



<https://doi.org/10.11646/megataxa.17.1.3>

<http://zoobank.org/urn:lsid:zoobank.org:pub:08ED422D-E196-4449-AAEA-9DEF657F7B9F>

## Revisiting the concept of ‘ultra evolved’ aedeagi of *Adelopsis* Portevin, 1907 (Coleoptera: Leiodidae: Cholevinae: Ptomaphagini) using scanning electron microscopy, with description and redescription of species

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### Abstract

We revisit the diagnosis and evolution concept of aedeagal morphology in the tribe Ptomaphagini using scanning electron microscopy (SEM) images. We here focus on *Adelopsis* Portevin, 1907, which is a speciose Neotropical genus, which includes species with male genitalia varying from elongate and slender to globose and very complex (including the so-called ‘ultra evolved aedeagi’). We analyzed SEM images focusing on the aedeagal morphology of 19 described species and eight species here described, representatives of most of the species groups recognized in the genus and representing a broad variety of aedeagal types observed in the genus. The eight Brazilian new species here described (all in *benardi* species group) are: *Adelopsis boraceia* Gnaspini & Gomyde, **new species**, *Adelopsis monticola* Gnaspini & Gomyde, **new species**, *Adelopsis vanini* Gnaspini & Gomyde, **new species**, *Adelopsis gibber* Gnaspini & Gomyde, **new species**, and *Adelopsis ilhabela* Gnaspini & Gomyde, **new species**, from São Paulo state, *Adelopsis caeteh* Gnaspini & Gomyde, **new species** and *Adelopsis gandarela* Gnaspini & Gomyde, **new species**, from Minas Gerais state, and *Adelopsis sacerdotis* Gnaspini & Gomyde, **new species**, from Bahia state. We record several types of probable sensory structures on the ‘ultra evolved’ aedeagi of species in *benardi* species group; and we also address more finely the complex morphology of the aedeagi in *benardi* and *elephas* species groups. Those characters will help with phylogenetic analysis of the genus and the tribe as a whole when the same kind of study includes the remaining species. We also add images of the aedeagus apex taken from slightly different views in order to highlight the importance of precisely illustrate the aedeagus to avoid misleading comparisons and misidentification of species.

**Key words:** Coleoptera, Cholevinae, *Adelopsis*, aedeagus morphology, evolution

### Introduction

The family Leiodidae Fleming, 1821 is in the staphylinoid group of beetle families, and includes more than 4200 described species (Newton, 1998, 2016, 2025). The tribe Ptomaphagini Jeannel, 1911 (in the subfamily Cholevinae Kirby, 1837) is diagnostically characterized by having the apex of the tibiae armed with a comb of many short and equal fixed spines, a male genital segment reduced to a set of one dorsal and two ventral plates, the latter two placed at the sides of a spiculum gastrale, and an aedeagus lacking a basal lamina (e.g., Jeannel, 1936; Gnaspini, 1993a, 1996; Gnaspini & Peck, 2019). Ptomaphagines are distributed in the Holarctic, Oriental, and Neotropical regions. Three subtribes have been recognized (e.g., Perreau, 2000, although this classification has been challenged—e.g., Gnaspini, 1996, Antunes-Carvalho *et al.*, 2019): Ptomaphagina (covering almost the whole distribution of the tribe), Ptomaphaginina Szymczakowski, 1964 (with a disjunct distribution, in Mexico + West Indies and Oriental region), and Baryodirina Perreau, 2000 (with a single female specimen known from Sarawak).

As discussed by Gnaspini & Peck (1996) and Gnaspini (1996), the Neotropical ptomaphagine genus *Adelopsis* Portevin, 1907 of earlier authors was shown not to be a monophyletic genus, and those authors started a revision of this group of taxa, including the description of genera based on a phylogenetic analysis of the tribe Ptomaphagini (as in Gnaspini, 1996: figs. 1–3). Gnaspini (1996) also included a discussion on the evolution of aedeagal morphology among the species in the tribe Ptomaphagini, using the main patterns for the establishment of genera, based on observations made under light microscopy. For that revision, Gnaspini (1996) examined type specimens of most of the “earlier” (from 1856 to about 1975) described species of Neotropical ptomaphagines and added some comments on misidentifications, and the needed nomenclatural acts were taken in Gnaspini & Peck (2019), who also reorganized the composition of species groups in *Adelopsis*.



For recent studies of Neotropical ptomaphagines, we used images taken by scanning electron microscopy (SEM) (e.g., Gomyde & Gnaspini, 2019; see also, e.g., Antunes-Carvalho & Gnaspini, 2016, Gnaspini *et al.*, 2021), and we have reanalyzed the aedeagi of the different genera of Ptomaphagini in order to better document and study the patterns observed (e.g., Gnaspini & Gomyde, 2024). Here we focus on the Neotropical genus *Adelopsis*, reporting important details for the recognition of species, and, especially for the species carrying what Jeannel (1936) defined as an ‘ultra evolved’ aedeagus, we recognized new features which can add important value to the discussion about the evolution of the aedeagal morphology among species in Ptomaphagini.

## Material and Methods

The specimens used in this study were dried specimens (paratypes of previously described species and types of species here described) mounted on card points fixed on entomological pins, borrowed for study from the Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZSP collection). Methods used here followed the ones previously used in the taxon (e.g., Gnaspini, 1996; Gnaspini & Peck, 1996; Gomyde & Gnaspini, 2019). When dissection of the genitalia was needed, specimens were relaxed in boiling water. Structures with much adhered tissue were cleaned for a few minutes in hot 10% KOH. The dissected specimens were afterwards mounted on cardboard triangles attached to entomological pins and the genitalia were either mounted on metallic stubs (as close to the upright position as possible) using carbon adhesive pads, sputter-coated with gold, and examined by scanning electron microscopy (SEM) in a Zeiss DSM 940 microscope and a Sigma VP Carl Zeiss microscope, both in the Instituto de Biociências da Universidade de São Paulo (IBUSP)—the stub was kept next to the pinned specimen, or mounted in PVA [Poly (vinyl alcohol)—Downs’ Fluid—see Downs, 1943] on a microslide, which was kept together with the pinned specimen. Light microscopy images were made with a stereomicroscope Leica M80 connected to a DFC295 camera and a microscope Leica DMLB connected to a MC170 HD camera, and both analysed with LAS V4.12 software. Images were rendered using Helicon Focus software. In the case of previously dissected specimens (paratypes), the microslide with the genitalia was removed from the pin and placed in a Petri dish with water at room temperature for a few hours (or up to a couple of days, if needed) in order to completely dissolve the PVA and release the aedeagus for study with SEM. The aedeagi were then mounted on metallic stubs and studied with SEM as previously cited. For the following reasons we decided to mount in stub the aedeagus of only one specimen of each species: (a) gold coating does not allow transparency for future analysis under light microscopy, (b) because it is not easy to remove an aedeagus from a stub without damaging it (especially in the case of fragile specimens—for instance, those from species in *benardi*

species group, in which the aedeagi is complex and has ‘thin, projecting parts’) and it is easier to remove it from Downs’ Fluid on a microslide (just using water), and (c) because stubs take more space in a collection than a microslide attached to the same pin of the specimen. We are aware that, by allowing more details to be seen, SEM details could lead to falsely recognize more species if one considers differences in details not as possible variations. We here used the general shape of the specimens (and a combination of all features observed, not only a single difference in a detail) to compare and describe species based on both SEM and light microscopy images—we used light microscopy to recognize the specific shape of the aedeagus, and used SEM images mainly to highlight the discovery of features which add to the concept of ‘ultra evolved aedeagi’ and to species identification.

For the (re)description of species, we follow the procedure and terminology previously used for the taxon (e.g., Gnaspini, 1996; Gnaspini & Peck, 1996; Gomyde & Gnaspini, 2019). We compared the length of each antennomere with the length of the 9<sup>th</sup> antennomere, because sometimes the first antennomere is missing or not accessed (either for being broken when detached from the head or for being not completely visible when still attached to the head—which was our case with *A. gandarela* **sp. nov.** and *A. monticola* **sp. nov.**), and this would cause the obtainment of imprecise proportions; and the 9<sup>th</sup> antennomere is easily recognized for being next to the generally shorter 8<sup>th</sup> antennomere.

In taxonomy papers dealing with leiodids, images show the aedeagus with its base towards the bottom of the figure and its apex towards the top of the figure; the reader should be reminded, therefore, that, since the apex of the aedeagus takes a posterior placement in relation to the longitudinal axis of the body, the right side of the aedeagus is placed at the left side of an image depicting a dorsal view, whereas the left side of the aedeagus is placed at the right side of the picture.

For purposes of description, we consider both dorsal and ventral views of the aedeagus when the same amount of both parameres is visible (e.g., Fig. 85A) (in the case of the ventral view, we also may consider the precise frontal view of the ventral opening of the aedeagus), and we consider both left and right views of the aedeagus when, while turning the aedeagus around its ‘longitudinal’ axis, the opposite side of the ventral opening of the aedeagus just disappears (e.g., Figs. 85E, Q).

For the description of the aedeagus, we follow the terminology used in previous works focusing on leiodids, but especially Gnaspini & Peck (2019), as summarized in their figs. 1–3:

- the body of the aedeagus has a ‘basal opening’ (‘bo’—e.g., Fig. 24K).

- due to the migration of the genital opening towards the dorsal surface, cutting through the left side, the apex of the aedeagus in Ptomaphagina has two ‘lobes’ (following Salgado, 2010): a wider ‘right lobe’ (‘rl’) and a narrower ‘left lobe’ (‘ll’), with a ‘dorsal opening’ (‘do’) between them (e.g., Fig. 38C)—the ‘dorsal opening’ is actually the ‘dorsal portion of the genital opening’ because the

ventral portion of the genital opening is still present. In some cases, a left lobe is missing (“ll”—e.g., Figs. 89A, D) and we can recognize a ‘turning point’ where the anteriormost margin of the dorsal opening meets the ventral margin of the aedeagus (‘tp’—e.g., Fig. 90C). An exception is the genus *Peckena* Gnaspini, 1996, in which the opening is still ventrally placed (see also Gnaspini & Gomyde, 2024).

- from its base, the right lobe of the aedeagus may become narrow and frequently elongate, defining an ‘arm’ (‘arm’) sensu Gnaspini & Peck (2019), which may narrow apically into a ‘crest’ (‘cr’) (e.g., Fig. 69A).

- the internal face of the arm may bear a tuberculate process, called an ‘internal knob’ (‘kn’—e.g., Fig. 69A) by Gnaspini & Peck (2019—who erroneously recorded it in *elephas* species group).

- laterally to the body, there is a pair of parameres—a ‘left paramere’ (‘lp’) and a ‘right paramere’ (‘rp’) (e.g., Figs. 24E, P), with a variable number of setae at/near their apex.

- internally to the aedeagus, there is a ‘flagellum’ (‘fl’—e.g., Figs. 2A, 33A, C, D, 74A) which carries the sperm. In our SEM images, which do not allow transparent viewing, the flagellum cannot be seen entirely.

Other abbreviations used here are:

- the body of the aedeagus may bear a ‘dorsal depression’ (‘dd’—e.g., Fig. 9E), which seems to be exclusive of *benardi* species group.

- the right lobe may be divided in two ‘lobules’, an ‘inner lobule’ (‘irl’) and an ‘outer lobule’ (‘orl’) (e.g., Figs. 3B, D, 4B).

- the right lobe may be enlarged apically on a ‘plate’ (‘pl’—e.g., Figs. 10A, B, D); or on a divided plate bearing an ‘outer plate’ (‘opl’) and an ‘inner plate’ (‘ipl’) (e.g., Figs. 86A, B); or on a ‘ventral face’ (‘vf’), which, exclusively in *elephas* species group, continues forward forming a ‘beak’ (‘bk’) and is connected backward to a shorter projection (‘ear’) (e.g., Figs. 89C, D).

- the apex of the right lobe may be elongate, forming an ‘apical projection’ (‘ap’) and its posteriormost face may bear an ‘apical depression’ (‘ad’) (e.g., Fig. 9P).

- the crest of the right lobe may widen and connect perpendicularly with a ‘ventral chin’ (‘vch’—e.g., Figs. 25B, D), which bear ‘tubercles’ (‘tb’—e.g., Fig. 26B), exclusively in *benardi* species group.

- the outer face of the right lobe bears seta(e), which may not be associated with an elevation and may be placed close to its base (‘rbs’—e.g., Fig. 89E) or may be associated with a ‘plateau’ (‘rlp’) and/or with a second elevation (‘rlc’), and an additional elevation not associated with a seta may be present (‘rlc2’) (e.g., Fig. 42D).

- the left side of the aedeagus apex also bears seta(e) (‘lls’) which may be placed at the apex of the left lobe (e.g., Fig. 25C) or on the anteriormost margin of the dorsal opening where a left lobe is missing (e.g., Fig. 89D).

- the integument of the aedeagus bears probable sensory structures which may be scattered on the body and/or may concentrate on the apical region (‘ss’—e.g., Figs. 42A, B).

- in specific cases, the lateral edges of the apical

margin of the aedeagus may form a ‘frill’ (‘fr’—e.g., Fig. 33D) or may be slightly elevated (‘me’—e.g., Figs. 25C, D); the anteriormost margin of the dorsal opening may project forward, reminding a ‘hump’ (‘hm’—e.g., Fig. 53H); the apical plate of the aedeagus may have a ‘ventral cavity’ (‘vc’—e.g., Fig. 80B), an ‘internal fold’ (‘if’—e.g., Figs. 79A, C), and blunt ‘horns’ (‘hn’—e.g., Figs. 79C, D), or an outward projection (‘ol’—e.g., Figs. 109A, B, D), or may expand laterally and backwards, forming a ‘hood’ (‘hd’—e.g., Figs. 115A, C); or the body of the aedeagus may bear a projection shaped like a ‘hunchback’ (‘hb’—e.g., Figs. 114O).

- mesotarsomeres have twin spines (‘tw’—Figs. 62, 67 and Gnaspini *et al.*, 2021).

- the tarsi (e.g., Fig. 61 and Antunes-Carvalho & Gnaspini, 2016) bear a pair of empodial setae (‘est’) and a pair of medial projections (‘mpp’); and claws have small dorsal spines (‘sdc’) and spines at their dorsolateral margin (‘slc’).

We introduce a morphometrical description of the aedeagus, which we understand is helpful in the recognition of species, especially those of ‘ultra evolved type’ in *benardi* species group, in which the aedeagus is globose and very complex. We rotate the images showing left and right views so that they take an ‘upright’ position (i.e., with the apex of the aedeagus upward) and define some lines to make measurements, as in Fig. 12. We are aware that a slight difference in angles may interfere in the morphometric results and that we used only one specimen of each species; therefore, we use those values only as a guide to distinguish species when the difference is large, and no statistical analysis was intended at this point. For the same reason, we use both left and right views to make measurements; and we use the combination of the different features measured together with other morphological features observed as a whole picture for the recognition of species.

For all species studied, we aligned the image based on a ventral line connecting the ventralmost edge of the ventral opening and the ventralmost edge of the apex of the right lobe of the aedeagus (Fig. 12A; ‘vl’—Fig. 88F), and we used the following measurement: concavity/total height (as ‘concavity’ in our descriptions) =  $(h4-h2)/(h4-h1)$  (where, for instance, ‘h4’ represents either lines ‘hl4’, from left view, or ‘hr4’, from right view, as in Fig. 12A).

In species in *elephas* species group, in addition to the measurement described above, we aligned the image disregarding the ‘beak’ (‘vlx’—e.g., Fig. 88F), and also measured concavity/total height (as above).

In species in *benardi* species group, in which the apical projection of the right lobe of the aedeagus projects ventrally and the dorsal opening is frequently enlarged, we added the following measurements (where, for instance, ‘l1’ represents either lines ‘ll1’, from left view, or ‘lr1’, from right view, as in Fig. 12A):

- concavity/total length =  $(l4-l3)/(l7-l1)$ ;

- length of apical projection/total length =  $(l3-l1)/(l7-l1)$  (as % length in our descriptions);

- depth of apical depression/apex length =  $(l2-l1)/(l3-l1)$  (where it applies—as % depth in our descriptions);

- height of apical depression/total height = (h4-h3)/(h4-h1) (where it applies—as % height in our descriptions);
- depth of dorsal opening/total length = (15-11)/(17-11) (as % length in our descriptions);
- position of dorsal depression (from bottom)/total length (as position in our descriptions) = (17-16)/(17-11).

In some species of *benardi* species group, the apical projection is very long (e.g., *A. claudina*—e.g., Fig. 24F) and this might interfere with the measurements above. Therefore, for this species group, we also made a second alignment, based on a ‘transversal’ line following the inner or outer margin of the apical projection: in species with an ‘apical depression’ (for instance, *A. cf. szymczakowskii*, as in Fig. 12B), we aligned the image with the internal margin of the projection of the apex of the right lobe of the aedeagus; in species without an ‘apical depression’ (i.e., showing a ‘flat’ outer margin—for instance, *A. claudina*), we aligned the image with the external margin of the projection of the apex of the right lobe of the aedeagus (‘tl’—Fig. 24F). We then made two additional measurements:

- height of apical depression/total height = (h5-h3)/(h4-h1) (as % height in our descriptions—it differs from the last measurement listed above because line ‘h5’ is not coincident with line ‘h4’, as it was in Fig. 12A);
- height of apical projection/total height = (h5-h2)/(h4-h1) (as % height in our descriptions—in the case of Fig. 12A, in which line ‘h5’ is coincident with line ‘h4’, this measurement corresponds to ‘concavity/total height’).

We also used:

- the ratio between length and width of the aedeagus in dorsal view (as l/w in our descriptions);
- the angle of the axis of the basal opening pointing ventrally in relation to the ‘sagittal’ plane of the aedeagus (as basal opening in our descriptions);
- the ratio between the length of the ‘ear’ (from its base at the crest to its apex) and the length of the ‘beak’ (from its base at the crest to its apex), in frontal view, exclusively in *elephas* species group (as ear/beak in our descriptions).

We use the following acronyms for institutions holding types.

CMNC	Canadian Museum of Nature, Ottawa, Canada
FMNH	Field Museum of Natural History, Chicago, Illinois, U.S.A.
FSCA	Florida State Collection of Arthropods, Gainesville, Florida, U.S.A.
MACN	Division Entomología, Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina
MLPA	Museo de La Plata, La Plata, Argentina
MNHN	Muséum National d’Histoire Naturelle, Paris, France
MZSP	Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil
NHRS	Naturhistoriska Riksmuseet, Stockholm, Sweden
NMPC	Department of Entomology, National

Museum (Natural History), Prague, Czech Republic  
 SBPC Stewart B. Peck Collection, Ottawa, Canada (types and most specimens now in CMNC)

## Systematics

### Family Leiodidae Fleming, 1821

#### Subfamily Cholevinae Kirby, 1837

#### Tribe Ptomaphagini Jeannel, 1911

#### Subtribe Ptomaphagina Jeannel, 1911

The following species are characterized, except when noted, by the following typical characters of the subtribe Ptomaphagina (e.g., Gnaspini & Peck, 2019): Shape oblong. Pubescence golden, with many short recumbent setae (e.g., Fig. 13). Antenna 11-segmented, antennomere 8 smaller than 7 and 9 (e.g., Fig. 14). Eye large. Pronotum transverse, widest at base, with closely distributed transverse strigae; posterior angles acute (e.g., Figs. 39A, C). Elytron regularly rounded, with transverse strigae, as dense as that of the pronotum (e.g., Figs. 23A, B). Sutural striae entire. Metathoracic wing fully developed. Mesoventrum with longitudinal carina. Apex of tibia armed with a comb of many short and equal fixed spines (e.g., Figs. 31 D–F). Protibia apex about three times as wide as base. Protarsi laterally expanded and bearing tenent setae ventrally in males (e.g., Figs. 31H, I), not expanded and lacking tenent setae in females (e.g., Fig. 31G). Mesotibia curved inwards (e.g., Fig. 31B) in both sexes (and may be bent among males). Mesotarsomeres have twin spines (‘tw’—see Figs. 62, 67 and Gnaspini *et al.*, 2021). Metatibia straight (e.g., Fig. 31C). Ptomaphagines also have (e.g., Fig. 61 and Antunes-Carvalho & Gnaspini, 2016) tarsi of all legs (in both sexes) bearing a pair of empodial setae with asymmetric length (‘est’); the distal margin of the terminal tarsomere with a pair of medial projections (‘mpp’); claws with small dorsal spines close to their base (‘sdc’) and with a few long and acuminate spines at their dorsolateral margin (‘slc’).

#### Genus *Adelopsis* Portevin

*Adelopsis* Portevin, 1907: 71; Jeannel, 1936: 59 (redescription) (*sensu* Gnaspini, 1996: 533 and Gnaspini & Peck, 1996: 407, redescription; and Gnaspini & Peck, 2019: 6). Type species: *Catops ruficollis* Portevin, 1903 = senior synonym of *Adelopsis heterocera* Portevin, 1907, originally established as type species, by monotypy (synonymy in Gnaspini & Peck, 2019: 23).

*Iuturuuca* Gnaspini, 1993a: 79 (as subgenus of *Adelopsis*); Gnaspini & Peck, 2019: 6 (synonymy). Type species: *Adelopsis leo* Gnaspini (orig. des.).

*Excelsiorella* Salgado, 2008b: 210 (as genus);



Gnaspini *et al.*, 2016: 274 (synonymy). Type species: *Excelsiorea latissima* Salgado (orig. des.).

Besides the typical characters of the tribe, species of *Adelopsis* are characterized by having (e.g., Gnaspini & Peck, 2019) (except when noted): antenna reaching base of elytra when laid back. Male abdominal ventrites (sternites), especially sternites V–VII (preceding the genital segment VIII), may be altered; aedeagus broad, base curved downwards, with the orifice somewhat facing ventrally, at an angle of 45° to 90° from the horizontal axis (but in a few species it follows the longitudinal axis of the aedeagus); apical orifice dorsally subterminal and cutting the left side of aedeagus; flagellum short or elongate, strongly developed; parameres flat, curved, shorter than aedeagus, bearing at least 3 small terminal setae, inserted close to each other. Male genital segment globular, slightly longer than broad; lateral lobes bearing several long and short setae; the spiculum gastrale may be straight and of the same width along its axis, or its anterior apex may be enlarged or divided. Spermatheca varies among species; it is frequently 2-turns coiled (and may have more turns) and always ends with a distinct bulb.

We here focus our descriptions on genitalic characters, since they most distinctively characterize species in Ptomaphagini. In the redescrptions, we will treat only the aedeagal morphology—the reader should refer to the original descriptions for external characters and also for spermathecal features. In descriptions of new species, only specific characters will be listed, and only those that would give diagnostic information for the recognition of species, based on illustrations made of the specimens examined. Characters mentioned as diagnostic for species groups and subgroups are not repeated in species descriptions, unless they differ. For the generic diagnosis and list of described species of *Adelopsis* Portevin, 1907, see Gnaspini (1996), Gnaspini & Peck (1996, 2019), and Peck *et al.* (2020). We follow the species groups (and subgroups) as discussed and redefined by Gnaspini & Peck (2019).

In all species treated here the aedeagus is curved ventrad (i.e., concave), except in *A. crassiflagellata*, *A. longipalpus*, and *A. picunche*.

The integument bears scattered probable sensory structures shaped as a depression from the center of which emerges a dome-shaped projection, variably among species, and other types of projections may appear; the sensory structures may be denser on the apical portion of the aedeagus, especially in *benardi* and *elephas* species groups, in which the apex is more complex.

The parameres have the same shape, being curved, following the curvature of the aedeagus, along the lateral faces of the aedeagus (except in *A. gilli*, *A. longipalpus*, *A. sacerdotis* sp. nov., and *A. vanini* sp. nov.); and are completely fused to the aedeagus body—the placement of the fusion can be recognized by the presence of a depression along the margins of the parameres, variably in the different species.

According to Gnaspini & Peck (2019), the left lobe is absent in *camella*, *capitanea*, *elephas*, and *soacha* species groups; atrophied/missing in *ascutellaris* species group; very short and broad in *triangulifer* species group; and

present in *benardi* and *bruchi* species groups. To have the left lobe ‘absent’ means that, from the apex of the aedeagus, the right margin of the dorsal opening proceeds inward and, when it reaches its maximum extension, instead of going back towards the apex and form a left margin in contact with a projected left lobe, it just ends and meets the internal/ventral left side of the aedeagus (therefore, a typical dorsal opening, with an U-shaped margin, is not produced—instead, the dorsal opening may have a C- or L-shaped margin, may have a long 90° curved margin, or be diagonal, or else, variably among species); the ‘corner’ or ‘turning point’ where the inner margin of the dorsal opening meets the internal/ventral margin of the left side may be placed just under the left paramere (or just dorsal or just ventral to the left paramere, variably among species); the apical margin of the ‘left lobe’ (actually, where it is expected to be placed [‘ll’—e.g., Figs. 74C, 89D]—compare with, for instance, Figs. 2C, 38A, in which a left lobe is present) bears setae projecting forward, variably among species in number and length, and in placement, may be placed from just at the ‘turning point’ to far away from it and close to the right lobe.

#### ***Ascutellaris* species group Gnaspini & Peck, 2001 (sensu Gnaspini & Peck, 2019)**

#### ***Ascutellaris* species subgroup Gnaspini & Peck, 2019**

#### ***Adelopsis confluens* Gnaspini & Peck, 1996 (Figs. 1–5)**

*Adelopsis confluens* Gnaspini & Peck, 1996: 408; Salgado, 2010: 215 (assignment to *peruviensis* species group); Salgado, 2011: 437; Gnaspini & Peck, 2019: 10 (tentative assignment to *ascutellaris* species group and subgroup); Peck *et al.*, 2020: 43.

Holotype male in SBPC [now in CMNC]; 11 male and 5 female paratypes in FMNH, MZSP, SBPC.

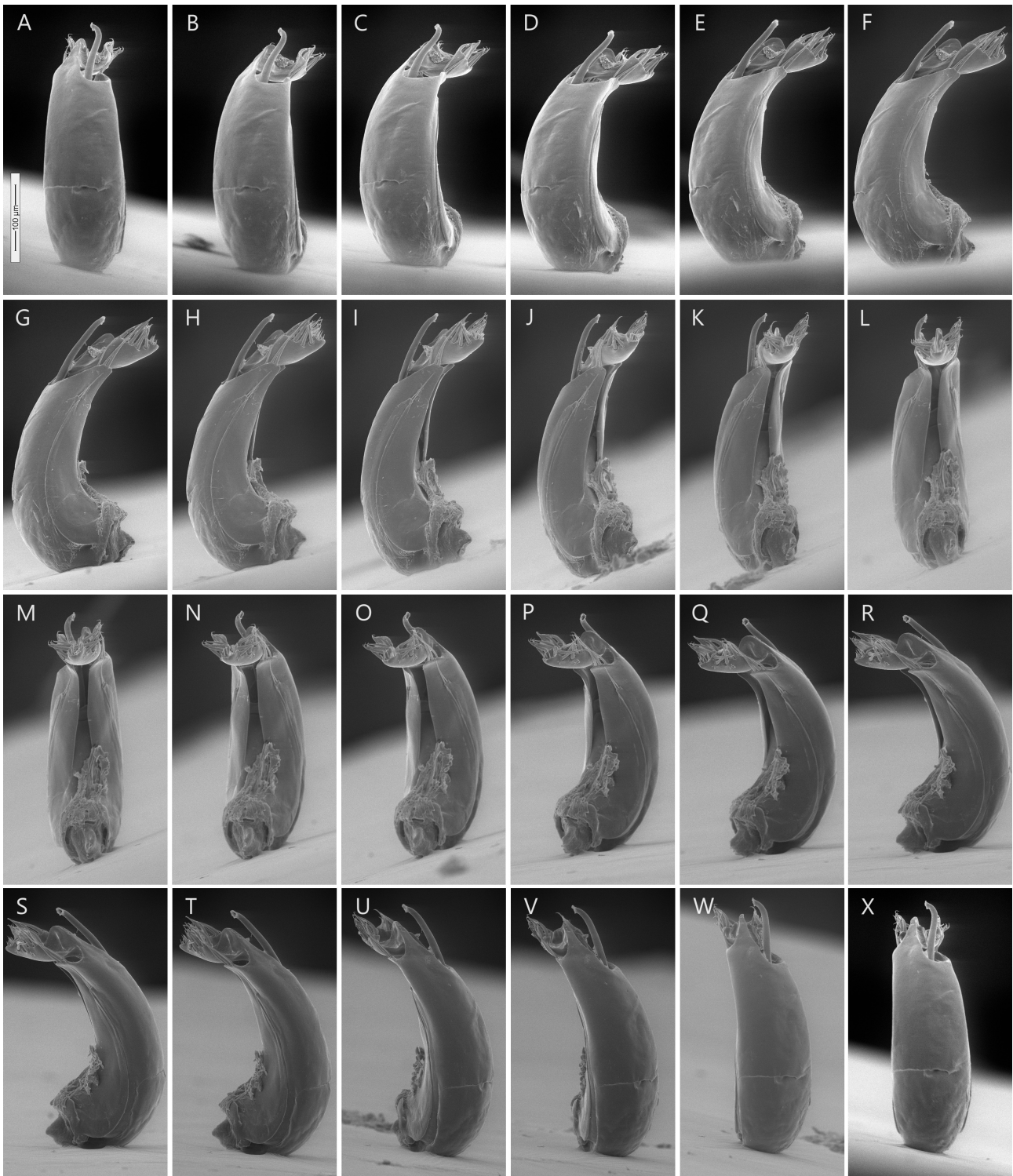
Type locality: San Vito de C.B., 1200 m, Las Cruces, Puntarenas Province, Costa Rica.

Distribution: Costa Rica: Cartago and Puntarenas Provinces.

Size (original description): Length: 2.05–2.85 mm; width: 1.05–1.35 mm.

**Material examined. Paratypes:** COSTA RICA—**Puntarenas:**—San Vito de C. B., Las Cruces; 1200m a.s.l.; 7–14.VIII.1982; B. Gill leg.; Label: “COSTA RICA: / San Vito de C. B. / Las Cruces / 7–14.VIII.82 / 1200m—B. Gill”; 2 males, MZSP 27025, 27026 (here illustrated; marked with pink label ‘Figure’ referring to its use in original description) (out of 3 male and 2 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~3.0, concavity ~47–50% [Figs. 1F, S]), basal opening 90° downwards; width a little bigger than height, widest near base (e.g., Fig. 1).

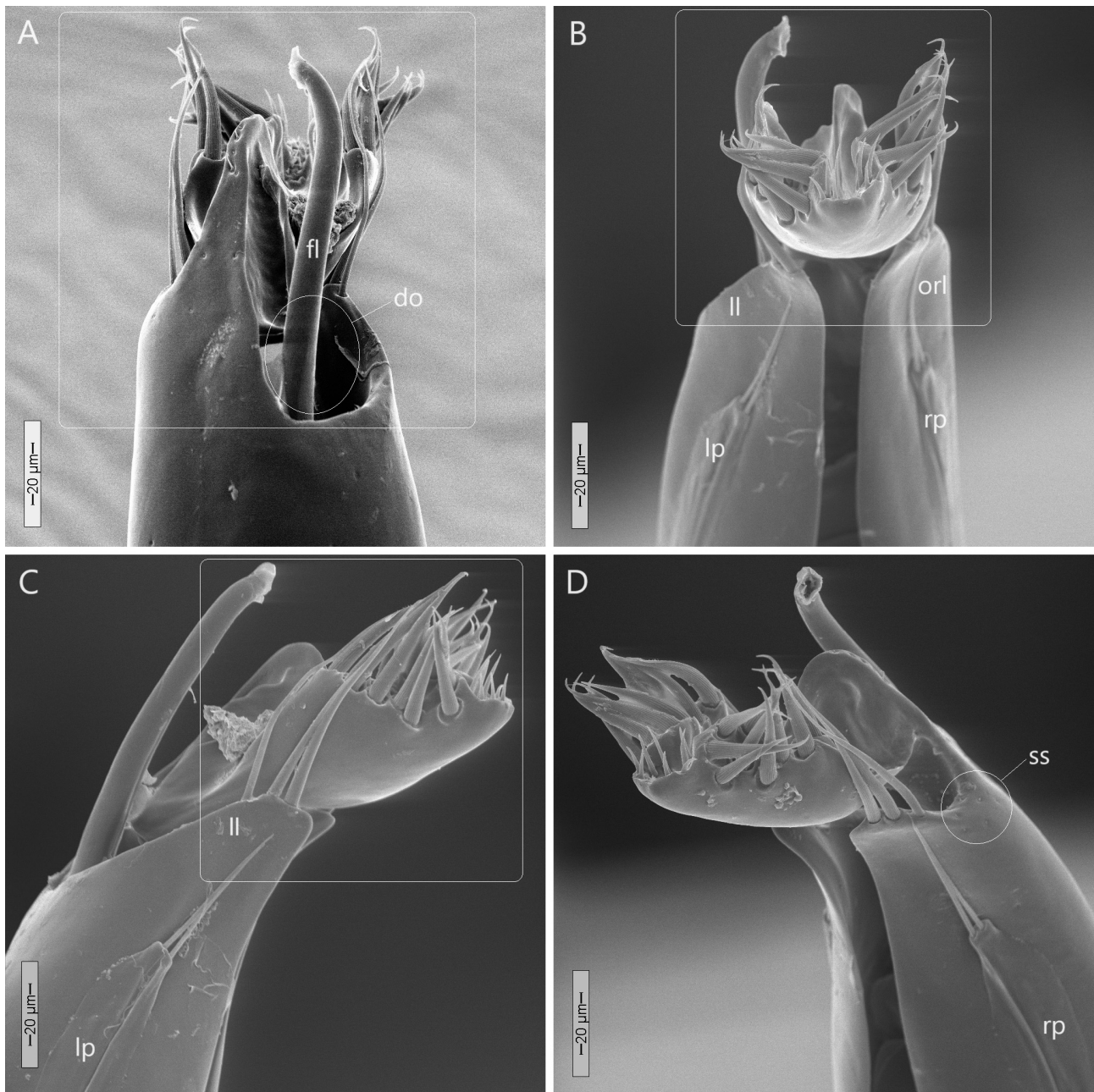


**FIGURE 1.** *Adelopsis confluens* Gnaspini & Peck, 1996 (*ascutellaris* species group—subgroup *ascutellaris*), male paratype MZSP 27026. A–X, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.

Right lobe (‘rl’—e.g., Figs. 3, 4) divided in two ‘lobules’—the outer lobule (‘orl’) is short and its apical margin bears three elongate setae, projecting forward, towards the ‘plate’ (‘pl’) of the inner lobule (e.g., Fig. 3D); the inner lobule (‘irl’) projects forward, narrowing towards its apex (i.e., with a subtriangular shape), forming a narrow ‘crest’ (‘cr’—e.g., Figs. 3A, D), which sides

extend downward and connect ventrally with an ample plate (‘pl’), which shapes like a ‘diamond’ with round corners (e.g., Figs. 3D, 4B); the apical dorsal surface of this plate is covered with small spines and conic structures (probably sensory), and the lateral margins bear seven/eight strong spines which converge apically towards each other.





**FIGURE 2.** *Adelopsis confluens* Gnaspini & Peck, 1996 (*ascutellaris* species group—subgroup *ascutellaris*), male paratype MZSP 27026. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in A, B, C are detailed in Fig. 3. do = dorsal opening; fl = flagellum; ll = left lobe; lp = left paramere; orl = outer lobule of the right lobe; rp = right paramere; ss = sensory structure.

The apex of the left lobe almost reaches the level of the apex of the outer right lobule ('ll'—e.g., Figs. 2B, 3B, C); the apical margin of the left lobe bears three elongate setae, projecting forward, 'surrounding' the 'plate' ('pl') of the inner lobule ('lls'—e.g., Figs. 3B, C).

The dorsal opening ('do'—e.g., Figs. 2A, 4B) takes ~23% of the total length of the aedeagus and bears a sharp turn (like a 'V') at its basal margin.

The sensory structures may bear a dome-shaped or conic projection ('ss'—e.g., Fig. 2D).

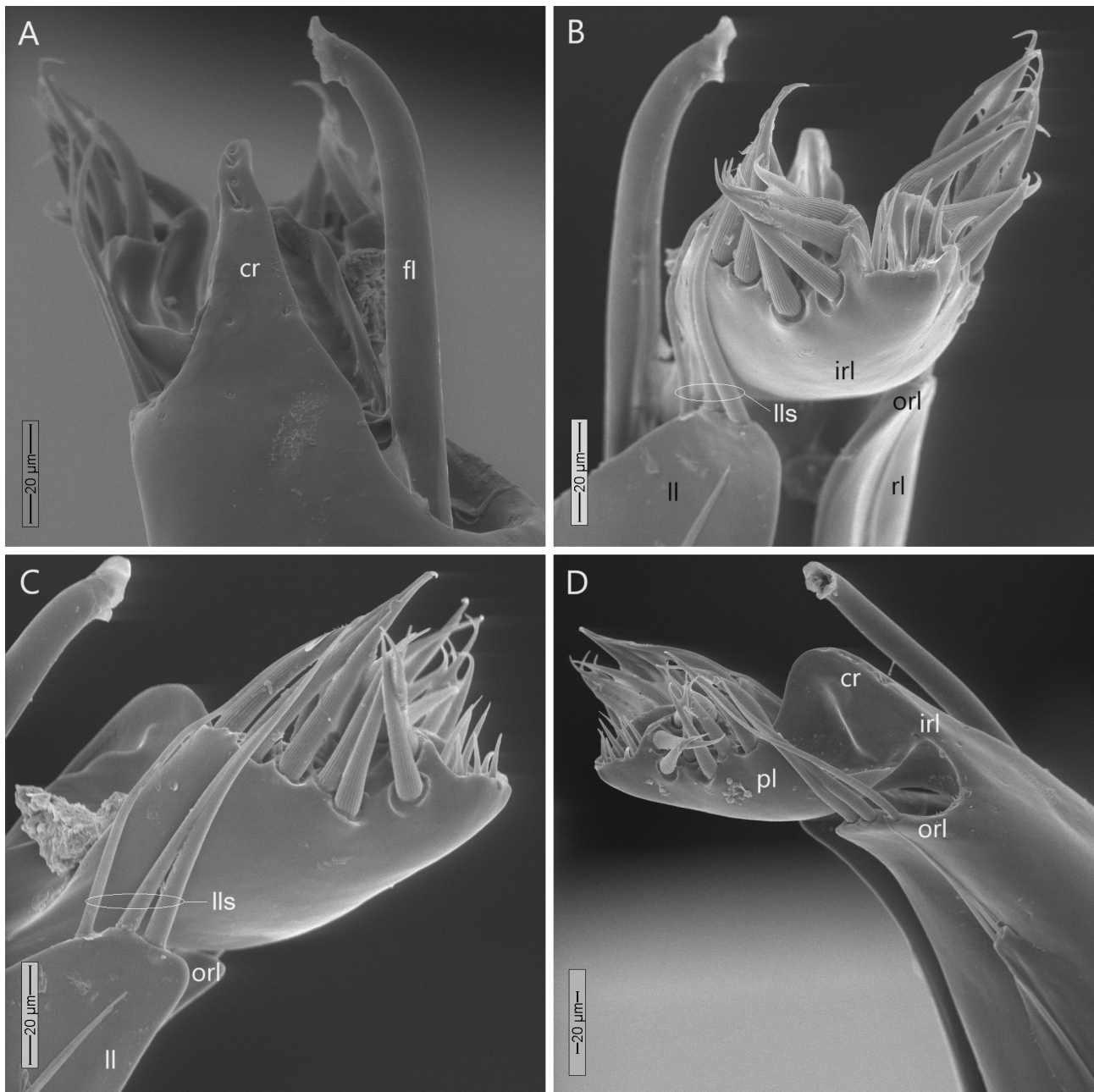
The somewhat narrow fused parameres can be recognized by the presence of a depression along the dorsal margin, but parts of the ventral margin cannot be

recognized from the aedeagus body (e.g., Fig. 1). The left paramere ('lp') is somewhat shorter than the right paramere ('rp') (e.g., Fig. 2B). Both parameres show a medial narrowing at the apex, which apical margin is blunt and bears a pair of long setae, projecting forward (e.g., Figs. 2C, D).

The flagellum cannot be seen entirely and was not drawn as such in the original description by Gnaspini & Peck (1996: figs. 13–15); its final portion ('fl'—e.g., Figs. 2A, 3A, 4B) is thin and its apex is curved towards the right side of the aedeagus.

*Taxonomic remarks.* *Adelopsis confluens* can be easily recognized from all other species in the genus because it is





**FIGURE 3.** *Adelopsis confluens* Gnaspini & Peck, 1996 (*ascutellaris* species group—subgroup *ascutellaris*), male paratype MZSP 27026. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—in detail, with views slightly rotated in relation with previous figure (except C, which is not rotated from Fig. 2C). cr = crest of right lobe; fl = flagellum; irl = inner lobule of the right lobe; ll = left lobe; lls = setae on the left lobe; orl = outer lobule of the right lobe; pl = plate of right lobe; rl = right lobe.

until now the only one which bears a group of strong setae at the sides of the inner right lobe. The original description indicated a total of five setae on each side, but we here identified nine spines on each side (e.g., Fig. 2D).

### ***Ruficollis* species subgroup Gnaspini & Peck, 2019**

#### ***Adelopsis longipalpus* Gnaspini & Peck, 2001** (Figs. 6–8)

*Adelopsis longipalpus* Gnaspini & Peck, 2001: 431 (assignment to *ascutellaris* species group); Salgado, 2010: 213 (as ‘Gnaspini

& Peck, 1996’ [sic]); Gnaspini & Peck, 2019: 23 (assignment to *ruficollis* species subgroup); Peck *et al.*, 2020: 46.

Holotype male in SBPC [now in CMNC]; 5 male and 8 female paratypes in MZSP, SBPC.

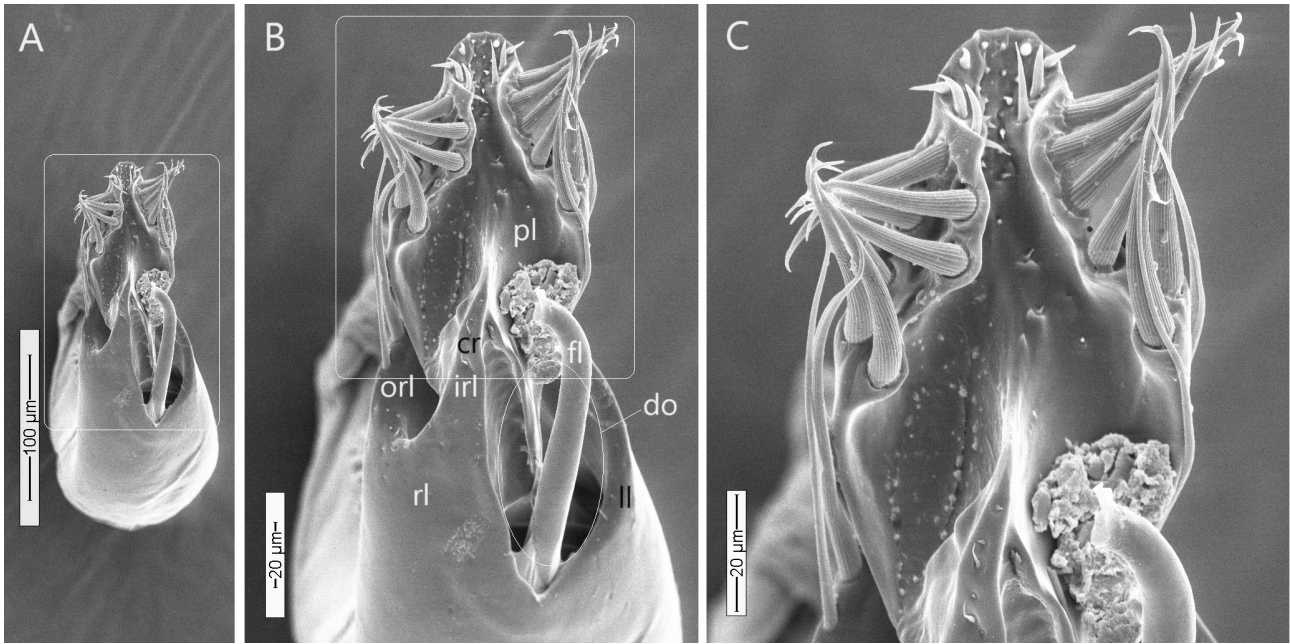
Type locality: 41 km S of Santa Marta, 7000’, San Lorenzo, Magdalena Department, Colombia.

Distribution: Colombia: Magdalena Department: known only from type locality.

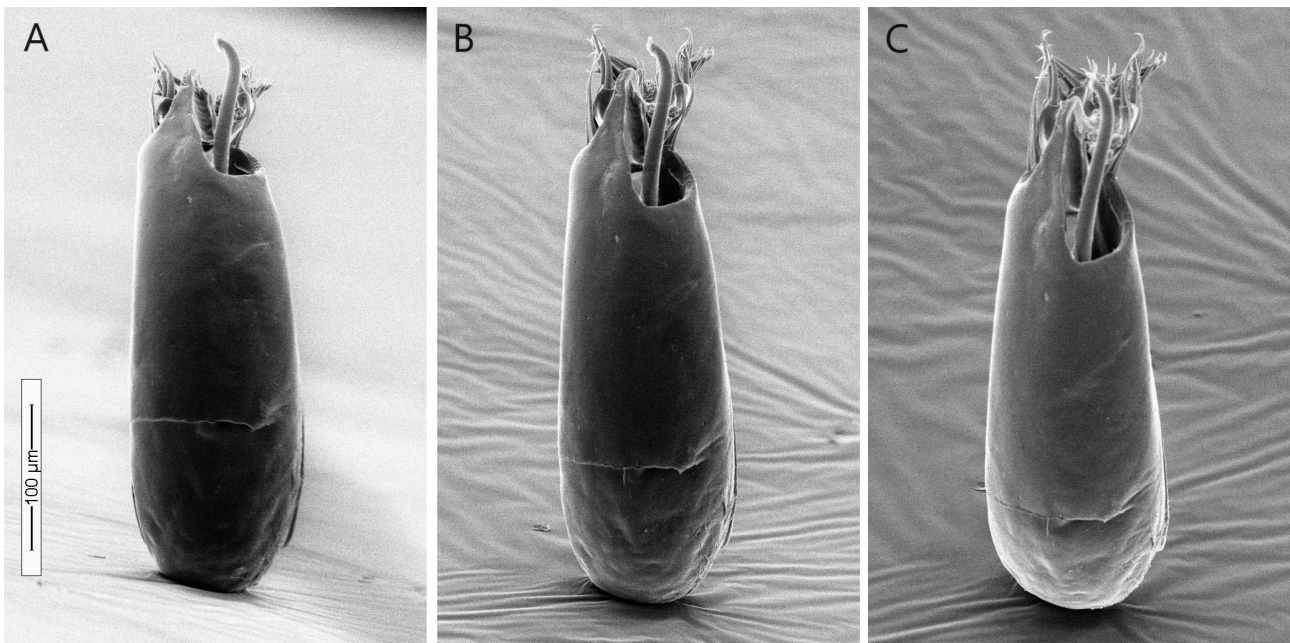
Size (original description): Length: 2.0–2.5 mm; width: 0.95–1.2 mm.

**Material examined. Paratypes:** COLOMBIA—**Magdalena:**—San Lorenzo, 41km S Santa Marta; 7000’





**FIGURE 4.** *Adelopsis confluens* Gnaspini & Peck, 1996 (*ascutellaris* species group—subgroup *ascutellaris*), male paratype MZSP 27026. **A**, Aedeagus in frontal view of right lobe. **B–C**, Frontal view of the right lobe of aedeagus in progressive detail. cr = crest of right lobe; do = dorsal opening; fl = flagellum; irl = inner lobule of the right lobe; ll = left lobe; orl = outer lobule of the right lobe; pl = plate of right lobe; rl = right lobe.



**FIGURE 5.** *Adelopsis confluens* Gnaspini & Peck, 1996 (*ascutellaris* species group—subgroup *ascutellaris*), male paratype MZSP 27026. **A–C**, Aedeagus in dorsal view, with slight rotation towards apex, following the ‘sagittal’ plane of the aedeagus, in order to show the influence of the view in the recognition of the aedeagal shape. All figures to the same scale.

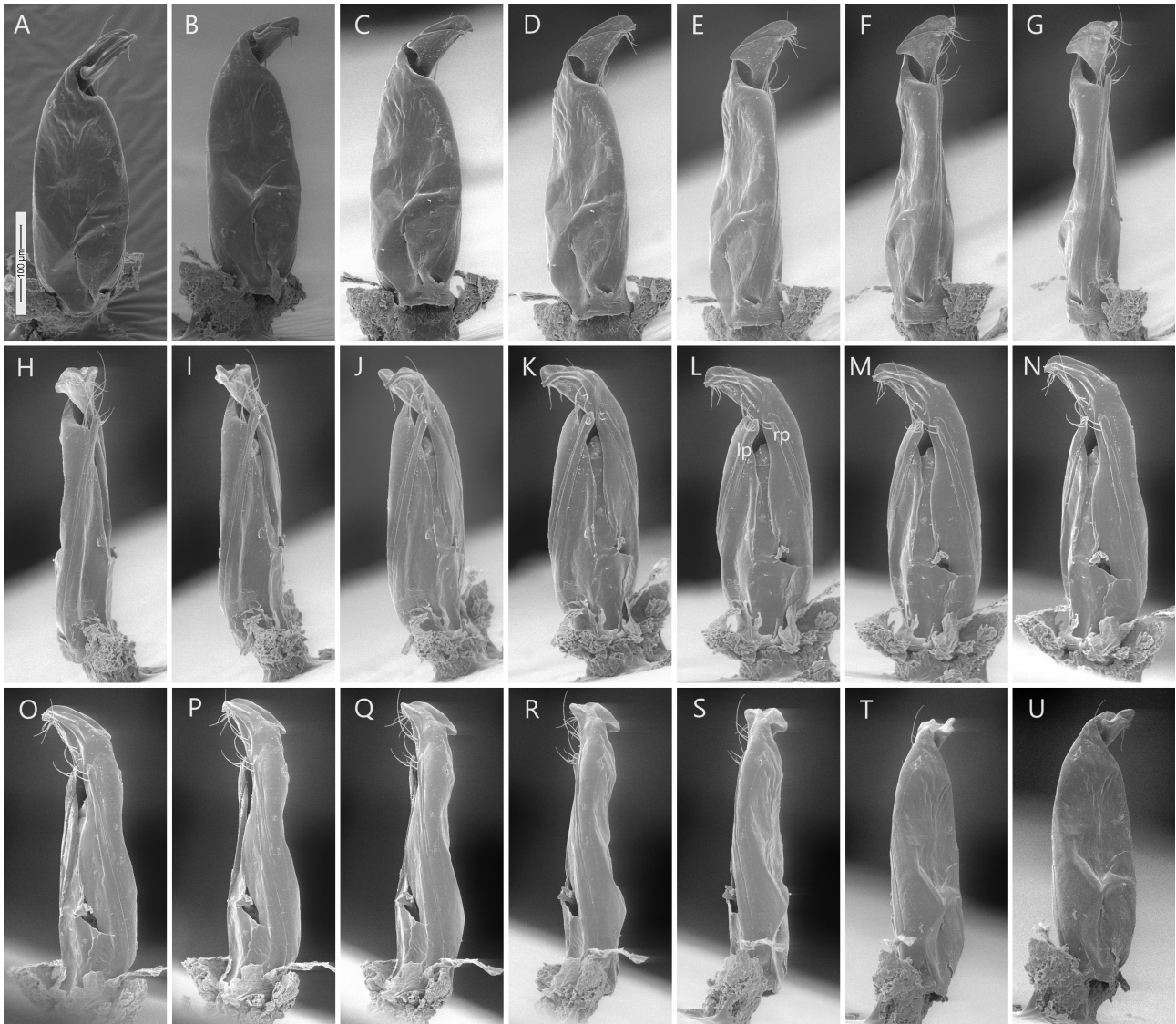
a.s.l., 09.V.1973; H.F. Howden leg.; Label: “Colombia: Magdalena: / San Lorenzo, 41km S Sta. / Marta, 7000’, 09.V.1973 / H. F. Howden”; 2 males, MZSP 27045 (here illustrated), 27046 (out of 2 male and 3 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~3.0), with ventral surface practically flat, except near its base (Figs. 6E, R), basal opening about 45°

downwards; width at least twice as big as height, widest about halfway from base (e.g., Fig. 6).

Right lobe (‘rl’—e.g., Figs. 7A, 8B, C) projects forward, narrowing towards its apex (i.e., with a subtriangular shape), forming a ‘crest’ (‘cr’—e.g., Figs. 7A, 8B, C)—the right side of this crest extends downward and bends ‘horizontally’, forming a small, ‘outer plate’ (‘opl’—e.g., Figs. 8B, C), whereas the left





**FIGURE 6.** *Adelopsis longipalpus* Gnaspi & Peck, 2001 (*ascutellaris* species group—subgroup *ruficollis*), male paratype MZSP 27045. A–U, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. lp = left paramere; rp = right paramere.

side also connects to a larger, ‘inner plate’ (‘ipl’) which projects toward the left side of the aedeagus and bends upward (e.g., Figs. 7D, 8B, C); where those plates meet, their margin are curved downward forming a V-shaped ‘beak’ (‘bk’—Fig. 7I), which bears, underneath, nine setae, projecting towards the body of the aedeagus (e.g., Fig. 7G)]; additionally, the right lobe bears three setae close to its base (i.e., a little ahead of the end of the right paramere—‘rbs’—e.g., Figs. 7I, J), and one of them is very elongate and projects forward (e.g., Figs. 7A, H, J, K)—it is not possible to recognize if the other two may be broken or actually shorter. The apical expansion of the right lobe is rotated in relation with the ‘horizontal’ plane of the aedeagus body, so that its right face can be observed on a dorsal view of the aedeagus (Fig. 6A), and its ventral face (almost at a completely frontal view) can be observed on a left view of the aedeagus (Fig. 6F).

A left lobe is ‘absent’ (“ll”—e.g., Fig. 7G); the ‘turning point’ is just dorsal to the left paramere (‘tp’—

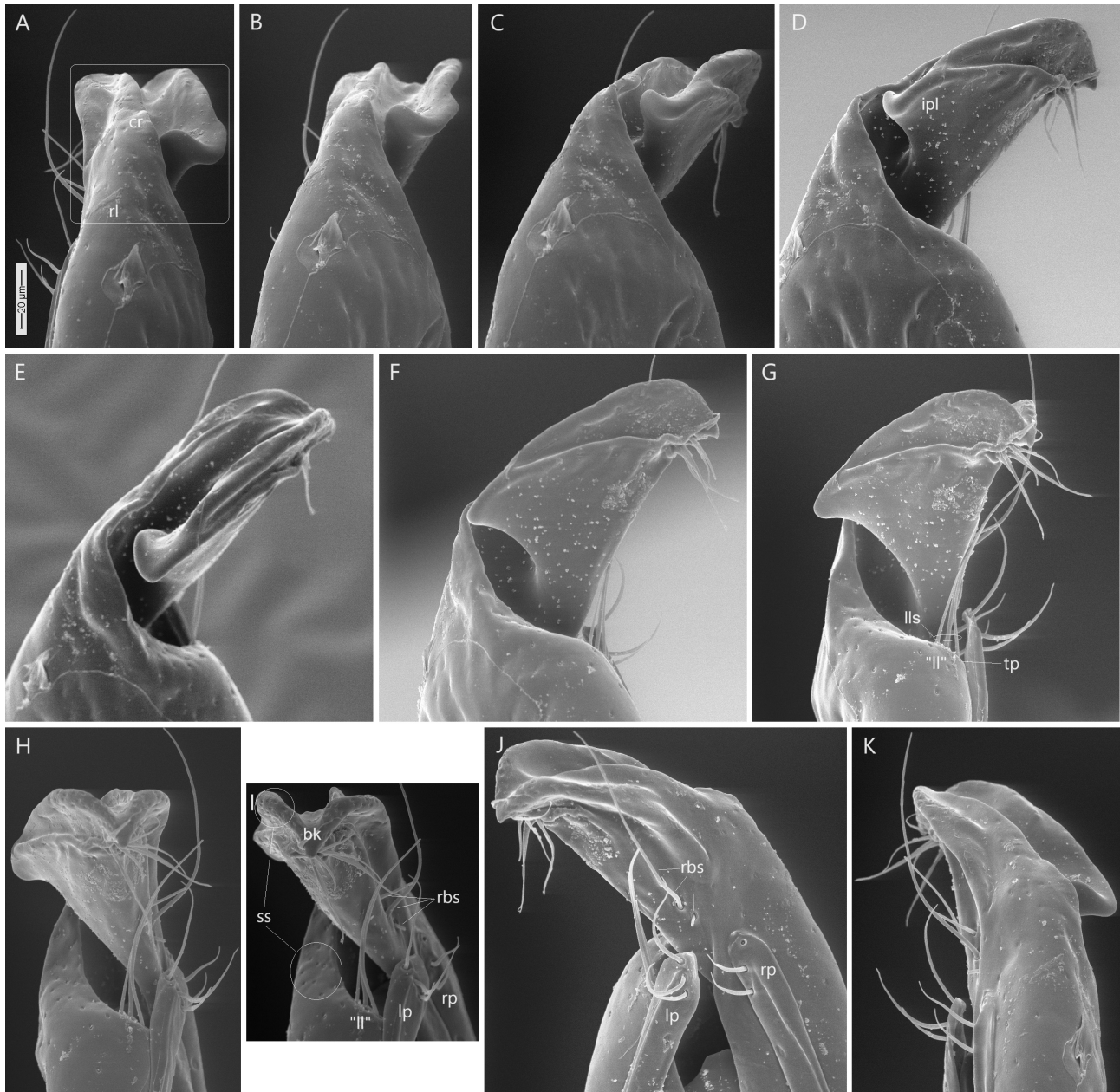
e.g., Fig. 7G); three elongate setae are placed just at the ‘turning point’ (‘lls’—e.g., Fig. 7G).

A dorsal opening is actually not clearly observed in dorsal view, although it is clear, at least in left lateral view, that there is a migration of the ventral genital opening towards the dorsal surface (e.g., Fig. 7). In left view, it takes ~23% of the total length of the aedeagus.

The sensory structures are densely distributed, especially on the margins of the V-shaped beak (‘ss’—e.g., Fig. 7I).

The parameres are somewhat narrow, and almost straight, having a curve close to their base (e.g., Fig. 6I); they ‘surround’ the aedeagus going from a dorsal placement near their base (Fig. 6A) to a ventral placement near their apex (Fig. 6L). The fused parameres can be recognized by the presence of a depression along the apical half of the ventral margin, but the basal half may not be recognized from the aedeagus body (e.g., Fig. 6). The left paramere (‘lp’) is somewhat shorter than the right paramere (‘rp’)





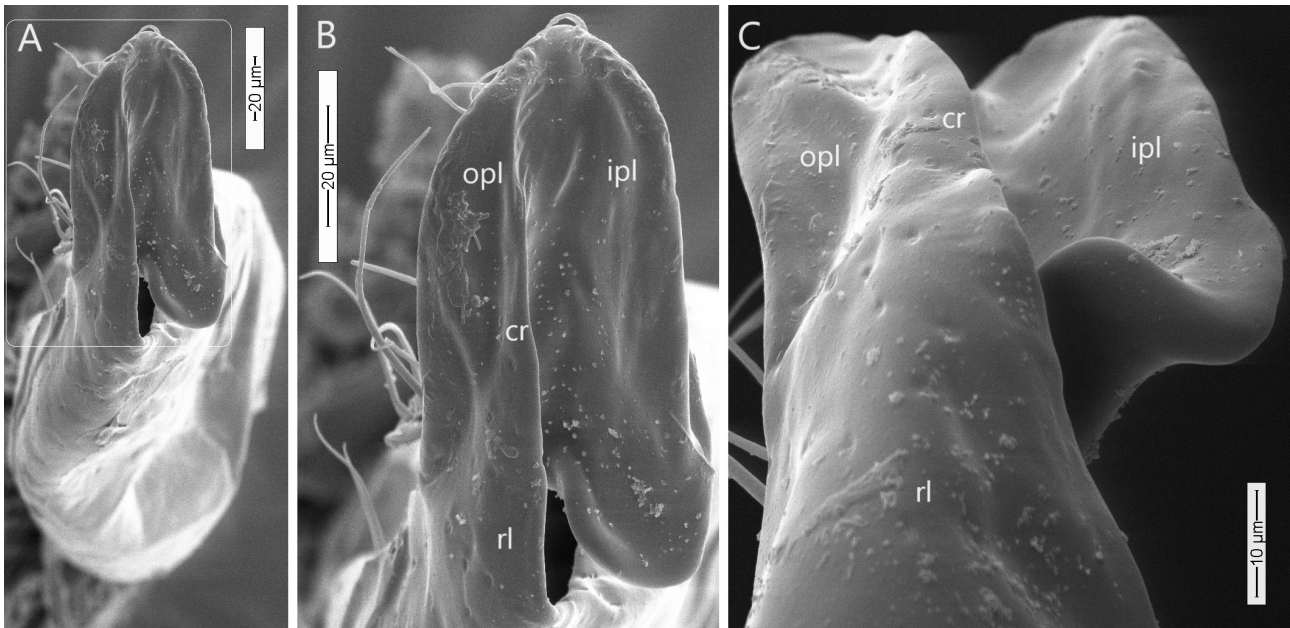
**FIGURE 7.** *Adelopsis longipalpus* Gnaspi & Peck, 2001 (*ascutellaris* species group—subgroup *ruficollis*), male paratype MZSP 27045. **A–K**, A rotational view of the apex of the aedeagus, around its ‘longitudinal’ axis, starting from the right lateral view. Note that the ‘sagittal’ plane of the apical region is rotated in relation with the ‘sagittal’ plane of the aedeagal body (see text for discussion). White square in **A** is detailed in Fig. 8C. All figures to the same scale. bk = V-shaped ‘beak’; cr = crest of right lobe; rpl = inner plate of right lobe; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

(e.g., Fig. 6L); the left paramere surpass the apical margin of the “left lobe” (e.g., Figs. 6L, 7I). Both parameres show a slight lateral expansion near the apex, which is slightly pointed; there are three setae aligned close to the ventral margin of the paramere, being the most apical one placed just at the apex (e.g., Fig. 7J).

The flagellum was originally described as ‘short and slightly sinuate’ (as in Gnaspi & Peck, 2001: figs. 16–18).

**Taxonomic remarks.** The figures here shown (taken with SEM) are much more informative than those from

the original description (see Gnaspi & Peck, 2001: figs. 16–18), and allowed the recognition of some important details not described originally, as, for instance, the V-shaped beak on the right lobe. Based on this ‘new’ view, *A. longipalpus* can be recognized by the presence of a V-shaped beak on the right lobe, which is rotated in relation to the aedeagus body. Actually, we here recognize that SEM images of additional species in *ascutellaris* species group are needed in order to identify details in the aedeagus which could help in the identification and phylogenetic placement of species.



**FIGURE 8.** *Adelopsis longipalpus* Gnaspi & Peck, 2001 (*ascutellaris* species group—subgroup *ruficollis*), male paratype MZSP 27045. **A**, Aedeagus in frontal view of right lobe. **B**, Frontal view of right lobe of aedeagus (detail from white rectangle in A). **C**, Detail from Fig. 7A. cr = crest of right lobe; ipl = inner plate of right lobe; opl = outer plate of right lobe; rl = right lobe.

### **Benardi species group Salgado, 2010 (sensu Gnaspi & Peck, 2019)**

In the species of *benardi* species group, the right lobe ('rl') is elongate (not much elongate in *A. boraceaia* sp. nov., *A. leo*, and *A. piruapuera*), curved ventrad (only slightly in *A. piruapuera*), and may bear a long 'arm' which narrows towards apex forming a narrow 'crest' ('cr'), or the right lobe may quickly narrow into a 'crest', depending on the species (except in *A. piruapuera*, in which the right lobe slowly widens towards its apex). The inner face of the crest/arm goes 'vertically' down toward the internal region; and the external face may also go 'vertically' down or it may be wide and curved ventrad (in most cases), depending on the species. The crest/arm widens again near the apex and the apical margin of the right lobe abruptly connects perpendicularly with a ventral surface which makes a curve towards the body of the aedeagus, forming a kind of 'ventral chin' ('vch'). In *A. claudina*, *A. gandarela* sp. nov., and *A. sacerdotis* sp. nov., just before the apical margin, the surface of the right lobe is slightly elevated (as can be seen in lateral views—'me'). Except in *A. gandarela* sp. nov. and *A. piruapuera*, the outer apical face of the right lobe bears medially a 'plateau' ('rlp'), which ventral apical margin is truncated and bears a variable number of setae, depending on the species; and additional setae and/or elevations may also be present.

The ventral projection of the apex of the right lobe can be observed and measured in lateral view and is here called the 'apical projection' ('ap'). In some species (*A. boraceaia* sp. nov., *A. caeteh* sp. nov., *A. gibber* sp. nov., *A. leo*, and *A. cf. szymczakowskii*), the posteriormost margin of the right lobe may bear an 'apical depression' ('ad'), variably shaped (being concave or convex) in the different species.

In several species (*A. caeteh* sp. nov., *A. insolita*, and *A. cf. szymczakowskii*—*benardi* species subgroup; *A. luculenta* Szymczakowski, 1963 and all species studied herein except *A. claudina*, *A. monticola* sp. nov., and *A. piruapuera*—*grouvellei* species subgroup), the flagellum is very robust and flat and makes a whole circumference inside the aedeagus body. Our interpretation is that this type of flagellum cannot be placed back inside the aedeagus body; but, using light microscopy, at least in one case it was possible to recognize that it can actually be pulled inside partially (Fig. 17A).

The internal knob ('kn') is variably shaped and its apex bears a group of probable sensory structures, shaped as a variably deep depression from the center of which emerges a small dome-shaped projection.

### **Benardi species subgroup Gnaspi & Peck, 2019**

#### ***Adelopsis* cf. *szymczakowskii* Gnaspi & Peck, 2019**

(Figs. 9–12)

*Adelopsis szymczakowskii* Gnaspi & Peck, 2019: 32 (assignment to *benardi* species group and subgroup); Peck *et al.*, 2020: 47.

**non** *Adelopsis benardi*—Szymczakowski, 1963: 670 (as “? *bernardi*” [sic]) [and figs. 8–9] (misidentification stated in Gnaspi, 1996: 540—Gnaspi & Peck, 2019: 32).

Holotype male in NMPC.

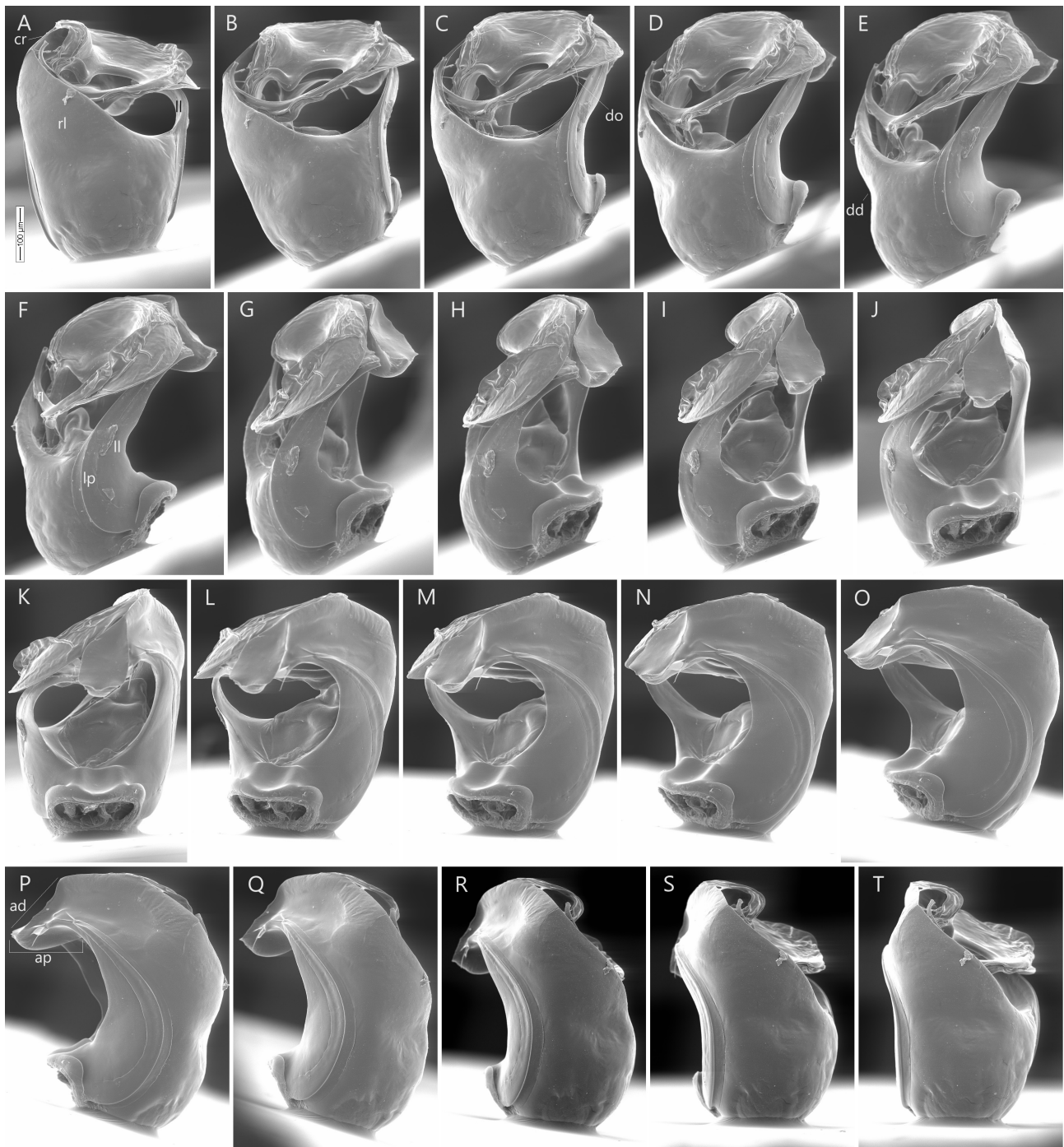
Type locality: São Paulo, São Paulo State, Brazil.

Distribution: Brazil: São Paulo State: known only from type locality.

Note: Specimen misidentified as *Adelopsis benardi* (Portevin, 1923) in Szymczakowski (1963: 670, as “? *bernardi*” [sic])—Gnaspi, 1996: 540; Peck *et al.*, 2020: 47.

Size (original description): Length: 2.5 mm.





**FIGURE 9.** *Adelopsis* cf. *szymczakowskii* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *benardi*), male MZSP 60994. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ad = apical depression; ap = apical projection; cr = crest of right lobe; dd = dorsal depression; do = dorsal opening; fl = flagellum; ll = left lobe; lp = left paramere; rl = right lobe.

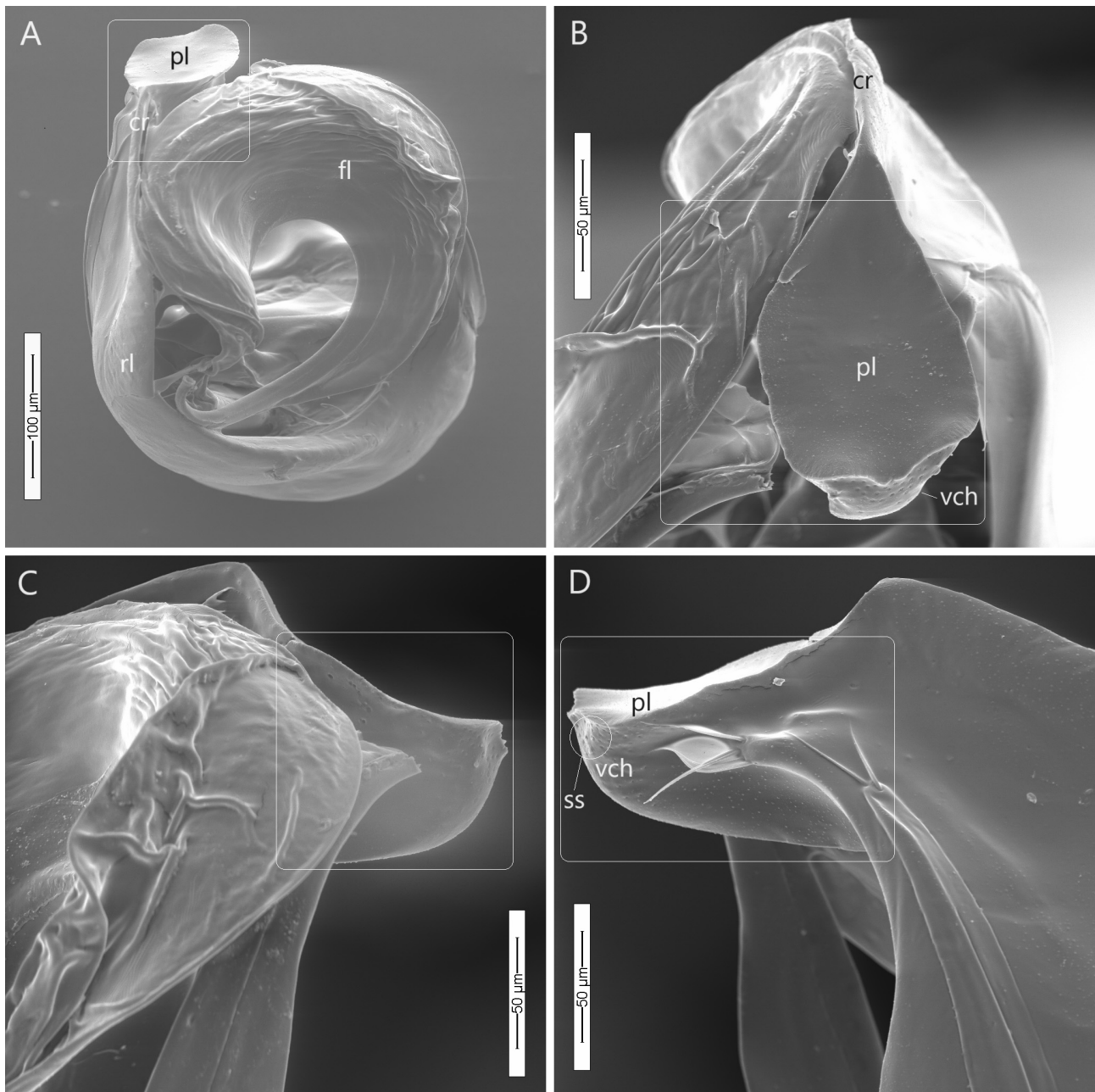
**Material examined.** BRAZIL—São Paulo:—Salesópolis, Estação Biológica de Boraceia [Boraceia Biological Station], Trilha dos Pilões—Moerliche; 23°38’S 45°53’W; I–IV.2003; J.S. Freitas leg.; Labels: “Brasil: SP: Salesópolis / Est. Biológica de Boraceia / Trilha dos Pilões—Moerliche /23°38’S 45°53’W / I–IV.2003 J.S.Freitas col.” and “E. Gomyde det.”; 1 male, MZSP 60994 (here illustrated), tentatively assigned to this species.

**Description of aedeagus of the specimen here**

**examined.** Aedeagus globose (l/w ~1.6, concavity ~39–47%; concavity/total length = ~35–38% [Figs. 9E, P, 12]), basal opening 90° downwards; width about as big as height near base but widening towards apex, widest near apex (e.g., Fig. 9).

Right lobe (‘rl’—e.g., Figs. 9A, 10A) elongate and narrowing into a ‘crest’ (‘cr’—e.g., Figs. 9A, 10A, B) with a wide external face; from the apex, the right lobe enlarges and bend ventrad, forming a descending ‘plate’ (‘pl’—e.g., Figs. 10A, B, D), which has an apical ‘doubled





**FIGURE 10.** *Adelopsis* cf. *szymczakowskii* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *benardi*), male MZSP 60994. **A**, Aedeagus in frontal view of right lobe. **B–D**, Apex of aedeagus in ventral, left, and right views, respectively. White squares are detailed in Fig. 11. cr = crest of right lobe; fl = flagellum; pl = plate of the right lobe; rl = right lobe; ss = sensory structure; vch = ‘ventral chin’ of the right lobe.

beak’ (‘bk’) medially (e.g., Figs. 11B, D); the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Figs. 10B, D). The outer ‘plateau’ (‘rlp’) bears five setae (e.g., Fig. 11D); a little behind, close to its base, there is a low and elongate elevation (‘rlc’), with no seta nearby (e.g., Fig. 11D). The ‘apical projection’ (‘ap’—e.g., Fig. 9P) % length = ~22–24%, % height = ~37–41%. The concave ‘apical depression’ (‘ad’—e.g., Fig. 9P) % depth = ~44–56%, % height = ~33–34%.

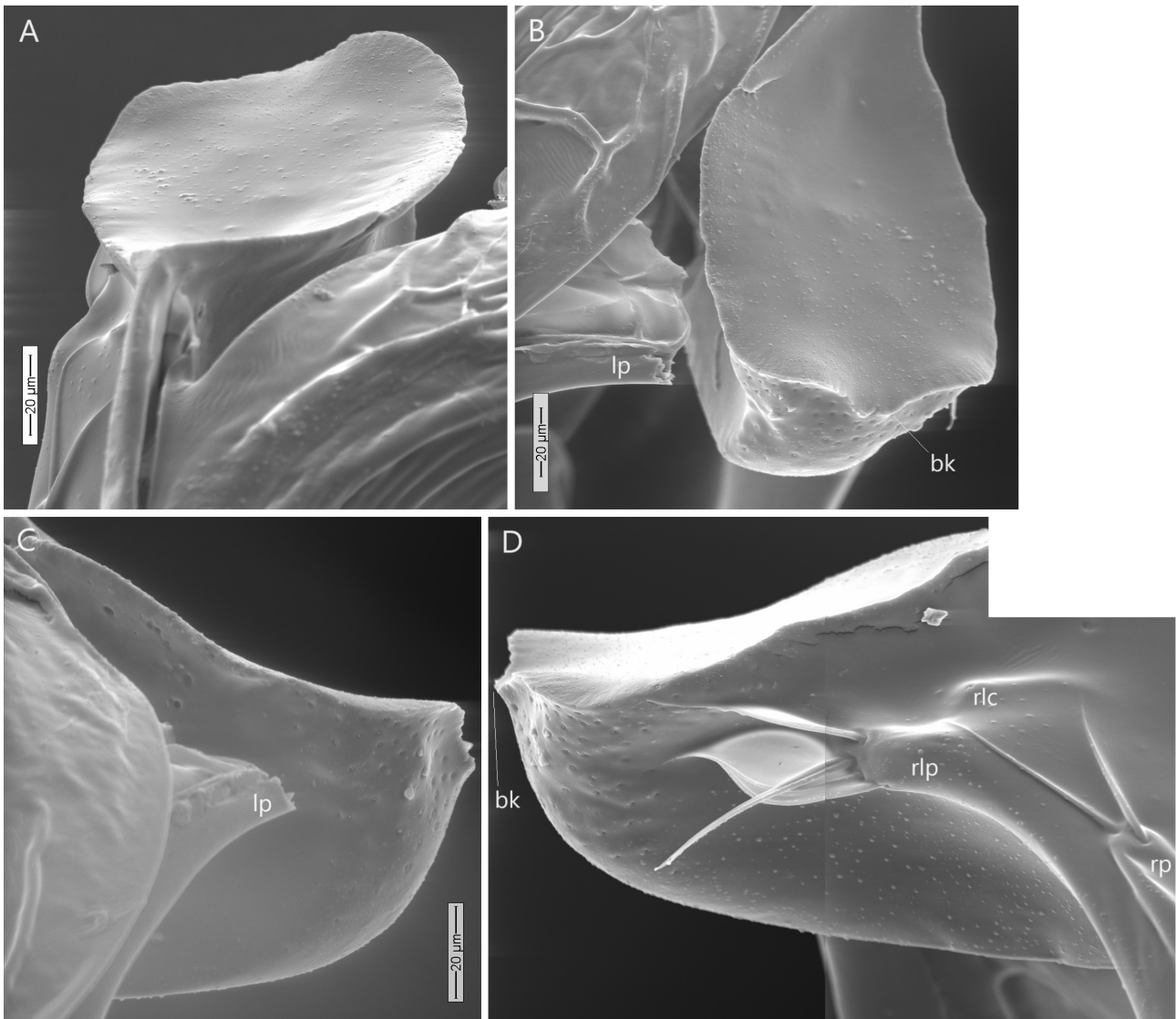
The left lobe (‘ll’) is a narrow stripe which makes a curve towards the ventral-apical region of the aedeagus (e.g., Figs. 9A, F); its apex cannot be properly seen because it is covered by the very large flagellum (Figs. 9,

10A—‘fl’); it might reach the inner face of the right lobe, but it might be broken, as can be taken by the fact that the left paramere is broken at its apex (‘lp’—e.g., Figs. 11B, C).

The dorsal opening (‘do’—e.g., Fig. 9C) is very ample (being probably related with the widening of the apical region of the aedeagus, as mentioned before), taking ~60–62% of the total length of the aedeagus.

The sensory structures concentrate on the apical expansion of the right lobe, densely on the ‘ventral chin’, in which the dome-shaped projections have different sizes (‘ss’—e.g., Fig. 10D).

