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Malagasy *Conostigmus* (Hymenoptera: Ceraphronoidea) and the secret of scutes

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We revise the genus *Conostigmus Dahlbom* 1858 occurring in Madagascar, based on data from more specimens than were examined for the latest world revision of the genus. Our results yield new information about intraspecific variability and the nature of the atypical latitudinal diversity gradient observed in Ceraphronoidea. We also investigate cellular processes that underlie body size polyphenism, by utilizing the correspondence between epidermal cells and scutes, polygonal units of leather-like microsculpture. Our results reveal that body size polyphenism in Megaspilidae is most likely related to cell number and not cell size variation, and that cell size differs between epithelial fields of the head and that of the mesosoma. Three species, *Conostigmus ballescoracas* Dessart 1997, *C. babaiax* Dessart 1996 and *C. longulus* Dessart 1997, are redescribed. Females of *C. longulus* is described for the first time, as are nine new species: *C. bucephalus* Mikó and Trietsch **sp. nov.**, *C. clavatus* Mikó and Trietsch **sp. nov.**, *C. fianarantsoaensis* Mikó and Trietsch **sp. nov.**, *C. lucidus* Mikó and Trietsch **sp. nov.**, *C. macrocupula*, Mikó and Trietsch **sp. nov.**, *C. madagascariensis* Mikó and Trietsch **sp. nov.**, *C. missyhazena* Mikó and Trietsch **sp. nov.**, *C. pseudobabaiax* Mikó and Trietsch **sp. nov.**, and *C. toliaraensis* Mikó and Trietsch **sp. nov.**. A fully illustrated identification key for Malagasy *Conostigmus* species and a Web Ontology Language (OWL) representation of the taxonomic treatment, including specimen data, nomenclature, and phenotype descriptions, in both natural and formal languages, are provided.

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ABSTRACT

We revise the genus *Conostigmus* Dahlbom 1858 occurring in Madagascar, based on data from more specimens than were examined for the latest world revision of the genus. Our results yield new information about intraspecific variability and the nature of the atypical latitudinal diversity gradient observed in Ceraphronoidea. We also investigate cellular processes that underlie body size polyphenism, by utilizing the correspondence between epidermal cells and scutes, polygonal units of leather-like microsculpture. Our results reveal that body size polyphenism in Megaspilidae is most likely related to cell number and not cell size variation, and that cell size differs between epithelial fields of the head and that of the mesosoma. Three species, *Conostigmus ballescoracas* Dessart 1997, *C. babaiax* Dessart 1996 and *C. longulus* Dessart 1997, are redescribed. Females of *C. longulus* is described for the first time, as are nine new species: *C. bucephalus* Mikó and Trietsch **sp. nov.**, *C. clavatus* Mikó and Trietsch **sp. nov.**, *C. fianarantsoaensis* Mikó and Trietsch **sp. nov.**, *C. lucidus* Mikó and Trietsch **sp. nov.**, *C. macrocupula* Mikó and Trietsch **sp. nov.**, *C. madagascariensis* Mikó and Trietsch **sp. nov.**, *C. missyhazena* Mikó and Trietsch **sp. nov.**, *C. pseudobabaiax* Mikó and Trietsch **sp. nov.**, and *C. toliaraensis* Mikó and Trietsch **sp. nov.**. A fully illustrated identification key for Malagasy *Conostigmus* species and a Web Ontology Language (OWL) representation of the taxonomic treatment, including specimen data, nomenclature, and phenotype descriptions, in both natural and formal languages, are provided.

Keywords: taxonomy, morphology, microscopy, male genitalia, phenotypic plasticity, imaginal disks, CLSM, LDG

INTRODUCTION

With 162 extant species, *Conostigmus* Dahlbom 1858 is the second most species-rich genus of Megaspilidae (Ceraphronoidea), a hymenopteran family showing a reverse latitudinal diversity gradient (LDG) in species richness (Johnson and Musetti, 2004; Noyes, 1989). Since ceraphronoid faunistic and taxonomic studies mostly focus on the Holarctic fauna, it is possible that sample bias is the reason for this atypical distribution. This might be especially true for *Conostigmus*, given that the only revision of the genus focused exclusively on non-American and non-European species (n=36) and was based on only 145 specimens (Dessart, 1997). The large number of Malagasy specimens examined in the present study will not only double the number of specimens of non-American and non-European *Conostigmus* but will also provide a reasonable data set for comparing the Malagasy fauna with that of a similarly sized area in Europe, the Atlantic Archipelago (British Isles; Broad and Livermore, 2014). Madagascar is considered a hotspot of biodiversity (Myers et al., 2000), and if reverse LDG is false and based on sample bias, we would be able to document more species in Madagascar than in the AA.

Ceraphronoids likely belong to the basal apocritan Evaniomorpha, and exhibit mostly ancestral sets of phenotypes (Heraty et al., 2011; Vilhelmsen et al., 2010). The complexity of the ceraphronoid ovipositor system and male genitalia is unparalleled among Apocritans (Mikó et al., 2013; Ernst et al., 2013), and the leather-like microsculpture covering their head and mesosoma (Mikó et al., 2011; Burks et al., 2016) is hypothesized to be an ancestral trait in Insecta (Hinton, 1970).

Besides the ten-fold interspecific body length variability from 0.37 mm (*Microceraphron subterraneus*

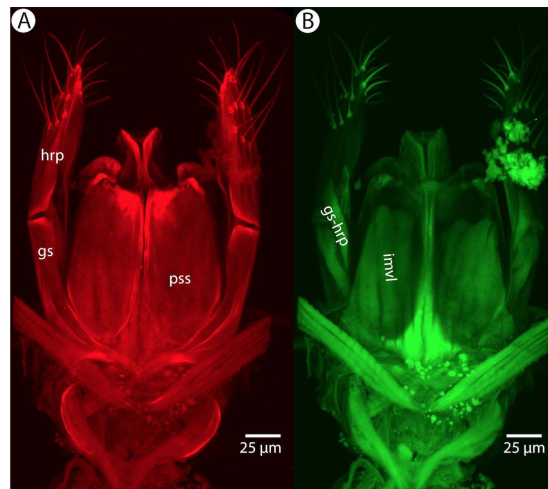


Figure 1. CLSM volume rendered micrographs showing the skeletomuscular system of the male genitalia of *Conostigmus longulus* Dessart 1997. A. Excitation wavelength=631 nm, emission wavelength=647 nm. B. Excitation wavelength=499 nm, emission wavelength=520 nm. Abbreviations: pss=parossiculus; gs=gonostipes; hrp=harpe; gs-hrp=proximal gonostyle/volsella complex-harpal muscle; imvl=medial gonostyle volsella complex-volsellal muscle.

47 Szelényi 1935) to 4.5 mm, (*Megaspilus armatus* Say 1836), up to four-fold intraspecific variability has
 48 been reported in Ceraphronoidea (Mackauer and Chow, 2015; Dessart and Gärdenfors, 1985; Liebscher,
 49 1972). Similar intraspecific variability is common among microhymenoptera and can be stimulated by
 50 alternative host species with different nutritional quality, gregariousness with variable nest sizes, and
 51 climatic differences, such as temperature. Ceraphronoids are ectoparasitoids on insect parasitoid and
 52 predator larvae (Haviland, 1920; Withycombe, 1924; Kamal, 1939) and have a broad host range (Gilkeson
 53 et al., 1993; Sullivan and Völkl, 1999). *Dendrocerus carpenteri*, for example, has been reared from >70
 54 aphidiine (Braconidae) species (Fergusson, 1980). Based on the few studies with appropriate rearing
 55 experiences, gregariousness might also be not uncommon among Ceraphronoidea (Kamal, 1939; Bennett
 56 and Sullivan, 1978; Mackauer and Chow, 2015; Cooper and Dessart, 1975; Dessart, 1997; Liebscher,
 57 1972)).

58 Environmental factors impact development and determine final adult body size (Nijhout and Callier,
 59 2015) by altering different cellular processes. Temperature and oxygen level usually impact cell size
 60 (Azevedo et al., 2002; Harrison and Haddad, 2011; Heinrich et al., 2011), while nutrition mostly regulates
 61 cell division (Emlen et al., 2007). *Conostigmus* species are relatively large ceraphronoids (0.8–2.2 mm)
 62 making them feasible to observe and examine scutes (Meyer, 1842; Cals, 1974; Krell, 1994), elements of
 63 the aforementioned leather like sculpture. Scutes likely have a one to one correspondence to epidermal
 64 cells in arthropods (Moretto et al., 2015; Hinton, 1970; Cals, 1973, 1974; Blaney and Chapman, 1969)
 65 and thus should provide information about the cellular basis of body size polyphenism.

66 Research related to geographic distribution and polyphenism requires a stable taxonomic framework.
 67 We revise the Malagasy *Conostigmus*, Dahlbom 1858 and use this system to explore the anomalous
 68 ceraphronoid diversity patterns and possible reasons for body size polyphenism.

69 MATERIALS AND METHODS

70 Specimens for the present study (Table S1) were obtained from Malaise trap samples and were loaned
 71 to the authors from the California Academy of Sciences. Morphological characters were scored with an
 72 Olympus SZX16 stereo-microscope equipped with an Olympus SDF PLAPO 2XPFC objective, resulting
 73 in 230× magnification. Specimens are deposited in the California Academy of Sciences (CAS), in the
 74 Frost Entomological Museum (FEM) and in the Royal Museum of Central Africa (MRAC) (Table S1).

75 Brightfield images of dried specimens were taken with an Olympus BX43 compound microscope
 76 equipped with an Olympus DP73 digital camera. Image stacking was performed with Zerene Stacker
 77 (Version 1.04 Build T201404082055, Zerene Systems LLC, Richland, WA) and extended focus images

78 were annotated and modified with Adobe Photoshop 6™ (Adobe Systems, San Jose, California) using
79 Adjust/Filter/Unsharp mask and Image/Adjustments/Exposure (Gamma correction) tools.

80 Metasomata were removed from the specimens and placed in 35% H₂O₂ for 20 minutes, rinsed
81 in distilled water for 30 minutes and dehydrated with 25% and 50% ethanol for 15–15 minutes, then
82 transferred to a glycerol droplet on a concavity slide (Sail Brand Ltd., West Yorkshire, UK) and dissected.
83 This protocol preserves muscle tissue while bleaching melanized structures, making them transparent for
84 confocal laser scanning microscopy (CLSM).

85 Sample preparation for CLSM followed Mikó and Deans (2013): male genitalia was temporarily
86 mounted between two coverslips (1.5 μm, 22×60) in a glycerin droplet, which did not reach the edge
87 of the coverslip. We used Blu-tack (Bostik, Wauwatosa, WI, USA) as spacer as this material does not
88 interact with glycerol and provides an adjustable, appropriate distance between the coverslips. Specimens
89 were examined with an Olympus FV10i desktop CLSM.

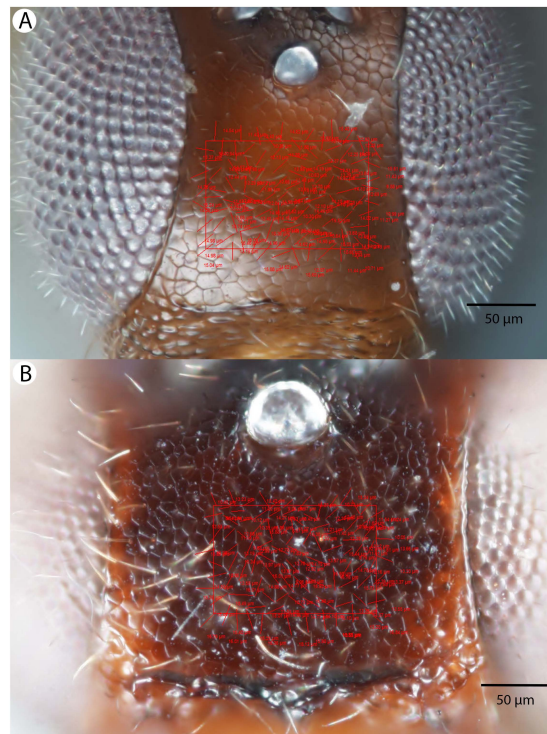


Figure 2. Brightfield image showing the median region of the cranium of *Conostigmus longulus* Dessart 1997, anterior view. The measured scute lengths and values and borders of measured rectangle are annotated in red color. Size of rectangular area=9636 μm².

90 Soft and sclerotized anatomical structures in arthropods tend to fluoresce with different intensities
91 at different wavelength intervals (Mikó and Deans, 2013). CLSM tissue-specific contrast is gained by
92 exciting specimens using multiple excitation wavelengths and/or recording the fluorescence on multiple
93 channels assigned to different laser wavelength intervals. In previous research (Mikó et al., 2013; Popovici
94 et al., 2014; Ernst et al., 2013), specimens were excited with only one blue laser (480 nm) and the
95 auto-fluorescence was detected with two channels (500–580 nm and 580–800 nm). Although the resulting
96 micrographs had differences in their intensity patterns, data from the two channels largely overlapped. In
97 the present paper, we use two different lasers (631 nm and 499 nm) and set filters (644 nm and 520 nm
98 respectively; narrow green and narrow red presets in Olympus Fluoview viewer software version 4.2) with
99 narrow wavelength windows that result a much higher tissue-specific contrast, almost perfectly separating
100 muscle tissue and skeletal components (Fig. 1).

101 For the morphometric analysis on scute patterns, extended focal images of the frons and the
102 mesocutellar-axillar complex of 14 *Conostigmus longulus* Dessart 1997 specimens were taken using
103 an Olympus BX43 compound microscope equipped with an Olympus DP73 digital camera on 200×
104 magnification. Extended focal images were generated using the online “extended focal imaging” (efi)

105 tool of an Olympus Cellsens™ software. Measurements (Table S2) were taken using the same soft-
106 ware. First, a 9636 μm^2 rectangular area was assigned on the extended focal images for recording scute
107 pattern. The lateral vertices of the medially-positioned rectangle were adjacent with the scutoscute-
108 sulcus on the mesonotum, while the rectangle was positioned medially on the frons with equal distance
109 from the anterior ocellus and the intertorular carina. Scutes overlapping this area (including scutes
110 adjacent to the margin of the rectangle) were counted and the longest diameter of each scute was mea-
111 sured. Measurements were taken on the images while constantly checking their accuracy on live view
112 at 200–500 \times magnification (Figures 2A, B). Body length largely depends on the relative orientations
113 of the tagmata. The head of most species is flattened dorsoventrally and attached at its posterior end to
114 the thorax (compare the position of the head on Figs 31A and B). We used the IOS (interorbital distance
115 (IOS, http://purl.obolibrary.org/obo/HAO_0000432) to refer body size in our statistical
116 analysis.

117 Bright field images, volume rendered CLSM micrographs and media files and scaleable vector (.msi)
118 annotated extended focal images of the frons and mesoscutum, complete with scute measurements, IOS
119 and rectangles can be accessed from Figshare (<http://dx.doi.org/10.6084/m9.figshare.>
120 [xxxxxxxxx](#)).

121 Abbreviations of anatomical structures used in Figures are listed in Table S3.

122 Intraspecific variation in scute diameter and relative size was scrutinized by linear regression analyses.
123 Intra-individual variation was scrutinized via Mann-Whitney sum-rank test (Mann and Whitney, 1947).
124 The relationship between morphometric variables was inspected through linear regression analyses.
125 Statistical analyses were carried out and Boxplots were generated in R version 3.2.2 (Core Team, 2015)
126 (Figure S1-S).

127 Taxonomic nomenclature, specimen information, OTU concepts and natural language (NL) pheno-
128 type representations were compiled in mx (<http://purl.org/NET/mx-database>). Taxonomic
129 history, description, and material examined sections (Table S1) were rendered from the same soft-
130 ware. Terminology of the phenotype statements used in descriptions, identification key and diagnoses
131 are mapped to the Hymenoptera Anatomy Ontology (HAO, available at the), Phenotypic Quality Ontol-
132 ogy (PATO, available at <http://purl.obolibrary.org/obo/pato.owl>), Biospatial Ontology
133 (BSPO, available at <http://purl.obolibrary.org/obo/bsp.owl>) and Common Anatomy
134 Reference Ontology (CARO, available at <http://obofoundry.org/>).

