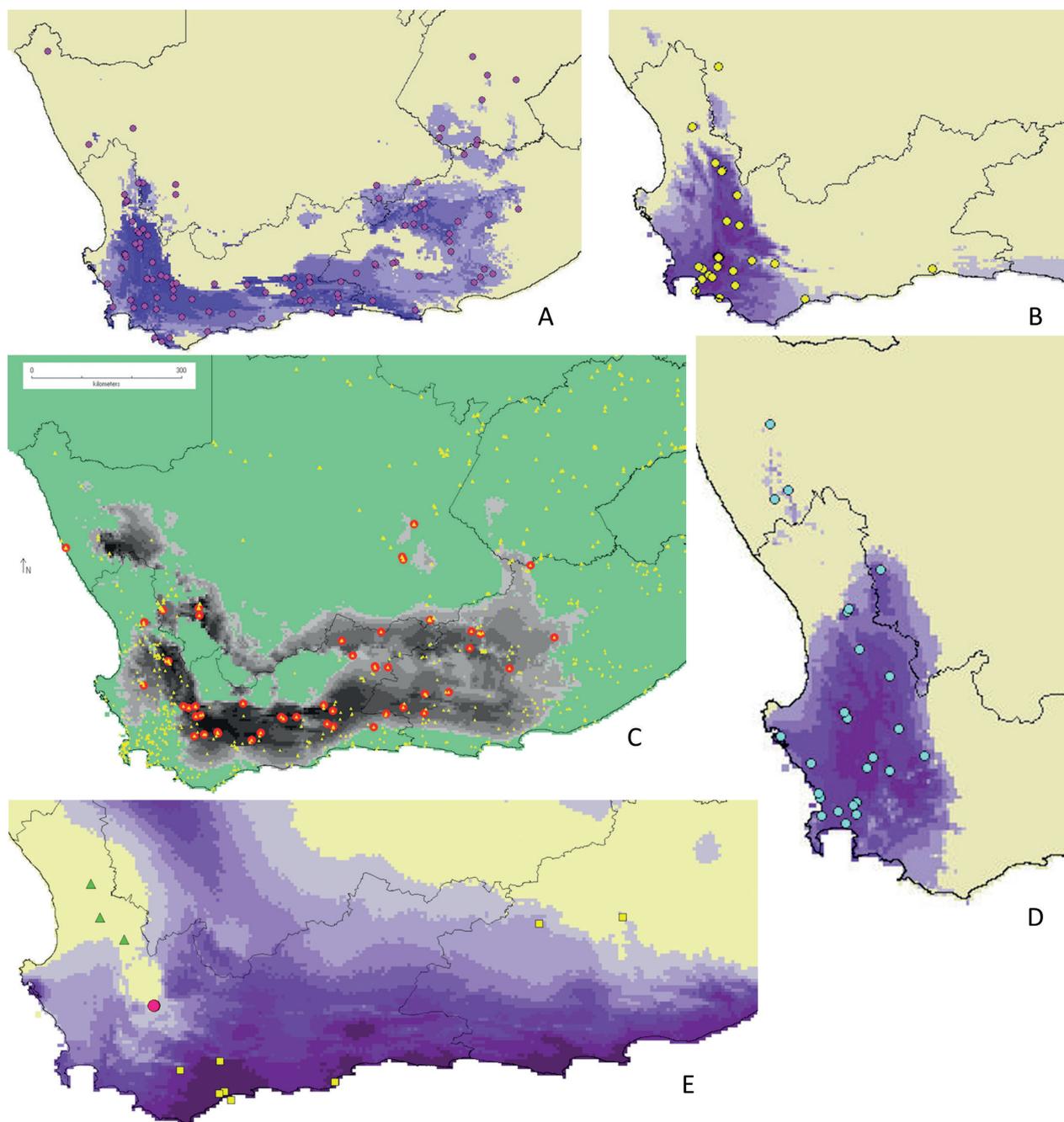
**Remarks.** Described from one whole and six dissected males and numerous females (six dissected) from three proximate localities in the Cedarberg Mountains. All had the same distinct color pattern on the tegmina. The aedeagus was least typical for *Hadroca*, with the preatrium produced more and the shaft least curvate. This configuration approached that of *Tzitzikamaia*, but without apical processes. At present the aedeagi of species of *Tzitzikamaia* have single, apical paired processes. The six dissected aedeagi of *H. treichroa* sp. nov. do not show signs of damage at the apex which could suggest broken processes. The ventral curvature of the style apophysis corresponded well to that of the other *Hadroca* species. The ligulate female sternite VII was wider than long or almost square, with a recessed ligula similar to that of *H. bualacauda* sp. nov., and the submacropterous specimens of *H. ramosa*.