The somewhat narrow fused parameres can be



**FIGURE 11.** *Adelopsis* cf. *szymczakowskii* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *benardi*), male MZSP 60994. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—in detail from Fig. 10 (D is slightly rotated from 10B). C and D to the same scale. bk = beak; lp = left paramere; rlc = elevation near the base of the right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere.

recognized by the presence of a depression along the length of the right paramere, but parts of the ventral margin of the left paramere cannot be recognized from the aedeagus body (e.g., Fig. 9). The left paramere (‘lp’) is fused to the left lobe of the aedeagus (‘ll’), being not possible to recognize if it totally or only partially covers the left lobe (especially because this region is covered by the large flagellum, as cited before—e.g., Fig. 9F); it is not possible to evaluate its length or the placement and number of apical setae because its apex is broken, as cited before (e.g., Figs. 11B, C). The right paramere (‘rp’) has a rounded apex which bears a pair of setae, projecting forward (e.g., Fig. 11D).

The flagellum (‘fl’—e.g., Fig. 10A) is very robust—it seems to be narrow inside the aedeagus and, as soon as it emerges from the dorsal opening, it strongly widens and makes a curve, practically completing a whole circumference, staying wide for more than half its length

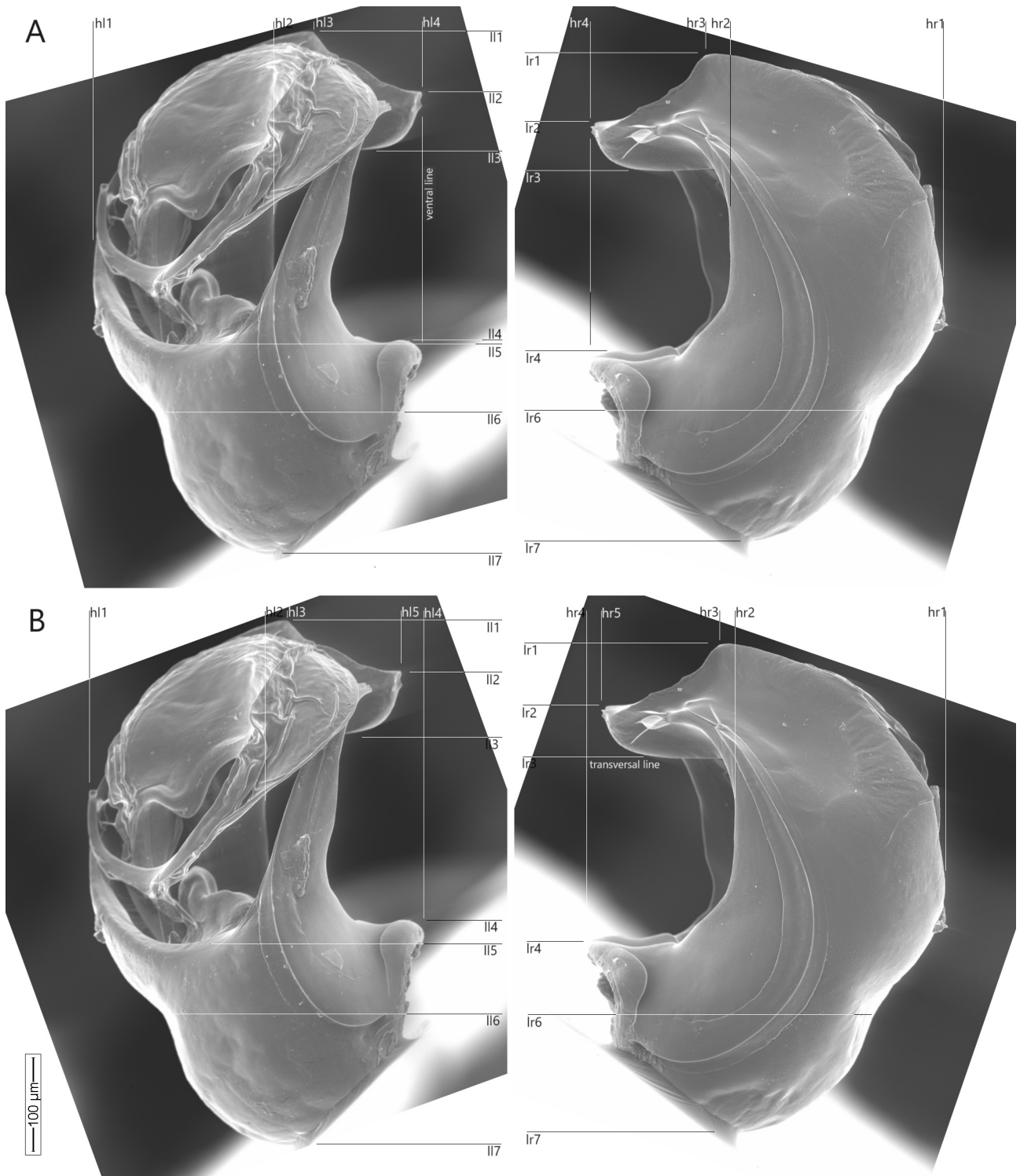
and it slowly narrows toward its apex, which opens just after a sharp curve inward.

The internal knob could not be observed and described—it is probably covered by the large flagellum.

There is a low transversal ‘dorsal depression’ (‘dd’—e.g., Fig. 9E); position = ~25–28%.

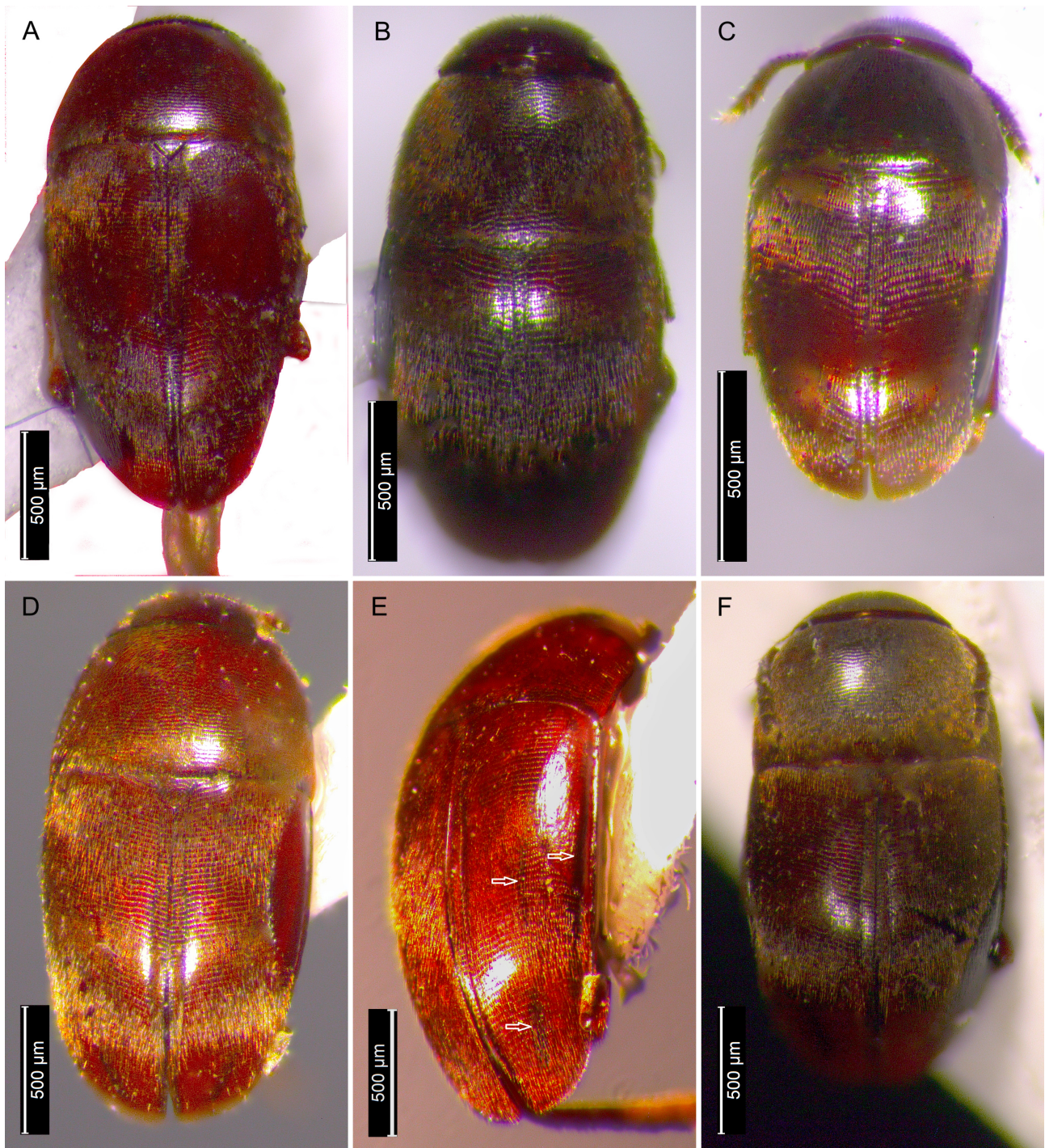
**Taxonomic remarks.** Gnaspini & Peck (2019: 32) discussed that the lateral view of the aedeagus (their fig. 143), together with the frontal view of the tip of the right lobe of the aedeagus (their fig. 145) and the coiled tape shaped flagellum (their fig. 143), seems to help in the recognition of this species. There are other species with an ample dorsal opening and a coiled flagellum. For instance, the drawing of the flagellum in the original description of *A. insolita* (Szymczakowski, 1961: fig. 10) resembles the image here observed; unfortunately, the drawings of the aedeagus in the redescription by Gnaspini & Peck (2019: figs. 128–131) are not clear—however, because





**FIGURE 12.** *Adelopsis cf. szymczakowskii* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *benardi*), male MZSP 60994. **A–B**, Lateral views of aedeagus, reproduced from Figs. 9E and P, rotated, and used for morphometrical analysis (see text for explanations). **A**, Alignment based on a ventral line connecting the ventralmost edge of the ventral opening and the ventralmost edge of the apex of the right lobe of the aedeagus. **B**, Alignment based on a ‘transversal’ line aligned with the internal margin of the projection of the apex of the right lobe of the aedeagus. hl1–hl4, hr1–hr4, ll1–ll7, lr1–lr7, ‘ventral line’, and ‘transversal line’ are lines used for making measurements—see text (Methods) for description.





**FIGURE 13.** *Adelopsis* spp., male habitus. **A**, *Adelopsis boraceia* Gnaspini & Gomyde, new species, male paratype MZSP 61002. **B**, *Adelopsis monticola* Gnaspini & Gomyde, new species, male paratype MZSP 61018. **C**, *Adelopsis gibber* Gnaspini & Gomyde, new species, male holotype MZSP 61023. **D–E**, *Adelopsis ilhabela* Gnaspini & Gomyde, new species, male holotype MZSP 61025 (arrows show dark marks on elytra). **F**, *Adelopsis gandarela* Gnaspini & Gomyde, new species, male holotype MZSP 59462.

those authors examined the holotypes of both species, we understand that they considered them as different species. (See also ‘Taxonomic remarks in *benardi* species group’).

We tentatively assigned this specimen to *Adelopsis* cf. *szymczakowskii* because the aedeagus resembles that originally described in Gnaspini & Peck (2019: figs. 143, 144), especially the shape of the apex of the right lobe and the coiled, flat flagellum. We made the same morphometric

calculations based on fig. 143 from Gnaspini & Peck (2019), and achieved the following results: concavity/total length = 38%; length of apical projection/total length = 25%; depth of apical depression/apex length = 47%; depth of dorsal opening/total length = 58%; position of dorsal depression (from bottom)/total length = 31%; and height of apical depression/total height = ~35%. These values are mostly very similar or at least close enough to those taken from the specimen here examined. However,

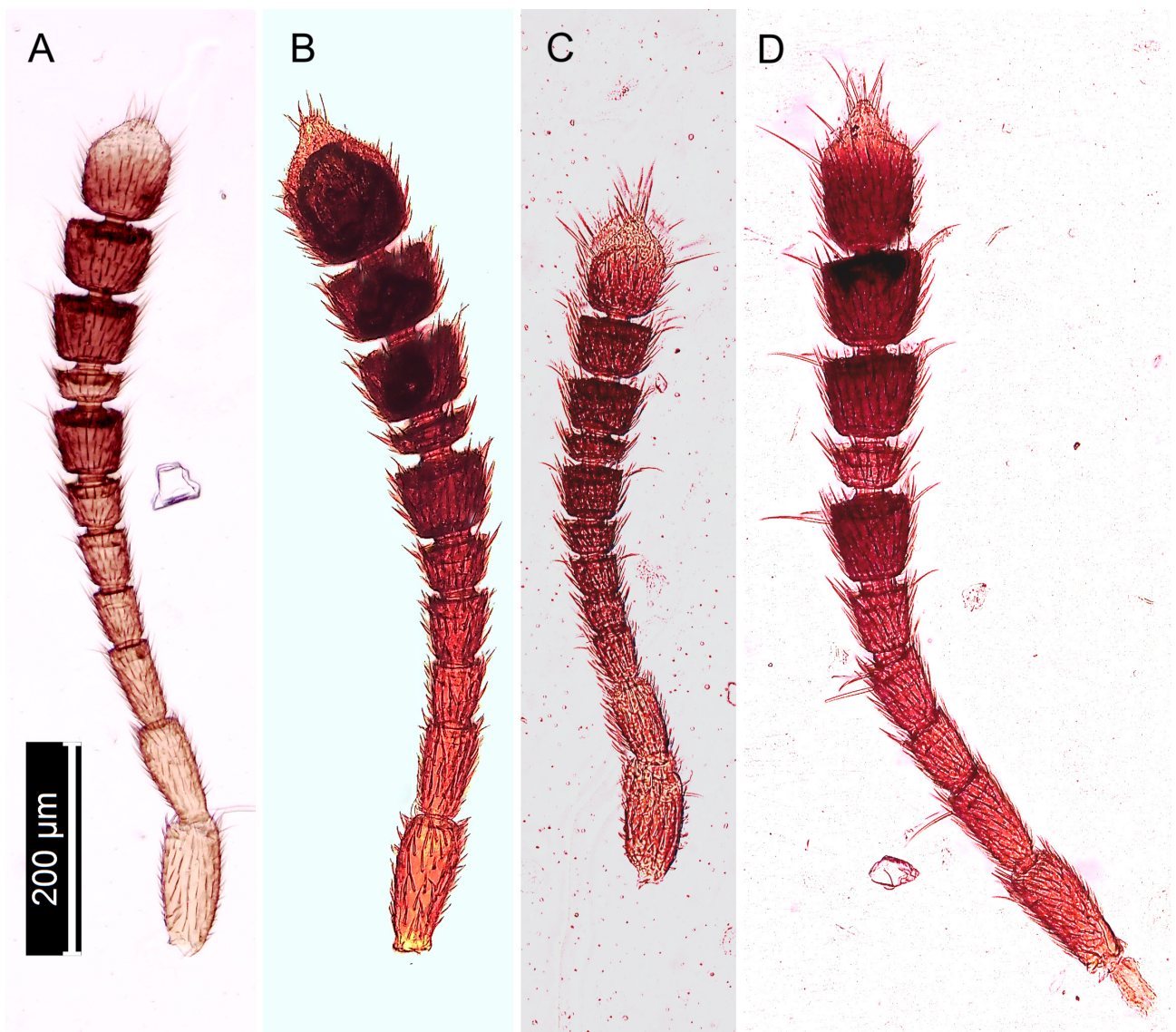


(1) line drawings in Gnaspini & Peck (2019) were made several years before and some were not complete; (2) SEM images help identifying important taxonomic details (as observed in several species treated here); and (3) we recently noted that the *benardi* species group is much more speciose than previously thought, and differences were recognized especially on the apex of the right lobe of the aedeagus as well as the general shape of the aedeagus and parameres, leading us to describe species even from the same locality (as is the case for the new species here described). Therefore, we plan to examine again the type of *A. szymczakowskii* in order to make images with more advanced techniques, which could help us very if this specimen indeed belongs in that species or in a different, probably undescribed species.

***Adelopsis caeteh* Gnaspini & Gomyde, new species**  
 urn:lsid:zoobank.org:act:C3FECEB4-2644-4D2B-8AE1-3EEA66C26067  
 (Figs. 14A, 15A, 16A, 17A, 18A, 19–22)

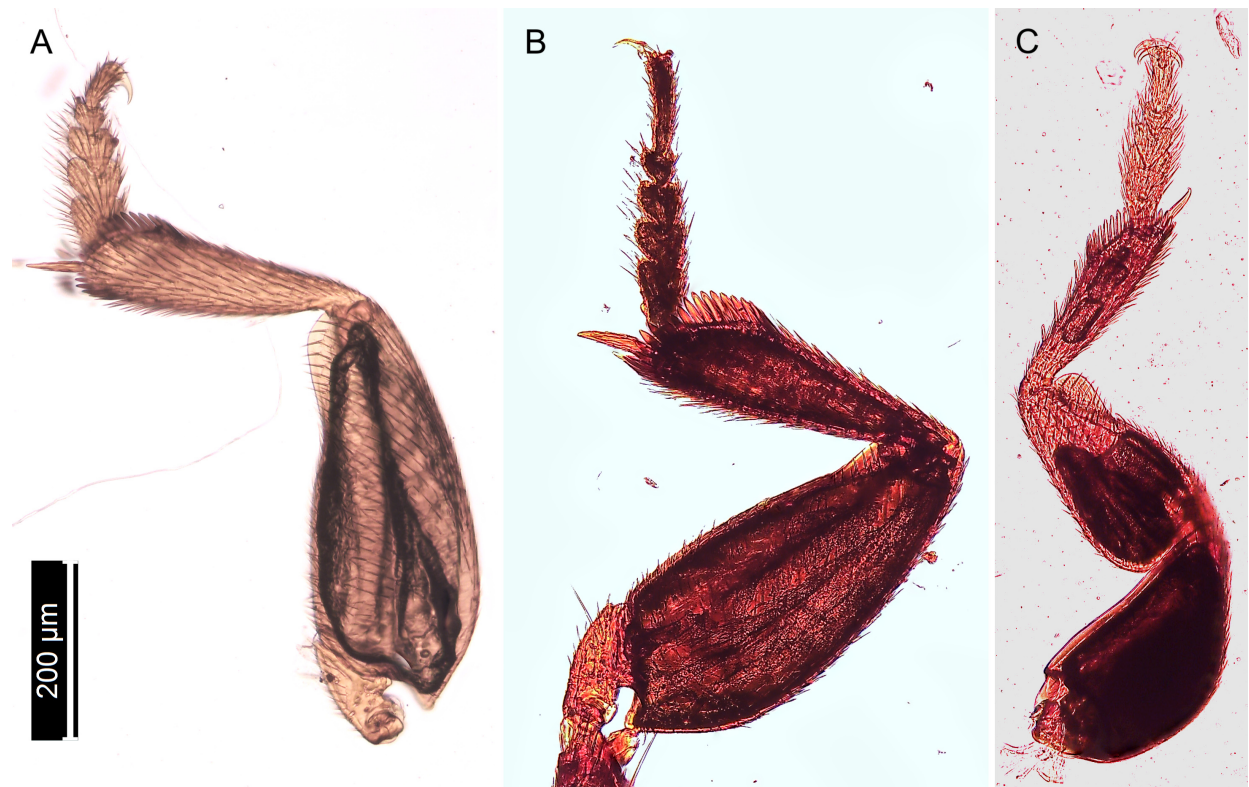
Type locality: Caeté, Minas Gerais State, Brazil.

**Material examined. Holotype male:** BRAZIL—**Minas Gerais:**—Caeté; 6–8.VII.2011; Caetano & Gudin leg.; “Proj. Mina Apolo - Vale/Amplo” [Project]; Pitfall trap A1-Pt01; MF41 [collection code]; Labels: “Caeté—MG / Proj. Mina Apolo - / Vale/Amplo / 6–8.VII.2011 / Caetano & Gudin col.”, “Coletado com Pitfall / A1-Pt01”, and “MF41”; MZSP 61027. **Paratypes:**—same data and label as for holotype; Pitfall trap A1-Pt8; additional labels “Coletado com Pitfall / A1-Pt8”, and “MF41”; 1 male, 3 females, MZSP male 61028 (here illustrated), females

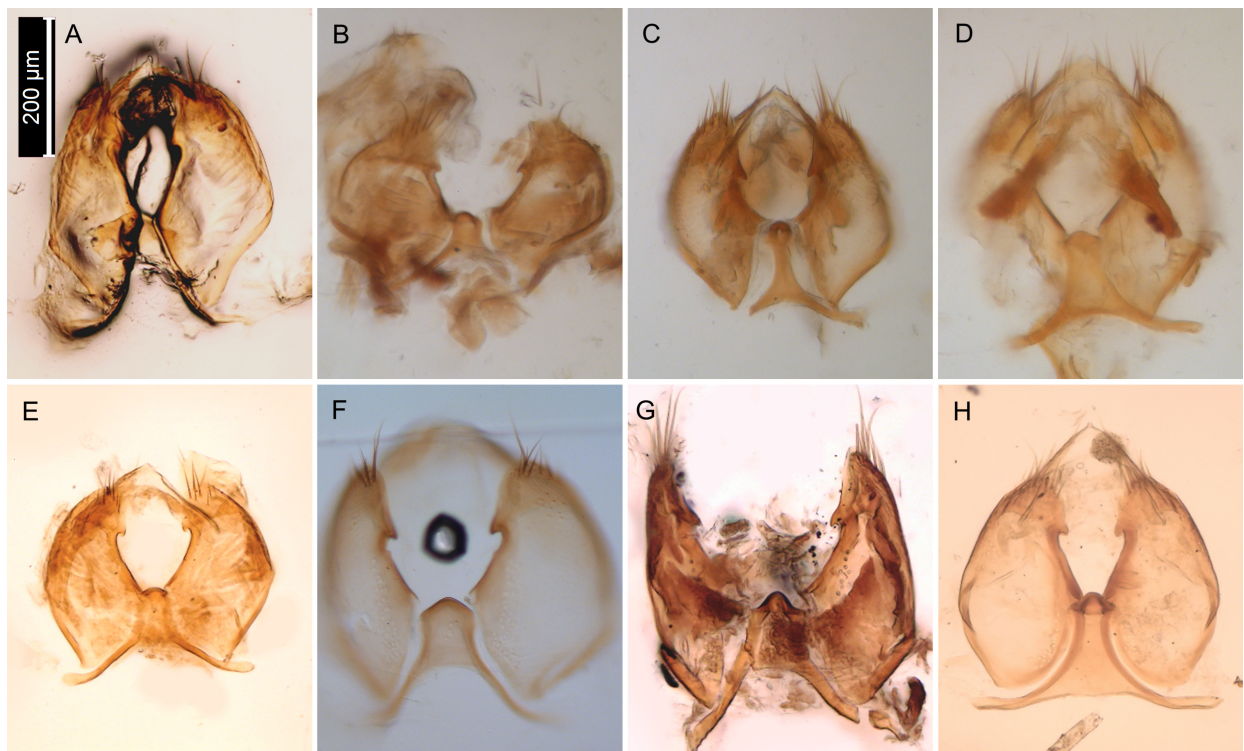


**FIGURE 14.** *Adelopsis* spp., male antenna. **A**, *Adelopsis caeteh* Gnaspini & Gomyde, new species, male holotype MZSP 61027. **B**, *Adelopsis monticola* Gnaspini & Gomyde, new species, male paratype MZSP 61018. **C**, *Adelopsis gibber* Gnaspini & Gomyde, new species, male holotype MZSP 61023. **D**, *Adelopsis gandarela* Gnaspini & Gomyde, new species, male holotype MZSP 59462. All figures to the same scale. Antennomere 1 missing in Figs. B and D.



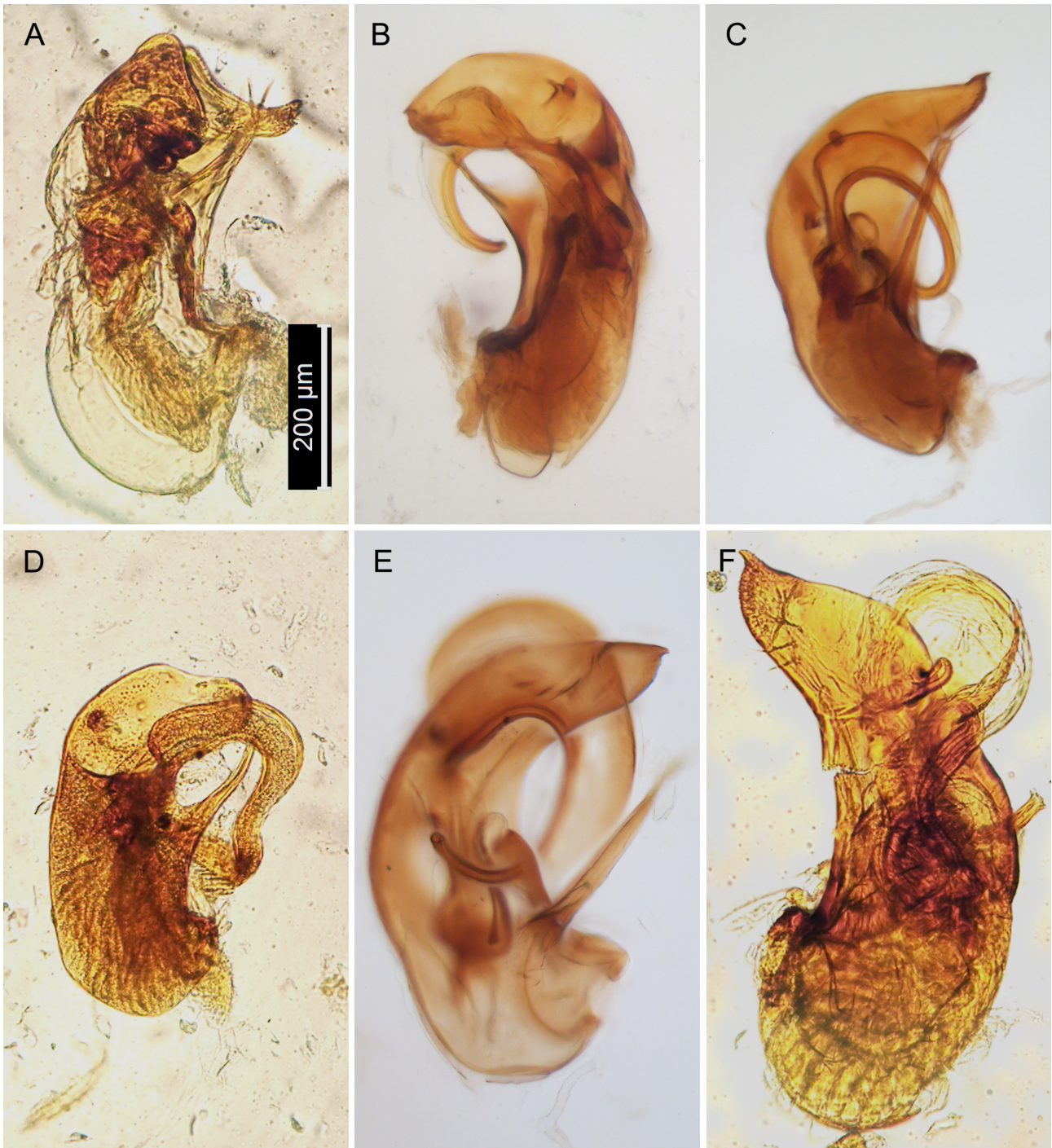


**FIGURE 15.** *Adelopsis* spp., male proleg. **A**, *Adelopsis caeteh* Gnaspini & Gomyde, new species, male holotype MZSP 61027. **B**, *Adelopsis monticola* Gnaspini & Gomyde, new species, male paratype MZSP 61018. **C**, *Adelopsis gibber* Gnaspini & Gomyde, new species, male holotype MZSP 61023. All figures to the same scale.



**FIGURE 16.** *Adelopsis* spp., male genital segment. **A**, *Adelopsis caeteh* Gnaspini & Gomyde, new species, male holotype MZSP 61027. **B**, *Adelopsis boraceia* Gnaspini & Gomyde, new species, male paratype MZSP 61012. **C**, *Adelopsis monticola* Gnaspini & Gomyde, new species, male holotype MZSP 61017. **D**, *Adelopsis vanini* Gnaspini & Gomyde, new species, male holotype MZSP 61022. **E**, *Adelopsis gibber* Gnaspini & Gomyde, new species, male holotype MZSP 61023. **F**, *Adelopsis ilhabela* Gnaspini & Gomyde, new species, male paratype MZSP 61026. **G**, *Adelopsis gandarela* Gnaspini & Gomyde, new species, male holotype MZSP 59462. **H**, *Adelopsis sacerdotis* Gnaspini & Gomyde, new species, male holotype MZSP 61031. All figures to the same scale.



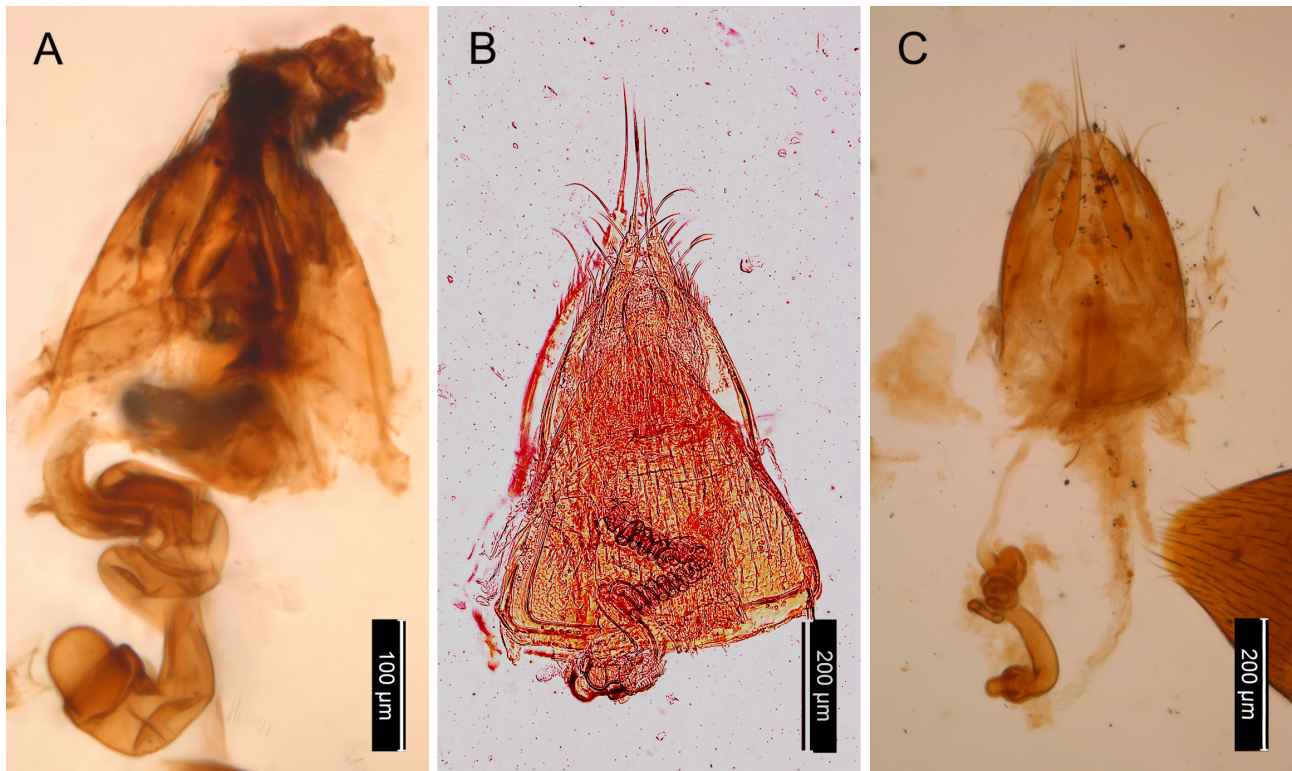


**FIGURE 17.** *Adelopsis* spp., male aedeagus. **A**, *Adelopsis caeteh* Gnaspini & Gomyde, new species, male holotype MZSP 61027. **B**, *Adelopsis boraceia* Gnaspini & Gomyde, new species, male paratype MZSP 61012. **C**, *Adelopsis monticola* Gnaspini & Gomyde, new species, male paratype MZSP 61018. **D**, *Adelopsis gibber* Gnaspini & Gomyde, new species, male paratype MZSP 61024. **E**, *Adelopsis ilhabela* Gnaspini & Gomyde, new species, male paratype MZSP 61026. **F**, *Adelopsis gandarela* Gnaspini & Gomyde, new species, male paratype MZSP 59456. All figures to the same scale.

61016, 61029, 61030 (here illustrated);—same data and label as for holotype; Berlese Funnel Extractor A1-Pt6; additional labels “Coletado com funil de Berlese / A1-Pt6”, and “MF41”; 1 female, MZSP 61143;—same data and label as for holotype; Leaf litter sample AP-54; MF13 [collection code]; additional labels “Folhico / AP-54”, and “MF13”; 1 female, MZSP 61144. Note: The specimen referred above as ‘male’ 61028 (because its aedeagus was

dissected) was mounted on cardboard with ‘the opposite sex first half’ (i.e., the cardboard had prothorax+head from a female and second half of body [meso/metathorax + abdomen] from a male) and the cardboard with the specimen referred as ‘female’ 61029 had prothorax+head from a male and second half of body from a female—we believe that those specimens were broken inside a vial and mistakenly ‘put together’ during preparation of the





**FIGURE 18.** *Adelopsis* spp., female spermatheca. **A**, *Adelopsis caeteh* Gnaspini & Gomyde, new species, female paratype MZSP 61030. **B**, *Adelopsis ilhabela* Gnaspini & Gomyde, new species, female paratype MZSP 61014. **C**, *Adelopsis gandarela* Gnaspini & Gomyde, new species, female paratype MZSP 59457.

pinned specimens; the specimen with the male genitalia was dissected and used for SEM, but it was not assigned as holotype, because it was not a complete specimen. We kept them as they were.

**Diagnosis and Description.** Length (holotype): 1.35 mm; width: 0.75 mm. General characteristics as listed above. Body ovoid, convex; color dark redish brown. Head integument punctuated, punctures not organized in strigae. Eyes normal. Antenna (Fig. 14A)—proportions of length of each antennomere and that of the 9th from 1st to 11th: 2.1, 1.7, 1.25, 0.95, 0.85, 0.85, 1.1, 0.5, 1.0, 1.1, 1.6; proportions of length and width of each antennomere from 1st to 11th: 2.3, 2.25, 1.95, 1.45, 1.15, 1.1, 1.05, 0.5, 0.75, 0.85, 1.25. Pronotum transverse; integument with transverse strigae. Elytra together 1.1 times as long as wide; with transverse, slightly diagonal, strigae. First four male protarsomeres expanded (Fig. 15A), with discoidal tenent setae ventrally. First segment of male protarsus 0.55 times as wide as the maximum width of tibia; proportions of length and width of each protarsomere, from 1st to 5th: 1.45, 1.1, 1.05, 1.1, 3.75. Male mesotibia curved internally. Male metatibia straight. Male genital segment with spiculum gastrale short and wide, and divided at apex, with long branches (Fig. 16A).

Aedeagus somewhat globose (l/w ~1.9, concavity ~28–31% [ventral alignment] or ~26% [transversal alignment]; concavity/total length = ~41–42% [both alignments] [Figs. 17A, 19F, P]), basal opening almost 90° downwards; as wide as high, widest a little below halfway from base (e.g., Fig. 19).

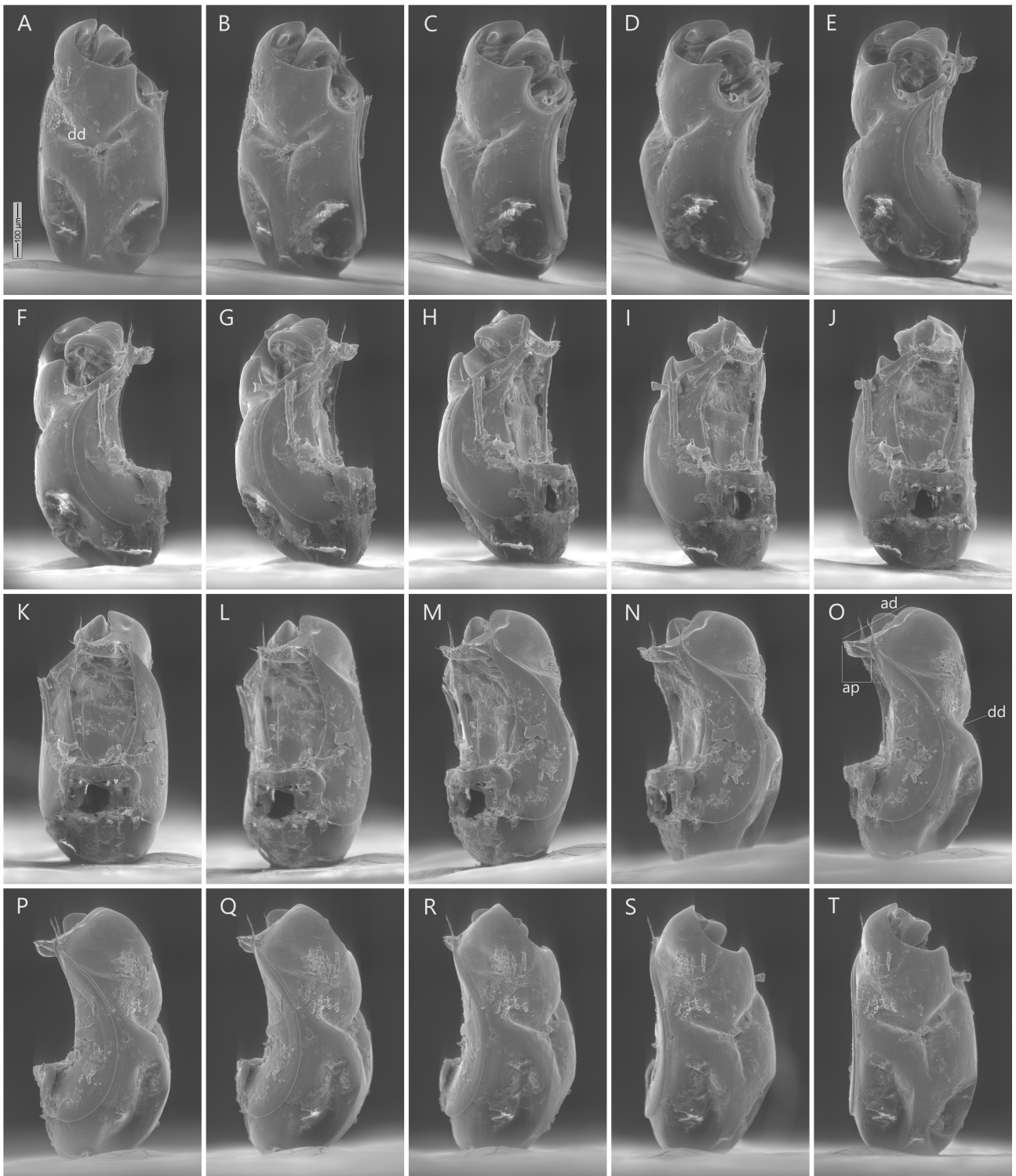
Right lobe ('rl'—e.g., Fig. 21A) elongate, with a long 'arm' ('arm'—e.g., Figs. 20A, 21A) with a wide external face; near the apex, the arm widens again, forming a plate which shapes like a 'four-toed human left foot' (e.g., Figs. 20B, C), and its apical margin abruptly connects to a 'ventral chin' ('vch'—e.g., Figs. 21A, B). The outer apical face of the right lobe bears (probably) three long setae, projecting forward, which may be (in comparison with other species here described) associated with a 'plateau' ('?rlp'—Fig. 20B)—unfortunately, this region is covered with debris and with the apex of the right paramere, not allowing a precise description. The 'apical projection' ('ap'—e.g., Fig. 19O) % length = ~19–20%, % height = ~29–32%. The concave 'apical depression' ('ad'—e.g., Fig. 19O) % depth = ~63–66%, % height = ~51–55%.

The left lobe ('ll') is a short and somewhat narrow stripe which goes straight posteriad towards the apex of the right lobe of the aedeagus (e.g., Fig. 21B); its round apical margin bears at least one seta projecting forward ('lls'—e.g., Fig. 21B—there is some debris covering the area, not allowing a precise observation).

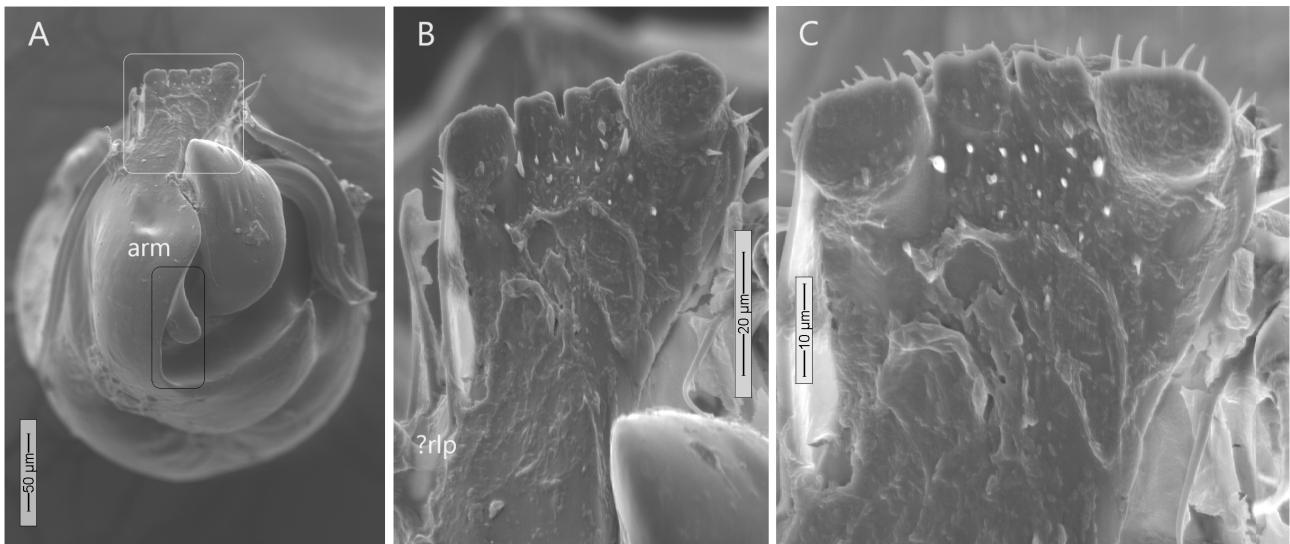
The dorsal opening ('do'—e.g., Fig. 21A) takes ~29% of the total length of the aedeagus; close to left lobe of the aedeagus, its margin projects forward, reminding a 'hump' ('hm'—e.g., Fig. 21A).

The sensory structures ('ss'—e.g., Fig. 21C) concentrate on the apex of the dorsal surface of the right lobe and on the 'ventral chin', where they have a shallow depression with a droplet-shaped projection or a conic projection ('ss'—e.g., Fig. 22A).





**FIGURE 19.** *Adelopsis caeteh* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *benardi*), male paratype MZSP 61028. **A–T**, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ad = apical depression; ap = apical projection; dd = dorsal depression.



**FIGURE 20.** *Adelopsis caeteh* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *benardi*), male paratype MZSP 61028. **A**, Aedeagus in frontal view of right lobe (white square is detailed in **B**. and **C**.—slightly rotated towards apex, in relation to each other; black rectangle is detailed in Fig. 22B). arm = arm of the right lobe; ?rlp = ‘plateau’ near the base of the right lobe.

The somewhat wide fused parameres can be recognized by the presence of a depression along their length, but the basal part of the ventral margin cannot be recognized from the aedeagus body; the apex of the left paramere is free beyond the margin of the dorsal opening (e.g., Fig. 19). The parameres have about the same length, and the right paramere is shorter than the right lobe, whereas the left paramere is slightly longer than the left lobe. They show a narrowing near the apex, which is pointy and bears three aligned setae (e.g., Figs. 21B, D).

The flagellum (‘fl’—e.g., Figs. 21A, C) has a robust, swollen base, and practically makes a whole circumference, covering the space of the dorsal opening.

The internal knob (‘kn’—e.g., Figs. 21C, 22B, C) is short and round; the few apical sensory structures have a shallow depression.

There is a low transversal ‘dorsal depression’ (‘dd’—e.g., Fig. 19O), which branches medially forming a depression which follows the ‘sagittal’ plane of the aedeagus towards the base of the aedeagus—the transversal and ‘sagittal’ depressions together shape as a ‘Y’ (‘dd’—e.g., Fig. 19A); position = ~55–56%.

**Female description.** We admitted the three females with the same data of males and two additional females of the same locality to belong to this species. They are similar to males, except for the non-expanded protarsus. Spermatheca coiled with 4-turns, bearing a globose apical bulb (Fig. 18A).

**Etymology.** The name is given as a noun in apposition, referring to the type locality.

**Distribution.** Brazil: Minas Gerais State: known only from the type locality.

**Taxonomic remarks.** The aedeagus in *A. caeteh* sp. nov. can be promptly recognized among the other known species in *Adelopsis* because its apical projection is very thin in lateral view (similarly to *A. piruapuera* Gnaspini, 1993—e.g., Fig. 37A), and, in frontal view, it has three

narrow longitudinal slits which result in the shape of a four-toed human foot. Together with *A. gibber* sp. nov., they can be recognized from the other species in *Adelopsis* by the presence of a forward projection on the margin of the dorsal opening of the aedeagus (shaped like a hump), but their aedeagus are very different from each other. Due to the typical shape of the male genital segment, the species is here placed in *benardi* species subgroup. (See also ‘Taxonomic remarks in *benardi* species group’).

#### ***Grouvellei* species subgroup Gnaspini & Peck, 2019**

In all species of the *grouvellei* species subgroup here studied, the sides of the ‘ventral chin’ of the aedeagus bear ‘tubercles’ (‘tb’—e.g., Figs. 26B, 48A, C, 59B).

Note: In the material we examined from Boraceia Biological Station, we had females from which we dissected at least four different types of spermathecae. Because many species of *Adelopsis* are very similar externally, we were not able to relate females to males and define to which species they belonged, except for *A. diabolica* Gomyde & Gnaspini, 2019, for which we achieved success after an extensive morphological analysis with SEM (see discussion in Gomyde & Gnaspini, 2019). Therefore, we prefer not to assign females to the following species here described: *A. boraceia* sp. nov., *A. gibber* sp. nov., *A. monticola* sp. nov., and *A. vanini* sp. nov.

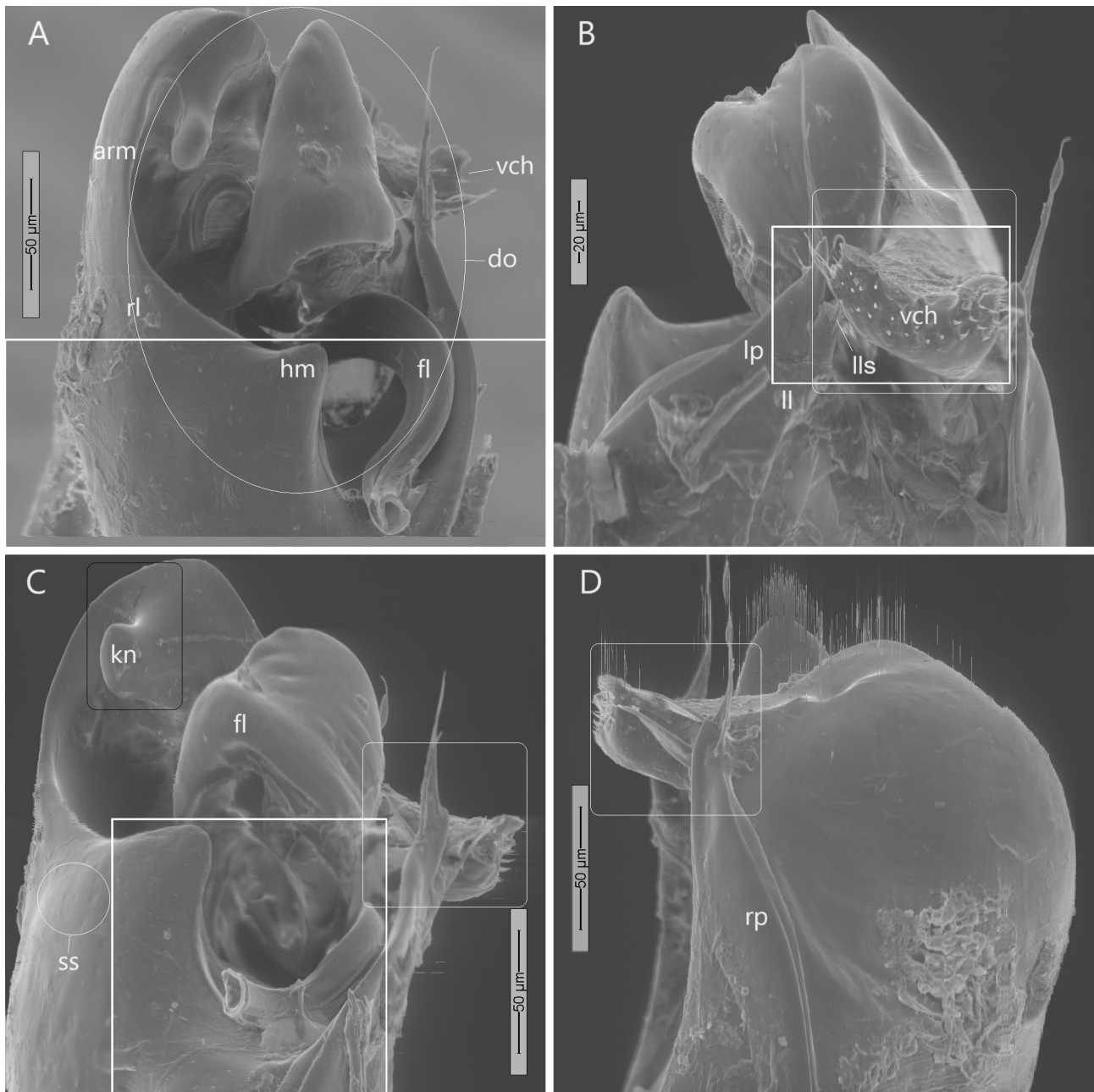
#### ***Adelopsis claudina* Gnaspini & Peck, 2019**

(Figs. 23–29)

*Adelopsis claudina* Gnaspini & Peck, 2019: 41 (assignment to *benardi* species group and *grouvellei* subgroup); Peck *et al.*, 2020: 47.

**non** *Adelopsis asperoides*—Gnaspini, 1993a: 83 [and figs. 23–29]





**FIGURE 21.** *Adelopsis caeteh* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *benardi*), male paratype MZSP 61028. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in B–D are detailed in Figs. 22A, C, D, respectively; black rectangle in C is detailed in Fig. 22C. White lines in A, B, and C indicate that two images in different depths of focus were combined together to produce each image shown. arm = arm of the right lobe; do = dorsal opening; fl = flagellum; hm = forward projection of the margin; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; rl = right lobe; rp = right paramere; ss = sensory structure; vch = ‘ventral chin’ of the right lobe.

(misidentification stated in Gnaspini, 1996: 540—Gnaspini & Peck, 2019: 41).

Holotype male in MZSP; 4 male paratypes in MZSP.

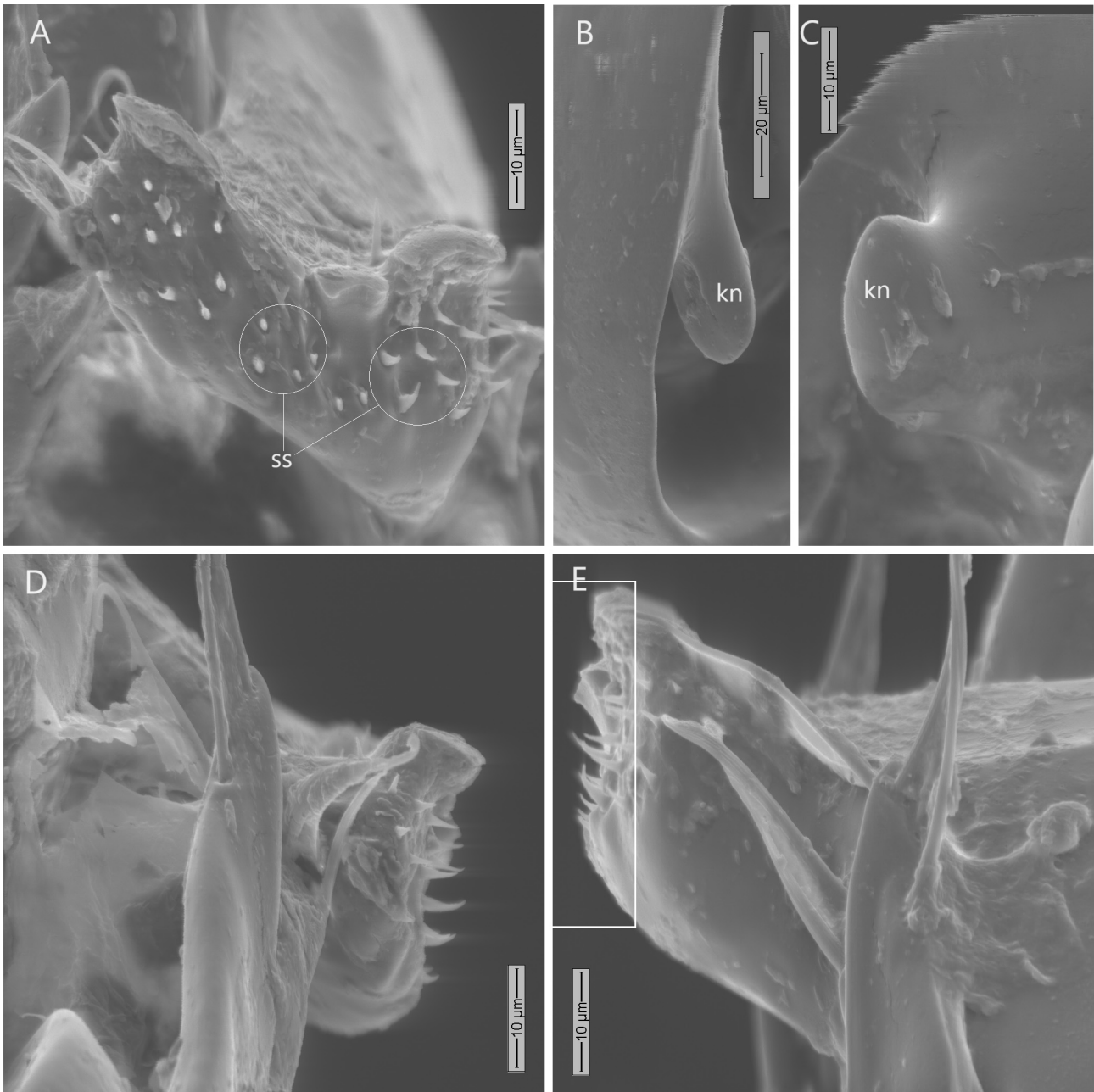
Type locality: Lapa da Claudina [Cave] (MG-088, 19°39′39″ S 44°00′15″ W), Montes Claros, Minas Gerais State, Brazil.

Distribution: Brazil: Minas Gerais State: known only from type locality.

Note: Specimen misidentified as *A. asperoides* Szymczakowski, 1963 in Gnaspini (1993a: 83)—Gnaspini, 1996: 540; Peck *et al.*, 2020: 47.

**Material examined. Holotype male:** BRAZIL—**Minas Gerais:**—Montes Claros, Lapa da Claudina [Claudina Cave]; X.1985; F. Chaimowicz leg.; Label: “Lapa da Claudina / Montes Claros, MG / F. Chaimowicz col. / x.1985”; MZSP 60995 (here illustrated; illustrated in Gnaspini, 1993a and assigned as holotype in Gnaspini & Peck, 2019: 41). **Paratypes:**—same data and label as for holotype; 4 males, MZSP 60996 to 60999 (the whole type series).

**Redescription.** We here add pictures and information



**FIGURE 22.** *Adelopsis caeteh* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *benardi*), male paratype MZSP 61028. **A, D–E**, Apex of aedeagus in ventral, left, and right views, respectively—detailed from Figs. 21B–D, respectively. **B, C**, Internal knob (B is detailed from Fig. 20A; C is detailed from Fig. 21C). White lines in D indicate that two images in different depths of focus were combined together to produce the image shown. kn = internal knob of the right lobe; ss = sensory structure.

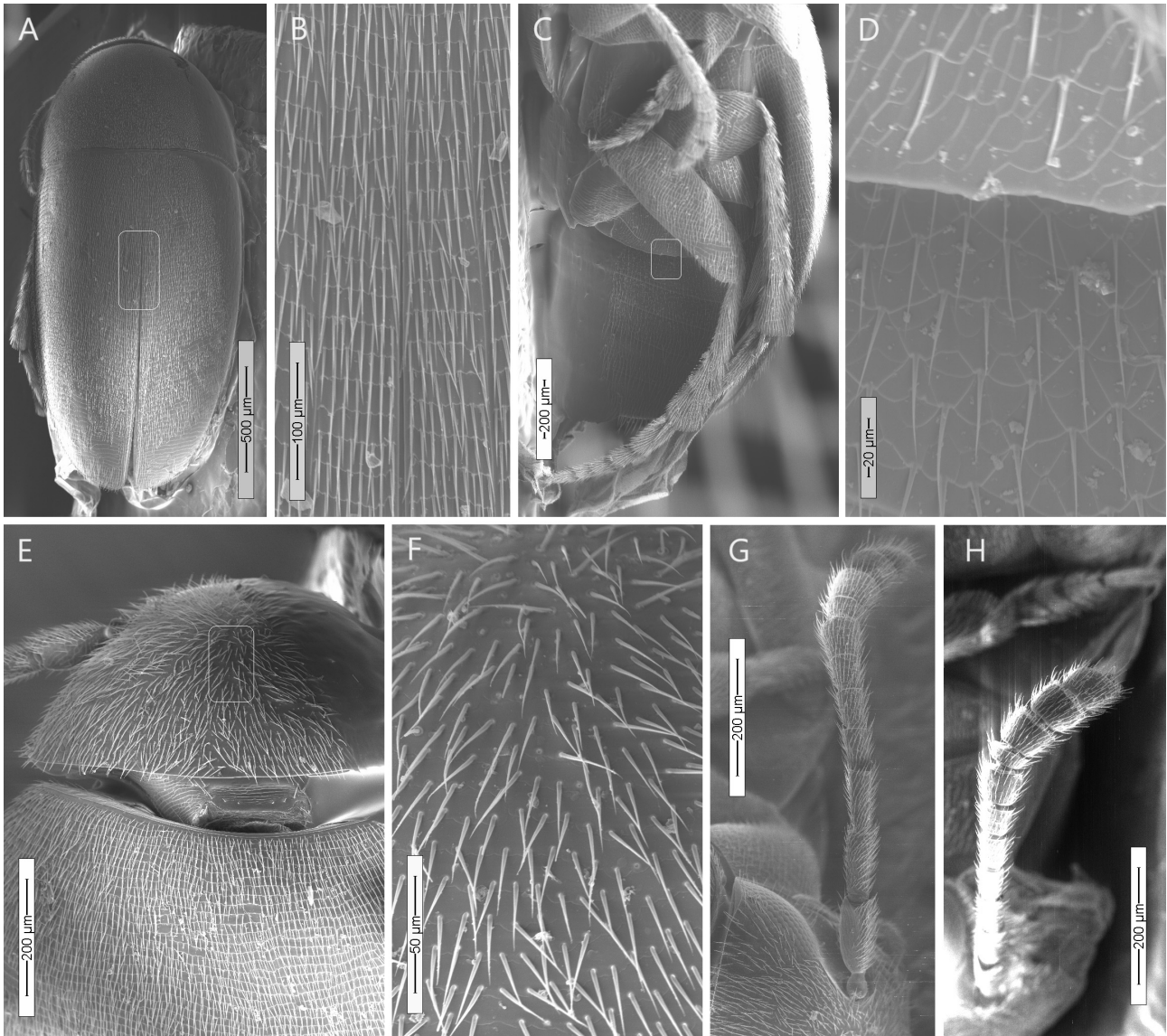
about some external characters which were not treated in the original description in Gnaspini & Peck (2019) or in Gnaspini (1993a). Length 2.25 mm; width 1.0 mm. Winged. Color dark brown. Eyes normal (Fig. 23E). Antennae normal (Figs. 23G, H), 1.8 times as long as pronotum; proportions of length of each antennomere and that of the 9<sup>th</sup> from 1<sup>st</sup> to 11<sup>th</sup> (taken from fig. 28 in Gnaspini, 1993a): 2.25, 1.75, 1.6, 1.15, 1.15, 0.9, 1.0, 0.45, 1.0, 1.0, 1.5; proportions of length and width of each antennomere of the club, from 1<sup>st</sup> to 11<sup>th</sup>: 2.0, 2.45, 2.55, 1.9, 1.7, 1.3, 1.15, 0.5, 0.85, 0.75, 1.35. Dorsal integument covered with short setae; head with regular

punctures and no strigae (Figs. 23E, F); pronotum with transversal strigae (Fig. 23E). Elytra together 1.65 times as long as wide (Fig. 23A); with dense oblique strigae (Fig. 23B). Male first four protarsomeres expanded; mesotibia curved; metatibia straight (Fig. 23C). Ventrites covered with short setae following very irregular strigae (Fig. 23D).

Female unknown.

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~2.5, concavity ~44–47% [ventral alignment] or ~37–43% [transversal alignment]; concavity/total length = ~47–53% [ventral alignment] or ~54–57%





**FIGURE 23.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. **A**, Habitus, dorsal view (white rectangle is detailed in **B**). **C**, Habitus ventrolateral view (white rectangle is detailed in **D**). **E**, Head and pronotum, dorsal view (white rectangle is detailed in **F**). **G–H**, Antenna, dorsal view.

[transversal alignment] [Figs. 24E, P]), basal opening almost 90° downwards; width larger than height, widest about halfway from base (e.g., Fig. 24).

Right lobe ('rl'—e.g., Figs. 24A, 25A) elongate, with a long 'arm' ('arm'—e.g., Figs. 25A, 27A) narrowing into a 'crest' ('cr'—e.g., Fig. 27A) with a wide external face; the apical margin abruptly connects to a 'ventral chin' ('vch'—e.g., Figs. 25B, D); the apex of the right lobe is slightly elevated ('me'—e.g., Figs. 25C, D); the apical margin is emarginated, forming pointy projections at the sides—this emargination can be observed in certain views (e.g., Fig. 26A), but not in others (e.g., Fig. 25A). The outer 'plateau' ('rlp') bears five setae, and one additional, long seta near its base (not associated with any kind of elevation) (e.g., Fig. 25D). The 'apical projection' ('ap'—e.g., Fig. 24P) % length = ~23–26%, % height = ~76–85%.

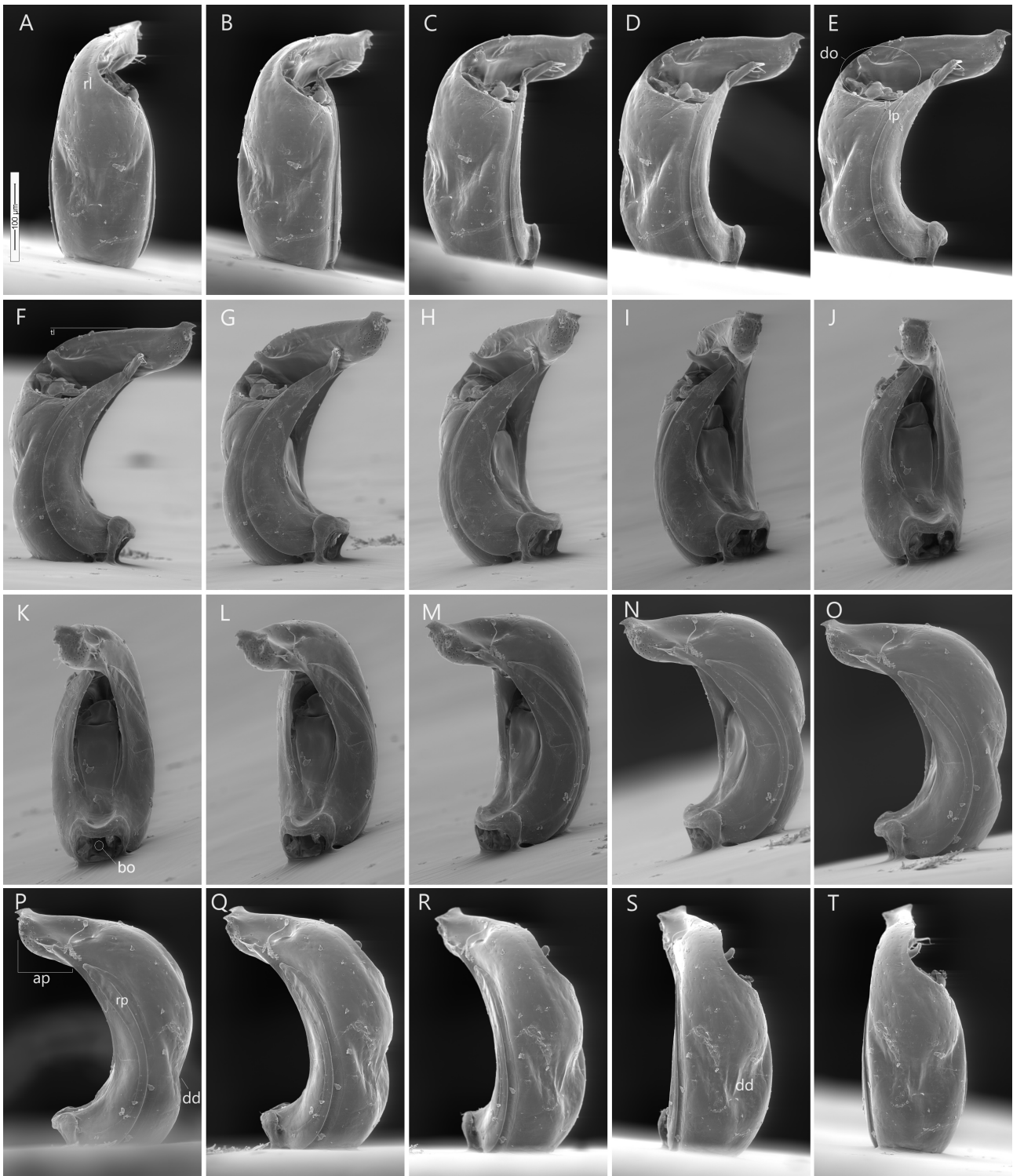
The left lobe ('ll') is a narrow stripe which makes a

curve towards the ventral-apical region of the aedeagus (e.g., Figs. 24, 25B, C); in the specimen examined, the apex of the left lobe reaches the inner face of the apical projection of the right lobe and is bent apically, but we understand that this may be restricted to this specimen or a result of our handling; its apical margin is truncated and bears four long setae projecting forward and an additional seta placed at the lateral margin, close to the apical margin, also projecting forward ('lls'—e.g., Fig. 25C).

The dorsal opening ('do'—e.g., Figs. 24E, 27A) takes ~38% (ventral alignment) or ~29% (transversal alignment) of the total length of the aedeagus.

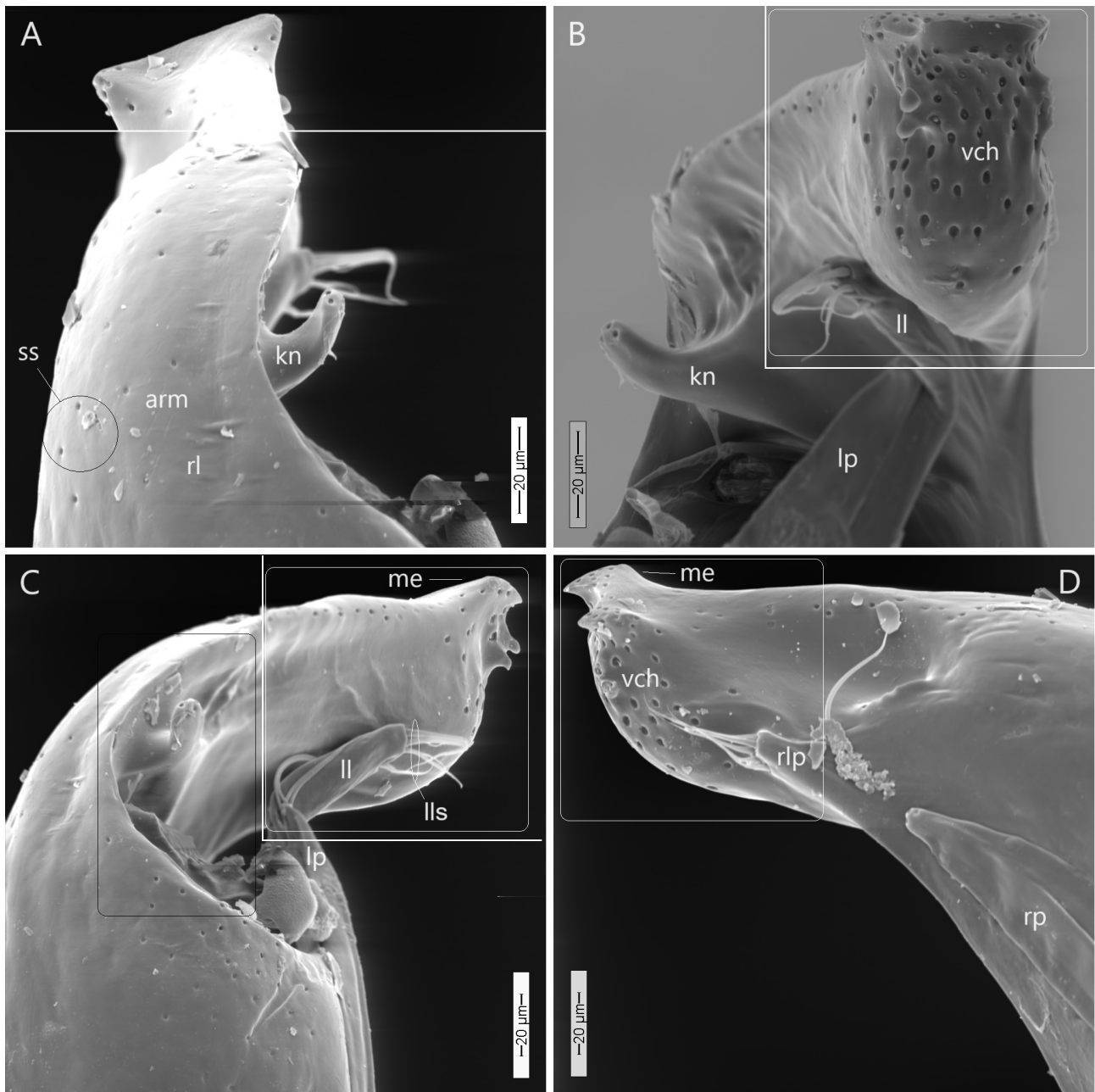
The sensory structures ('ss'—e.g., Fig. 25A) concentrate on the 'ventral chin', where the inner projection may be dome-shaped (of different sizes) ('ss'—e.g., Figs. 26A, B) or a short hair ('ss'—e.g., Fig. 26D).

The somewhat narrow fused parameres can be recognized by the presence of a depression along the



**FIGURE 24.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ‘tl’ denotes the ‘transversal line’ used to align images to make morphometric measurements (see text for details). ap = apical projection; bo = basal opening of aedeagus; dd = dorsal depression; do = dorsal opening; lp = left paramere; rl = right lobe; rp = right paramere.





**FIGURE 25.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in B–D are detailed in Fig. 26; black rectangle in C is detailed in Fig. 28D (slightly rotated). White lines in A, B, and C indicate that two images in different depths of focus were combined together to produce each image shown. arm = arm of the right lobe; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; me = marginal elevation; rl = right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; ss = sensory structure; vch = ‘ventral chin’ of the right lobe.

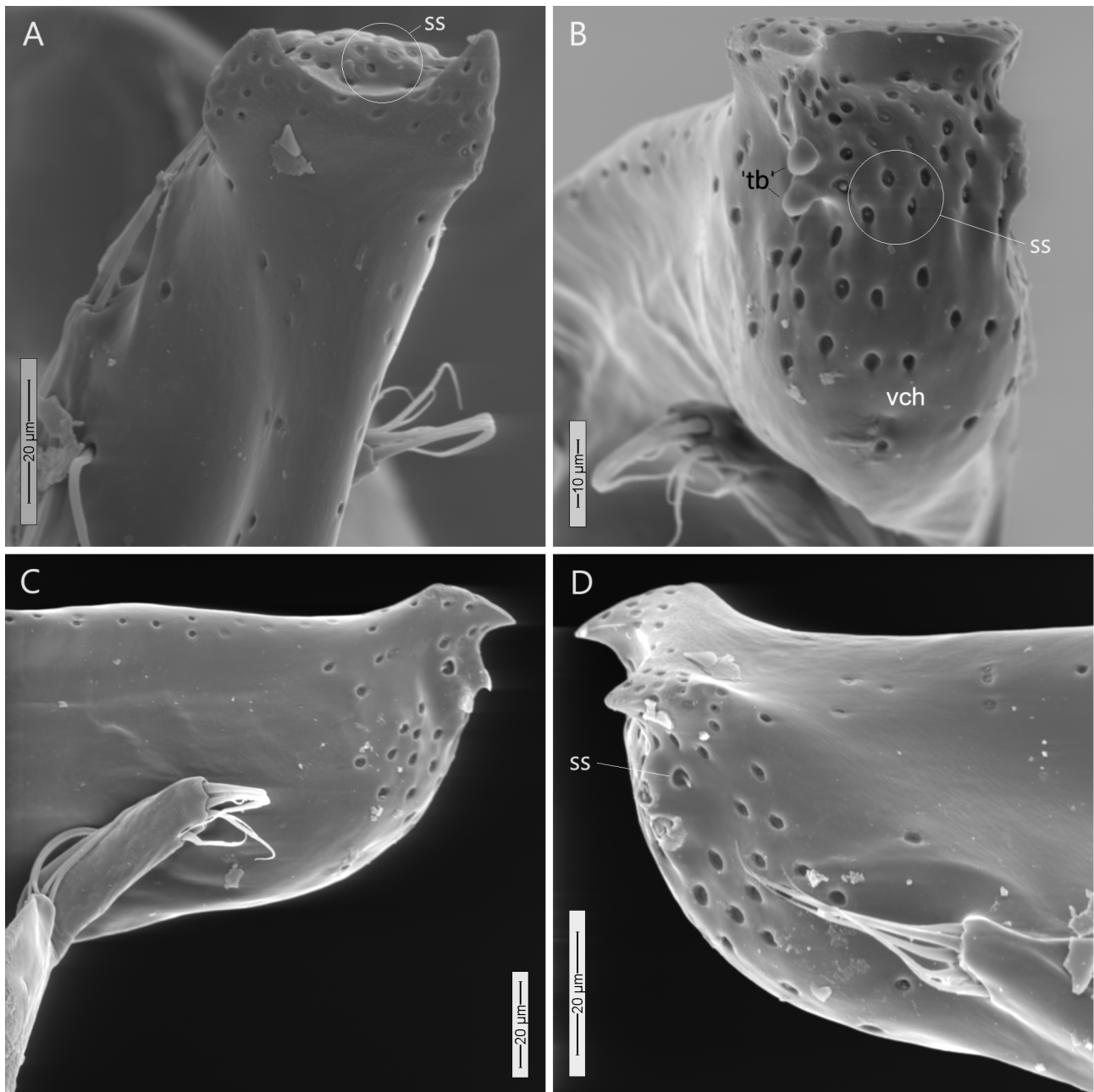
length of the right paramere, but parts of the ventral margin of the left paramere cannot be recognized from the aedeagus body (e.g., Fig. 24). The parameres have about the same length and are shorter than the lobes, and show a slight widening near the apex (more pronounced on the right paramere—‘lp’ and ‘rp’—e.g., Figs. 24E, P) followed by a medial narrowing at the apex, which apical margin is round; the left paramere seems to bear four setae, placed just at the apex and projecting forward (‘lp’—e.g., Fig. 25C); the setae of the right paramere are missing, but it seems that there are three apical setae, which can

be recognized by the ‘holes’ which correspond to their insertion (‘rp’—e.g., Fig. 25D).

The flagellum (‘fl’—e.g., Fig. 27A) was originally described as ‘short with a seemingly bifid apex’ (as in Gnaspini & Peck, 2019: 41 and Gnaspini, 1993a: fig. 24).

The internal knob (‘kn’—e.g., Figs. 25A, B, 28B, C, D) is somewhat elongate, and curved dorsally; the apical sensory structures have a deep depression.

There is a low, V-shaped, transversal ‘dorsal depression’ (‘dd’—e.g., Fig. 24P); position = ~26–29% (ventral alignment) or ~36% (transversal alignment).

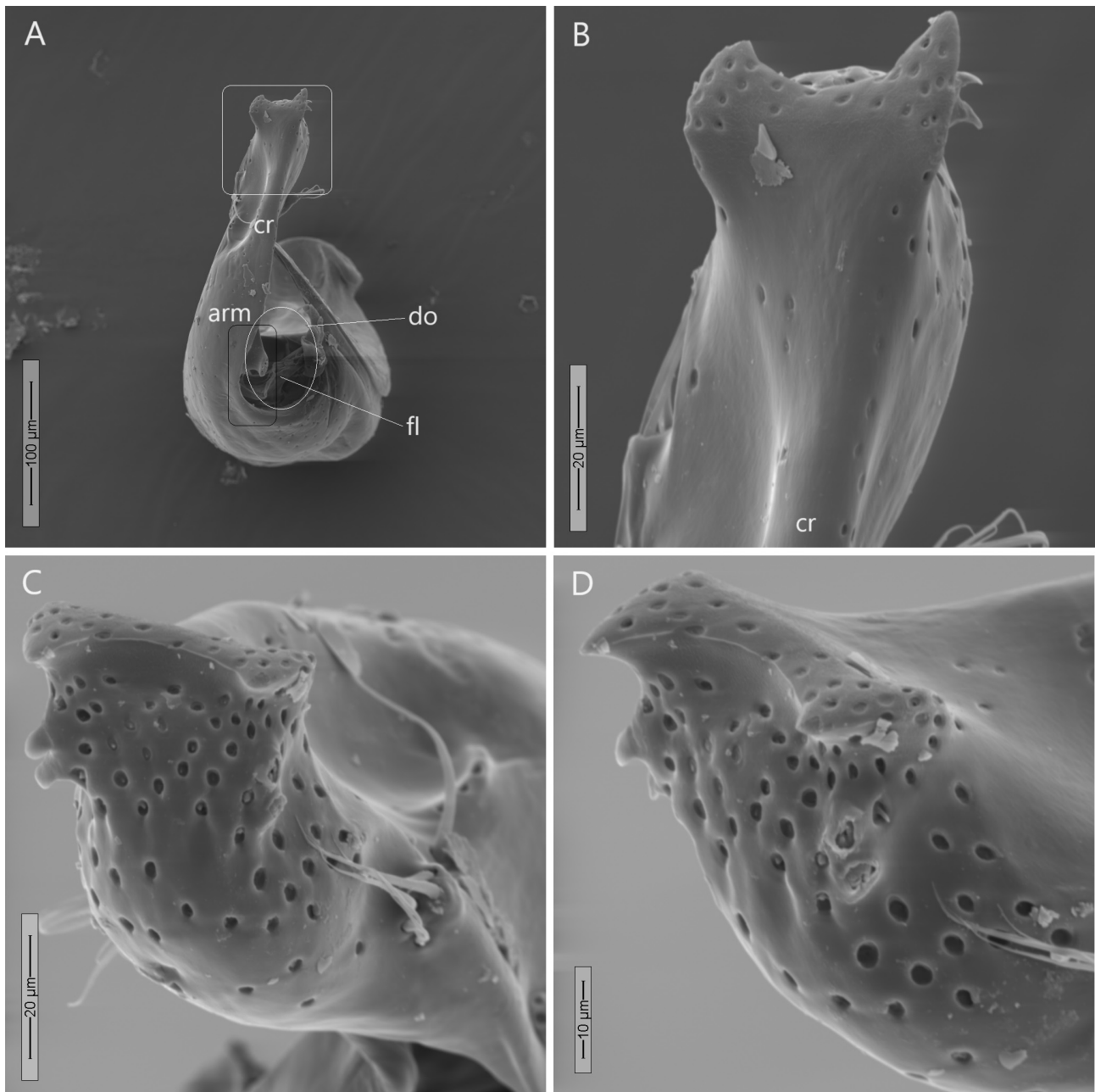


**FIGURE 26.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—A is in detail from Fig. 27A (slightly rotated); B–D are in detail from Figs. 25B, C (slightly rotated), D. ss = sensory structure; ‘tb’ = ‘tubercule’ on the ‘ventral chin’.