135 Natural language phenotypes are represented in “Entity attribute: value” format. Semantic statements
136 for phenotype descriptions were created in Protégé 5.0.0-beta-16 ([http://protege.stanford.](http://protege.stanford.edu/)
137 <http://www.w3.org/TR/owl2-manchester-syntax/>)
138 following Balhoff et al. (2013), Mikó et al. (2015) and Mikó et al. (2014) (Table S4). The OWL
139 (<http://www.w3.org/TR/owl2-overview/>; accessed February 4, 2014) representation of the
140 full data set was deposited as a single Resource Description Framework (RDF)-XML file (<http://www.w3.org/TR/REC-rdf-syntax/>;
141 accessed March 12) in the Github repository (https://github.com/hymao/hymao-data/blob/master/miko2016_malagasy.owl).

143 RESULTS

144 **Body size polyphenism in *Conostigmus longulus* Mikó and Trietsch sp. nov.**

145 ***Intraspecific variation in scute diameter and relative scute size***

146 Fourteen specimens were measured and are represented in analysis of frons measurement distribution.
147 Ten of these specimens were also measured on the mesoscutellum and make up the mesoscutellar analysis.
148 Four specimens could not be measured for both regions due to inaccessibility of all scutes required for
149 mesoscutellar measurements (*i.e.*, the specimen preparation obscured these parts). One specimen was
150 found to have measurements four standard deviations from the mean, and was removed from subsequent
151 analyses. Removal of this influential point from linear regression and further statistical analyses was
152 justified by the reduction in statistical power caused by its inclusion in our small sample size (Osborne
153 and Overbay, 2008).

154 Measurements were tested for normalcy and found to not follow the normal distribution, even after
155 removal of the outlier from analyses. The scutes in a 9636 μm^2 rectangular region of the frons and
156 mesoscutellum were counted and measured. It was found that maximum scute length varied from 6.6 μm
157 to 19.5 μm on the frons (Table 1). On the mesoscutellum, maximum scute length varied from 8.8 μm
158 to 23.4 μm (Table 2). Median cell length of each specimen was used as a variable in statistical analyses.

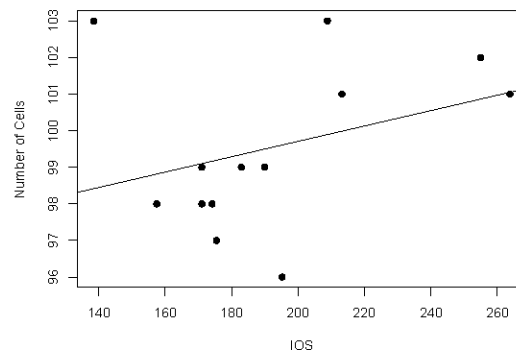


Figure 3. Relationship between body size and number of cells as linear regression. Interorbital space length (IOS), measured in μm , stands as a proxy for body size. Number of cells refers to the number of scutes/cells of a standard sized rectangular area. The size of these cells is not correlated to significant body size differences (Figure S4).

150 Linear regression analyses were carried out independently on both the frons and mesoscutellar fields.
 160 There was a weak negative correlation between median scute length and scute number in the frons region
 161 ($R^2 = 0.1369023$). In the mesoscutellar region, scute length had a stronger negative correlation with scute
 162 number ($R^2 = 0.7149943$).

Table 1. Mesoscutellar average scute size, length and scute number in *Conostigmus longulus* Dessart 1997. ID: CASENT identifier for specimen, aCS: average cell size in μm^2 , mCL: median cell length in μm , nS: number of scutes (cells) in a rectangular area of $9636 \mu\text{m}^2$.

mesoscutellum	ID	aCS	mCL	nS
	2041918	119.02	17.13	81
	2003474	109.56	17.22	88
	2044193	107.12	14.52	90
	2044825	101.48	15.19	95
	2040900	101.48	16.01	95
	2009756	101.48	16.01	95
	2002193	101.48	16.01	95
	2044755	94.52	14.09	102
	2040771	91.82	13.02	105
	2053554	90.95	13.635	106
median		101.48	15.60	95
mean		101.89	15.28	95.2
s.d.		2.188891	1.437595	7.743097

163 **Intraindividual variation in scute size: frons vs. mesoscutellum**

164 In individuals where average scute size and diameter were measured on both the frons and the
 165 mesoscutellum, we found a variation in median cell length ranging from $11.43 \mu\text{m}$ to $17.22 \mu\text{m}$. Wilcoxon
 166 rank-sum test revealed a significant difference in cell length between the frons and mesoscutellar regions
 167 ($p\text{-value} = 0.0004011$). Measurements of average scute size varied from $90.95 \mu\text{m}^2$ to $119.02 \mu\text{m}^2$. There
 168 was no significant difference in average scute size between the frons and mesoscutellar regions in this
 169 sample when analyzed by Wilcoxon rank-sum test ($p\text{-value} = 0.0809$).

Table 2. Frontal average scute size, length and scute number in *Conostigmus longulus* Dessart 1997. ID: CASENT identifier for specimen, IOS: interorbital space (referring to body size) in μm , aCS: average scute (cell) size in μm^2 , mCL: median cell length in μm , nS: number of scutes (cells) in a rectangular area of $9636 \mu\text{m}^2$. Note the outlier 2002193 with significantly larger average cell size and median cell length as well as a lower number of scutes.

	ID	IOS	aCS	mCL	nS
	2003474	182.91	97.38	12.78	99
	2009756	157.42	98.38	13.655	98
	2040771	174.12	98.38	12.195	98
	2040900	171.04	98.38	13.12	98
	2002193	251.06	133.90	16.195	72
	2053688	195.22	100.43	13.695	96
	2053554	189.95	97.38	13.55	99
	2053308	175.44	99.39	12.32	97
	2046100	208.85	93.60	11.43	103
	2041918	213.25	95.46	12.68	101
	2044193	263.82	95.46	13.37	101
	2044511	138.51	93.60	13.02	103
	2044755	171.04	97.38	12.75	99
	2044825	255.02	94.52	12.82	102
median		186.4	97.38	12.92	99
mean		196.3	99.55	13.11	97.57
s.d.		37.95319	10.10979	1.081914	7.673273

170 **Body size vs. scute size**

171 Interorbital space was used as a measure of body size for all 14 specimens examined. Linear regression
 172 analysis for the relationship between scute size and body size was carried out using measurements for
 173 interorbital space and the measurements of average frons scute size, which were available for all measured
 174 specimens (Figure 3). Correlation between median cell length and IOS was extremely weak and negative
 175 ($R^2=0.001341984$). The correlation between cell number and IOS was much stronger and weakly positive
 176 ($R^2=0.1114898$).

177 **Taxonomic treatment of Malagasy *Conostigmus***

178

179 ***Conostigmus babaiax* Dessart, 1997**

180 *Conostigmus babaiax* Dessart, 1997 *Conostigmus babaiax*: Dessart, 1997 (original description)

181

182 Figures 4, 5, 6

183

184 **Diagnosis**

185 *Conostigmus babaiax* Dessart 1996 shares the presence of a prognathous head (dorsal-most point of
 186 occipital carina is dorsal to posterior ocellus in lateral view) and the presence of transverse scutes on
 187 the ventral region of frons with *Conostigmus longulus* Dessart 1997, *C. toliaraensis* sp. nov. and *C.*
 188 *pseudobabaiax* sp. nov. *Conostigmus babaiax*, *C. toliaraensis* sp. nov. and *C. pseudobabaiax* differ from
 189 all other *Conostigmus* species by the presence of ventromedian and ventrolateral white, setiferous patches
 190 on the frons. The LOL is longer than OOL in *Conostigmus babaiax* and the LOL is shorter than OOL in
 191 *C. toliaraensis* sp. nov. and *C. pseudobabaiax* sp. nov.

192

193 **Description**

194 Body length: 2200 μm . Color intensity pattern: NOT CODED. Color hue pattern: scape, pedicel, F1-3,
 195 head, anterior mesosoma ochre, F4-F9, posterior mesosoma, metasoma brown, legs except darker proximal
 196 regions of meso and metacoxae yellow. Occipital carina sculpture: smooth. Median flange of occipital



197 carina count: absent. Submedial flange of occipital carina count: absent. Dorsal margin of occipital carina
 198 vs. dorsal margin of lateral ocellus in lateral view: occipital carina is dorsal to lateral ocellus in lateral view.
 199 Preoccipital lunula count: NOT CODED. Preoccipital carina count: absent. Preoccipital carina shape:
 200 NOT CODED. Preoccipital furrow count: present. Preoccipital furrow anterior end: Preoccipital furrow
 201 ends inside ocellar triangle. Postocellar carina count: absent. Male ocular ocellar line (OOL): posterior
 202 ocellar line (POL); lateral ocellar line (LOL): NOT CODED. Female ocular ocellar line (OOL): posterior
 203 ocellar line (POL); lateral ocellar line (LOL): 0.85:0.85:1.00. Head width vs. interorbital space (HW/IOS)
 204 Male: NOT CODED. Head width vs. interorbital space (HW/IOS) Female : 2.65. Setal pit on vertex size:
 205 smaller than diameter of scutes. Transverse frontal carina count: absent. Transverse scutes on frons count:
 206 present. Rugose region on frons count: absent. Randomly sized areolae around setal pits on frons count:
 207 absent. Antennal scrobe count: absent. Ventromedian setiferous patch and ventrolateral setiferous patch
 208 count: present. Facial pit count: no external corresponding structure present. Supraclypeal depression
 209 count: absent. Supraclypeal depression structure: NOT CODED. Interrotular carina count: present.
 210 Interrotular area count: present. Median region of interrotular area shape: flat. Ventral margin of antennal
 211 rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count: absent. Subtorular carina
 212 count: absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel: 1.09. Female ninth
 213 flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere pattern: NOT CODED.
 214 Length of setae on male flagellomere vs. male flagellomere width: NOT CODED. Male flagellomere 1
 215 length vs. male second flagellomere length: NOT CODED. Male flagellomere 1 length vs. pedicel length:
 216 NOT CODED. Ventrolateral invagination of the pronotum count: present. Scutes on posterior region of
 217 mesoscutum and dorsal region of mesoscutellum convexity: flat. Notaulus posterior end location: adjacent
 218 to transscutal articulation. Median mesoscutal sulcus posterior end: not adjacent to transscutal articulation
 219 (ends anterior to transscutal articulation). Scutoscutellar sulcus vs. transscutal articulation: adjacent.
 220 Axillular carina count: absent. Axillular carina shape: NOT CODED. Epicnemium posterior margin shape:
 221 anterior discriminal pit absent; epicnemial carina interrupted medially. Epicnemial carina count: present
 222 only laterally. Sternaulus count: absent. Sternaulus length: NOT CODED. Speculum ventral limit: not
 223 extending ventrally of pleural pit line. Mesometapleural sulcus count: present. Metapleural carina count:
 224 present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum:
 225 adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted
 226 "U" (left and right lateral propodeal carina are adjacent to the antecostal sulcus of the first abdominal
 227 tergumsubmedially). Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex
 228 count: absent. S1 length vs. shortest width: S1 wider than long. Transverse carina on petiole shape:
 229 concave. Distal margin of male S9 shape: NOT CODED. Proximolateral corner of male S9 shape: NOT
 230 CODED. Cupula length vs. gonostyle-volsella complex length: NOT CODED. Proximodorsal notch
 231 of cupula count: NOT CODED. Proximodorsal notch of cupula shape: NOT CODED. Proximolateral
 232 projection of the cupula shape: NOT CODED. Proximodorsal notch of cupula width vs length: NOT
 233 CODED. Distodorsal margin of cupula shape: NOT CODED. Dorsomedian conjunctiva of the gonostyle-
 234 volsella complex length relative to length of gonostyle-volsella complex: NOT CODED. Dorsomedian
 235 conjunctiva of the gonostyle-volsella complex count: NOT CODED. Distal end of dorsomedian con-
 236 junctiva of the gonostyle-volsella complex shape: NOT CODED. Parossiculus count (parossiculus and
 237 gonostipes fusion): NOT CODED. Apical parossiculus seta number: NOT CODED. Distal projection of
 238 the parossiculus count: NOT CODED. Distal projection of the penisvalva count: NOT CODED. Dorsal
 239 apodeme of penisvalva count: NOT CODED. Harpe length: NOT CODED. Distodorsal setae of sensillar
 240 ring of harpe length vs. harpe width in lateral view: NOT CODED. Distodorsal setae of sensillar ring of
 241 harpe orientation: NOT CODED. Sensillar ring area of harpe orientation: NOT CODED. Lateral setae of
 242 harpe count: NOT CODED. Lateral setae of harpe orientation: NOT CODED. Distal margin of harpe in
 243 lateral view: shape: NOT CODED. Lateral margin of harpe shape: NOT CODED.

244

245 *Material Examined*

246 Holotype female: MADAGASCAR: PSUC.FEM 000006723, COLL. MUS. Congo Madagascar: Man-
 247 draka II-1944 A. Seyrig HOLOTYPUS Holotype Prep. micros-copique n 9508/051 (deposited in MRAC)

248

249 *Conostigmus ballescoracas* Dessart, 1997

250 *Conostigmus ballescoracas*: Dessart, 1997 (original description)

251

252 Figures 7, 8, 9

253

254 *Diagnosis*

255 *Conostigmus ballescoracas* Dessart 1997 differs from other *Conostigmus* species by the presence of a
256 strong preoccipital carina that is continuous with the orbital carina, the presence of randomly sized areolae
257 around the setal bases on the frons (shared with the ceraphronid *Masner lubomirus* Deans and Mikó 2009)
258 and the posteromedially adjacent axillular carinae (left and right axillar carinae compose a U-shaped
259 carina that surrounds the mesoscutellar disc).