However, the serration of the valvula 2 was least typical, i.e. with rectangular, close-set teeth. All other species of *Hadroca* have small teeth in the trough between larger, rounded teeth. Distribution on map in Fig. 26E indicated by three green triangles.

## Conclusion

Asteraceae was well represented with 41 recorded plants in 55 records and 18 other plant families and 27 plant species in 33 records. Most species of *Hadroca* appear restricted to the Western Cape province, commonly in the Fynbos Biome (Fig. 26B, D, E) and *H. hapsistylis* sp. nov. in the Western Cape, Eastern Cape and Northern Cape provinces (central, south- and north-western parts of South Africa) (Fig. 26C). *Hadroca alavittata* sp. nov. appears to be associated with wild asparagus based on limited records and specimens.

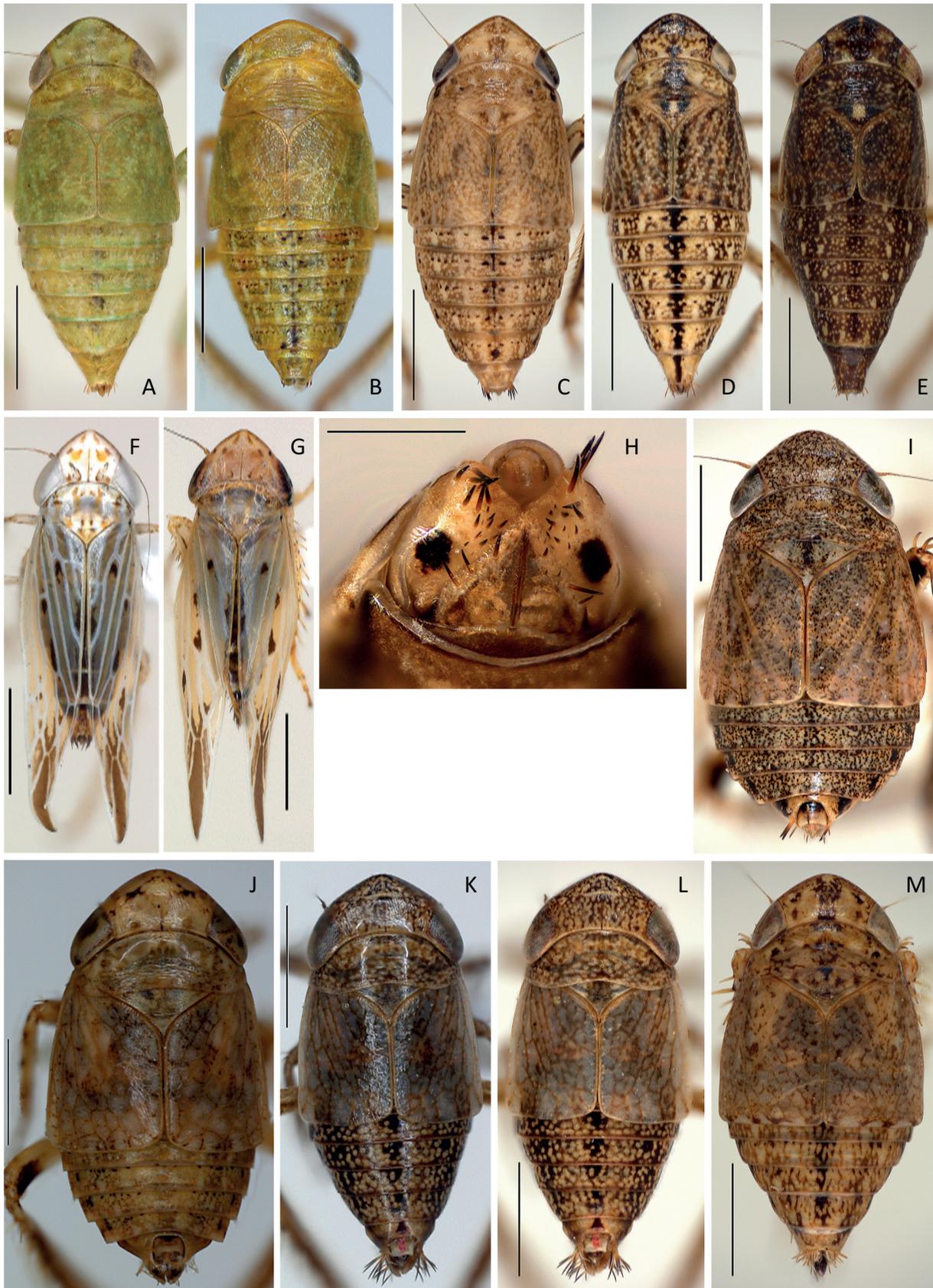
Specimens of the species of *Hadroca* vary greatly in size, color and shape of the posterior margin of the tegmina. Two species, i.e., *H. bualacauda* sp. nov. and *H. alacaudella* sp. nov., have the tegmina with a tail-like posterior process. The genus is recognized by combined features of the aedeagus and style. The male aedeagus is uniformly sclerotized, the shaft curvate, preatrium re-