*Taxonomic remarks.* Gnaspini & Peck (2019: 41) discussed that the combination of the lateral and frontal views of the aedeagus and size and shape of the flagellum (as in figs. 23–26 in Gnaspini, 1993a) seem to help in the recognition of this species; and stated that, in lateral view, the tip of the aedeagus resembles that of *A. luculenta* Szymczakowski, 1963 (see figs. 190, 192 in Gnaspini & Peck, 2019), but the dorsal opening of the aedeagus seems to be larger in the latter species and the flagellum is quite different. Gnaspini & Peck (2019) also stated that this is a good example of the need to carefully examine and illustrate the apex of the aedeagus, because, based only on illustrations in Szymczakowski (1963), Gnaspini

(1993a) misidentified this species as *A. asperoides* Szymczakowski, 1963, and, when he started a revision of the genus and examined types (Gnaspini, 1996), he recognized differences when several views were taken. An emarginated apical margin of the aedeagus forming pointy projections at the sides (Fig. 26A) was also observed (at least—considering images from the literature which allow this observation) in *A. aspera* Jeannel, 1936 (e.g., Gnaspini & Peck, 2019: fig. 165), *A. asperoides* Szymczakowski, 1963 (e.g., Gnaspini & Peck, 2019: fig. 183), *A. benardi* (Portevin, 1923) (e.g., Gnaspini & Peck, 2019: fig. 117), and *A. diabolica* Gomyde & Gnaspini, 2019 (e.g., Gomyde & Gnaspini, 2019: fig. 3b), but other





**FIGURE 27.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. **A**, Aedeagus in frontal view of right lobe (white square is detailed in **B**). **C–D**, Apex of right lobe of aedeagus in ventral and ventro-lateral views, respectively (compare with Fig. 26B). White square in **A** is detailed in **B**. and in Fig. 26A (slightly rotated); black rectangle in **A** is detailed in Fig. 28C. arm = arm of the right lobe; cr = crest of right lobe; do = dorsal opening; fl = flagellum.

features, and especially the morphometrical patterns in lateral view, allow prompt species recognition. We here recognize that SEM images provide additional, very informative, details of the genitalia (see also ‘Taxonomic remarks in *benardi* species group’).

***Adelopsis leo* Gnaspini, 1993**  
(Figs. 30–35)

*Adelopsis leo* Gnaspini, 1993a: 81; Gnaspini, 1996: 539; Salgado, 2010: 213 (assignment to *benardi* species group); Salgado,

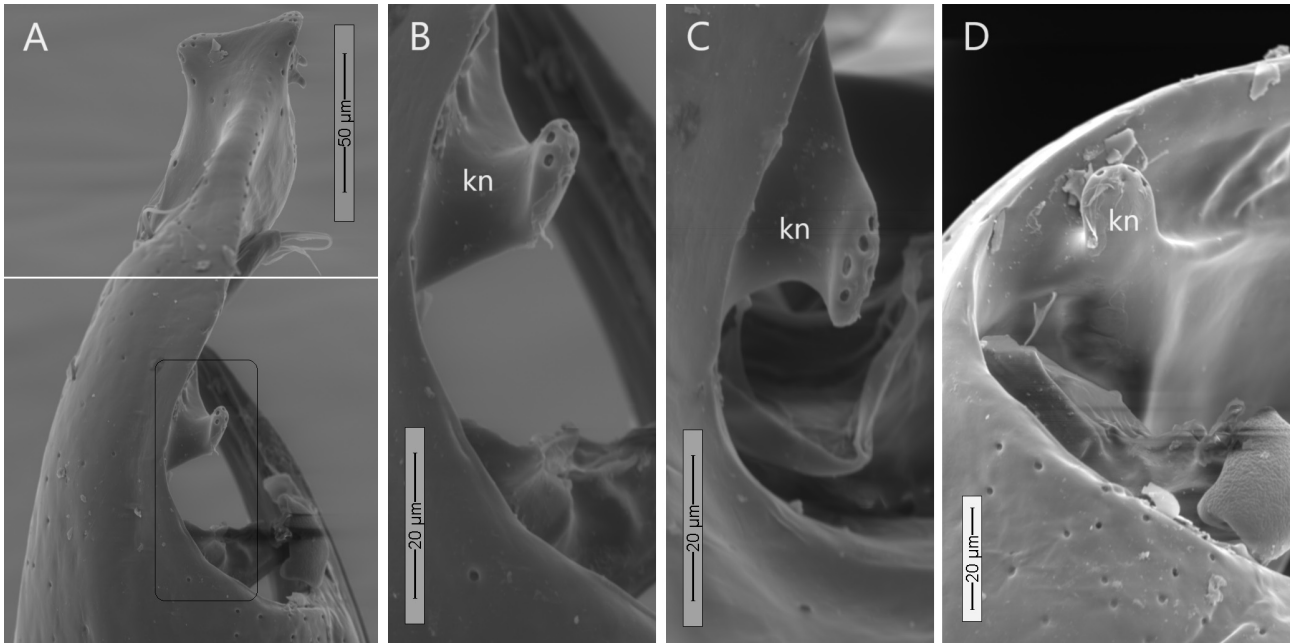
2019: 157 (assignment to *peruviensis* species group); Gnaspini & Peck, 2019: 33 (assignment back to *benardi* species group, and to *grouvellei* subgroup); Peck *et al.*, 2020: 48.

Holotype male in MZSP; 56 male and 40 female paratypes in MZSP.

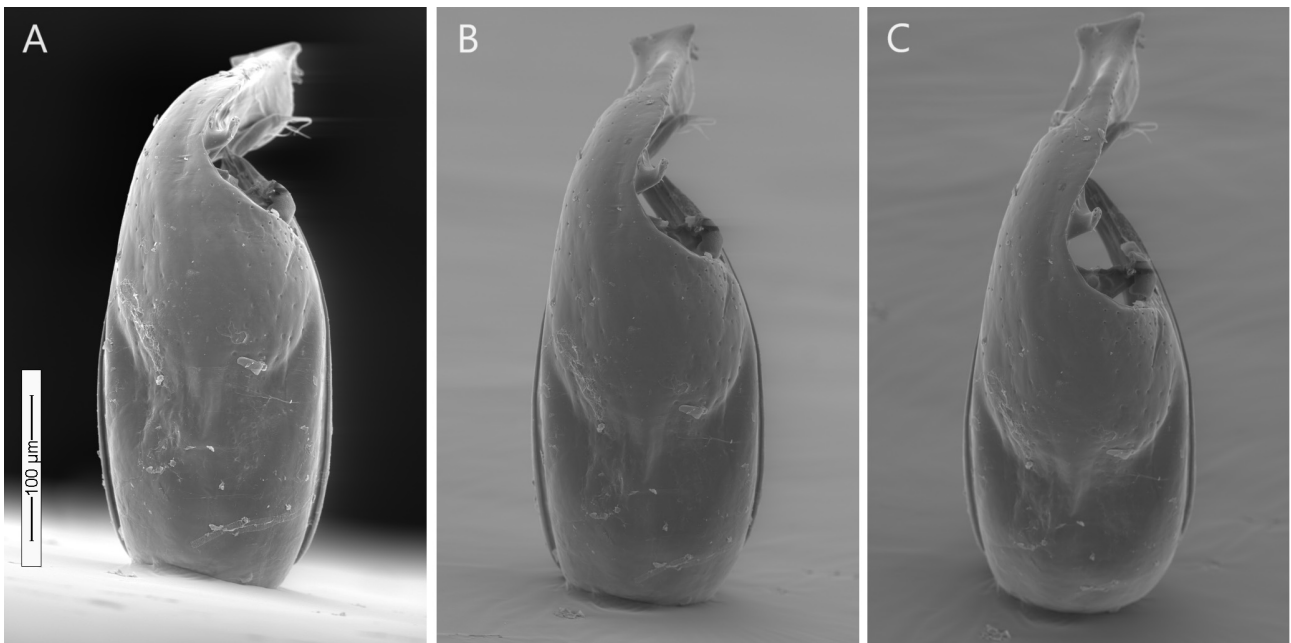
Type locality: Gruta Colorida [Cave] (SP-129), 24°16'13" S 48°35'25" W, Iporanga, São Paulo State, Brazil.

Distribution: Brazil: São Paulo State (in caves). Biology and Larvae: Gnaspini, 1993b: 92.

Size (original description): Length: 2.7–3.2 mm; width: 1.2–1.5 mm.



**FIGURE 28.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. **A**, Frontal view of the right lobe of aedeagus (slightly rotated following the ‘sagittal’ plane of the aedeagus in relation to Fig. 27A) (black rectangle is detailed in **B**). **B–D**, Internal knob (‘kn’) in detail, respectively from Figs. 28A, 27A, 25C (slightly rotated). The white line in A indicates that two images in different depths of focus were combined together to produce the image shown. kn = internal knob of the right lobe.

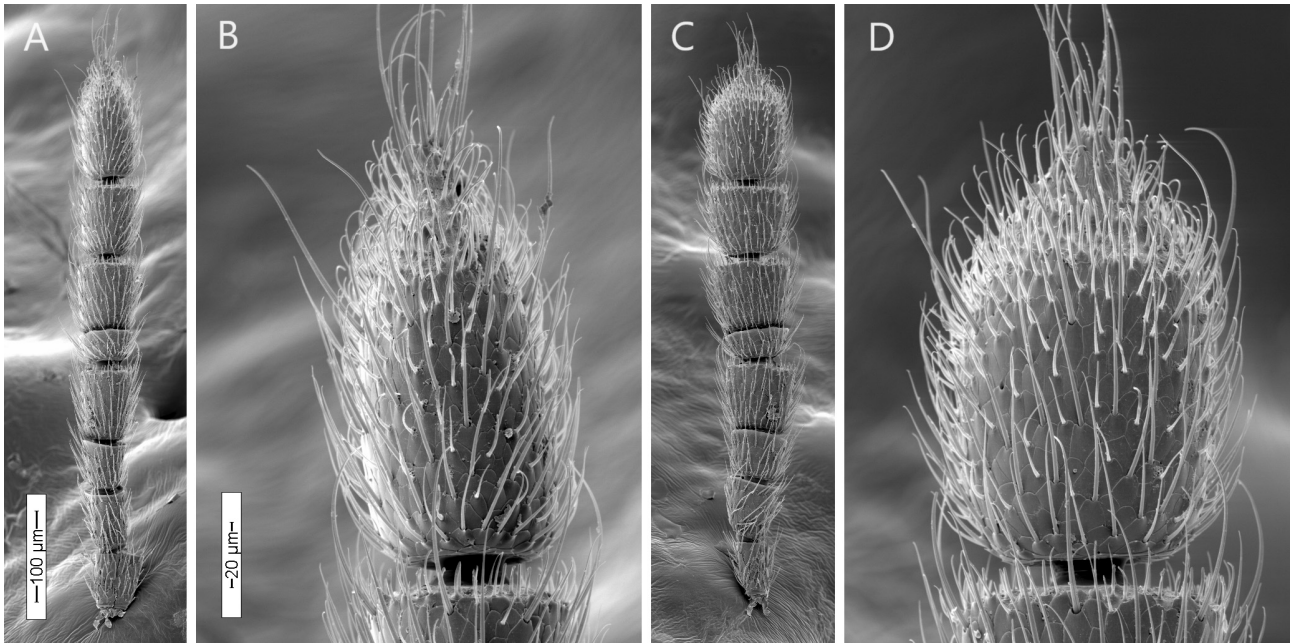


**FIGURE 29.** *Adelopsis claudina* Gnaspini & Peck, 2019 (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 60995. **A–C**, Aedeagus in dorsal view, with slight rotation towards apex, following the ‘sagittal’ plane of the aedeagus, in order to show the influence of the view in the recognition of the aedeagal shape. All figures to the same scale.

**Material examined.** BRAZIL—**São Paulo**:—Guapiara, Gruta dos Pianos [Pianos Cave]; 07.X.1992; P. Gnaspini leg., 1 male, 1 female;—Iporanga, Gruta do Floido [Floido’s Cave]; 05.VIII.1992; P. Gnaspini leg., 1 male MZSP 61000, 1 female;—Iporanga, Gruta do Moquem [Moquem Cave]; 07.VIII.1992; P. Gnaspini leg., 1 male. All here illustrated.

**Redescription.** We here add SEM images and information about some external characters which were treated before, but not with SEM. The antennae are somewhat flattened (i.e., the cross-section of the antennomeres is elliptical) (Fig. 30). Male first four protarsomeres expanded, with ventral surface covered with tenent setae (Figs. 31A, H, I); mesotibia curved (Fig. 31B); metatibia straight (Fig. 31C). As typical of





**FIGURE 30.** *Adelopsis leo* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), female from ‘Gruta do Fluido’. **A, C**, Antenna, in lateral and dorsal views, respectively (apical antennomere is detailed in **B** and **D**., respectively). Figures **A, C** and **B, D** to the same scale.

ptomaphagines: female protarsus not expanded (Fig. 31G); apex of tibiae with a crown of spines and two spurs (Figs. 31D–F); empodial setae asymmetrical (‘est’—Fig. 31J, following Antunes-Carvalho & Gnaspini, 2016); dorsal surface of tarsal claws covered with spines near base (‘slc’—Fig. 31K, following Antunes-Carvalho & Gnaspini, 2016).

**Redescription of aedeagus.** Aedeagus somewhat globose (l/w ~2.5, concavity ~35% [ventral alignment] or ~26–30% [transversal alignment]; concavity/total length = ~44–45%, considering both alignments described in methods [Figs. 32 E, M]), basal opening almost 90° downwards; width larger than height, widest about halfway from base (e.g., Fig. 32).

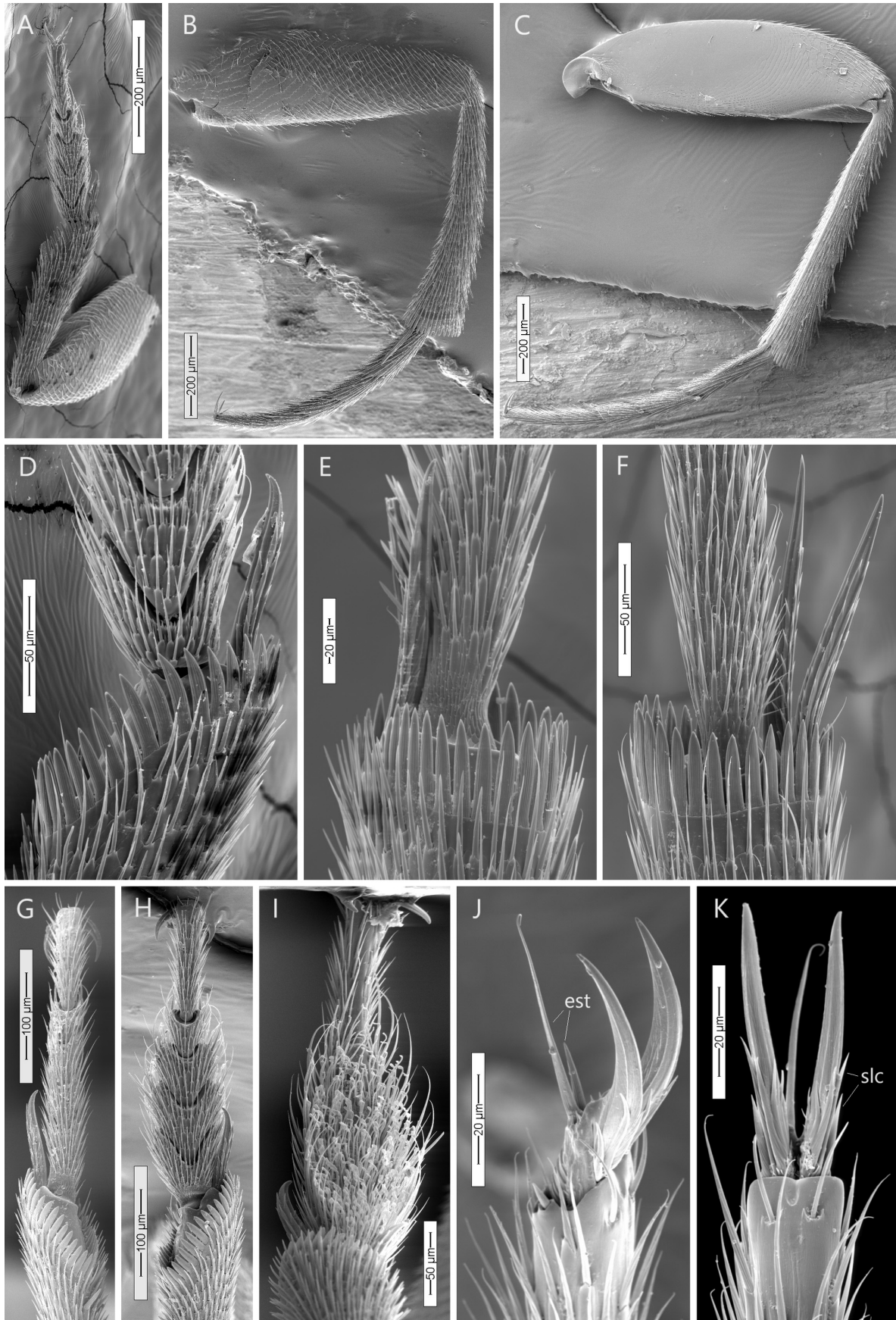
Right lobe (‘rl’—e.g., Figs. 33A, 35A) somewhat elongate, quickly narrowing into a long ‘crest’ (‘cr’—e.g., Figs. 33A, D, 35A) with ‘vertical’ inner and outer faces; the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Figs. 33D, 34B); the lateral edges of the apical margin projects outside and are undulated, forming a ‘frill’ (‘fr’—e.g., Fig. 33D). Although covered by the apex of the right paramere, in comparison with other species in *benardi* species group and based on what is visible, we interpret that there is an outer ‘plateau’ (‘rlp’) with three setae, and one additional, long seta near its base (not associated with any kind of elevation) (e.g., Figs. 33B, 34A); at the center of the outer face of the apical projection of the right lobe, there is an additional, small and low elevation (‘rlc2’), with no seta nearby (e.g., Fig. 34A). The ‘apical projection’ (‘ap’—e.g., Fig. 32M) % length = ~27%, % height = ~52%. The convex ‘apical depression’ (‘ad’—e.g., Figs. 32M, 33D) % depth = ~46% (ventral alignment) or ~59% (transversal alignment), % height = ~54% (ventral alignment) or ~59% (transversal alignment).

The left lobe (‘ll’) is very low and wide (e.g., Fig. 33A): from the apex of the aedeagus, the right margin of the dorsal opening proceeds inward and, when it reaches its maximum extension, instead of going back towards the apex and form a left margin in contact with a projected left lobe, it follows a transversal plane towards the ventral side (therefore, a typical dorsal opening, with an U-shaped margin, is not produced); just before reaching its ventralmost margin, there is a slight projection towards the apex of the aedeagus, forming a short and thin lobe (‘ll’—Fig. 33D), which rounded apical margin bears at least three setae (it is not possible to recognize if the depression observed would correspond to insertion of setae) projecting forward (‘lls’—e.g., Fig. 33D).

The dorsal opening (‘do’—e.g., Fig. 35A) takes ~31% of the total length of the aedeagus.

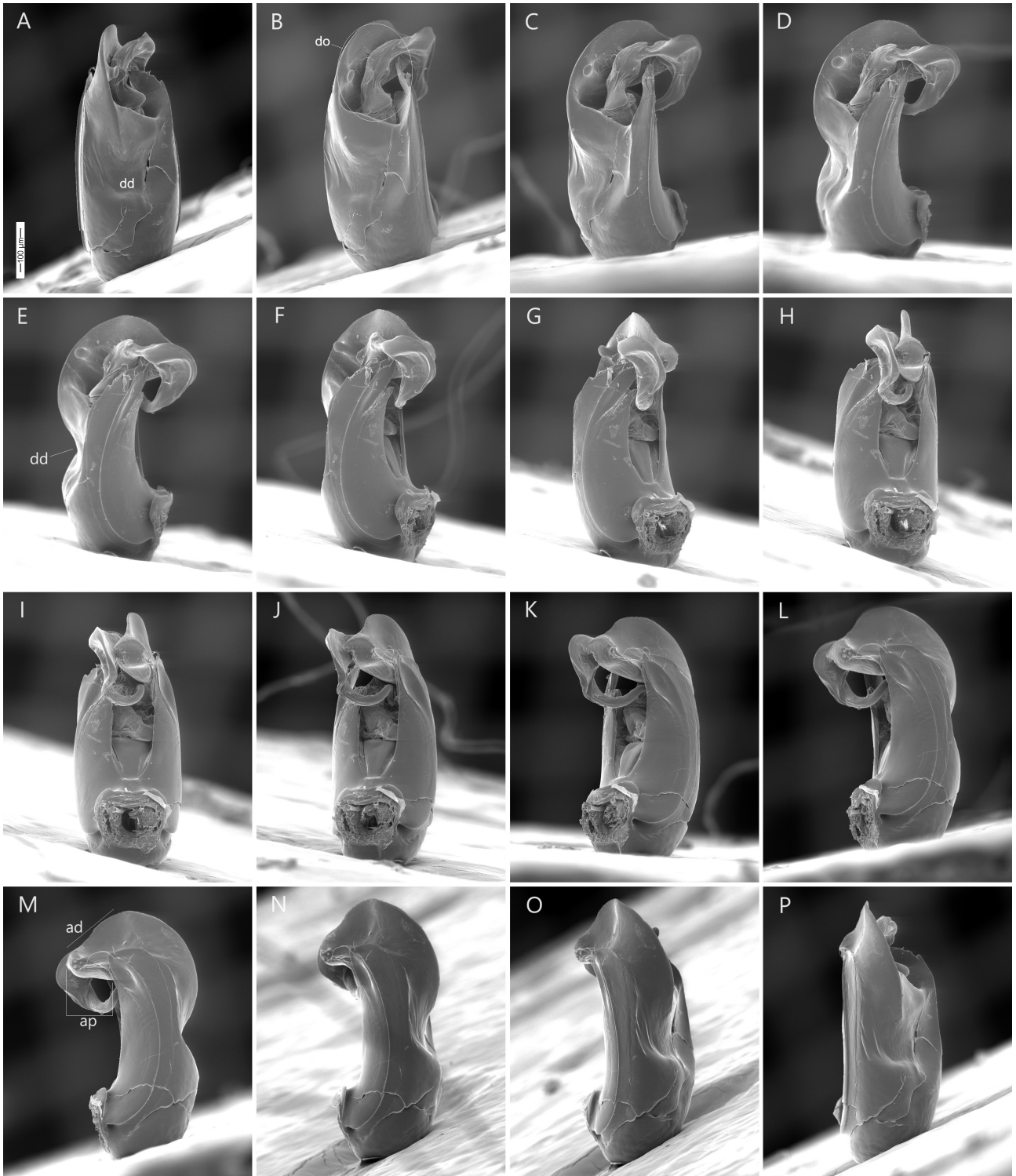
The integument is smooth on most of the aedeagus (e.g., Fig. 32), except on the right lobe, which outer face bears sensory structures with a shallow depression (‘ss’—e.g., Fig. 33B), but the inner face is smooth (e.g., Fig. 33C). The sensory structures concentrate along the crest (‘ss’—e.g., Fig. 35D) and mainly on the ‘ventral chin’, where they are shaped as a shallow depression with a dome-shaped or conic projection (of different sizes) (‘ss’—e.g., Fig. 34D). The surface on the apicalmost region of the apical projection and the ventral chin is irregularly sculptured (e.g., Figs. 34C, D).

The somewhat wide fused parameres can be recognized by the presence of a depression along the length of the right paramere, but parts of the ventral margin of the left paramere cannot be recognized from the aedeagus body (e.g., Fig. 32); their apex are free (‘lp’ and ‘rp’—e.g., Figs. 33A, C). The parameres have about the same length, and the right paramere (‘rp’) is shorter



**FIGURE 31.** *Adelopsis leo* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), **A, D–F**, male MZSP 61000; **B–C, H–I**, male from ‘Gruta dos Pianos’; **G** female from Gruta dos Pianos; **J–K**, female from Gruta do Floido. **A–C**, Front, middle, and hind leg, respectively. **D–F**, Apex of tibia of front, middle, and hind leg, respectively. **G–H**, Apex of protibia and protarsus of female and male, respectively (compare the non-expanded tarsomeres in females), dorsal view. **I**, Apex of protibia and protarsus, ventral view. **J–K**, Apex of mesotarsus in lateral and dorsal view, respectively. est = empodial setae; slc = spines near base of tarsal claw.



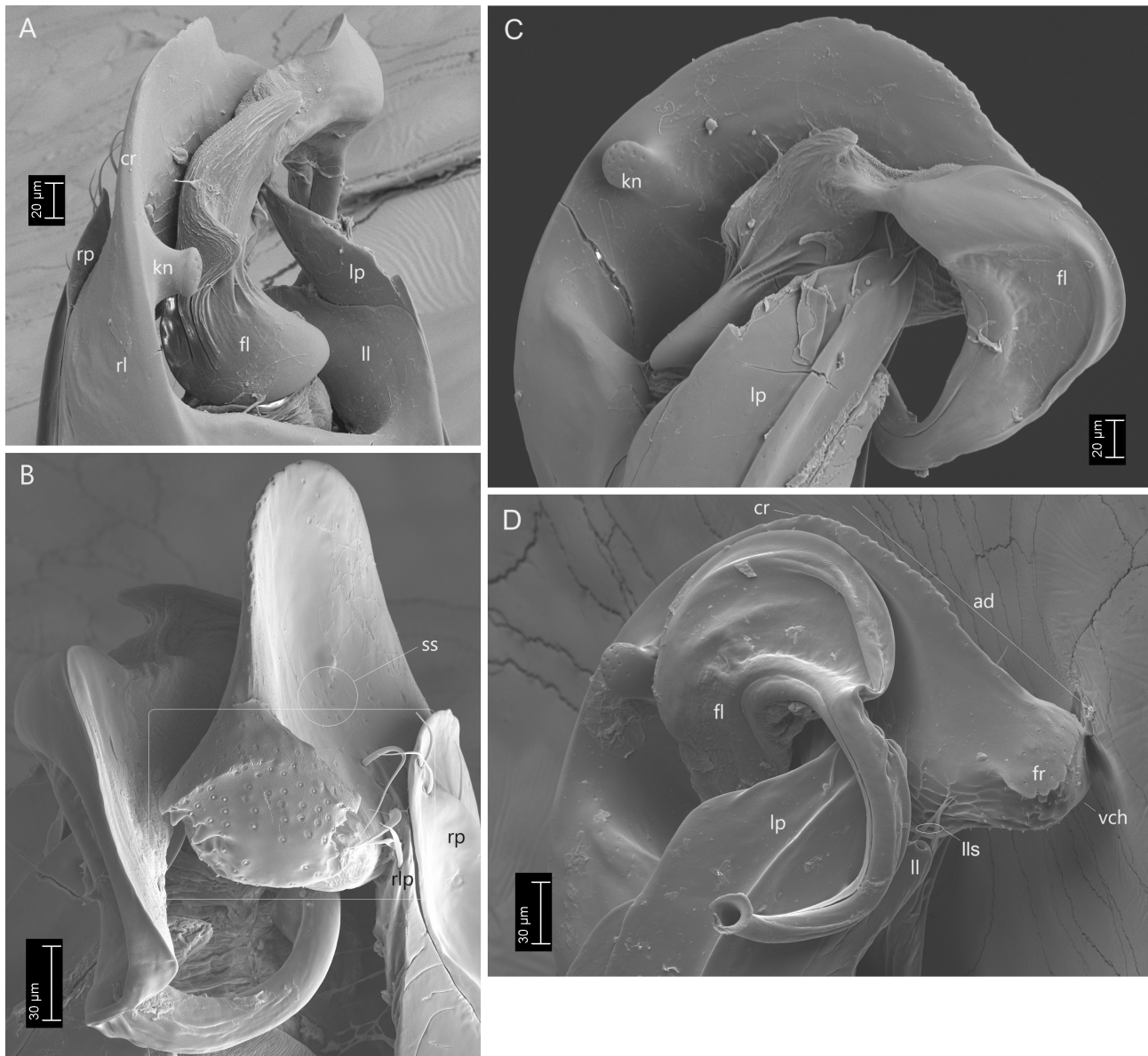


**FIGURE 32.** *Adelopsis leo* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), male MZSP 61000. A–P, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ad = apical depression; ap = apical projection; dd = dorsal depression; do = dorsal opening.

than the right lobe (‘rl’), whereas the left paramere (‘lp’) is longer than the left lobe (‘ll’) (e.g., Fig. 33A). Both parameres show a slight widening near the apex followed by a medial narrowing at the apex, which apical margin is round; and they bear four setae, two placed close to the apex, a third seta placed a little distant from the apical edge and medially placed, considering the width of the

paramere, and a fourth seta placed a little further than the previous one and closer to the dorsal margin of the paramere (e.g., Figs. 33A–C).

The flagellum (‘fl’—e.g., Figs. 33A, C, D) is robust and complex—it seems to be wider inside the aedeagus and, as soon as it emerges from the dorsal opening, there is a constriction followed by a new



**FIGURE 33.** *Adelopsis leo* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), **A–C**, male MZSP 61000; **D**, male from Gruta do Moquem. **A–D**, Apex of aedeagus in dorsal, ventral, and left (**C, D**—differing by the position of the flagellum) views, respectively. White rectangle in **C** is detailed in Fig. 34B. ad = apical depression; cr = crest of right lobe; fl = flagellum; fr = lateral frill of the right lobe; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; rl = right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; ss = sensory structure; vch = ‘ventral chin’ of the right lobe.

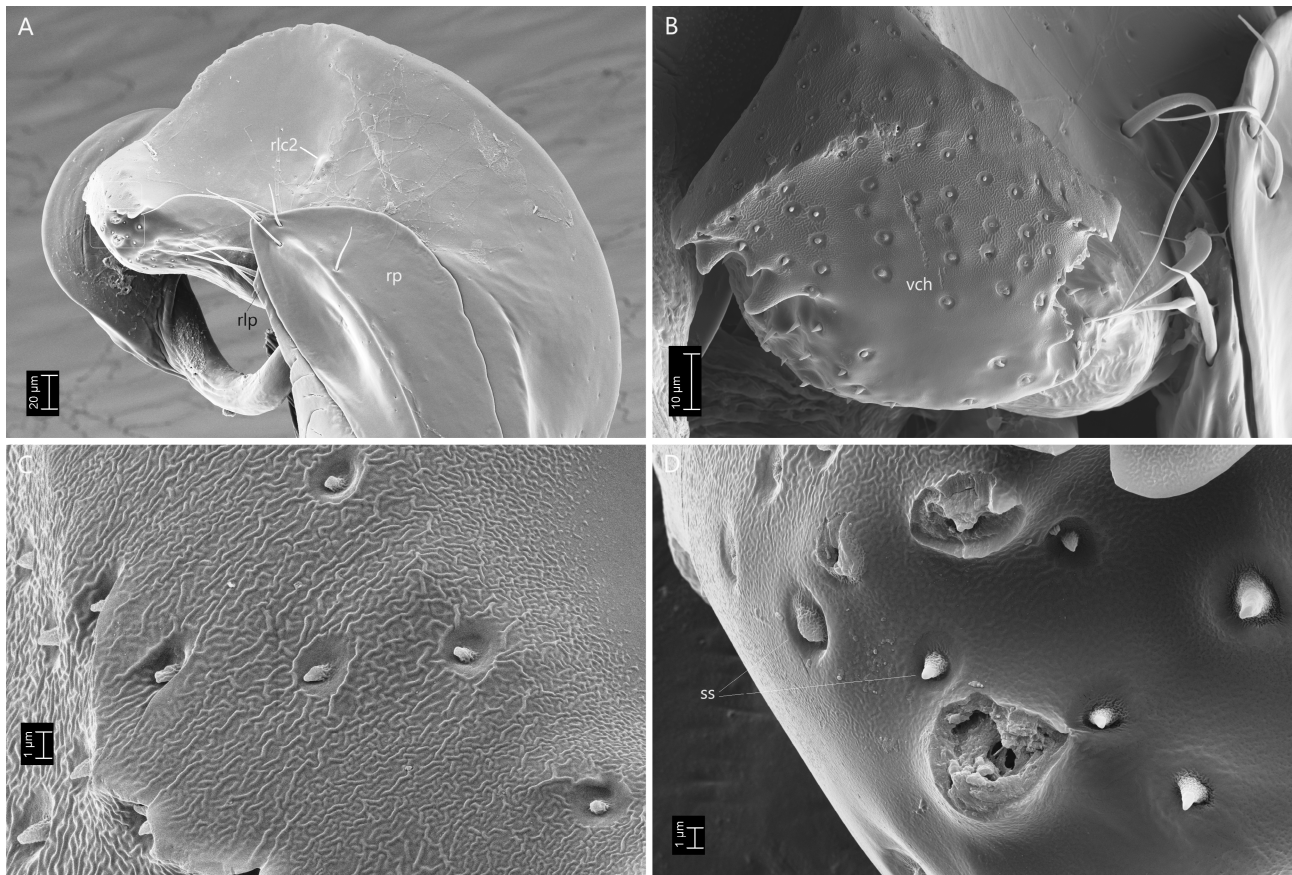
expansion, forming a kind of bulb, followed by a flattened curved expansion, which suddenly narrows and is followed by a ‘regular’, curved tube, with an apical opening surrounded by a kind of ‘lip’; the curve from the basal bulb until the opening practically makes a whole circumference.

The internal knob (‘kn’—e.g., Figs. 33A, C, 35A, and detailed in Fig. 35C) is short, perpendicularly projecting inward from the inner face of the apical projection of the right lobe; the apical sensory structures have a shallow depression.

There is a deep transversal ‘dorsal depression’ (‘dd’—e.g., Fig. 32E); position = ~46% (ventral alignment) or ~48–51% (transversal alignment).

**Taxonomic remarks.** Considering the overall shape, with a short apical projection and a deep transversal dorsal depression, the aedeagus of *A. leo* resembles that of *A. boraceia* **sp. nov.** and *A. mrazi* Gnaspini & Peck, 2019 (and differs them from other species in *benardi* species group); however, the male genital segment of *A. mrazi* is of a completely different type than that of the other two species, which led Gnaspini & Peck (2019) to place them in different species subgroups. The main feature that allows prompt recognition of *A. leo* is the typical flagellum (see also Gnaspini, 1993a: fig. 7), which is until now unique among all known species of *Adelopsis* (and other ptomaphagines as well). (See also ‘Taxonomic remarks in *benardi* species group’).





**FIGURE 34.** *Adelopsis leo* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), male MZSP 61000. **A–B**, Apex of aedeagus in right and ventral views, respectively (white rectangles in A are detailed in C. and D.). B is detailed from Fig. 33B. rlc2 = elevation far from the base of the right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; vch = ‘ventral chin’ of the right lobe.

### *Adelopsis piruapuera* Gnaspini, 1993

(Figs. 36–38)

*Adelopsis piruapuera* Gnaspini, 1993a: 82; Gnaspini, 1996: 539; Salgado, 2010: 213 (assignment to *benardi* species group); Salgado, 2019: 157 (assignment to *peruviensis* species group); Gnaspini & Peck, 2019: 33 (assignment back to *benardi* species group, and to *grouvellei* subgroup); Peck *et al.*, 2020: 48.

Holotype male in MZSP; 1 male and 2 female paratypes in MZSP. Type locality: Gruta do Convento [Cave] (BA-002), 10°02’56” S 40°43’37” W, Campo Formoso, Bahia State, Brazil.

Distribution: Brazil: Bahia State: known only from type locality.

Size (original description): Length: 2.7 mm; width: 1.4 mm.

**Material examined. Paratype:** BRAZIL—Bahia:—Campo Formoso, Gruta do Convento [Convent Cave]; II.1987; F. Chaimowicz leg.; Label: “Gruta do Convento / Campo Formoso, BA / F. Chaimowicz col. / ii.1987”; 1 male, MZSP 27131 (here illustrated) (out of 1 male holotype and 1 male and 2 female paratypes).

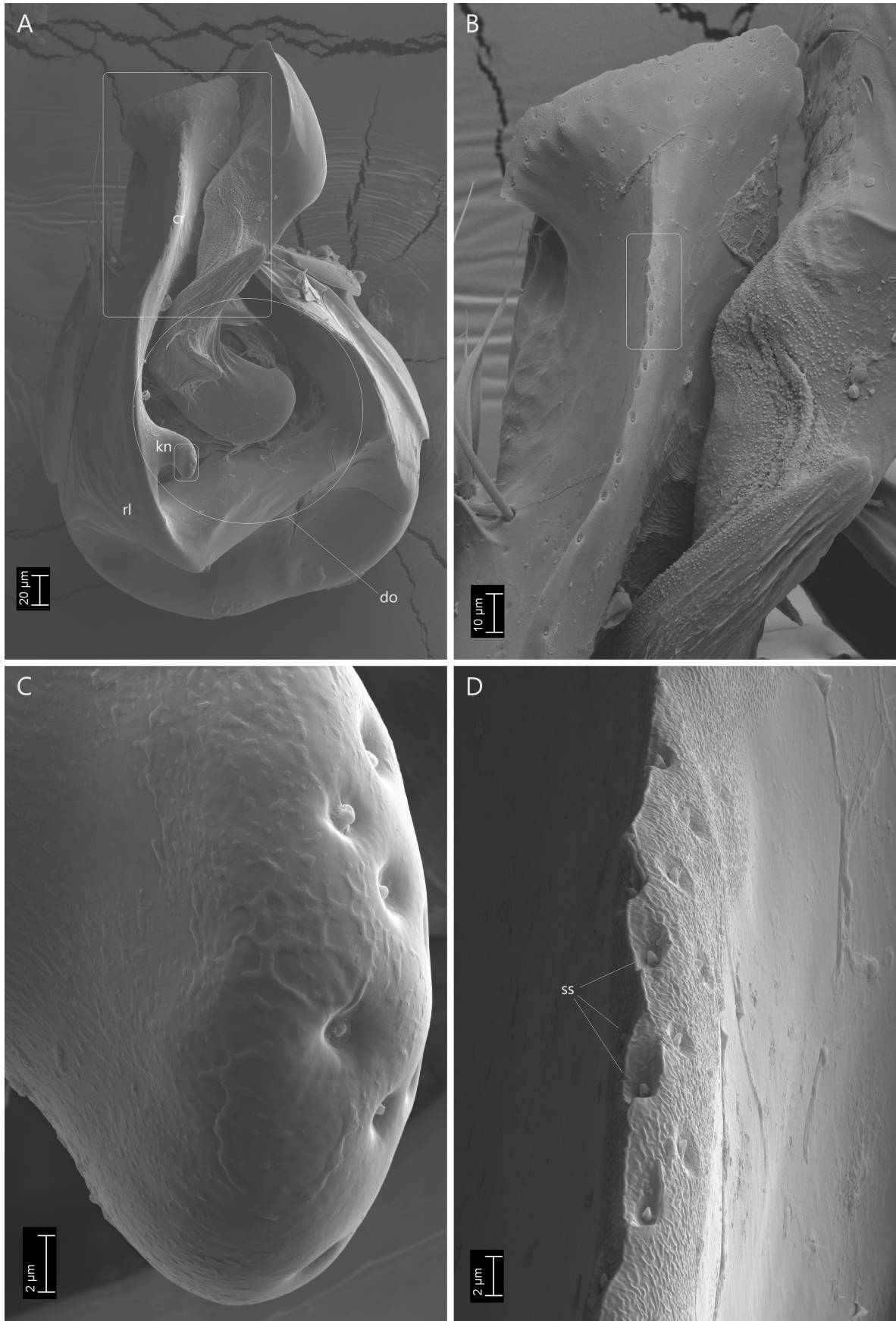
**Redescription of aedeagus.** Aedeagus somewhat globose (l/w ~1.9, concavity ~38–42% [ventral alignment] or ~26–37% [transversal alignment]; concavity/total length = ~52–54%, considering both alignments described in methods [Figs. 36F, Q]), basal opening almost 90°

downwards; width larger than height, widest about halfway from base (e.g., Fig. 36).

Right lobe (‘rl’—e.g., Fig. 38A) somewhat elongate, slightly curved ventrad and widening towards apex, which has a deep emargination; the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Fig. 37A); there is one long seta close to the apical margin (e.g., Figs. 37, 38B) and two additional, short setae, one at each side of the apical emargination (the seta near the outer margin is broken, but we interpret that it may have the same shape and length as the one near the inner margin). The ‘apical projection’ (‘ap’—e.g., Fig. 36Q) % length = ~19%, % height = ~50–71%.

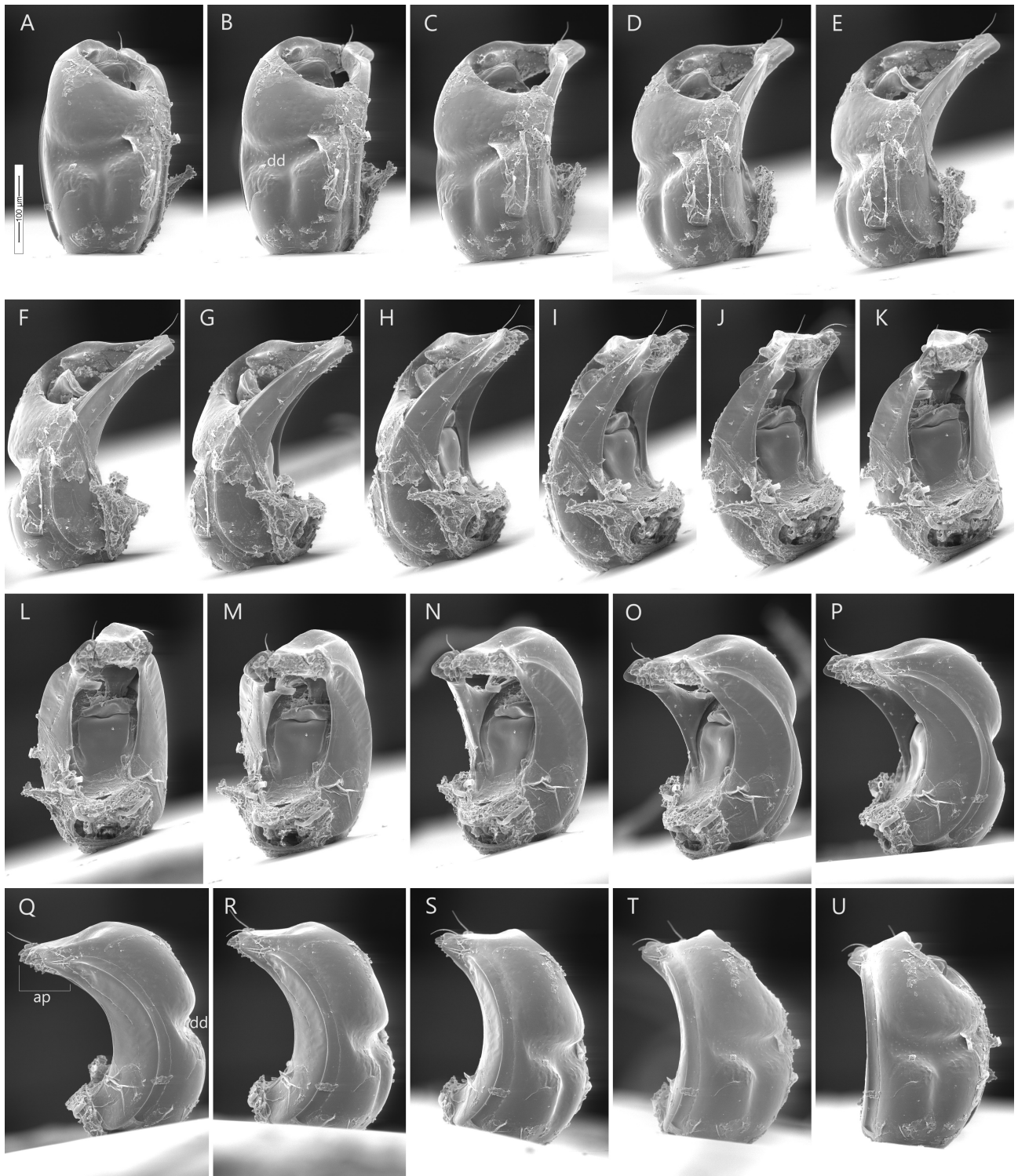
The left lobe (‘ll’) is somewhat elongate, and slightly curved both ventrad and inward; its width slightly reduces towards the apex, which is strongly enlarged (e.g., Figs. 37A, 38A, B); there is a long seta placed close to the ‘corner’ between the inner and the apical margins (‘lls’—e.g., Fig. 38B). The apex of both right and left lobes have a somewhat flat inner surface which are very close to each other (e.g., Fig. 38A). The ventral faces of the left lobe and the outer region of the right lobes have short and strong tubercles (‘tb’—e.g., Figs. 37A, 38B).

The dorsal opening (‘do’—e.g., Fig. 38C) takes ~35% (ventral alignment) or ~27% (transversal alignment) of the total length of the aedeagus.



**FIGURE 35.** *Adelopsis leo* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), male MZSP 61000. **A**, Aedeagus in frontal view of right lobe (white rectangles are detailed in **B.** and **C.**; white rectangle in **B.** is detailed in **D.**). do = dorsal opening; kn = internal knob of the right lobe; rl = right lobe; ss = sensory structure.



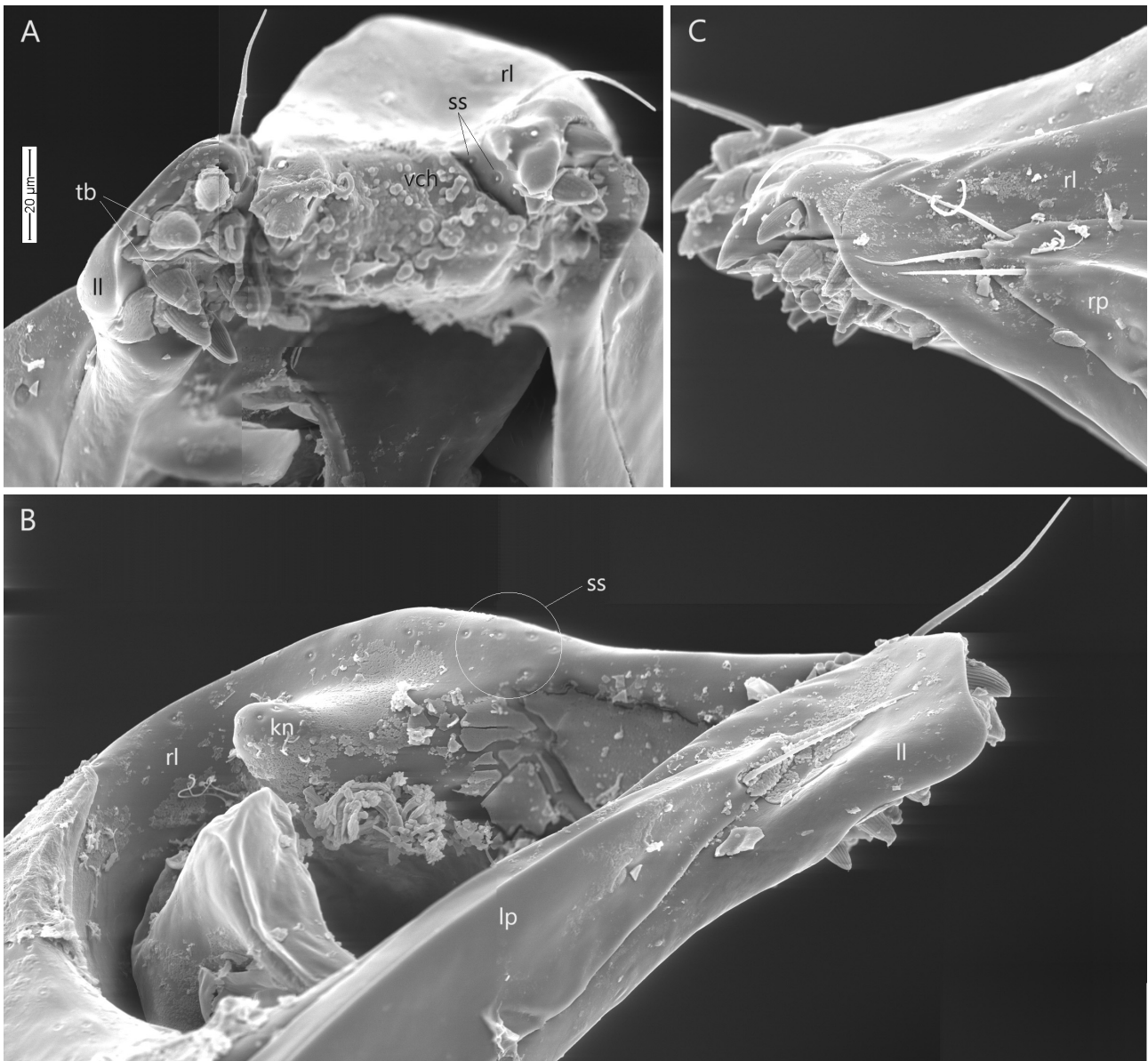


**FIGURE 36.** *Adelopsis piruapuera* Gnaschini, 1993 (*benardi* species group—subgroup *grouvellei*), male paratype MZSP 27131. A–U, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ap = apical projection; dd = dorsal depression.

The sensory structures have a shallow depression with a dome-shaped projection (‘ss’—e.g., Figs. 37B, 38A) or a conic projection, in the case of the ‘ventral chin’ (‘ss’—e.g., Fig. 37A—unfortunately, the ‘ventral chin’ is covered with debris, not allowing the proper observation of the integument).

The somewhat narrow fused parameres can be

recognized by the presence of a depression along their length (e.g., Fig. 36). They are shorter than the lobes (e.g., Fig. 38A); being the left paramere (‘lp’) somewhat longer than the right paramere (‘rp’). Both parameres have a medial narrowing close to the apex, which apical margin is round; and they bear three setae projected forward (e.g., Figs. 37B, C).



**FIGURE 37.** *Adelopsis piruapuera* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), male paratype MZSP 27131. A–C, Apex of aedeagus in ventral, left, and right views, respectively. kn = internal knob of the right lobe; ll = left lobe; lp = left paramere; rl = right lobe; rp = right paramere; ss = sensory structure; tb = tubercule; vch = ‘ventral chin’ of the right lobe.

The flagellum (‘fl’—e.g., Fig. 38A) seems to be short and strong, as originally described (as in Gnaspini, 1993a: figs. 16–18).

The internal knob (‘kn’—e.g., Figs. 37B, 38A, D) is short; the apical sensory structures have a shallow depression.

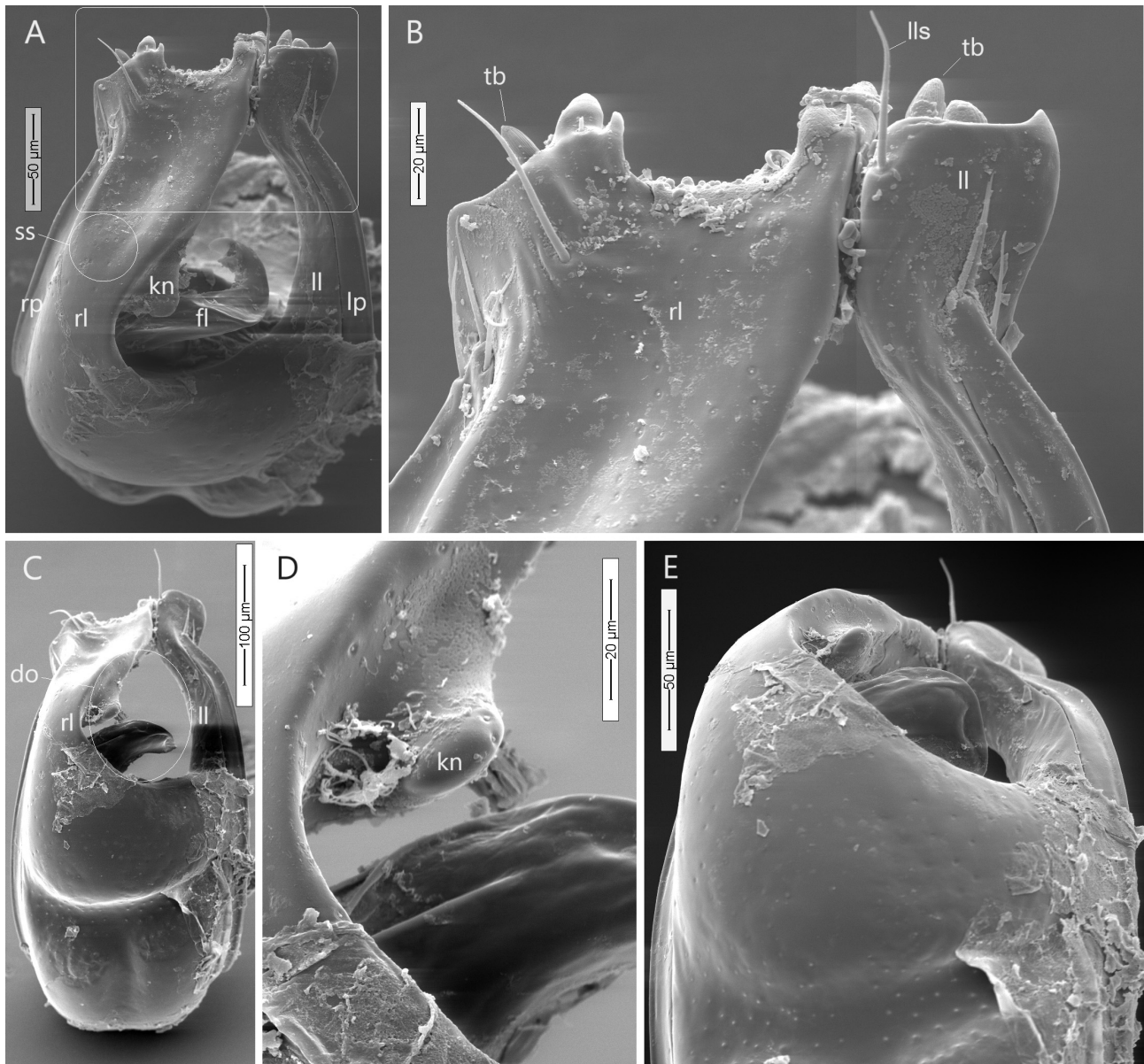
There is a somewhat deep transversal ‘dorsal depression’ (‘dd’—e.g., Fig. 36Q), which branches medially forming a depression which follows the ‘sagittal’ plane of the aedeagus towards the base of the aedeagus—the transversal and ‘sagittal’ depressions together shape as a ‘T’ (‘dd’—e.g., Fig. 36B); position = ~34–41% (ventral alignment) or ~43% (transversal alignment).

**Taxonomic remarks.** *Adelopsis piruapuera* can be easily recognized from all other species in the genus because it is until now the only one which bears a group

of strong tubercles on the ventral faces of the right and left lobes of the aedeagus. In addition, the left lobe of the aedeagus is not as narrow as in the other species of the *benardi* species group, and is elongate, reaching the same length as that of the right lobe.

Although the ventral face of the right lobe of the aedeagus is covered with debris, a small part of its surface allows the recognition of probable sensory structures (‘ss’—e.g., Fig. 37A), which lead us to interpret that this region is similar to what was observed in the other species of the *benardi* species group here examined, and was here called a ‘ventral chin’ (e.g., *A. claudina*—Fig. 25B, *A. leo*—Fig. 34B, and *A. cf. szymczakowskii*—Figs. 10B, D), but this region is very thin in *A. piruapuera*, and also in *A. caeteh* **sp. nov.** (e.g., Fig. 21B). (See also ‘Taxonomic remarks in *benardi* species group’).





**FIGURE 38.** *Adelopsis piruapuera* Gnaspini, 1993 (*benardi* species group—subgroup *grouvellei*), male paratype MZSP 27131. **A**, Aedeagus in frontal view of right lobe (white rectangle is detailed in **B**). **C**, Aedeagus in frontal view of right lobe, slightly rotated following the ‘sagittal’ plane of the aedeagus in relation to **A** (white rectangle is detailed in **D**). **E**, Dorsal view of the posterior half of the aedeagus. do = dorsal opening; fl = flagellum; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; rl = right lobe; rp = right paramere; ss = sensory structure; tb = tubercule.

***Adelopsis boraceia* Gnaspini & Gomyde, new species**

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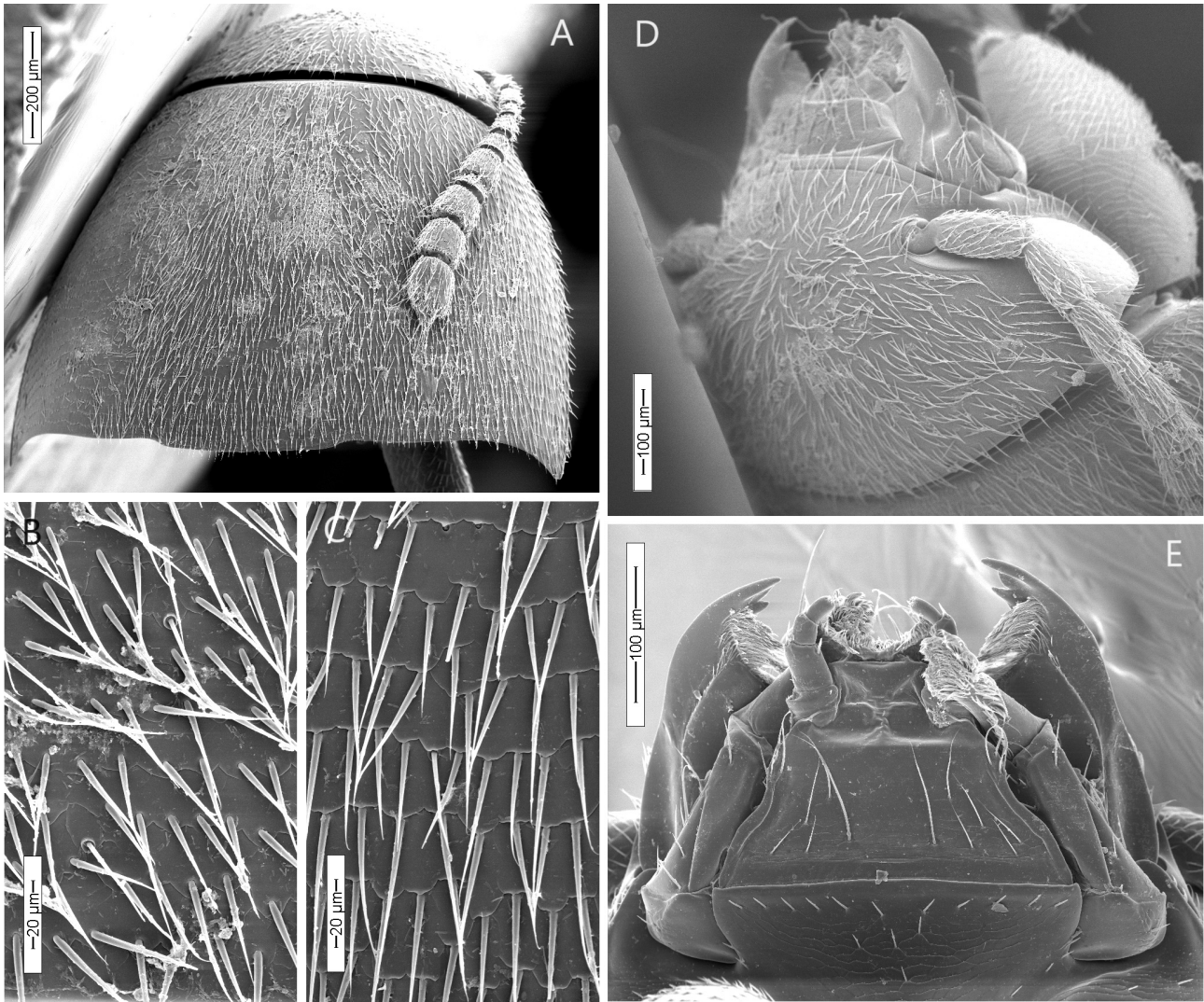
(Figs. 13A, 16B, 17B, 39–45)

Type locality: Estação Biológica de Boracéia [‘Boracéia Biological Station’], Salesópolis, São Paulo State, Brazil.

**Material examined. Holotype male:** BRAZIL—São Paulo:—Salesópolis, Estação Biológica de Boracéia [Boracéia Biological Station], 800–900m a.s.l.; 28–30.IV.1997; F. Génier & S. Ide leg.; ex. feces trap, cloud forest; Label: “BRASIL: SÃO PAULO / 50km SE Mogi

das Cruzes / Serra do Mar, Est. Biol. / Boracéia, 800–900m, 28–30 / IV.1997 / F. Génier & S. Ide / ex. feces trap, cloud forest”; MZSP 61001. **Paratypes:**—same data and label as for holotype; 13 males, MZSP 61002 to 61010 (61002 here illustrated), 2 CMNC, 1 FMNH, 1 MNHN;—Salesópolis, Estação Biológica de Boracéia [Boracéia Biological Station]; 24.V–20.VII.2002; S.A. Casari & I.B. Francini leg.; FIT.3 LOE I; Label: “Salesópolis, SP / Estação Biol. Boracéia / 24.V–20.VII.2002 / S.A. Casari & I.B. Francini col. / FIT.3 LOE I”; 1 male, MZSP 61011;—same collection data as for preceding; 22.II–22.III.2001; FIT; Labels: “Salesópolis, SP / Estação Biol. Boracéia / 22.II–22.III.2001 / S.A. Casari & I.B. Francini col.” and “FIT”; 1 male, MZSP 61012 (here illustrated);—same





**FIGURE 39.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A**, Head and pronotum, dorsal view. **B–C**, Detail of the integument of head and pronotum, respectively. **D**, Head, dorsal view. **E**, mouth parts, ventral view.

collection data as for preceding; 27.I–01.III.2002; FIT-2 LO81; Label: “Salesópolis, SP / Est. Biol. Boracéia / 27.I–01.III.2002 / S.A. Casari & I.B. Francini / FIT-2 LO81”; 1 male, MZSP 61013.

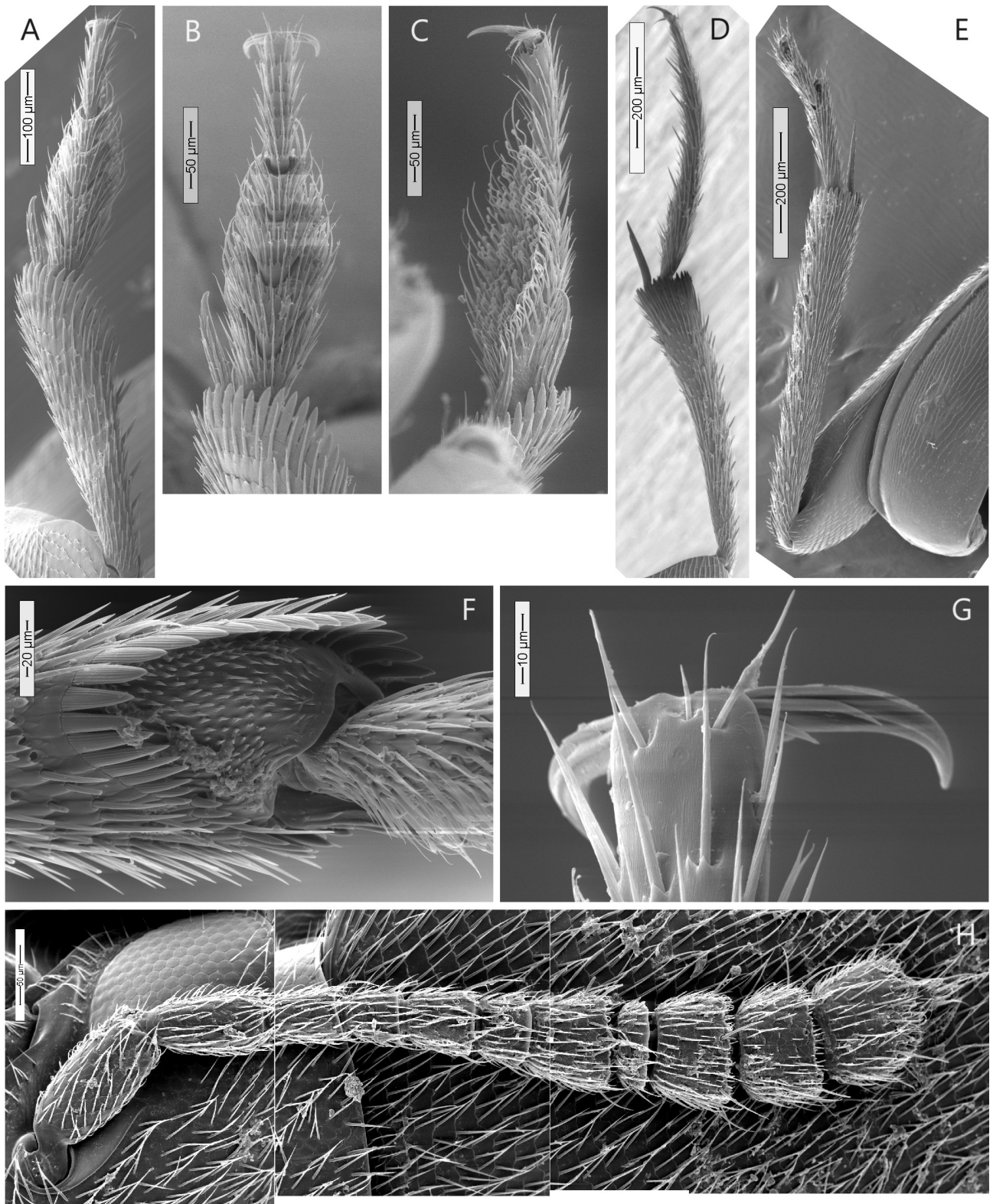
**Diagnosis and Description.** Length (holotype): 2.0 mm; width: 1.05 mm. Body ovoid, convex; color dark redish brown (Fig. 13A). Winged. Head with setae organized transversally, following fine strigae (Figs. 39A, B). Eyes normal (Figs. 39D, 40H). Antenna (Figs. 39A, 40H) 1.15 times as long as pronotum; proportions of length of each antennomere and that of the 9th from 1st to 11th: 2.0, 1.6, 1.0, 0.85, 1.0, 0.75, 1.1, 0.45, 1.0, 1.05, 1.6; proportions of length and width of each antennomere from 1st to 11th: 2.1, 2.1, 1.5, 1.2, 1.25, 0.8, 0.9, 0.35, 0.7, 0.7, 1.1. Pronotum transverse; integument with transverse strigae (Figs. 39A, C). Elytra together 1.5 times as long as wide; with transverse, slightly diagonal, strigae (Fig. 13A). First four male protarsomeres expanded, with discoidal tenent setae ventrally (Figs. 40A–C). First segment of male protarsus 0.6 times as wide as the maximum width of tibia; proportions of length and width

of each protarsomere, from 1st to 5th: 1.3, 1.3, 1.2, 1.35, 4.95. Integument of apex of protibia internal to the crown of spines covered with microspines (e.g., Fig. 40F). Male mesotibia curved internally (Fig. 40D). Male metatibia straight (Fig. 40E). Male genital segment with spiculum gastrale divided at apex, with long branches (Fig. 16B).

Aedeagus somewhat globose (l/w ~2.5, concavity ~39–43%; concavity/total length = ~47% [Figs. 17B, 41E, M]), basal opening 90° downwards; width slightly larger than height, widest closer to base (e.g., Fig. 41).

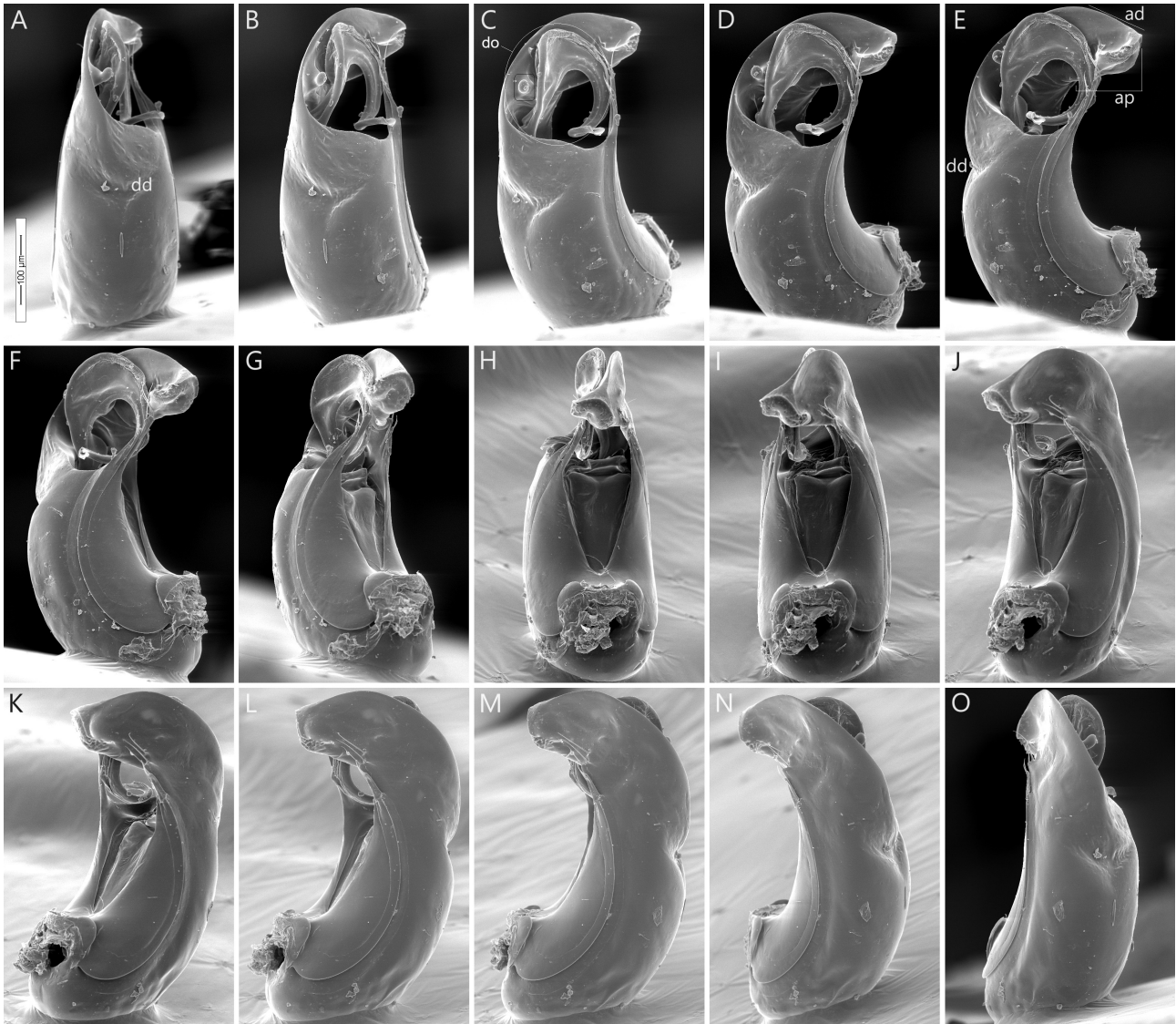
Right lobe (‘rl’—e.g., Fig. 42A) somewhat elongate, quickly narrowing into a long ‘crest’ (‘cr’—e.g., Figs. 42A, 44B) with ‘vertical’ inner and outer faces; the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Figs. 42B, C). The outer ‘plateau’ (‘rlp’) bears two long setae, projecting forward, and one additional, long seta near its base, and close to the base of an additional, small elevation (‘rlc’) (e.g., Fig. 42D); at the center of the outer face of the apical projection of the right lobe, there is an additional, low, wide-based elevation (‘rlc2’), with no seta nearby (e.g., Fig. 42D). The ‘apical projection’ (‘ap’—





**FIGURE 40.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A**, Proleg; **B–C**, Protarsus, dorsal and ventral views, respectively. **D–E**, Mid- and hindlegs, respectively. **F**, Apex of protibia, showing spiny integument, lateral view. **G**, Apex of protarsus, dorsal view. **H**, Antenna, dorsal view.





**FIGURE 41.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A–O**, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. Black rectangle in C is detailed in Fig. 45C. All figures to the same scale. ad = apical depression; ap = apical projection; dd = dorsal depression; do = dorsal opening.

e.g., Fig. 41E) % length = ~22%. The convex ‘apical depression’ (‘ad’—e.g., Fig. 41E) % depth = ~30–37%, % height = ~33–37%.

The left lobe (‘ll’) is a narrow stripe which goes straight posteriad towards the apex of the right lobe of the aedeagus (e.g., Fig. 42C); its diagonally truncated apical margin bears three setae projecting forward (‘lls’—e.g., Fig. 42C).

The dorsal opening (‘do’—e.g., Fig. 44A) takes ~39% of the total length of the aedeagus.

The sensory structures (‘ss’—e.g., Fig. 42A) concentrate on the apical widening of the right lobe (‘ss’—e.g., Fig. 44B) and on the ‘ventral chin’, where they appear in at least two different types, with a central dome-shaped or conic projection (‘ss’—e.g., Fig. 42B). The sides of the ‘ventral chin’ are emarginated.

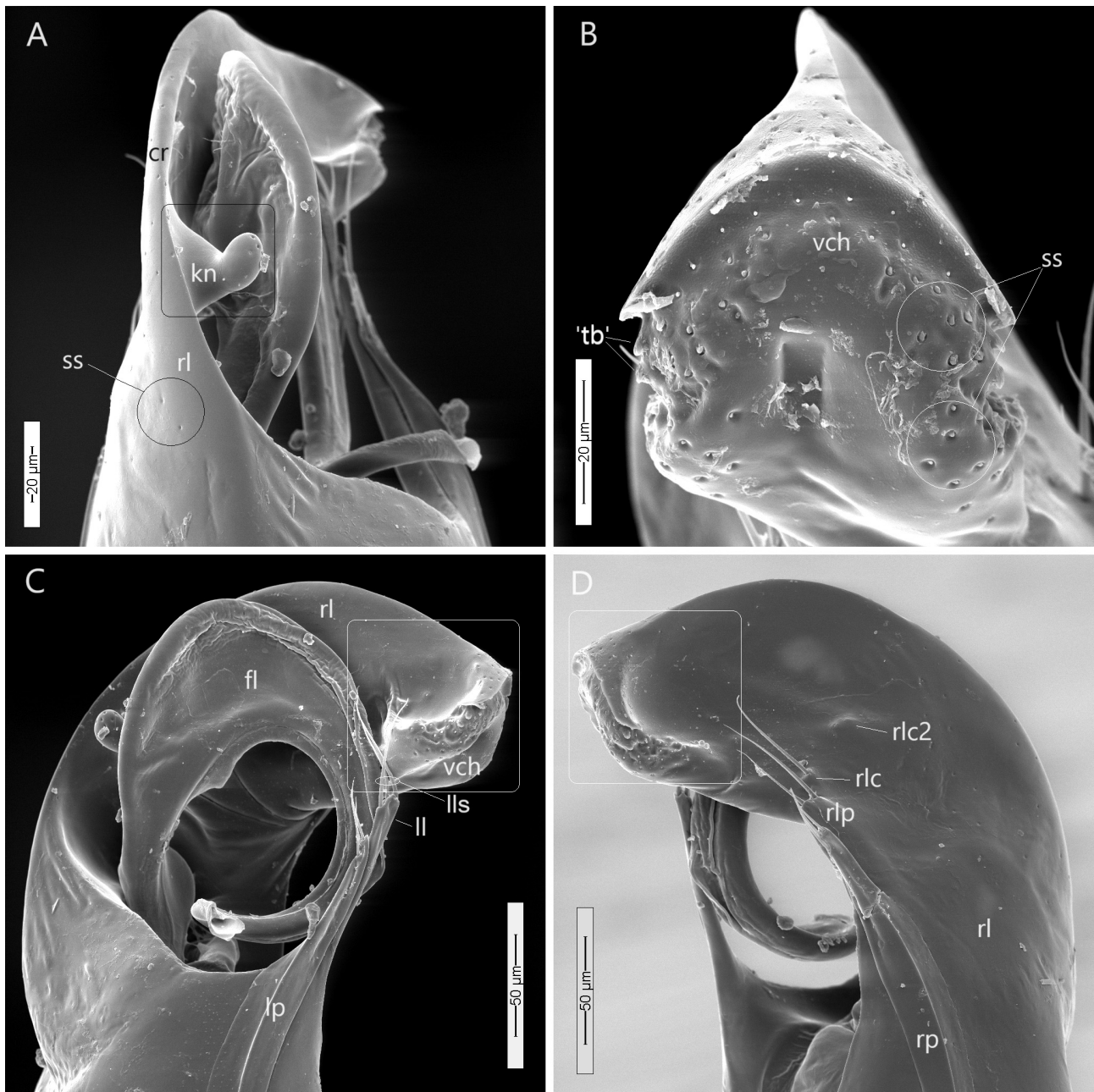
The somewhat narrow fused parameres can be recognized by the presence of a depression along their

length (e.g., Fig. 41). They are shorter than the lobes (e.g., Figs. 42C, D), being the left paramere (‘lp’) somewhat shorter than the right paramere (‘rp’). Both parameres have a dorsal narrowing close to the apex, which apical margin is round; and they bear three setae projected forward, two apically and one a little behind the others (e.g., Figs. 42C, D).

The flagellum (‘fl’—e.g., Figs. 42C, 44A) is very robust—it seems to be narrower inside the aedeagus and, as it emerges from the dorsal opening, it progressively and strongly widens and makes a curve, practically completing a whole circumference, staying wide for more than half its length and it slowly narrows toward its apex, which has a small, projecting ‘lip’; using light microscopy, it is possible to recognize the presence of a globose base (Fig. 17B).

The internal knob (‘kn’—e.g., Figs. 42A, 44A, detailed in Fig. 45) is short, diagonally produced, and





**FIGURE 42.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in C, D are detailed in Figs. 43A, B, respectively; black square in A is detailed in Fig. 45A. cr = crest of right lobe; fl = flagellum; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; rl = right lobe; rlc = elevation near the base of the right lobe; rlc2 = elevation far from the base of the right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; ss = sensory structure; ‘tb’ = ‘tubercule’ on the ‘ventral chin’; vch = ‘ventral chin’ of the right lobe.

has a constriction just before its apex; the apical sensory structures have a shallow depression.

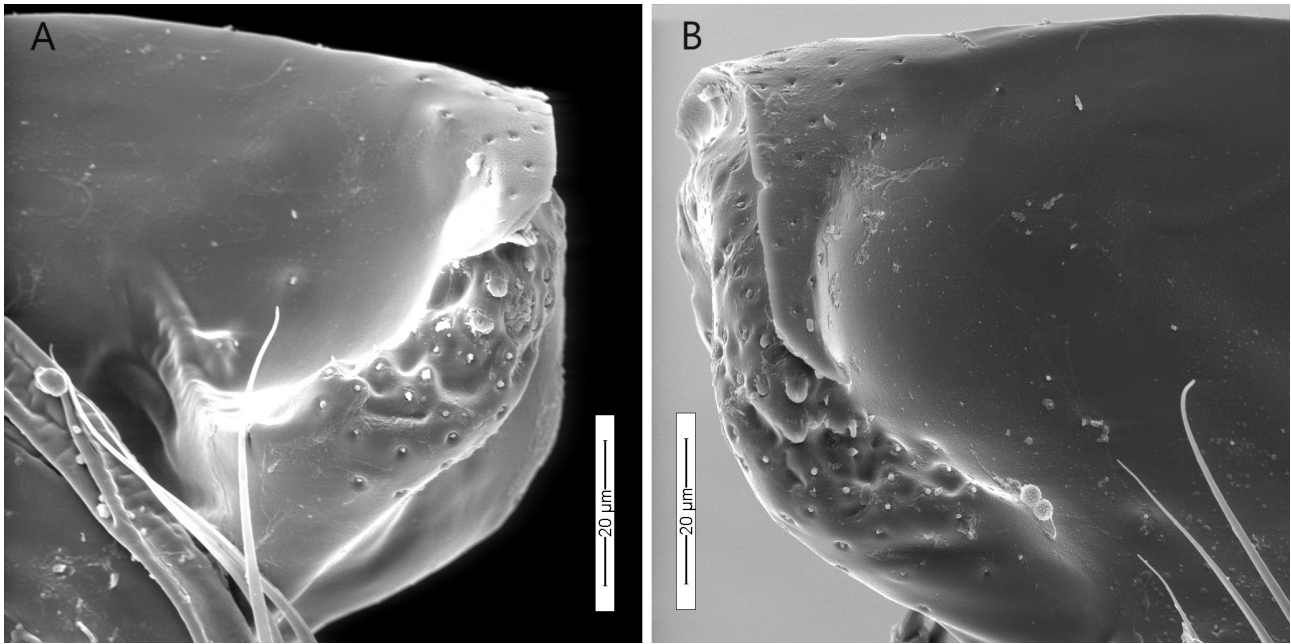
There is a low, V-shaped, transversal ‘dorsal depression’ (‘dd’—e.g., Figs. 41A, E); position = ~50–53%.

Female. Not assigned (see Note under the heading ‘*Grouvellei* species subgroup Gnaspini & Peck, 2019’, above).