260

261 *Description*

262 Body length: 1650-1875 μm . Color intensity pattern: NOT CODED. Color hue pattern: Cranium black;
263 mesosoma, metasoma, F4-F9 brown; rest of antenna, legs and mandible ochre; Cranium brown; mesosoma
264 except legs, metasoma ochre; F4-F9 brown; rest of antenna ochre, legs yellow. Occipital carina sculpture:
265 crenulate. Median flange of occipital carina count: absent. Submedial flange of occipital carina count: ab-
266 sent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina
267 is ventral to lateral ocellus in lateral view. Preoccipital lunula count: present. Preoccipital carina count:
268 present. Preoccipital carina shape: complete. Preoccipital furrow count: present. Preoccipital furrow
269 anterior end: Preoccipital furrow ends inside ocellar triangle. Postocellar carina count: absent. Male ocular
270 ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): NOT CODED. Female ocular
271 ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.5-3.0:1.9-2.0:1.0. Head
272 width vs. interorbital space (HW/IOS) Male: NOT CODED. Head width vs. interorbital space (HW/IOS)
273 Female : 1.7-1.8. Setal pit on vertex size: smaller than diameter of scutes. Transverse frontal carina count:
274 absent. Transverse scutes on frons count: absent. Rugose region on frons count: absent. Randomly sized
275 areolae around setal pits on frons count: present. Antennal scrobe count: absent. Ventromedian setiferous
276 patch and ventrolateral setiferous patch count: absent. Facial pit count: facial pit present. Supraclypeal
277 depression count: absent. Supraclypeal depression structure: NOT CODED. Intertorular carina count:
278 present. Intertorular area count: present. Median region of intertorular area shape: convex. Ventral margin
279 of antennal rim vs. dorsal margin of clypeus: adjacent. Torulo-clypeal carina count: absent. Subtorular
280 carina count: absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel: 0.8-0.9.
281 Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere pattern:
282 NOT CODED. Length of setae on male flagellomere vs. male flagellomere width: NOT CODED. Male
283 flagellomere 1 length vs. male second flagellomere length: NOT CODED. Male flagellomere 1 length
284 vs. pedicel length: NOT CODED. Ventrolateral invagination of the pronotum count: present. Scutes on
285 posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Notaulus posterior
286 end location: adjacent to transscutal articulation. Median mesoscutal sulcus posterior end: adjacent to
287 transscutal articulation. Scutoscuteellar sulcus vs. transscutal articulation: adjacent. Axillular carina count:
288 present. Axillular carina shape: left and right carina continuous posteromedially forming a U-shape
289 carina on the mesoscutellar axillar complex. Epicnemium posterior margin shape: anterior discriminal
290 pit present; epicnemial carina curved. Epicnemial carina count: complete. Sternaulus count: present.
291 Sternaulus length: elongate, exceeding 3/4 of mesopleuron length at level of stermaulus. Speculum ventral
292 limit: not extending ventrally of pleural pit line. Mesometapleural sulcus count: present. Metapleural
293 carina count: present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first
294 abdominal tergum: adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal
295 carina shape: NOT CODED. Anteromedian projection of the metanoto-propodeo-metaplecto-mesopectal
296 complex count: present. S1 length vs. shortest width: S1 wider than long. Transverse carina on petiole
297 shape: straight. Distal margin of male S9 shape: NOT CODED. Proximolateral corner of male S9 shape:
298 NOT CODED. Cupula length vs. gonostyle-volsella complex length: NOT CODED. Proximodorsal notch
299 of cupula count: NOT CODED. Proximodorsal notch of cupula shape: NOT CODED. Proximolateral
300 projection of the cupula shape: NOT CODED. Proximodorsal notch of cupula width vs length: NOT
301 CODED. Distodorsal margin of cupula shape: NOT CODED. Dorsomedian conjunctiva of the gonostyle-
302 volsella complex length relative to length of gonostyle-volsella complex: NOT CODED. Dorsomedian
303 conjunctiva of the gonostyle-volsella complex count: NOT CODED. Distal end of dorsomedian con-
304 junctiva of the gonostyle-volsella complex shape: NOT CODED. Parossiculus count (parossiculus and
305 gonostipes fusion): NOT CODED. Apical parossiculus seta number: NOT CODED. Distal projection of
306 the parossiculus count: NOT CODED. Distal projection of the penisvalva count: NOT CODED. Dorsal

307 apodeme of penisvalva count: NOT CODED. Harpe length: NOT CODED. Distodorsal setae of sensillar
 308 ring of harpe length vs. harpe width in lateral view: NOT CODED. Distodorsal setae of sensillar ring of
 309 harpe orientation: NOT CODED. Sensillar ring area of harpe orientation: NOT CODED. Lateral setae of
 310 harpe count: NOT CODED. Lateral setae of harpe orientation: NOT CODED. Distal margin of harpe in
 311 lateral view: shape: NOT CODED. Lateral margin of harpe shape: NOT CODED.

312

313 *Material Examined*

314 Holotype female: CONGO: PSUC_FEM 8883 Congo Belge : P.N.A 7-XIII-1953 H. Synave 6853 Massif
 315 Ruwenzori Mont Ngulingo pres Nyamgaleke, 2.500m, ex P.N.A HOLOTYPE Prep. micros-copique n
 316 9507/241 (deposited in MRAC).

317 Other material (2 females): MADAGASCAR: 2 females. CASENT 2001391, 2016542 (CAS).

318

319 *Conostigmus bucephalus* Mikó and Trietsch sp. nov.

320

321 *Figures 15, 16, 17*

322

323 *Diagnosis*

324 *Conostigmus bucephalus* sp. nov. differs from other *Conostigmus* species in the presence of the antennal
 325 scrobe and the size of impressions around the setal bases on the head: impressions are larger than scutes
 326 on cranium and mesonotum in *Conostigmus bucephalus* sp. nov. whereas in other Malagasy species
 327 depressions are smaller than scutes on cranium and mesonotum.

328


329 *Description*

330 Body length: 2575 μm . Color intensity pattern: distal scape, legs except hind coxa lighter than metasoma.
 331 Color hue pattern: Cranium, mesosoma brown; antenna, legs except brown metacoxa, metasoma ochre.
 332 Occipital carina sculpture: crenulate. Median flange of occipital carina count: absent. Submedial flange
 333 of occipital carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus
 334 in lateral view: occipital carina is dorsal to lateral ocellus in lateral view. Preoccipital lunula count:
 335 absent. Preoccipital carina count: absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow
 336 count: present. Preoccipital furrow anterior end: Preoccipital furrow ends posterior to ocellar triangle.
 337 Postocellar carina count: absent. Male ocular ocellar line (OOL); posterior ocellar line (POL); lateral
 338 ocellar line (LOL); NOT CODED. Female ocular ocellar line (OOL); posterior ocellar line (POL); lateral
 339 ocellar line (LOL); 1.0:1.2:1.0. Head width vs. interorbital space (HW/IOS) Male: NOT CODED. Head
 340 width vs. interorbital space (HW/IOS) Female : 2.2. Setal pit on vertex size: larger than diameter of
 341 scutes. Transverse frontal carina count: absent. Transverse scutes on frons count: present. Rugose region
 342 on frons count: absent. Randomly sized areolae around setal pits on frons count: absent. Antennal scrobe
 343 count: present. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. Facial pit
 344 count: no external corresponding structure present. Supraclypeal depression count: present. Supraclypeal
 345 depression structure: present medially, inverted U-shaped. Intertorular carina count: present. Intertorular
 346 area count: absent. Median region of intertorular area shape: NOT CODED. Ventral margin of antennal
 347 rim vs. dorsal margin of clypeus: adjacent. Torulo-clypeal carina count: absent. Subtorular carina
 348 count: absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel: 0.7. Female ninth
 349 flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere pattern: NOT CODED.
 350 Length of setae on male flagellomere vs. male flagellomere width: NOT CODED. Male flagellomere 1
 351 length vs. male second flagellomere length: NOT CODED. Male flagellomere 1 length vs. pedicel length:
 352 NOT CODED. Ventrolateral invagination of the pronotum count: present. Scutes on posterior region of
 353 mesoscutum and dorsal region of mesoscutellum convexity: flat. Notaulus posterior end location: adjacent
 354 to transscutal articulation. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation.
 355 Scutoscutellar sulcus vs. transscutal articulation: adjacent. Axillular carina count: absent. Axillular
 356 carina shape: NOT CODED. Epicnemium posterior margin shape: anterior discriminal pit absent; epic-
 357 nemial carina interrupted medially. Epicnemial carina count: present only laterally. Sternaulus count:
 358 absent. Sternaulus length: NOT CODED. Speculum ventral limit: not extending ventrally of pleural
 359 pit line. Mesometapleural sulcus count: present. Metapleural carina count: present. Transverse line of
 360 the metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum: adjacent sublaterally.
 361 Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted "Y" (left and right

362 lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and
 363 connected to the antecostal sulcus by a median carina representing the median branch of the inverted
 364 “Y”). Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex count: absent.
 365 S1 length vs. shortest width: S1 wider than long. Transverse carina on petiole shape: concave. Distal
 366 margin of male S9 shape: NOT CODED. Proximolateral corner of male S9 shape: NOT CODED. Cupula
 367 length vs. gonostyle-volsella complex length: NOT CODED. Proximodorsal notch of cupula count:
 368 NOT CODED. Proximodorsal notch of cupula shape: NOT CODED. Proximolateral projection of the
 369 cupula shape: NOT CODED. Proximodorsal notch of cupula width vs length: NOT CODED. Distodorsal
 370 margin of cupula shape: NOT CODED. Dorsomedian conjunctiva of the gonostyle-volsella complex
 371 length relative to length of gonostyle-volsella complex: NOT CODED. Dorsomedian conjunctiva of the
 372 gonostyle-volsella complex count: NOT CODED. Distal end of dorsomedian conjunctiva of the gonostyle-
 373 volsella complex shape: NOT CODED. Parossiculus count (parossiculus and gonostipes fusion): NOT
 374 CODED. Apical parossiculus seta number: NOT CODED. Distal projection of the parossiculus count:
 375 NOT CODED. Distal projection of the penisvalva count: NOT CODED. Dorsal apodeme of penisvalva
 376 count: NOT CODED. Harpe length: NOT CODED. Distodorsal setae of sensillar ring of harpe length
 377 vs. harpe width in lateral view: NOT CODED. Distodorsal setae of sensillar ring of harpe orientation:
 378 NOT CODED. Sensillar ring area of harpe orientation: NOT CODED. Lateral setae of harpe count: NOT
 379 CODED. Lateral setae of harpe orientation: NOT CODED. Distal margin of harpe in lateral view: shape:
 380 NOT CODED. Lateral margin of harpe shape: NOT CODED.

381

382 *Comments*

383 Due to the antennal scrobe that accommodates the scape in almost its entire length, the head is nearly
 384 cube shaped in lateral view (Fig. 15B). 

385

386 *Etymology*

387 The species epithet *bucephalus* (Ancient Greek: $\text{bou} \kappa \epsilon \varphi \alpha \gamma \omicron \varsigma = \text{ox-head}$) refers to the unique shape of
 388 the head that is certainly impacted by the distinct antennal scrobe (asr: Fig. 15B), which is diagnostic for
 389 this species.

390

391 *Material Examined*

392 Holotype female: CASENT 2053589 MADAGASCAR: Province Fianarantsoa, Parc National Ranomafana,
 393 radio tower at forest edge, elev 1130m 20 March 3 April 2003 21°15.05'S, 47°24.43'E collector: R.
 394 Harin'Ħala California Acad of Sciences malaise, mixed tropical forest MA-02-09B-56 (deposited in CAS).

395

396 *Conostigmus clavatus* Mikó and Trietsch sp. nov.

397

398 Figures 10, 11, 12, 13, 14

399

400 *Diagnosis*

401 *Conostigmus clavatus* sp. nov. shares the presence of the axillular carina, bulging eyes and medially
 402 convex intertorular area (and intertorular carina) with *C. uninasutus* Alekseev 1994 and *C. binasutus*
 403 Dessart and Cancemi 1987 and differs from them in the enlarged distal-most female flagellomere (length
 404 of F9=length of F6+length of F7+ length of F8, Fig. 13A).

405

406 *Description* Body length: 2325-2500 μm . Color intensity pattern: metasoma lighter than mesosoma
 407 and cranium. Color hue pattern: Dark brown except pedicel, proximal 1/5th of scape, fore and middle
 408 leg, mandible ochre/yellowish. Occipital carina sculpture: crenulate. Median flange of occipital carina
 409 count: present. Submedial flange of occipital carina count: present. Dorsal margin of occipital carina
 410 vs. dorsal margin of lateral ocellus in lateral view: occipital carina is ventral to lateral ocellus in lateral
 411 view. Preoccipital lunula count: present. Preoccipital carina count: present; absent. Preoccipital carina
 412 shape: interrupted dorsally and represented by irregular, not continuous carinae. Preoccipital furrow
 413 count: present. Preoccipital furrow anterior end: Preoccipital furrow ends posterior to ocellar triangle.
 414 Postocellar carina count: absent. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral
 415 ocellar line (LOL): 2.9-3.6:2.1-2.2:1. Female ocular ocellar line (OOL): posterior ocellar line (POL):
 416 lateral ocellar line (LOL): 3.4:2.1-2.2:1.0. Head width vs. interorbital space (HW/IOS) Male: 1.6-1.7.

417 Head width vs. interorbital space (HW/IOS) Female : 1.6-1.7. Setal pit on vertex size: smaller than
 418 diameter of scutes. Transverse frontal carina count: absent. Transverse scutes on frons count: absent.
 419 Rugose region on frons count: present; absent. Randomly sized areolae around setal pits on frons count:
 420 absent. Antennal scrobe count: absent. Ventromedian setiferous patch and ventrolateral setiferous patch
 421 count: absent. Facial pit count: median facial keel present. Supraclypeal depression count: present.
 422 Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit.
 423 Intertorular carina count: present. Intertorular area count: present. Median region of intertorular area
 424 shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal
 425 carina count: absent. Subtorular carina count: present. Mandibular tooth count: 2. Female flagellomere 1
 426 length vs. pedicel: 0.9. Female ninth flagellomere length: $F9=F6+F7+F8$. Sensillar patch of the male
 427 flagellomere pattern: F5-F9. Length of setae on male flagellomere vs. male flagellomere width: setae
 428 shorter than width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere length:
 429 1.2-1.3. Male flagellomere 1 length vs. pedicel length: 2.1-2.4. Ventrolateral invagination of the pronotum
 430 count: present. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity:
 431 flat. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus poster-
 432 ior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation: adjacent.
 433 Axillular carina count: present. Axillular carina shape: The left and right carina are separated posterome-
 434 dially. Epinemium posterior margin shape: anterior discriminal pit present; epinemial carina curved.
 435 Epinemial carina count: complete. Sternaulus count: present. Sternaulus length: short, not reaching 1/2
 436 of mesopleuron length at level of sternaulus. Speculum ventral limit: not extending ventrally of pleural
 437 pit line. Mesometapleural sulcus count: present. Metapleural carina count: present. Transverse line of the
 438 metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum: adjacent sublaterally. Lateral
 439 propodeal carina count: present. Lateral propodeal carina shape: NOT CODED. Anteromedian projection
 440 of the metanoto-propodeo-metaplecto-mesoplectal complex count: present. S1 length vs. shortest width:
 441 S1 wider than long. Transverse carina on petiole shape: straight. Distal margin of male S9 shape: convex.
 442 Proximolateral corner of male S9 shape: acute. Cupula length vs. gonostyle-volsella complex length:
 443 cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of
 444 cupula count: present. Proximodorsal notch of cupula shape: arched. Proximolateral projection of the
 445 cupula shape: acute. Proximodorsal notch of cupula width vs length: as long as wide. Distodorsal
 446 margin of cupula shape: concave. Dorsomedian conjunctiva of the gonostyle-volsella complex length
 447 relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of
 448 gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex
 449 count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: blunt.
 450 Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical
 451 parossiculus seta number: one; two. Distal projection of the parossiculus count: absent. Distal projection
 452 of the penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe shorter
 453 than gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral
 454 view: setae as long or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation:
 455 distomedially. Sensillar ring area of harpe orientation: medially. Lateral setae of harpe count: present.
 456 Lateral setae of harpe orientation: oriented distally. Distal margin of harpe in lateral view: shape: blunt.
 457 Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella
 458 complex.

459

460 *Etymology* The species epithet *clavatus* refers to the enlarged apical female flagellomere, resembling a
 461 club ($F9 > F8 + F7 + F6$).

462

463 *Comments*

464 *Conostigmus clavatus*, *C. binasutus* and *C. uninasutus* share numerous morphological traits with *Megaspilus*
 465 Westwood, 1929 including the presence of bulging eyes, the crenulate and distinct ocular suture, the
 466 presence of the axillular carina and the large body size (>2000 μm). Females of all *Conostigmus* species
 467 exhibit a distinct clava with 3 rows of ventral, female specific basiconic sensilla (distally gradually
 468 widening flagellum). *Megaspilus* female antenna is filiform and lacks ventral basiconic sensilla (pers.
 469 obs.).

470

471 *Material Examined*

472 Holotype male: MADAGASCAR: Province Fianarantsoa, Parc National Ranomafana, Vohiparara at
 473 broken bridge, Malaise trap in high altitude rainforest, 22-28.11.2001, R. Harin'Hala, CASENT 2044514
 474 (deposited in CAS). Paratypes (7 males, 4 females): MADAGASCAR: 7 males, 4 females. CASENT
 475 2002179, 2032775, 2044150, 2045085, 2045509, 2045602, 2045755, 2046024, 2046178-2046179,
 476 2053642 (deposited in CAS, MRAC).

477

478 ***Conostigmus fianarantsoaensis* Mikó and Trietsch sp. nov.**

479

480 Figures 18, 19, 20, 21



481

482 *Diagnosis*

483 *Conostigmus fianarantsoaensis* sp. nov. is most similar to *C. madagascariensis* sp. nov. among Malagasy
 484 *Conostigmus* and differs from it by the following characters: mandible with one tooth (mandible is with 2
 485 teeth in *C. madagascariensis*); flagellar setae shorter than the flagellomere width (in *C. madagascariensis*,
 486 flagellar setae are distinctly longer than the flagellomere width); blunt proximolateral projection of cupula
 487 (acute in *C. madagascariensis*); notched proximodorsal notch of cupula (arched in *C. madagascariensis*);
 488 blunt distal end of dorsomedial conjunctiva of gonostyle/volsella complex (acute in *C. madagascariensis*);
 489 and the acute distal margin of harpe in lateral view (blunt in *C. madagascariensis*).