**Figure 26.** A–E Distribution maps and potential natural distribution models. **A.** *Bloemia hieroglyphica*; **B.** *H. ramosa*; **C.** *H. hapsistylis* sp. nov., small yellow triangles represent all leafhopper records; **D.** *H. bualacauda* sp. nov.; **E.** *H. alavittata*, yellow squares, distribution points for *H. alacaudella*, single red circle, *H. treichroa*, three green triangles.

duced, or slightly produced in *H. treichroa* sp. nov., and the dorsal apodeme short and transverse. The apophysis of the style is curved ventrad, commonly short relative to the style (*H. ramosa* (Naudé), *H. bualacauda* sp. nov., *H. alacaudella* sp. nov. and *H. treichroa* sp. nov.), or very long in *H. hapsistylis* sp. nov., and in *H. alavittata* sp. nov. somewhat curved laterad, with the least ventrad curvature. Species recognition is based subjectively on color (Figs 1A–O, 2L, M, 3A–H, M, N, 4A–D, 10A–L, 11A–D, 19A–F, H, 24A–D, G) and shape (Figs 15A–C, 22A–D). Variability in the shape of the posterior margin of the

sternite VII is ascribed to an adaptation to different oviposition plants, most notable in *H. ramosa* and *H. hapsistylis*. Similar variation was noted in *Colistra acapitatus* (Stiller and Webb 2022), *Retevolatus flexiverpus* (Stiller 2021), *Geelus dundraad* and *G. platdraad* (Stiller 2020), *Discolopeus diacaenus* (Stiller 2019), *Bretega quinispiverpa* (Stiller 2016), three species of *Pravistylus* (Stiller 2010a), *Vilargus trunculicans* (Stiller 2010b) and *Elginus cultellus* (Stiller 2009). The submacropter *Bloemia hieroglyphica* (Naudé) is similar in shape (Fig. 28A–F) to submacropters of *Hadroca ramosa*, but the aedeagus



**Figure 27.** A–M Superficially corresponding species with specimen localities. A–E, H, *Basutoia brachyptera* Linnavuori, 1961, dorsally. A. Koppies; B. Witsieshoek; C. Highlands; D. Carolina; E. Springfontein; F, G. *Teinopterus microphallus* Stiller, 2011, Eastern Cape province, dorsally; F. Male; G. Female; H. *B. brachyptera*, male, genital capsule, posteroventrally; I–L. *Tzitzikamaia* species, male; I. Belfast; J. Kirkwood; K. Sani Pass; L. Jonkiespoort; M. *Goniagnathus brachypterus* Linnavuori, 1978, female, DNyala. A–M. Scale bars: 1 mm.