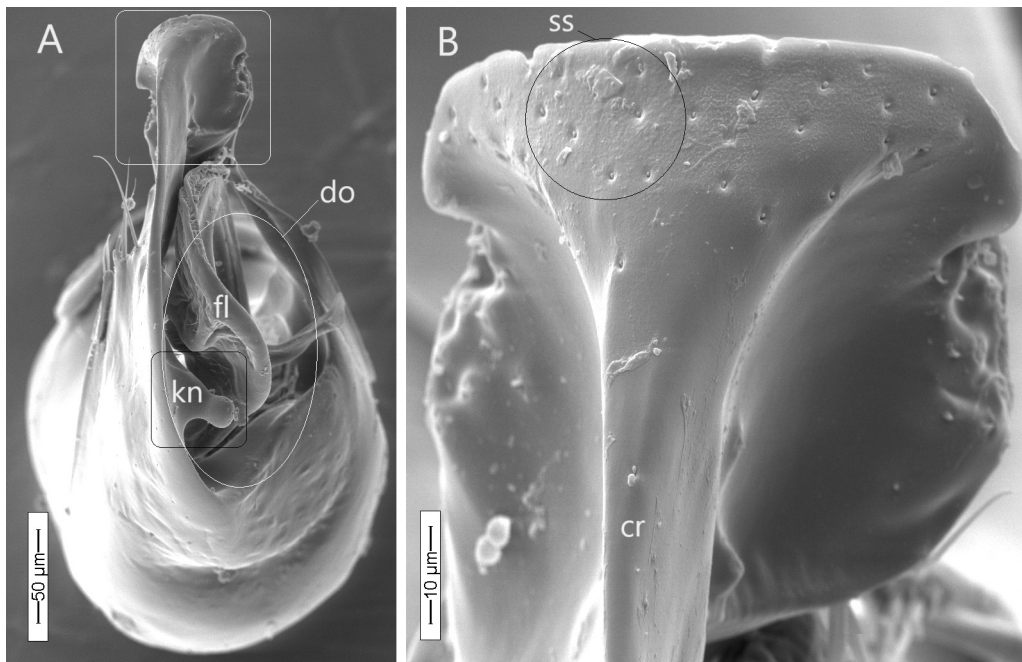
**Etymology.** The name is given as a noun in apposition, referring to the type locality.

**Distribution.** Brazil: São Paulo State: known only from the type locality.

**Taxonomic remarks.** Considering the overall shape, with a short apical projection and a deep transversal dorsal depression, the aedeagus of *A. boraceia* sp. nov. resembles that of *A. leo* and *A. mrazi* Gnaspini & Peck, 2019 (and differs them from other species); however, the male genital segment of *A. mrazi* is of a completely different type than that of the other two species, which led Gnaspini & Peck (2019) to place them in different species subgroups. The aedeagus of *A. boraceia* sp. nov.



**FIGURE 43.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A–B**, Details of apex of aedeagus in left and right views, respectively, slightly rotated dorsad in relation to Figs. 42C, D.



**FIGURE 44.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A**, Aedeagus in frontal view of right lobe (white square is detailed in **B**, slightly rotated). Black square in **A** is detailed in Fig. 45B. cr = crest of right lobe; do = dorsal opening; fl = flagellum; kn = internal knob of the right lobe; ss = sensory structure.

and *A. leo* differ in several aspects, such as the shape of the apical projection, shape of the left lobe, shape of the flagellum, shape of the internal knob, types of sensorial structures on the ‘ventral chin’, among others. (See also ‘Taxonomic remarks in *benardi* species group’).

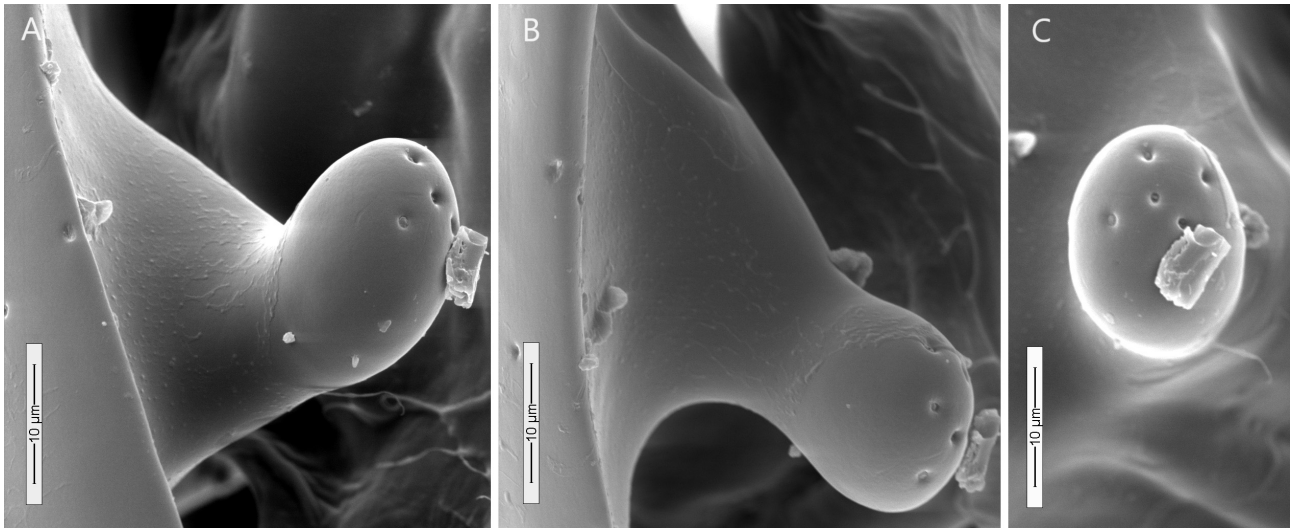
***Adelopsis monticola* Gnaspini & Gomyde, new species**

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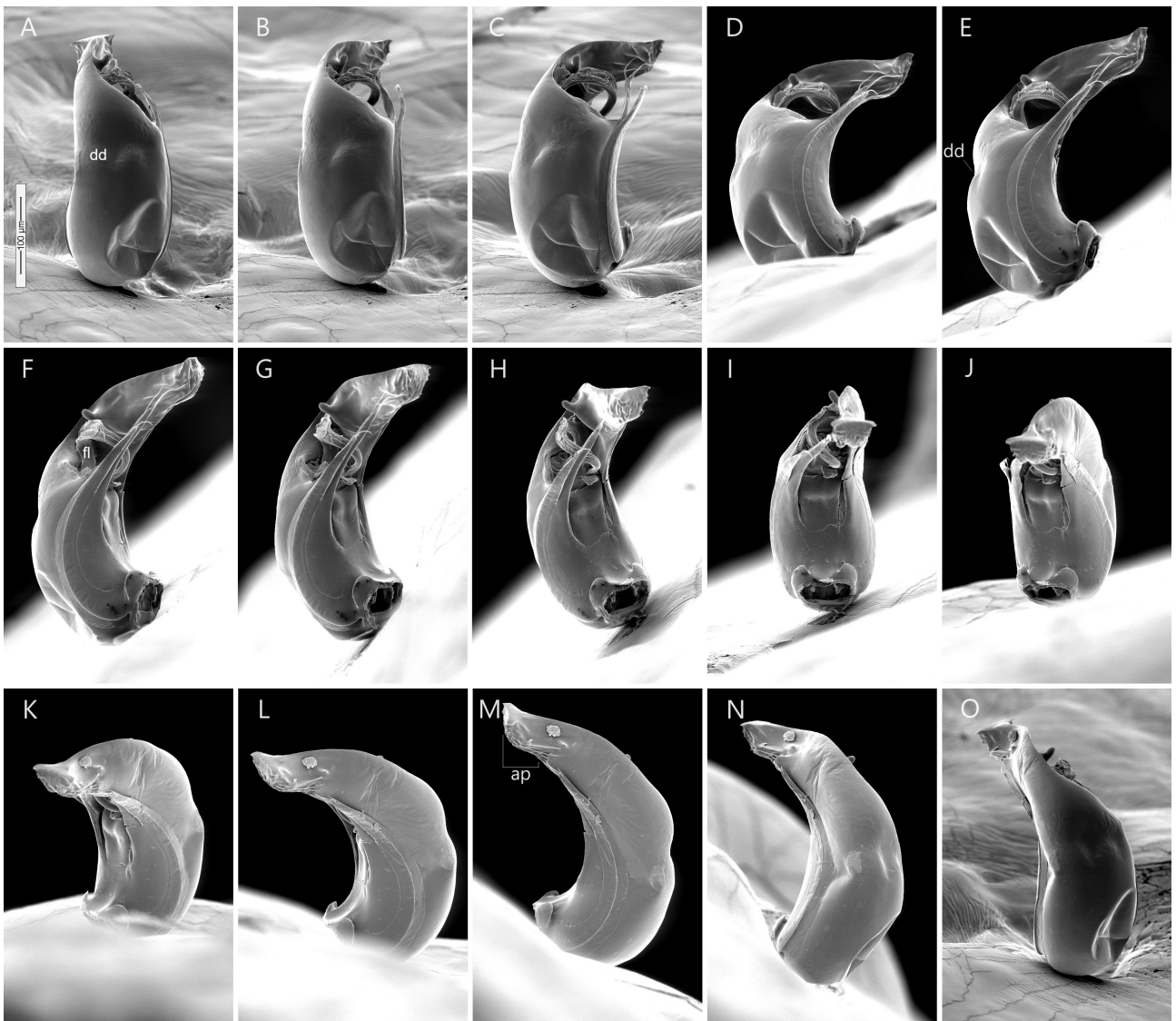
(Figs. 13B, 14B, 15B, 16C, 17C, 46–50)

Type locality: Estação Biológica de Boracéia [‘Boracéia Biological Station’], Salesópolis, São Paulo State, Brazil.





**FIGURE 45.** *Adelopsis boraceia* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61001. **A–C**, Internal knob ('kn') of right lobe of aedeagus, in different views—details from Figs. 42A (A), 44B (B), 41C (C).

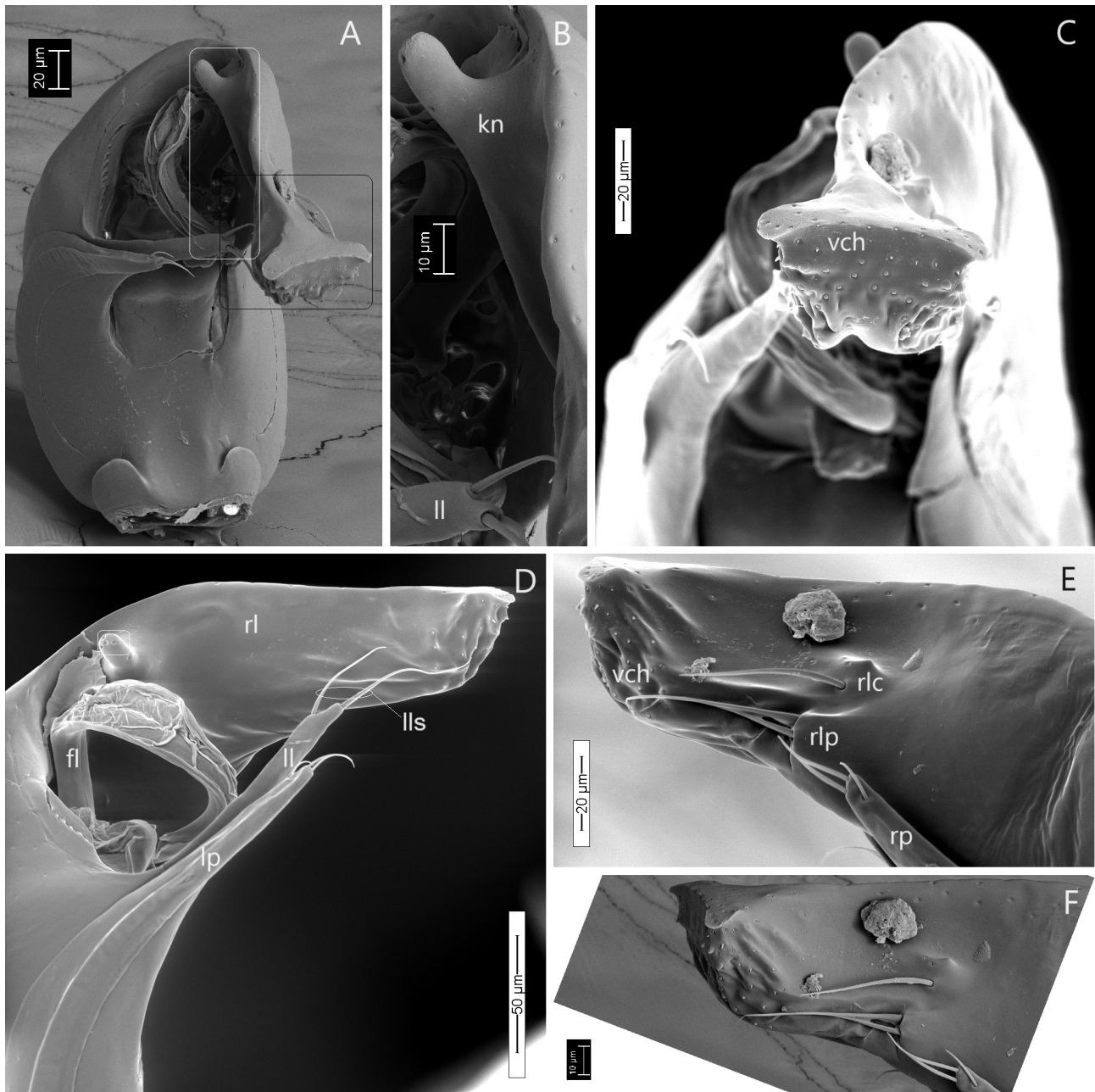


**FIGURE 46.** *Adelopsis monticola* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61017. **A–O**, A rotational view of the aedeagus, around its 'longitudinal' axis, starting from the dorsal view. All figures to the same scale. ap = apical projection; dd = dorsal depression; fl = flagellum.

**Material examined. Holotype male:** BRAZIL—São Paulo:—Salesópolis, Estação Biológica de Boraceia [Boraceia Biological Station], 800–900m a.s.l.; 28–30.IV.1997; F. Génier & S. Ide leg.; ex. feces trap, cloud forest; Label: “BRASIL: SÃO PAULO / 50km SE Mogi das Cruzes / Serra do Mar, Est. Biol. / Boracéia, 800–900m, 28–30/IV.1997 / F. Génier & S. Ide / ex. feces trap, cloud forest”; MZSP 61017. **Paratypes:**—Salesópolis, Estação Biológica de Boraceia [Boraceia Biological Station]; 24.V–20.VII.2002; S.A. Casari & I.B. Francini leg.; FIT.3 LOE I; Label: “Salesópolis, SP / Estação Biol. Boracéia / 24.V–20.VII.2002 / S.A. Casari & I.B.

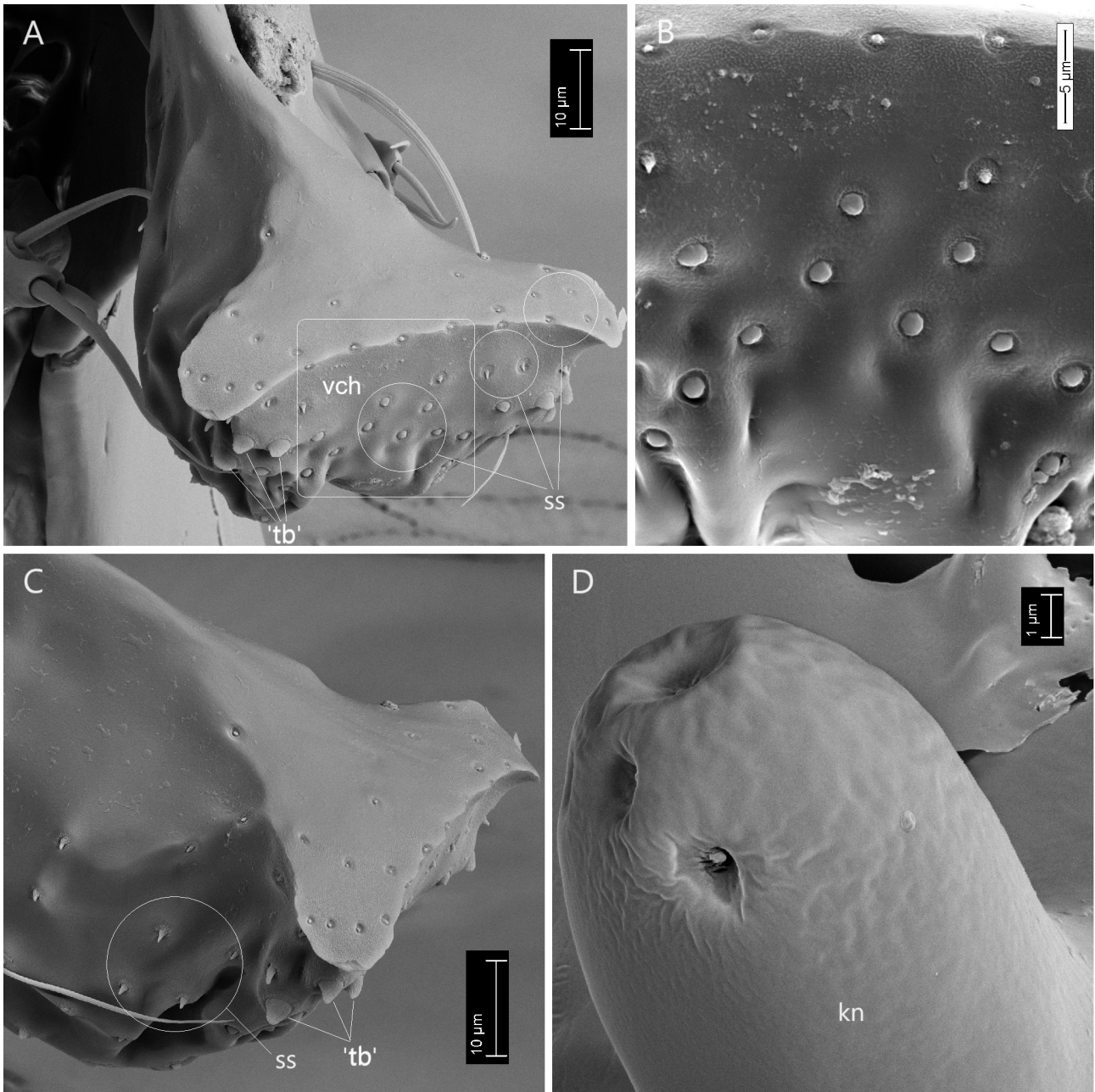
Francini col. / FIT.3 LOE I”; 2 males, MZSP 61018 (here illustrated), 61019;—Salesópolis, Estação Biológica de Boraceia [Boraceia Biological Station], Riacho Estrada do Castelinho; 09.XII.2021–25.V.2022; 23°39′20.5″S 45°53′26.6″W; 830m a.s.l.; N. Hamada, J. Silva, L. Fusari & T. Polizei leg.; Malaise trap; Label “Brasil. São Paulo. Salesópolis / Estação Biológica de Boracéia / Riacho Estrada do Castelinho / 09.XII.2021—25.V.2022 Malaise / 830m, 23°39′20.5″S 45°53′26.6″W / Neusa Hamada, Jefferson Silva, / Livia Fusari & Thiago Polizei leg.”; 1 male, MZSP 61021.

**Diagnosis and Description.** Length (holotype):



**FIGURE 47.** *Adelopsis monticola* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61017. **A**, Aedeagus in ventral view (white rectangle is detailed in **B**.; black rectangle is detailed in Fig. 48A). **C–F**, Apex of aedeagus in ventral, left, and right (**E**, **F**—slightly different views) views, respectively. White square in **D** is detailed in Fig. 48D. fl = flagellum; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; rl = right lobe; rlc = elevation near the base of the right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; vch = ‘ventral chin’ of the right lobe.



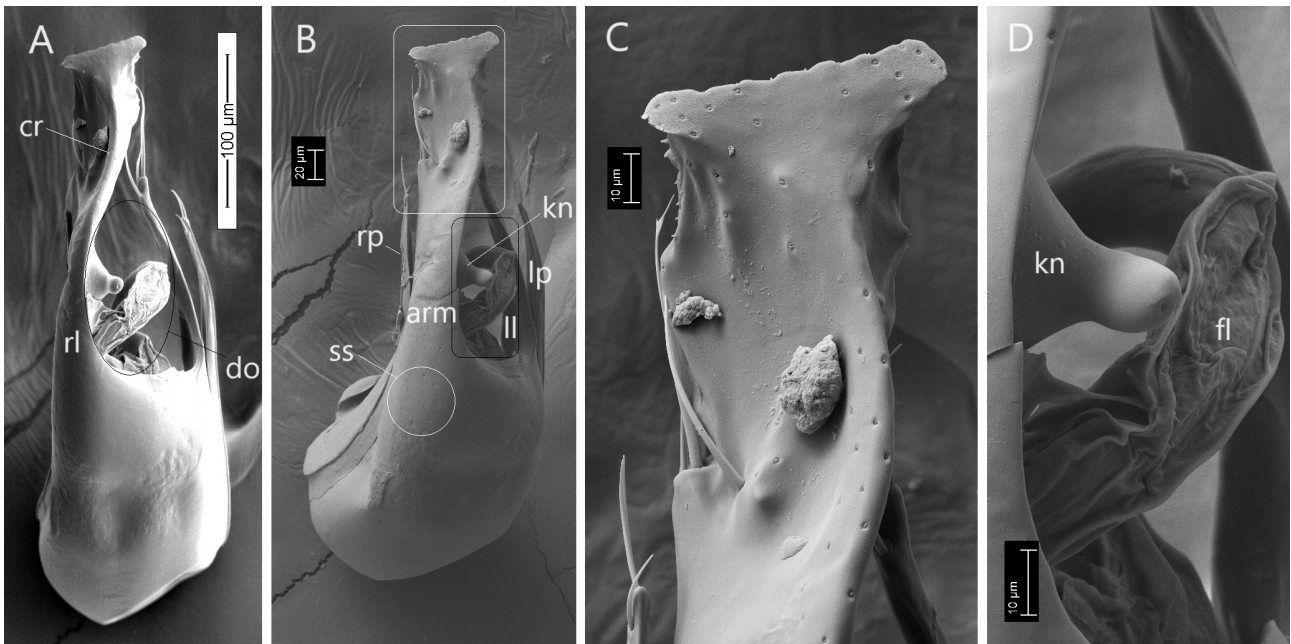


**FIGURE 48.** *Adelopsis monticola* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61017. **A**, Apex of aedeagus in ventral view (detail from Fig. 47A) (white square is detailed in **B**., slightly rotated dorsad). **C**, Apex of aedeagus in ventro-lateral view (slightly rotated in relation to **A**). **D**, Internal knob ('kn'), detailed from Fig. 47D (slightly rotated). kn = internal knob of the right lobe; ss = sensory structure; 'tb' = 'tubercule' on the 'ventral chin'; vch = 'ventral chin' of the right lobe.

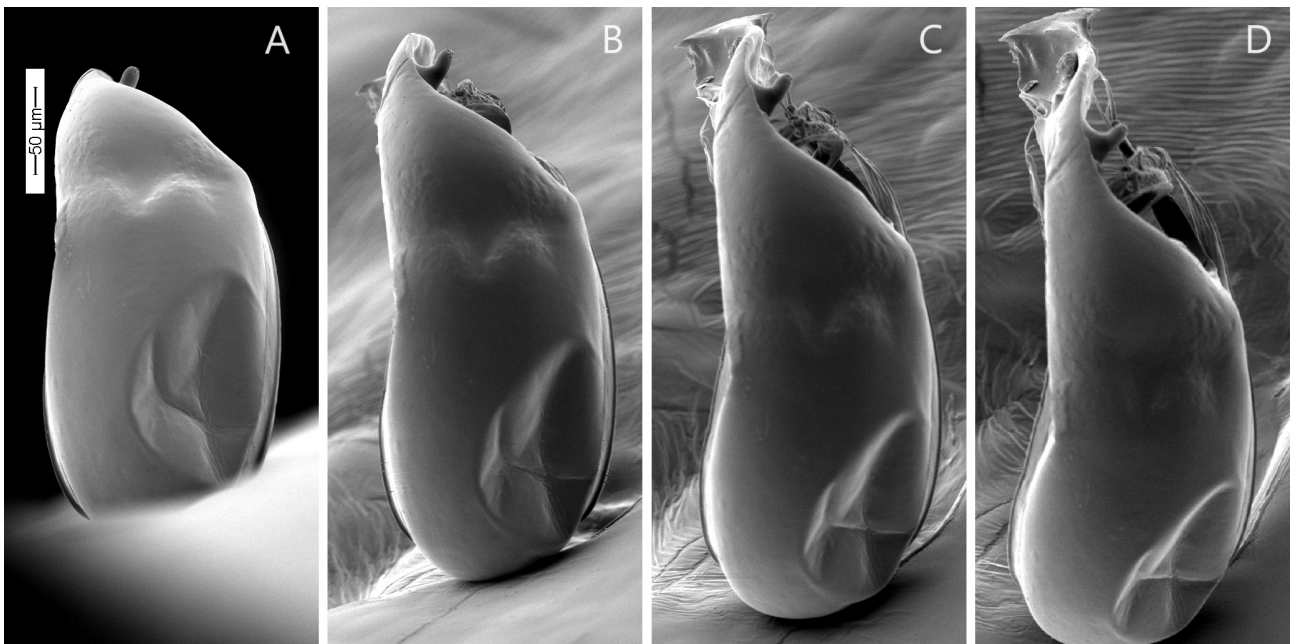
1.75 mm; width: 0.95 mm. General characteristics as listed above. Body ovoid, convex; color dark brown (Fig. 13B). Winged. Head integument punctuated, punctures not organized in strigae. Eyes normal. Antenna (Fig. 14B)—proportions of length of each antennomere and that of the 9th from 2nd to 11th: 1.75, 1.2, 0.8, 0.85, 0.75, 1.05, 0.4, 1.0, 1.0, 1.9; proportions of length and width of each antennomere from 2nd to 11th: 2.35, 1.85, 1.35, 1.25, 0.9, 0.9, 0.4, 0.8, 0.7, 1.35. Pronotum transverse; integument with undulated transverse strigae (Fig. 13B). Elytra together 1.1 times as long as wide; with transverse, slightly diagonal, strigae (Fig. 13B). First four male

protarsomeres expanded (Fig. 15B), with discoidal tenent setae ventrally. First segment of male protarsus [paratype 61018] 0.6 times as wide as the maximum width of tibia; proportions of length and width of each protarsomere, from 1st to 5th: 1.5, 1.15, 1.1, 1.25, 4.0. Male mesotibia slightly curved internally. Male metatibia straight. Male genital segment with a thin body and spiculum gastrale divided at apex, with long branches (Fig. 16C).

Aedeagus somewhat elongate (l/w ~2.6), slightly sinuose in dorsal view (e.g., Fig. 46A), concavity ~41% [ventral alignment] or ~26–30% [transversal alignment]; concavity/total length = ~52–53% [ventral alignment] or



**FIGURE 49.** *Adelopsis monticola* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61017. **A–B**, Aedeagus in frontal view of right lobe (slightly rotated in relation to each other) (white rectangle in B is detailed in C.; black rectangle is detailed in D.). arm = arm of the right lobe; cr = crest of right lobe; do = dorsal opening; fl = flagellum; kn = internal knob of the right lobe; ll = left lobe; lp = left paramere; rl = right lobe; rp = right paramere; ss = sensory structure.



**FIGURE 50.** *Adelopsis monticola* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61017. **A–D**, Aedeagus in dorsal view, with slight rotation towards apex, following the ‘sagittal’ plane of the aedeagus, in order to show the influence of the view in the recognition of the aedeagal shape. All figures to the same scale.

~53–59% [transversal alignment] [Figs. 17C, 46E, M], basal opening almost 90° downwards; width a little larger than height, widest closer to base (e.g., Fig. 46).

Right lobe (‘rl’—e.g., Fig. 49A) elongate, with a long ‘arm’ (‘arm’—e.g., Fig. 49B) narrowing into a ‘crest’ (‘cr’—e.g., Fig. 49A) with a wide external face; the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Figs. 47C, E); the apical margin is slightly curved backward (i.e., concave—e.g., Figs. 48A, C). The

outer ‘plateau’ (‘rlp’) bears two long setae, projecting forward, and one additional, long seta near its base, and close to the base of an additional, low, wide-based, conic elevation (‘rlc’—e.g., Fig. 47E). The ‘apical projection’ (‘ap’—e.g., Fig. 46M) % length = ~18–20%, % height = ~86–100%.

The left lobe (‘ll’) is a narrow stripe which goes straight posteriad towards the apex of the right lobe of the aedeagus (e.g., Figs. 47D, 49B); its diagonally truncated



apical margin bears two setae projecting forward ('lls'—e.g., Fig. 47D).

The dorsal opening ('do'—e.g., Fig. 49A) takes ~44% (ventral alignment) or ~30% (transversal alignment) of the total length of the aedeagus.

The sensory structures ('ss'—e.g., Fig. 49B) concentrate on the apex of the dorsal surface of the right lobe and on the 'ventral chin', where they have a shallow depression with a dome-shaped projection (of different sizes) or a conic projection ('ss'—e.g., Figs. 48A, C).

The somewhat narrow fused parameres can be recognized by the presence of a depression along their length; their apical forth are free ('lp' and 'rp'—e.g., Figs. 46, 49B). The parameres have about the same length and are shorter than the lobes, and their width slowly narrows towards their apex in their free part ('lp'—e.g., Fig. 47D); their apical margin is round and bears three setae, projecting forward, two placed at the margin and one placed a little behind (e.g., Figs. 47D, E).

The flagellum ('fl'—e.g., Figs. 47D, 49D) seems to be a soft tape which makes a whole circumference inside the dorsal opening; using light microscopy, it is possible to recognize the presence of a globose base (Fig. 17C).

The internal knob ('kn'—e.g., Fig. 47B, 48D, 49D) is short; the apical sensory structures have a somewhat deep depression.

There is a low transversal 'dorsal depression' ('dd'—e.g., Fig. 46E); position = ~37% (ventral alignment) or ~55–57% (transversal alignment).

Female. Not assigned (see Note under the heading '*Grouvellei* species subgroup Gnaspini & Peck, 2019', above).

**Etymology.** The name is derived from Latin for mountaineer, highlander, referring to the hilly region where it was captured.

**Distribution.** Brazil: São Paulo State: known only from the type locality.

**Taxonomic remarks.** See 'Taxonomic remarks in *benardi* species group'.

***Adelopsis vanini* Gnaspini & Gomyde, new species**  
 urn:lsid:zoobank.org:act:43D1FE5B-5D70-480D-A476-BBDD84933219  
 (Figs. 16D, 51–52)

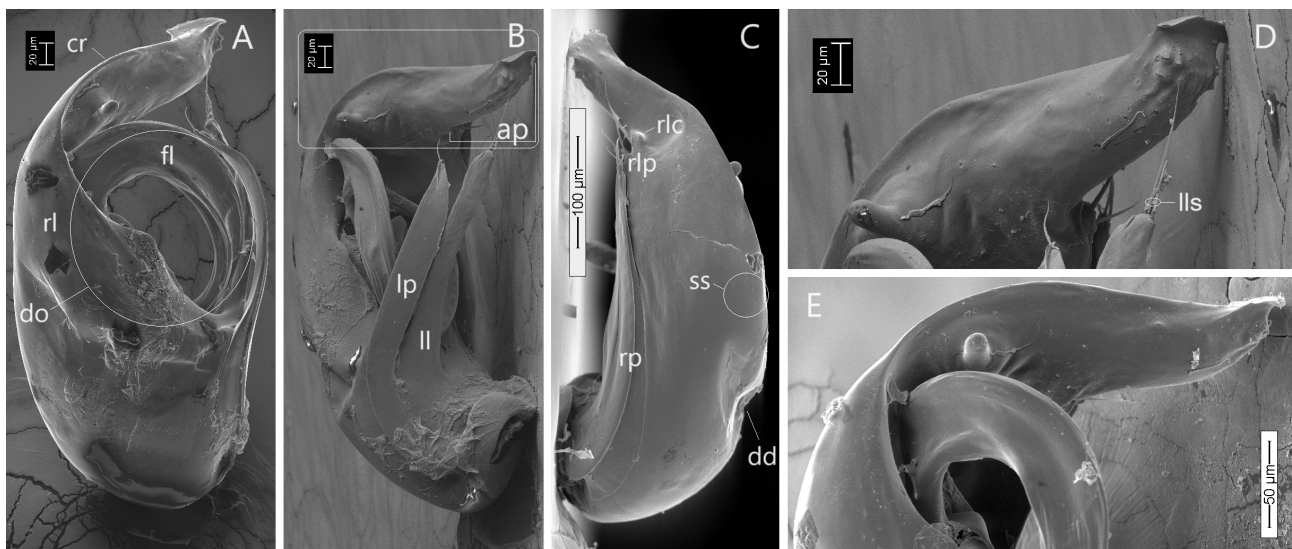
Type locality: Estação Biológica de Boracéia ['Boracéia Biological Station'], Salesópolis, São Paulo State, Brazil.

**Material examined. Holotype male: BRAZIL—São Paulo:**—Salesópolis, Estação Biológica de Boracéia [Boracéia Biological Station], 800–900m a.s.l.; 28–30.IV.1997; F. Génier & S. Ide leg.; ex. feces trap, cloud forest; Label: "BRASIL: SÃO PAULO / 50km SE Mogi das Cruzes / Serra do Mar, Est. Biol. / Boracéia, 800–900m, 28–30 / IV.1997 / F. Génier & S. Ide / ex. feces trap, cloud forest"; MZSP 61022. Note: Body incomplete, in poor condition—does not allow full description.

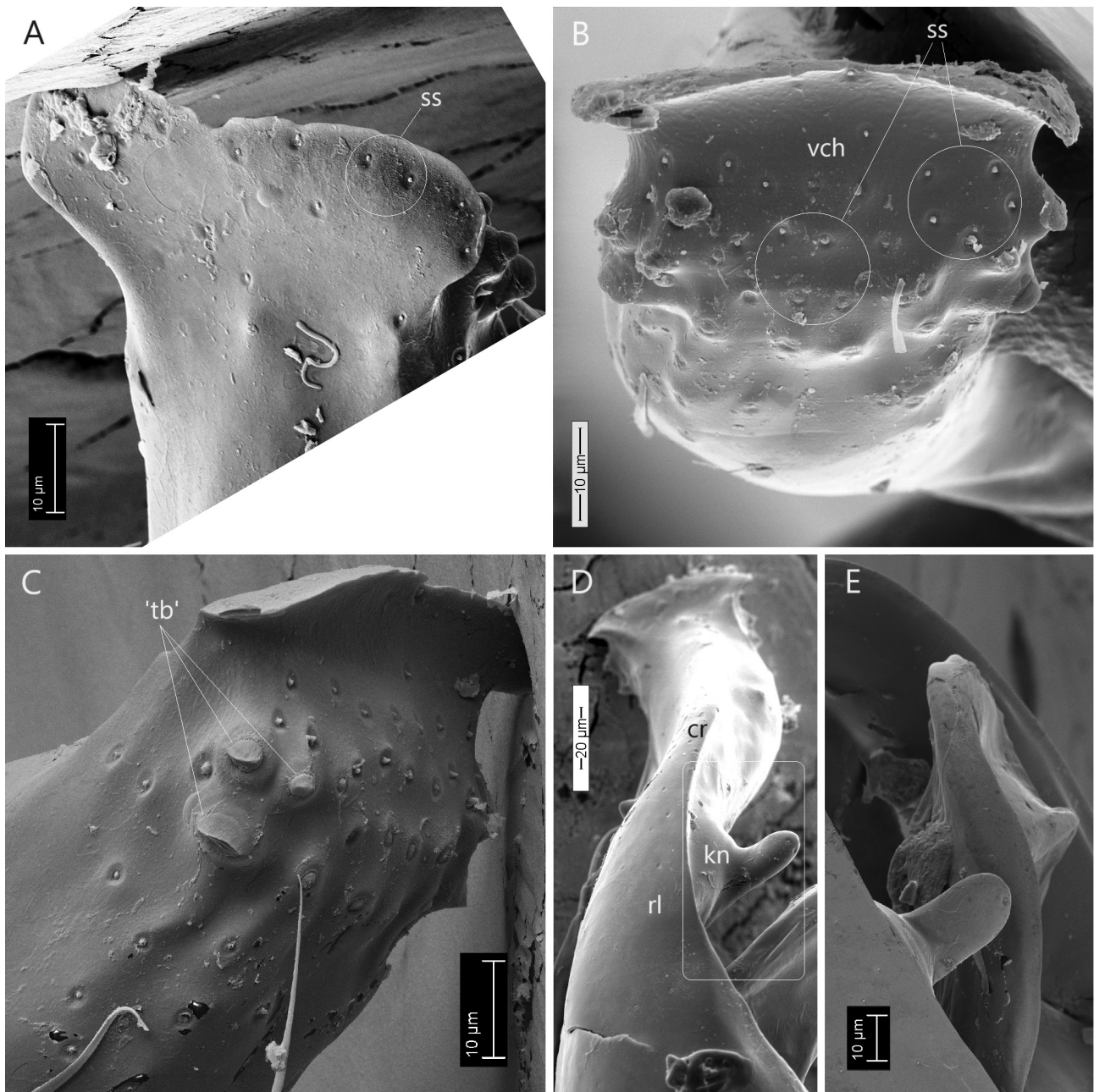
**Diagnosis and Description.** Length of elytron (holotype): 1.6 mm. General characteristics as listed above. Body ovoid, convex; color dark brown. Winged. Elytra with transverse, slightly diagonal, strigae. Male genital segment with spiculum gastrale divided at apex, with long branches (Fig. 16D).

Aedeagus somewhat globose (l/w ~1.8, concavity ~29–33%; concavity/total length = ~56–58% [Fig. 51B]), basal opening almost 90° downwards; width much larger than height, widest near the apex of the left lobe, where the dorsal opening is wider (e.g., Fig. 51A).

Right lobe ('rl'—e.g., Figs. 51A, 52D) elongate, narrowing into a 'crest' ('cr'—e.g., Figs. 51A, 52D)



**FIGURE 51.** *Adelopsis vanini* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61022. **A–C,** Aedeagus in dorsal, left, and right views, respectively (white rectangle in B is detailed in **D**., slightly rotated dorsad). **D–E,** Apex of aedeagus in right view, slightly rotated in relation to each other. ap = apical projection; cr = crest of right lobe; dd = dorsal depression; do = dorsal opening; fl = flagellum; ll = left lobe; lls = setae on the left lobe; lp = left paramere; rl = right lobe; rlc = elevation near the base of the right lobe; rlp = 'plateau' near the base of the right lobe; rp = right paramere; ss = sensory structure.



**FIGURE 52.** *Adelopsis vanini* Gnaspari & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61022. **A–D**, Apex of aedeagus in frontal, ventral, ventro-lateral, and dorsal views, respectively (white rectangle in **D** is detailed in **E**, slightly rotated). cr = crest of right lobe; kn = internal knob of the right lobe; rl = right lobe; ss = sensory structure; 'tb' = 'tubercle' on the 'ventral chin'; vch = 'ventral chin' of the right lobe.

with a wide external face; the apical margin abruptly goes backward (forming a thin plate) and connects to a 'ventral chin' ('vch'—e.g., Fig. 52B). The outer 'plateau' ('rlp') bears two long setae, projecting forward, and one additional, long seta near its base, and close to the base of an additional, low, conic elevation ('rlc'—e.g., Fig. 51C). The 'apical projection' ('ap'—e.g., Fig. 51B) % length = ~16%, % height = ~41%.

The left lobe ('ll') is a somewhat narrow stripe which goes straight posteriad towards the apex of the right lobe of the aedeagus (e.g., Fig. 51B); its round apical margin bears (probably) two setae projecting forward ('lls'—e.g.,

Fig. 51D—there is some debris covering the base of the setae, not allowing a precise observation).

The dorsal opening ('do'—e.g., Fig. 51A) is very ample and diagonally produced, taking ~60–62% of the total length of the aedeagus.

The sensory structures ('ss'—e.g., Fig. 51C) concentrate on the apex of the dorsal surface of the right lobe and on the 'ventral chin', where they have a shallow depression with a dome-shaped projection (of different sizes) or a conic projection ('ss'—e.g., Figs. 52A, B).

The parameres are different from each other. The right paramere ('rp'—e.g., Fig. 51C) is curved (and follows the



curvature of the aedeagus, along the right lateral face of the aedeagus); it is completely fused to the aedeagus body (the placement of the fusion can be recognized by the presence of a depression along its length) on its first half, and seems to be free on the apical half; it is wider at base and slowly narrows towards its apex, which is round and seems to bear three apical setae, projecting forward. The left paramere ('lp'—e.g., Fig. 51B) is wider at base and completely fused to the aedeagus body (the placement of the fusion can be recognized by the presence of a depression along its length) until it reaches the basalmost region of the dorsal opening, where it makes a sharp turn; after that, its lateral margins are subparallel and the paramere is free and follows the left lobe of the aedeagus, very closely; near the apex, its ventral margin curves upwards to meet the dorsal margin and form a pointy apex, which seems to bear two setae.

The flagellum ('fl'—e.g., Fig. 51A) is very robust, and practically makes a whole circumference, covering the space of the dorsal opening.

The internal knob ('kn'—e.g., Fig. 52D) is somewhat elongate; the apical sensory structures have a shallow depression.

There is a low transversal 'dorsal depression' ('dd'—e.g., Fig. 51C); position = ~33–34%.

Female. Not assigned (see Note under the heading '*Grouvellei* species subgroup Gnaspini & Peck, 2019', above).

**Etymology.** The name is given in honor of Prof. Sergio Antonio Vanin, for his contribution to systematics of Coleoptera and long history of collecting and teaching in the collection area.

**Distribution.** Brazil: São Paulo State: known only from the type locality.

**Taxonomic remarks.** Unfortunately we had only one specimen of *A. vanini* sp. nov. to examine. It was very fragile and the aedeagus ended up breaking apart during handling for SEM analysis. Because of that, we could not produce images which would allow a complete analysis and description of the aedeagus. However, we decided to describe this species because its aedeagus is very unique and can be easily recognized from that of other species. As far we know, from descriptions and images, *A. gibber* sp. nov. and *A. vanini* sp. nov. are until now the only species of *Adelopsis* (and maybe of Ptomaphagini as a whole) in which the left paramere is not fused to the body of the aedeagus, but it runs parallel to the elongate left lobe of the aedeagus (Fig. 51B); and, in *A. vanini* sp. nov., the parameres have different shape. Those species can be promptly told apart because *A. gibber* sp. nov. has a forward projection on the margin of the dorsal opening of the aedeagus. (See also 'Taxonomic remarks in *benardi* species group').

***Adelopsis gibber* Gnaspini & Gomyde, new species**

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(Figs. 13C, 14C, 15C, 16E, 17D, 53–55)

Type locality: Estação Biológica de Boracéia ['Boracéia Biological Station'], Salesópolis, São Paulo State, Brazil.

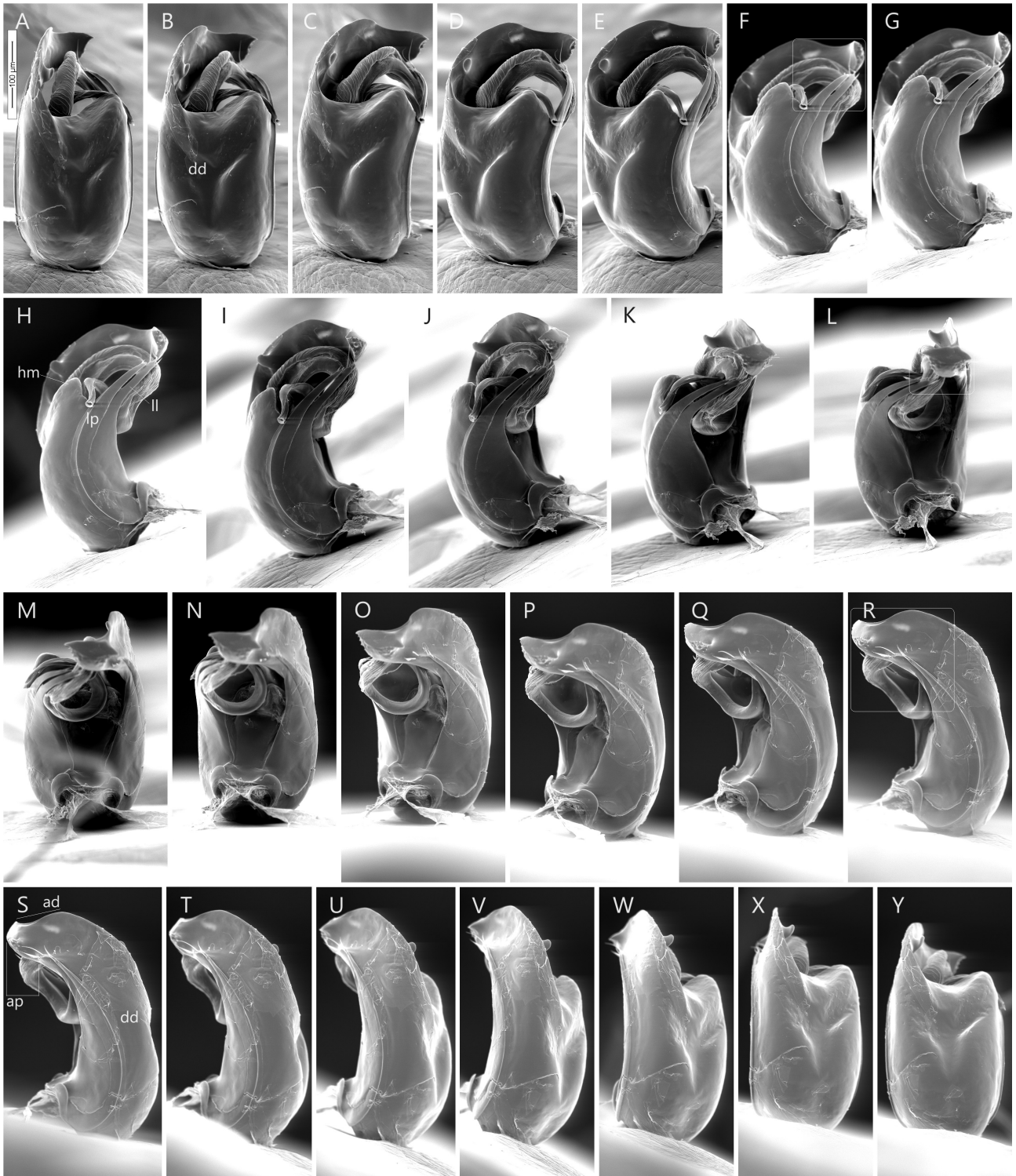
**Material examined. Holotype male:** BRAZIL—São Paulo:—Salesópolis, Estação Biológica de Boracéia [Boracéia Biological Station]; 12–17.VI.1997; B.M. Dietz & C.I. Yamamoto leg.; GW18a [Winkler extractor sample code]; Label: "BRASIL, SP, Salesópolis / E.B.B. 12–17.vi.1997 / B.M. Dietz, C.I. Yamamoto / GW18a"; MZSP 61023. **Paratypes:**—Salesópolis, Estação Biológica de Boracéia [Boracéia Biological Station]; 2–6.V.1997; D. Agosti, C.R.F. Brandão & C.I. Yamamoto leg.; 9-Re [sample code]; Label "BRASIL, SP, Salesópolis / E.B.B. 2–6.v.1997 / D. Agosti, C.R.F. Brandão, C.I. Yamamoto / 9-Re"; 1 male, MZSP 61024 (here illustrated);—same collection data as for preceding; 5–7.VII.1997; C.I. Yamamoto leg.; W23 [Winkler extractor sample code]; Label "BRASIL, SP, Salesópolis / E.B.B. 5–7.vii.1997 / C.I. Yamamoto / W23"; 1 male, MZSP 61020.

**Diagnosis and Description.** Length (holotype): 1.3 mm; width: 0.7 mm. General characteristics as listed above. Body ovoid, convex; color dark brown, slightly redish (Fig. 13C). Winged. Head integument punctuated, punctures organized in transverse lines not characterizing strigae. Eyes normal. Antenna (Fig. 14C)—proportions of length of each antennomere and that of the 9th from 1st to 11th: 2.1, 1.7, 0.95, 0.7, 0.75, 0.7, 1.05, 0.5, 1.0, 1.1, 1.95; proportions of length and width of each antennomere from 1st to 11th: 1.95, 2.05, 1.35, 1.0, 0.9, 0.75, 0.95, 0.45, 0.75, 0.8, 1.4. Pronotum transverse; integument with transverse strigae (Fig. 13C). Elytra together 1.3 times as long as wide; with transverse, diagonal, strigae (Fig. 13C). First four male protarsomeres expanded (Fig. 15C), with discoidal tenent setae ventrally. First segment of male protarsus 0.75 times as wide as the maximum width of tibia; proportions of length and width of each protarsomere, from 1st to 5th: 1.55, 1.3, 1.1, 1.2, 3.4. Male mesotibia slightly curved internally, almost straight. Male metatibia straight. Male genital segment with spiculum gastrale divided at apex, with long branches (Fig. 16E).

Aedeagus somewhat globose (l/w ~2.0, concavity ~41% [ventral alignment] or ~22% [transversal alignment]; concavity/total length = ~50–51% [ventral alignment] or ~47–48% [transversal alignment] [Figs. 17D, 53H, S]), basal opening almost 90° downwards; width a little smaller than height, widest about halfway from base (e.g., Fig. 53).

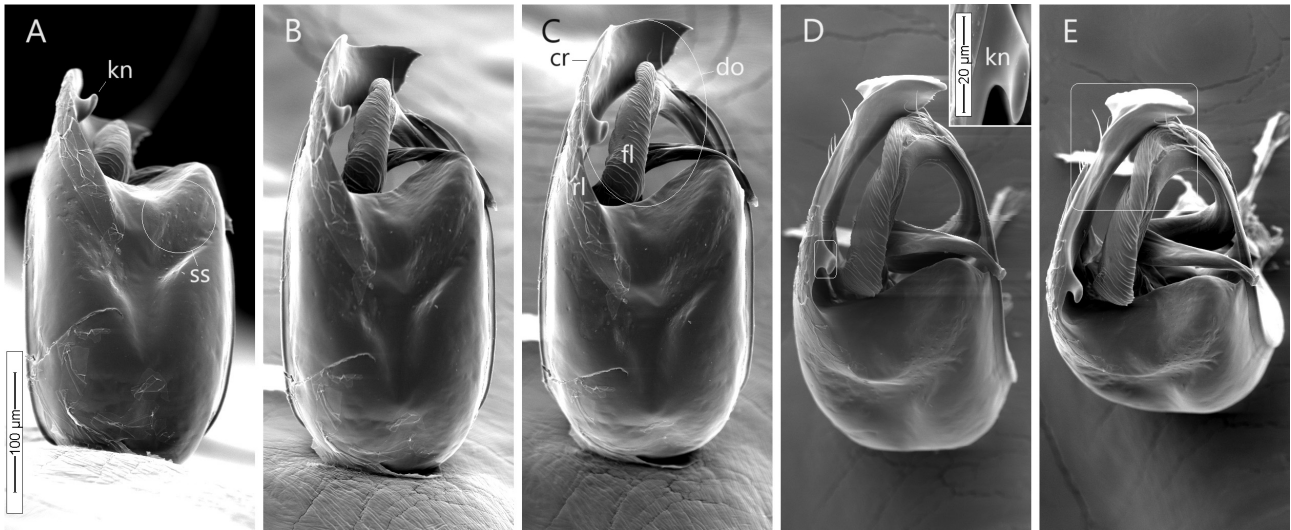
Right lobe ('rl'—e.g., Fig. 54C) elongate, quickly narrowing into a long 'crest' ('cr'—e.g., Fig. 54C) with 'vertical' inner and outer faces; the apical margin abruptly connects to a 'ventral chin' ('vch'—e.g., Figs. 55B, C). The outer 'plateau' ('rlp') bears three setae, projecting forward (e.g., Fig. 55D). The 'apical projection' ('ap'—e.g., Fig. 53S) % length = ~16–18% [ventral alignment] or ~25% [transversal alignment], % height = ~82–93%. The concave 'apical depression' ('ad'—e.g., Fig. 53S) % depth = ~38–41%, % height = ~43–50%.

The left lobe ('ll') is a somewhat narrow stripe which goes straight posteriad towards the apex of the right lobe



**FIGURE 53.** *Adelopsis gibber* Gnaspirini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61023. A–Y, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. White squares in F, L, R are detailed in Figs. 55C, B, D, respectively. ad = apical depression; ap = apical projection; dd = dorsal depression; hm = forward projection of the margin; ll = left lobe; lp = left paramere.





**FIGURE 54.** *Adelopsis gibber* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61023. A–E, Aedeagus in dorsal view, with rotation towards apex, following the ‘sagittal’ plane of the aedeagus, in order to show the influence of the view in the recognition of the aedeagal shape. All figures to the same scale. White rectangle in D is detailed in the inset; white square in E is detailed in Fig. 55A (slightly rotated towards apex). cr = crest of right lobe; do = dorsal opening; fl = flagellum; kn = internal knob of the right lobe; rl = right lobe; ss = sensory structure.

of the aedeagus; its round apical margin bears three setae projecting forward (‘lls’—e.g., Fig. 55B).

The dorsal opening (‘do’—e.g., Fig. 54C) takes ~32–35% of the total length of the aedeagus; close to left lobe of the aedeagus, its margin projects forward, reminding a ‘hump’ (‘hm’—e.g., Fig. 53H).

The sensory structures (‘ss’—e.g., Fig. 54A) concentrate on the apical half of the body, and on the apex of the dorsal surface of the right lobe and on the ‘ventral chin’, where they have a shallow depression with a dome-shaped projection (of different sizes) or a conic projection (‘ss’—e.g., Figs. 55B, C).

The somewhat wide fused parameres can be recognized by the presence of a depression along their length; their apical forth/third are free (‘lp’ and ‘rp’—e.g., Figs. 53, 55A, B, D)—after it reaches the basalmost region of the dorsal opening, the left paramere is completely free and follows the left lobe of the aedeagus, very closely. The parameres have about the same length and are shorter than the lobes, and their width slowly narrows towards their apex in their free part; their apical margin is round and bears three setae, projecting forward, two placed at the margin and one placed at the apex.

The flagellum (‘fl’—e.g., Fig. 54C) is thick, and makes more than a whole circumference, following the margins of the dorsal opening; using light microscopy, it is possible to recognize the presence of a globose, thicker base (Fig. 17D).

The internal knob (‘kn’—e.g., Fig. 54A) is short and curved forward; the few apical sensory structures have a shallow depression (‘kn’—e.g., Fig. 54D, inset).

There is a low, V-shaped, transversal ‘dorsal depression’ (‘dd’—e.g., Figs. 53B, S); position = ~43–44% [ventral alignment] or ~58–60% [transversal alignment].

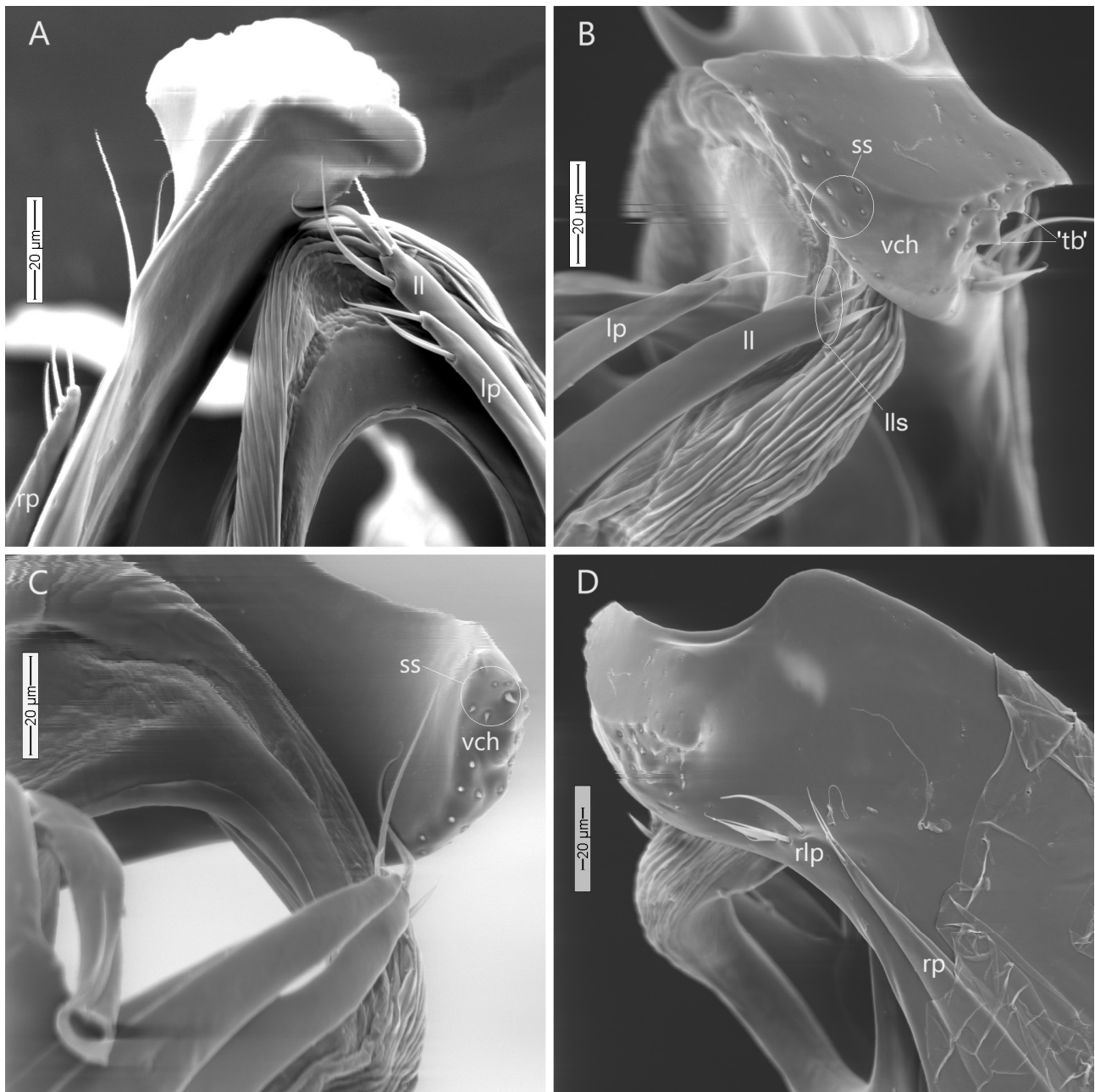
Female. Not assigned (see Note under the heading ‘*Grouvellei* species subgroup Gnaspini & Peck, 2019’, above).

**Etymology.** The name is given as a noun in apposition, derived from Latin for hump, referring to the forward projection observed in the margin of the dorsal opening of the aedeagus.

**Distribution.** Brazil: São Paulo State: known only from the type locality.

**Taxonomic remarks.** Unfortunately we had only a few specimens of *A. gibber* sp. nov. to examine, but we decided to describe this species because its aedeagus is very unique and can be easily recognized from that of other species. As far we know, from descriptions and images, *A. gibber* sp. nov. and *A. vanini* sp. nov. are until now the only species of *Adelopsis* (and maybe of Ptomaphagini as a whole) in which the left paramere is not fused to the body of the aedeagus, but it runs parallel to the elongate left lobe of the aedeagus (Fig. 53H). Those species can be promptly told apart because *A. gibber* sp. nov. has a forward projection on the margin of the dorsal opening of the aedeagus; a similar forward projection on the margin of the dorsal opening of the aedeagus was also observed in *A. caeteh* sp. nov., but their aedeagi are very different from each other.

The apex of the aedeagus in *A. gibber* sp. nov. slightly resembles that of *A. cf. szymczakowskii*, but the morphological analysis show that they can be recognized as different species, and they belong in different species subgroups, because the type of male genital segment is different. (See also ‘Taxonomic remarks in *benardi* species group’).



**FIGURE 55.** *Adelopsis gibber* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61023. **A–D**, Apex of aedeagus in frontal, ventral, left, and right views, respectively—in detail from Fig. 54E (slightly rotated towards apex), 53L, F, R (slightly rotated), respectively. ll = left lobe; lls = setae on the left lobe; lp = left paramere; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; ss = sensory structure; ‘tb’ = ‘tubercle’ on the ‘ventral chin’; vch = ‘ventral chin’ of the right lobe.

***Adelopsis ilhabela* Gnaspini & Gomyde, new species**

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(Figs. 13D, E, 16F, 17E, 18B, 56–60)

Type locality: Parque Estadual de Ilha Bela [‘Ilha Bela State Park’], Ilha Bela, São Paulo State, Brazil.

**Material examined. Holotype male:** BRAZIL—São Paulo:—Ilha Bela, Parque Estadual de Ilha Bela [Ilha Bela State Park]; X.2001; Pitfall trap, Winkler extractor;

Label: “Parque Estadual de Ilha / Bela, SP—X.2001 / Pitfall / Winckler”; MZSP 61025. **Paratypes:**—same data and label as for holotype; 1 male, 2 females, MZSP male 61026 (here illustrated), females 61014 (here illustrated), 61015.

**Diagnosis and Description.** Length (holotype): 2.1 mm; width: 1.1 mm. General characteristics as listed above. Body ovoid, convex; color light reddish brown; elytra each with a pair of longitudinal dark lines, one shorter, diagonal and closer to the angles of the elytra, and the other longer and closer to the outer margin (Figs. 13D, E, arrows). Winged. Head integument punctuated,

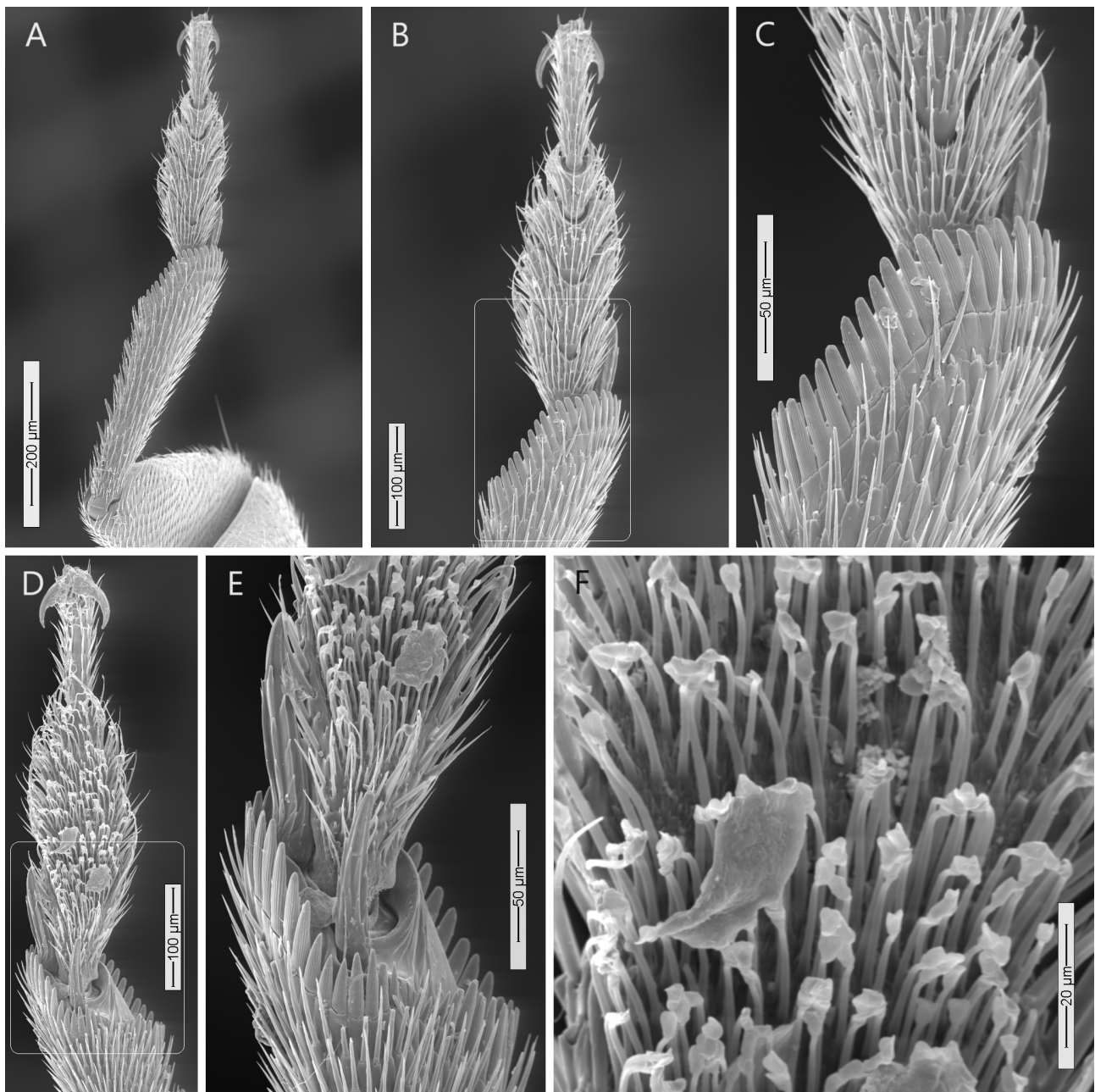


punctures not organized in strigae. Eyes normal. Antenna [Paratype 61026]—proportions of length of each antennomere and that of the 9th from 1st to 11th: 1.95, 1.4, 1.05, 0.85, 0.75, 0.7, 0.7, 0.5, 1.0, 1.1, 1.3; proportions of length and width of each antennomere from 1st to 11th: 1.9, 1.7, 1.6, 1.2, 1.15, 1.1, 0.95, 0.7, 1.0, 1.05, 1.3. Pronotum transverse; integument with transverse strigae (Fig. 13D). Elytra together 1.3 times as long as wide; with transverse, slightly diagonal, strigae (Fig. 13D). First four male protarsomeres expanded (Figs. 56A, B), with discoidal tenent setae ventrally (Figs. 56D–F). First segment of male protarsus 0.6 times as wide as the maximum width of tibia; proportions of length and width of each protarsomere, from 1st to 5th: 1.6, 1.4, 1.15, 1.25,

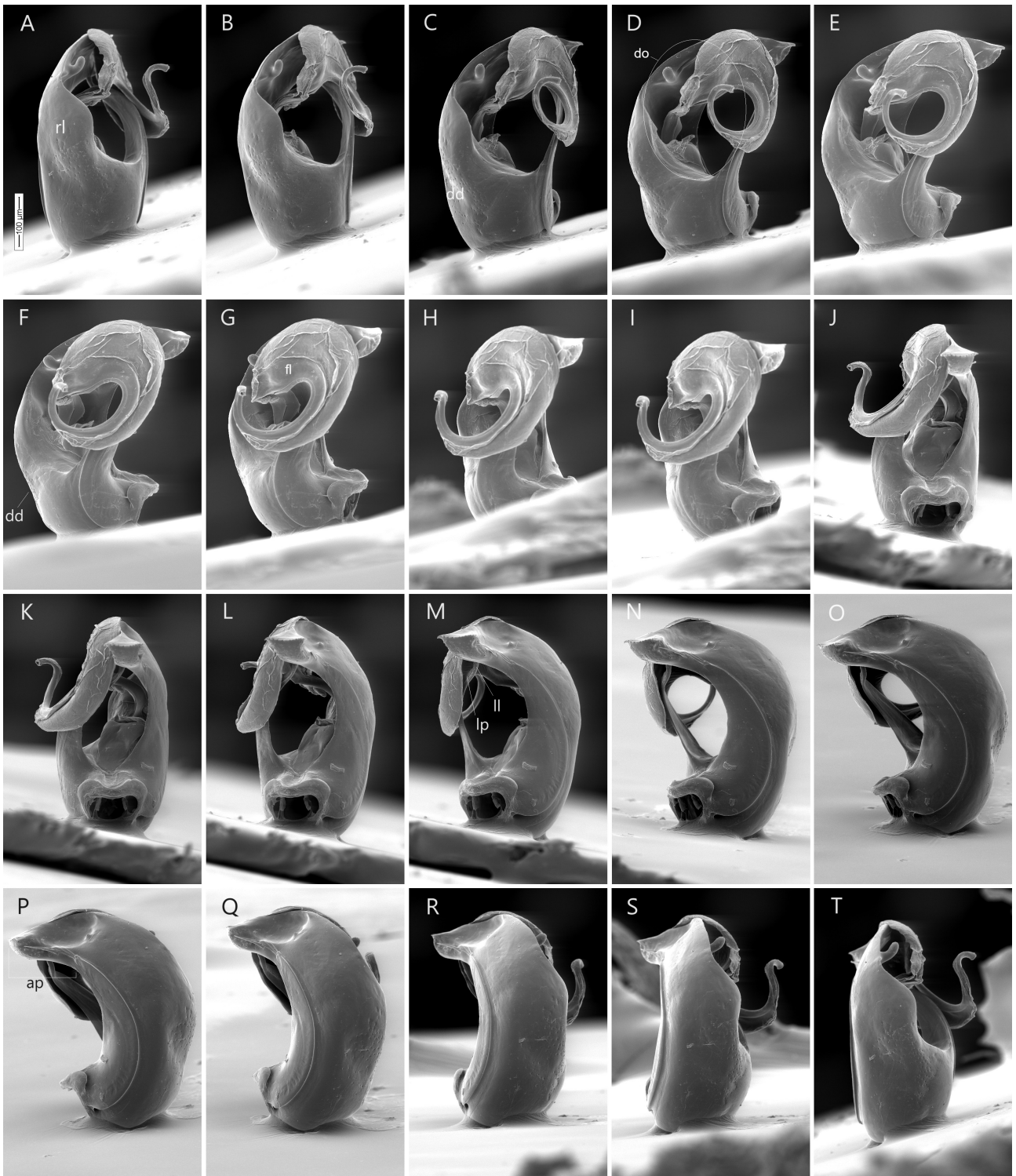
3.8. Male mesotibia curved internally. Male metatibia straight. Male genital segment with spiculum gastrale divided at apex, with long branches (Fig. 16F).

Aedeagus somewhat globose (l/w ~2.0, concavity/total height = ~38–41%; concavity/total length = ~43% [Figs. 17E, 57F, P]), basal opening almost 90° downwards; width larger than height, widest about halfway from base (e.g., Fig. 57).

Right lobe ('rl'—e.g., Figs. 57A, 58A) elongate, with a long and wide 'arm' ('arm'—e.g., Fig. 60A) which quickly narrows into a 'crest' ('cr'—e.g., Fig. 60A) with 'vertical' inner and outer faces; the apical margin abruptly connects to a 'ventral chin' ('vch'—e.g., Figs. 59A, C); the apical margin is undulated, with several

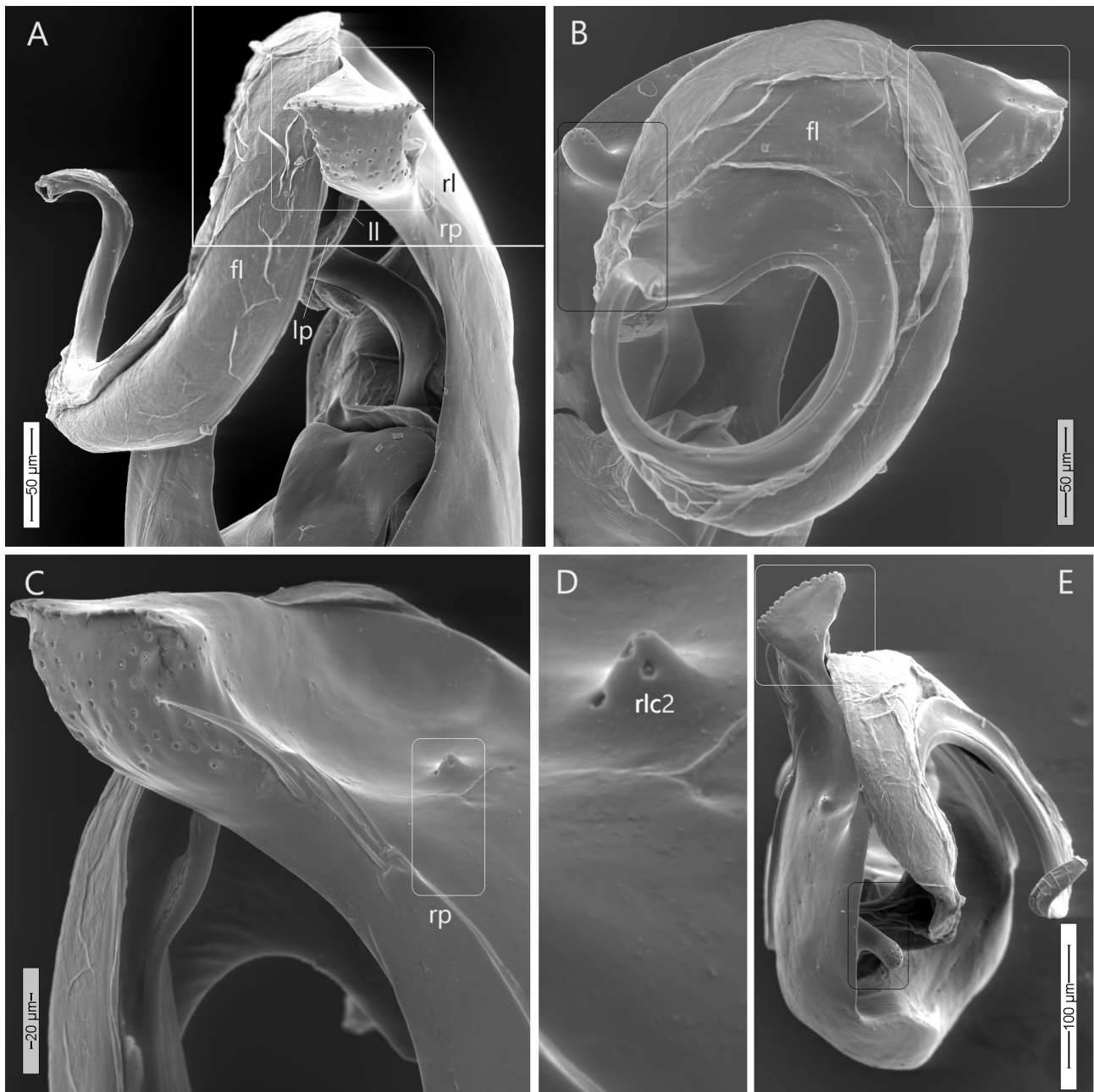


**FIGURE 56.** *Adelopsis ilhabela* Gnaspi & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61025. **A**, Proleg. **B**, **D**, Apex of protibia and protarsus in dorsal and ventral views, respectively (white rectangle in B is detailed in C.; white rectangle in D is detailed in E.). **F**, Detail of ventral view of first protarsomere showing tenent setae.



**FIGURE 57.** *Adelopsis ilhabela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61025. **A–T**, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ap = apical projection; dd = dorsal depression; do = dorsal opening; fl = flagellum; ll = left lobe; lp = left paramere; rl = right lobe.





**FIGURE 58.** *Adelopsis ilhabela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61025. **A–C**, Apex of aedeagus in ventral, left, and right views, respectively (white rectangle in C is detailed in **D**). **E**, Aedeagus in frontal view of right lobe. White squares in A, B, and E are detailed in Figs. 59A, B, and D, respectively. Black rectangles in B, E are detailed in Figs. 60C, E, respectively. The white line in A indicates that two images in different depths of focus were combined together to produce the image shown. fl = flagellum; ll = left lobe; lp = left paramere; rl = right lobe; rlc2 = elevation near the base of the right lobe; rp = right paramere.

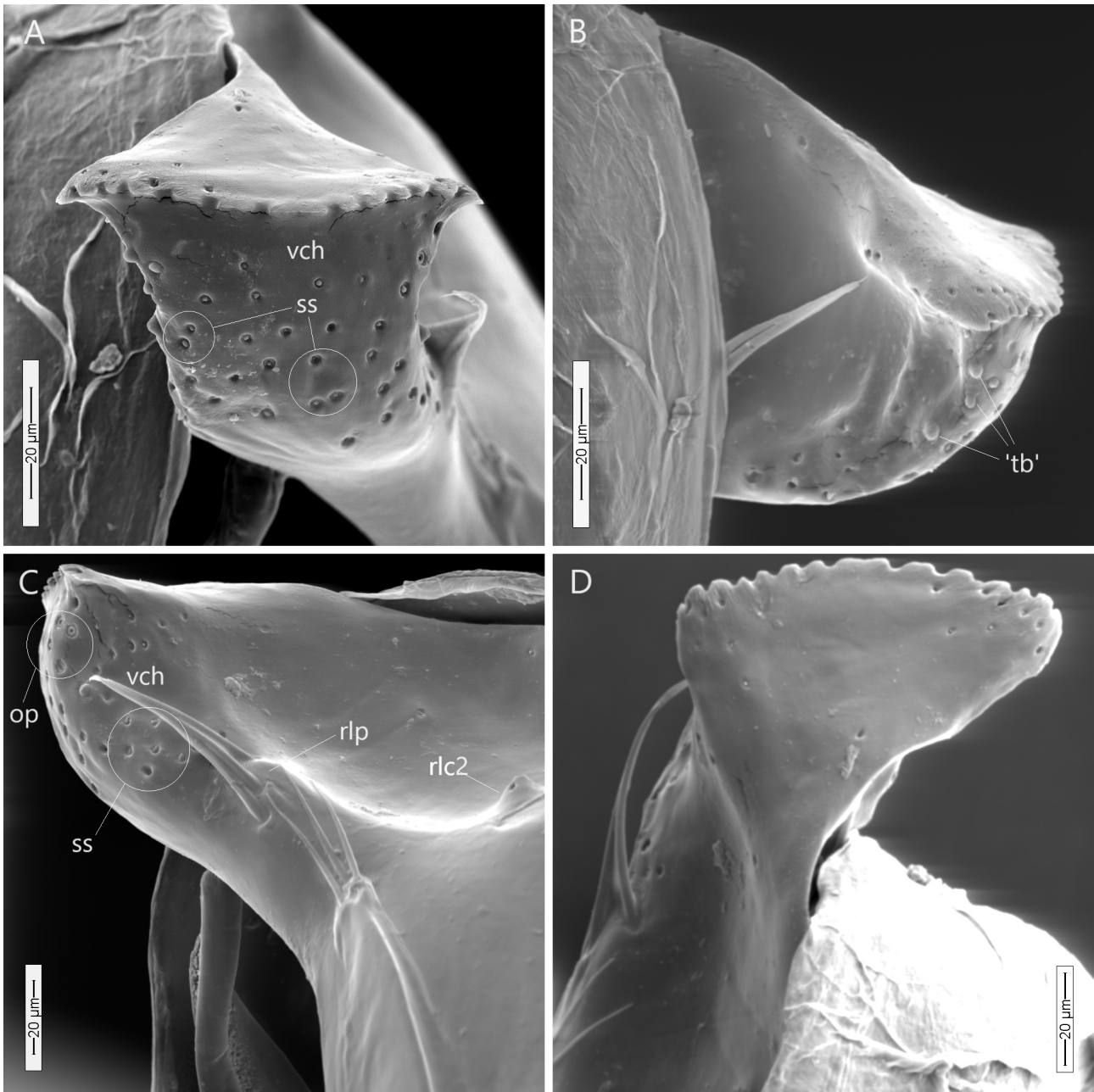
narrow emarginations along its width—the ones closer to the lateral extremities correspond to the depressions of the sensory structures (e.g., Figs. 59A, D). The outer ‘plateau’ (‘rlp’) bears three setae (e.g., Fig. 59C); a little behind there is a somewhat high conic elevation (‘rlc2’), with no seta nearby (e.g., Figs. 58D, 59C). The ‘apical projection’ (‘ap’—e.g., Fig. 57P) % length = ~24%, % height = ~37–46%.

The left lobe (‘ll’) is a narrow stripe which makes a curve towards the ventral-apical region of the aedeagus (e.g., Figs. 57M, 58A, 60A); it is covered by the flagellum,

and it is not possible, therefore, to observe and describe it properly, especially the apex and apical setae.

The dorsal opening (‘do’—e.g., Fig. 60A) takes ~53–57% of the total length of the aedeagus.

The sensory structures have a shallow depression (‘ss’—e.g., Fig. 60A), and concentrate on the ‘ventral chin’, where they have a dome-shaped projection (of different sizes), which may be surrounded (or not) by a ring, or a conic projection (‘ss’—e.g., Figs. 59A, C). At the left side of the ‘ventral chin’ there are ‘tubercles’ (‘tb’—e.g., Fig. 59B) which correspond to openings surrounded



**FIGURE 59.** *Adelopsis ilhabela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61025. **A–C**, Apex of aedeagus in ventral, left, and right views, respectively—details from Figs. 58A, B (slightly rotated), and C (slightly rotated), respectively. **D**, Apex of aedeagus in frontal view of right lobe (detail from Fig. 58E, slightly rotated). op = opening on the ‘ventral chin’; rlc = elevation near the base of the right lobe; rlp = ‘plateau’ near the base of the right lobe; ss = sensory structure; ‘tb’ = ‘tubercule’ on the ‘ventral chin’; vch = ‘ventral chin’ of the right lobe.

by rings which appear at the same place on the right side of the ‘ventral chin’ (‘op’—e.g., Fig. 59C)—therefore, those ‘tubercles’ might represent ‘plugs’ of substances which oozed out of the openings (but this needs to be verified).