490

491 *Description*

492 Body length: 1150-2300 μm . Color intensity pattern: metasoma and mandible lighter than mesosoma.
 493 Color hue pattern: F3-8, ium, mandible, metasoma, tegula brown; legs, except brown proximal region
 494 of metacoxa and distal region of metafemur, scape, pedicel, F1-4 ow. Occipital carina sculpture:
 495 crenulate. Median flange of occipital carina count: absent. Submedial flange of occipital carina count:
 496 absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital
 497 carina is ventral to lateral ocellus in lateral view. Preoccipital lunula count: present. Preoccipital carina
 498 count: absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow count: present. Preoc-
 499 cipital furrow anterior end: Preoccipital furrow ends posterior to ocellar triangle. Postocellar carina
 500 count: absent. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL):
 501 1.4-1.8:1.5-1.8:1. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line
 502 (LOL): 1.7-2.3:1.7-1.8:1.0. Head width vs. interorbital space (HW/IOS) Male: 1.6-1.9. Head width vs.
 503 interorbital space (HW/IOS) Female: 2.0-2.2. Setal pit on vertex size: smaller than diameter of scutes.
 504 Transverse frontal carina count: absent. Transverse scutes on frons count: absent. Rugose region on frons
 505 count: absent. Randomly sized areolae around setal pits on frons count: absent. Antennal scrobe count:
 506 absent. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. Facial pit count:
 507 facial pit present. Supraclypeal depression count: present. Supraclypeal depression structure: absent
 508 medially, represented by two grooves laterally of facial pit. Intertorular carina count: present. Intertorular
 509 area count: present. Median region of intertorular area shape: flat. Ventral margin of antennal rim vs.
 510 dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count: present. Subtorular carina count:
 511 absent. Mandibular tooth count: 1. Female flagellomere 1 length vs. pedicel: 0.8-1.16. Female ninth
 512 flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere pattern: F5-F9. Length
 513 of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Male
 514 flagellomere 1 length vs. male second flagellomere length: 1.2-1.4. Male flagellomere 1 length vs. pedicel
 515 length: 2.9-3.3. Ventrolateral invagination of the pronotum count: present. Scutes on posterior region of
 516 mesoscutum and dorsal region of mesoscutellum convexity: flat. Notaulus posterior end location: adjacent
 517 to transscutal articulation. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation.
 518 Scutoscutellar sulcus vs. transscutal articulation: adjacent; not adjacent. Axillular carina count: absent.
 519 Axillular carina shape: NOT CODED. Epicnemium posterior margin shape: anterior discriminal pit
 520 present; epicnemial carina curved. Epicnemial carina count: interrupted medially; complete. Sternaulus
 521 count: present. Sternaulus length: short, not reaching 1/2 of mesopleuron length at level of sternaulus.
 522 Speculum ventral limit: not extending ventrally of pleural pit line. Mesometapleural sulcus count: present.
 523 Metapleural carina count: present. Transverse line of the metanotum-propodeum vs. antecostal sulcus
 524 of the first abdominal tergum: adjacent sublaterally. Lateral propodeal carina count: present. Lateral
 525 propodeal carina shape: inverted "V" (left and right lateral propodeal carinae are adjacent medially at
 526 their intersection with antecostal sulcus of the first abdominal tergum). Anteromedian projection of the

527 metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest width: S1
 528 wider than long. Transverse carina on petiole shape: straight. Distal margin of male S9 shape: straight.
 529 Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex length:
 530 cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of
 531 cupula count: present. Proximodorsal notch of cupula shape: notched. Proximolateral projection of
 532 the cupula shape: blunt. Proximodorsal notch of cupula width vs length: wider than long. Distodorsal
 533 margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex length
 534 relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of
 535 gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex
 536 count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: blunt.
 537 Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical
 538 parossiculus seta number: one. Distal projection of the parossiculus count: absent. Distal projection of the
 539 penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe shorter than
 540 gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral
 541 view: setae as long or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation:
 542 medially. Sensillar ring area of harpe orientation: medially. Lateral setae of harpe count: present. Lateral
 543 setae of harpe orientation: oriented distally. Distal margin of harpe in lateral view: shape: acute. Lateral
 544 margin of harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella complex.

545

546 *Etymology*

547 The species epithet refers to the Fianarantsoa Province of Madagascar, where all specimens of this species
 548 were collected.

549

550 *Comments*

551 This species is very similar to *Conostigmus madagascariensis* sp. nov., and the two might possibly
 552 represent a single species.

553

554 *Material Examined*

555 Holotype male: MADAGASCAR: Ranomafana JIRAMA water works , Malaise trap near river , 16.10-
 556 8.11.2001, R. Harin'Hala , CASENT 2053691 (deposited in CAS). Paratypes (17 males, 1 sex unknown, 3
 557 females): MADAGASCAR: 17 males, 1 sex unknown, 3 females. CASENT 2022988, 2044151, 2045601,
 558 2045741, 2045975, 2046177, 2046180, 2053303, 2053306, 2053641, 2053667; IM 2288; PSUC_FEM
 559 79695, 79734, 79737-79738, 79740, 79749, 79756, 79760, 79762 (CAS, MRAC).

560

561 *Conostigmus longulus* Dessart, 1997

562 *Conostigmus longulus* : Dessart, 1997 (original description)

563

564 Figures 22, 23, 24, 25, 26

565

566 *Diagnosis*

567 *Conostigmus longulus* Dessart 1997 shares the presence of a prognathous head (dorsal-most point of
 568 occipital carina is dorsal to posterior ocellus in lateral view) and the presence of transverse scutes on the
 569 ventral region of frons with *C. babaiax* Dessart 1996, *C. toliaraensis* sp. nov. and *C. pseudobabaiax* sp.
 570 nov. *Conostigmus longulus* differs from *C. babaiax*, *C. toliaraensis* sp. nov. and *C. pseudobabaiax* in the
 571 presence of an impression surrounding the frontal pit, the absence of white setal patches on the frons,
 572 and the presence of the transverse frontal carina. *Conostigmus longulus* differs from other *Conostigmus*
 573 species in the distodorsal orientation of the sensillar ring of the harpe (the sensillar ring is oriented
 574 distomedially or distoventrally in other *Conostigmus* species).

575

576 *Description*

577 Body length: 1750-2450 μm . Color intensity pattern: ventral region of cranium is lighter than dorsal
 578 region of cranium. Color hue pattern: Legs except proximal region of metacoxa and distal region of
 579 metafemur, mouthparts yellow; rest of body ochre; Legs except proximal region of metacoxa and distal 2/3
 580 of metafemur, mouthparts, scape and F1 orange; rest of body brown. Occipital carina sculpture: crenulate.
 581 Median flange of occipital carina count: absent. Submedial flange of occipital carina count: absent. Dorsal

margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina is dorsal to lateral ocellus in lateral view. Preoccipital lunula count: NOT CODED. Preoccipital carina count: absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow count: present. Preoccipital furrow anterior end: Preoccipital furrow ends inside ocellar triangle. Postocellar carina count: absent. Male ocular ocellar line (OOL); posterior ocellar line (POL); lateral ocellar line (LOL): 1.1-1.2:1:1. Female ocular ocellar line (OOL); posterior ocellar line (POL); lateral ocellar line (LOL): 1.2-1.3:1.0:1.0. Head width vs. interorbital space (HW/IOS) Male: 2.0-2.5. Head width vs. interorbital space (HW/IOS) Female : 2.3-2.4. Setal pit on vertex size: smaller than diameter of scutes. Transverse frontal carina count: present. Transverse scutes on frons count: present. Rugose region on frons count: absent. Randomly sized areolae around setal pits on frons count: absent. Antennal scrobe count: absent. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. Facial pit count: facial pit present. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular carina count: present. Intertorular area count: present. Median region of intertorular area shape: flat. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count: absent. Subtorular carina count: absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel: F1 as long as pedicel (1.0-1.1). Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere pattern: F4-F9; F5-F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere length: 1.2-1.4. Male flagellomere 1 length vs. pedicel length: 2.4-2.5. Ventrolateral invagination of the pronotum count: present. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation: adjacent. Axillular carina count: absent. Axillular carina shape: NOT CODED. Epicnemium posterior margin shape: anterior discriminal pit absent; epicnemial carina interrupted medially. Epicnemial carina count: present only laterally. Sternaulus count: absent; present. Sternaulus length: short, not reaching 1/2 of mesopleuron length at level of sternaulus. Speculum ventral limit: not extending ventrally of pleural pit line. Mesometapleural sulcus count: present. Metapleural carina count: present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum: adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted "Y" (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted "Y"); straight (left and right lateral propodeal carinae compose a carina that is not broken medially). Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest width: S1 wider than long. Transverse carina on petiole shape: concave. Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex length: cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched. Proximolateral projection of the cupula shape: acute. Proximodorsal notch of cupula width vs length: wider than long. Distodorsal margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex length relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: acute. Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical parossiculus seta number: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe shorter than gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae two times as long as harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: dorsomedially. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Distal margin of harpe in lateral view: shape: acute. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella complex.

634 *Comments*

635 Males and females are variable in color pattern: in smaller males the coloration is lighter; the legs except
636 the proximal region of hind coxa and distal 2/3 of hind femur, mouthparts, scape and F1 are yellow and

637 rest of the body is ochre, whereas in larger males the colors of these body parts are orange and brown.
 638 In most female specimens, the legs except the proximal region of the hind coxa and the distal 2/3 of
 639 hind femur, mouthparts, distal part of scape, pedicel and F1–F4 are yellow and the rest of body is brown,
 640 whereas in one specimen (CAS2002193), only the distal 1/5 of scape is yellow and the rest of the antenna
 641 is brown. The length of the preoccipital furrow is variable, from reaching the anterior 1/5 of the length of
 642 the ocellar triangle (CAS204825) to barely exceeding POL (CAS2053554).

643 The sternaulus is present and short in larger specimens of *Conostigmus longulus* and absent from smaller
 644 specimens. The lateral propodeal carina of *Conostigmus longulus* is straight or Y-shaped and the frontal
 645 carina is distinct, sharply defined in larger and indistinct marked by a blunt edge in smaller specimens.
 646

647 *Material Examined*

648 Holotype male: MADAGASCAR: PSUC_FEM 8919 COLL. MUS. Congo Madagascar: Mandraka
 649 II-1944 A. Seyrig HOLOTYPUS Holotype Prep. micros-copique n 9508/051 (deposited in MRAC).

650 Other material (10 males, 6 females): MADAGASCAR: 10 males, 6 females. CASENT 2002193,
 651 2009756, 2040771, 2040900, 2044193, 2046098, 2046100, 2053308, 2053354, 2053688; PSUC_FEM
 652 79732, 79735, 79745, 79748, 79753, 79757 (deposited in CAS, MRAC).
 653

654 *Conostigmus lucidus* Mikó and Trietsch sp. nov.

655
 656 Figures 27, 28, 29, 30
 657

658 *Diagnosis*

659 *Conostigmus lucidus* sp. nov. differs from other Malagasy *Conostigmus* species in the presence of the
 660 long anterior neck of T1 (petiole neck and corresponding S1 are as long as wide in *C. lucidus* and at least
 661 about 2× as wide as long in other Malagasy *Conostigmus* species), absence of dorsomedian conjunctiva
 662 of the gonostyle/volsella complex and absence of the proximodorsal notch of cupula (both structures are
 663 present in other Malagasy *Conostigmus* species). The parossiculus as an independent sclerite is absent
 664 (parossiculus and gonostyle fused).

665 The petiole neck and corresponding first abdominal sternite is also elongated in the Oriental species
 666 *Conostigmus ampullaceus* Dessart 1997 where the petiole neck is even longer (sometimes 2× as long as
 667 wide) than in *C. lucidus*. The two species differ in numerous distinct characters such as the presence of
 668 color contrast between the black head and orange abdomen and the absence of the preoccipital lunula and
 669 preoccipital sulcus in *Conostigmus ampullaceus* (all tagmata are uniformly brown and both the preoccipital
 670 lunula and preoccipital sulcus are present in *C. lucidus*).
 671

672 *Description*

673 Body length: 2100-2600 µm. Color intensity pattern: front and middle leg lighter than distal half of scape,
 674 pedicel and tegula; cranium, distal region of flagellum, mesosoma except legs and petiole neck darker
 675 than proximal region of flagellum, hind leg and metasoma posterior to petiole neck and mesosoma d.
 676 Color hue pattern: Distal half of scape, pedicel, fore leg and middle leg yellow; proximal part of scape,
 677 flagellum, mesosoma except front and middle leg, metasoma brown. Occipital carina sculpture: crenulate.
 678 Median flange of occipital carina count: absent. Submedial flange of occipital carina count: absent.
 679 Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina is
 680 ventral to lateral ocellus in lateral view. Preoccipital lunula count: present. Preoccipital carina count:
 681 absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow count: present. Preoccipital furrow
 682 anterior end: Preoccipital furrow ends posterior to ocellar triangle. Postocellar carina count: present. Male
 683 ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.2:1.1-1.4:1. Female
 684 ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.5-2.1:1.2-1.4:1.0.
 685 Head width vs. interorbital space (HW/IOS) Male: 2.1. Head width vs. interorbital space (HW/IOS)
 686 Female : 2.0-2.1. Setal pit on vertex size: smaller than diameter of scutes. Transverse frontal carina count:
 687 absent. Transverse scutes on frons count: absent. Rugose region on frons count: absent. Randomly sized
 688 areolae around setal pits on frons count: absent. Antennal scrobe count: absent. Ventromedian setiferous
 689 patch and ventrolateral setiferous patch count: absent. Facial pit count: facial pit present. Supraclypeal
 690 depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped.
 691 Intertorular carina count: present. Intertorular area count: present. Median region of intertorular area

692 shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal
 693 carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Female flagellomere 1
 694 length vs. pedicel: 1.0. Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch of the male
 695 flagellomere pattern: F5-F9. Length of setae on male flagellomere vs. male flagellomere width: setae
 696 shorter than width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere length: 1.4.
 697 Male flagellomere 1 length vs. pedicel length: 2.5. Ventrolateral invagination of the pronotum count:
 698 present. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat.
 699 Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus posterior
 700 end: not adjacent to transscutal articulation (ends anterior to transscutal articulation). Scutoscutellar
 701 sulcus vs. transscutal articulation: adjacent. Axillular carina count: absent. Axillular carina shape: NOT
 702 CODED. Epicnemium posterior margin shape: anterior discrimenal pit present; epicnemial carina curved.
 703 Epicnemial carina count: complete. Sternaulus count: present. Sternaulus length: elongate, exceeding
 704 3/4 of mesopleuron length at level of sternaulus. Speculum ventral limit: not extending ventrally of
 705 pleural pit line. Mesometapleural sulcus count: present. Metapleural carina count: present. Transverse
 706 line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum: adjacent sublateral-
 707 ally. Lateral propodeal carina count: present. Lateral propodeal carina shape: straight (left and right
 708 lateral propodeal carinae compose a carina that is not broken medially). Anteromedian projection of
 709 the metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest width: S1
 710 longer than wide. Transverse carina on petiole shape: straight. Distal margin of male S9 shape: convex.
 711 Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex length:
 712 cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of
 713 cupula count: absent. Proximodorsal notch of cupula shape: NOT CODED. Proximolateral projection
 714 of the cupula shape: NOT CODED. Proximodorsal notch of cupula width vs length: NOT CODED.
 715 Distodorsal margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex
 716 length relative to length of gonostyle-volsella complex: NOT CODED. Dorsomedian conjunctiva of the
 717 gonostyle-volsella complex count: absent. Distal end of dorsomedian conjunctiva of the gonostyle-volsella
 718 complex shape: NOT CODED. Parossiculus count (parossiculus and gonostipes fusion): absent (fused
 719 with the gonostipes). Apical parossicula seta number: one. Distal projection of the parossiculus count:
 720 absent. Distal projection of the penisvalva count: absent. Dorsal apodeme of penisvalva count: absent.
 721 Harpe length: harpe shorter than gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe
 722 length vs. harpe width in lateral view: setae as long or shorter than harpe width. Distodorsal setae of
 723 sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: dorsomedially.
 724 Lateral setae of harpe count: absent. Lateral setae of harpe orientation: oriented distally. Distal margin
 725 of harpe in lateral view: shape: blunt. Lateral margin of harpe shape: widest point of harpe is at its
 726 articulation site with gonostyle-volsella complex.