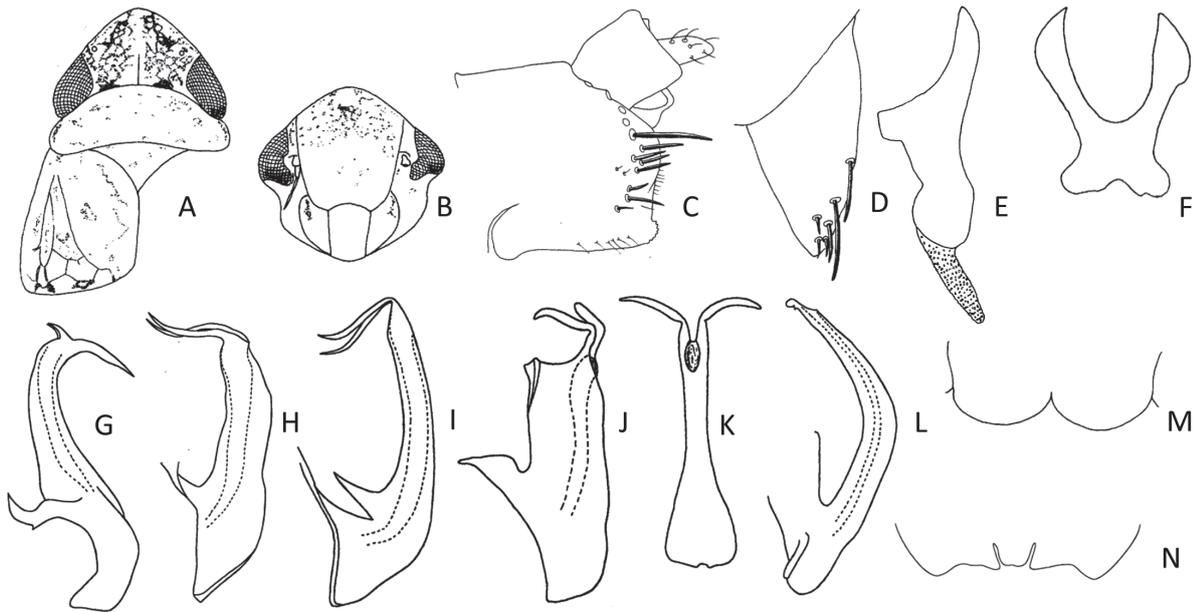


**Figure 28.** A–F *Bloemia hieroglyphica* (Naudé, 1926), male and female, habitus images with specimen localities. A. Female, Jonkiespoort; B. Male, Aberdeen; C. Male, New Bethesda; D. Male, Oudtshoorn; E. Male, Ladismith; F. Male, Jonkiespoort. A–F. Scale bars: 1 mm.