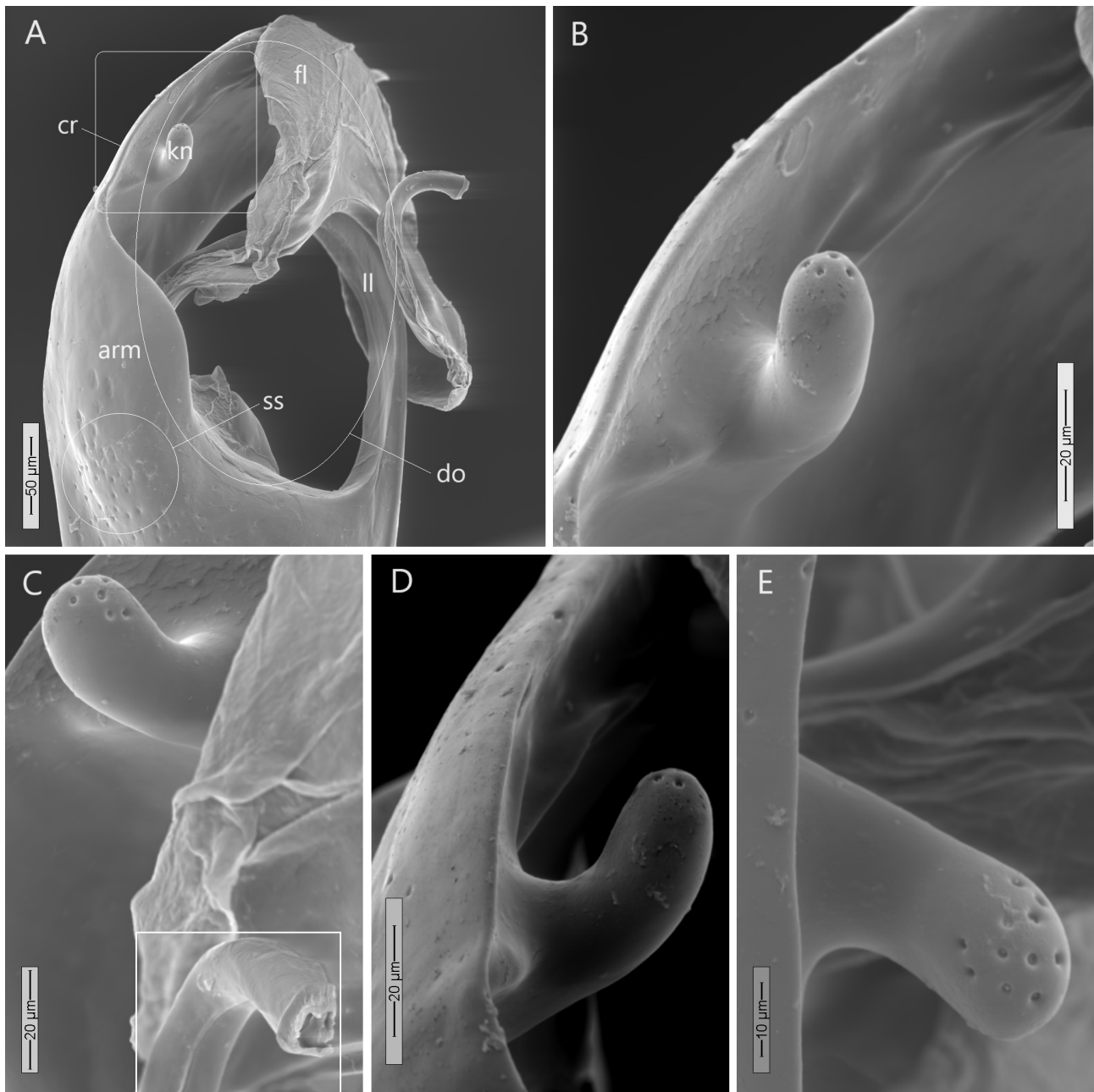
The somewhat narrow fused parameres can be recognized by the presence of a depression along the length of the right paramere, but parts of the ventral margin of the left paramere cannot be recognized from the aedeagus body (e.g., Fig. 57). The left paramere (‘lp’) is somewhat shorter than the right paramere (‘rp’) (e.g., Fig. 58A). Both parameres have a round apical margin—the right paramere bears three long setae at the apex,

projecting forward (e.g., Fig. 58C); the setae of the left paramere are missing.

The flagellum (‘fl’—e.g., Figs. 58A, B, 60A) is very robust—it is narrow inside the aedeagus and, as soon as it emerges from the dorsal opening, it strongly widens and makes a curve, completing a whole circumference, and slowly narrowing toward its apex; using light microscopy, it is possible to recognize the presence of a globose base (Fig. 17E).

The internal knob (‘kn’—e.g., Fig. 60) is somewhat elongate, and curved dorsally; the several apical sensory structures have a deep depression.





**FIGURE 60.** *Adelopsis ilhabela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61025. **A**, Aedeagus in dorsal view (white square is detailed in **B**. and, slightly rotated, in **D**.). **C**, **E**, Internal knob ('kn') in detail from Figs. 58B and 58E, respectively. The white line in C indicates that two images in different depths of focus were combined together to produce the image shown. arm = arm of the right lobe; cr = crest of right lobe; do = dorsal opening; fl = flagellum; kn = internal knob of the right lobe; ll = left lobe; ss = sensory structure.

There is a low diagonal, mirrored-J-shaped, 'dorsal depression' ('dd'—e.g., Figs. 57C, F) [in comparison with other species, the dorsal depression would possibly have a V-shape, but, because of the very deep dorsal opening, only the left arm and part of the right arm of the 'V' can be recognized]; position = ~15–18%.

**Female description.** The two females we examined from Ilha Bela also exhibited the same dark stripes on the elytra (as described for the males), allowing us relating those females to this species. They are similar to males, except for the non-expanded protarsus. Spermatheca

coiled with 5-turns followed by 4 more turns making a sharp turn and an additional 8-turns coil, and bearing a globose apical bulb (Fig. 18B).

**Etymology.** The name is given as a noun in apposition, referring to the type locality.

**Distribution.** Brazil: São Paulo State: known only from the type locality.

**Taxonomic remarks.** The presence of a color pattern on the elytra of *A. ilhabela* sp. nov. (Fig. 13E) allows species recognition using external characters. See also 'Taxonomic remarks in *benardi* species group'.

***Adelopsis gandarela* Gnaspini & Gomyde, new species**

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(Figs. 13F, 14D, 16G, 17F, 18C, 61–65)

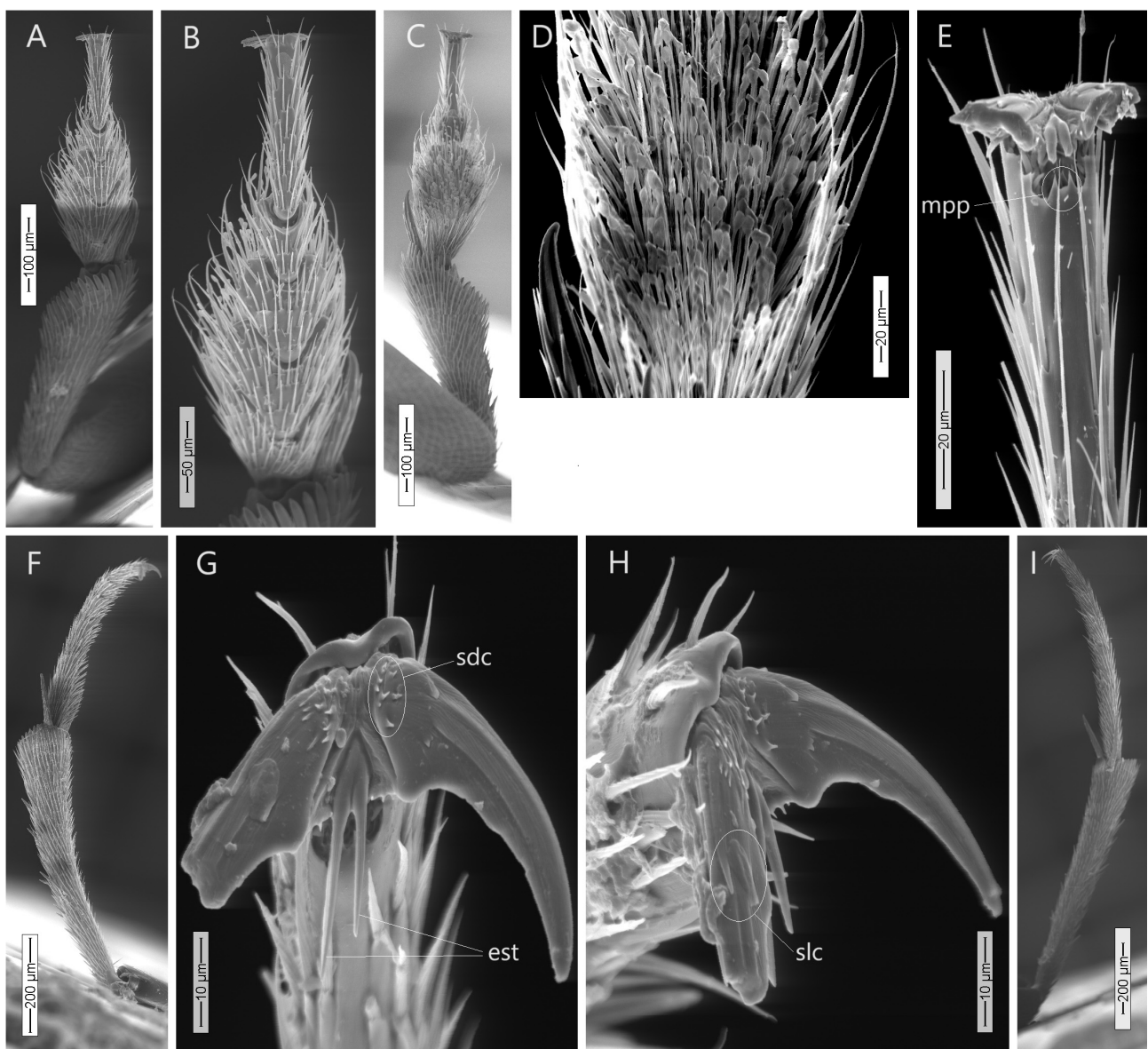
Type locality: Serra do Gandarela [‘Gandarela Mountain’], Santa Bárbara, Minas Gerais State, Brazil.

**Material examined. Holotype male:** BRAZIL—Minas Gerais:—Santa Bárbara, Serra do Gandarela; -20.028772, -43.682904; 4–11.XII.2012; R. Andrade *et al.* leg.; ‘V Apolo’ [Project]; Pitfall trap 323; ‘Carste(Coleo) 17064’ [Organization sample code]; ‘ITV57260’ [Project sample code]; Labels: ‘Brasil. MG. Santa Bárbara. Serra do / Gandarela. (V Apolo—Pitfall 323). / -20.028772, -43.682904. / 4–11.xii.2012, Andrade *et al.* leg. /

Carste(Coleo) 17064’ and ‘ITV57260’; MZSP 59462.

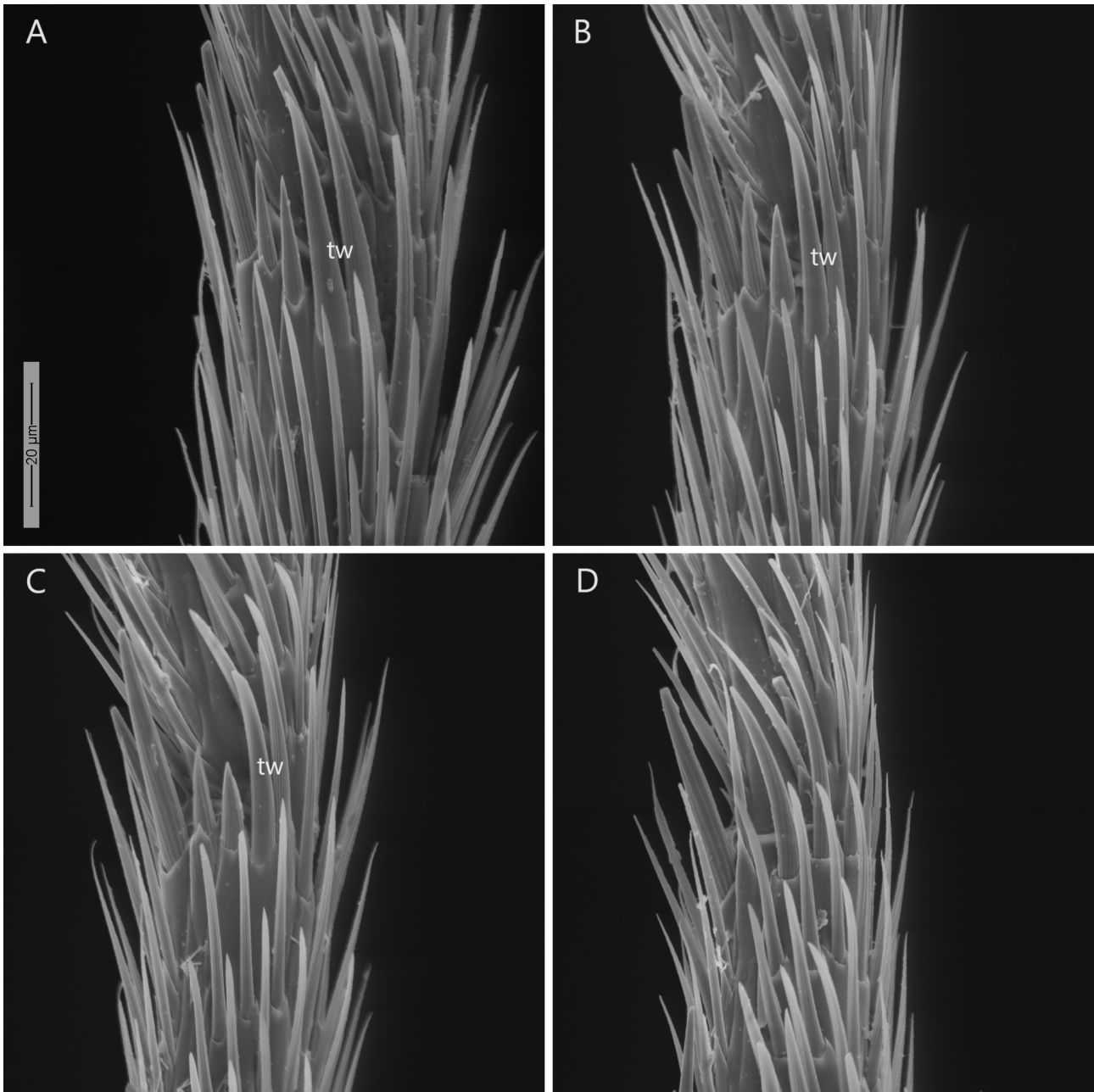
**Paratypes:**—same data and label as for holotype; 5 males, 3 females—males MZSP 59456 + ITV57254 (here illustrated), MZSP 59458 + ITV57256, MZSP 59464 + ITV57262, MZSP 59465 + ITV57263, MZSP 59461 + ITV57259, females MZSP 59457 + ITV57255 (here illustrated), MZSP 59460 + ITV57258, MZSP 59463 + ITV57261.

**Diagnosis and Description.** Length (holotype): 1.95 mm; width: 1.05 mm. General characteristics as listed above. Body ovoid, convex; color dark brown (Fig. 13F). Winged. Head integument punctuated, punctures not organized in strigae. Eyes normal. Antenna (Fig. 14D)—proportions of length of each antennomere and that of the 9th from 2nd to 11th: 1.65, 1.25, 0.9, 0.95, 0.85, 1.2, 0.5, 1.0, 1.15, 1.85; proportions of length and width of each



**FIGURE 61.** *Adelopsis gandarela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 59462. **A, F, I,** Pro-, mid-, and hindlegs, respectively. **B–C,** Apex of protibia and protarsus in dorsal and ventral views, respectively. **D,** Detail of ventral view of protarsus showing tenent setae. **E, G–H,** Detail of apex of protarsus and mesotarsus (G–H), respectively. est = empodial setae; mpp = pair of medial projections on the distal margin of the terminal tarsomere; sdc = small dorsal spines close to the base of tarsal claw; slc = spines near base of tarsal claw.



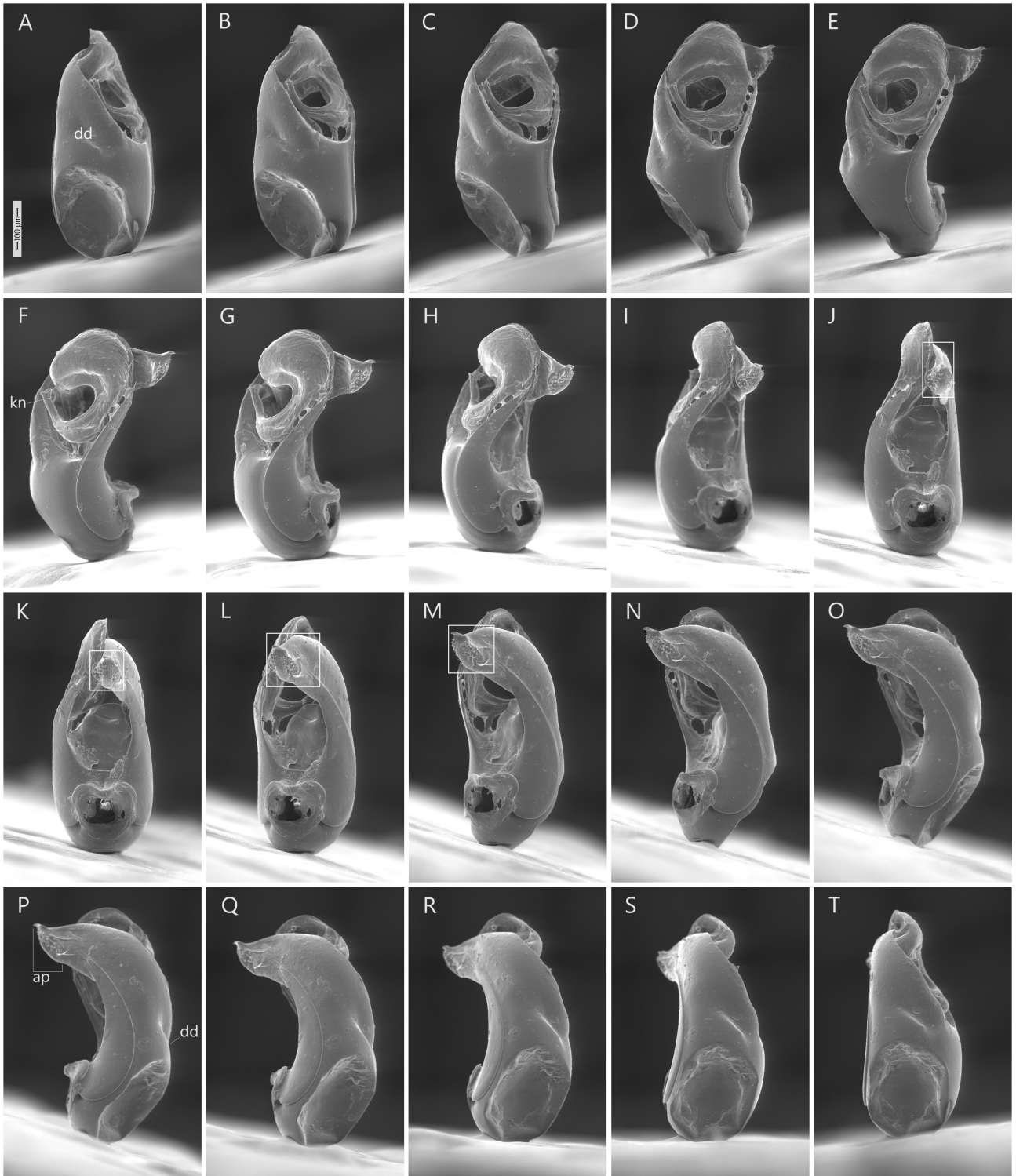


**FIGURE 62.** *Adelopsis gandarela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 59462. **A–D**, Detail of apex of mesotarsomeres I–IV, respectively, showing the twin spines (absent in IV). tw = twin spines.

antennomere from 2nd to 11th: 2.45, 2.05, 1.45, 1.45, 1.2, 1.55, 0.65, 0.85, 0.95, 1.6. Pronotum transverse; integument with transverse strigae (Fig. 13F). Elytra together 1.3 times as long as wide; with transverse, diagonal, strigae (Fig. 13F). First four male protarsomeres expanded (Figs. 61A–C), with discoidal tenent setae ventrally (Figs. 61C, D). First segment of male protarsus 0.8 times as wide as the maximum width of tibia; proportions of length and width of each protarsomere, from 1st to 5th: 1.05, 1.05, 1.25, 1.55, 5.7. Male mesotibia curved internally (Fig. 61F). First three mesotarsomeres with twin spines ('tw'—Fig. 62). Male metatibia straight (Fig. 61I). As typical of ptomaphagines (following Antunes-Carvalho & Gnaspini, 2016): empodial setae asymmetrical ('est'—Fig. 61G);

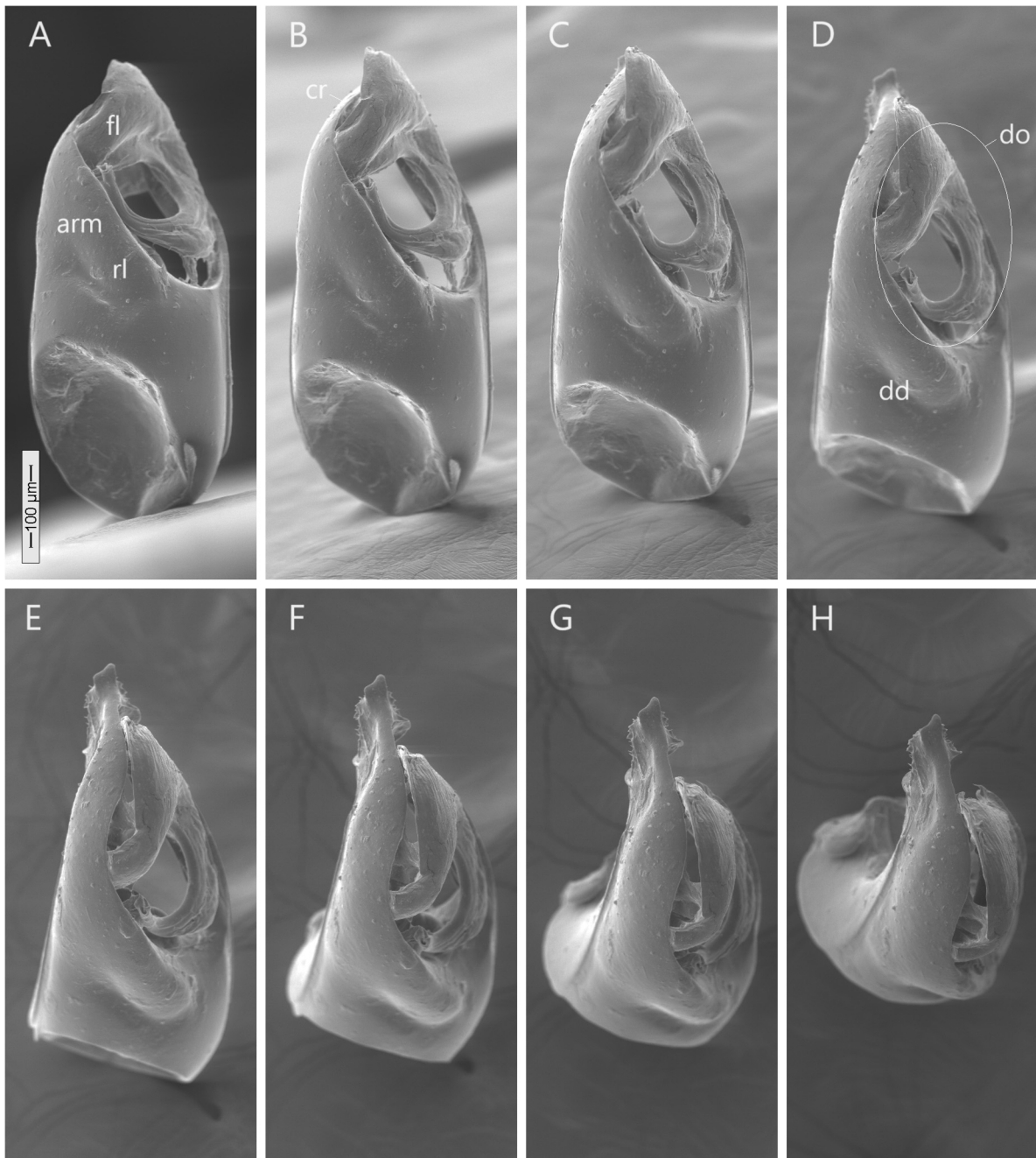
distal margin of the terminal tarsomere with a pair of medial projections ('mpp'—Fig. 61E); claws with small dorsal spines close to their base ('sdc'—Fig. 61G) and with a few long and acuminate spines at their dorsolateral margin ('slc'—Fig. 61H). Male genital segment with spiculum gastrale divided at apex, with long branches (Fig. 16G).

Aedeagus somewhat globose (l/w ~2.1, concavity ~45% [ventral alignment] or ~31% [transversal alignment]; concavity/total length = ~46–48% [ventral alignment] or ~43–48% [transversal alignment] [Figs. 17F, 63F, P]), basal opening 90° downwards; width around 40% smaller than height, widest a little below halfway from base (e.g., Fig. 63).



**FIGURE 63.** *Adelopsis gandarela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 59462. **A–T**, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. White lines in **J–M** indicate that two images in different depths of focus were combined together to produce each image shown. ap = apical projection; dd = dorsal depression; kn = internal knob of the right lobe.





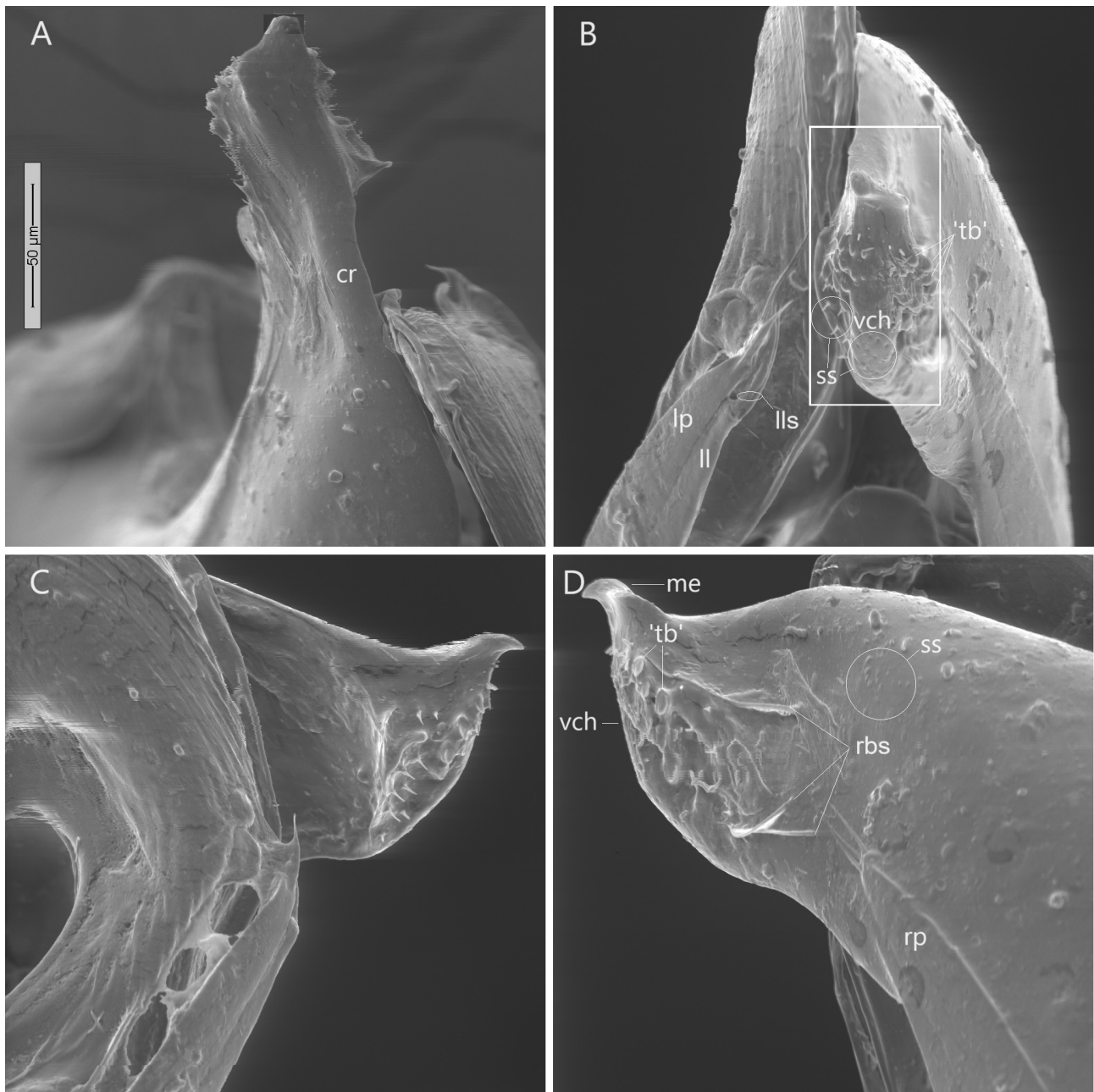
**FIGURE 64.** *Adelopsis gandarela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 59462. **A–H**, Aedeagus in dorsal view, with slight rotation towards apex, following the ‘sagittal’ plane of the aedeagus, until a frontal view of the apex, in order to show the influence of the view in the recognition of the aedeagal shape. All figures to the same scale. arm = arm of the right lobe; cr = crest of right lobe; dd = dorsal depression; do = dorsal opening; fl = flagellum; rl = right lobe.

Right lobe (‘rl’—e.g., Fig. 64A) elongate, with a long ‘arm’ (‘arm’—e.g., Fig. 64A) strongly narrowing into a ‘crest’ (‘cr’—e.g., Figs. 64B, 65A) with a wide external face; the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Figs. 65B, D); the apex of the right lobe is slightly elevated (‘me’—e.g., Fig. 65D); the apical margin is diagonally produced (e.g., Fig. 65A). The outer pair of setae, and one additional, long seta more posteriorly, none of them associated with any kind of elevation (‘rbs’—e.g., Fig. 65D). The ‘apical projection’ (‘ap’—e.g., Fig. 63P) % length = ~17–20%, % height = ~68–80%.

The left lobe (‘ll’) is a narrow and long stripe which makes a curve towards the ventral-apical region of the aedeagus (e.g., Figs. 63, 65B); its truncate apical margin bears (probably) two setae projecting forward (‘lls’—e.g., Fig. 65B—there is some debris covering the base of the setae, not allowing a precise observation).

The dorsal opening (‘do’—e.g., Fig. 64D) is ample and diagonally produced, taking ~51–56% of the total length of the aedeagus.

The sensory structures have a shallow depression with a wide dome-shaped projection (‘ss’—e.g., Fig.



**FIGURE 65.** *Adelopsis gandarela* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 59462. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White lines in B indicate that two images in different depths of focus were combined together to produce the image shown. cr = crest of right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; me = marginal elevation; rbs = setae on the right lobe; rp = right paramere; ss = sensory structure; 'tb' = 'tubercle' on the 'ventral chin'; vch = 'ventral chin' of the right lobe.

65D), and concentrate on the apex of the dorsal surface of the right lobe and on the 'ventral chin', where they have a deep depression with a minute dome-shaped projection or a short hair ('ss'—e.g., Fig. 65B).

The parameres have a wide base, narrowing towards their apex; the placement of the fusion to the aedeagus body is almost imperceptible on the right paramere, and can be recognized by the presence of a depression along the dorsal margin and apical ventral margin of the left paramere; the right paramere is longer than the left paramere (e.g., Figs. 63, 65B, D). The right paramere is shorter than the right lobe, whereas the left paramere is

slightly longer than the left lobe. The parameres have a pointy apex; the right paramere bears three setae placed just at the apex and projecting forward ('rp'—e.g., Fig. 65D); the setae of the left paramere are covered with debris, being not possible to recognize the precise number of associated setae ('lp'—e.g., Fig. 65B).

The flagellum ('fl'—e.g., Fig. 64A) is very robust, and practically makes a whole circumference, covering the space of the dorsal opening; using light microscopy, it is possible to recognize the presence of a globose base (Fig. 17F).

The internal knob ('kn'—e.g., Fig. 63F) is hidden



behind the strong flagellum, but it seems to be short, with apex bearing a group of probable sensory structures.

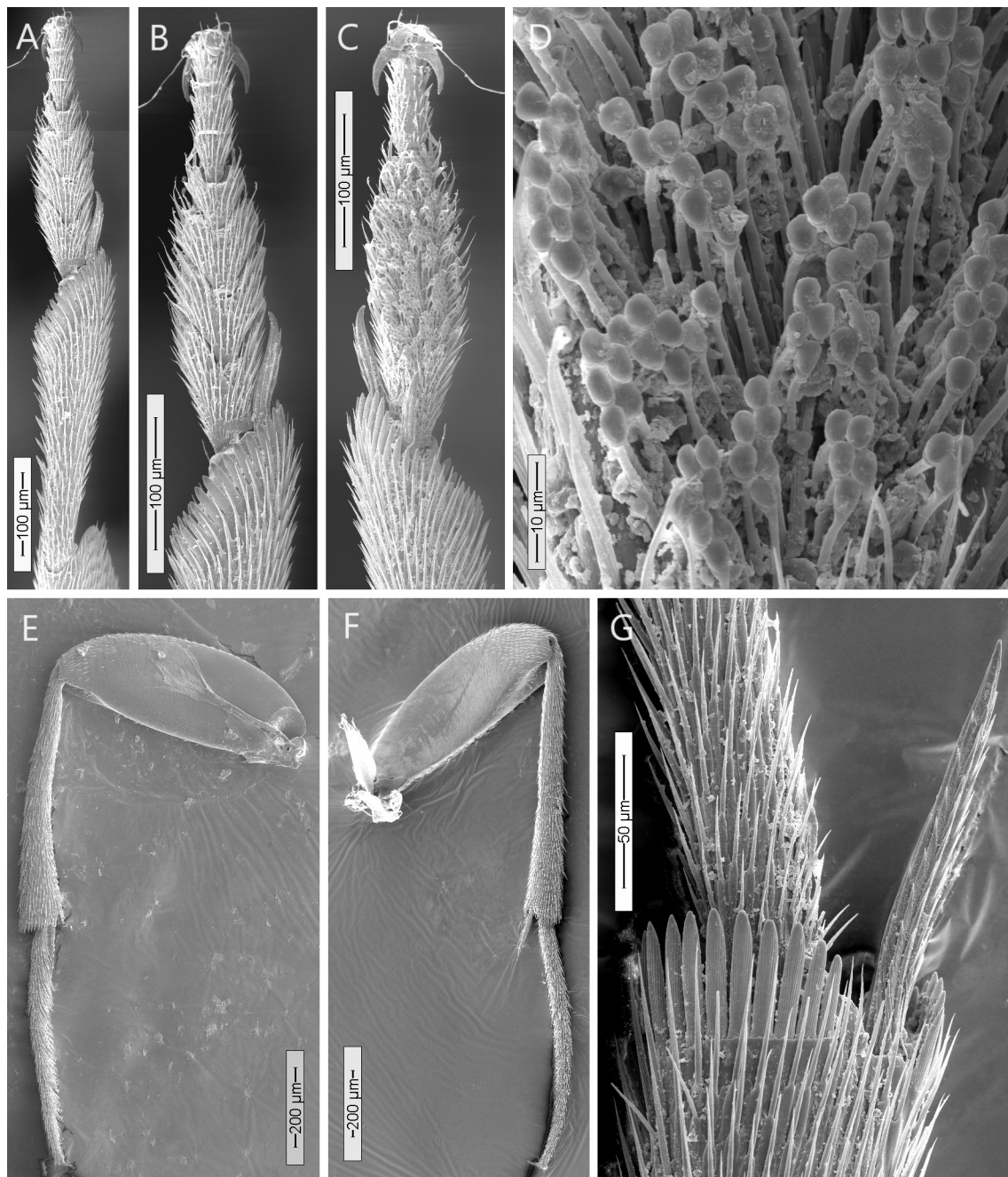
There is a low diagonal, mirrored-J-shaped, ‘dorsal depression’ (‘dd’—e.g., Figs. 63A, P, 64D) [in comparison with other species, the dorsal depression would possibly have a V-shape, but, because of the very deep dorsal opening, only the left arm and part of the right arm of the ‘V’ can be recognized]; position = ~39% [ventral alignment] or ~48–50% [transversal alignment].

Female description. In the material we examined from the locality (with the same collection data), we admitted three females with the same size of males to belong to this species. They are similar to males, except for the non-expanded protarsus. Spermatheca coiled with 5-turns

narrower than the body of the spermatheca, and bearing a thin, elongate apical bulb (Fig. 18C). Note 1: we examined an additional female (“MZSP 59459”+ “ITV57257”) with same data, but with a different spermatheca; therefore, the assignment of the three females above to this species should be considered tentative. Note 2: the collection series from this locality also included five additional females of smaller size and with different collection data (different pitfall trap and slightly different geographical data), which we did not examine.

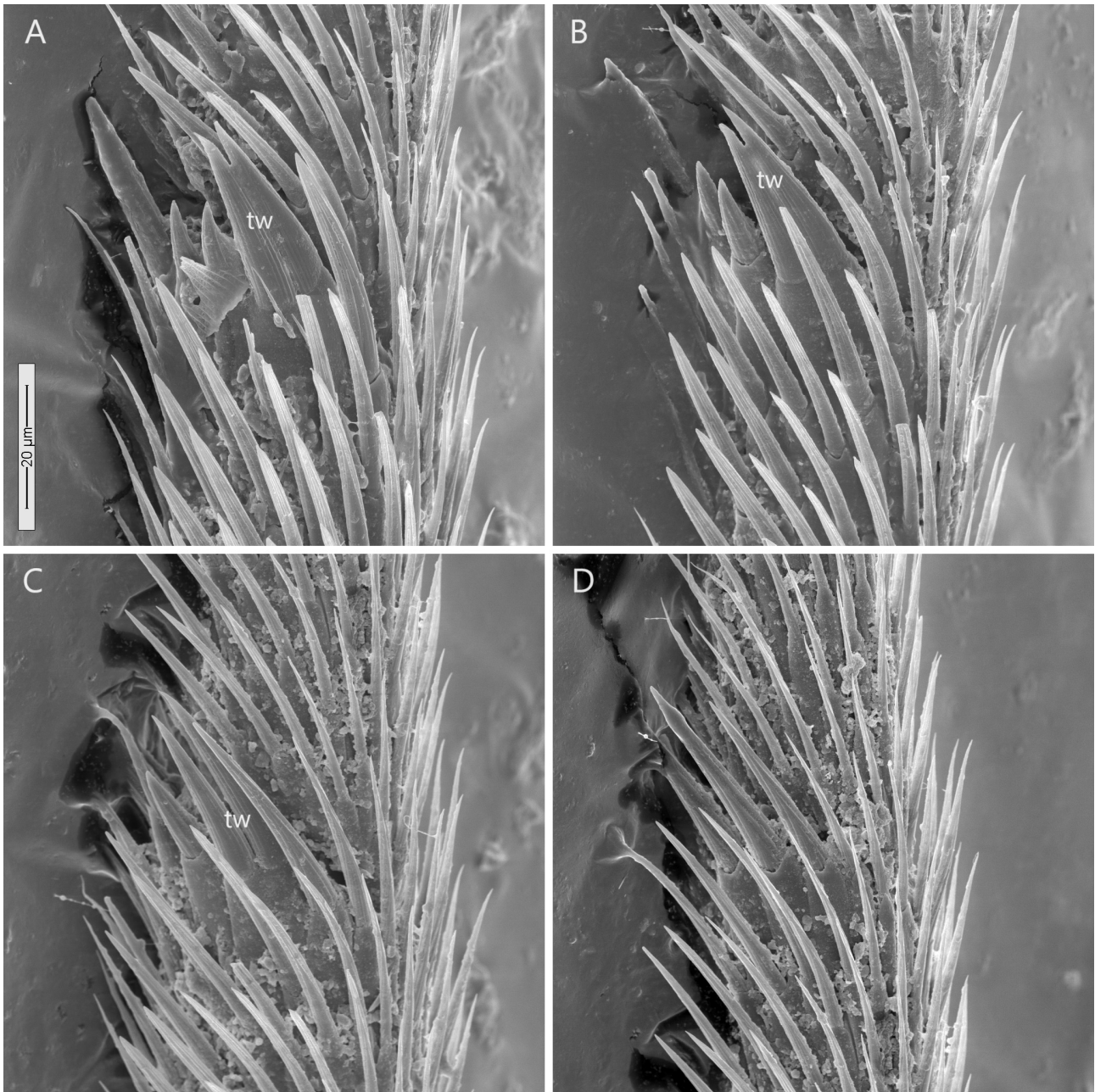
**Etymology.** The name is given as a noun in apposition, referring to the type locality.

**Distribution.** Brazil: Minas Gerais State: known only from the type locality.



**FIGURE 66.** *Adelopsis sacerdotis* Gnaspi & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A, E–F**, Pro-, mid-, and hindlegs, respectively. **B–C**, Apex of protibia and protarsus in dorsal and ventral views, respectively. **D**, Detail of ventral view of protarsus showing tenent setae. **G**, Detail of apex of metatibia and metatarsus.





**FIGURE 67.** *Adelopsis sacerdotis* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A–D**, Detail of apex of mesotarsomeres I–IV, respectively, showing the twin spines (absent in IV). tw = twin spines.

**Taxonomic remarks.** See ‘Taxonomic remarks in *benardi* species group’.

***Adelopsis sacerdotis* Gnaspini & Gomyde, new species**

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(Figs. 16H, 66–72)

Type locality: Gruta do Padre [Cave], Santana, Bahia State, Brazil.

**Material examined. Holotype male:** BRAZIL—Bahia:—Santana, Gruta do Padre [Padre Cave];

16.IX.2001; P. Gnaspini *et al.* leg.”; Label: “Gruta do Padre / Santana, BA, Brasil / 16.IX.2001 / P. Gnaspini *et al.* col.”; MZSP 61031.

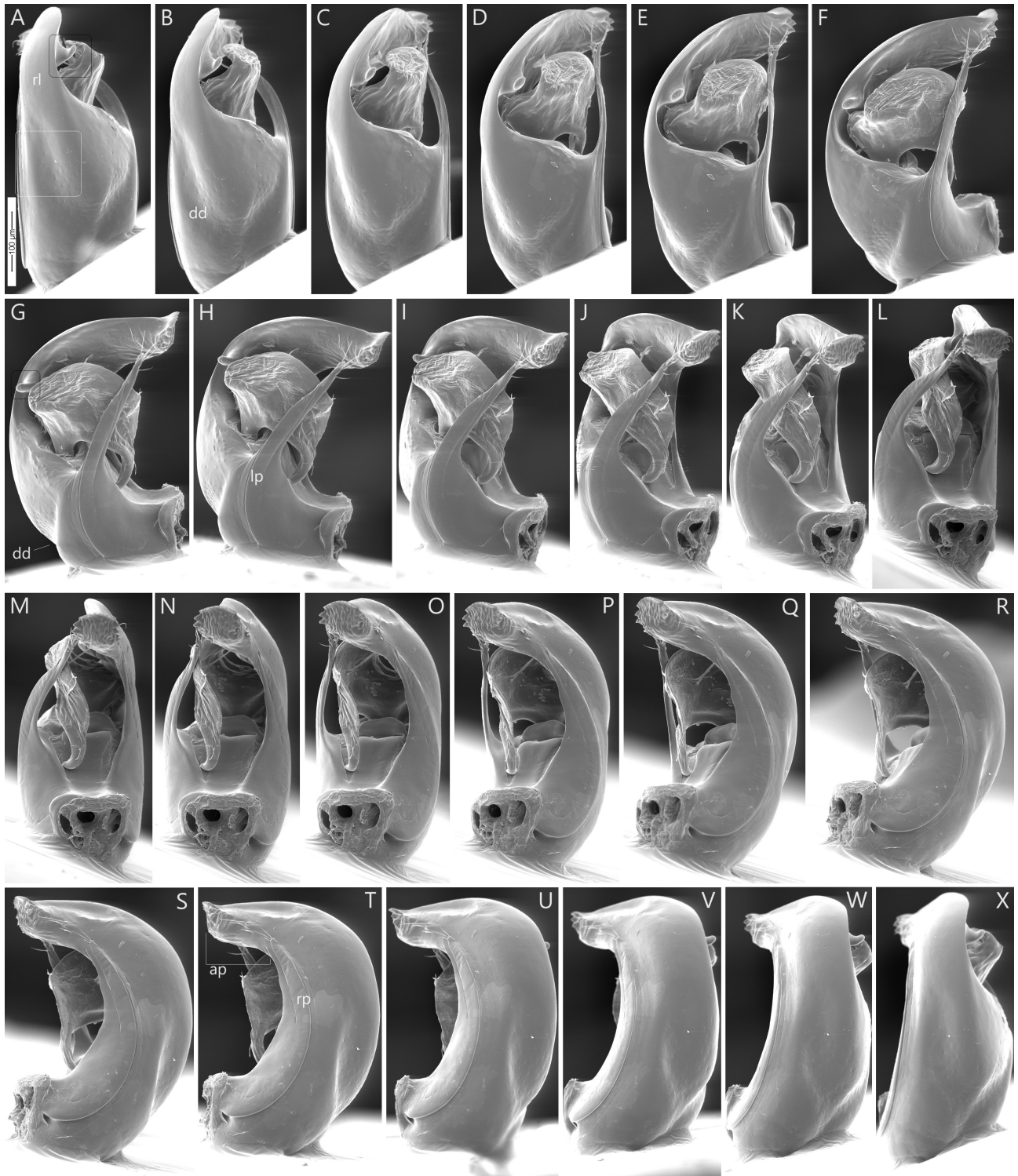
**Diagnosis and Description.** Length of elytron (holotype): 1.4 mm. General characteristics as listed above. Body ovoid, convex; color dark brown. Winged. Head integument punctuated, punctures not organized in strigae. Eyes normal. Pronotum transverse; integument with transverse strigae. Elytra with transverse, slightly diagonal, strigae. First four male protarsomeres expanded (Figs. 66A–C), with discoidal tenent setae ventrally (Figs. 66C, D). First segment of male protarsus 0.75 times as wide as the maximum width of tibia; proportions of length and width of each protarsomere, from 1st to 5th: 1.65,



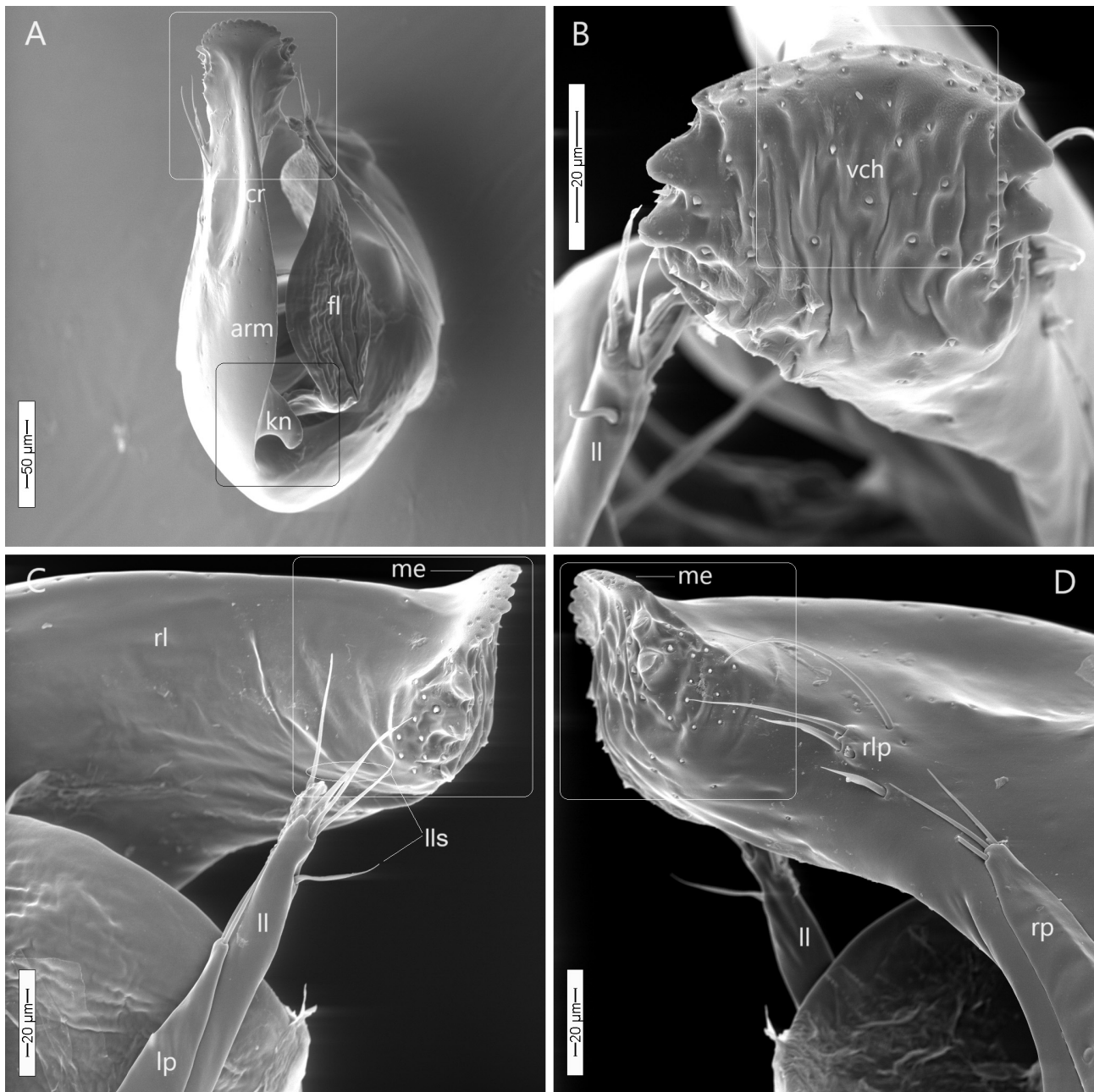
1.35, 1.25, 1.15, 4.0. Male mesotibia curved internally (Fig. 66E). First three mesotarsomeres with twin spines ('tw'—Fig. 67). Male metatibia straight, but with a slight curve internally (Fig. 66F). Male genital segment with spiculum gastrale divided at apex, with long branches (Fig. 16H).

Aedeagus somewhat globose (l/w ~2.1, concavity ~44–46%; concavity/total length = ~46–50% [Figs. 68G, T]), basal opening 90° downwards; width larger than height, widest about halfway from base (e.g., Fig. 68).

Right lobe ('rl'—e.g., Fig. 68A) elongate, with a long 'arm' ('arm'—e.g., Fig. 69A) narrowing into a



**FIGURE 68.** *Adelopsis sacerdotis* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A–X**, A rotational view of the aedeagus, around its 'longitudinal' axis, starting from the dorsal view. Black square in A is detailed in Fig. 72B; white square in A is detailed in Fig. 71C; black square in G is detailed in Fig. 72C. All figures to the same scale. ap = apical projection; dd = dorsal depression; lp = left paramere; rl = right lobe; rp = right paramere.



**FIGURE 69.** *Adelopsis sacerdotis* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A**, Aedeagus in frontal view of right lobe. **B–D**, Apex of aedeagus in ventral, left, and right views, respectively. White squares are detailed in Fig. 70. Black square in A is detailed in Fig. 72A. arm = arm of the right lobe; cr = crest of right lobe; fl = flagellum; kn = internal knob of the right lobe; ll = left lobe; lls = setae on the left lobe; lp = left paramere; me = marginal elevation; rl = right lobe; rlp = ‘plateau’ near the base of the right lobe; rp = right paramere; vch = ‘ventral chin’ of the right lobe.

‘crest’ (‘cr’—e.g., Fig. 69A) with a wide external face; the apical margin abruptly connects to a ‘ventral chin’ (‘vch’—e.g., Fig. 69B), which is very ‘wrinkled’; the apex of the right lobe is slightly elevated (‘me’—e.g., Figs. 69C, D); the apical margin is undulated, with several narrow emarginations along its width, which correspond to the depressions of the sensory structures (e.g., Figs. 69A, B). The outer ‘plateau’ (‘rlp’), which apical margin is ‘trifid’, bears three setae (e.g., Fig. 69D); there is one additional, long seta near its base, more dorsally, and another additional, short seta near its base, more ventrally, none of them associated with any kind of elevation (e.g.,

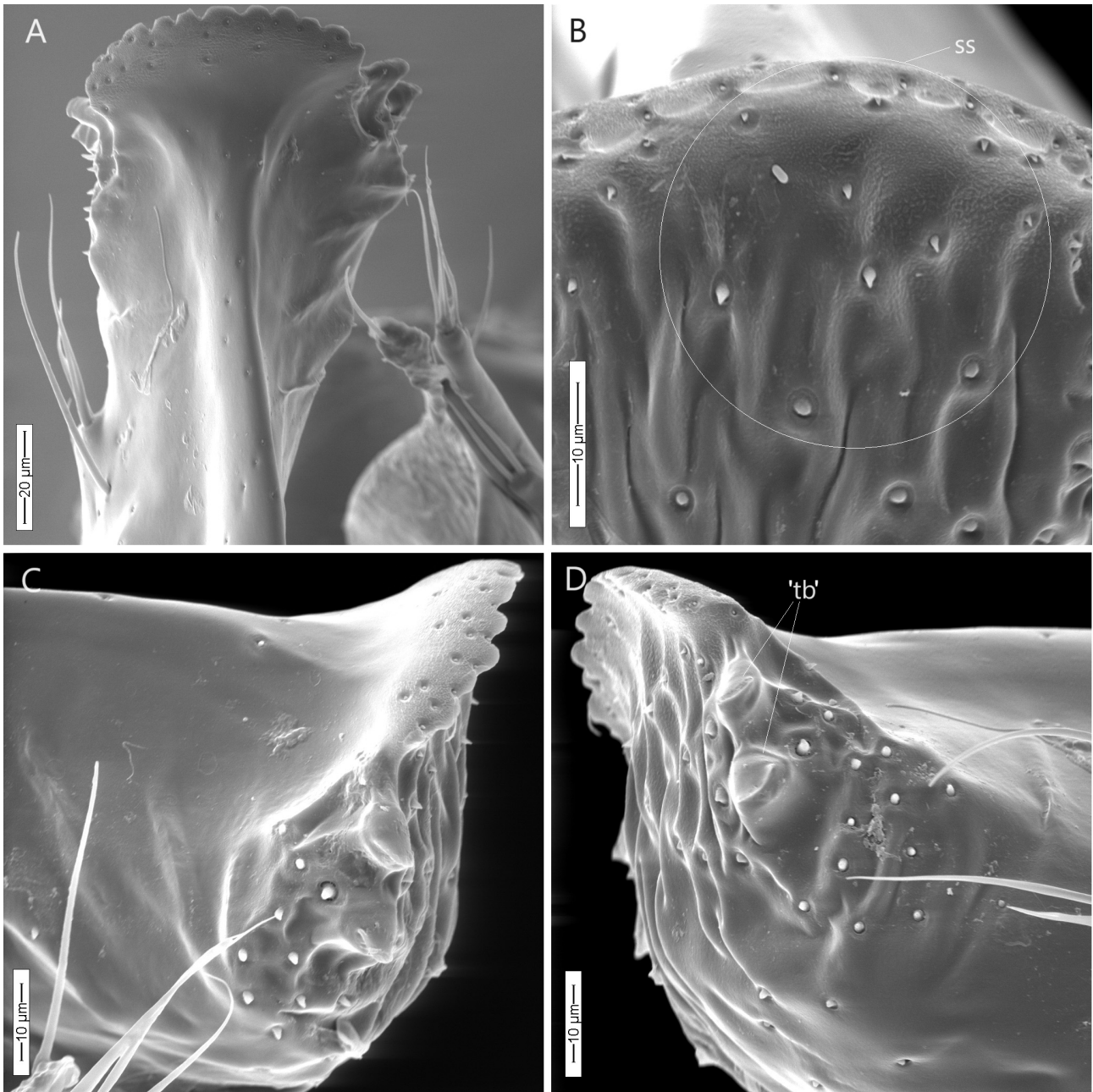
Fig. 69D). The ‘apical projection’ (‘ap’—e.g., Fig. 68T) % length = ~19–22%, % height = ~41–57%.

The left lobe (‘ll’) is a narrow stripe which goes straight posteriad towards the apex of the right lobe of the aedeagus (e.g., Figs. 69B–D, 71B); its diagonally truncated apical margin bears three long setae, projecting forward, and two additional setae, placed a little behind on the ventro-lateral faces (‘lls’—e.g., Fig. 69C).

The dorsal opening (‘do’—e.g., Fig. 71A) takes ~59–61% of the total length of the aedeagus.

The sensory structures have a very shallow depression with a minute dome-shaped projection (‘ss’—e.g., Fig.





**FIGURE 70.** *Adelopsis sacerdotis* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A**, Apex of aedeagus in frontal view of right lobe. **B–D**, Apex of aedeagus in ventral, left, and right views, respectively. All figures in detail from Fig. 69. ss = sensory structure; ‘tb’ = ‘tubercule’ on the ‘ventral chin’.

71C), and concentrate on the ‘ventral chin’, where they have a shallow depression with a dome-shaped or conic (of different sizes) projection (‘ss’—e.g., Fig. 70B).

The fused parameres can be recognized by the presence of a depression along their length, and are different from each other (e.g., Fig. 68). The right paramere (‘rp’—e.g., Figs. 68T, 69D) is curved (and follows the curvature of the aedeagus, along the right lateral face of the aedeagus); it is wider at base and slowly narrows towards its apex, which is round and bears three apical setae, projecting forward. The left paramere (‘lp’—e.g., Figs. 68H, 69C, 71B) is wider at base and curved until it reaches the basalmost region of the dorsal opening; after that, it is straight, following the left lobe of the aedeagus; it is

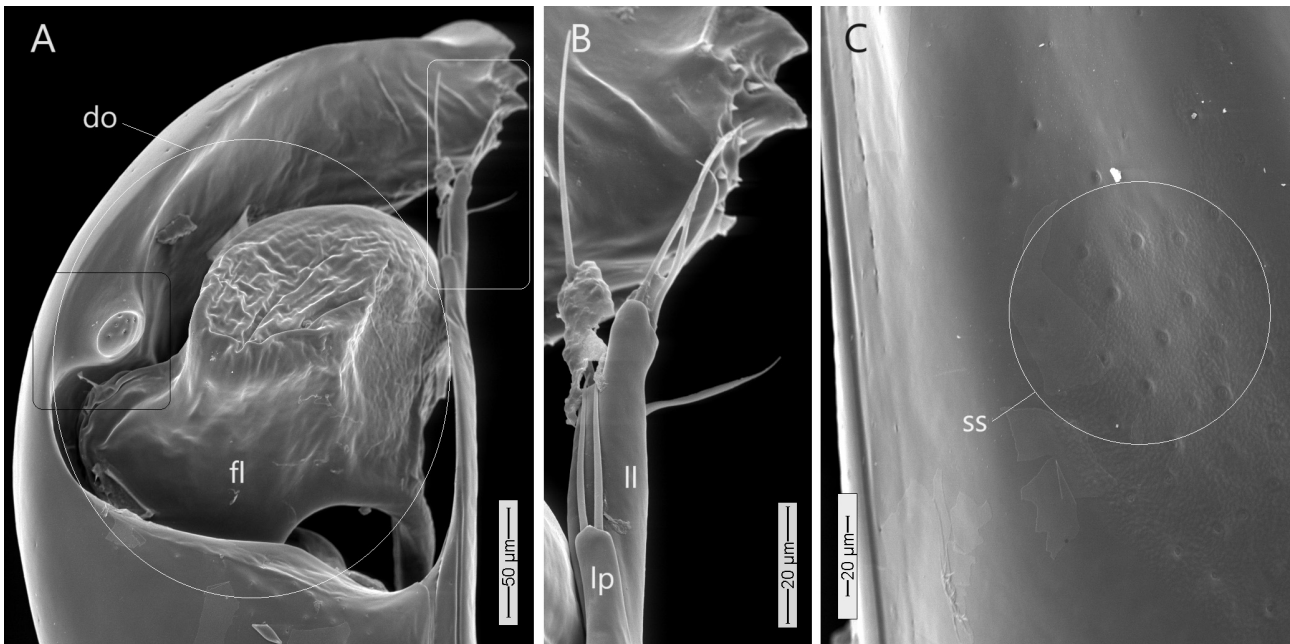
shorter than the left lobe; the apex is round and bears two setae, projecting forward.

The flagellum (‘fl’—e.g., Figs. 69A, 71A) is very robust—it seems to be narrow inside the aedeagus and, as soon as it emerges from the dorsal opening, it strongly widens and makes a curve, practically completing a whole circumference, staying wide for more than half its length and it seems to suddenly narrow toward its apex.

The internal knob (‘kn’—e.g., Figs. 69A, 72) is short and curved dorsally, with apical sensory structures.

There is a low, U-shaped, transversal ‘dorsal depression’ (‘dd’—e.g., Figs. 68B, G); position = ~9–15%.

Female unknown.



**FIGURE 71.** *Adelopsis sacerdotis* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A**, Apex of aedeagus in dorsal view (white rectangle is detailed in **B**). **C**, Detail of aedeagal integument, showing probable sensory structures (‘depressions’) (detail from Fig. 68A). Black square in **A** is detailed in Fig. 72D. do = dorsal opening; fl = flagellum; ll = left lobe; lp = left paramere; ss = sensory structure.

**Etymology.** The name is derived from the noun ‘sacerdos’ (Latin for ‘priest’), in the genitive case ‘sacerdotis’, referring to the type locality (“do Padre” in Portuguese = “Priest’s”).

**Distribution.** Brazil: Bahia State: known only from the type locality.

**Taxonomic remarks.** See ‘Taxonomic remarks in *benardi* species group’.

#### Taxonomic remarks in *benardi* species group

The elongate apical projection of the aedeagus (‘ap’) actually differs in dimensions—for instance, the apical projection is ‘thick’ in *A. boraceia* sp. nov., *A. claudina*, *A. gandarela* sp. nov., *A. gibber* sp. nov., *A. ilhabela* sp. nov., *A. leo*, *A. monticola* sp. nov., *A. sacerdotis* sp. nov., and *A. cf. szymczakowskii* (e.g., Figs. 24P, 63P, 68T), whereas it seems to be ‘thin’ in *A. caeteh* sp. nov., *A. piruapuera*, *A. vanini* sp. nov. (e.g., Figs. 19O, 51B) and *A. aspera* Jeannel, 1936 (as in Gnaspini & Peck, 2019: figs. 164–169).

The curvature at the apex of the apical projection, connecting the ventral and the anterior faces of the ventral chin of the aedeagus, is short and somewhat abrupt in *A. boraceia* sp. nov., *A. caeteh* sp. nov., *A. leo*, and *A. sacerdotis* sp. nov. (e.g., Figs. 19O, 68T) but long and less pronounced in the other species (e.g., Figs. 46M, 57P).

The apical margin of the apical projection of the aedeagus may be emarginated in *A. claudina*, *A. monticola* sp. nov., and *A. piruapuera* (e.g., Figs. 26A, 38A, 47A), and *A. aspera* Jeannel, 1936 (in which it can be seen under certain views but not in others—Gnaspini &

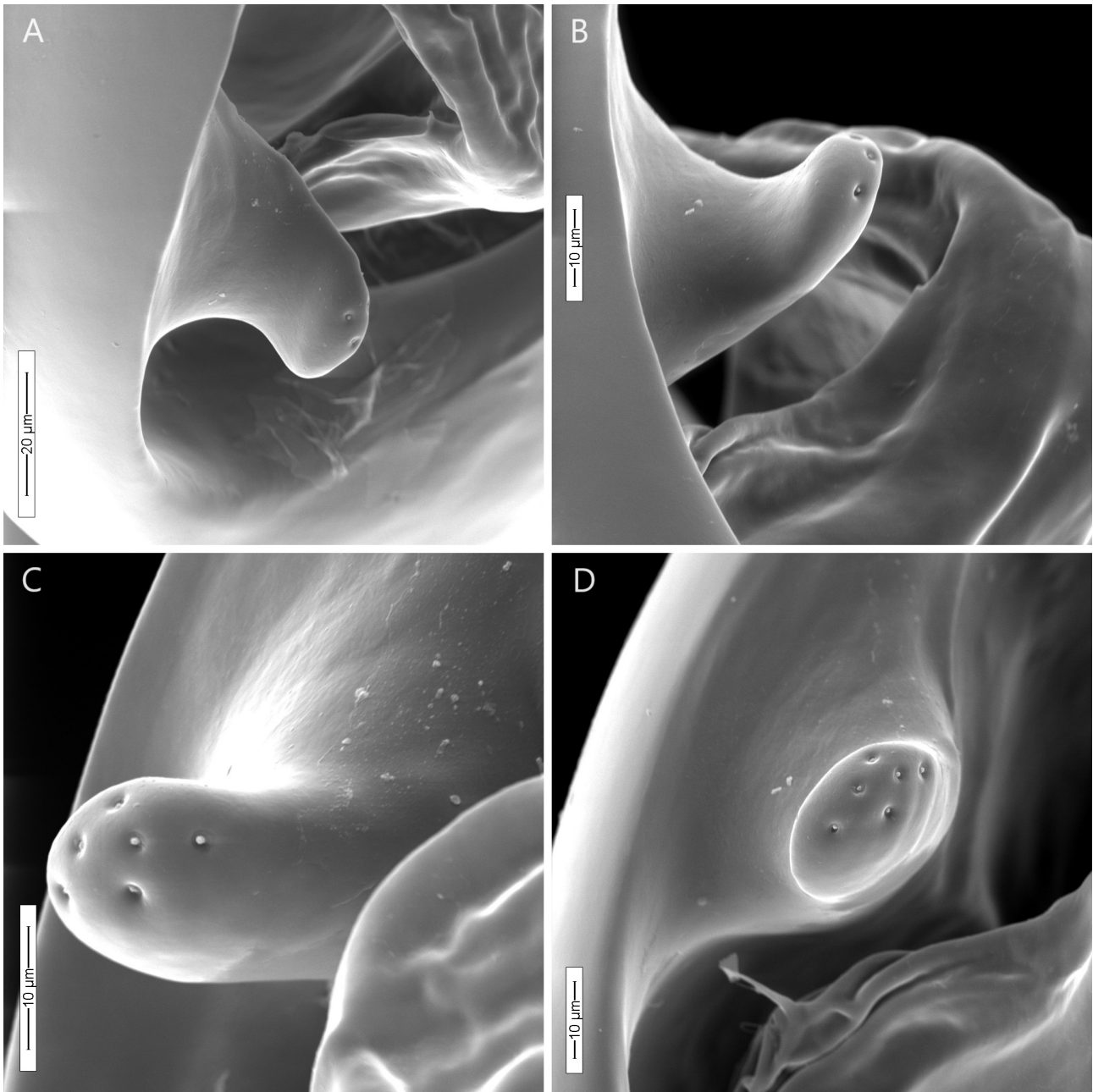
Peck, 2019: figs. 165, 169; as in *A. claudina*—e.g., Figs. 25A, 26A), and may also be the case with *A. luculenta* Szymczakowski, 1963 (but fig. 191 in Gnaspini & Peck, 2019 does not allow a precise interpretation, because the view strongly interferes with the interpretation of patterns in *Adelopsis*), or convex in the other species (e.g., Figs. 52B, 59D, 70A).

The contour of the ventral curvature of the aedeagus may be well pronounced in *A. boraceia* sp. nov., *A. caeteh* sp. nov., *A. leo*, *A. sacerdotis* sp. nov., and *A. cf. szymczakowskii* (e.g., Figs. 9, 68), and *A. luculenta* Szymczakowski, 1963, with a shorter distance between the inner face of the ventral chin and the basal opening, or it makes a soft curve in *A. claudina*, *A. gandarela* sp. nov., *A. gibber* sp. nov., *A. ilhabela* sp. nov., *A. monticola* sp. nov., *A. piruapuera*, and *A. vanini* sp. nov. (e.g., Figs. 36, 46).

The right lobe of the aedeagus of *A. claudina*, *A. gandarela* sp. nov., and *A. sacerdotis* sp. nov. has an elevation near the apex (‘me’—Figs. 25C, D, 65D, 69C, D), as is the case with *A. aspera* Jeannel, 1936, which also has a long apical projection (Gnaspini & Peck, 2019: figs. 164, 167), differing from the other species (e.g., Figs. 34A, 47D).

The apex of the apical projection of the aedeagus may have an apical depression (‘ad’), which may be convex in *A. boraceia* sp. nov. and *A. leo* (e.g., Figs. 32M, 41E), or concave in *A. caeteh* sp. nov., *A. gibber* sp. nov., and *A. cf. szymczakowskii* (e.g., Figs. 9P, 19O, 53S), and *A. asperoides* Szymczakowski, 1963 (as in Gnaspini & Peck, 2019: fig. 179), *A. benardi* (Portevin, 1923) (as in Gnaspini & Peck, 2019: fig. 114), *A. grouvellei* Jeannel, 1936 (as in Gnaspini & Peck, 2019: fig. 152), and *A. mrazi* Gnaspini





**FIGURE 72.** *Adelopsis sacerdotis* Gnaspini & Gomyde, new species (*benardi* species group—subgroup *grouvellei*), male holotype MZSP 61031. **A–D**, Internal knob ('kn'), in detail from Figs. 69A, 68A, 68G, and 71A, respectively.

& Peck, 2019 (as in Gnaspini & Peck, 2019: fig. 137), and also seems to be the case with *A. catarina* Salgado, 2005, but the figures in the original description (Salgado, 2005b: figs. 5–6) do not allow a precise interpretation.

The depth of the dorsal opening ('do') of the aedeagus may be not very large (about 30–40% of the length of the aedeagus) in *A. boraceia* sp. nov., *A. caeteh* sp. nov., *A. claudina*, *A. gibber* sp. nov., *A. leo*, *A. monticola* sp. nov., and *A. piruapuera* (e.g., Figs. 32B, 41C), or the dorsal opening may be very ample (about 50–60% of the length of the aedeagus) in *A. gandarela* sp. nov., *A. ilhabela* sp. nov., *A. sacerdotis* sp. nov., *A. cf. szymczakowskii*, and *A. vanini* sp. nov. (e.g., Figs. 9C, 57D) and *A. luculenta* Szymczakowski, 1963 (as in figs. 190–192 in Gnaspini & Peck, 2019).

The flagellum ('fl') of the aedeagus is a robust, very long coiled tape which practically makes a whole circumference (or more) outside the genital opening in *A. boraceia* sp. nov., *A. caeteh* sp. nov., *A. gandarela* sp. nov., *A. gibber* sp. nov., *A. ilhabela* sp. nov., *A. leo*, *A. sacerdotis* sp. nov., *A. cf. szymczakowskii*, and *A. vanini* sp. nov. (e.g., Figs. 9F, 57G), and *A. insolita* Szymczakowski, 1961 (as in fig. 10 in Szymczakowski, 1961) and *A. luculenta* Szymczakowski, 1963 (as in fig. 190 in Gnaspini & Peck, 2019), or it may be a regular, thin tube in other species (e.g., Fig. 46F).

The dorsal depression ('dd') of the aedeagus is shallow in *A. boraceia* sp. nov., *A. caeteh* sp. nov., *A. claudina*, *A. gandarela* sp. nov., *A. gibber* sp. nov., *A. ilhabela* sp. nov., *A. monticola* sp. nov., *A. sacerdotis* sp.

**nov.**, *A. cf. szymczakowskii*, and *A. vanini sp. nov.* (e.g., Figs. 9E, 57F), and *A. asperoides* Szymczakowski, 1963 (as in fig. 181 in Gnaspini & Peck, 2019), *A. grouvellei* Jeannel, 1936 (as in fig. 152 in Gnaspini & Peck, 2019), and *A. waclawi* Gnaspini & Peck, 2019 (as in figs. 150–151 in Gnaspini & Peck, 2019), and it is deep in *A. leo* and *A. piruapuera* (e.g., Figs. 32E, 36Q), and *A. mrazi* Gnaspini & Peck, 2019 (as in figs. 137, 139 in Gnaspini & Peck, 2019). It may be completely transverse in *A. leo*, *A. monticola sp. nov.*, *A. cf. szymczakowskii*, and *A. vanini sp. nov.* (e.g., Figs. 32A, 46A), or be formed by two diagonally produced depressions which together form a V-shaped depression in *A. boraceia sp. nov.*, *A. claudina*, and *A. gibber sp. nov.* (e.g., Figs. 24S, 41A) or a U-shaped depression in *A. sacerdotis sp. nov.* (e.g., Fig. 68B), or have a transverse depression associated with a ‘sagittal’ depression, forming a T-shaped depression in *A. piruapuera* (e.g., Fig. 36B), or have two diagonal depressions associated with a ‘sagittal’ depression, forming a Y-shaped depression in *A. caeteh sp. nov.* (e.g., Fig. 19A), or, even, be ‘incomplete’, forming a mirrored-J-shaped depression in *A. ilhabela sp. nov.* and *A. gandarela sp. nov.* (e.g., Figs. 63A, 64D).

The shape of the internal knob of the aedeagus varies in the different species, being a good tool for species recognition.

The setae of the outer (right) face of the right lobe of the aedeagus are placed on the apical margin of a ‘plateau’ (‘rlp’) in *A. boraceia sp. nov.*, *A. claudina*, *A. gibber sp. nov.*, *A. ilhabela sp. nov.*, *A. leo*, *A. monticola sp. nov.*, *A. sacerdotis sp. nov.*, *A. cf. szymczakowskii*, and *A. vanini sp. nov.* (e.g., Figs. 11D, 25D, less pronouncedly, e.g., in Figs. 42D, 69D), but not in the other species here studied. An additional, conic elevation (‘rlc’) with an additional seta associated to its base appears in *A. boraceia sp. nov.*, *A. monticola sp. nov.*, and *A. vanini sp. nov.* (e.g., Figs. 42D, 47E, 51C) and in *A. cf. szymczakowskii*, which belongs in a different species subgroup, but with no seta associated to it (e.g., Fig. 11D). In turn, *A. claudina* and *A. leo* have that seta but no elevation close to it (e.g., Figs. 27C, 34B). An additional elevation, placed farther away, with no seta associated to it (‘rlc2’) was observed in *A. boraceia sp. nov.*, *A. ilhabela sp. nov.*, and *A. leo* (e.g., Figs. 34A, 42D, 58D). Finally, no ‘rlp’ or ‘rlc’ were observed in *A. piruapuera*. Those features cannot be observed in the line drawings of other species from the literature.

The ‘ventral chin’ (‘vch’) of the aedeagus may be ‘vertically produced’ in *A. claudina* and *A. gandarela sp. nov.* (e.g., Figs. 25B, 65B), be ‘horizontally produced’ in *A. caeteh sp. nov.*, *A. monticola sp. nov.*, *A. piruapuera*, and *A. vanini sp. nov.* (e.g., Figs. 21B, 52B), or have about the same width and height in *A. boraceia sp. nov.*, *A. gibber sp. nov.*, *A. ilhabela sp. nov.*, *A. leo*, *A. sacerdotis sp. nov.*, and (maybe) *A. cf. szymczakowskii* (e.g., Figs. 34B, 69B). The surface of the ‘ventral chin’ may be wrinkled in *A. monticola sp. nov.* (slightly and only closer to the anterior face) and *A. sacerdotis sp. nov.* (e.g., Figs. 48A, 69B) or somewhat ‘smooth’ in the other species (e.g., Figs. 34B, 52B).

In all species here studied, the sensory structures (‘ss’) on the ‘ventral chin’ of the aedeagus are shaped as a shallow depression (e.g., Figs. 48A, 65B, D) (deep in *A. claudina* and *A. ilhabela sp. nov.*—e.g., Figs. 26B, 59A) from the center of which emerges, in part, a dome-shaped projection (e.g., Figs. 26B, 48A) (of different sizes in *A. claudina*, *A. gibber sp. nov.*, *A. ilhabela sp. nov.* [part of them surrounded by a ring], *A. monticola sp. nov.*, *A. cf. szymczakowskii*, and *A. vanini sp. nov.*; minute in *A. gandarela sp. nov.*). Alternatively, the central projection may be conic (e.g., Figs. 22A, 48A, C) in all species (being of different sizes in *A. leo* and *A. sacerdotis sp. nov.*), except in *A. claudina*, *A. gandarela sp. nov.*, and *A. cf. szymczakowskii*, being a short hair in the first two species (e.g., Figs. 26D, 65B).

### **Camella species group Gnaspini & Peck, 2001**

#### **Adelopsis crassiflagellata Gnaspini & Peck, 2001**

(Figs. 73–76)

*Adelopsis crassiflagellata* Gnaspini & Peck, 2001: 434 (assignment to *camella* species group); Salgado, 2010: 227 (as Gnaspini y Pewck [sic]); Peck *et al.*, 2020: 49.

Holotype male in SBPC [now in CMNC]; 4 male and 7 female paratypes in MZSP, SBPC.

Type locality: 25 km S Chinácota, 7000’, Norte de Santander Department, Colombia.

Distribution: Colombia: Norte de Santander Department; Ecuador: Napo Province.

Size (original description): Length: 1.9–2.2 mm; width: 0.95–1.1 mm.

**Material examined. Paratypes:** COLOMBIA—Norte de Santander:—25km S Chinácota; 7000’ a.s.l.; 10–14.V.1974; S.B. Peck leg.; Label: “Colombia: Norte Santander: / 25km S Chinácota, 7000’ / 10–14.V.1974 / S.B. Peck”; 2 males, MZSP 27007, 27008 (here illustrated) (out of 2 male and 3 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~2.9), basically flat ventrally, but with a sharp curve ventrad near the base, resulting in a concave ventre (concavity ~27–28% [Figs. 73E, O]), basal opening 90° downwards; width a little bigger than height, widest near base of dorsal opening (e.g., Fig. 73).

Right lobe (‘rl’—e.g., Fig. 74A) projects forward and slightly ventrad, with a somewhat short ‘arm’ with subparallel sides, in dorsal/ventral views (‘arm’—e.g., Fig. 74A); the arm connects to an apical ‘plate’ (‘pl’—e.g., Fig. 74A) which has a triangular shape (with a pointy apex, slightly curved ventrad), which bears four seta on each side, being three setae placed aligned with the dorsal margin and a fourth displaced ventrally (e.g., Fig. 74); additionally, the right lobe bears one seta close to its base (i.e., a little ahead of the end of the right paramere—‘rbs’—e.g., Fig. 74D).

A left lobe is ‘absent’ (“ll”’—e.g., Fig. 74C); the ‘turning point’ is just under the left paramere (‘tp’—e.g., Fig. 74D); one seta is placed a little before the ‘turning point’ (‘lls’—e.g., Fig. 74C).

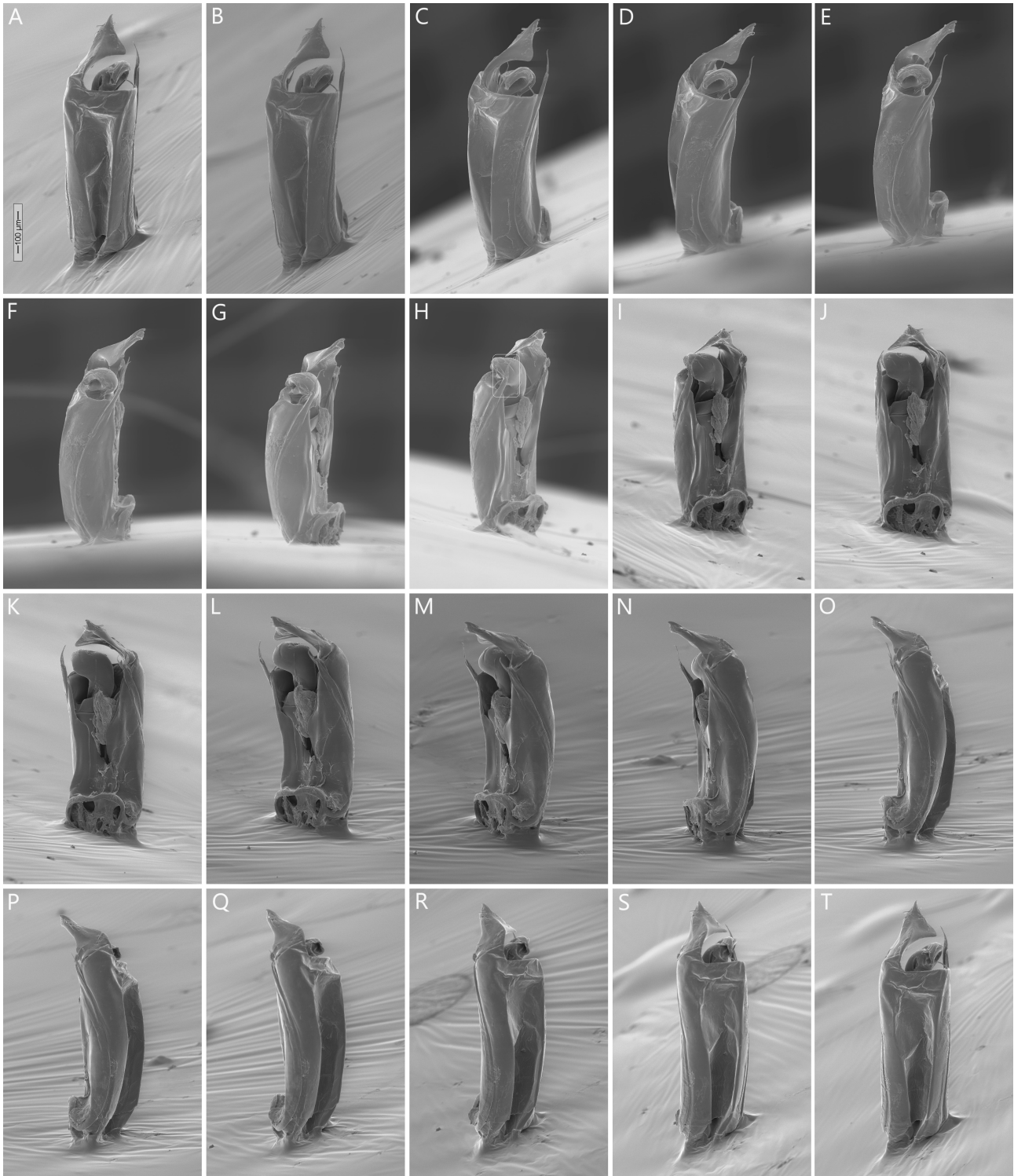


The dorsal opening ('do'—e.g., Fig. 74A) takes ~34% of the total length of the aedeagus and its inner margin is C-shaped, because a typical left lobe is missing.