727

728 *Etymology*

729 The species epithet is derived from the Latin *lucidus* which means “shining”, in reference to the shining
 730 appearance of the cuticle due to the weak microsculpture of the large portion of the body.

731

732 *Material Examined*

733 Holotype male: MADAGASCAR: 3km 41° NE Andranomay, 11.5km 147°SSE Anjozobe, sifted litter in
 734 montane rainforest, 3-13.12.2000, Fisher, Griswold et al., CASENT 2001309 (deposited in CAS).

735 Paratypes (1 male, 6 females): MADAGASCAR: 1 male, 6 females. CASENT 2002181, 2004743,
 736 2004751, 2040895, 2045754, 2046026, 2046176 (deposited in CAS, MRAC).

737

738 *Conostigmus macrocupula* Mikó and Trietsch sp. nov.

739

740 Figures 31, 32, 33, 34, 35, 36

741

742 *Diagnosis*

743 *Conostigmus macrocupula* sp. nov. differs from other *Conostigmus* species in the elongate cupula, which
 744 is as long as the gonostyle volsella complex (the cupula is less than half as long as the gonostyle volsella
 745 complex in other *Conostigmus* species).

746 The only other Ceraphronoidea species with an unusually long cupula is *Dendrocerus phallocrates* Dessart

747 1987.

748

749 *Description*

750 Body length: 1270-1300 μm . Color intensity pattern: flagellum, tibiae and tarsi lighter than scape,
751 pedicel, mandible, tegula, coxae and femora. Color hue pattern: Cranium, mesosoma except legs and
752 metasoma except gonostipes and volsella ochre; antenna, legs, mandible, gonostipes and volsella yellow.
753 Occipital carina sculpture: crenulate. Median flange of occipital carina count: absent. Submedial flange
754 of occipital carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus
755 in lateral view: occipital carina is ventral to lateral ocellus in lateral view. Preoccipital lunula count:
756 present. Preoccipital carina count: absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow
757 count: present. Preoccipital furrow anterior end: Preoccipital furrow ends posterior to ocellar triangle.
758 Postocellar carina count: absent. Male ocular ocellar line (OOL); posterior ocellar line (POL); lateral
759 ocellar line (LOL): 2.0-2.1:1.7-1.8:1. Female ocular ocellar line (OOL); posterior ocellar line (POL);
760 lateral ocellar line (LOL): NOT CODED. Head width vs. interorbital space (HW/IOS) Male: 1.8-2.0.
761 Head width vs. interorbital space (HW/IOS) Female : NOT CODED. Setal pit on vertex size: smaller
762 than diameter of scutes. Transverse frontal carina count: absent. Transverse scutes on frons count:
763 absent. Rugose region on frons count: absent. Randomly sized areolae around setal pits on frons count:
764 absent. Antennal scrobe count: absent. Ventromedian setiferous patch and ventrolateral setiferous patch
765 count: absent. Facial pit count: facial pit present. Supraclypeal depression count: present. Supraclypeal
766 depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular
767 carina count: present. Intertorular area count: present. Median region of intertorular area shape: flat.
768 Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count:
769 present; absent. Subtorular carina count: absent. Mandibular tooth count: 2. Female flagellomere 1
770 length vs. pedicel: NOT CODED. Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch
771 of the male flagellomere pattern: F5-F9. Length of setae on male flagellomere vs. male flagellomere
772 width: setae shorter than width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere
773 length: 1.2-1.3. Male flagellomere 1 length vs. pedicel length: 1.2-1.3. Ventrolateral invagination of
774 the pronotum count: present. Scutes on posterior region of mesoscutum and dorsal region of meso-
775 cutellum convexity: flat. Notaulus posterior end location: adjacent to transscutal articulation. Median
776 mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal
777 articulation: adjacent. Axillular carina count: absent. Axillular carina shape: NOT CODED. Epicnemium
778 posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Epicnemial carina
779 count: complete. Sternaulus count: absent. Sternaulus length: NOT CODED. Speculum ventral limit:
780 not extending ventrally of pleural pit line. Mesometapleural sulcus count: absent. Metapleural carina
781 count: present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal
782 tergum: adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal carina shape:
783 inverted "Y" (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the
784 first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median
785 branch of the inverted "Y"). Anteromedian projection of the metanoto-propodeo-metaplecto-mesopectal
786 complex count: absent. S1 length vs. shortest width: S1 wider than long. Transverse carina on petiole
787 shape: straight. Distal margin of male S9 shape: concave. Proximolateral corner of male S9 shape: blunt.
788 Cupula length vs. gonostyle-volsella complex length: cupula as long as gonostyle-volsella complex in
789 lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched.
790 Proximolateral projection of the cupula shape: blunt. Proximodorsal notch of cupula width vs length: at
791 least two times as long as wide. Distodorsal margin of cupula shape: straight. Dorsomedian conjunctiva
792 of the gonostyle-volsella complex length relative to length of gonostyle-volsella complex: dorsomedian
793 conjunctiva not extending 2/3 of length of gonostyle-volsella complex in dorsal view. Dorsomedian
794 conjunctiva of the gonostyle-volsella complex count: present. Distal end of dorsomedian conjunctiva of
795 the gonostyle-volsella complex shape: acute. Parossiculus count (parossiculus and gonostipes fusion):
796 present (not fused with the gonostipes). Apical parossiculus seta number: two. Distal projection of
797 the parossiculus count: absent. Distal projection of the penisvalva count: absent. Dorsal apodeme of
798 penisvalva count: absent. Harpe length: harpe as long as gonostipes in lateral view. Distodorsal setae
799 of sensillar ring of harpe length vs. harpe width in lateral view: setae two times as long as harpe width.
800 Distodorsal setae of sensillar ring of harpe orientation: dorsally. Sensillar ring area of harpe orientation:
801 medially. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Distal

margin of harpe in lateral view: shape: blunt. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella complex.

Etymology

The species epithet is derived from the Greek macro (large) and the Latin noun cupula (small, inverted cup). The latin name of the species refers to the large cupula that is as long as the gonostyle/volsella complex.

Material Examined

Holotype male: MADAGASCAR: Parc National Ranomafana, Belle Vue at Talatakely, Malaise, secondary tropical forest, 12-19.2.2002, R. Harin'Hala, CASENT 2046023 (deposited in CAS).

Paratypes (7 males): MADAGASCAR: 7 males. CASENT 2046022, 2046025, 2046181, 2053451; PSUC_FEM 79741-79742, 79750 (CAS, MRAC).

Conostigmus madagascariensis Mikó and Trietsch sp. nov.

Figures 37, 38, 39, 40, 41, 42, 43

Diagnosis

Conostigmus madagascariensis sp. nov. is the most similar to *C. fianarantsoaensis* sp. nov. among Malagasy *Conostigmus*. *Conostigmus madagascariensis* differs from *C. fianarantsoaensis* in the presence of two teeth on the mandibles, flagellar setae longer than the flagellomere width (in *C. fianarantsoaensis*, flagellar setae are shorter than flagellomere width), acute proximolateral projection of cupula (blunt in *C. fianarantsoaensis*), arched proximodorsal notch of cupula (notched in *C. fianarantsoaensis*), acute distal end of dorsomedial conjunctiva of gonostyle/volsella complex (blunt in *C. fianarantsoaensis*), and blunt distal margin of harpe in lateral view (acute in *C. fianarantsoaensis*).

Description Body length: 1500-2700 µm. Color intensity pattern: metasoma and mandible lighter than mesosoma. Color hue pattern: Antenna except pedicel, cranium, mesosoma except fore and middle legs and metasoma brown; fore and middle legs, tegula, pedicel, maxillary palp and labial palp yellow; F3-8, cranium, mandible, metasoma, tegula brown; legs, except brown proximal region of metacoxa and distal region of metafemur, scape, pedicel, F1-4 yellow; Antenna except pedicel and scape, cranium, mesosoma except fore and middle legs and distal region of metacoxa, and metasoma brown; fore and middle legs, tegula, pedicel, scape, proximal part of metacoxa, palpus maxillaris, and palpus labialis yellow; Antenna except pedicel and scape, cranium, mesosoma except fore and middle legs and distal region of metacoxa, and metasoma brown; fore and middle legs, tegula, pedicel, scape, maxillary palp, and labial palp yellow; Antenna except pedicel, cranium, mesosoma except fore and middle legs and distal region of metacoxa, and metasoma brown; fore and middle legs, tegula, pedicel, proximal region of metacoxa, maxillary palp, and labial palp yellow; Scape, F4-8, cranium, mandible, metasoma, tegula brown; legs, except brown proximal region of metacoxa and distal region of metafemur, pedicel, F1-3 yellow; F1-8, cranium, mandible, metasoma, tegula brown; legs, scape, pedicel yellow. Occipital carina sculpture: crenulate. Median flange of occipital carina count: absent. Submedial flange of occipital carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina is ventral to lateral ocellus in lateral view. Preoccipital lunula count: present. Preoccipital carina count: absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow count: present. Preoccipital furrow anterior end: Preoccipital furrow ends posterior to ocellar triangle. Postocellar carina count: absent. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8-2:1.7-1.8:1. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.4:1.6-1.7:1.0. Head width vs. interorbital space (HW/IOS) Male: 1.6-1.9. Head width vs. interorbital space (HW/IOS) Female: 2.3. Setal pit on vertex size: smaller than diameter of scutes. Transverse frontal carina count: absent. Transverse scutes on frons count: absent. Rugose region on frons count: absent. Randomly sized areolae around setal pits on frons count: absent. Antennal scrobe count: absent. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. Facial pit count: facial pit present. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped; absent medially, represented by two grooves laterally of facial pit. Intertorular carina count: present. Intertorular

857 area count: present. Median region of intertorular area shape: flat. Ventral margin of antennal rim vs.
858 dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count: present. Subtorular carina count:
859 absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel: 0.8-1.2. Female ninth
860 flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere pattern: F5-F9. Length
861 of setae on male flagellomere vs. male flagellomere width: setae longer than width of flagellomeres. Male
862 flagellomere 1 length vs. male second flagellomere length: 1.2-1.5. Male flagellomere 1 length vs. pedicel
863 length: 4-4.2. Ventrolateral invagination of the pronotum count: present. Scutes on posterior region of
864 mesoscutum and dorsal region of mesoscutellum convexity: flat. Notaulus posterior end location: adjacent
865 to transscutal articulation. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation.
866 Scutoscutellar sulcus vs. transscutal articulation: adjacent. Axillular carina count: absent. Axillular carina
867 shape: NOT CODED. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial
868 carina curved. Epicnemial carina count: interrupted medially; complete. Sternaulus count: present. Ster-
869 naulus length: short, not reaching 1/2 of mesopleuron length at level of sternaulus. Speculum ventral limit:
870 not extending ventrally of pleural pit line. Mesometapleural sulcus count: present. Metapleural carina
871 count: present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal
872 tergum: adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal carina shape:
873 inverted "V" (left and right lateral propodeal carinae are adjacent medially at their intersection with
874 antecostal sulcus of the first abdominal tergum); inverted "Y" (left and right lateral propodeal are adjacent
875 medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal
876 sulcus by a median carina representing the median branch of the inverted "Y"). Anteromedian projection
877 of the metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest width: S1
878 wider than long. Transverse carina on petiole shape: straight. Distal margin of male S9 shape: straight.
879 Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex length:
880 cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of
881 cupula count: present. Proximodorsal notch of cupula shape: arched. Proximolateral projection of the
882 cupula shape: acute. Proximodorsal notch of cupula width vs length: wider than long. Distodorsal
883 margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex length
884 relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of
885 gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex
886 count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: acute.
887 Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical
888 parossiculus seta number: one. Distal projection of the parossiculus count: absent. Distal projection of the
889 penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe shorter than
890 gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral
891 view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: medially.
892 Sensillar ring area of harpe orientation: medially. Lateral setae of harpe count: present. Lateral setae of
893 harpe orientation: oriented distally. Distal margin of harpe in lateral view: shape: blunt. Lateral margin of
894 harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella complex.

895

896 *Etymology*

897 The species epithet refers to Madagascar where *Conostigmus madagascariensis* is the most commonly
898 collected among *Conostigmus* species.

899

900 *Comments*

901 The coloration of *Conostigmus madagascariensis* males is variable: specimens CASENT2040905 and
902 CASENT 2046020 have distally yellow hind coxa, and specimens CASENT2040905 and CASENT2022986
903 have yellow scapes. The coloration of *Conostigmus madagascariensis* females is also variable: F1–8,
904 cranium, mandible, metasoma, tegula brown, legs, scape, pedicel yellow in specimens CASENT2053365,
905 CASENT2053573, CASENT2053574; scape, F4–8, cranium, mandible, metasoma, tegula brown, legs,
906 except brown proximal region of hind coxa and distal region of hind femur, pedicel, F1–4 yellow in
907 specimens CASENT2041648, CASENT2044995.

908 Most specimens of *Conostigmus madagascariensis* lack postocellar carina. In larger specimens, a
909 very shallow sulcus connecting the posterior margins of lateral ocelli present. In one specimen (CASENT
910 2044509) the postocellar carina is similar to *Conostigmus lucidus* sp. nov. Other characteristics of *Conos-*
911 *tigmus lucidus* are absent from this specimen (e.g. petiole neck as long as wide, very weak microsculpture

912 allover the body, sternaulus longer than half of length of mesopleuron in the level of sternaulus, presence
913 of straight lateral propodeal carinae).

914

915 *Material Examined*

916 Holotype male: MADAGASCAR: Province Fianarantsoa, Parc National Ranomafana, radio tower at
917 forest edge, Malaise mixed tropical forest, 12-19.2.2002, R. Harin'Hala, CASENT 2044913 (deposited
918 in CAS).

919 Paratypes (44 males, 15 females): MADAGASCAR: 44 males, 15 females. CASENT 2000886, 2002178,
920 2002180, 2002187-2002191, 2004742, 2004744, 2004746-2004750, 2004753-2004754, 2009143-2009144,
921 2022986-2022987, 2040889-2040894, 2040896-2040899, 2040901, 2040905-2040908, 2041648, 2041940,
922 2041942, 2041945, 2044507, 2044509, 2044824, 2044895, 2044912, 2044995, 2045756, 2046020,
923 2053365, 2053393, 2053503, 2053573-2053574; IM 2289; PSUC_FEM 79702, 79759, 79761, 79763,
924 PSUC_79714 (deposited in CAS, MRAC).

925

926 *Conostigmus missyhazena* Mikó and Trietsch sp. nov.

927

928 Figures 44, 45, 46, 47

929

930 *Diagnosis*

931 *Conostigmus missyhazena* sp. nov. differs from other Malagasy *Conostigmus* species in the globular
932 head (almost as long as wide in dorsal view and as high as long in lateral view) and the absence of the
933 preoccipital sulcus.