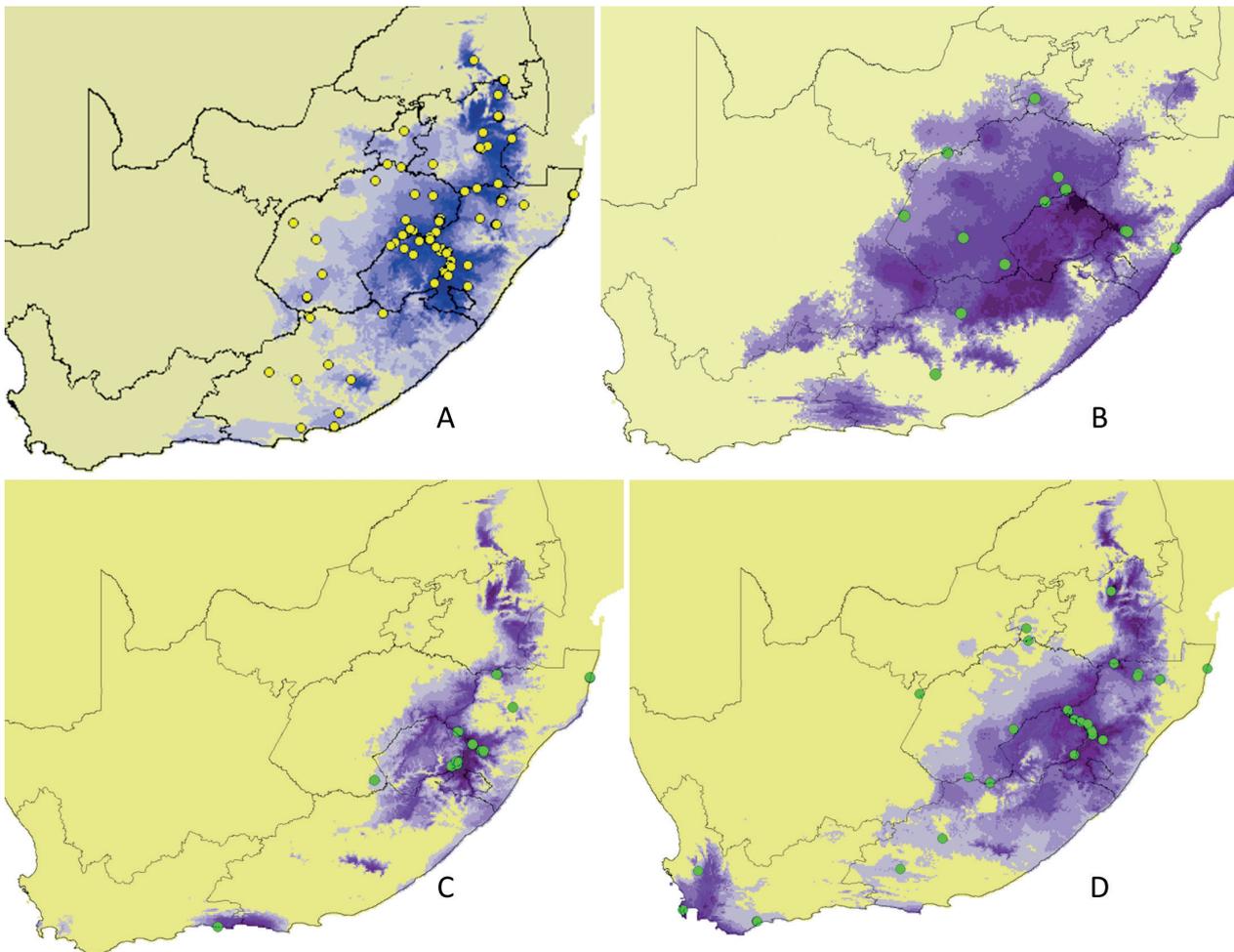
has three levels of sclerotization and some differences in profile. More confounding are the brachypters of *H. ramosa* (Fig. 3A–H) which bear some resemblance to species of *Tzitzikamaia* Linnavuori (Fig. 27I–L), although all four species in *Tzitzikamaia* have the aedeagal shaft with apical, paired processes. A few indeterminate examined specimens of the latter lacked these paired processes.

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**Figure 29.** A–N *Basutoia* and *Tzitzikamaia* species, male and female terminalia, line drawings. A–H, M, *T. adspersa* Theron, 1974. A. Head, pronotum and tegmina; B. Face; C. Genital capsule, laterally; D. Subgenital plate; E. Style; F. Connective; G. Aedeagus, laterally; H. Aedeagus, posteriorly; I. *T. irrorata* Linnavuori, 1961, aedeagus, laterally; J. *T. longipennis* Linnavuori, 1961, aedeagus, laterally; K. *T. silvicola* Linnavuori, 1961, aedeagus, laterally; L. *B. brachyptera* Linnavuori 1961, aedeagus, laterally; M. *T. adspersa*, sternite VII; N. *T. longipennis*, sternite VII.



**Figure 30.** A–D Distribution maps and potential natural distribution models. A. *Basutoia brachyptera* Linnavuori, 1961; B. *Tzitzikamaia adspersa* Theron, 1974; C. *T. irrorata* Linnavuori, 1961; D. *T. silvicola* Linnavuori, 1961.

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## Supplementary material 1

### Additional material examined

Authors: Michael Stiller

Data type: species data

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