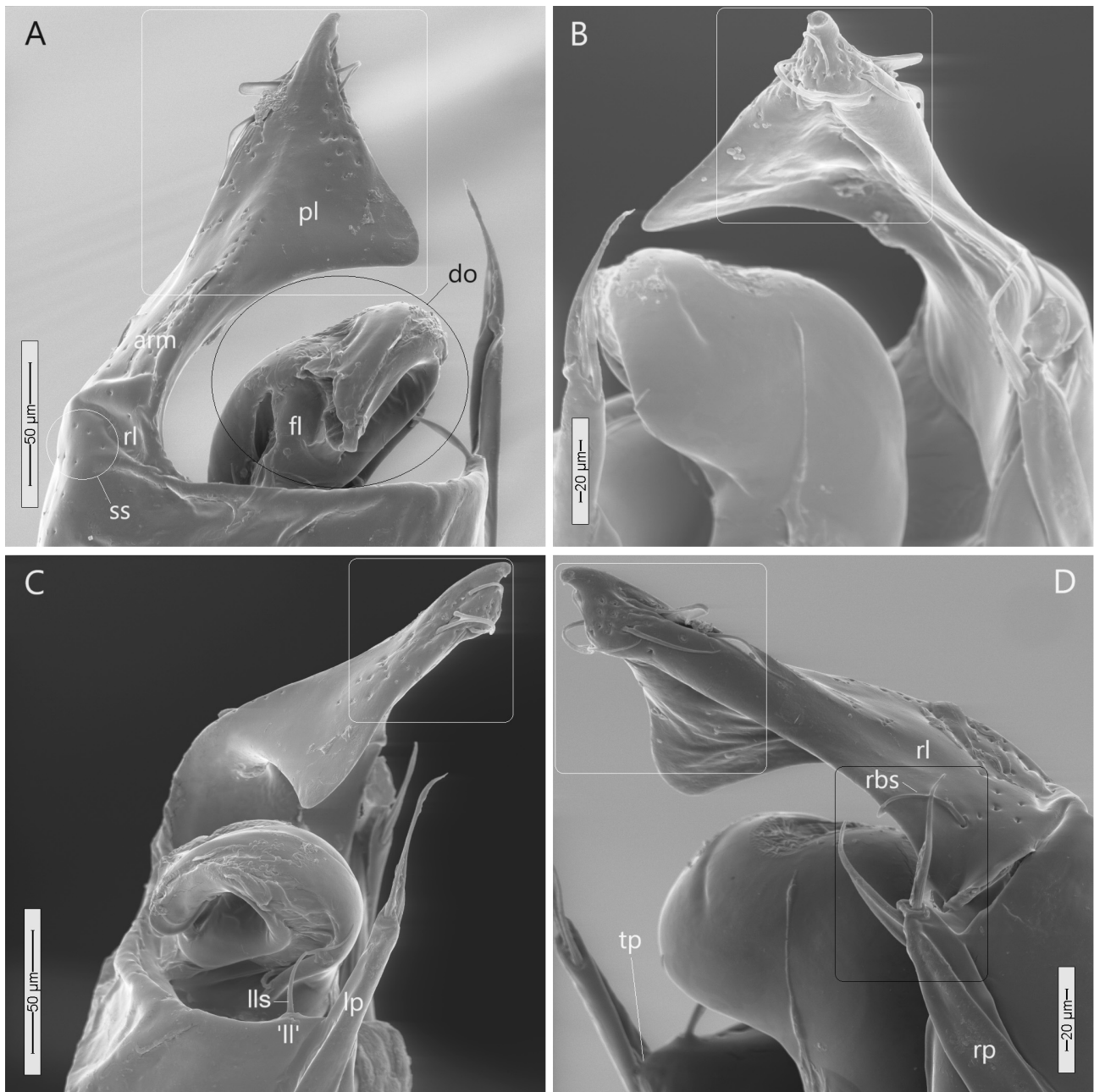
The sensory structures concentrate on the right lobe ('ss'—e.g., Figs. 74A, 75A, B).

The somewhat narrow fused parameres can be recognized by the presence of a depression along their

length, but parts of the basalmost margins cannot be recognized from the aedeagus body; their apex are free ('lp' and 'rp'—e.g., Figs. 74C, D, 76B, C). The parameres have about the same length, and have a round apical margin with three setae, projecting forward, being two of them placed more ventrally and a third one placed more dorsally.



**FIGURE 73.** *Adelopsis crassiflagelata* Gnaspini & Peck, 2001 (*camella* species group), male paratype MZSP 27008. A–T, A rotational view of the aedeagus, around its 'longitudinal' axis, starting from the dorsal view. White rectangle in H is detailed in Fig. 76C. All figures to the same scale.



**FIGURE 74.** *Adelopsis crassiflagelata* Gnaspini & Peck, 2001 (*camella* species group), male paratype MZSP 27008. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares are detailed in Fig. 75—that in D is detailed in Figs. 75D and 76A (slightly rotated); black rectangle in D is detailed in Fig. 76B. arm = arm of the right lobe; do = dorsal opening; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; pl = plate of right lobe; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

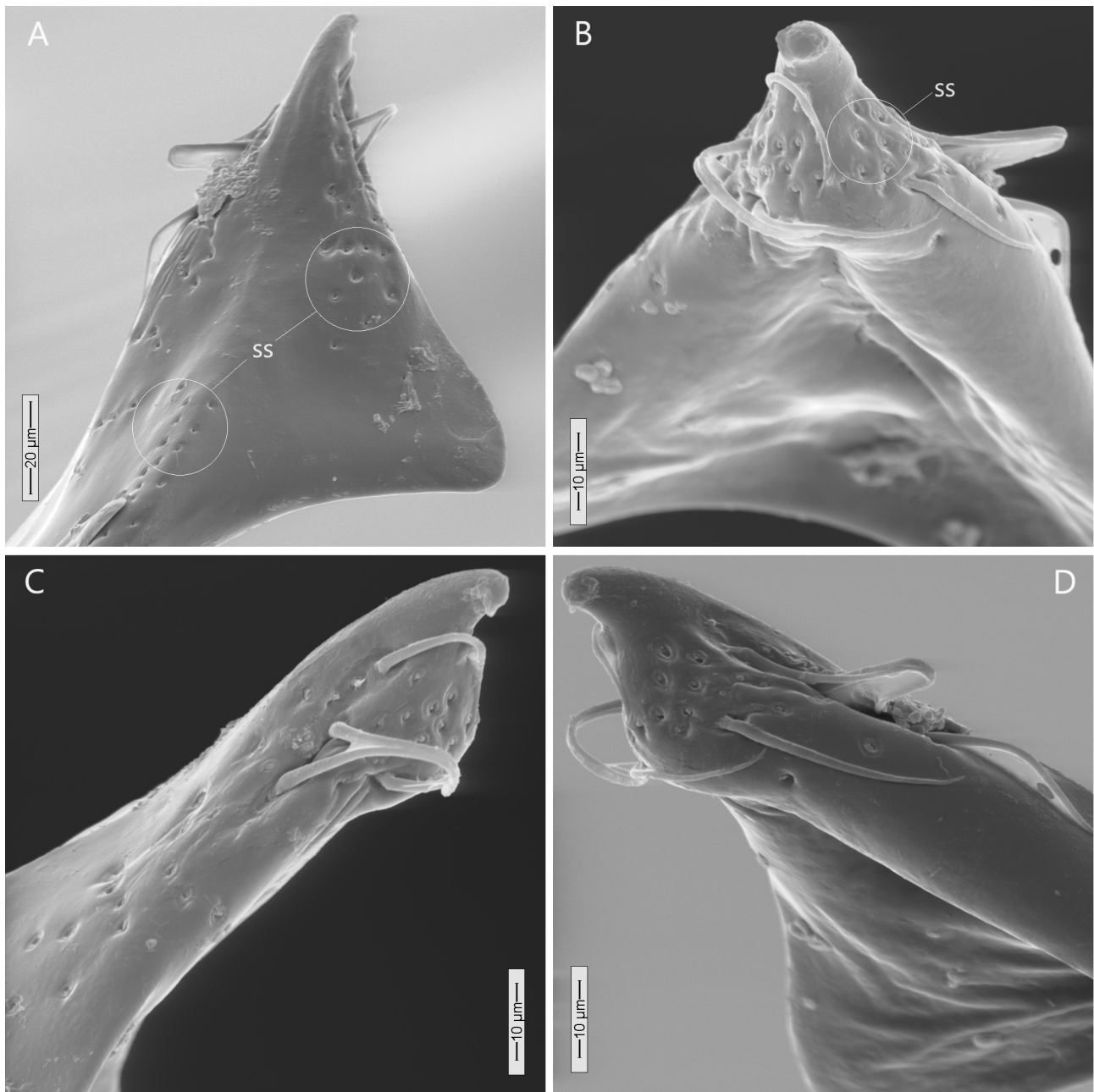
The flagellum was originally described as ‘thick and slightly sinuate at apex’ (as in Gnaspini & Peck, 2001: figs. 67–69); its visible portion (‘fl’—e.g., Fig. 74A) is strong and short, with an ample opening.

**Taxonomic remarks.** *Adelopsis crassiflagelata* has the apex of the aedeagus triangular with setae on both sides, typical of *Ptomaphagus* Hellwig, 1795, but with an ample dorsal opening, which does not allow the proper recognition of a left lobe (e.g., Fig. 74A), therefore differing from *Ptomaphagus*.

#### ***Capitanea* species group Gnaspini & Peck, 2001**

In all species in *capitanea* species group, the dorsal opening is somewhat ample, being a little difficult to actually define its dimension, because its inner margin is C- or L-shaped, because a typical left lobe is missing. The parameres are wide near their base and slowly narrow towards their apices, which are free.





**FIGURE 75.** *Adelopsis crassiflagelata* Gnaschini & Peck, 2001 (*camella* species group), male paratype MZSP 27008. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—detailed from Fig. 74. ss = sensory structure.

***Adelopsis anceps* Gnaschini & Peck, 2001**  
(Figs. 77–80)

*Adelopsis anceps* Gnaschini & Peck, 2001: 435 (assignment to *capitanea* species group); Peck *et al.*, 2020: 49.

Holotype male in SBPC [now in CMNC]; 4 male and 10 female paratypes in MZSP, SBPC.

Type locality: 11–23 km E Calarcá, 7–10000', Quindío Department, Colombia.

Distribution: Colombia: Quindío Department: known only from vicinity of type locality.

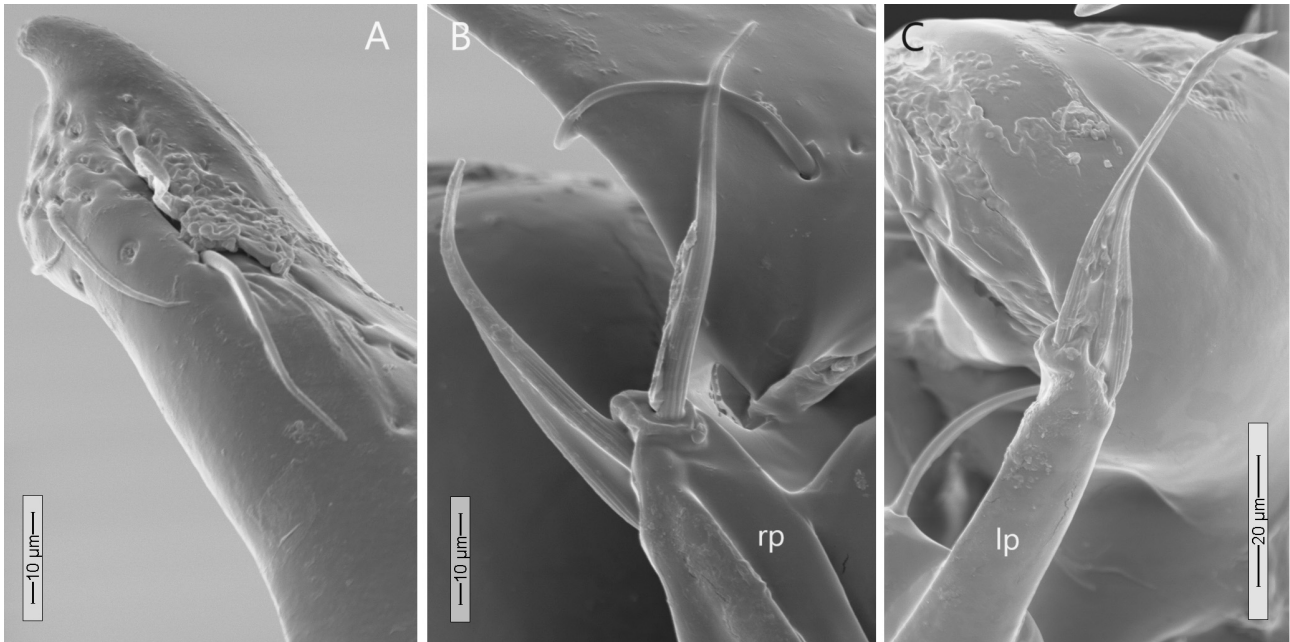
Size (original description): Length: 2.95–3.7 mm; width: 1.5–2.0 mm.

**Material examined. Paratypes:** COLOMBIA—

**Quindío:**—15km E Calarcá; 8000' a.s.l.; 07–10.III.1974; S. & J. Peck leg.; DT993; Label: “Colombia: Quindio / 15km E Calarcá, 8000' / 07–10.III.1974, DT993 / S & J. Peck”; 2 males, MZSP 12984, 12985 (here illustrated) (out of 2 male and 3 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~2.7, concavity ~34–40% [Figs. 77F, Q]), basal opening 90° downwards; width almost twice as big as height, widest about halfway from base (e.g., Fig. 77).

Right lobe ('rl'—e.g., Fig. 78A) quickly narrowing to form a narrow 'crest' ('cr'—e.g., Fig. 78A), which connects ventrally with a subquadrate plate ('pl'—e.g., Figs. 78A, 79A), which ventral face has a deep 'ventral cavity', with an U-shaped internal margin ('vc'—e.g., Figs. 78B, 80B); the internal face of the plate is folded



**FIGURE 76.** *Adelopsis crassiflagelata* Gnaspini & Peck, 2001 (*camella* species group), male paratype MZSP 27008. **A**, Apex of aedeagus in right view, detailed from Fig. 74D, slightly rotated. **B**, Apex of right paramere, detailed from Fig. 74D. **C**, Apex of left paramere, detailed from Fig. 73H. lp = left paramere; rp = right paramere.

dorsad, forming an ‘internal fold’ (‘if’—e.g., Figs. 79A, C, 80B); and the apical sides are projected dorsad, forming blunt ‘horns’ (‘hn’—e.g., Figs. 79C, D); the right lobe bears three setae close to its base, ventrally to the ventral margin of the right paramere (‘rbs’—e.g., Fig. 79B).

A left lobe is ‘absent’ (“ll”—e.g., Figs. 78B, C, 80A); the ‘turning point’ is just under the left paramere (‘tp’—e.g., Fig. 78B); three elongate setae are placed close to the ‘turning point’ (‘lls’—e.g., Fig. 80A).

The dorsal opening (‘do’—e.g., Fig. 79A) takes ~19% of the total length of the aedeagus and its inner margin is C-shaped.

The sensory structures are densely distributed and have a shallow depression (‘ss’—e.g., Fig. 78A); those on the apical plate are deeper and bear a small dome-shaped projection (‘ss’—e.g., Figs. 79D, 80D).

The fused parameres can be recognized by the presence of a depression along their length (e.g., Fig. 77). They have the same length and their apical margin is round; there are four long setae placed aligned along the ventral margin near the apex, projecting ventrally (‘lp’ and ‘rp’—e.g., Figs. 78C, D).

The flagellum was originally described as ‘short and slightly sinuate’ (as in Gnaspini & Peck, 2001: figs. 77–79).

**Taxonomic remarks.** *Adelopsis anceps* seems to be (until now) the only species in which the setae close to the base of the right lobe of the aedeagus (‘rbs’—e.g., Fig. 79B) are placed ventrally to the ventral margin of the right paramere. The apex of the aedeagus with a deep ‘ventral cavity’ and a pair of blunt ‘horns’ is so far unique among ptomaphagines.

***Adelopsis bifida* Gnaspini & Peck, 2001**  
(Figs. 81–84)

*Adelopsis bifida* Gnaspini & Peck, 2001: 436 (assignment to *capitanea* species group); Peck *et al.*, 2020: 49.

Holotype male in SBPC [now in CMNC]; 11 male and 13 female paratypes in FMNH, MNHN, MZSP, SBPC.

Type locality: Below Tecandama Falls, 7000’, Soacha, Cundinamarca Department, Colombia.

Distribution: Colombia: Cundinamarca Department: known only from type locality.

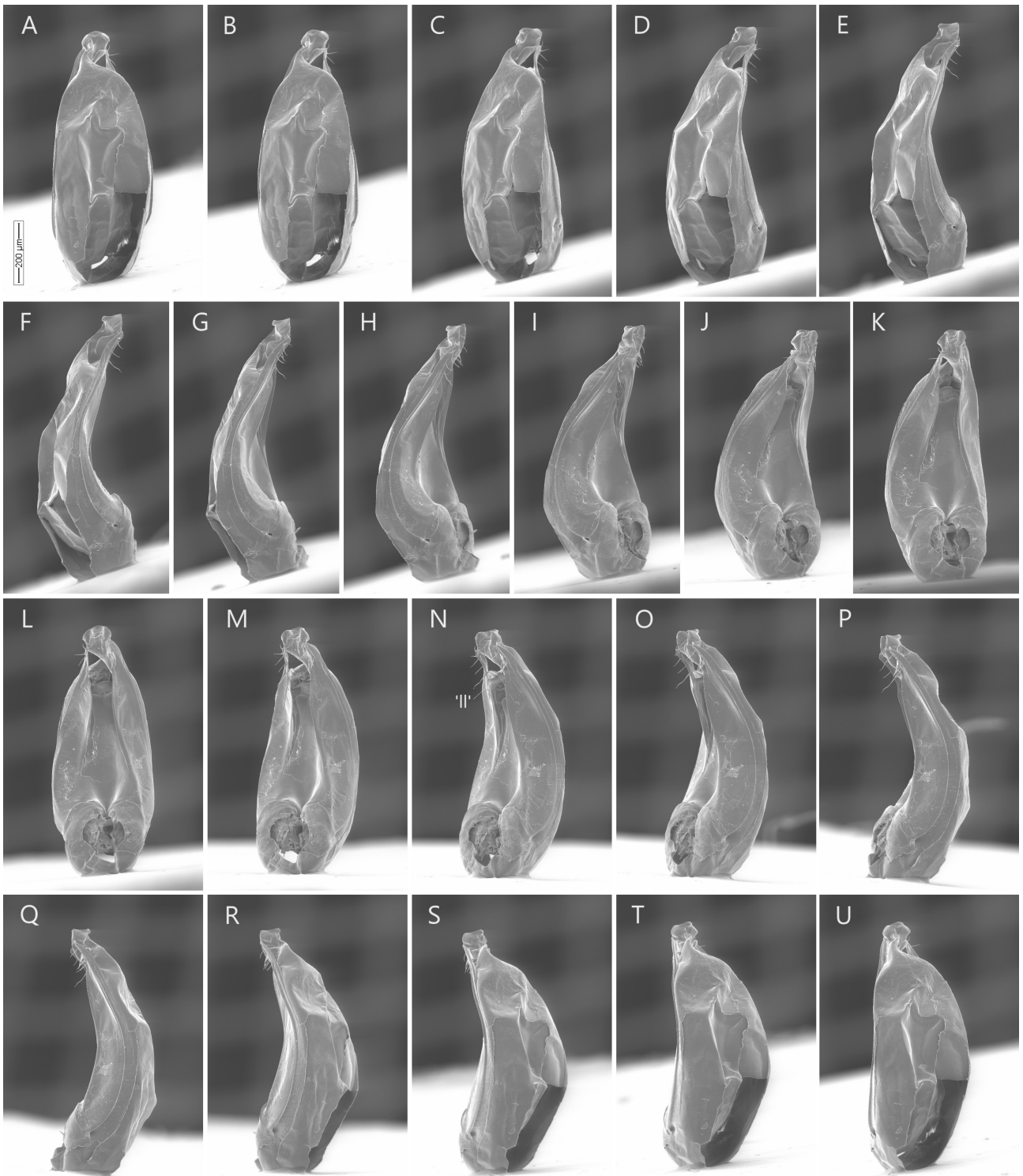
Size (original description): Length: 3.2–4.25 mm; width: 1.55–2.05 mm.

**Material examined. Paratypes:** COLOMBIA—Cundinamarca:—Soacha, below Tecandama Falls; 7000’ a.s.l.; 27.II–06.III.1972; S. & J. Peck leg.; traps; Label: “Colombia: Cundin.: Soacha / below Tecandama Falls / 7000’, 27.II–06.III.1972, / traps, S & J. Peck”; 2 males, MZSP 12975 (here illustrated), 12980 (out of 3 male and 3 female paratypes).

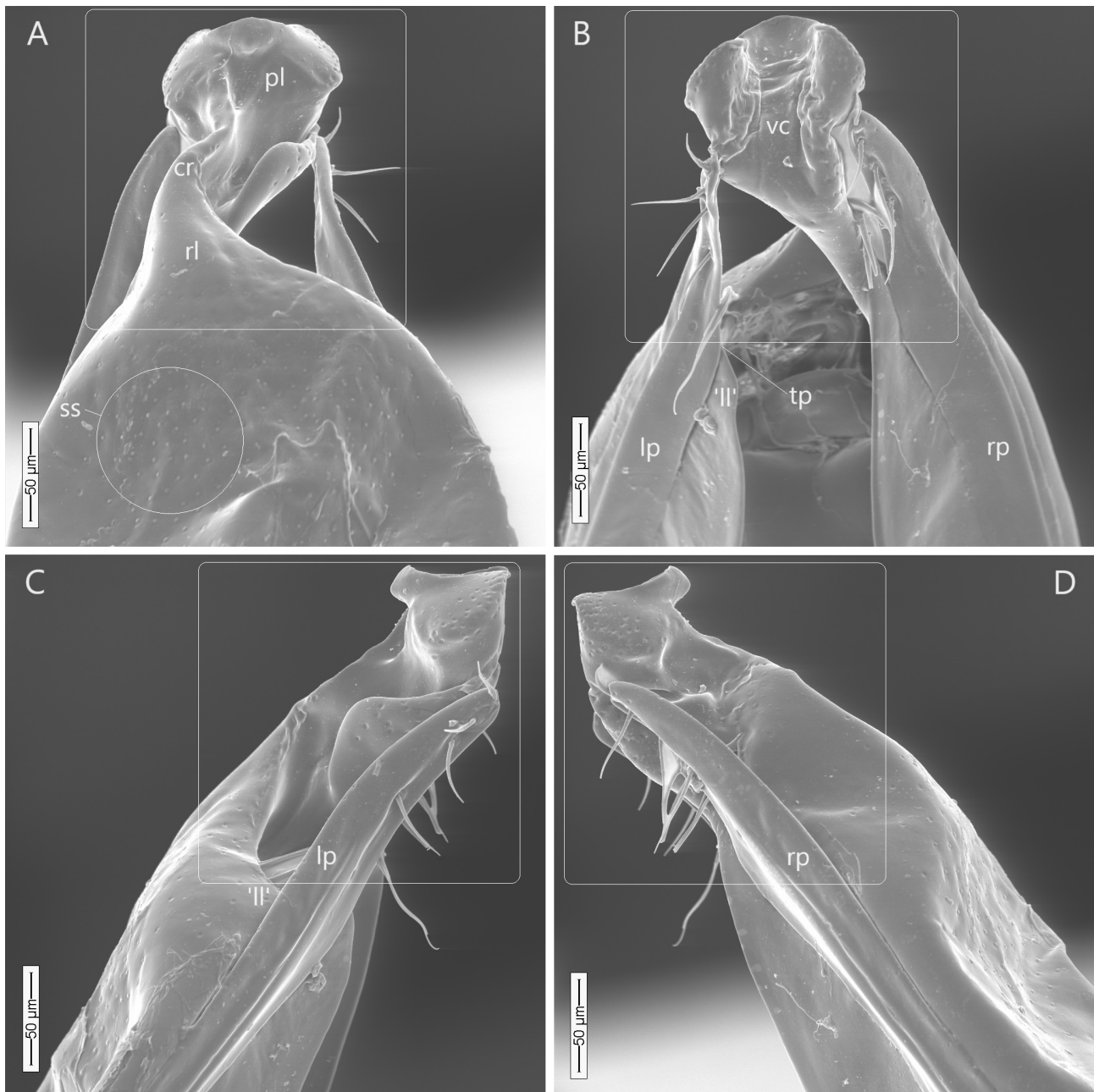
**Redescription of aedeagus.** Aedeagus globose (l/w ~2.3, concavity ~28–29% [Figs. 81E, P]), basal opening 90° downwards; width a little bigger than height, widest about halfway from base (e.g., Fig. 81).

Right lobe (‘rl’—e.g., Fig. 82A) quickly narrowing to form a ‘crest’ (‘cr’—e.g., Fig. 82A), which continues forward to form an elongate, pointy ‘outer plate’ (‘opl’—e.g., Figs. 82A, B); the inner margin of the outer plate extends ventrally and connects to a larger, pointy ‘inner plate’ (‘ipl’) which projects toward the left side of the aedeagus (e.g., Figs. 82A, B)—both, inner and outer plates, are concave ventrally (e.g., Fig. 82B); the right lobe bears at least two setae close to its base, a little ahead





**FIGURE 77.** *Adelopsis anceps* Gnaspi & Peck, 2001 (*capitanea* species group), male paratype MZSP 12985. A–U, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ‘ll’ = left lobe absent.



**FIGURE 78.** *Adelopsis anceps* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12985. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares are detailed in Fig. 79—that in B is detailed in Figs. 79B and 80C (slightly rotated). cr = crest of right lobe; ‘ll’ = left lobe absent; lp = left paramere; pl = plate of right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description); vc = ‘ventral cavity’.

of the apical margin of the right paramere (‘rbs’—e.g., Figs. 83B, D).

A left lobe is ‘absent’ (‘ll’—e.g., Figs. 82A, C, 84B); the ‘turning point’ is just ventral to the left paramere (‘tp’—e.g., Fig. 82C); three elongate setae are placed close to the left paramere (‘lls’—e.g., Fig. 83C).

The dorsal opening (‘do’—e.g., Fig. 82A) takes ~25% of the total length of the aedeagus and its inner margin is L-shaped.

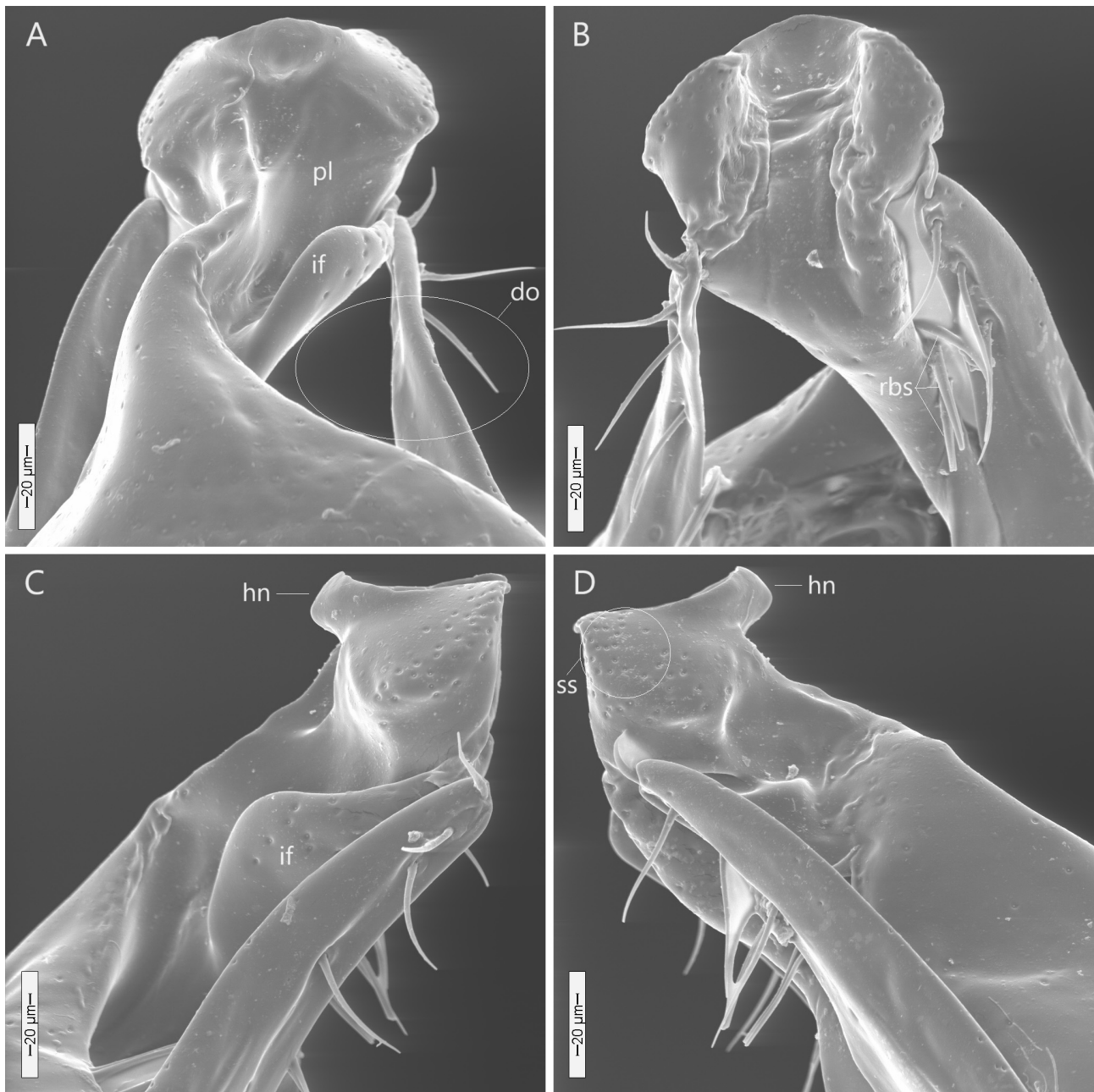
The sensory structures are densely distributed and may have a small dome-shaped projection—in most cases, the dome cannot be observed and only a ‘pore’ can

be observed (‘ss’—e.g., Fig. 82A); the domes are clearer on the apical plates (‘ss’—e.g., Fig. 83B).

The fused parameres can be recognized by the presence of a depression along their length, but parts of the ventral margin of the left paramere cannot be recognized from the aedeagus body (e.g., Fig. 81). They have the same length and their apical margin is round; there are five long setae placed aligned along the ventral margin near the apex, projecting ventrally (‘lp’ and ‘rp’—e.g., Fig. 82B).

The flagellum cannot be seen and it was not mentioned in the original description (see Gnaspini & Peck, 2001: figs. 87–89).





**FIGURE 79.** *Adelopsis anceps* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12985. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—detailed from Fig. 78. do = dorsal opening; hn = ‘horn’; if = internal fold; pl = plate of right lobe; rbs = setae near the base of the right lobe; ss = sensory structure.

**Taxonomic remarks.** See discussion under *A. capitanea*.

***Adelopsis capitanea* Gnaspini & Peck, 2001**  
(Figs. 85–87)

*Adelopsis capitanea* Gnaspini & Peck, 2001: 436 (assignment to *capitanea* species group); Peck *et al.*, 2020: 49.

Holotype male in SBPC [now in CMNC]; 8 male and 5 female paratypes in FMNH, MZSP, SBPC.

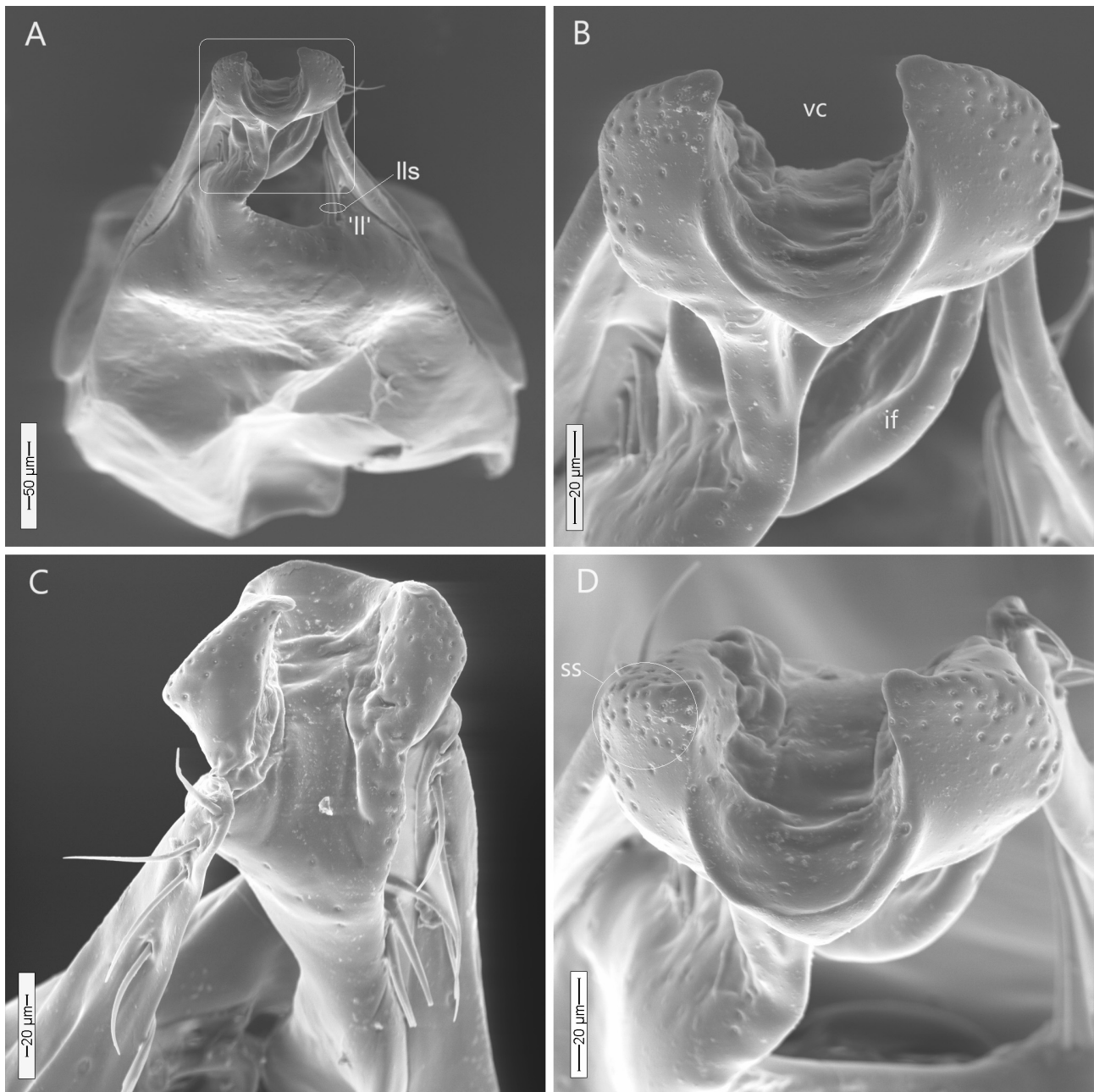
Type locality: 11–23 km E Calarcá, 7–10000’, Quindío Department, Colombia.

Distribution: Colombia: Quindío Department: known only from vicinity of type locality.

Size (original description): Length: 3.1–4.45 mm; width: 1.3–2.0 mm.

**Material examined. Paratypes:** COLOMBIA—**Quindío:**—21km E Calarcá; 10000’ a.s.l.; 06–11.III.1974; S. & J. Peck leg.; DT987; Label: “Colombia: Quindio / 21km E Calarcá, 10000’ / 06–11.III.1974, DT987 / S & J. Peck”; 2 males, MZSP 12964, 12965 (here illustrated) (out of 2 male and 2 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat globose (l/w ~2.2, concavity ~30–31% [Figs. 85F, R]),



**FIGURE 80.** *Adelopsis anceps* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12985. **A**, Aedeagus in frontal view of right lobe (white square is detailed in **B**, and **D**.—slightly rotated). **C**, Apex of aedeagus in ventral view—detailed from Fig. 78B, slightly rotated. if = internal fold; 'll' = left lobe absent; lls = setae on the 'left lobe'; ss = sensory structure; vc = 'ventral cavity'.

basal opening 90° downwards; width a little bigger than height, widest about halfway from base (e.g., Fig. 85).

Right lobe ('rl'—e.g., Fig. 86A) projecting forward on an 'arm' ('arm'—e.g., Fig. 86A) with a not clearly defined 'crest' ('cr'—e.g., Fig. 86A), which continues forward to form an elongate, pointy 'outer plate' ('opl'—e.g., Figs. 86A, B); the ventral inner face of the outer plate extends towards the left side to form a larger, pointy 'inner plate' ('ipl'—e.g., Figs. 86A, B)—both, inner and outer plates, have a small, shallow concavity ventrally (e.g., Fig. 86B); the internal face of the arm is folded dorsad, forming an 'internal fold' ('if'—e.g., Figs. 86A, C), which connects posteriorly

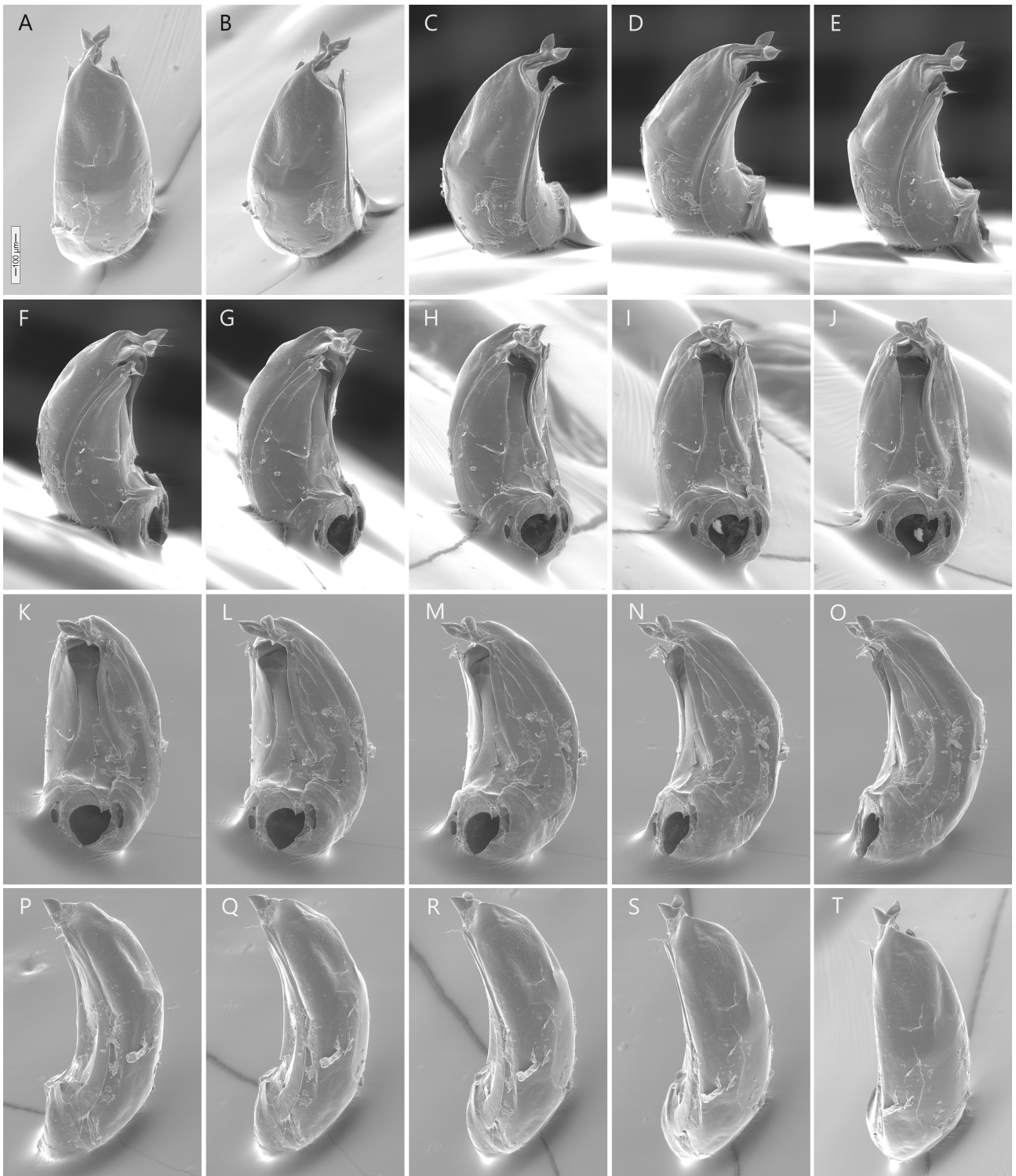
with the inner plate; the right lobe seems to bear setae close to its base, just below the apical margin of the right paramere, but there is debris covering this region in the specimen examined, making it impossible to describe it properly.

A left lobe is 'absent' ('ll'—e.g., Figs. 86A, C); the 'turning point' is just ventral to the left paramere ('tp'—e.g., Fig. 86C); two elongate setae are placed very close to the left paramere ('lls'—e.g., Fig. 86A).

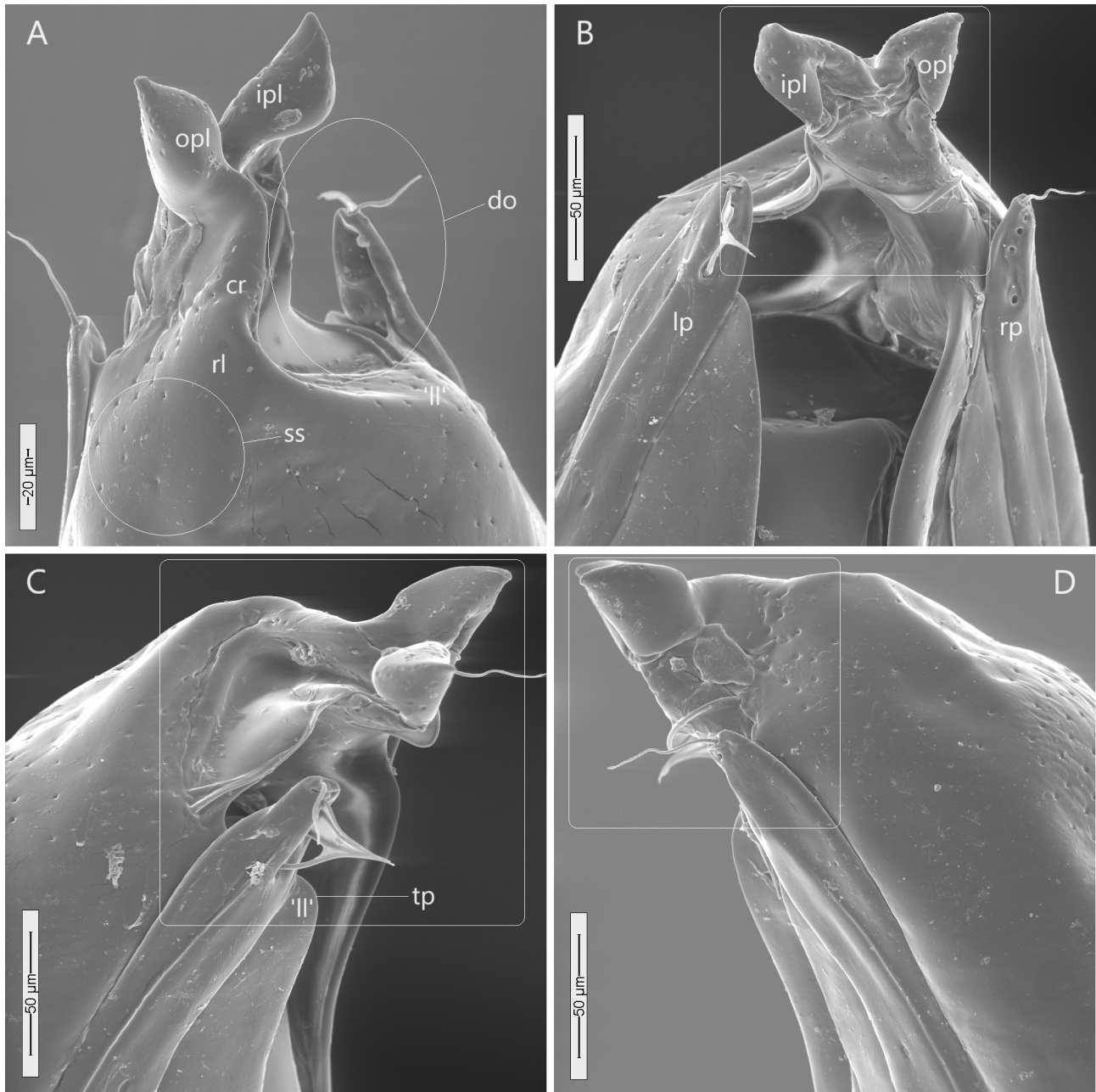
The dorsal opening ('do'—e.g., Fig. 86A) takes ~18% of the total length of the aedeagus and its inner margin is L-shaped.

The sensory structures are densely distributed and





**FIGURE 81.** *Adelopsis bifida* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12975. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.



**FIGURE 82.** *Adelopsis bifida* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12975. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White square in B is detailed in Figs. 83A (slightly rotated), B; white squares in C, D are detailed in Figs. 83C, D, respectively. cr = crest of right lobe; do = dorsal opening; ipl = inner plate of right lobe; ‘ll’ = left lobe absent; lp = left paramere; opl = outer plate of right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

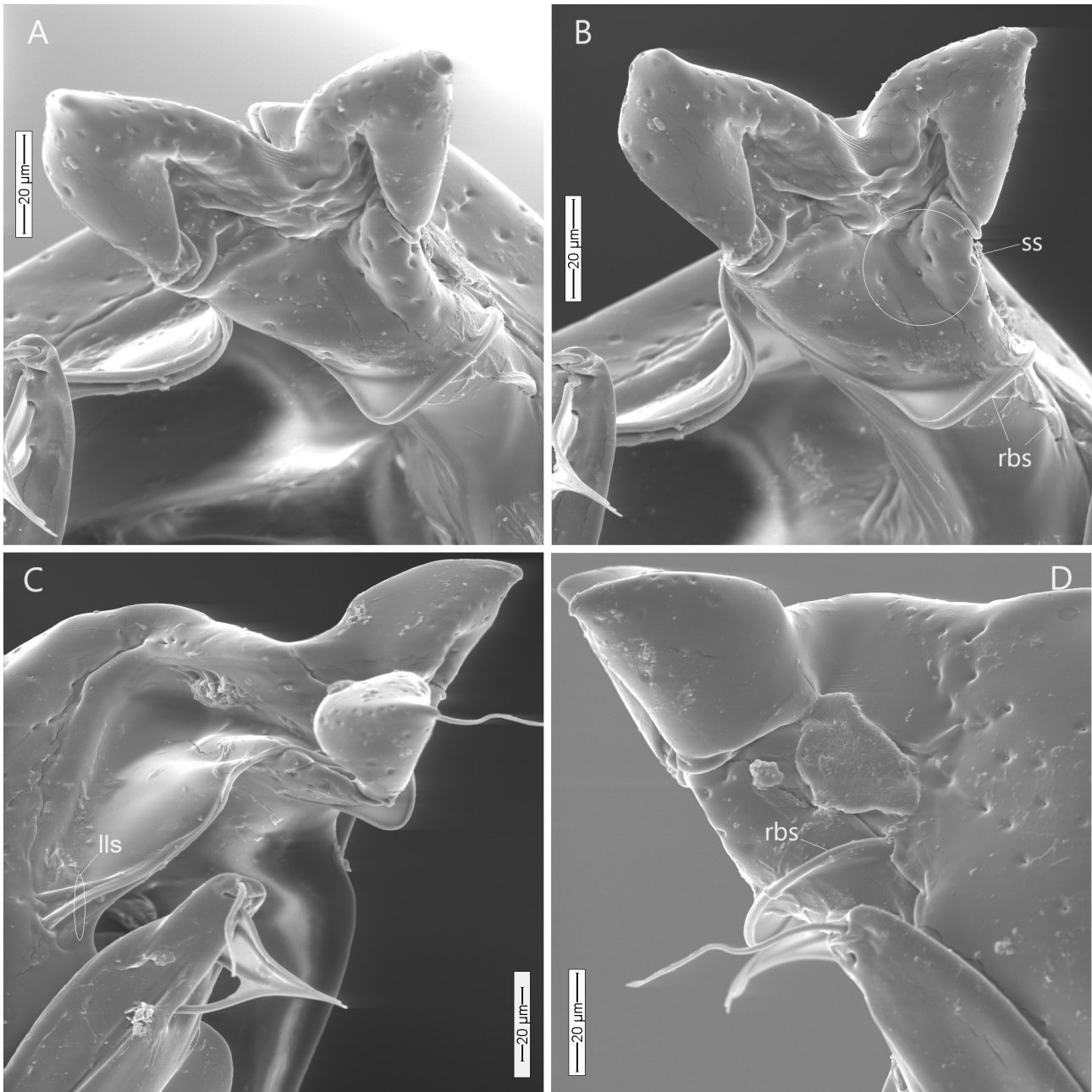
have a small dome-shaped projection (‘ss’—e.g., Fig. 87A); on the apical plates, in most cases, the dome cannot be observed and only a ‘pore’ can be observed (‘ss’—e.g., Fig. 87B).

The fused parameres can be recognized by the presence of a depression along their margins on their apical half, being imperceptible on their basal half (e.g., Fig. 85). They have the same length and their apical margin is round; there are five long setae placed aligned along the ventral margin near the apex, projecting ventrally (‘lp’ and ‘rp’—e.g., Figs. 86C, D).

The flagellum was originally described as ‘short and slightly sinuate’ (as in Gnaspini & Peck, 2001: figs. 97–99).

**Taxonomic remarks.** *Adelopsis bifida* and *A. capitanea* have a very similar aedeagus, with some differences that allow species recognition—for instance, the connection between the outer and inner plates of the right lobe is more abrupt in *A. bifida*; the ventral concavities of those plates is larger in *A. bifida*; and the presence of an internal fold on the inner plate of the right lobe is clearer in *A. capitanea*.





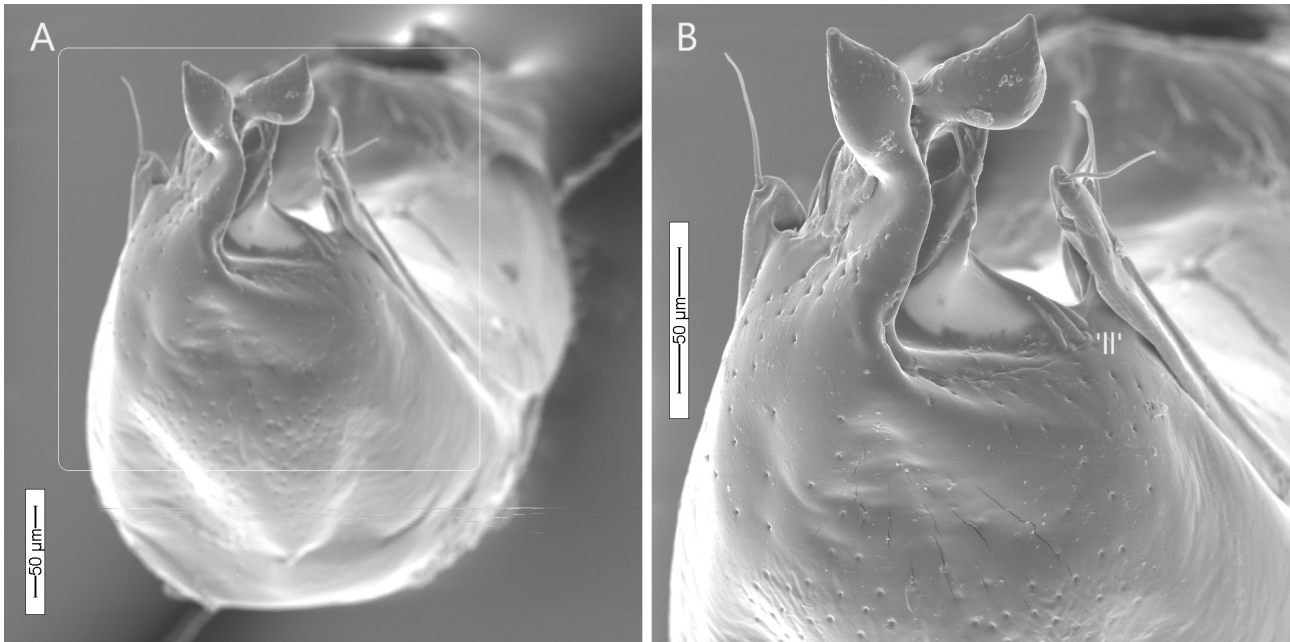
**FIGURE 83.** *Adelopsis bifida* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12975. **A–D**, Apex of aedeagus in ventral (A, B), left, and right views, respectively—detailed from Fig. 82. lls = setae on the ‘left lobe’; rbs = setae near the base of the right lobe; ss = sensory structure.

### ***Elephas* species group Gnaspini & Peck, 1996**

In dorsal view, the right lobe of the species in *elephas* species group is subtriangular (except in *A. dumbo*, in which the anteriormost margin of the dorsal opening is transversally produced), and narrows either into an ‘arm’ which gradually decreases in width posteriad, or more quickly into a narrow ‘crest’ (‘cr’). The inner face of the crest/arm goes ‘vertically’ down toward the internal region; and the external face may also go ‘vertically’ down or it may be wide and curved ventrad, depending on the species. The posteriormost, apical margin of the crest/arm may make either a sharp curve (perpendicularly, almost 90°, or diagonally, about 45–60°), abruptly

connecting with a ‘ventral face’ (‘vf’), or a continuous curve towards the body of the aedeagus; after which, at a ventral position, there is an opposite curve followed by a projection, forming a kind of ‘beak’ (‘bk’), with variable shape and length depending on the species. At the middle of the descending ‘ventral face’ or at the base of the ‘beak’, the internal surface of the right lobe projects internally, forming a projection (‘ear’), also with variable shape and length depending on the species. The apical surface of the ‘ear’ bears a group of probable sensory structures, shaped as a depression from the center of which emerges a small dome-shaped projection.

In lateral view, the right lobe (‘rl’) makes a long 90° curve ventrad (slightly curved or sharply curved, depending



**FIGURE 84.** *Adelopsis bifida* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12975. **A**, Aedeagus in frontal view of right lobe (white square is detailed in **B**). ‘ll’ = left lobe absent.

on the species); when the curve reaches the ventralmost position, there may be a sharp turn backwards, defining a ‘ventral face’ (‘vf’—see above), from which there is an opposite curve ventrad and the lobe narrows forming a ‘beak’ (‘bk’—see above), variably among species, or the curve may smoothly continue backwards and form a ‘beak’, depending on the species. On the internal margin of the external face of the right lobe, near the base of the beak (or at the middle of the external face, in *A. dybasi*), there are setae (‘rbs’), variably in number and position among the different species.

In all species in *elephas* species group, the dorsal opening is somewhat ample, being a little difficult to actually define its dimension in dorsal view, because its inner margin is diagonal or concave, because a typical left lobe is missing; but it can be recognized in left lateral view, where its inner margin is C-shaped.

### *Albipinna* species subgroup Gnaspini & Peck, 2019

#### *Adelopsis dybasi* Gnaspini & Peck, 1996

(Figs. 88–90)

*Adelopsis dybasi* Gnaspini & Peck, 1996: 415 (assignment to *elephas* species group); Salgado, 2015: 33; Gnaspini & Peck, 2019: 43 (assignment to *albipinna* species subgroup); Peck *et al.*, 2020: 49.

Holotype male in FMNH; 5 male and 10 female paratypes in FMNH, MZSP, SBPC.

Type locality: Finca Lerida, 6900’, near Boquete, Chiriquí Province, Panama.

Distribution: Panama: Chiriquí Province.

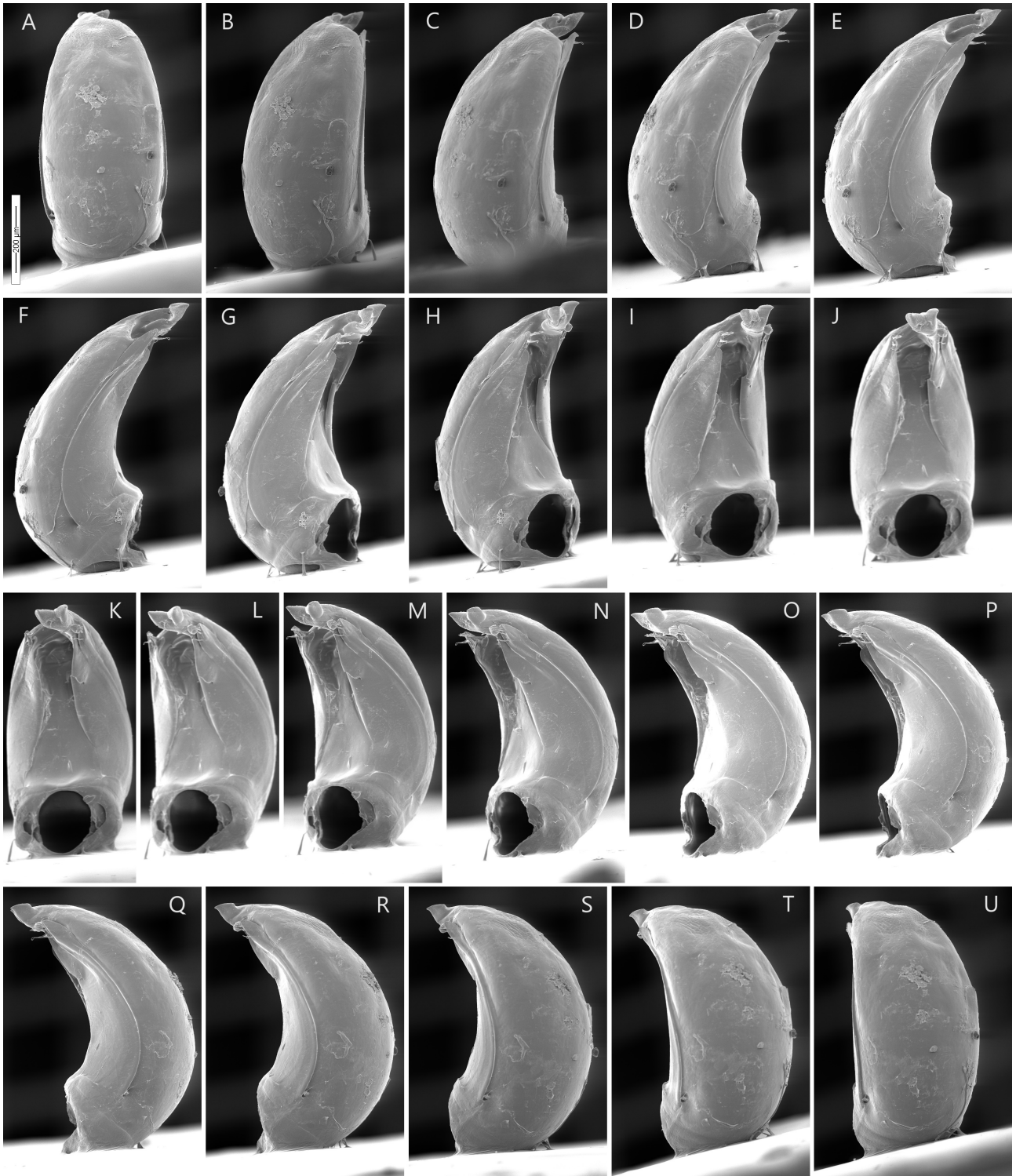
Size (original description): Length: 2.0–2.9 mm; width: 0.95–1.1 mm.

**Material examined. Paratypes:** PANAMA—**Chiriquí:**—Boquete, Finca Lerida; 7750 ft. a.s.l.; 17.III.1959; H.S. Dybas leg.; CNHM Panama Zoological Expedition (1959); forest litter, under palms; Labels: “Finca Lerida, near / Boquete, Chiriqui / Prov., PANAMA / March 17 1959” and “CNHM Panama / Zool. Exped. (1959) / III-17 1959 / H.S. Dybas leg.” and “alt. 7750 ft. / forest litter / under palms”; 2 males, MZSP 27002 (here illustrated), 27003 (marked with pink label ‘Figure’ referring to its use in original description) (out of 3 male and 2 female paratypes).

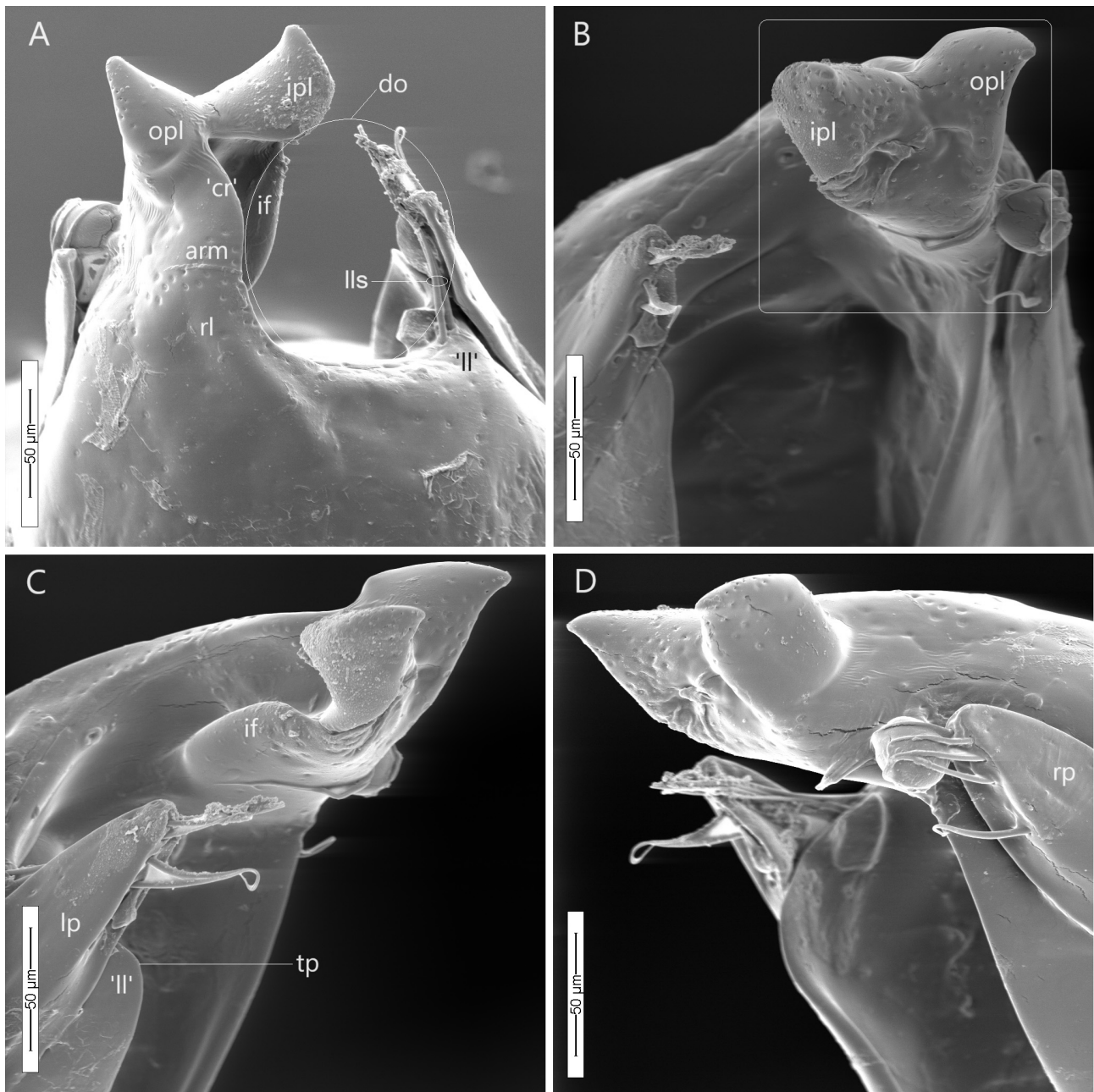
**Redescription of aedeagus.** Aedeagus elongate (l/w ~3.5, concavity ~60% or ~43% (disregarding the ‘beak’) [Figs. 88E, P]), basal opening almost 90° downwards; width a little bigger than height, widest near base (e.g., Fig. 88).

Right lobe (‘rl’—e.g., Fig. 89A) slowly narrowing into a ‘crest’ (‘cr’—e.g., Fig. 89C) with a wide external face; the apical margin of the crest abruptly connects perpendicularly (almost 90°) with a ‘ventral face’ (‘vf’), which makes an opposite, long, 90° curve, forming a ‘beak’ (‘bk’) (e.g., Figs. 89C, D), which is very long and narrow in lateral view; in frontal view (e.g., Fig. 89C), from its connection with the ‘crest’, the ‘ventral face’ widens towards the left side, achieving its widest condition near the base of the ‘beak’, from which place the margins of the beak converge to the pointy apex, forming a long, subtriangular ‘beak’. At the middle of the descending ‘ventral face’, the internal surface of the right lobe has a wide, flat and somewhat long projection (‘ear’—e.g., Figs. 89A, C, D), and is curved towards the dorsal surface of the aedeagus. Ratio ear/beak = 33% (e.g., Fig. 89C). In lateral view, the right lobe makes a long 90° curve ventrad (‘rl’—e.g., Fig. 89D). External face of right lobe with one long seta, projecting ventrad (‘rbs’—e.g., Fig. 89E).





**FIGURE 85.** *Adelopsis capitanea* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12965. A–U, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.



**FIGURE 86.** *Adelopsis capitanea* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12965. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—A is detailed from Fig. 87A. White square in B is detailed in Fig. 87B. arm = arm of the right lobe; ‘cr’ = ‘crest’ of right lobe, not clear; do = dorsal opening; if = internal fold; ipl = inner plate of right lobe; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rl = right lobe; opl = outer plate of right lobe; rp = right paramere; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

A left lobe is ‘absent’ (“‘ll’”—e.g., Figs. 89A, D); the ‘turning point’ is just dorsal to the left paramere (‘tp’—e.g., Fig. 90C); three elongate setae are placed midway to the ‘turning point’ (‘lls’—e.g., Fig. 89D).

The dorsal opening (‘do’—e.g., Figs. 89A, 90C) takes ~16% of the total length of the aedeagus and its inner margin is a long concave 90° curve.

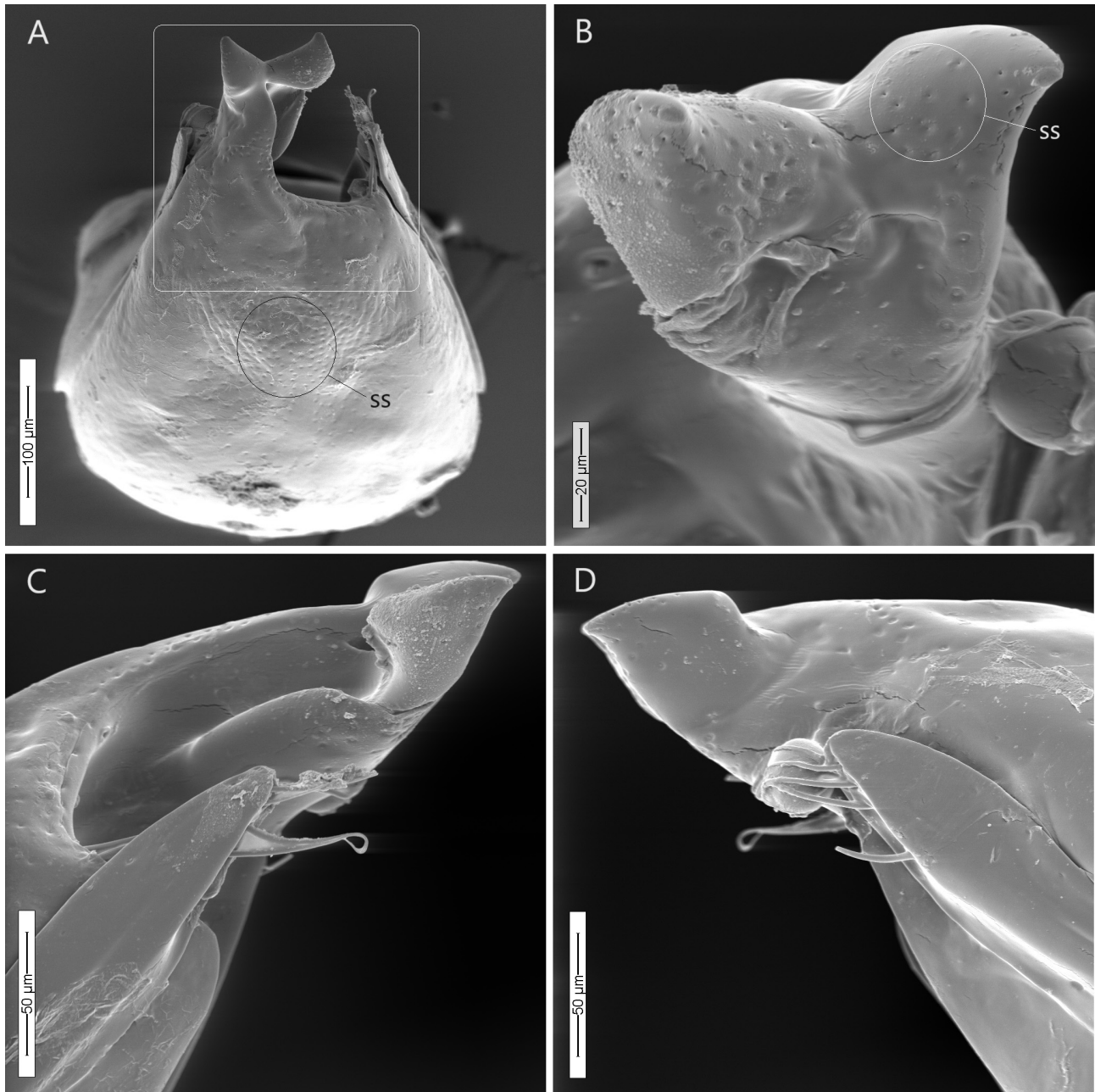
The sensory structures have a shallow depression with a small dome-shaped projection (‘ss’—e.g., Fig. 89D), and concentrate on the frontal and lateral faces of the apical projection (‘ventral face’ and ‘beak’) (‘ss’—e.g., Fig. 90D).

The parameres are wide, with a wider base;

the placement of the fusion to the aedeagus body is imperceptible, except in a few cases where it can be recognized by the presence of a depression; their very tip are free (e.g., Fig. 88). The left paramere (‘lp’) is somewhat shorter than the right paramere (‘rp’) (e.g., Figs. 89D, E). In both parameres, the apex is round and its subapical ventral margin is truncated and bears three long setae, projecting ventrad (e.g., Figs. 89D, E).

The flagellum (‘fl’—e.g., Fig. 89D) is thin, and the figures in the original description show it to be long, with width decreasing from base towards apex (as in Gnaspini & Peck, 1996: figs. 70–72).





**FIGURE 87.** *Adelopsis capitanea* Gnaspini & Peck, 2001 (*capitanea* species group), male paratype MZSP 12965. **A**, Aedeagus in frontal view of right lobe. **B–D**, Apex of aedeagus in ventral, left, and right views, respectively. White square in A is detailed in Fig. 86A. C and D are slight rotated in relation to Figs. 86C and D, respectively. ss = sensory structure.

**Taxonomic remarks.** *Adelopsis dybasi* can be recognized by having an elongate, thin ‘beak’ and a volumous backward ‘ear’.

***Adelopsis howdenorum* Gnaspini & Peck, 1996**  
(Figs. 91–94)

*Adelopsis howdenorum* Gnaspini & Peck, 1996: 423 (assignment to *elephas* species group); Salgado, 2011: 439; Gnaspini & Peck, 2019: 44 (assignment to *albipinna* species subgroup); Peck *et al.*, 2020: 49.

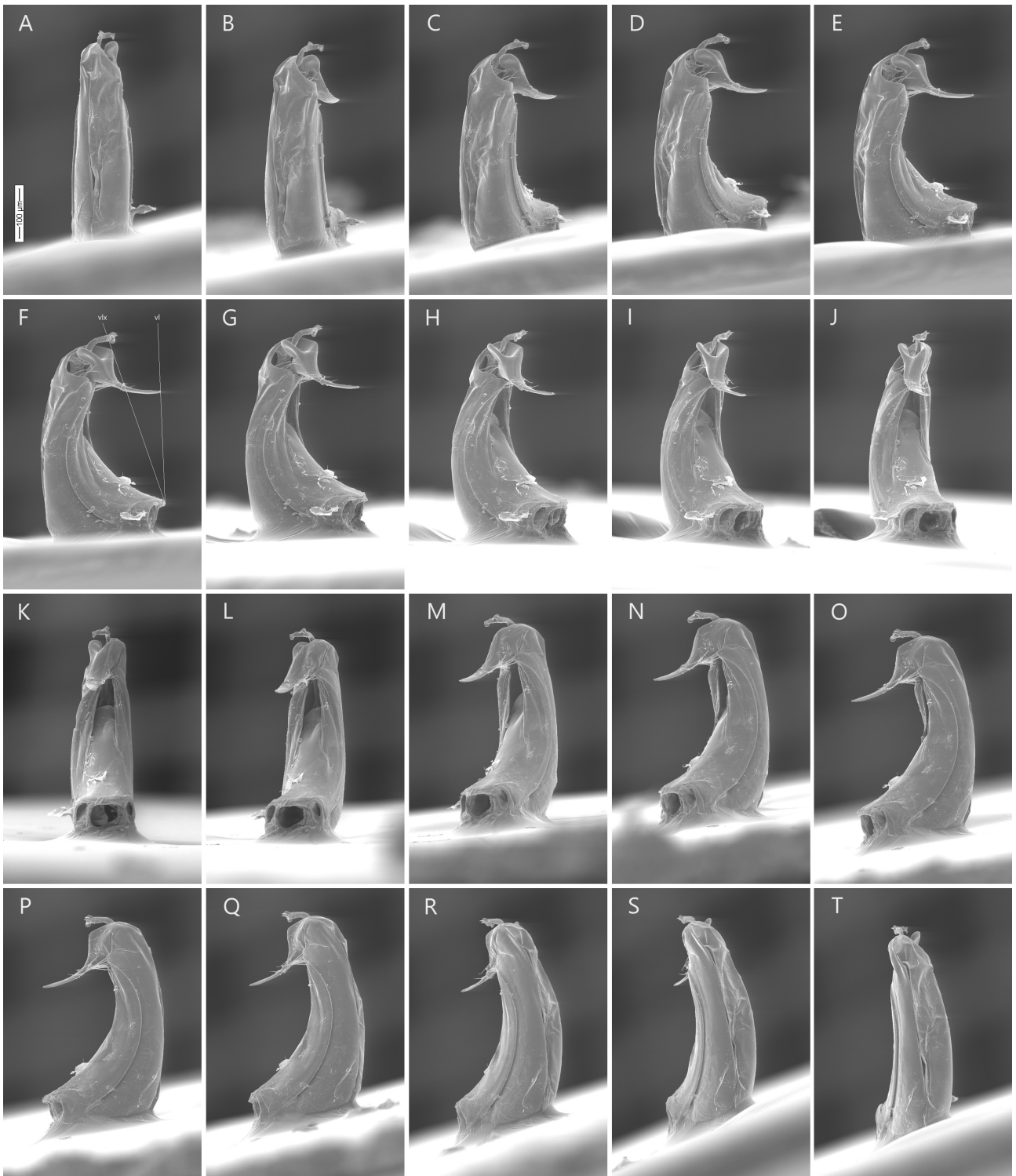
Holotype male in SBPC [now in CMNC]; 16 male and 14 female paratypes in MZSP, SBPC.

Type locality: Monte Verde, 1700 m, Puntarenas Province, Costa Rica.

Distribution: Costa Rica: Puntarenas and Cartago Provinces; Panama: Chiriquí Province.

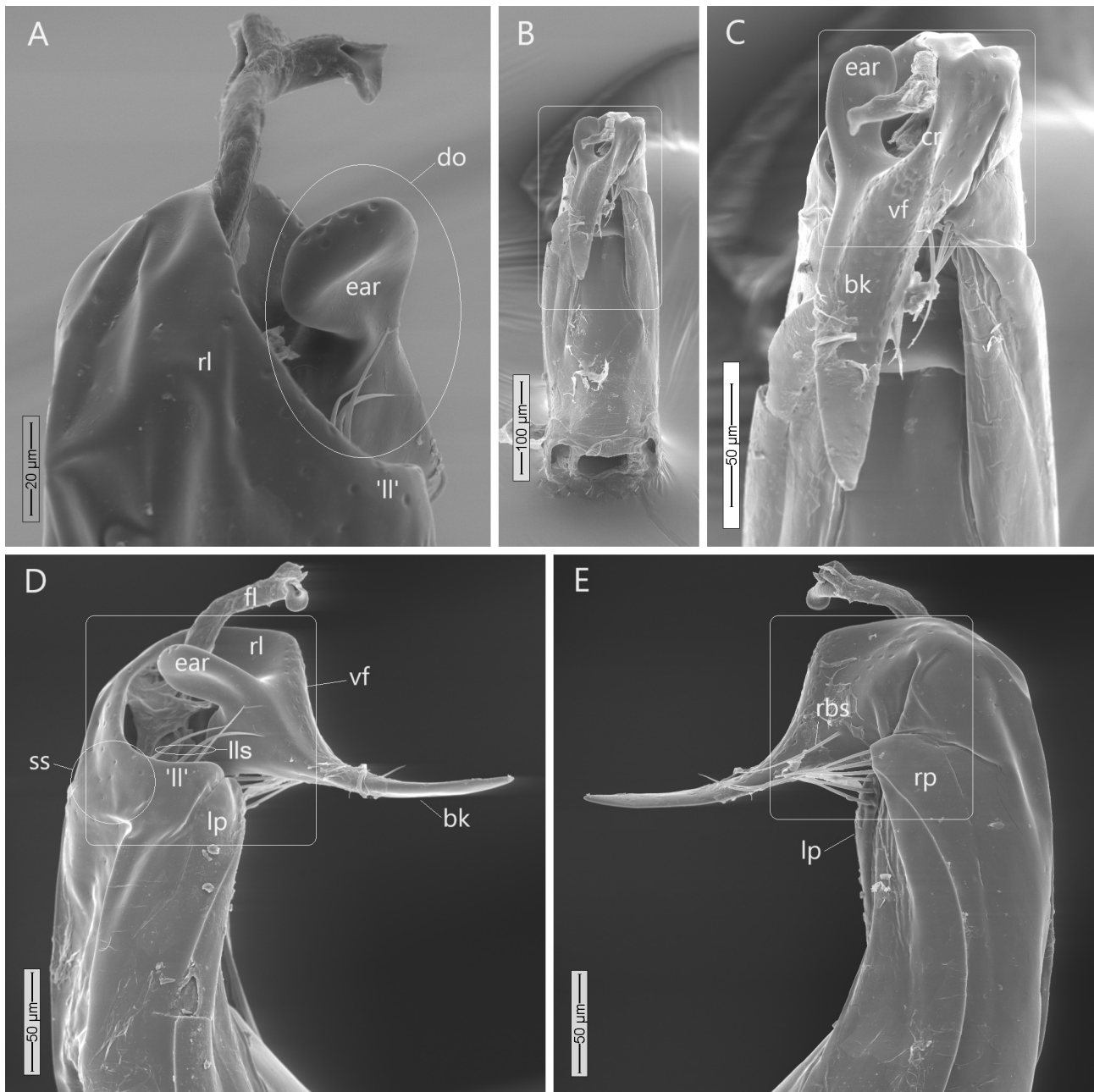
Size (original description): Length: 2.15–2.6 mm; width: 1.15–1.4mm.

**Material examined. Paratypes:** COSTA RICA—**Puntarenas:**—Monte Verde; 1400m a.s.l.; 24.V.1979; H. & A. Howden leg.; Label: “C. R. Punt. / Monte Verde 1400m / 24.v.1979 / H&A Howden”; 2 males, MZSP 12991, 12992 (here illustrated; marked with pink label ‘Figure’ referring to its use in original description) (out of 3 male and 4 female paratypes).



**FIGURE 88.** *Adelopsis dybasi* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 27002. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. ‘vl’ denotes the ‘ventral line’ used to align images to make morphometric measurements, and ‘vlx’ denotes the ‘ventral line’ used when the ‘beak’ of the aedeagus is disregarded in the morphometric measurements (see text for details).