934

935 *Description*

936 Body length: 1750-2000 μm . Color intensity pattern: NOT CODED. Color hue pattern: Cranium,
937 mandible, mesosoma excluding front and proximal middle tibia, metasoma, antenna excluding distal
938 scape and pedicel brown; distal scape, pedicel, protibia and proximal mesotibia ochre. Occipital carina
939 sculpture: smooth. Median flange of occipital carina count: absent. Submedial flange of occipital carina
940 count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipi-
941 tal carina is ventral to lateral ocellus in lateral view. Preoccipital lunula count: absent. Preoccipital carina
942 count: absent. Preoccipital carina shape: NOT CODED. Preoccipital furrow count: absent. Preoccipital
943 furrow anterior end: NOT CODED. Postocellar carina count: absent. Male ocular ocellar line (OOL):
944 posterior ocellar line (POL); lateral ocellar line (LOL): 1.1-1.2:1.6-1.8:1. Female ocular ocellar line
945 (OOL); posterior ocellar line (POL); lateral ocellar line (LOL): 1.0-1.1:1.4:1.0. Head width vs. interorbital
946 space (HW/IOS) Male: 1.8-1.9. Head width vs. interorbital space (HW/IOS) Female: 2.4. Setal pit
947 on vertex size: smaller than diameter of scutes. Transverse frontal carina count: absent. Transverse
948 scutes on frons count: absent. Rugose region on frons count: absent. Randomly sized areolae around
949 setal pits on frons count: absent. Antennal scrobe count: absent. Ventromedian setiferous patch and
950 ventrolateral setiferous patch count: absent. Facial pit count: facial pit present. Supraclypeal depression
951 count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular carina
952 count: present. Intertorular area count: present. Median region of intertorular area shape: flat. Ventral
953 margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count: present.
954 Subtorular carina count: absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel:
955 0.9-1.0. Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere
956 pattern: F5-F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than
957 width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere length: 1.1-1.2. Male
958 flagellomere 1 length vs. pedicel length: 3.2-4.0. Ventrolateral invagination of the pronotum count:
959 present. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat.
960 Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus posterior
961 end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation: adjacent.
962 Axillular carina count: absent. Axillular carina shape: NOT CODED. Epicnemium posterior margin
963 shape: anterior discrimenal pit present; epicnemial carina curved. Epicnemial carina count: complete.
964 Sternaulus count: present. Sternaulus length: short, not reaching 1/2 of mesopleuron length at level of
965 sternaulus. Speculum ventral limit: not extending ventrally of pleural pit line. Mesometapleural sulcus
966 count: present. Metapleural carina count: present. Transverse line of the metanotum-propodeum vs.

967 antecostal sulcus of the first abdominal tergum: adjacent sublaterally. Lateral propodeal carina count:
 968 present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent
 969 medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal
 970 sulcus by a median carina representing the median branch of the inverted “Y”). Anteromedian projection
 971 of the metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest width: S1
 972 wider than long. Transverse carina on petiole shape: concave. Distal margin of male S9 shape: convex.
 973 Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex length:
 974 cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of
 975 cupula count: present. Proximodorsal notch of cupula shape: arched. Proximolateral projection of the
 976 cupula shape: acute. Proximodorsal notch of cupula width vs length: wider than long. Distodorsal
 977 margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex length
 978 relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of
 979 gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex
 980 count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: acute.
 981 Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical
 982 parossiculus seta number: one. Distal projection of the parossiculus count: absent. Distal projection of the
 983 penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe shorter than
 984 gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral
 985 view: setae as long or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation:
 986 distomedially. Sensillar ring area of harpe orientation: medially. Lateral setae of harpe count: present.
 987 Lateral setae of harpe orientation: oriented distoventrally. Distal margin of harpe in lateral view: shape:
 988 blunt. Lateral margin of harpe shape: widest point of harpe is in its proximal 1/3rd.

990 *Etymology* The species epithet honors Missy Hazen, research technologist at The Huck Institute of the
 991 Life Sciences, Pennsylvania State University, who facilitated the microscopy of these and other specimens.

993 *Material Examined* Holotype male: MADAGASCAR: Parc National Ranomafana, Belle Vue at Talatakely,
 994 Malaise, secondary tropical forest, 12-19.2.2002, R. Harin’Hala CASENT 2046019 (deposited in CAS).
 995 Paratypes (2 males, 2 females): MADAGASCAR: 2 males, 2 females. CASENT 2002183, 2004752;
 996 PSUC_FEM 79731, 79747 (CAS).

998 ***Conostigmus pseudobabaiax* Mikó and Trietsch sp. nov.**

1000 Figures 48, 49, 50, 51, 52

1002 *Diagnosis*

1003 *Conostigmus pseudobabaiax* sp. nov. shares the presence of a prognathous head (dorsal-most point of
 1004 occipital carina is dorsal to posterior ocellus in lateral view) and the presence of transverse scutes on
 1005 the ventral region of frons with *C. babaiax* Dessart 1996, *C. toliaraensis* sp. nov. and *Conostigmus*
 1006 *longulus* Dessart 1997. *Conostigmus pseudobabaiax*, *C. babaiax*, and *C. toliaraensis* sp. nov. differ from
 1007 other *Conostigmus* species by the presence of ventromedian and ventrolateral white, setiferous patches
 1008 on the frons. *Conostigmus pseudobabaiax* and *C. toliaraensis* differ from *Conostigmus babaiax* in OOL
 1009 longer than LOL (in *Conostigmus babaiax* OOL is shorter than LOL). *Conostigmus toliaraensis* can
 1010 be readily differentiated from *C. pseudobabaiax* by the following phenotypes: first female flagellomere
 1011 $0.9\times$ the length of pedicel ($1.4\times$ as long in *C. pseudobabaiax*); male flagellomere $1.1\times$ as long as
 1012 second male flagellomere ($1.3-1.4\times$ as long in *C. pseudobabaiax*); scutes are strongly convex (flat in *C.*
 1013 *pseudobabaiax*); proximodorsal notch of cupula as long as wide and harpe as long as gonostyle/volsella
 1014 complex in lateral view (proximodorsal notch of cupula almost $2\times$ as wide as long; harpe $0.7\times$ length of
 1015 gonostyle/volsella complex in *C. pseudobabaiax*).

1017 *Description*

1018 Body length: 2450-3125 μm . Color intensity pattern: ventral region of cranium is lighter than dorsal
 1019 region of cranium. Color hue pattern: Distal part of scape, pedicel, F1-3 ochre; legs except proximal
 1020 metacoxa yellow; rest of body brown. Occipital carina sculpture: crenulate. Median flange of occipital
 1021 carina count: absent. Submedial flange of occipital carina count: absent. Dorsal margin of occipital carina

1022 vs. dorsal margin of lateral ocellus in lateral view: occipital carina is dorsal to lateral ocellus in lateral
 1023 view. Preoccipital lunula count: NOT CODED. Preoccipital carina count: absent. Preoccipital carina
 1024 shape: NOT CODED. Preoccipital furrow count: present. Preoccipital furrow anterior end: Preoccipital
 1025 furrow ends inside ocellar triangle. Postocellar carina count: absent. Male ocular ocellar line (OOL):
 1026 posterior ocellar line (POL): lateral ocellar line (LOL): 1.2-1.3:1:1. Female ocular ocellar line (OOL):
 1027 posterior ocellar line (POL): lateral ocellar line (LOL): 1.4:1.0-1.2:1.0. Head width vs. interorbital space
 1028 (HW/IOS) Male: 2.0-2.2. Head width vs. interorbital space (HW/IOS) Female : 2.3-2.6. Setal pit on
 1029 vertex size: smaller than diameter of scutes. Transverse frontal carina count: absent. Transverse scutes on
 1030 frons count: present. Rugose region on frons count: absent. Randomly sized areolae around setal pits
 1031 on frons count: absent. Antennal scrobe count: absent. Ventromedian setiferous patch and ventrolateral
 1032 setiferous patch count: present. Facial pit count: no external corresponding structure present. Supra-
 1033 clypeal depression count: absent. Supraclypeal depression structure: NOT CODED. Intertorular carina
 1034 count: present. Intertorular area count: present. Median region of intertorular area shape: flat. Ventral
 1035 margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count: present.
 1036 Subtorular carina count: absent. Mandibular tooth count: 2. Female flagellomere 1 length vs. pedicel:
 1037 1.4. Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch of the male flagellomere
 1038 pattern: F4-F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than
 1039 width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere length: 1.3-1.4. Male
 1040 flagellomere 1 length vs. pedicel length: 3.0-3.2. Ventrolateral invagination of the pronotum count:
 1041 present. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat.
 1042 Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus posterior
 1043 end: not adjacent to transscutal articulation (ends anterior to transscutal articulation). Scutoscutellar
 1044 sulcus vs. transscutal articulation: adjacent. Axillular carina count: absent. Axillular carina shape: NOT
 1045 CODED. Epicnemium posterior margin shape: anterior discriminal pit absent; epicnemial carina inter-
 1046 rupted medially. Epicnemial carina count: present only laterally. Sternaulus count: present. Sternaulus
 1047 length: short, not reaching 1/2 of mesopleuron length at level of sternaulus. Speculum ventral limit: not
 1048 extending ventrally of pleural pit line. Mesometapleural sulcus count: present. Metapleural carina count:
 1049 present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum:
 1050 adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal carina shape: straight
 1051 (left and right lateral propodeal carinae compose a carina that is not broken medially). Anteromedian
 1052 projection of the metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest
 1053 width: S1 wider than long. Transverse carina on petiole shape: concave. Distal margin of male S9 shape:
 1054 convex. Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex
 1055 length: cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch
 1056 of cupula count: present. Proximodorsal notch of cupula shape: arched. Proximolateral projection of
 1057 the cupula shape: blunt. Proximodorsal notch of cupula width vs length: wider than long. Distodorsal
 1058 margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex length
 1059 relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of
 1060 gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex
 1061 count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: acute.
 1062 Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical
 1063 parossiculus seta number: one. Distal projection of the parossiculus count: absent. Distal projection of the
 1064 penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe shorter than
 1065 gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral
 1066 view: setae as long or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation:
 1067 distomedially. Sensillar ring area of harpe orientation: medially. Lateral setae of harpe count: present.
 1068 Lateral setae of harpe orientation: oriented distally. Distal margin of harpe in lateral view: shape: blunt.
 1069 Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella
 1070 complex.

1071

1072 *Etymology* From the Greek *pseudo-* (=false) and the specific name *babaiax*, indicating a close resemblance
 1073 of *Conostigmus pseudobabaiax* and *C. babaiax*.

1074

1075 *Material Examined* Holotype male: MADAGASCAR: Ranomafana JIRAMA water works , Malaise trap
 1076 near river , 16.10-8.11.2001, R. Harin'Hala, CASENT 2053690 (deposited in CAS).

1077 Paratypes (5 males, 6 females): MADAGASCAR: 5 males, 6 females. CASENT 2006450-2006451,
 1078 2032774, 2041943, 2046097, 2046151, 2053381-2053382, 2053425, CASENT_2040937; PSUC_FEM
 1079 79736 (deposited in CAS, MRAC).

1080

1081 ***Conostigmus toliaraensis* Mikó and Trietsch sp. nov.**

1082

1083 Figures 53, 54, 55, 56, 57

1084

1085 *Diagnosis*

1086 *Conostigmus toliaraensis* sp. nov. shares the presence of a prognathous head (dorsal-most point of
 1087 occipital carina is dorsal to posterior ocellus in lateral view) and the presence of transverse scutes on
 1088 the ventral region of frons with *C. babaiax* Dessart 1996, *C. pseudobabaiax* sp. nov. and *Conostigmus*
 1089 *longulus* Dessart 1997. *Conostigmus toliaraensis*, *C. babaiax*, and *C. pseudobabaiax* sp. nov. differ from
 1090 other *Conostigmus* species by the presence of ventromedian and ventrolateral white, setiferous patches
 1091 on the frons. *Conostigmus pseudobabaiax* and *C. toliaraensis* differ from *Conostigmus babaiax* in OOL
 1092 longer than LOL (in *Conostigmus babaiax* OOL is shorter than LOL). *Conostigmus toliaraensis* can
 1093 be readily differentiated from *C. pseudobabaiax* by the following phenotypes: first female flagellomere
 1094 $0.9\times$ the length of pedicel ($1.4\times$ as long in *C. pseudobabaiax*); male flagellomere $1.1\times$ as long as
 1095 second male flagellomere ($1.3-1.4\times$ as long in *C. pseudobabaiax*); scutes are strongly convex (flat in *C.*
 1096 *pseudobabaiax*); proximodorsal notch of cupula as long as wide and harpe as long as gonostyle/volsella
 1097 complex in lateral view (proximodorsal notch of cupula almost $2\times$ as wide as long; harpe $0.7\times$ length of
 1098 gonostyle/volsella complex in *C. pseudobabaiax*).

1099

1100 *Description*

1101 Body length: 2000-3450 μm . Color intensity pattern: ventral region of cranium is lighter than dorsal
 1102 region of cranium. Color hue pattern: Distal part of scape, pedicel, F1-3 ochre; legs except proximal
 1103 metacoxa yellow; rest of body brown; Scape, hind leg except metacoxa ochre; fore and hind legs, distal
 1104 metacoxa yellow; rest of body brown. Occipital carina sculpture: crenulate. Median flange of occipital
 1105 carina count: absent. Submedial flange of occipital carina count: absent. Dorsal margin of occipital carina
 1106 vs. dorsal margin of lateral ocellus in lateral view: occipital carina is dorsal to lateral ocellus in lateral
 1107 view. Preoccipital lunula count: NOT CODED. Preoccipital carina count: absent. Preoccipital carina
 1108 shape: NOT CODED. Preoccipital furrow count: present. Preoccipital furrow anterior end: Preoccipital
 1109 furrow ends inside ocellar triangle. Postocellar carina count: absent. Male ocular ocellar line (OOL):
 1110 posterior ocellar line (POL): lateral ocellar line (LOL): 1.3-1.5:1:1. Female ocular ocellar line (OOL):
 1111 posterior ocellar line (POL): lateral ocellar line (LOL): 1.2-1.3:1.0:1.0. Head width vs. interorbital
 1112 space (HW/IOS) Male: 2.0-2.2. Head width vs. interorbital space (HW/IOS) Female : 2.3-2.7. Setal
 1113 pit on vertex size: smaller than diameter of scutes. Transverse frontal carina count: absent. Transverse
 1114 scutes on frons count: present. Rugose region on frons count: absent. Randomly sized areolae around
 1115 setal pits on frons count: absent. Antennal scrobe count: absent. Ventromedian setiferous patch and
 1116 ventrolateral setiferous patch count: present. Facial pit count: no external corresponding structure present.
 1117 Supraclypeal depression count: absent. Supraclypeal depression structure: NOT CODED. Intertorular
 1118 carina count: present. Intertorular area count: present. Median region of intertorular area shape: flat.
 1119 Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo-clypeal carina count:
 1120 absent. Subtorular carina count: absent. Mandibular tooth count: 2. Female flagellomere 1 length
 1121 vs. pedicel: 0.9. Female ninth flagellomere length: F9 less than F7+F8. Sensillar patch of the male
 1122 flagellomere pattern: F4-F9; F5-F9. Length of setae on male flagellomere vs. male flagellomere width:
 1123 setae shorter than width of flagellomeres. Male flagellomere 1 length vs. male second flagellomere
 1124 length: 1.0-1.1; 1.1. Male flagellomere 1 length vs. pedicel length: 2.5-3.0. Ventrolateral
 1125 invagination of the pronotum count: present. Scutes on posterior region of mesoscutum and dorsal
 1126 region of mesoscutellum convexity: convex. Notaulus posterior end location: adjacent to transscutal
 1127 articulation. Median mesoscutal sulcus posterior end: not adjacent to transscutal articulation (ends anterior
 1128 to transscutal articulation). Scutoscutellar sulcus vs. transscutal articulation: adjacent. Axillular carina
 1129 count: absent. Axillular carina shape: NOT CODED. Epicnemium posterior margin shape: anterior
 1130 discimal pit absent; epicnemial carina interrupted medially. Epicnemial carina count: present only
 1131 laterally. Sternaulus count: present. Sternaulus length: short, not reaching $1/2$ of mesopleuron length at

level of sternaulus. Speculum ventral limit: not extending ventrally of pleural pit line. Mesometapleural sulcus count: present. Metapleural carina count: present. Transverse line of the metanotum-propodeum vs. antecostal sulcus of the first abdominal tergum: adjacent sublaterally. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted "Y" (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted "Y"); straight (left and right lateral propodeal carinae compose a carina that is not broken medially). Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex count: absent. S1 length vs. shortest width: S1 wider than long. Transverse carina on petiole shape: concave. Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Cupula length vs. gonostyle-volsella complex length: cupula less than 1/2 the length of gonostyle-volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched. Proximolateral projection of the cupula shape: blunt. Proximodorsal notch of cupula width vs length: as long as wide. Distodorsal margin of cupula shape: straight. Dorsomedian conjunctiva of the gonostyle-volsella complex length relative to length of gonostyle-volsella complex: dorsomedian conjunctiva extending 2/3 of length of gonostyle-volsella complex in dorsal view. Dorsomedian conjunctiva of the gonostyle-volsella complex count: present. Distal end of dorsomedian conjunctiva of the gonostyle-volsella complex shape: acute. Parossiculus count (parossiculus and gonostipes fusion): present (not fused with the gonostipes). Apical parossiculus seta number: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Dorsal apodeme of penisvalva count: absent. Harpe length: harpe as long as gonostipes in lateral view. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: medially. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Distal margin of harpe in lateral view: shape: blunt. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle-volsella complex.

Comments


The length of the preoccipital furrow is variable in *Conostigmus toliaraensis* Dessart 1997, from reaching the median ocellus (CAS2053309) to barely exceeding POL (CAS2040934). Two specimens from Foret Classee have narrower heads and bodies (distinct in HW/IOS ratio). Since the rest of the specimens are from Forret d' Ankazotsihitafootra, these two specimens might represent a different subspecies or species. The fact that there are only a few minute differences in the male genitalia morphology between *Conostigmus toliaraensis* and *C. pseudobabaiax* is unique, since male genitalia characters are traditionally used for species separation in Megaspilidae and in some cases provide the only diagnostic tool.

Etymology From the Greek *pseudo-* (=false) and the specific name *babaiax*, indicating a close resemblance of *Conostigmus pseudobabaiax* and *C. babaiax*.

Material Examined Holotype male: CASENT 2053309 MADAGASCAR: Toliara Prov: Res. Speciale d' Ambohijanahary: Foret d' Ankazotsihitafootra: 35.2km; NW Ambaravarana; 1050m; 18°16'00"S, 45°24'24"E; 13-17.i.2003; MT; MISC BLF7019; Fisher, Griswold, et al. California Academy of Sciences. Yellow pan trap- in montane rainforest. (deposited in CAS).
Paratypes (9 females): MADAGASCAR: 9 females. CASENT 2009754, 2040934-2040936, 2040983, 2041206, 2053310-2053311, 2053452 (CAS).(deposited in CAS MRAC).

Identification key for Malagasy *Conostigmus* Dahlbom

1. a. Antennomeres gradually widening apically (Figs 6B, 8B, 13A, females) 2
 - aa. Antennomeres not widening apically (Fig. 13B, males) 12
2. a. Scutes on ventral region of frons transverse (vrf: Figs 1A, 16B, 22B, 48A) 3
 - aa. Scutes on ventral region of frons not transverse (Figs 7A, 10A, 18A) 6
3. a. White setal patches on frons absent (Figs 22A, B)
 - b. Depression surrounding frontal pit present (dep: Figs 22A, B)
 - c. Transverse frontal carina present (tfc: Figs 22A, B) *Conostigmus longulus* Dessart 1997

- 1184 **aa.** White setal patches on frons present (msp, ssp: Figs 4A, 48A)
- 1185 **bb.** Depression surrounding frontal pit absent (Figs 4A, 48A) 
- 1186 **cc.** Transverse frontal carina absent (Figs 4A, 48A) 4
- 1187 **4. aa.** LOL longer than OOL (Fig. 6A)
- 1188 *Conostigmus babaiax* Dessart 1997
- 1189 **bb.** OOL shorter than LOL (Figs 48) 5
- 1190 **5. a.** Flagellomere 1 length $0.9 \times$ pedicel length (Fig. 53A)
- 1191 **b.** Scutes on frons and mesonotum strongly convex (Figs 55A, B, 51A) *Conostigmus toliaraaensis*
- 1192 Mikó and Trietsch sp. nov.
- 1193 **aa.** Flagellomere 1 $1.4 \times$ as long as pedicel (Fig. 49A)
- 1194 **bb.** Scutes on frons and mesonotum flat (Figs 50A, B, 51B) . *Conostigmus pseudobabaiax* Mikó
- 1195 and Trietsch sp. nov.
- 1196 **6. a.** Flagellomere 9 as long as sum of lengths of flagellomeres 6–8 (Fig. 13A)
- 1197 **b.** Rugous region on frons present (Figs 10A, B)
- 1198 **c.** Subtorular carina present (stc: Fig. 10C)
- 1199 **d.** Median and submedial flanges of occipital carina present (mfc, sfc: Figs 11A, 12B)
- 1200 **e.** Axillular carina present, carinae not adjacent posteriorly (not composing a U-shaped carina
- 1201 surrounding disc of mesoscutellum) (axc: Figs 11B, 12A, B) ... *Conostigmus clavatus* Mikó and
- 1202 Trietsch sp. nov.
- 1203 **aa.** Flagellomere 9 shorter than sum of lengths of flagellomere 7 and flagellomere 8 (Figs 6B, 8B)
- 1204 **bb.** Rugous region on frons absent (Figs 3A, 7A, 16B)
- 1205 **cc.** Subtorular carina absent (Figs 18A, B, 37A, B)
- 1206 **dd.** Median and submedial flanges of occipital carina absent (Figs 7B, 8A)
- 1207 **ee.** Axillular carina absent (Figs 5A, 15A, 19B) or axillular carinae adjacent posteriorly (composing
- 1208 a U-shaped carina surrounding disc of mesoscutellum) (usc: Figs 8A, 9A, B) 7
- 1209 **7. a.** Preoccipital carina present (poc: Figs 7B, 11A, 12B)
- 1210 **b.** Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex present
- 1211 (app: Fig. 8A)
- 1212 **c.** Randomly sized areolae around setal basis on frons present (aro: Fig. 7A)
- 1213 **d.** Axillular carinae adjacent posteriorly (composing a U-shaped carina surrounding disc of
- 1214 mesoscutellum) (usc: Figs 8A, 9A, B) *Conostigmus ballescoracas* Dessart 1997
- 1215 **aa.** Preoccipital carina absent (Figs 5A, 15A, 25A, B)
- 1216 **bb.** Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex absent
- 1217 (Figs 5A, 15A, 25A, B)
- 1218 **cc.** Randomly sized areolae around setal basis on frons absent (Figs 4A, 16B, 18A)
- 1219 **dd.** Axillular carinae absent (Figs 5A, 15A, 19B) 8
- 1220 **8. a.** Anterior neck of T1 (and corresponding S1) as long as wide (Fig. 28B)
- 1221 **b.** Median mesoscutal line marked by a row of punctures (mml: Fig. 28B)
- 1222 **c.** Sternaulus elongate (exceeding $3/4$ of mesopleuron length measured at level of sternaulus)(ste:
- 1223 Figs 29A, B)
- 1224 **d.** Postocellar carina present (pcc: Figs 28B, 29B) .. *Conostigmus lucidus* Mikó and Trietsch sp.
- 1225 nov.
- 1226 **aa.** Anterior neck of T1 (and corresponding S1) much wider than long (9B, 16A, 25B)
- 1227 **bb.** Median mesoscutal line marked by a groove (mml: Figs 5A, B, 9A, B, 12 A, B)
- 1228 **cc.** Sternaulus short, not reaching $1/2$ of mesopleuron length measured at level of sternaulus (ste:
- 1229 Figs 6B, 19A, 24B)
- 1230 **dd.** Postocellar carina absent (Figs 5A, 15A, 25A, 42A, B) 9
- 1231 **9. a.** Antennal scrobe present (asr: Figs 15B, 16B)
- 1232 **b.** Depressions around setal bases on dorsal region of cranium and mesonotum larger than scutes
- 1233 (Fig. 15A) *Conostigmus bucephalus* Mikó and Trietsch sp. nov.

- 1234 **aa.** Antennal scrobe absent (Figs 4A, 7A, 10A, B)
 1235 **bb.** Depressions around setal bases on cranium and mesonotum smaller than scutes 10
- 1236 **10. a.** Head globular, almost as long as wide in dorsal view and as high as long in lateral view (Figs
 1237 46A, B)
 1238 **b.** OOL almost as long as LOL (Fig. 46A)
 1239 **c.** Preoccipital sulcus absent (Fig. 46A) . *Conostigmus missyhazena* Mikó and Trietsch sp. nov.
- 1240 **aa.** Head transverse, distinctly wider than long in dorsal view
 1241 **bb.** OOL about 2× as long as LOL (Figs 41A, B)
 1242 **cc.** Preoccipital sulcus present (pos: Figs 41A, B, 39 A, B) 11
- 1243 **11. a.** Mandible with one tooth (Figs 18A, B) *Conostigmus fianarantsoaensis* Mikó and Trietsch sp.
 1244 nov.
 1245 **aa.** Mandible with two teeth (Figs 37A, B) *Conostigmus madagascariensis* Mikó and Trietsch sp.
 1246 nov.
- 1247 **12. a.** Scutes on ventral region of frons transverse (vrf: Figs 1A, 16B, 22B, 48A) 13
 1248 **aa.** Scutes on ventral region of frons not transverse (Figs 7A, 10A, 18A) 15
- 1249 **13. a.** White setal patches on frons absent (Figs 22A, B)
 1250 **b.** Depression surrounding frontal pit present (dep: Figs 22A, B)
 1251 **c.** Transverse frontal carina present (tfc: Figs 22A, B)
 1252 **d.** Setal ring area of the harpe oriented dorsomedially (hrp: Figs 26A, B)
 1253 **e.** Dorsomedial setae of harpal setal ring elongate, apical ends adjacent medially, 2–3× as long as
 1254 harpe width in lateral view (dhs: Fig. 26B) *Conostigmus longulus* Dessart 1997
- 1255 **aa.** White setal patches on frons present (msp, ssp: Figs 4A, 48A)
 1256 **bb.** Depression surrounding frontal pit absent (Figs 4A, 48A))
 1257 **cc.** Transverse frontal carina absent (Figs 4A, 48A)
 1258 **dd.** Setal ring area of the harpe oriented medially (hrp: Fig. 57B)
 1259 **ee.** Dorsomedial setae of harpal setal ring short, apical ends not adjacent medially, shorter than
 1260 harpe width in lateral view (dhs: Fig. 57B) 14
- 1261 **14. a.** Flagellomere 1 1.1× as long as second flagellomere (Fig. 53B)
 1262 **b.** Scutes on frons and mesonotum strongly convex (Fig. 51A)
 1263 **c.** Proximodorsal notch of cupula as long as wide (pdc: Fig. 57B)
 1264 **d.** Harpe as long as gonostyle-volsella complex in lateral view (hrp, gvs: Fig. 57B) *Conostigmus*
 1265 *toliaraensis* Mikó and Trietsch sp. nov.
- 1266 **aa.** Flagellomere 1 1.3–1.4× as long as second flagellomere (Fig. 49B)
 1267 **bb.** Scutes on frons and mesonotum flat (Fig. 51B)
 1268 **cc.** Proximodorsal notch of cupula almost 2X as wide as long (pdc: Fig. 51B)
 1269 **ee.** Harpe 0.7 length of gonostyle/volsella complex in lateral view (hrp, gvs: Fig. 51B) *Conostigmus*
 1270 *pseudobabaiax* Mikó and Trietsch sp. nov.
- 1271 **15. a.** Subtorular carina present (stc: Fig. 10C)
 1272 **b.** Axillular carina present (axc: Figs 11B, 12A, B)
 1273 **c.** Median and submedial flanges of occipital carina present (mfc, sfc: Figs 11A, 12B)
 1274 **d.** Rugulose sculpture on frons present (Figs 10A, B)
 1275 **e.** OOL/LOL > 3.3 (Fig. 10B)
 1276 **f.** Interorbital space wide (HW/IOS = 1.63–1.66)
 1277 **g.** Distodorsal margin of cupula concave medially (ddm: Fig. 14B)
 1278 **h.** Eyes bulging (Figs 10, 11A, 12B); (Fig. 10B) *Conostigmus clavatus* Mikó and Trietsch sp. nov.
- 1279 **aa.** Subtorular carina absent (stc: Fig. 10C)
 1280 **bb.** Axillular carina absent (axc: Figs 11B, 12A, B)
 1281 **cc.** Median and submedial flanges of occipital carina absent (mfc, sfc: Figs 11A, 12B)
 1282 **dd.** Rugulose sculpture on frons absent (Figs 10A, B)
 1283 **ee.** OOL/LOL < 3.3 (Fig. 10B)

- 1284 **ff.** Interorbital space narrow (HW/IOS > 1.8)
- 1285 **gg.** Distodorsal margin of cupula straight medially
- 1286 **hh.** Eyes not bulging (Figs 10, 11A, 12B) 16
- 1287 **16. a.** Anterior neck of T1 (and corresponding S1) as long as wide (Fig. 28B)
- 1288 **b.** Median mesoscutal line marked by a row of punctures (mml: Fig. 28B)
- 1289 **c.** Sternaulus elongate (exceeding $\frac{3}{4}$ of mesopleuron length measured at level of sternaulus; ste:
1290 Figs 29A, B)
- 1291 **d.** Postocellar carina present (pcc: Figs 28B, 29B)
- 1292 **e.** Dorsomedian conjunctiva of the gonostyle/volsella complex absent (Fig. 30C)
- 1293 **f.** Proximodorsal notch of cupula absent (Fig. 30C)
- 1294 **g.** Parossiculus absent (parossiculus and gonostyle fused, Fig. 30C) . *Conostigmus lucidus* Mikó
1295 and Trietsch sp. nov.
- 1296 **aa.** Anterior neck of T1 (and corresponding S1) much wider than long (9B, 16A, 25B)
- 1297 **bb.** Median mesoscutal line marked by a groove (mml: Figs 5A, B, 9A, B, 12 A, B)
- 1298 **cc.** Sternaulus short, not reaching $\frac{1}{2}$ of mesopleuron length measured at level of sternaulus (ste:
1299 Figs 6B, 19A, 24B)
- 1300 **dd.** Postocellar carina absent (Figs 5A, 15A, 25A, 42A, B)
- 1301 **ee.** Dorsomedian conjunctiva of the gonostyle/volsella complex present (dc: Figs 21C, 43A)
- 1302 **ff.** Proximodorsal notch of cupula present (pdc: Fig. 21B)
- 1303 **gg.** Parossiculus present (parossiculus and gonostyle not fused, Fig. 1A) 17
- 1304 **17. a.** Preoccipital carina present (poc: Figs 7B,)
- 1305 **b.** Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex present
1306 (app: Fig. 8A)
- 1307 **c.** Randomly sized areolae around setal bases on frons present (aro: Fig. 7A)
- 1308 **d.** Axillular carinae adjacent posteriorly (composing a U-shaped carina surrounding posteriorly and
1309 laterally mesoscutellar disc) (usc: Figs 8A, 9A, B) *Conostigmus ballescoracas* Dessart 1997
- 1310 **aa.** Preoccipital carina absent (Figs 5A, 15A, 25A, B)
- 1311 **bb.** Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex absent
1312 (Figs 5A, 15A, 25A, B)
- 1313 **cc.** Randomly sized areolae around setal bases on frons absent (Figs 4A, 16B, 18A)
- 1314 **dd.** Axillular carinae absent (Figs 5A, 15A, 19B) 18
- 1315 **18. a.** Head globular, almost as long as wide in dorsal view and as high as long in lateral view (Figs
1316 46A, B)
- 1317 **b.** OOL almost as long as LOL (Fig. 46A)
- 1318 **c.** Preoccipital sulcus absent (Fig. 46A)
- 1319 **d.** Proximal region of lateral margins of harpe diverging distally and widest point of harpe is in its
1320 proximal $\frac{1}{3}$ rd (hrp: Figs 47 B, C) *Conostigmus missyhazena* Mikó and Trietsch sp. nov.
- 1321 **aa.** Head transverse, distinctly wider than long in dorsal view
- 1322 **bb.** OOL about $2\times$ as long as LOL (Figs 41A, B)
- 1323 **cc.** Preoccipital sulcus present (pos: Figs 41A, B, 39 A, B)
- 1324 **dd.** Lateral margins of harpe gradually converging distally, widest point of harpe is at its articulation
1325 site with gonostyle-volsella complex (Figs 30A, 36A, 52A) 19
- 1326 **19. a.** Cupula as long as gonostyle-volsella complex (cup: Fig. 36A)
- 1327 **b.** Distal 3–4 setae in dorsal region of sensillar ring of harpe oriented distodorsally (Figs 36A–C)
- 1328 **c.** Distal margin of S9 concave
- 1329 **d.** Distal end of dorsomedial conjunctiva of gonostyle-volsella complex not extending $\frac{1}{2}$ of length
1330 of gonostyle-volsella complex (dc: Fig. 36C)
- 1331 **e.** Parossiculus with two parossiculus setae (pss: Fig. 36D) *Conostigmus macrocupula* Mikó and
1332 Trietsch sp. nov.
- 1333 **aa.** Cupula at least $\frac{1}{2}$ of gonostyle (Figs 21A, B)
- 1334 **bb.** Setae of sensillar ring of harpe oriented distomedially (Figs 21, 43)
- 1335 **cc.** Distal margin of S9 convex