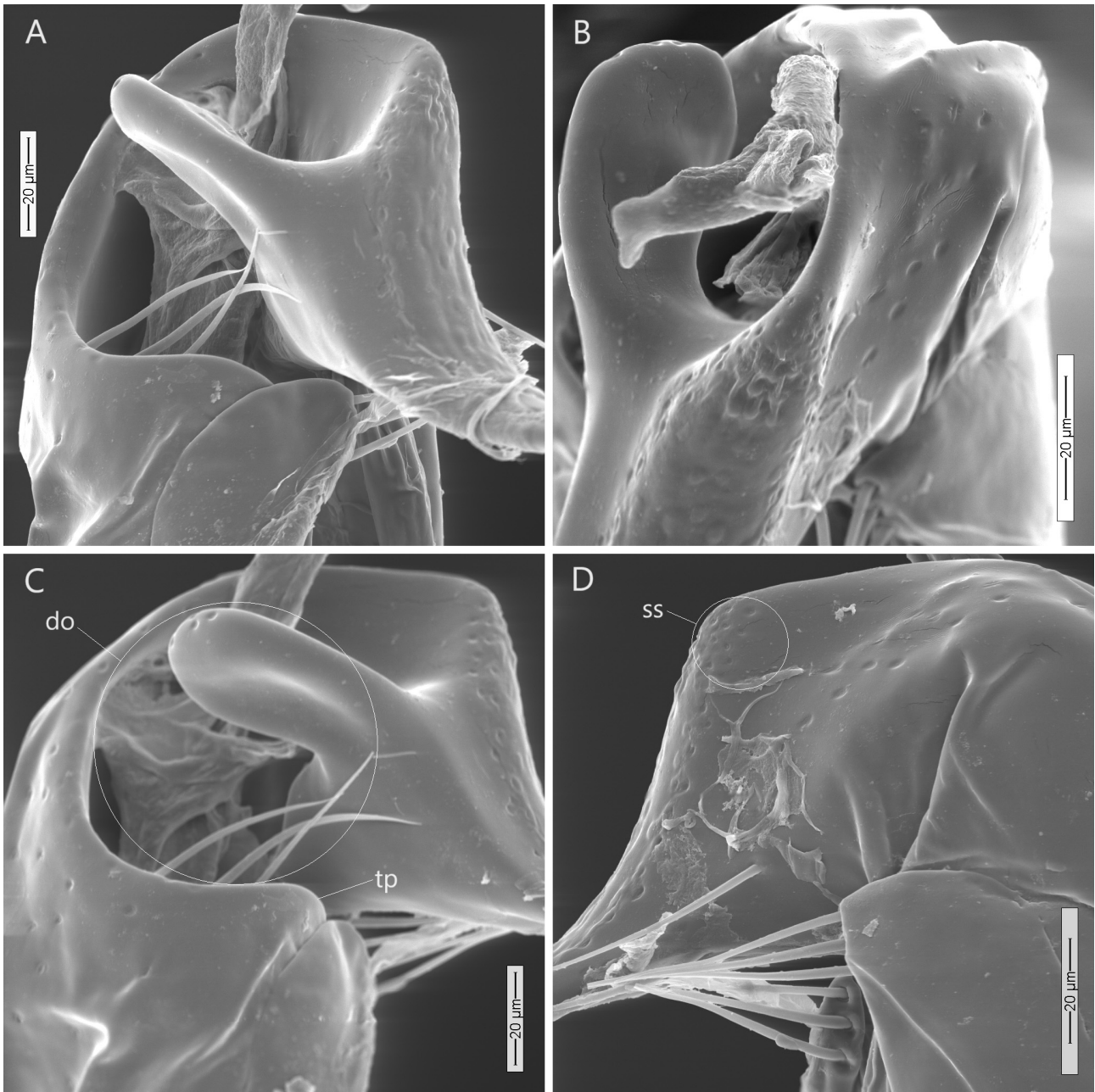


**FIGURE 89.** *Adelopsis dybasi* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 27002. **A, D–E**, Apex of aedeagus in dorsal, left, and right views, respectively. **B**, Aedeagus in frontal view of right lobe (white rectangle is detailed in **C**). White squares in **C, D, E** are detailed in Figs. 90B, C, D, respectively. bk = ‘beak’; cr = crest of right lobe; do = dorsal opening; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; vf = ‘ventral face’ of the right lobe.

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~2.7, concavity ~46–50% or ~30–32% (disregarding the ‘beak’) [Figs. 91D, P]), basal opening almost 90° downwards; width a little bigger than height, widest about halfway from base (e.g., Fig. 91).

Right lobe (‘rl’—e.g., Fig. 92A) slowly narrowing into a ‘crest’ (‘cr’—e.g., Fig. 94B) with ‘vertical’ inner and outer faces; the apical margin of the crest connects with an oblique (about 45°) ‘ventral face’ (‘vf’), which makes an opposite oblique (about 45°) curve, forming a ‘beak’ (‘bk’) (e.g., Fig. 92C), which is long and narrow

in lateral view; in frontal view (e.g., Fig. 94B), the ‘crest’ is sinuose, crossing from the right to the left side of the aedeagus, and the ‘ventral face’ has subparallel sides; from its connection with the ‘ventral face’, the ‘beak’ widens, reaching its widest width at its midlength, and narrows again towards its pointy apex, therefore shaping as a ‘diamond’. At the middle of the descending ‘ventral face’, the internal surface of the right lobe has a short, round projection (‘ear’—e.g., Figs. 92C, 94B), which apical sensory structures have a small depression. Ratio ear/beak = 28% (e.g., Fig. 94B). In lateral view, the right



**FIGURE 90.** *Adelopsis dybasi* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 27002. A–D, Apex of aedeagus in ventro-lateral, ventral, left, and right views, respectively—B–D are detailed from Figs. 89C–E. do = dorsal opening; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

lobe makes a long 90° curve ventrad ('rl'—e.g., Fig. 92C). External face of right lobe with three long setae, projecting outward ('rbs'—e.g., Fig. 94B).

A left lobe is 'absent' ("ll"—e.g., Fig. 92C); the 'turning point' is just under the left paramere ('tp'—e.g., Fig. 92B); (at least) two elongate setae are placed midway to the 'turning point' ('lls'—e.g., Fig. 94B).

The dorsal opening ('do'—e.g., Fig. 92C) takes ~23% of the total length of the aedeagus and its inner margin is diagonal.

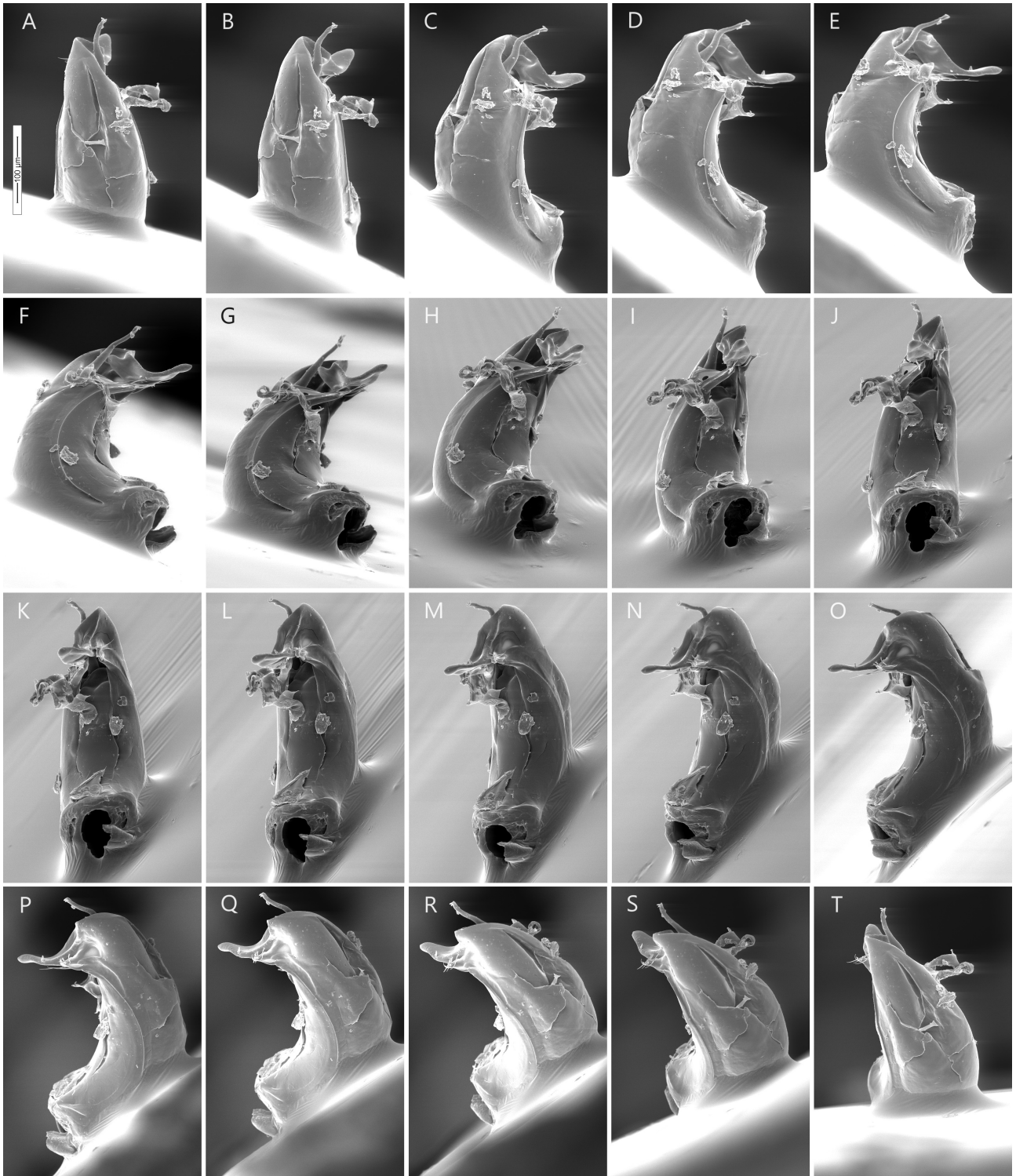
The sensory structures have a small depression with a small dome-shaped projection ('ss'—e.g., Fig. 92A), and concentrate on the frontal and lateral faces of the apical

projection ('ventral face' and 'beak') ('ss'—e.g., Fig. 94B).

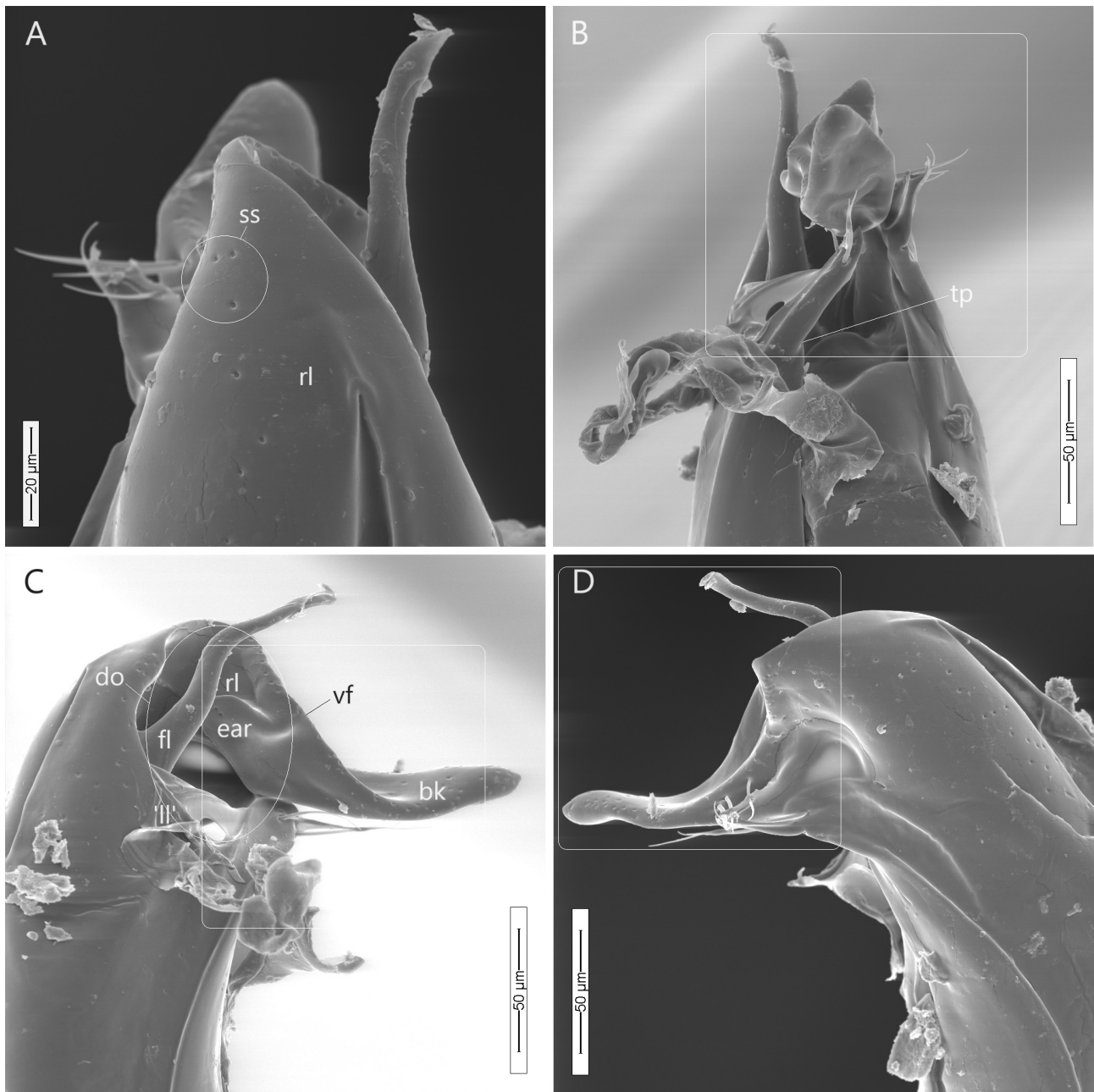
The parameres are wide at base, with slowly decreasing width towards their apex; the placement of the fusion to the aedeagus body is imperceptible, except in a few cases where it can be recognized by the presence of a depression, for instance along the dorsal margin of the left paramere; their apex are free (e.g., Fig. 91). The left paramere ('lp') is somewhat shorter than the right paramere ('rp') (e.g., Fig. 94C). In both parameres, the apex is round and bears three long setae, projecting outwards (e.g., Figs. 93C, 94C).

The flagellum ('fl'—e.g., Fig. 92C) seems to be thin,





**FIGURE 91.** *Adelopsis howdenorum* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 12992. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.



**FIGURE 92.** *Adelopsis howdenorum* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albinpinna*), male paratype MZSP 12992. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in B, C, D are detailed in Figs. 93B, C, D, respectively. bk = ‘beak’; do = dorsal opening; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; rl = right lobe; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description); vf = ‘ventral face’ of the right lobe.

with width decreasing from base towards apex, as in the figures in the original description (as in Gnaspini & Peck, 1996: figs. 111–113, in which it is somewhat long).

**Taxonomic remarks.** See discussion under *A. rostrata*.

***Adelopsis rostrata* Gnaspini & Peck, 1996**  
(Figs. 95–97)

*Adelopsis rostrata* Gnaspini & Peck, 1996: 427 (assignment to *elephas* species group); Salgado, 2011: 439; Salgado, 2013b:

73; Gnaspini & Peck, 2019: 44 (assignment to *albinpinna* species subgroup); Peck *et al.*, 2020: 49.

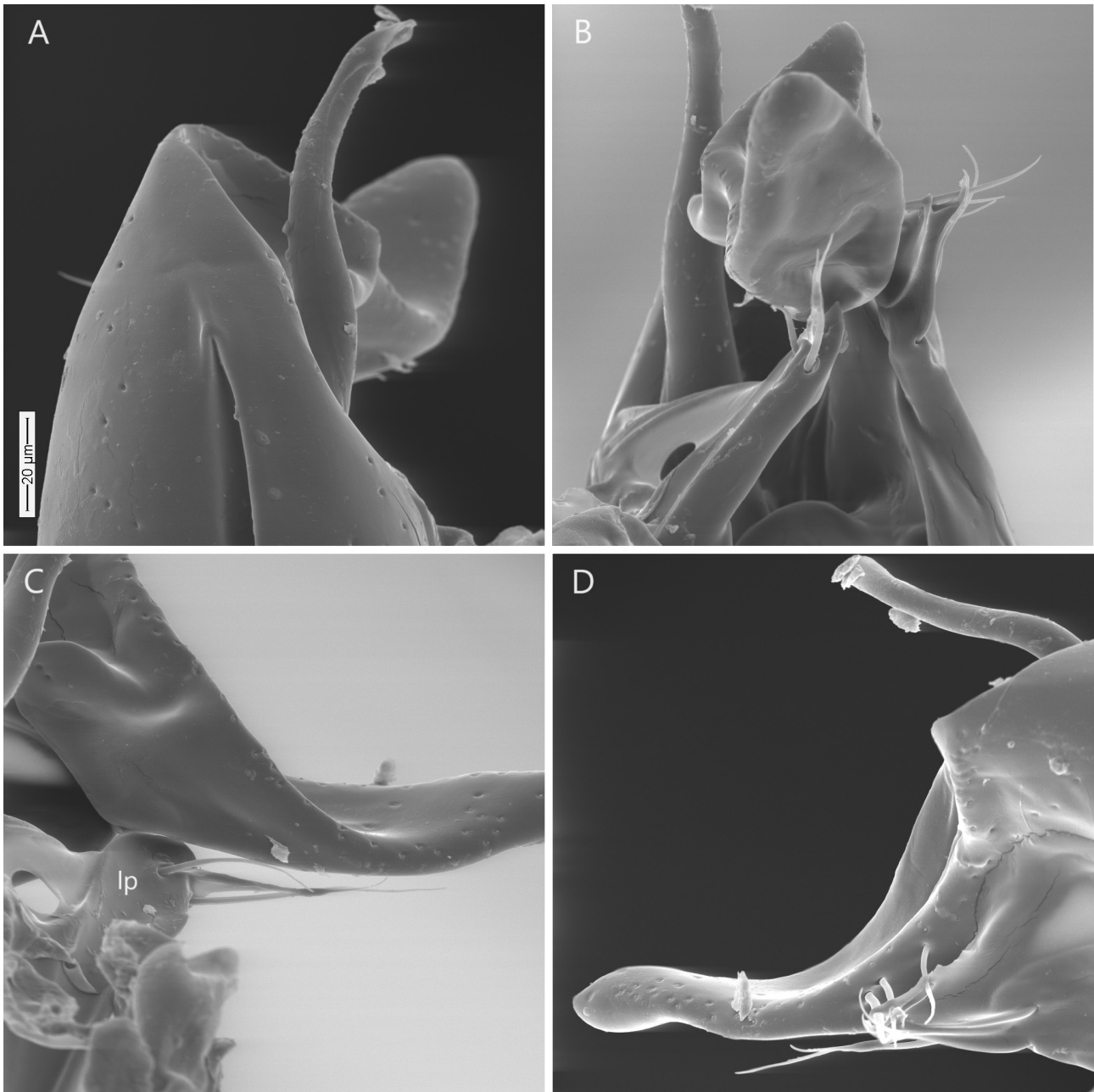
Holotype male in SBPC [now in CMNC]; 12 male and 12 female paratypes in MZSP, SBPC.

Type locality: Monte Verde, 1500 m, Puntarenas Province, Costa Rica.

Distribution: Costa Rica: Alajuela, Cartago, Heredia, and Puntarenas Provinces; Ecuador: Pichincha Province; Panama: Bocas del Toro, Chiriquí, and Panamá Provinces.

Size (original description): Length: 2.1–2.7 mm; width: 1.05–1.3 mm.





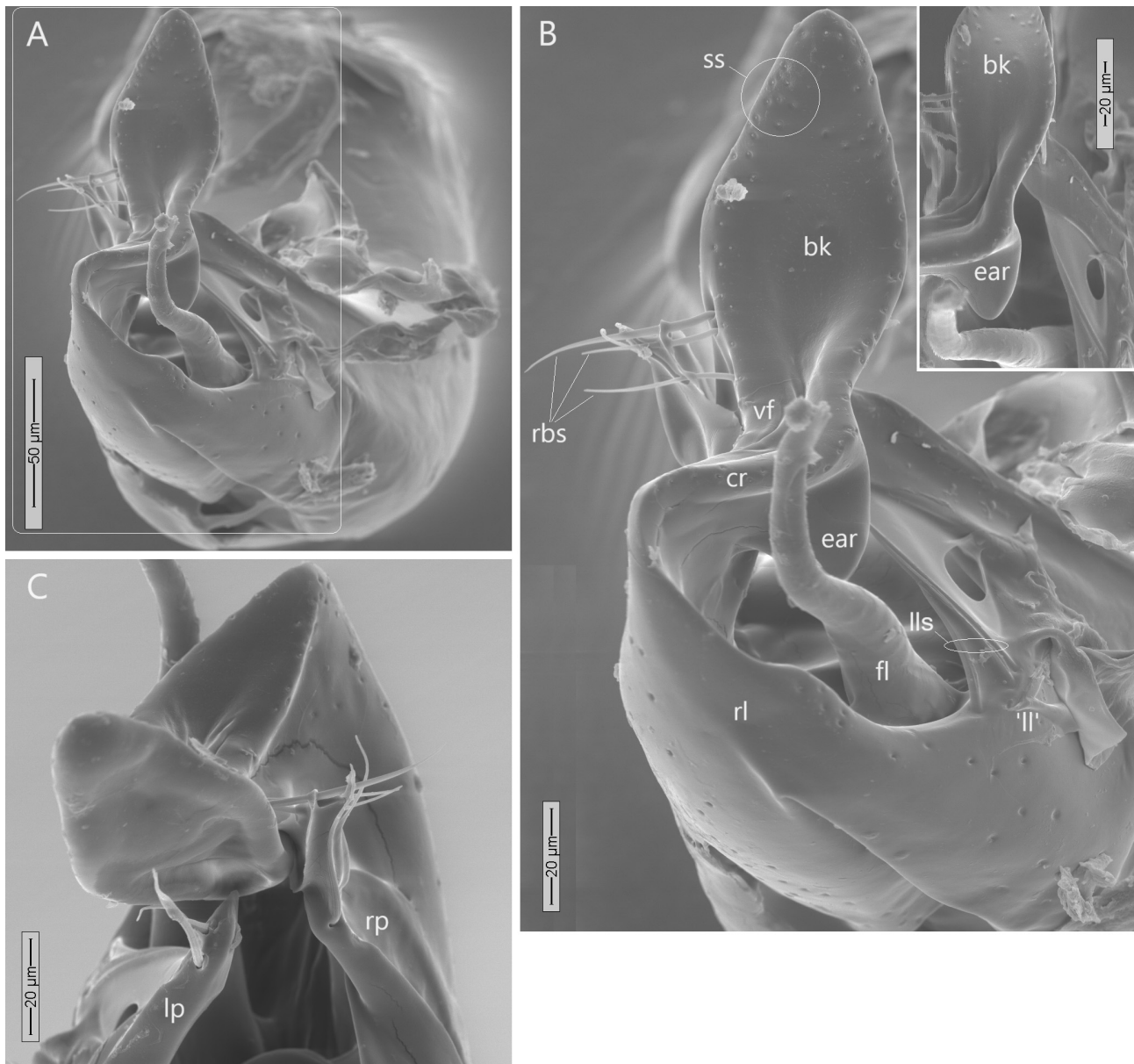
**FIGURE 93.** *Adelopsis howdenorum* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 12992. A–D, Apex of aedeagus in dorsal, ventral, left, and right views, respectively—A is slightly rotated in relation to Fig. 92A; B–D are detailed from Figs. 92B–D. lp = left paramere.

**Material examined. Paratypes:** COSTA RICA—**Puntarenas:**—Monte Verde Reserve; 1700m a.s.l.; 01.VI.1979; H. & A. Howden leg.; cuptraps, 3 days; Label: “C. R. Punt. / Monte Verde Reser. / 1700m 1.VI.1979 / cuptrps. 3 days / H&A Howden”; 2 males, MZSP 27128, 27130 (here illustrated) (out of 3 male and 5 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat elongate (l/w ~3.1, concavity ~49–51% or ~35–36% (disregarding the ‘beak’) [Figs. 95F, R]), basal opening almost 90° downwards; width as big as height, widest near base (e.g., Fig. 95).

Right lobe (‘rl’—e.g., Fig. 96A) posterior surface forms a wide, not well defined ‘crest’ (‘cr’—e.g., Fig.

97E) with a wide external face; the apical margin of the crest has an elevation (e.g., Fig. 96D, inset) and connects with an oblique (about 45°) ‘ventral face’ (‘vf’), which makes an opposite oblique (but less than 45°) curve, forming a ‘beak’ (‘bk’) (e.g., Fig. 96C), which is long and narrow in lateral view; in frontal view (e.g., Fig. 97E), the ‘crest’ is sinuose, crossing from the right to the left side of the aedeagus, and the ‘ventral face’ has subparallel sides, which continue on a ‘beak’ with subparallel sides, narrowing only near the pointy apex. At the middle of the descending ‘ventral face’, the internal surface of the right lobe has a short, round projection (‘ear’—e.g., Figs. 96C, 97E—no sensory structure could be detected on it). Ratio ear/beak = 11% (e.g., Fig. 97E). In lateral view, the right



**FIGURE 94.** *Adelopsis howdenorum* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 12992. **A**, Aedeagus in frontal view of right lobe (white rectangle is detailed in **B**—inset shows a slightly rotated view in which the ‘ear’ can be viewed in full). **C**, Apex of aedeagus in ventral view (slightly rotated in relation to Fig. 93B). bk = ‘beak’; cr = crest of right lobe; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; vf = ‘ventral face’ of the right lobe.

lobe makes a long 90° curve ventrad (‘rl’—e.g., Fig. 96C). External face of right lobe with two long setae, projecting forward (‘rbs’—e.g., Fig. 96D).

A left lobe is ‘absent’ (‘ll’—e.g., Fig. 96C); the ‘turning point’ is just under the left paramere (‘lp’—e.g., Fig. 96C); three elongate setae are placed far from the ‘turning point’ (‘lls’—e.g., Fig. 96C).

The dorsal opening (‘do’—e.g., Figs. 96A, C) takes ~23% of the total length of the aedeagus and its inner margin is slightly concave.

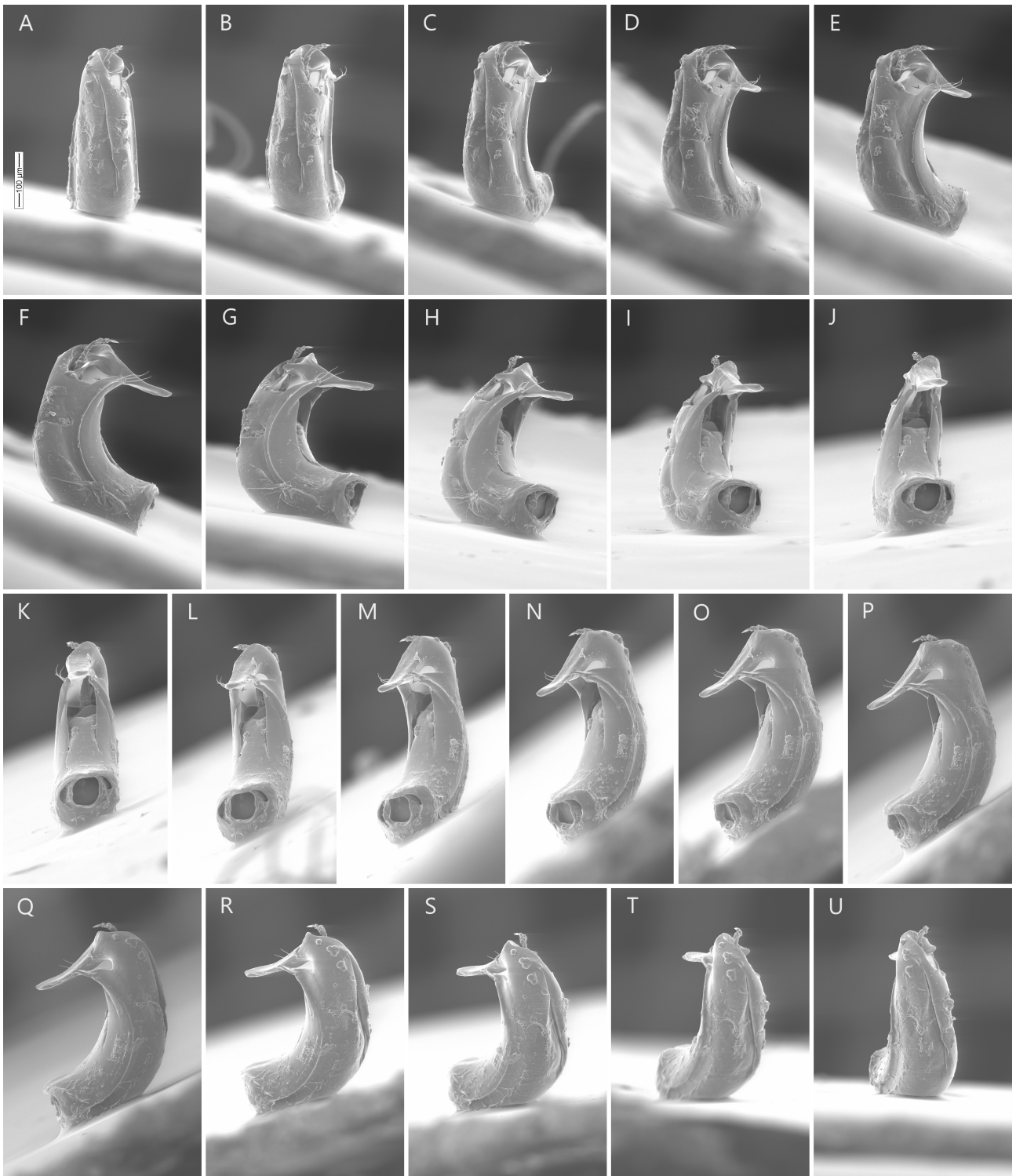
The sensory structures have a small depression with a small dome-shaped projection (‘ss’—e.g., Fig. 96A), and concentrate on the frontal and lateral faces of the

apical projection (‘ventral face’ and ‘beak’), where they have a shallow depression with a dome-shaped projection (‘ss’—e.g., Fig. 97E).

The somewhat wide fused parameres can be recognized by the presence of a depression along the length of the left paramere, but is mostly imperceptible on the right paramere; their apex are free (e.g., Fig. 95). The parameres have the same length (‘lp’ and ‘rp’—e.g., Fig. 96B) and a round apex, which bears three long setae, projecting forward, two of them at the apical margin and the third one placed a little behind (e.g., Figs. 96C, D).

The flagellum (‘fl’—e.g., Fig. 96C) seems to be thin—it was not mentioned in the original description,



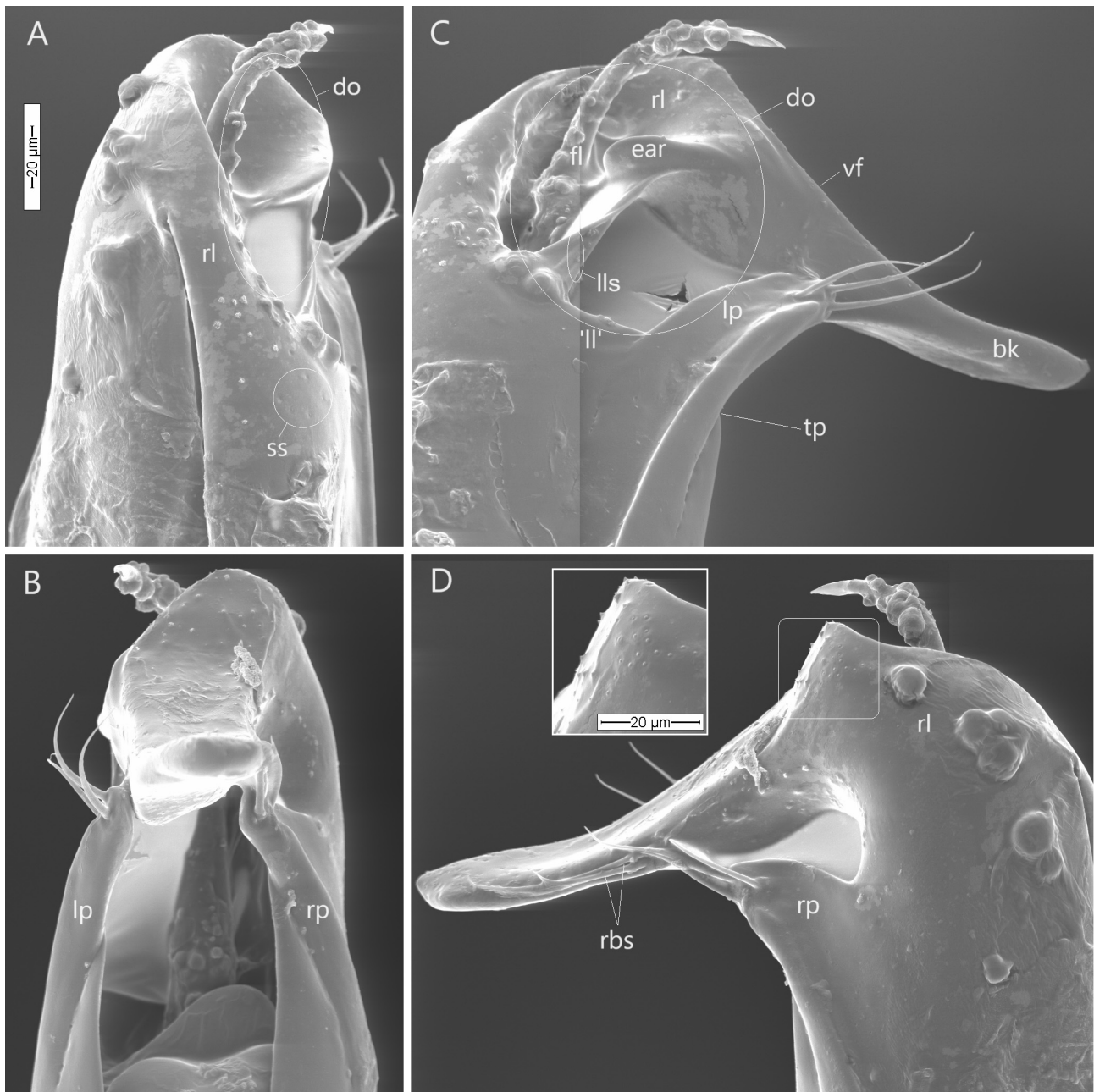


**FIGURE 95.** *Adelopsis rostrata* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 27130. A–U, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.

which figures show it to be long and thin, with width decreasing from base towards apex (as in Gnaspini & Peck, 1996: figs. 149–151).

**Taxonomic remarks.** In their original description, Gnaspini & Peck (1996) discussed that *A. howdenorum* and *A. rostrata* are very difficult to tell apart. However,

here, we recognized them especially using the morphology of the beak—in *A. rostrata*, it seems a little shorter, with a less pronounced curvature, in lateral view, and, in frontal view, it can be recognized that the beak has subparallel sides, instead of having a widening at the middle (shaping as a ‘diamond’) as occurs in *A. howdenorum*.



**FIGURE 96.** *Adelopsis rostrata* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 27130. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively (white square in D is detailed in inset). bk = ‘beak’; do = dorsal opening; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description); vf = ‘ventral face’ of the right lobe.

### *Elephas* species subgroup Gnaspini & Peck, 2019

#### *Adelopsis calarcensis* Gnaspini & Peck, 2001 (Figs. 98–100)

*Adelopsis calarcensis* Gnaspini & Peck, 2001: 437 (assignment to *elephas* species group); Salgado, 2010: 214 (as *carcelensis* [sic]); Gnaspini & Peck, 2019: 44 (assignment to *elephas* species subgroup); Peck *et al.*, 2020: 50.

Holotype male in SBPC [now in CMNC]; 15 male and 21 female paratypes in FMNH, MNHN, MZSP, SBPC.

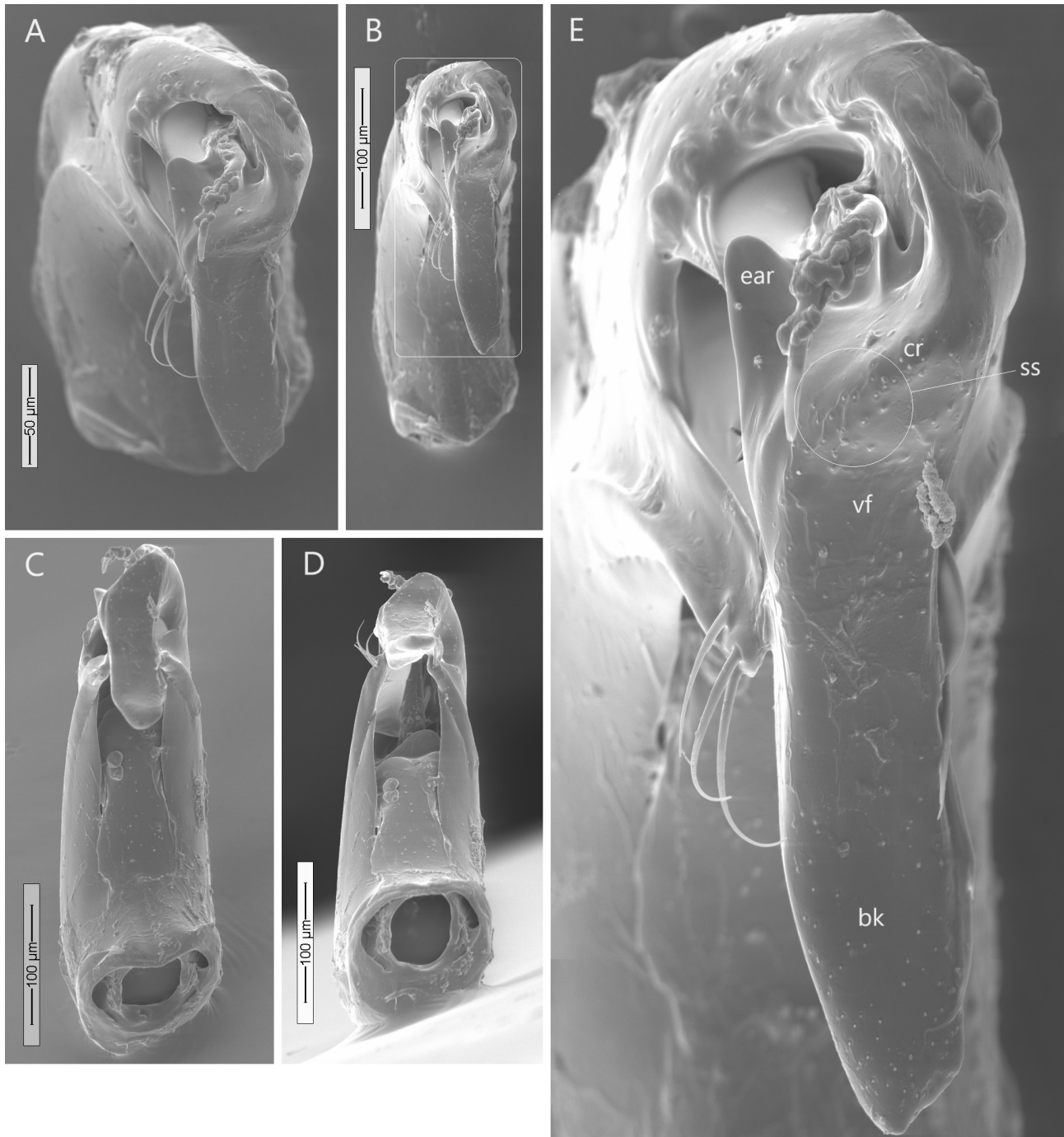
Type locality: 11–23 km E Calarcá, 7–10000’, Quindío Department, Colombia.

Distribution: Colombia: Quindío Department: known only from vicinity of type locality.

Size (original description): Length: 2.85–3.65 mm; width: 1.35–1.75 mm.

**Material examined. Paratypes:** COLOMBIA—**Quindío:**—21 km E Calarcá; 10000’ a.s.l.; 06–11.III.1974; S.B. Peck leg.; Sardines; Label: “Colombia: Quindio / 21 km E Calarcá, 10000’ / 06–11.III.1974, Sardines / S.B.





**FIGURE 97.** *Adelopsis rostrata* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *albipinna*), male paratype MZSP 27130. **A–D**, Aedeagus in frontal view of right lobe, with slight rotation towards base, following the ‘sagittal’ plane of the aedeagus (reaching ventral view in D), in order to show the influence of the view in the recognition of the aedeagal shape (white rectangle in B is detailed in E.). bk = ‘beak’; cr = crest of right lobe; ear = internal projection of the right lobe; ss = sensory structure; vf = ‘ventral face’ of the right lobe.

Peck”; 2 males, MZSP 12973, 12974 (here illustrated) (out of 3 male and 4 female paratypes).

**Redescription of aedeagus.** Aedeagus elongate (l/w ~3.6, concavity ~50–52% or ~39–40% (disregarding the ‘beak’) [Figs. 98F, P]), basal opening around 45° downwards; width a little smaller than height, widest near base (e.g., Fig. 98).

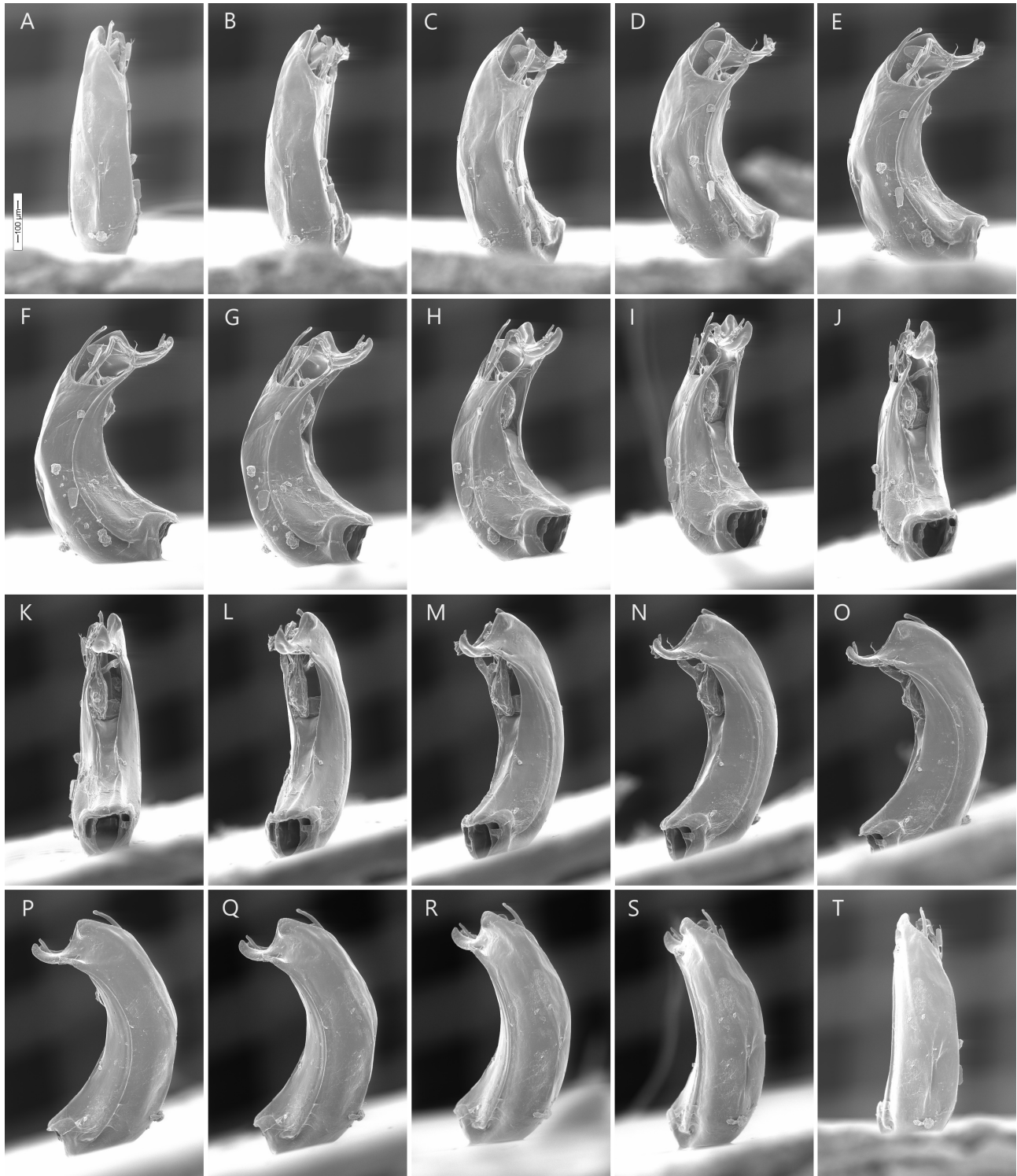
Right lobe (‘rl’—e.g., Fig. 99A) slowly narrowing into a ‘crest’ (‘cr’—e.g., Fig. 100A) with ‘vertical’ inner

and outer faces; the apical margin of the crest connects with an oblique (about 45°) ‘ventral face’ (‘vf’), which makes an opposite oblique curve, forming a ‘beak’ (‘bk’) (e.g., Fig. 99D), which is long and somewhat narrow in lateral view, and keeps a curve posteriad, reaching back about half the ‘height’ of the ‘ventral face’; in frontal view (e.g., Fig. 100A), the ‘ventral face’ is diagonal, crossing from the right to the left side of the aedeagus, and it is followed by the ‘beak’, which widens to both

sides of its connection with the ‘ventral face’, and slightly narrows towards its pointy apex, having a subtriangular shape. At the middle of the descending ‘ventral face’, the internal surface of the right lobe has a somewhat elongate and narrow projection (‘ear’—e.g., Figs. 99C, 100A—no sensory structure could be detected on it). Ratio ear/beak = 47% (e.g., Fig. 100A), but the beak is longer in lateral

view, because it is curved upward (e.g., Fig. 99D). In lateral view, the right lobe makes a long 90° curve ventrad (‘rl’—e.g., Fig. 99C). External face of right lobe with at least one long seta, projecting outward (‘rbs’—e.g., Fig. 99B).

A left lobe is ‘absent’ (“ll”—e.g., Fig. 99C); the ‘turning point’ is just under the left paramere (‘tp’—e.g.,



**FIGURE 98.** *Adelopsis calarcensis* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 12974. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.



Fig. 99C); (at least) four elongate setae are placed midway to the ‘turning point’ (‘lls’—e.g., Fig. 99C).

The dorsal opening (‘do’—e.g., Figs. 99A, C) takes ~24% of the total length of the aedeagus and its inner margin is diagonal.

The sensory structures have a shallow depression (‘ss’—e.g., Fig. 99A), and concentrate on the frontal and lateral faces of the apical projection (‘ventral face’ and ‘beak’), where they are generally deeper, with a smaller dome-shaped projection (‘ss’—e.g., Fig. 99D).

The parameres are wide at base, slowly decreasing width towards their apex; the placement of the fusion to the aedeagus body is imperceptible, except in a few cases where it can be recognized by the presence of a depression; their apex are free (e.g., Fig. 98). The left paramere (‘lp’) is somewhat longer than the right paramere (‘rp’) (e.g., Fig. 99B). In both parameres, the apex is round and bears

three long setae, projecting outwards (e.g., Figs. 99C, D).

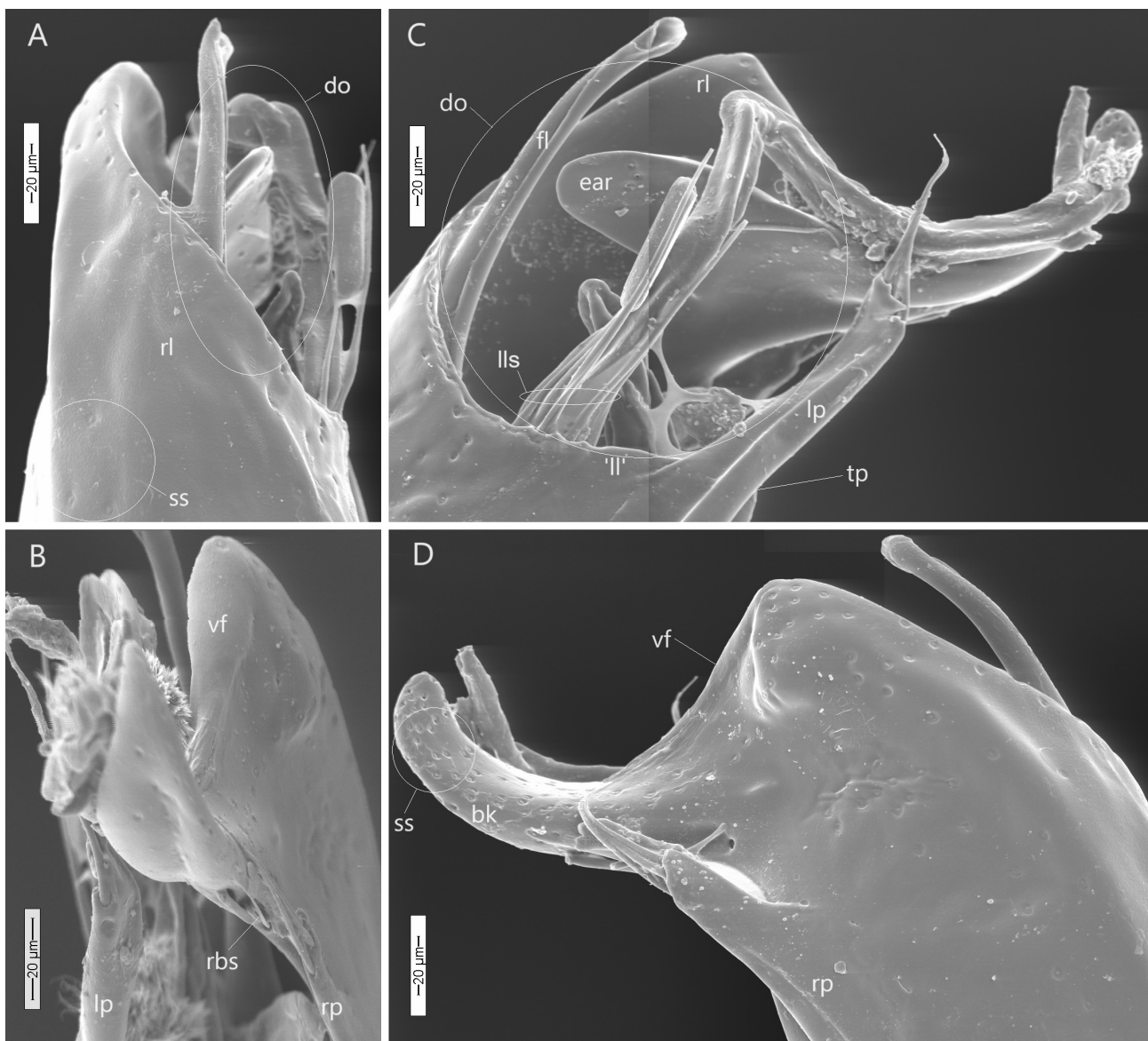
The flagellum (‘fl’—e.g., Fig. 99C) seems to be thin—it was originally described as ‘strong’ and the original figures show it to be long and thin, strong at base and with width decreasing from base towards apex (as in Gnaspini & Peck, 2001: figs. 110–112).

**Taxonomic remarks.** The aedeagus of *A. calarcensis* reminds that of *A. howdenorum* in lateral view (compare Figs. 91 and 98), but the structure of the ‘beak’ and ‘ear’ clearly differs (compare Figs. 94A, B and 100).

***Adelopsis dumbo* Gnaspini & Peck, 2001**

(Figs. 101–104)

*Adelopsis dumbo* Gnaspini & Peck, 2001: 438 (assignment to *elephas*



**FIGURE 99.** *Adelopsis calarcensis* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 12974. A–D, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. bk = ‘beak’; do = dorsal opening; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description); vf = ‘ventral face’ of the right lobe.



**FIGURE 100.** *Adelopsis calarcensis* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 12974. **A**, Apex of aedeagus in frontal view of right lobe (white rectangle is detailed in **B**). bk = ‘beak’; cr = crest of right lobe; ear = internal projection of the right lobe; vf = ‘ventral face’ of the right lobe.

species group); Gnaspini & Peck, 2019: 44 (assignment to *elephas* species subgroup); Peck *et al.*, 2020: 50.

Holotype male in SBPC [now in CMNC]; 7 male and 7 female paratypes in MZSP, SBPC.

Type locality: 11–23 km E Calarcá, 7[000]–10000’, Quindío Department, Colombia.

Distribution: Colombia: Quindío Department: known only from vicinity of type locality.

Size (original description): Length: 2.35–2.5 mm; width: 1.05–1.35 mm.

**Material examined. Paratypes:** COLOMBIA—**Quindío:**—21km E Calarcá; 10000’ a.s.l.; 06–11.III.1974; S.B. Peck leg.; Sardines; Label: “Colombia: Quindío / 21km E Calarcá, 10000’ / 06–11.III.1974, Sardines / S.B. Peck”; 2 males, MZSP 27011 (here illustrated), 27012 (out of 3 male and 2 female paratypes).

**Redescription of aedeagus.** Aedeagus elongate (l/w ~3.3, concavity ~49–52% or ~42–45% (disregarding the ‘beak’) [Figs. 101F, P]), basal opening around 60° downwards; as wide as high, widest about halfway from base (e.g., Fig. 101).

Right lobe (‘rl’—e.g., Fig. 102A) subrectangular, quickly narrowing into a narrow ‘crest’ (‘cr’—e.g., Fig. 102A), with ‘vertical’ inner and outer faces; the apical margin of the crest connects with an oblique (about 60°) ‘ventral face’ (‘vf’), which makes an opposite oblique (about 45°) curve, forming a ‘beak’ (‘bk’) (e.g., Fig. 102C), which is long and narrow in lateral view, and

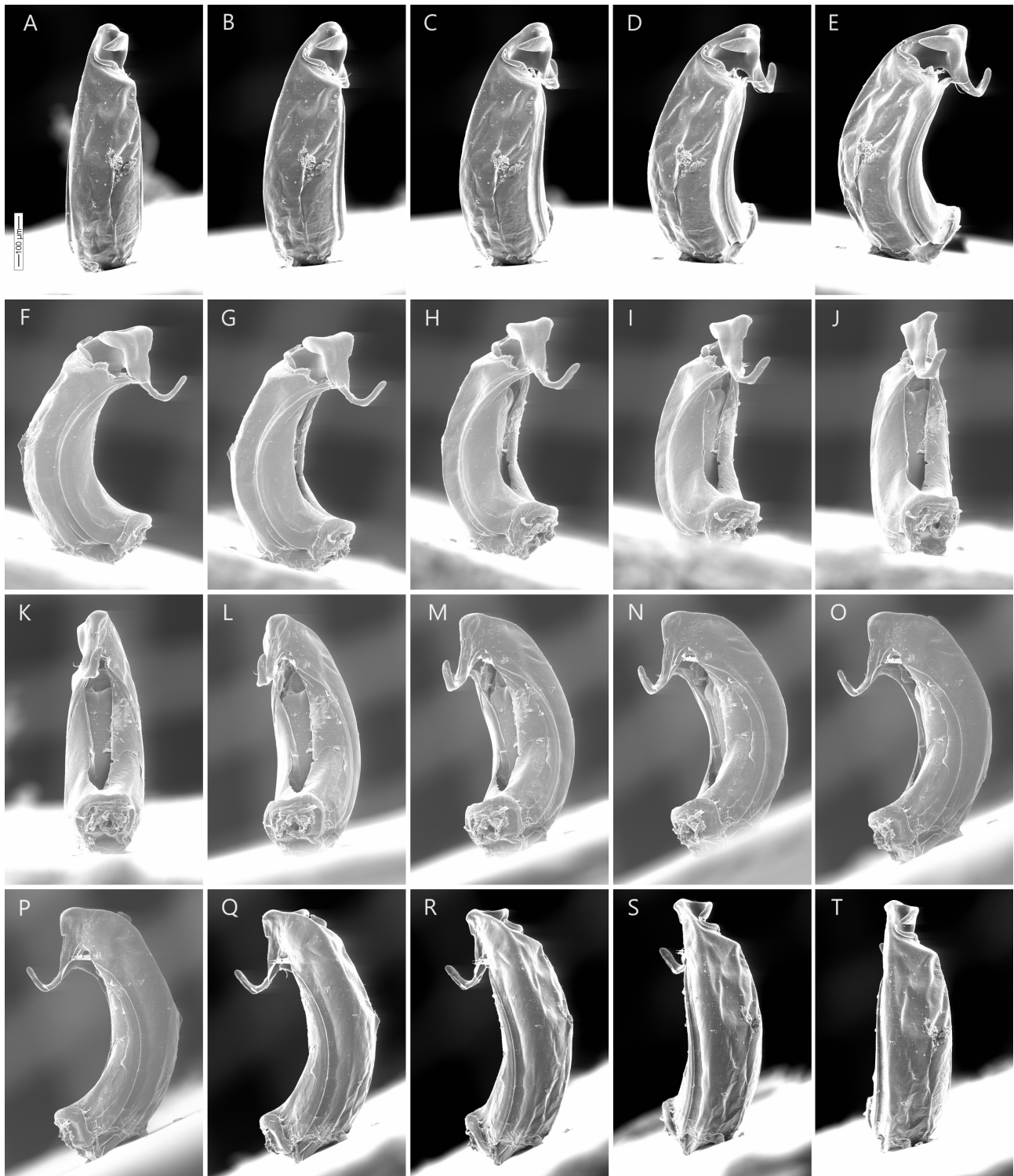
keeps a curve posteriad, reaching back about two thirds of the ‘height’ of the ‘ventral face’; in frontal view (e.g., Fig. 104C), the ‘crest’ is straight, slightly widening before it reaches the ‘ventral face’, which is followed by a narrow and long ‘beak’ with subparallel sides until its midlength, and afterwards narrowing towards its pointy apex. At the middle of the descending ‘ventral face’, the internal surface of the right lobe has a somewhat long, subtriangular projection, with pointy apex (‘ear’—e.g., Figs. 102A, C, 104C), which apical sensory structures interior could not be properly observed, and seems to be only a pore. Ratio ear/beak = 75% (e.g., Fig. 104C), but the beak is much longer in lateral view, because it is curved upward (e.g., Fig. 102C). In lateral view, the right lobe makes a long 90° curve ventrad (‘rl’—e.g., Fig. 102D). External face of right lobe with three long setae, projecting outward (‘rbs’—e.g., Fig. 103C).

A left lobe is ‘absent’ (“ll”’—e.g., Fig. 102C); the ‘turning point’ is dorsal to the left paramere and placed far from the ventral face of the aedeagus body (‘tp’—e.g., Fig. 102C); four elongate setae are placed midway to the ‘turning point’ (‘lls’—e.g., Fig. 102C).

The dorsal opening (‘do’—e.g., Figs. 102A, 103D) takes ~23% of the total length of the aedeagus and its inner margin is L-shaped.

The sensory structures have a shallow depression with a small dome-shaped projection (‘ss’—e.g., Fig. 102C), and concentrate on the frontal and lateral faces of the apical projection (‘ventral face’ and ‘beak’), but





**FIGURE 101.** *Adelopsis dumbo* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27011. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.

in part of them the dome cannot be observed and only a ‘pore’ can be observed (‘ss’—e.g., Fig. 102B).

The parameres are somewhat narrow, slightly wider at base; the placement of the fusion to the aedeagus body can be recognized by the presence of a depression along their length; the apex of the left paramere and the very tip of the right paramere are free (e.g., Fig. 101). The

left paramere (‘lp’) is somewhat shorter than the right paramere (‘rp’) (e.g., Fig. 102D). In both parameres, the apex is round and bears three long setae, projecting ventrally (e.g., Figs. 102D, 103D).

The flagellum (‘fl’—e.g., Figs. 102A, C) seems to be short and thin, with width decreasing from base towards apex—it was originally described as ‘short’ (as in Gnaspini & Peck, 2001: figs. 123–124).



**FIGURE 102.** *Adelopsis dumbo* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27011. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in A and D are detailed in Figs. 104A and B, respectively. bk = ‘beak’; cr = crest of right lobe; do = dorsal opening; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description); vf = ‘ventral face’ of the right lobe.

**Taxonomic remarks.** *Adelopsis dumbo* is the only species of the *elephas* species group until now examined in which the left paramere is ventrally placed in relation to the ‘turning point’ of the left lobe—in *A. dybasi*, the turning point is just dorsal to the left paramere, not as far as in *A. dumbo*; and the ‘beak’ and ‘ear’ of the aedeagus of *A. dumbo* are typical and easily recognized among the other species.

***Adelopsis gilli* Gnaspini & Peck, 1996**

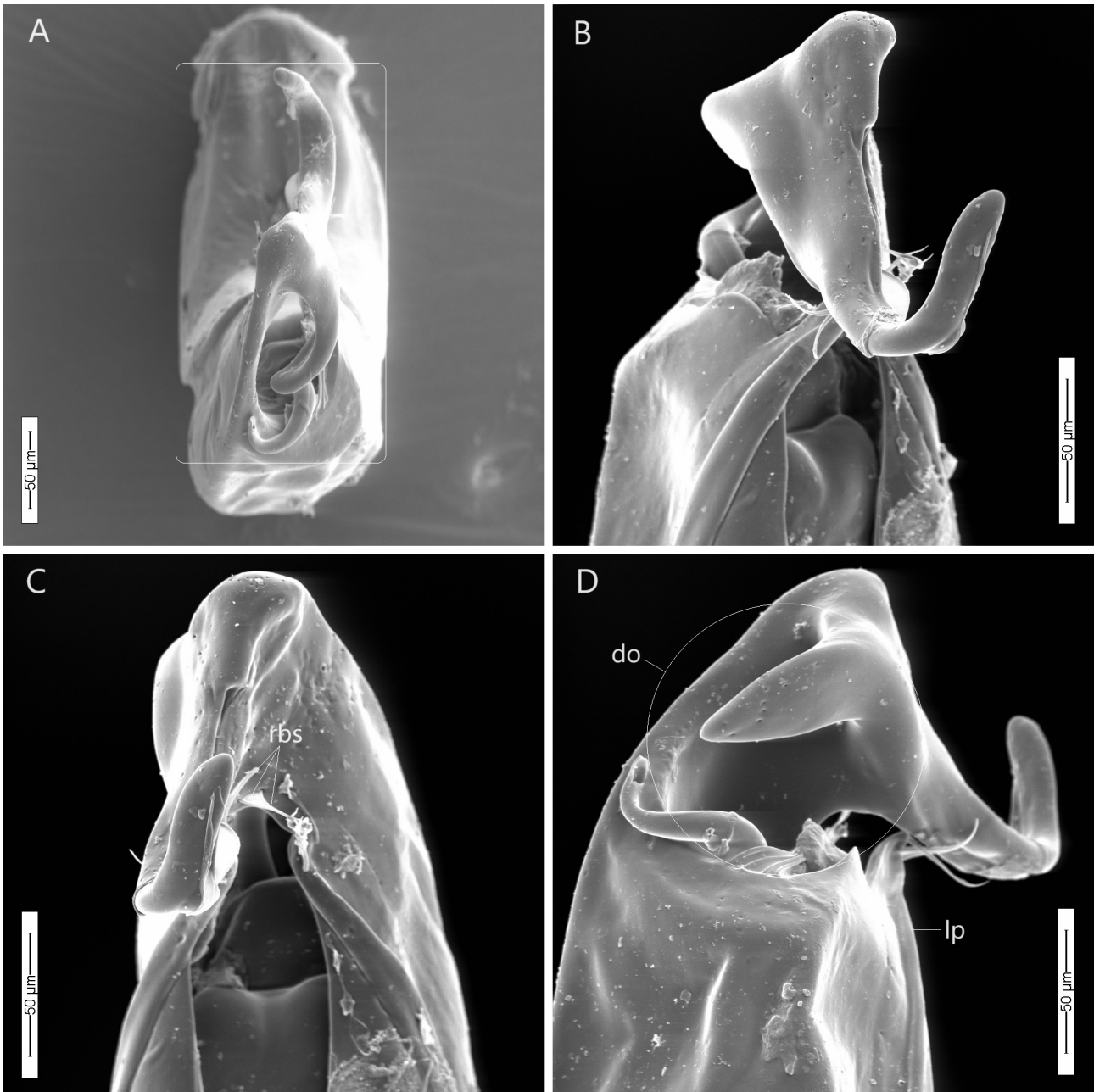
(Figs. 105–107)

*Adelopsis gilli* Gnaspini & Peck, 1996: 421 (assignment to *elephas* species group); Salgado, 2011: 438 [but see Note]; Gnaspini & Peck, 2019: 44 (assignment to *elephas* species subgroup); Peck *et al.*, 2020: 50.

Holotype male in SBPC [now in CMNC]; 11 male and 5 female paratypes in MZSP, SBPC.

Type locality: Cerro Pelota, 1500 m, Chiriquí Province, Panama.





**FIGURE 103.** *Adelopsis dumbo* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27011. **A**, Aedeagus in frontal view of right lobe (white rectangle is detailed in Fig. 104C). **B–D**, Apex of aedeagus in ventral (B, C) and left views, respectively—B and C are slightly rotated in relation to each other and to Fig. 102B; D is slightly rotated in relation to Fig. 102C. do = dorsal opening; lp = left paramere; rbs = setae near the base of the right lobe.

Distribution: Costa Rica: Cartago, and Puntarenas Provinces; Panama: Chiriquí Province.

Note (here included): The records in Salgado, 2011: 438 (Costa Rica: Cartago and Puntarenas Provinces) are doubtful, because they are based on females.

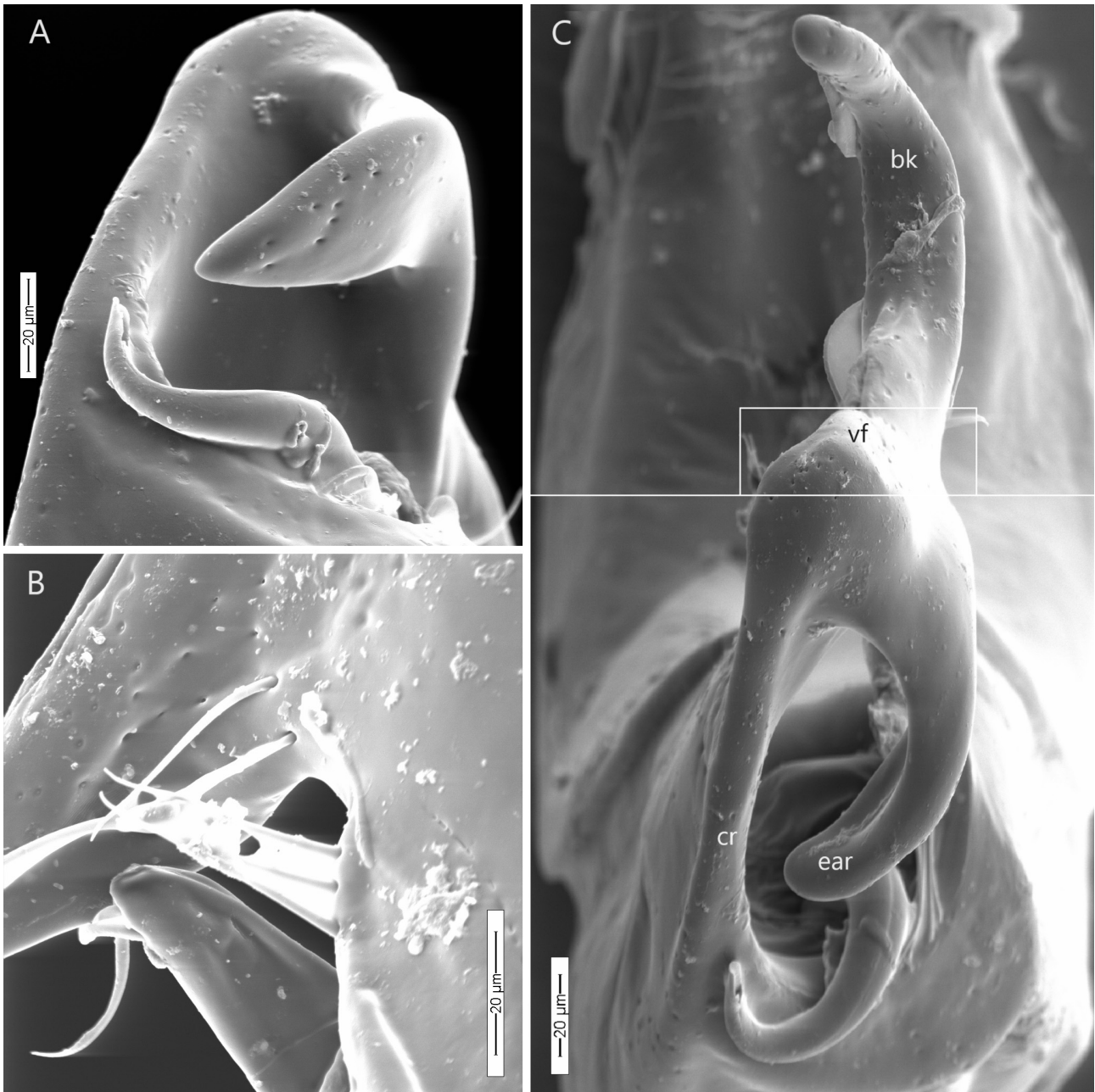
Size (original description): Length: 2.2–2.5 mm; width: 1.0–1.25 mm.

**Material examined. Paratypes:** COSTA RICA—**Puntarenas:**—Monteverde, Campbell’s Farm; 07.VII.1983; D.H. Lindeman leg.; Label: “COSTA RICA: 1475m / Monteverde / Campbell’s Farm / 7.VII.1983 / D.H. Lindeman”; 1 male, MZSP 12993 (marked with pink

label ‘Figure’ referring to its use in original description);—Monte Verde Reserve; 1700m a.s.l.; 29.V.1979; H. & A. Howden leg.; Labels: “C. R. Punt. / Monte Verde Res / 1700m 29.V.1979 / H&A Howden” and “COSTA RICA. Punt. / Monte Verde Reserve / 1700m 29.V.1979 / H & A Howden”; 1 male, MZSP 12996 (here illustrated) (out of 2 male and 2 female paratypes).

**Redescription of aedeagus.** Aedeagus somewhat globose (l/w ~2.5, concavity ~47–48% or ~35–37% (disregarding the ‘beak’) [Figs. 105F, Q]), basal opening about 60° downwards; as wide as high, widest about halfway from base (e.g., Fig. 105).

Right lobe (‘rl’—e.g., Fig. 107A) quickly narrowing



**FIGURE 104.** *Adelopsis dumbo* Gnaspini & Peck, 2001 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27011. **A–B**, Apex of aedeagus in dorsal and right views, respectively—detailed from Figs. 102A and 102D, respectively. **C**, Frontal view of right lobe of aedeagus—detailed from Fig. 103A. The white lines in C indicate that three images in different depths of focus were combined together to produce the image shown. bk = ‘beak’; cr = crest of right lobe; ear = internal projection of the right lobe; vf = ‘ventral face’ of the right lobe.

into a narrow ‘crest’ (‘cr’—e.g., Fig. 107E) with ‘vertical’ inner and outer faces; the crest is curved inward, and bifurcates in two branches—one is curved ventrad and forms an elongate, curved ‘beak’ (‘bk’) with subparallel sides (e.g., Fig. 107E), and the other is projected dorsad, forming a subtriangular projection, with pointy apex (‘ear’—e.g., Fig. 107E), which apical single sensory structure has a shallow depression. Ratio ear/beak = 44% (e.g., Fig. 107E). In lateral view, the right lobe makes a long 90° curve ventrad (‘rl’—e.g., Fig. 106B). External face of right lobe with four long setae, projecting outward (‘rbs’—e.g., Fig. 107I).

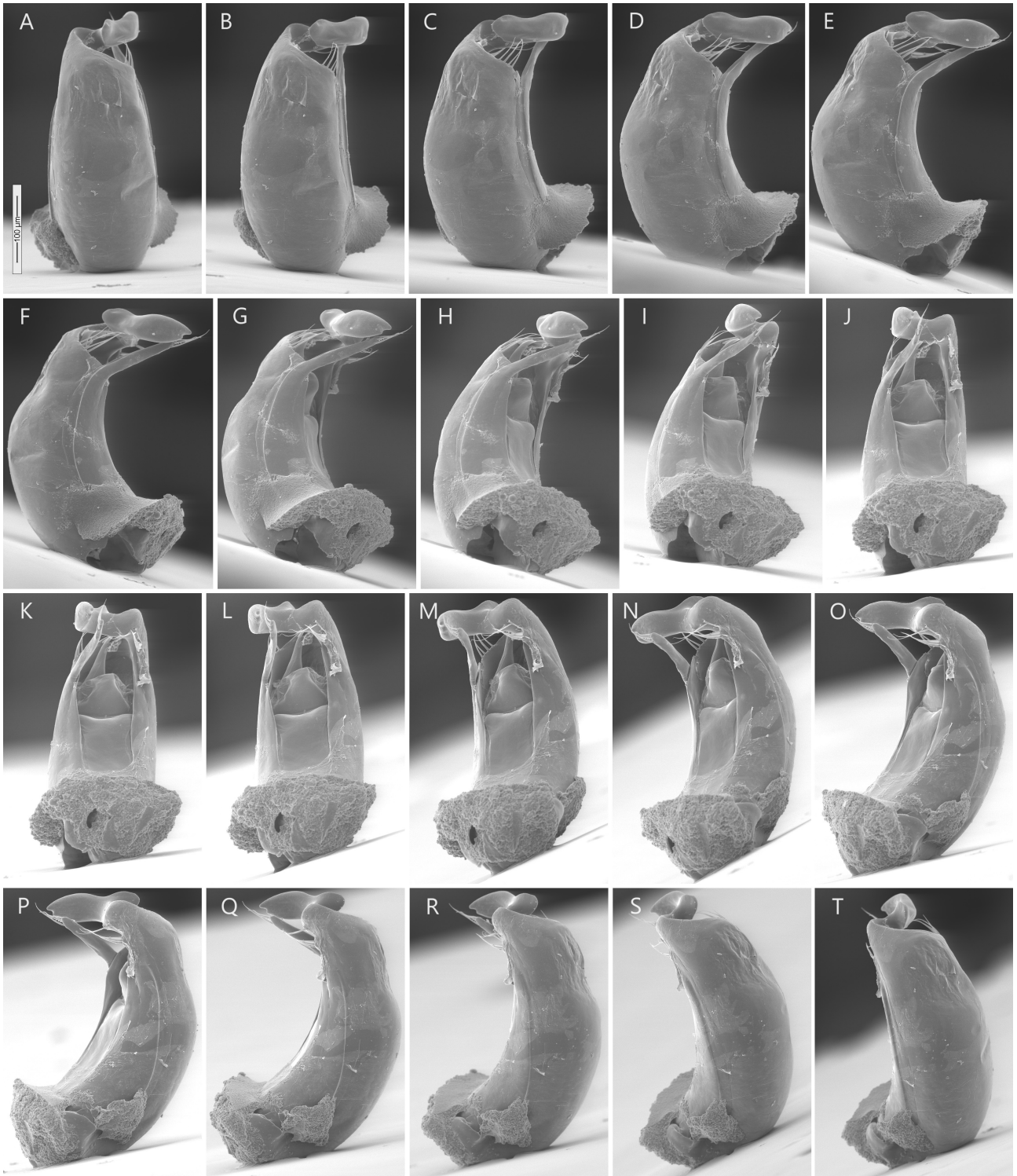
A left lobe is ‘absent’ (‘ll’—e.g., Fig. 106A); the ‘turning point’ is just under the left paramere (‘tp’—e.g., Fig. 106A); four elongate setae are placed far from the ‘turning point’ (‘lls’—e.g., Fig. 106A).

The dorsal opening (‘do’—e.g., Figs. 106A, 107A) takes ~22% of the total length of the aedeagus and its inner margin is diagonal.

The sensory structures have a shallow depression with a small dome-shaped projection (‘ss’—e.g., Fig. 106A).

The parameres are different from each other, but both begin wide; the placement of the fusion to the aedeagus body can be recognized by the presence of a depression



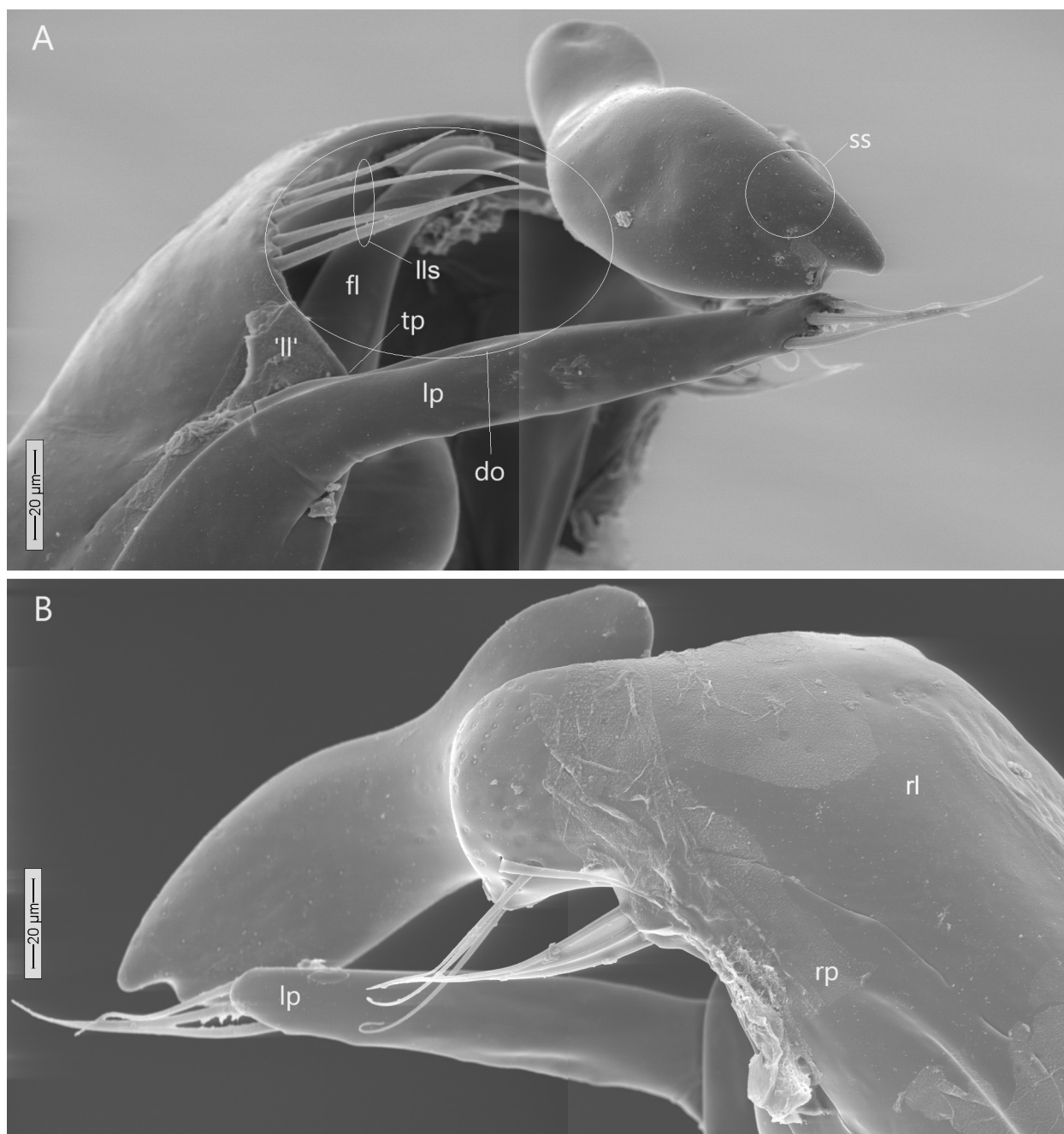


**FIGURE 105.** *Adelopsis gilli* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 12996. A–T, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.

along their length, except the ventral margin of the right paramere, which cannot be recognized from the aedeagus body (e.g., Fig. 105). The right paramere (‘rp’—e.g., Fig. 106B) has a round apex which subapical ventral margin is truncated and bears three long setae, projecting ventrad; it is shorter than the right lobe of the aedeagus and than the left paramere (‘lp’—e.g. Figs. 106A, B), which has a similar shape as the right paramere until it reaches the

margin of the dorsal opening, where it makes a sharp turn ventrad, becomes free, narrows, and has subparallel sides until its diagonally truncated apex, which bears three long setae, projecting forward.

The flagellum (‘fl’—e.g., Fig. 106A) seems to be thin, with width decreasing from base towards apex—it was originally described as ‘short and strong’ and the original figures show it to be somewhat long and strong,



**FIGURE 106.** *Adelopsis gilli* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 12996. **A–B**, Apex of aedeagus in left and right views, respectively. do = dorsal opening; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

with width decreasing from base towards apex (as in Gnaspini & Peck, 1996: figs. 99–101).

**Taxonomic remarks.** Although the aedeagus of *A. gilli* does not bear a typical beak in lateral view (with a structure that allows the prompt recognition of this species—e.g., Fig. 106), a structure composed of an elongate ‘beak’ and a backward ‘ear’, typical of the species in this species group, can be recognized in frontal view (e.g., Fig. 107E).

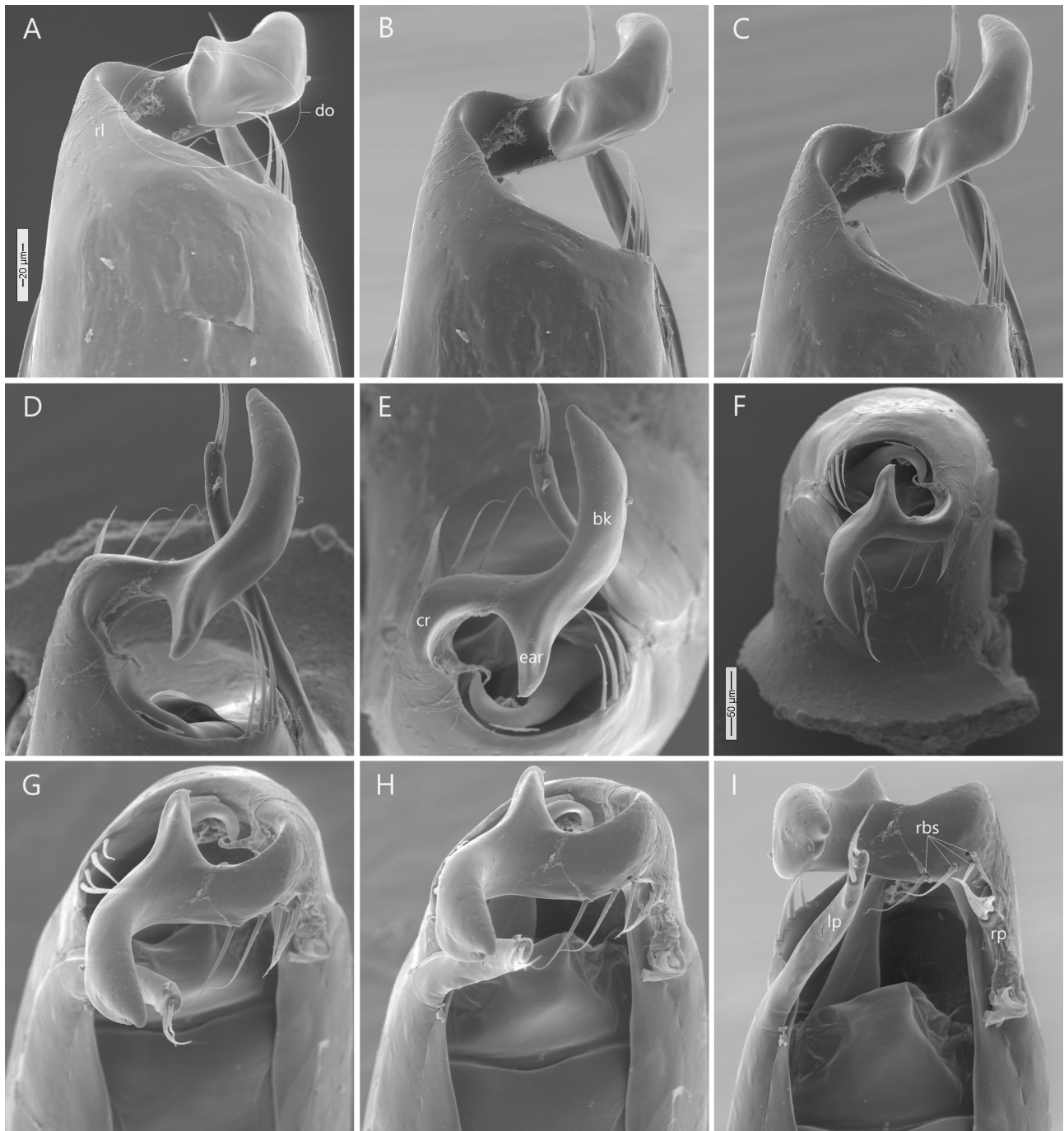
***Adelopsis perimeces* Gnaspini & Peck, 1996**  
(Figs. 108–110)

*Adelopsis perimeces* Gnaspini & Peck, 1996: 425 (assignment to *elephas* species group); Salgado, 2010: 215 (as *perimeces* [sic]); Salgado, 2011: 439 [but see Note]; Gnaspini & Peck, 2019: 44 (assignment to *elephas* species subgroup); Peck *et al.*, 2020: 50.

Holotype male in SBPC [now in CMNC]; 33 male and 14 female paratypes in FMNH, MNHN, MZSP, SBPC.

Type locality: El Llano—Carti Road, 400 m, Panamá Province, Panama.





**FIGURE 107.** *Adelopsis gilli* Gnaspirini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 12996. A–I, A rotational view of the apex of the aedeagus, around its ‘sagittal’ plane, starting from the dorsal view. A–E are rotated 180° in relation to F–I in order to keep the apex of the aedeagus facing the top of the image. All figures to the same scale (except F). bk = ‘beak’; cr = crest of right lobe; do = dorsal opening; ear = internal projection of the right lobe; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere.

Distribution: Costa Rica: Puntarenas Province; Panama: Panamá Province.

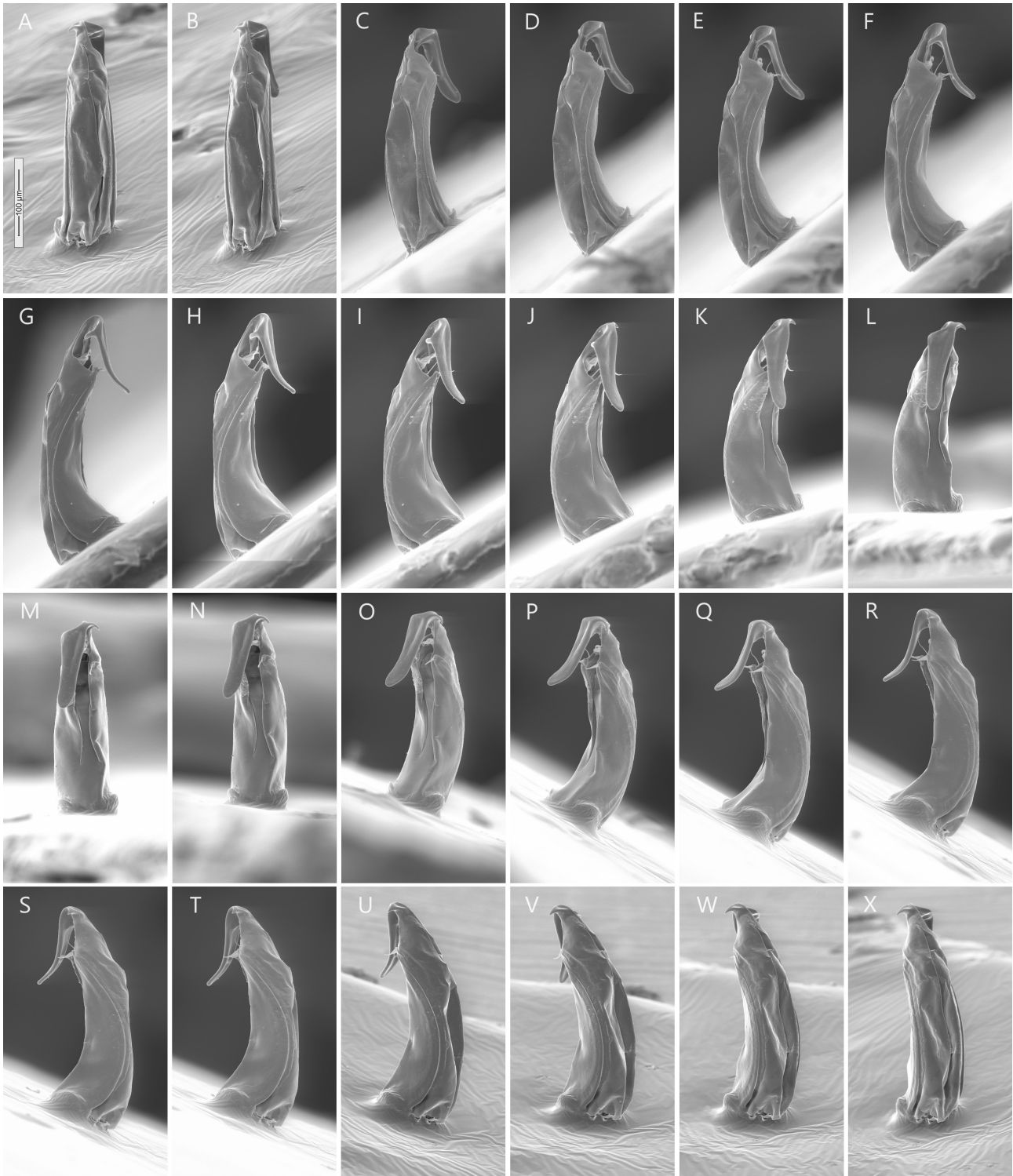
Note (here included): The record in Salgado, 2011: 439 (Costa Rica: Puntarenas Provinces) is doubtful, because it is based on a female.

Size (original description): Length: 1.75–2.4 mm; width: 0.85–1.1 mm.

**Material examined. Paratypes:** PANAMA—Panama:—

El Llano—Carti Road; 400m; VI.1982; B. Gill leg.; FIT; Label: “PAN: Panama / El Llano—Carti Rd. / June 1982, 400m / B. Gill FIT”; 2 males, MZSP 27039, 27041 (here illustrated; marked with pink label ‘Figure’ referring to its use in original description) (out of 4 male and 3 female paratypes).

**Redescription of aedeagus.** Aedeagus elongate (l/w ~5.3, concavity ~53–54% or ~41–43% (disregarding the ‘beak’) [Figs. 108G, R]), basal opening about 45°



**FIGURE 108.** *Adelopsis perimeces* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27041. A–X, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale.

downwards; as wide as high, with subparallel sides in dorsal view, except near apex (e.g., Fig. 108).

Right lobe (‘rl’—e.g., Fig. 109A) with a short ‘arm’ slightly decreasing in width posteriad (‘arm’—e.g., Fig. 109A) and with a wide external face; and which apical, posterior region has an outward projection (‘ol’—e.g., Figs. 109A, B, D) and connects with an oblique, ventrally produced ‘beak’ (‘bk’—e.g., Figs. 109B–D), which is

long and narrow in lateral view, and in which base there is a very short projection backward (‘ear’—e.g., Figs. 109A–C), which apical few sensory structures have a small depression. Ratio ear/beak = 14% (e.g., Fig. 109B). In lateral view, the right lobe makes a backward curve ventrad (‘rl’—e.g., Fig. 109C). External face of right lobe with two long setae, projecting inward (‘rbs’—e.g., Fig. 110D).



A left lobe is ‘absent’ (“ll”—e.g., Figs. 109C, 110B); the ‘turning point’ is just under the left paramere (‘tp’—e.g., Fig. 110B); one elongate seta is placed close to the left paramere (‘lls’—e.g., Fig. 109A).

The dorsal opening (‘do’—e.g., Figs. 109A, C) takes ~22% of the total length of the aedeagus and its inner margin is diagonal.

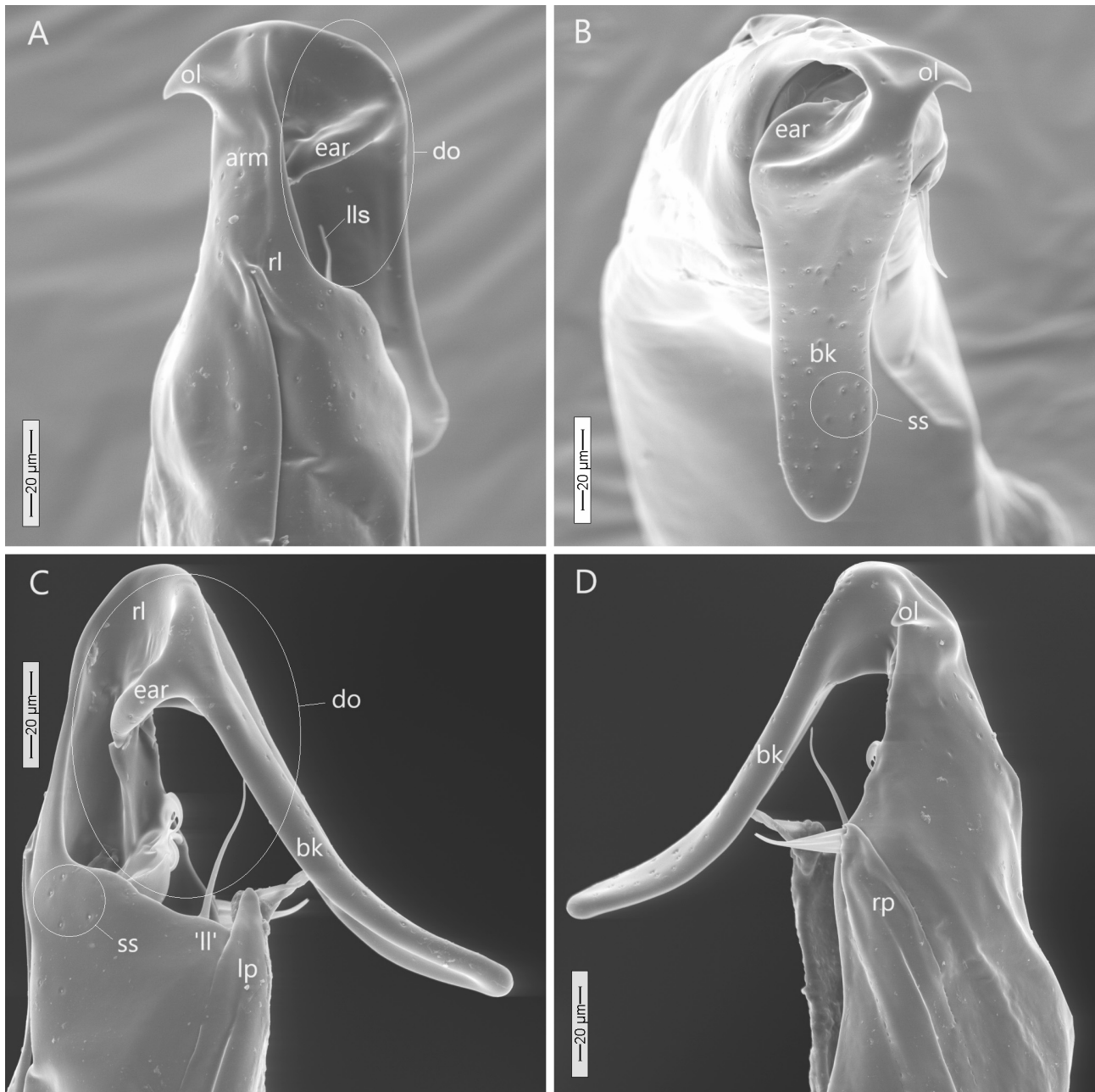
The sensory structures have a small dome-shaped projection (‘ss’—e.g., Fig. 109C), and are more densely distributed on the ‘beak’ (‘ss’—e.g., Fig. 109B).

The somewhat narrow fused parameres have the same length, and can be recognized by the presence of

a depression along their dorsal margin, but their ventral margin cannot be recognized from the aedeagus body; their very apex are free, pointy but round, and bear three long setae, projecting ventrally (‘lp’ and ‘rp’—e.g., Figs. 109C, D).

The flagellum was originally described as ‘short and strong’ (as in Gnaspini & Peck, 1996: figs. 123–125).

**Taxonomic remarks.** *Adelopsis perimeces* seems to be (until now) the only species in which the aedeagus bears an outward projection near the base of the ventrally produced ‘beak’ (‘ol’—e.g., Fig. 109).



**FIGURE 109.** *Adelopsis perimeces* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27041. A–D, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. arm = arm of the right lobe; bk = ‘beak’; do = dorsal opening; ear = internal projection of the right lobe; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; ol = outward projection of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure.



**FIGURE 110.** *Adelopsis perimeces* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27041. **A**, aedeagus in frontal view of right lobe (white rectangle is detailed in **B**). **C–D**, Apex of aedeagus in left and right views, slightly rotated in relation to Figs. 109C and D, respectively. ‘ll’ = left lobe absent; lp = left paramere; rbs = setae near the base of the right lobe; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

***Adelopsis pileata* Gnaspini & Peck, 1996**  
(Figs. 111–113)

*Adelopsis pileata* Gnaspini & Peck, 1996: 427 (assignment to *elephas* species group); Gnaspini & Peck, 2019: 44 (assignment to *elephas* species subgroup); Peck *et al.*, 2020: 50.

Holotype male in SBPC [now in CMNC]; 11 male and 4 female paratypes in FMNH, MZSP, SBPC.

Type locality: Monte Verde, 1700 m, Puntarenas Province, Costa Rica.

Distribution: Costa Rica: Alajuela and Puntarenas Provinces.

Size (original description): Length: 2.2–2.65 mm; width: 1.1–1.25 mm.

**Material examined. Paratypes:** COSTA RICA—**Puntarenas:**—Monte Verde Reserve; 1700m a.s.l.; 27.V.1979; cloud forest, cuptraps 3 days; H. & A. Howden leg.; Label: “C. R. Punt. / Monte Verde Reser. / 1700m cloud forest / 27.V.79 cuptr. 3 days / H&A Howden”; 2 males, MZSP 27029, 27030 (here illustrated) (out of 3 male and 1 female paratypes).

**Redescription of aedeagus.** Aedeagus elongate (l/w ~3.3, concavity ~54% or ~48% (disregarding the ‘beak’) [Figs. 111F, R]), basal opening almost 90° downwards; width a little bigger than height, widest about halfway from base (e.g., Fig. 111).

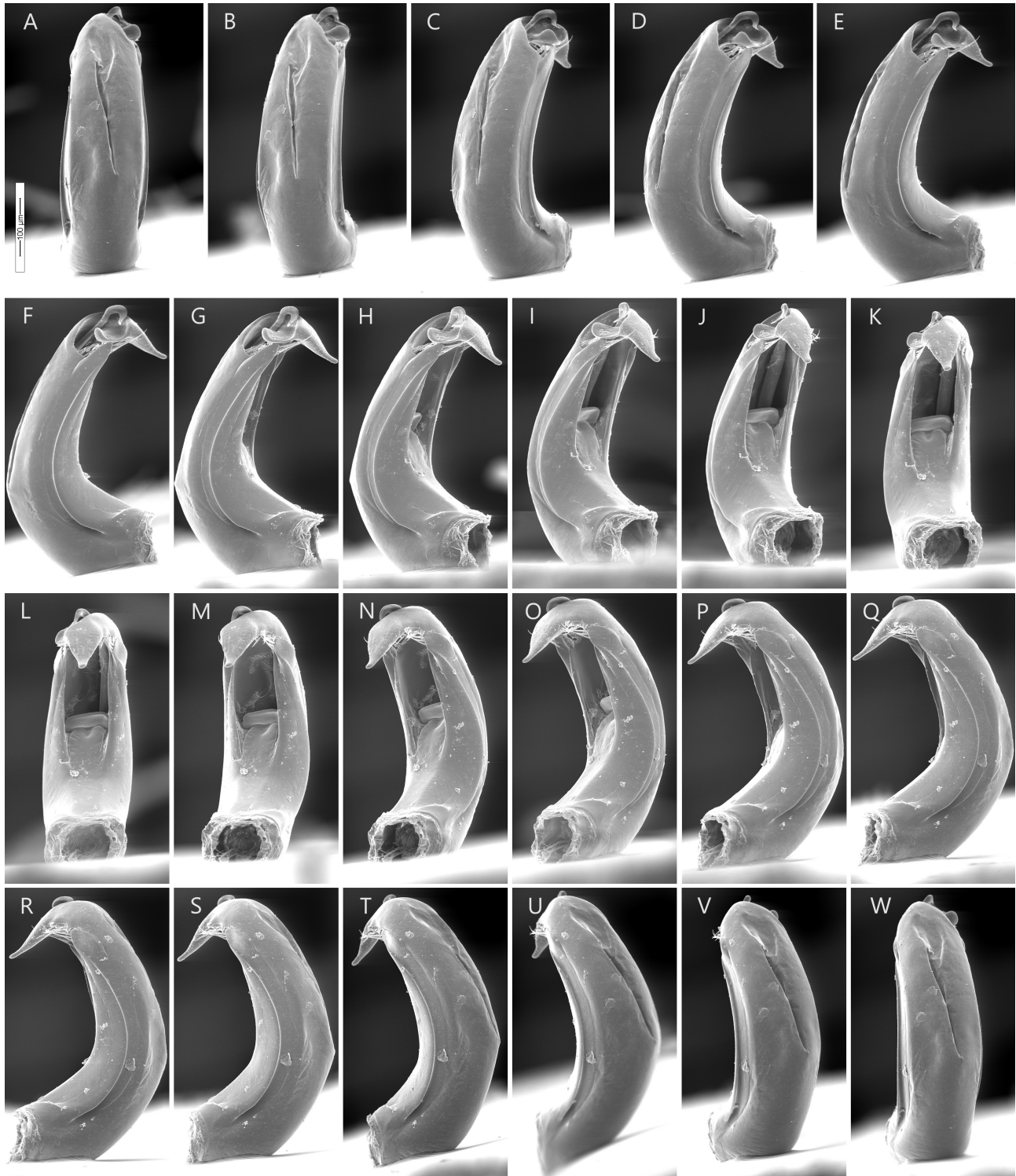
Right lobe (‘rl’—e.g., Fig. 112A) with a short ‘arm’



slightly decreasing in width posteriad ('arm'—e.g., Fig. 113B) and with 'vertical' inner and outer faces; the posteriormost region of the arm connects with a plate which widens towards the left side, achieving its widest condition at this point and projects forward, with margins converging to a pointy apex, to form a subtriangular 'beak' ('bk'—e.g., Fig. 113B); at the base of the 'beak', the internal surface of the right lobe projects internally, forming a wide, flat

projection ('ear'—e.g., Figs. 112A, C, 113B), and is curved towards the dorsal surface of the aedeagus; its apical sensory structures have a shallow depression. Ratio ear/beak = 48% (e.g., Fig. 113B). In lateral view, the right lobe makes a long backward curve ventrad ('rl'—e.g., Fig. 112C). External face of right lobe with three long setae, projecting forward ('rbs'—e.g., Fig. 112D).

A left lobe is 'absent' ("ll"—e.g., Fig. 112C); the



**FIGURE 111.** *Adelopsis pileata* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27030. A–W, A rotational view of the aedeagus, around its 'longitudinal' axis, starting from the dorsal view. All figures to the same scale.

‘turning point’ is just under the left paramere (‘tp’—e.g., Fig. 113E); four elongate setae are placed close to the left paramere (‘lls’—e.g., Fig. 112C).

The dorsal opening (‘do’—e.g., Figs. 112A, C) takes ~18% of the total length of the aedeagus and its inner margin is diagonal.

The sensory structures have a shallow depression with a small dome-shaped projection (‘ss’—e.g., Fig. 113E), and concentrate on the frontal and lateral faces of the ‘beak’, where they are wider and somewhat deep (‘ss’—e.g., Fig. 113C).

The somewhat narrow fused parameres have the same length, and can be recognized by the presence of a depression along their length; their very apex are free,

pointy but round, and bear three long setae, projecting ventrally (‘lp’ and ‘rp’—e.g., Figs. 112C, D).

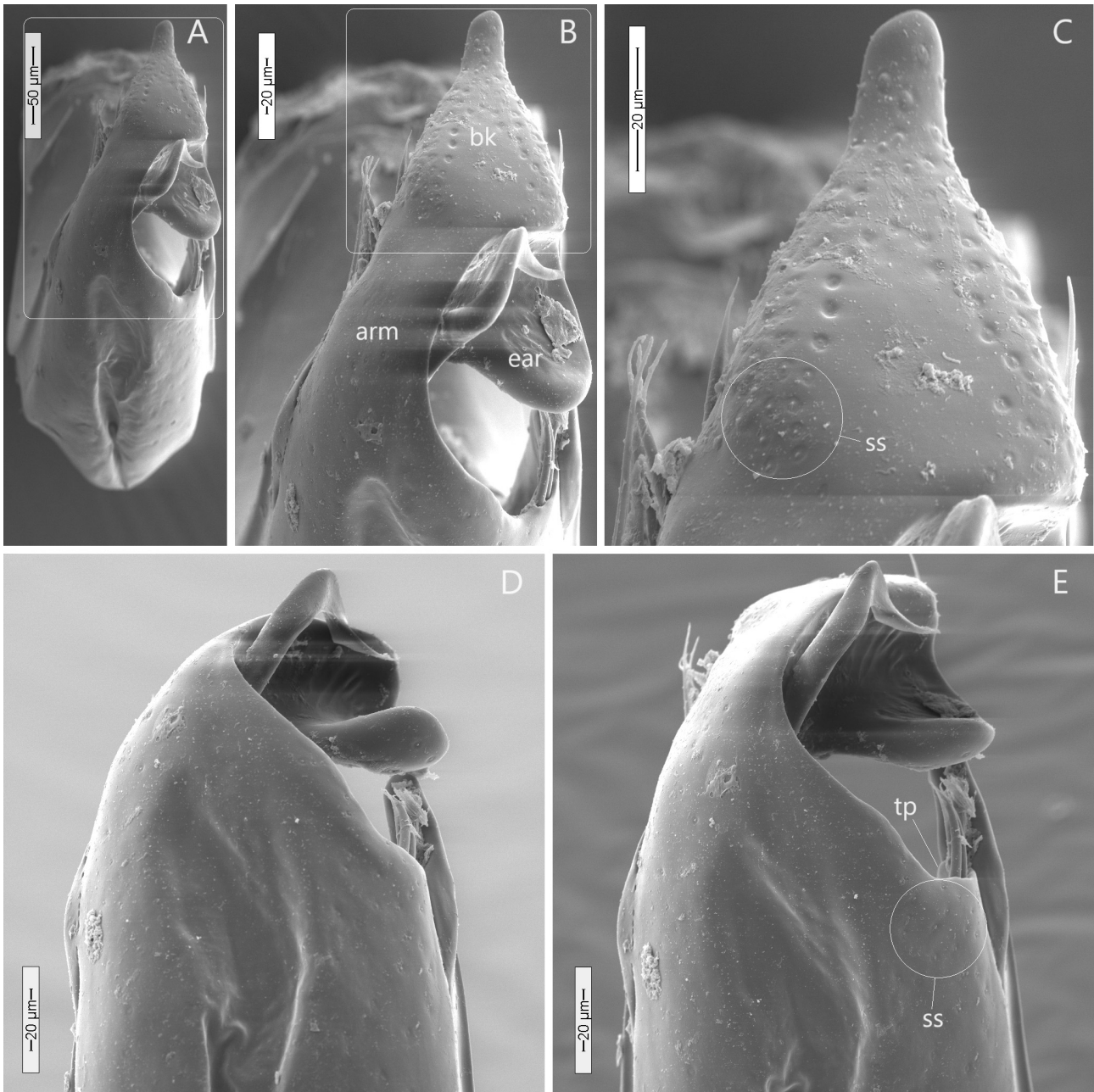
The flagellum (‘fl’—e.g., Fig. 112C) seems to be somewhat elongate and thin, with a backward curved apex (shaping as a round scythe), as in the figures in the original description (as in Gnaspini & Peck, 1996: figs. 137–139, in which it is very long).

**Taxonomic remarks.** The aedeagus of *A. pileata* has a subtriangular ‘beak’ (which reminds the apex of the aedeagus of species of *Ptomaphagus* Hellwig, 1795, but it is ventrally produced and a typical ‘ear’, characteristic of the species in this species group, can be recognized) with many, well-marked sensory structures (e.g., Fig. 113B).



**FIGURE 112.** *Adelopsis pileata* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27030. A–D, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. bk = ‘beak’; do = dorsal opening; ear = internal projection of the right lobe; fl = flagellum; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; rbs = setae near the base of the right lobe; rl = right lobe; rp = right paramere.





**FIGURE 113.** *Adelopsis pileata* Gnaspini & Peck, 1996 (*elephas* species group—subgroup *elephas*), male paratype MZSP 27030. **A**, Aedeagus in frontal view of right lobe (white rectangle is detailed in **B**.; white square in **B** is detailed in **C**.). **D–E**, Apex of aedeagus in dorsal view, with slight rotation towards apex, following the ‘sagittal’ plane of the aedeagus, in relation to each other and to Fig. 112A, in order to show the influence of the view in the recognition of the aedeagal shape. arm = arm of right lobe; bk = ‘beak’; ear = internal projection of the right lobe; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

### Taxonomic remarks in *elephas* species group

The structure of the apical region of the aedeagus is an important tool for species recognition in *elephas* species group. The combination of the shape in frontal and lateral views, curvature in lateral view, and length of the ‘beak’ together with the same features of the ‘ear’ allows a perfect species recognition, especially the combined observation of left lateral and frontal views of the beak+ear structure (e.g., Figs. 89C+D, 92C+94B, 96C+97E, 99C+100A, 102C+104C, 109C+B, and 112C+113B).

The axis of the basal opening of the aedeagus points diagonally, around 45° downwards in relation to the ‘sagittal’ plane of the aedeagus, in *A. calarcensis* and *A. perimeces* (e.g., Figs. 98, 108), and also in *A. acuminis* Salgado, 2013, *A. carolinae* Salgado, 2008, *A. curvata* Salgado, 2011, *A. mixta* Salgado, 2011, *A. pichinde* Gnaspini & Peck, 2001, *A. procera* Gnaspini & Peck, 2001, *A. vallicola* Gnaspini & Peck, 1996, and *A. vulcania* Salgado, 2016; or around 60° in *A. dumbo* and *A. gilli* (e.g., Figs. 101, 105), and *A. elephas* Gnaspini & Peck, 1996, *A. jarmilae* Gnaspini & Peck, 2001, and *A.*

*protuberans* Salgado, 2019; or ventrally (almost 90°) in the other species (e.g., Figs. 88, 111).

The right lobe of the aedeagus is subtriangular in dorsal view (e.g., Figs. 92A, 99A—this seems to be the general rule, but some drawings from the original descriptions do not allow a proper observation), except in *A. dumbo*, in which it is subrectangular (e.g., Fig. 102A) because the anteriormost margin of the dorsal opening is almost transversally produced (and not clearly diagonally produced as in the other species).

The apical surface of the ‘ear’ of the aedeagus bears a group of sensory structures in all species here studied (e.g., Figs. 89D, 102A, C), except in *A. calarcensis* and *A. rostrata*, in which no sensory structure could be detected (e.g., Figs. 96–97, 99–100). This feature cannot be addressed in other species from the literature.

The ‘turning point’ (the place where a left lobe would appear) is generally placed under the left paramere in the species here studied (‘tp’—e.g., Figs. 106A, 110B) and additional species which figures allow this observation (as *A. albipinna* Gnaspini & Peck, 1996, *A. elephas* Gnaspini & Peck, 1996, *A. procera* Gnaspini & Peck, 2001, and *A. stella* Gnaspini & Peck, 1996), but it is placed just dorsal to the left paramere in *A. dybasi* (e.g., Fig. 90C) and *A. jarmilae* Gnaspini & Peck, 2001, and it is placed far from the ventral face of the aedeagus body in *A. dumbo* (e.g., Fig. 102C).

The setae of the ‘left lobe’ (‘lls’) are generally placed midway from the ‘turning point’ towards the region where the right lobe narrows into an ‘arm’ or a ‘crest’ (e.g., Figs. 89D, 99C; and it also seems the case with *A. jarmilae* Gnaspini & Peck, 2001), but it is placed far from the ‘turning point’ in *A. gilli* (e.g., Fig. 106A), and *A. albipinna* Gnaspini & Peck, 1996 and *A. procera* Gnaspini & Peck, 2001, and it is placed close to the left paramere in *A. perimeces* and *A. pileata* (e.g., Figs. 109A, 112C).

## Not assigned to species group (as in Gnaspini & Peck, 2019)

### *Adelopsis picunche* (Gnaspini, 1991)

(Figs. 114–117)

*Ptomaphagus picunche* Gnaspini, 1991: 391.

*Adelopsis picunche*—Gnaspini, 1996: 539 (comb.); Salgado, 2010: 213 (assignment to *ascutellaris* species group); Gnaspini & Peck, 2019: 46 (unassignment to species group); Peck *et al.*, 2020: 52.

Holotype male in MACN; 3 male and 6 female paratypes in MACN, MLPA, MZSP, SBPC.

Type locality: Sistema (Cueva) Cuchillo Cura [Cave], Neuquén Province, Argentina.

Distribution: Argentina: Neuquén Province: known only from type locality.

Note: Because of the uniqueness of the aedeagus, and because they avoided establishing monotypic species groups, Gnaspini & Peck, 2019: 46 decided not to assign this species to a species group. Peck *et al.* (2020) adopted this position.

Size (original description): Length: 2.9 mm; width: 1.2 mm.

**Material examined. Paratype:** ARGENTINA—**Neuquén:**—Las Lajas, Sistema Cuchillo Curá [Cuchillo Curá cave system]; 1990; INAE [Instituto Argentino de Investigaciones Espeleológicas] leg.; Label: “Sistema Cuchillo Cura / Neuquen—Argentina / INAE col. / 1990”; 1 male, MZSP 27031 (here illustrated) (out of 1 male and 3 female paratypes).

**Redescription of aedeagus.** Aedeagus elongate (l/w ~4.0), with ventral surface practically flat, except near its base (Figs. 114E, O), then defining a curved ventre (concavity ~46–49% [Figs. 114E, O]), basal opening almost 90° downwards; width a little bigger than height, with subparallel sides in dorsal view, except near apex (e.g., Fig. 114).

Right lobe (‘rl’—e.g., Fig. 115A) divided in two ‘lobules’—the outer lobule (‘orl’—e.g., Figs. 115A, D) is short and its apical margin bears four setae, projecting forward, being three elongate and one, the dorsalmost one, shorter (having less than half the length of the other three setae); the inner lobule (‘irl’—e.g., Figs. 115A, D) projects forward, narrowing towards its apex (i.e., with a subtriangular shape), and have a dorsal projection, which expands laterally and backwards, forming a ‘hood’ (‘hd’—e.g., Figs. 115A, C).

A left lobe is ‘absent’ or ‘very subtle’ (‘ll’—e.g., Figs. 115A, C); the ‘turning point’ is considered to be placed just out of the subtle projection (‘tp’—e.g., Figs. 115B, C); four setae, being three elongate and one, the dorsalmost one, shorter (having less than half the length of the other three setae), are placed on the apex of the subtle projection, just dorsal to the ‘turning point’ (‘lls’—e.g., Fig. 115C).

The dorsal opening (‘do’—e.g., Fig. 115A) takes ~19% of the total length of the aedeagus and has a C-shaped margin.

The sensory structures have a shallow depression with a small dome-shaped projection (‘ss’—e.g., Fig. 115A), and concentrate near the base of the spines of both outer right lobule and ‘left lobe’ (‘ss’—e.g. Fig. 116D) and on the dorsal face of the apical projection of the aedeagus (‘ss’—e.g., Fig. 117B).

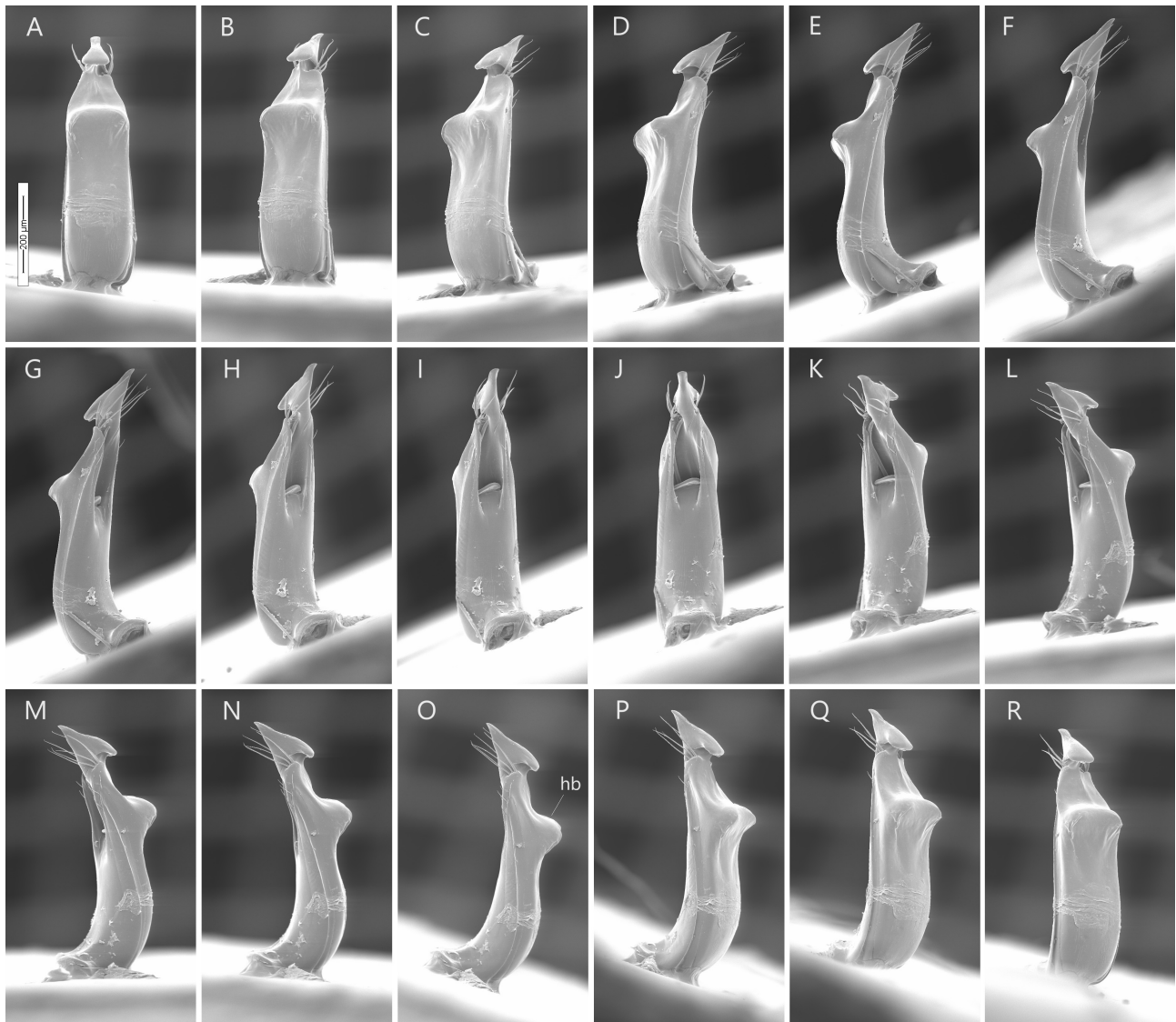
The somewhat narrow fused parameres can be recognized by the presence of a depression along their dorsal margin, but their ventral margin cannot be [totally] recognized from the aedeagus body (e.g., Fig. 114). The left paramere (‘lp’) is somewhat shorter than the right paramere (‘rp’) (e.g., Figs. 115B–D). In both parameres, the apex is round and bears three long setae, projecting ventrad, two of them placed at the apex and one placed a little behind, more ventrally (e.g., Figs. 115C, D).

The flagellum (‘fl’—e.g., Fig. 115B) seems to be elongate and thin—it was originally described as ‘long’ (as in Gnaspini, 1991: figs. 5–7).

The aedeagus bears medially a dorsal, blunt projection, shaped like a ‘hunchback’ (‘hb’—e.g., Figs. 114O, 116A, 117A).

**Taxonomic remarks.** *Adelopsis picunche* can be easily recognized by the hunchback projection on the





**FIGURE 114.** *Adelopsis picunche* (Gnaspini, 1991), male paratype MZSP 27031. **A–R**, A rotational view of the aedeagus, around its ‘longitudinal’ axis, starting from the dorsal view. All figures to the same scale. hb = ‘hunchback’.

very elongate aedeagus. This species was originally placed in the genus *Ptomaphagus* Hellwig, 1795, and it was transferred to *Adelopsis*, but its placement is still to be better defined. (See also the Discussion section, under ‘Species groups with aedeagus with a pointy apex’).

## Discussion

### Revisiting species groups. A discussion on the evolution of the aedeagal morphology in *Adelopsis*

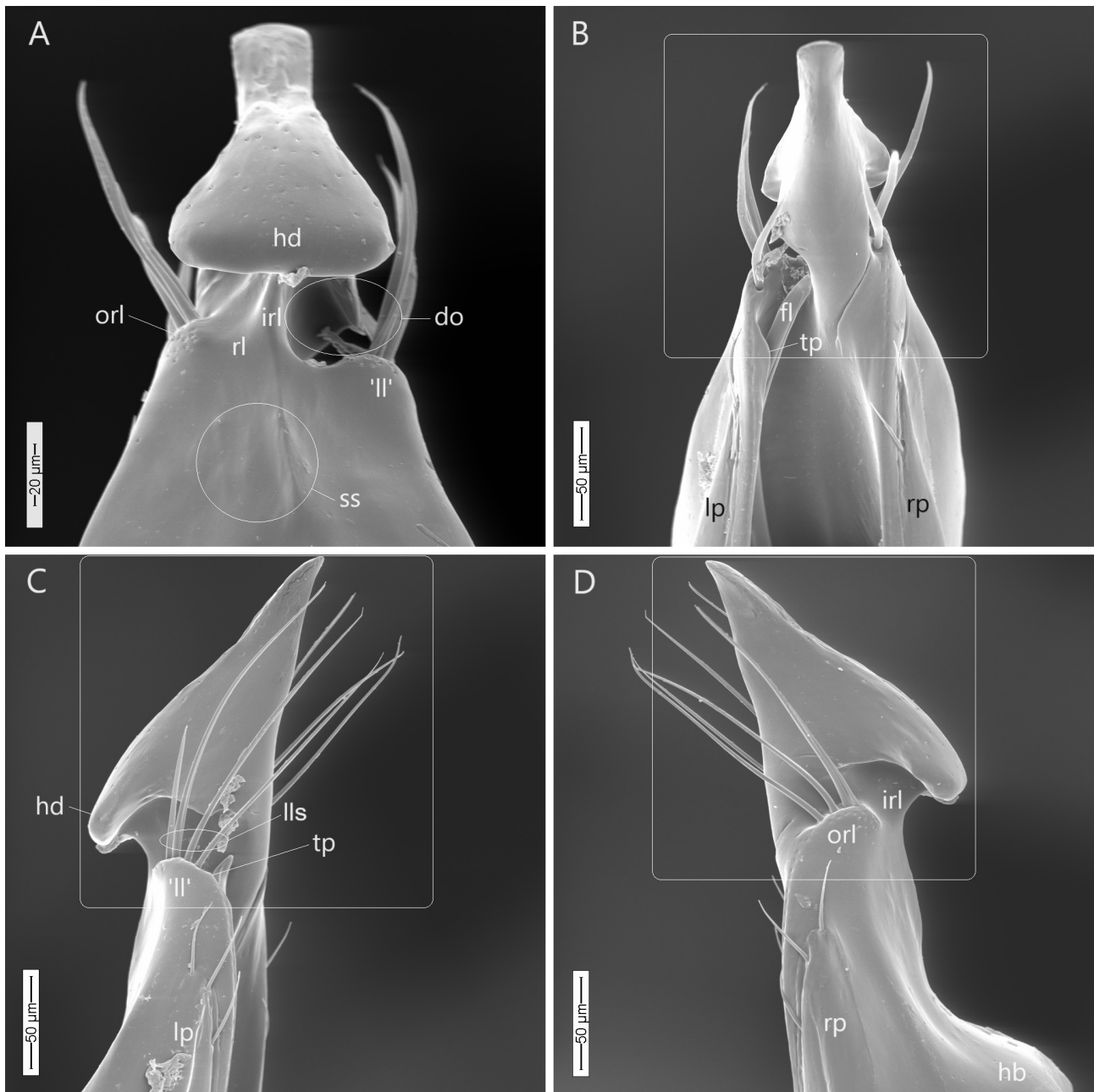
#### Species groups with aedeagus with a pointy apex

Gnaspini & Peck (2019) redefined species groups in *Adelopsis*, using several features to do that. One important feature was the shape of the right lobe of the aedeagus—a pointy, subtriangular right lobe was considered to be ‘plesiomorphic’ because it resembles the pattern in, e.g., the genera *Ptomaphagus* Hellwig, 1795 and also the pointy

aedeagus observed in *Peckena* Gnaspini, 1996 as well as in other tribes of Leiodidae (and other Coleoptera) (see, also, Jeannel, 1936; Gnaspini and Gomyde, 2024; Gomyde *et al.*, 2024). Three species groups show this pattern: *trianguliger* species group (with four species), *camella* species group (with two species), and *elephas* species group (with 24 species, organized in two subgroups), and the species *A. picunche*, not assigned to a species group.

#### The *trianguliger* species group

Gnaspini & Peck (2019) also highlighted the resemblance of the species in *trianguliger* species group with those in the genus *Ptomaphagus*, and discussed that the generic placement of those species deserves a more precise analysis in the future. Gnaspini *et al.* (2021) recognized that the twin spines appear as triplets in *Ptomaphagus*, at least in the American subgenera *Adelops* and *Appadelopsis*, whereas they are composed of a pair of setae in all other



**FIGURE 115.** *Adelopsis picunche* (Gnaspini, 1991), male paratype MZSP 27031. **A–D**, Apex of aedeagus in dorsal, ventral, left, and right views, respectively. White squares in B–D are detailed in Figs. 116B–D, respectively. do = dorsal opening; fl = flagellum; hd = ‘hood’; iri = inner lobule of the right lobe; ‘ll’ = left lobe absent; lls = setae on the ‘left lobe’; lp = left paramere; orl = outer lobule of the right lobe; rl = right lobe; rp = right paramere; ss = sensory structure; tp = turning point when dorsal opening meets the ventral margin of the aedeagus (see text for description).

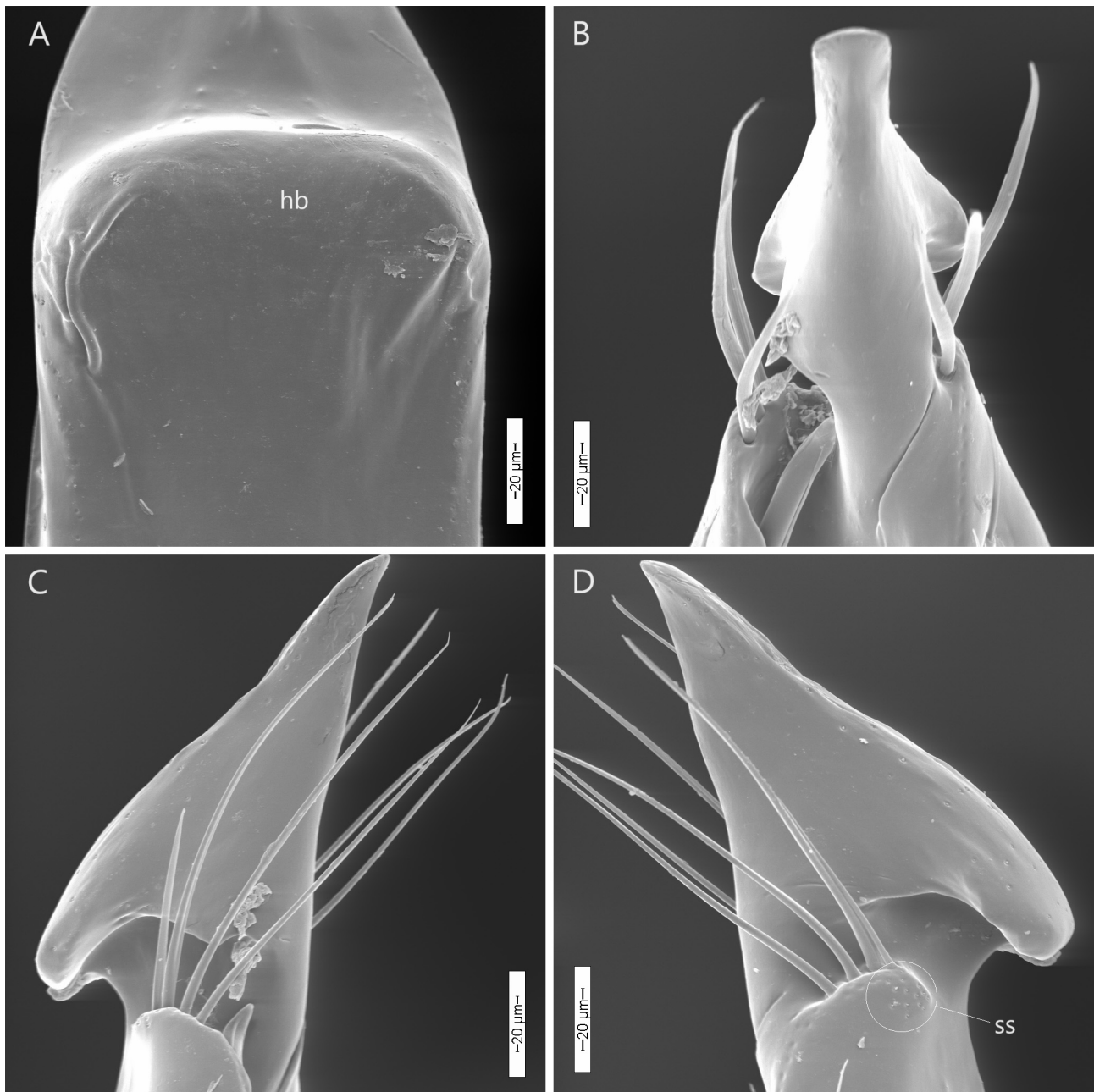
taxa where they were recorded, and this feature may help in this subject. We here did not examine any species in this species group, but Gnaspini & Gomyde (2024) also discussed the need to examine *Adelopsis triangulifer* in order to verify if its aedeagus actually has a dorsal opening (if it does not, than it should not be placed neither in *Ptomaphagus* or *Adelopsis*, but in *Peckena*).

### The *camella* species group

The species in *camella* species group also have an aedeagus very similar to that of *Ptomaphagus*, and this species group was created by Gnaspini & Peck (2001) to include two species which females have a very typical spermatheca with an enlarged apical bulb. This pattern differs from the spermatheca recorded in *Ptomaphagus*, which is simpler (as in Peck, 1973).

We here had the opportunity to examine *A. crassiflagelata*. In this species, the triangular apex of the





**FIGURE 116.** *Adelopsis picunche* (Gnaspini, 1991), male paratype MZSP 27031. **A**, Dorsal view of medial region of aedeagus showing detail of the ‘hump’. **B–D**, Apex of aedeagus in ventral, left, and right views, detailed from Figs. 115B–D, respectively. hb = ‘hunchback’; ss = sensory structure.

aedeagus with setae on both sides, typical of *Ptomaphagus*, was observed, but the dorsal opening is ampler and, because of that, a left lobe cannot be properly recognized (see Figs. 73–76), thus also differing from *Ptomaphagus*.

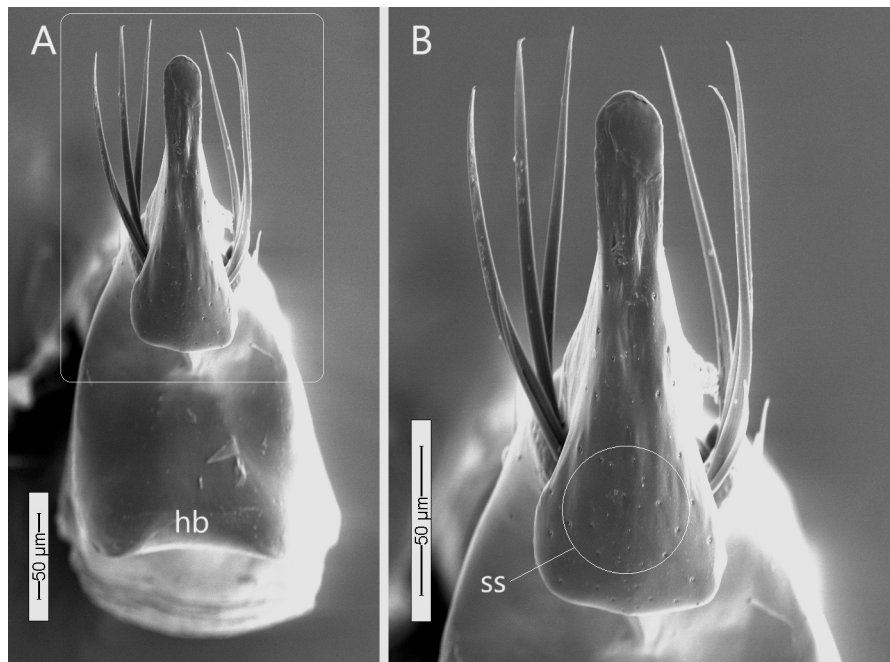
### *Adelopsis picunche*

*Adelopsis picunche* also has an elongate aedeagus with pointed apex, which actually led Gnaspini (1991) to describe it in *Ptomaphagus* (afterwards transferring it to *Adelopsis*, in Gnaspini, 1996). Its aedeagus has unique features which make it difficult to assign it to a genus and to a species group. We would tend to assign it to

*triangulifer* species group because of its elongate shape with a pointy tip, but the right lobe of the aedeagus is divided in two lobules (see Figs. 114–117), which is not recorded in the *triangulifer* species group, and was observed in one species of the *ascutellaris* species group here examined, which does not carry a pointy apex (see also ‘Right lobe divided in inner and outer lobules’).

### The *elephas* species group

The species in *elephas* species group greatly differ from the other species with a pointy aedeagus because they have a typical aedeagus (see Figs. 88–113) (see also ‘The



**FIGURE 117.** *Adelopsis picunche* (Gnaspini, 1991), male paratype MZSP 27031. **A**, Aedeagus in frontal view of right lobe (white rectangle is detailed in **B**). hb = ‘hunchback’; ss = sensory structure.

‘ultra evolved aedeagus’ concept revisited’). The apical triangular projection is bent ventrad, and is frequently elongated, forming a ‘beak’. Near the base of this beak, the internal face of the right lobe bears a flat projection, which extends dorsad, with different length among the different species—in lateral view, the apex of the aedeagus resembles the head of an elephant in some species (e.g., Figs. 89D, 102C), the beak would correspond to the ‘trunk’ and the internal projection to the ‘ear’ (we here use this term to refer to that structure) (see also ‘Projections on the internal face of the right lobe’). In most species here examined, the ‘ear’ has ‘sensory structures’ on its round apex. The outer (right) face of the right lobe has one or more setae projected forward, placed close to the base of the right lobe and frequently close to the apical setae of the right paramere (see also ‘Setae on the right lobe’). The aedeagus of species in *elephas* species group also lacks a typical left lobe (see also ‘The presence or absence of a left lobe and the placement of the associated setae’). The dorsal opening (actually the dorsal portion of the genital opening) is generally ample, which is associated with the elongation of the apical projection of the right lobe (the ‘beak’) and the absence of a left lobe.

### The *ascutellaris* species group

This species group includes 31 species (including the type species of the genus), organized in three species subgroups (see Gnaspini & Peck, 2019; Peck *et al.*, 2020). The aedeagus is very similar in many species—species recognition is difficult and the species identification needs a revision. We here examined two species belonging to this species group, *A. confluens*, which is very easy

to identify, because of the typical spines on the apex of the aedeagus (see Figs. 1–5), and *A. longipalpus*, which belongs in a different species subgroup.

Typically, the right lobe of the aedeagus has a short arm which connects to a ventrally produced plate which extends to the left side, and may also extend to the right side on a shorter extension. The plate has a typical upside-down trapezoid shape in most species (as, e.g., in Gnaspini & Peck, 2019: figs. 6, 18, 32, 42, 55, 71, 77, and 90). In *A. confluens*, we recognized that the right lobe is actually divided in two lobules (e.g., Figs. 2–4), a small, short outer (right) lobule which bears three setae, and an inner (left) lobule, which is actually the part which extends onto the plate cited above. (see also ‘Right lobe divided in inner and outer lobules’).

### The *benardi* species group

This species group includes 25 species (including the eight species here described), organized in two species subgroups, based on the pattern of the male genital segment (see Gnaspini & Peck, 2019; Peck *et al.*, 2020). The species with the so-called ‘ultra evolved aedeagus’ according to Jeannel (1936) belong in this species group (but see ‘The ‘ultra evolved aedeagus’ concept revisited’). Their aedeagus is typically globose.

Typically, the right lobe of the aedeagus has a ventrally produced apical projection, with a typical ventral face here called a ‘ventral chin’. The dorsal opening (actually the dorsal portion of the genital opening) is generally ample (to very ample), which is associated with the elongation of the apical projection of the right lobe. The flagellum in most species here studied is a long and coiled tape (of



different dimensions), which so far seems to be exclusive of this species group (and recorded in both species subgroups), but it may be a smaller tube, as in other species groups and other ptomaphagines—the flat coiled flagellum appears in most of the species in *grouvellei* species subgroup and only in a few species in *benardi* species subgroup (although the coiled flagellum might be seen as a shared derived character, Gnaspini & Peck, 2019 preferred to use the shape of the male genital segment to establish species subgroups). The aedeagus bears an internal knob (see also ‘Projections on the internal face of the right lobe’), as a rule with sensory structures on its apical region.

We here recognize that the aedeagus of the species in this species group has a dorsal depression, and we predict that this feature probably occurs in all species of this species group (at least in the great majority of them), even subtly (in this case not being properly recorded in images in the literature). It is very variable, and its position along the dorsal face of the aedeagus and its depth and shape seem to be species specific.

The outer (right) face of the right lobe has a group of setae projected forward and placed (in most cases) on the apical margin of a ‘plateau’ placed close to the base of the right lobe and frequently close to the apical setae of the right paramere. An additional, conic elevation (with or without a seta) or an additional seta may appear close to that plateau or far away from it. (See also ‘Setae on the right lobe’).

As observed in all species here analyzed (including those in other species groups), there are probable sensory structures (see also ‘Sensory structures’) scattered on the surface of the aedeagus, commonly concentrating on the apical region of the aedeagus. It is, however, in the *benardi* species group that a large variation (considering shape, size, distribution, etc.) within the same aedeagus or among different species can be observed, especially in the apical region of the aedeagus, the ‘ventral chin’.

We here describe eighth new species in this species group. Actually, considering the large number of species presently recorded in the Boraceia Biological Station (six in *benardi* species group of *Adelopsis*—*A. boraceia* sp. nov., *A. diabolica* Gomyde & Gnaspini, 2019, *A. gibber* sp. nov., *A. monticola* sp. nov., *A. cf. szymczakowskii* Gnaspini & Peck, 2019, and *A. vanini* sp. nov.; and *Peckena verrucosa* Gnaspini & Gomyde, 2024), we predict that several places along the Atlantic Forest will have the same pattern (as, for instance, Nova Teutônia, Santa Catarina State, in which at least five species have been recorded—*Adelopsis curvipes* Salgado, 2005, *A. catarina* Salgado, 2005, *A. insolita* Szymczakowski, 1961, *A. triangulifer* Szymczakowski, 1961, and *Paulipalpina claudicans* (Szymczakowski, 1980), and possibly three additional *Adelopsis* species considered doubtful records—see Peck *et al.*, 2020), and an increase in collection in this area may increase significantly the number of Brazilian species known, probably superficially alike but actually different from each other when all characters are taken into consideration.

See also a more complete discussion under ‘Taxonomic remarks in *benardi* species group’.

## Other species group

Three more species groups are recognized in *Adelopsis* (see Gnaspini & Peck, 2019; Peck *et al.*, 2020): *bruchii* species group (with 2 species), *capitanea* species group (with 3 species), and *soacha* species group (with 2 species), and five additional species are not assigned to species group (being three of them known only based on females). Only species in *capitanea* species group (all three) were examined here.

**The *capitanea* species group.** All three species in *capitanea* species group have a globose aedeagus without a left lobe. *Adelopsis bifida* and *A. capitanea* show the same type of apex of the aedeagus, which is divided in an inner and an outer plates; and *A. anceps* has a different apex, with one single, deeply concave, plate. Therefore, they may not belong in the same species group—this will be revisited in the future.

## Evolution of some character states in *Adelopsis*

We here discuss some characters used in our (re)descriptions of the aedeagus, focusing mainly on the recognition of potential phylogenetic signals.

**Right lobe divided in inner and outer lobules.** A right lobe divided in a small, outer lobule, bearing setae, and a larger, inner lobule, expanded laterally and posteriorly (‘orl’ and ‘irl’—e.g., Figs. 3D, 4B, 115A) was here identified in *A. picunche* (not assigned to a species group), a species with pointy apex, and *A. confluens* (tentatively assigned in Gnaspini & Peck, 2019 to *ascutellaris* species group, which includes species with a subtrapezoidal apex with flat apical margin), but that feature was not observed here in *A. longipalpus* (also in *ascutellaris* species group). Unfortunately, it is not possible to recognize the presence (or absence) of the outer lobule on the images of the aedeagus shown in species descriptions in the literature. The possible presence of an outer lobule in other species in *ascutellaris* species group (or even in other groups) as well as whether this trait is plesiomorphic or derived deserves further investigation.

**Setae on the right lobe.** In *Peckena*, the apex of the aedeagus bears apical setae on both sides (as, e.g. in figs. 9B–D in Gnaspini & Gomyde, 2024). In *Ptomaphagus*, in which a slit cuts the aedeagus anteriorly to the apex, the right lobe also bears apical setae on both sides (as, e.g. in fig. 1i in Gomyde *et al.*, 2024, or in fig. 30 in Jeannel, 1936 [in which the setae are mistakenly placed on the dorsal face]). In the other genera in *Ptomaphagina*, the migration of the genital opening occurs more medially and both right and left lobes bear setae (as, e.g., in fig. 4d in Gomyde *et al.*, 2024) and is the case with *Adelopsis*. For the left lobe, see ‘The presence or absence of a left lobe and the placement of the associated setae’.

The outer (right) face of the right lobe bears, depending on the species, a variable number of setae projected forward. In species with the right lobe divided in lobules (see ‘Right lobe divided in inner and outer lobules’, above), the setae are placed apically on the

outer lobule ('orl'—e.g., Figs. 3D, 115D). In the other species (except in *benardi* species group—see below), the setae are placed close to the base of the right lobe and frequently close to the apical setae of the right paramere (or at the outer face of the 'beak', in some species in *elephas* species group) ('rbs'—e.g., Figs. 7I–J, 74D, 83D, 89E, 94B). In *benardi* species group, the outer apical face of the right lobe bears medially a 'plateau', which ventral apical margin is truncated and bears setae ('rlp'—e.g., Figs. 25D, 42D), except in *A. gandarela* sp. nov. and *A. piruapuera*, here studied ('rbs'—e.g., Fig. 65D), and additional setae and/or elevations may also be present. Our interpretation is that the setae on the right lobe are homologous and the variation observed is a result of the evolution of the aedeagus morphology—this deserves further investigation and it is premature to propose the direction of transformation (i.e., which one [with or without a plateau] would represent the plesiomorphic state). Yet, the plateau in *benardi* species group may be homologous to the outer lobule of the right lobe (in the species with a divided right lobe), because they represent an elevation on the outer face of the right lobe, in a similar placement, and bearing setae projected forward, but this also deserves further investigation.

**The presence or absence of a left lobe and the placement of the associated setae.** Salgado (2010) established species groups in *Adelopsis*, which were afterwards modified by Gnaspini & Peck (2019). Based on the drawings from the original descriptions (Jeannel, 1936; Szymczakowski, 1969; Blas, 1980; Gnaspini & Peck, 1996, 2001, 2019 [unfortunately not drawing the setae of the left lobe in most cases]; Salgado, 1999, 2003, 2005a, 2005b, 2008a, 2008b, 2010, 2011, 2013a, 2013b, 2014, 2016, 2019; Perreau, 2016; Gomyde & Gnaspini, 2019) and redescrptions in Gnaspini & Peck (2019) and here, it can be stated (with a few exceptions—see below) that the aedeagus of the species in *benardi* and *bruchii* species groups have a noticeable left lobe, frequently long and thin, bearing setae (one to five, more frequently three or two) at the apex, whereas the aedeagus of the species in *ascutellaris*, *camella*, *capitanea*, *elephas*, and *soacha* species groups lack a left lobe and the setae are placed internally close to the left paramere in most cases—in *elephas* species group, it seems that there is a tendency for those setae to be placed midway ('lls'—e.g., Figs. 89D, 99C, 102C) or closer ('lls'—e.g., Figs. 96C, 106A) to the right lobe. Species with a short, round left lobe (for instance, *A. confluens* Gnaspini & Peck, 1996 [in *ascutellaris* species group] and *A. picunche* (Gnaspini, 1991) [not assigned to a species group], here studied, and *A. tandapi* Salgado, 2005 [in *ascutellaris* species group]) have setae apically placed at that projection. This feature deserved further investigation, based on a phylogenetic analysis, to understand the transformation series involved.

As exceptions, *A. peruviansis* Blas, 1980, in *ascutellaris* species group, has a left lobe, with setae; and a left lobe is absent in *A. barbula* Salgado, 2013, *A. singularis* Salgado, 2014, and apparently in *A. sinuosa* Gnaspini & Peck, 1996, all three in *benardi* species group,

indicating that, at least, their placement in species groups should be reassessed. In *triangulifer* species group, a (short) left lobe is apparently present in *A. rhomboidea* Salgado, 2013 and *A. triangulifer* Szymczakowski, 1961 [unfortunately, setae were not represented on images of those species], but it is absent in *A. acutipennis* Salgado, 2013 and apparently in *A. yasuni* Salgado, 2013—as discussed in 'Species groups with aedeagus with a pointy apex', above, and in Gnaspini & Gomyde, 2024, the species in this group should be reassessed.

**Sensory structures.** Gnaspini & Gomyde (2024) recorded probable sensory structures on the integument of the aedeagus of the species of the genera *Peckena* Gnaspini, 1996 and *Amplexella* Gnaspini, 1996. Those structures also occur in other ptomaphagines (personal data) and in all species groups here studied. In most of the species here analysed (and in other ptomaphagines), they are scattered (in a few cases they are densely distributed) on the surface of the aedeagus, sometimes concentrating on the apex, and they are generally shaped as a depression from the center of which emerges a dome-shaped projection—the width and depth of the depression and the size of the dome-shaped projection may vary among the different species, and it may also vary in the same species in different regions of the aedeagus, and this seems to help in species recognition ('ss'—e.g., Figs. 60A, 71C, 78A, 87A). In *benardi* species group, a large variation within the same aedeagus or among different species can be observed, especially in the apical region of the aedeagus, the 'ventral chin', including other shapes of the central projection, which may also be conic (of different shapes and sizes) or a short hair (e.g., Figs. 22A, 26D, 48A, C, 70B), and this seems to represent a phylogenetic signal which needs to be further investigated.

**Projections on the internal face of the right lobe.**

In the species in *benardi* species group, the internal face of the arm of the right lobe bears a tuberculate process called an 'internal knob' ('kn'—e.g., Figs. 25A–B, 33A, C). Gnaspini & Peck (2019, Table 1) recorded this feature also in *ruficollis* subgroup of *ascutellaris* species group, in *bruchii* species group, and in *elephas* species group. We here recognized that the record in *elephas* species group is in error. Therefore, we understand that a further investigation in other species groups rather than *benardi* species group is needed, especially using SEM, to verify the presence of an internal knob in other species groups.

The species in *elephas* species group also have an internal projection on the right lobe, called the 'ear', placed near the base of the 'beak' (e.g., Figs. 89A, C, D, 102A, C).

The shape of both the internal knob and the 'ear' varies in the different species, being a good tool for species recognition. Both have sensory structures (see also 'Sensory structures', above) on their apical region (with some exceptions) (e.g., Figs. 28B–D, 72, 89A, D, 102A, C).

Whether the 'internal knob' and the 'ear' represent homologies deserves further analysis, but they actually differ in general shape and placement—whereas the 'internal knob' is typically shaped somewhat as a cylinder



(which may be curved) and is placed close to the base of the right lobe (e.g., Figs. 33A, C), the ‘ear’ is typically flat and wide and is placed more apically on the right lobe, forming a somewhat continuous plate together with the ‘beak’ (e.g., Figs. 89C, D).

### The ‘ultra evolved aedeagus’ concept revisited

Jeannel (1936) recorded that an ultra evolved aedeagus occurs in some species of *Adelopsis*, being the flagellum highly developed, with very variable torsions and modifying the appearance of the apical opening which often becomes immense and asymmetrical, and the apical lobes of the aedeagus take on very diverse shapes. He recorded the figures of *A. aspera* Jeannel, 1936 (presently in *benardi* species group) as an example. We recognize that the *benardi* species group includes many species which aedeagus fit that description. Our SEM images helped to identify several additional features, so far seemingly exclusive to that group (see ‘The *benardi* species group’, above), such as a ventrally produced apical projection with a ‘ventral chin’ which bears diverse shapes of sensory structures, a dorsal depression of variable shapes, and a ‘plateau’ bearing setae on the outer face of the right lobe.

We here recognize that the species in *elephas* species group should also be considered to carry an ‘ultra evolved aedeagus’, with a different sensus than that used by Jeannel (1936), who did not know any species in this group (the first species in *elephas* species group were described in Gnaspini & Peck, 1996). The species in this group have a very complex aedeagal apex with a variable ‘beak’ and ‘ear’.

Actually, both groups share several features. Although in dorsal view the aedeagus in *benardi* species group tends to be globose whereas the aedeagus in *elephas* species group is somewhat slender, in lateral view the aedeagus of both groups are globose, and somewhat C-shaped (in left view), due to the presence of an elongation of the apex of the aedeagus represented by the ‘ventral chin’ in *benardi* species group and by the ‘beak’ in *elephas* species group. The apical elongation somewhat forms a ‘plate’, which is represented by an ample surface in lateral view (especially on an internal [left] view of the right lobe) and a ‘stripe’ (either an ‘arm’ or a narrow ‘crest’) in dorsal/frontal view. Both have an ample (or very ample) dorsal portion of the genital opening, though differently—because a left lobe is present in *benardi* species group, the dorsal opening has a somewhat U-shape in dorsal view, whereas, because a left lobe is absent in *elephas* species group, the dorsal opening has a somewhat C- or L-shape; but in both cases an ample dorsal opening can be recognized in the left lateral view. And both have an internal projection on the right lobe, represented by an ‘internal knob’ in *benardi* species group or an ‘ear’ in *elephas* species group (see ‘Projections on the internal face of the right lobe’, above).

### The complex three dimensional structure of the aedeagus in *Adelopsis* and the need of making images in different views

We reinforce the need to analyze and illustrate the aedeagus in as many views as possible. We here added some figures, of different species, of different species groups (e.g., Figs. 5, 8B, C, 25A+26A+27A, 29, 50, 54, 64, 97A–D, and 107), to show that different angles of what would be considered a dorsal view of the aedeagus (i.e., views with slight, even very subtle, rotation towards apex, following the ‘sagittal’ plane of the aedeagus) will result in different interpretations and descriptions of the aedeagus and, especially, the aedeagal apex, which bears the main variation in relation to other species.

On a quick, superficial observation, the aedeagi of some species look alike and misidentifications may occur (and have been occurring), but a morphological and morphometrical analysis, among other features, shows that they can be recognized as different species. Figure 118 shows a summarized view of the species in *benardi* species group here studied (together with a line drawing of an additional species, for comparison), showing lateral left and lateral right views of aedeagus, frontal view of the aedeal right lobe, and frontal view of the ‘ventral chin’, and may help to understand that the use of a combination of several characters (even if some of them are very similar among some species) actually leads to a proper recognition of species identities.

We also made some morphometrical analyses, which, together with the morphological observation, help in species identification. In some cases (*A. claudina*, *A. gibber* sp. nov., *A. monticola* sp. nov., *A. piruapuera*, and *A. vanini* sp. nov.), we found differences in the morphometrical measurements taken using either a ventral line or a transversal line aligned with the top of the apical projection in some species. This is explained by a strong elongation of the apex of the right lobe, and seems to be an additional good tool to tell seemingly similar species apart.

We also suggest to focus on as many features of the aedeagus as possible. For instance, in *benardi* species group (e.g., Fig. 118), from which we had several specimens for study, we noticed that the combination of the various characters observed (including the shape of the right and left lobes, right and left parameres, dorsal depression, types of sensory structures found on the body of the aedeagus and especially on the ‘ventral chin’, shape of the internal knob, among others) can lead to a proper recognition of species, and species which would seem the same on a superficial observation may show several differences. For instance, this allowed us to recognize several undescribed species. This is also the case with *elephas* species group, which has some species with a very similar aedeagal shape in lateral view, but can be easily recognized as different species when the ‘beak’ and ‘ear’ are observed in several views.

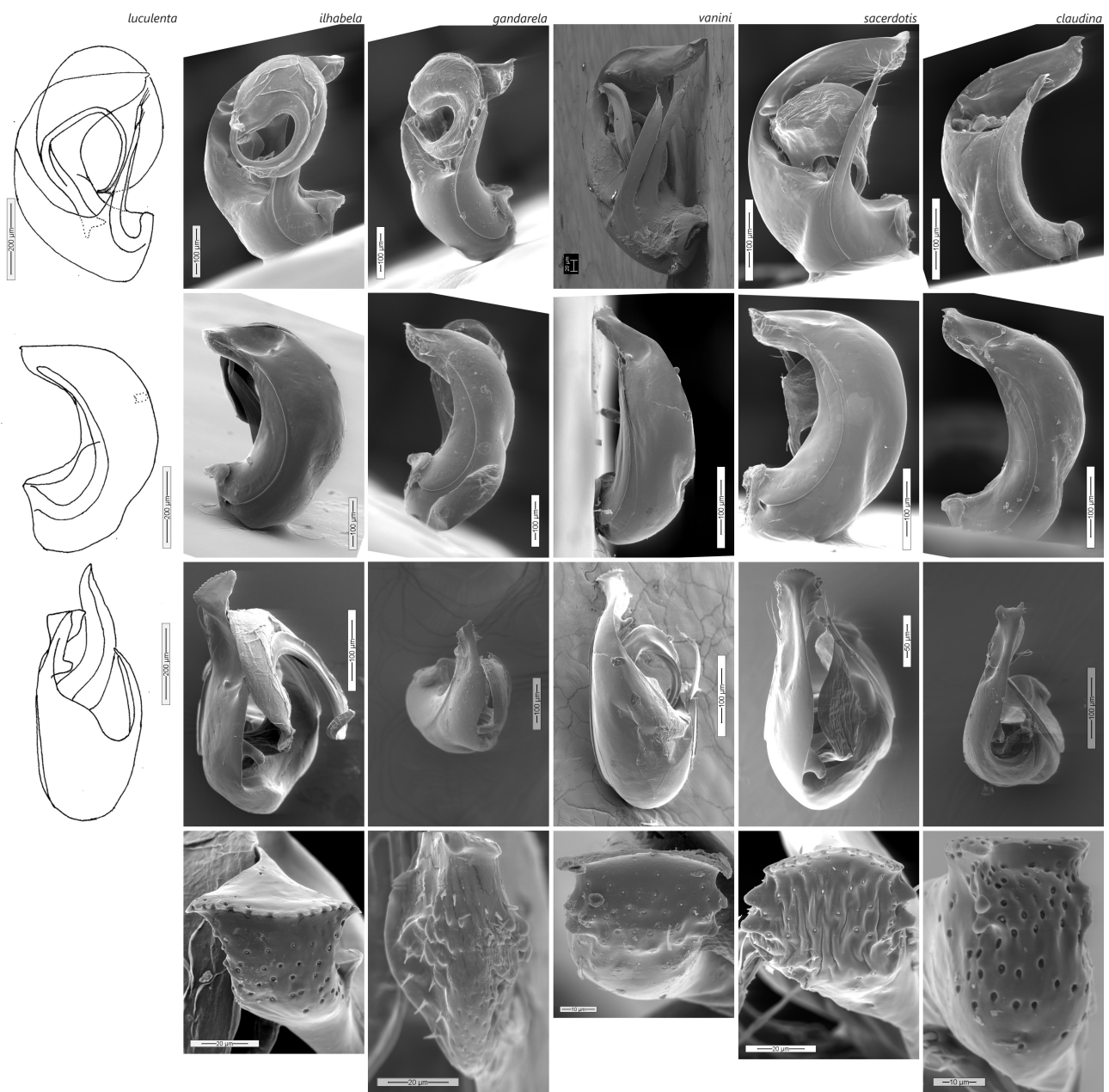
## Final remarks

Images taken with SEM of the aedeagus of species of *Adelopsis* allowed the recognition of additional features (e.g., lobules on the right lobe, setae on the right and left lobes, possible sensory structures, etc.) that help in further understanding the evolution of the aedeagal morphology in the genus and in Ptomaphagina as a whole. A large number of different types of probable sensory structures were recorded for the first time on the apex of the aedeagus. We plan to proceed with the revision of *Adelopsis* (presently totalling 99 described species, including the ones here described, and a few dozens still to be described—personal data). We also understand that needed next steps include the exam of other species using SEM, especially those in *ascutellaris* and *benardi* species

groups, which show a diversity of species with subtle differences in the apex of the aedeagus, and in the species groups not addressed here—that will allow a proper knowledge on the evolution of such a complex aedeagal morphology and also to collect data for a phylogenetic analysis to be conducted. We hope to be allowed to analyze type specimens to do that.

## Acknowledgements

Partial financial support was received from FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo, Brazil). We thank Dr. S.A. Casari for allowing examination of material from Museu de Zoologia da Universidade de São Paulo. We thank Dr. A.A.G.F.C. Ribeiro and M.V.



**FIGURE 118 (part1 and part2).** A comparative overview of the aedeagus in species in *benardi* species group, showing (lines) left lateral view, right lateral view, frontal view of the apical projection of the right lobe, and frontal view of the ‘ventral chin’ of the apex. Line drawings of *A. luculenta* modified from Gnaspini & Peck (2019).



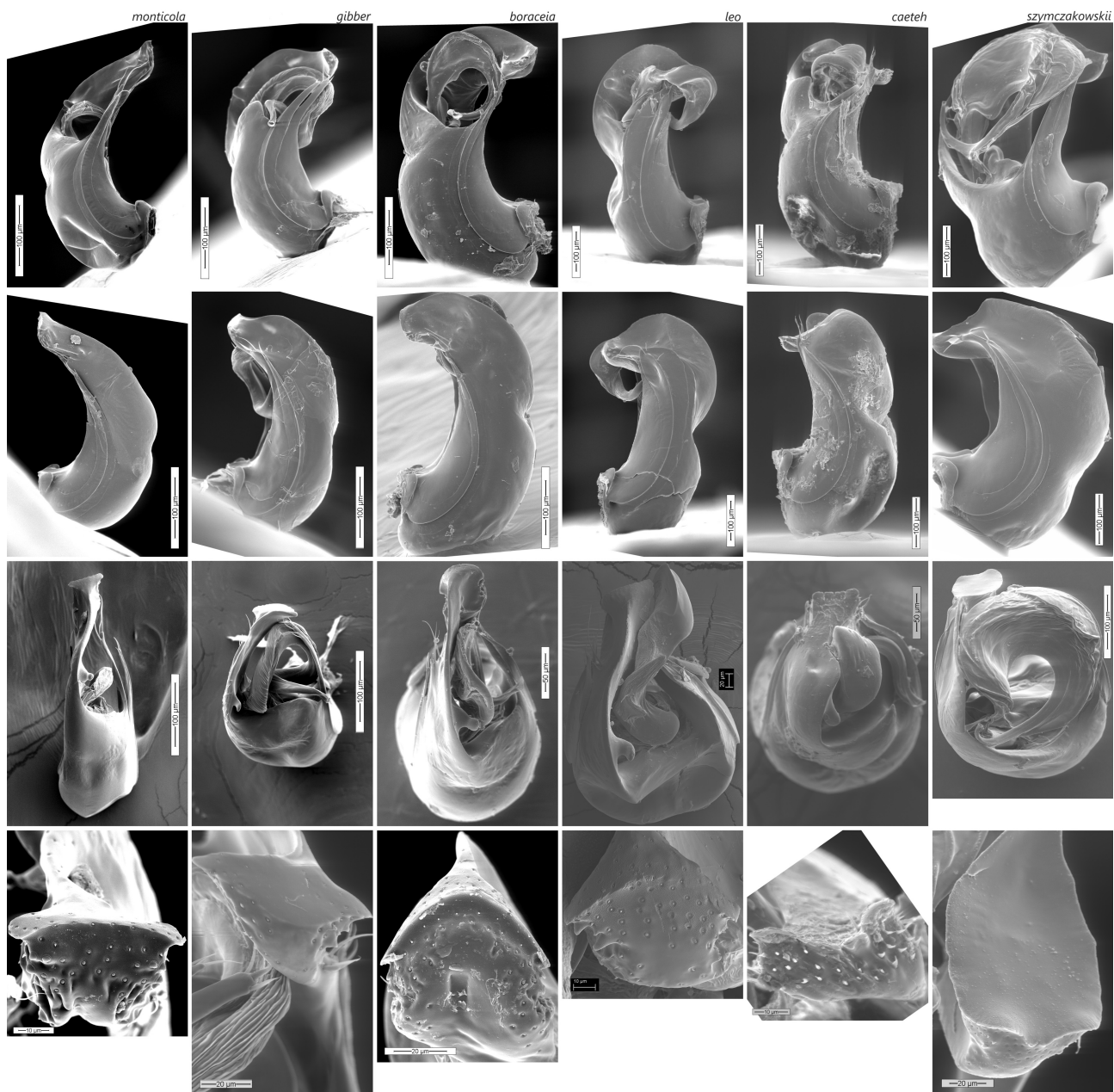


FIGURE 118 (Continued).

Cruz for the access and help in the use of the electron microscopy facilities from the Electronic Microscopic Laboratory of IBUSP; Dr. J.E.A.R. Marian (IBUSP) for the use of the light microscopes to make images; and we thank the reviewer for helpful criticism and suggestions.

The authors declare no conflicts of interest. All relevant data are included in this manuscript; additional data may be provided under request.

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