- 1336 **dd.** Distal end of dorsomedial conjunctiva of gonostyle-volsella complex extending $\frac{2}{3}$ of length of
 1337 gonostyle-volsella complex (dc: Fig. 43A)
 1338 **e.** Parossiculus with one parossiculus seta (pss: Fig. 43) **20**
- 1339 **20. a.** Mandible with one tooth (Figs 18A, B)
 1340 **b.** Setae on antenna shorter than or as long as width of flagellomeres (Fig. 40A)
 1341 **c.** Proximolateral projection of cupula blunt (Fig. 21A)
 1342 **d.** Proximodorsal notch of cupula notched (pdc: Fig. 21C)
 1343 **e.** Distal end of dorsomedial conjunctiva of gonostyle/volsella complex blunt (dc: Fig. 21C)
 1344 **f.** Distal margin of harpe in lateral view acute (hrp: Fig. 21C) .. *Conostigmus fianarantsoaensis*
 1345 Mikó and Trietsch sp. nov.
- 1346 **aa.** Mandible with two teeth (Figs 37A, B)
 1347 **bb.** Setae on antenna longer than width of flagellomeres (Fig. 20A)
 1348 **cc.** Proximolateral projection of cupula acute (ppc: Fig. 43B)
 1349 **dd.** Proximodorsal notch of cupula arched (pdc: Fig. 43)
 1350 **e.** Distal end of dorsomedial conjunctiva of gonostyle-volsella complex acute (dc: Fig. 43A)
 1351 **f.** Distal margin of harpe in lateral view blunt (hrp: Fig. 43C) .. *Conostigmus madagascariensis*
 1352 Mikó and Trietsch sp. nov.

1353 DISCUSSION

1354 Latitudinal diversity gradient and Malagasy *Conostigmus*

1355 Including our data, almost an order of magnitude more *Conostigmus* species have been described
 1356 from the Holarctic (n=125) than from the Afrotropical region (n=13) (Johnson and Musetti, 2004; Dessart,
 1357 1997). This biodiversity pattern suggests that *Conostigmus* joins other taxa known to be exceptions to the
 1358 typical latitudinal diversity gradient (LDG): mollusks (Valdovinos et al., 2003), nematodes (Lambshhead
 1359 et al., 2000), fig wasps (Agaonidae; Hawkins and Compton, 1992), galling insects (Price et al., 1998),
 1360 bees (Anthophila; Michener, 1979), sawflies (“Symphyta”; Kouki et al., 1994), Ichneumonidae (Gauld,
 1361 1986; Owen and Owen, 1974), Braconidae (Quicke and Krufft, 1995), some Lepidoptera (Holloway, 1987),
 1362 psyllids and aphids (Dixon et al., 1987; Eastop, 1977, 1978).

1363 Noyes (1989) survey of two similarly-sized countries supports the validity of reverse LDG in Cer-
 1364 aphronoidea. Standardized sampling of the megaspilids of Sulawesi and Great Britain revealed a much
 1365 higher diversity in the temperate (69 spp.) than in the tropical (9 spp.) region, as determined by Paul
 1366 Dessart.

1367 Deviation from the LDG in Ceraphronoidea has been only superficially examined, however, and could
 1368 result from sampling bias. The only taxonomic revision of *Conostigmus* species was published by Dessart
 1369 (1997). He treated the faunas of Africa, Asia, and Australia and examined 145 specimens compared to
 1370 the many hundreds if not thousands of specimens examined for Palearctic species. Of the 36 species,
 1371 nineteen are known exclusively by holotypes, eight by the holotype and one paratype, and only one
 1372 species (*Conostigmus canariensis*) was based on more than 10 specimens.

1373 The present revision focuses solely on Malagasy *Conostigmus* and is based on observations of 159
 1374 specimens representing 12 species, more than five times as many as the earlier recorded *Conostigmus*
 1375 species from Madagascar (Dessart, 1997). This species number is still just a small fragment of the known
 1376 Palearctic *Conostigmus* species (n=97; Johnson and Musetti, 2004) and one fourth of the number of
 1377 species recorded from the Atlantic Archipelago (n=44; Broad and Livermore, 2014), which is almost half
 1378 the size of Madagascar (315,159 km² vs. 587,041 km²). Considering that Madagascar is a biodiversity
 1379 hotspot (Myers et al., 2000), our study lends support to the hypothesis that Megaspilidae show a reverse
 1380 latitudinal biodiversity gradient.

1381 The single layer epithelium and body size polyphenism

1382 Insects are epidermal organisms (Locke, 1998) and the single-layered epidermis is responsible for
 1383 their tremendous phenotypic diversity. Epidermal cells produce the cuticle, the acellular exoskeleton
 1384 that is the subject of most morphological descriptions in insect systematics (Deans et al., 2012). For
 1385 instance, in the present paper we exclusively used cuticle-related phenotypes. The dominance of cuticular
 1386 characters in insect systematics descriptions is easy to explain: besides the remnants of some skeletal
 1387 muscles, the cuticle is perhaps the only component of an insect body that can be accurately studied

1388 even on an improperly fixed specimen. This resilient replica of the pupal epidermis can be studied on
1389 specimens that are millions of years old (Carpenter, 1992).

1390 The epidermis arises exclusively and solely from imaginal disks. The growth of imaginal disks, and
1391 thus the final cell number and cell size of the epidermis, is regulated in collaboration by insulin and
1392 ecdysone (Nijhout and Grunert, 2010; Nijhout et al., 2007; Nijhout and Callier, 2015) that are controlled
1393 mostly by environmental factors, such as temperature, oxygen level and nutrition. Oxygen concentration
1394 and temperature mostly influence body size through cell growth (Callier and Nijhout, 2014; Heinrich
1395 et al., 2011; Harrison and Haddad, 2011; Peck and Maddrell, 2005; Azevedo et al., 2002; Partridge et al.,
1396 1994) while nutrition level seems to impact cell number through regulating proliferation (Emlen et al.,
1397 2007; Liu et al., 2015).

1398 Ceraphronoidea exhibit substantial body size polyphenism, which varies by almost a factor of two
1399 in some species (Mikó et al., 2013; Fergusson, 1980; Liebscher, 1972). This tendency is followed by
1400 Malagasy *Conostigmus*, for example the IOS (interorbital distance, an anatomical line between the medial
1401 eye margins that reflects body size) reveals a two-fold difference in *C. longulus* (138–263 μm). Body size
1402 polyphenism is usually induced by variability in host body size in polyphagous and nest size in gregarious
1403 parasitic Hymenoptera (Quicke, 1997; Nalepa and Grisell, 1993; Medal and Smith, 2015). Numerous
1404 ceraphronoid species are known to parasitize hosts with variable body size (Fergusson, 1980; Gilkeson
1405 et al., 1993) and gregariousness is not uncommon (Cooper and Dessart, 1975; Starý, 1977; Liebscher,
1406 1972; Mackauer and Chow, 2015; Takada, 1973). Mackauer and Chow (2015) A clear relationship between
1407 ceraphronoid body mass and nest size was recently shown in the facultative gregarious *Dendrocerus*
1408 *carpenteri*, where the body mass of a single solitary specimen did not differ from the combined body
1409 mass of two gregarious specimens Mackauer and Chow (2015).

1410 Information on *Conostigmus* biology is very limited, but body size of their hosts (Syrphidae and boreid
1411 mecopterans) certainly allows the development of multiple parasitoids specimens (Dessart, 1980; Cooper
1412 and Dessart, 1975; Weems and Howard, 1954; Kamal, 1926; Ulber et al., 2010; Panis, 2008). These data
1413 suggest that differences in ceraphronoid body size is nutrition dependent thus body size polyphenism is
1414 most likely related to differences in cell number.

1415 Wing trichomes (http://purl.obolibrary.org/obo/HAO_0002454) have a one to one
1416 match to epidermal cells (Dobzhansky, 1929; Stevenson et al., 1995; Partridge et al., 1994; Heinrich et al.,
1417 2011) and they were traditionally used in comparative evo-devo studies to estimate cell density and size in
1418 different *Drosophila* mutant specimens (Stern and Emlen, 1999; Emlen et al., 2007; Nijhout and Callier,
1419 2015).

1420 Sculptural elements of the cuticle likewise correspond to the patterns and geometry of epidermal cells
1421 (Wigglesworth, 1973; Locke, 1959, 1967) and they have never been explored as a potential source for
1422 understanding cellular processes in the developing imaginal disks.

1423 The nature of scutes

1424 In Malagasy *Conostigmus* species, the head and the mesosoma is covered with repetitive, usually
1425 hexagonal and isodiametric, 6.6–25 μm wide elements, referred as scutes (Cals, 1974; Moretto et al.,
1426 2015) or sculpticells (Allen and Ball, 1979). Arthropod taxa often exhibit scutes (Meyer, 1842; Cals, 1974;
1427 Krell, 1994) that are considered as ancestral sculpture elements in Insecta (Hinton, 1970). The surface
1428 morphology of scutes (convex vs concave; Figs 51A, 51B) and the depth of the impressions separating
1429 them (Figs 50, 31A, B) are important for separating Malagasy *Conostigmus species* while differences in
1430 their superficial density (Figs 24, 25A, B; they are less dense in smaller specimens) is perhaps the most
1431 obvious intraspecific trait.

1432 Due to their hexagonal shape and size, scutes have long been speculated to reflect the surface of
1433 epidermal cells (Kölliker, 1856; Warren, 1903). Fusco et al. (2000) studied the correspondence between
1434 scutes and epidermal cells in subsequent instars of lithobiomorph centipedes and demonstrated a one to
1435 one match between the cells and scutes. Hinton (1970); Cals (1973, 1974); Blaney and Chapman (1969)
1436 likewise found correspondences between the number of epidermal cell nuclei in mature adults and scutes
1437 in different insect groups, but Blaney and Chapman (1969) found 1–2 percent less epidermal cells than
1438 scutes and explained this discrepancy by ecdysial cell death based on the presence of some degraded cell
1439 nuclei. One-to-one correspondence between scutes and epidermal cells is also supported by the fact that
1440 elongate scutes correspond to elongate epidermal cells (Hinton, 1970).

1441 Locke (1959, 1967) and Wigglesworth (1973) performed detailed histological and developmental

1442 studies to reveal cellular origin of stellate folding, ripple patterns, dome-like plaques, and setal pits and
1443 revealed that these structures are the product of multiple epidermal cells. Unfortunately, the relationships
1444 between scutes and epidermal cells have never been proved by similarly detailed examinations.

1445 **Bigger cells or more cells?**

1446 Although the relationship between scutes and epidermal cells have been broadly acknowledged in
1447 insect systematics (Ball, 1985; Allen and Ball, 1979; Burks et al., 2013; Krell, 1994), no one has used this
1448 knowledge to understand body size polyphenism. According to our findings, scute size is independent of
1449 body size (*i.e.* the epithelium of smaller specimens is built by proportionally less scutes than that in larger
1450 specimens). The number of scutes along the IOS (interorbital space, shortest distance between compound
1451 eyes) of a smaller specimen is half the number of scutes along the same line in a specimen with an IOS
1452 two times as long (Figs 31A, B).

1453 It follows that there is no difference in epidermal cell size of the smaller and the larger specimens
1454 and therefore cell number differences must contribute exclusively to body size polyphenism in Malagasy
1455 *Conostigmus longulus* Dessert 1997 specimens. Based on our collective understanding of underlying
1456 developmental processes, the size difference in *Conostigmus longulus* is likely related to nutritional
1457 differences that likely result from the complexities of polyphagy and gregariousness.

1458 We observed a substantial intraindividual variation in scute morphology: scutes and cell size on the
1459 frons are smaller than that on the mesoscutellum. This variation might reflect the difference in the growth
1460 of the head and wing imaginal disks contributing to allometric changes.

1461 Intraspecific differences in body size often impact species diagnoses. Statements, such as “smaller
1462 specimens can be very difficult, if not impossible, to identify correctly because the morphology of
1463 typical specimens is not expressed” (Al Khatib et al., 2014, page 809) and “in smaller specimens, the
1464 characters are subdued” (Smith, 2012, page 215) are common in taxonomic descriptions and often refer
1465 cuticular specializations, such as carinae or grooves. Despite the importance of allometric reductions,
1466 developmental causes of these phenomena have never been revealed. In *Conostigmus longulus* the
1467 transverse carina of the frons is less expressed in smaller specimens (ffc: Figs 22 A, B), encumbering
1468 their identification. The carina is the product of the concerted action of 52 epidermal cells (26 columns
1469 in 2 rows) in small specimens and 156 cells (52 columns in 3 rows) in a large specimens (Figs 22 A, B)
1470 suggesting that allometric reduction of cuticular specializations might be related to cell number and that
1471 more epidermal cells are able to produced more conspicuous structures. In this respect, the impact of
1472 epidermal cell density to the distinctness of cuticular specialization might be similar to the impact of pixel
1473 density to the resolution of digital images; one can see more details on an image with 1200 dpi than on
1474 one with 256 dpi resolution.

1475 **CONCLUSIONS**

1476 Our data reveal that Megaspilidae show a reverse latitudinal biodiversity gradient, but we acknowledge
1477 that *Conostigmus* in the temperate zone remains poorly understood (e.g., types of half the described
1478 Holarctic species are missing (Johnson and Musetti, 2004)). Species concepts are also based strictly on
1479 morphological data, which, for some taxa, can mask true species-level diversity (Smith et al., 2008).

1480 The correspondence between scutes and epidermal cells has already been proved by developmental
1481 studies in centipedes (Moretto et al., 2015), but we need to validate this relationship in insects. To
1482 understand spatial relationships between cellular and subcellular components of the epithelium is now
1483 easier to achieve with the advent of contemporary 3D reconstruction techniques such as confocal laser
1484 scanning microscopy or serial block face scanning electron microscopy. Ceraphronoidea would be espe-
1485 cially feasible model for this kind of examination since the head and the mesosoma are almost uniformly
1486 covered with scutes, and it is relatively easy to establish sustainable colonies of multiple species (Araj
1487 et al., 2006; Chow and Mackauer, 1999). *Dendrocerus carpenteri* is facultatively gregarious (Mackauer
1488 and Chow, 2015) with nest size varying between 1 and 3 larvae making this taxon feasible even for
1489 simultaneous analyses of nutrition, oxygen level and temperature dependence of epidermal development.

1490 Being able to understand cellular processes in the developing epithelium of adult insects by reading
1491 sculptural elements can provide invaluable information about the influence of environmental factors on
1492 allometric differentiation. Sculpture is not only one of the most important traits for insect classification, it
1493 also conserves the history of developmental processes in the single cell thick epithelium accountable for

1494 the tremendous morphological diversity in arthropods. Sculpture also remains available as a source of
1495 biological information long after a specimen has been collected or preserved as a fossil.

1496 Therefore we believe that sculpture, a witness to developmental and evolutionary history of arthropods,
1497 could serve as a messenger between morphology based classical arthropod taxonomy and the 21st century
1498 insect ecology, evolutionary biology, and cell and developmental biology.

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Figure 4. Brightfield image showing the lateral habitus of *Conostigmus babaiax* Dessart 1997.



Figure 5. Brightfield image showing the head and mesosoma of *Conostigmus babaiax* Dessart 1997. A. Lateral view. B. Dorsal view.

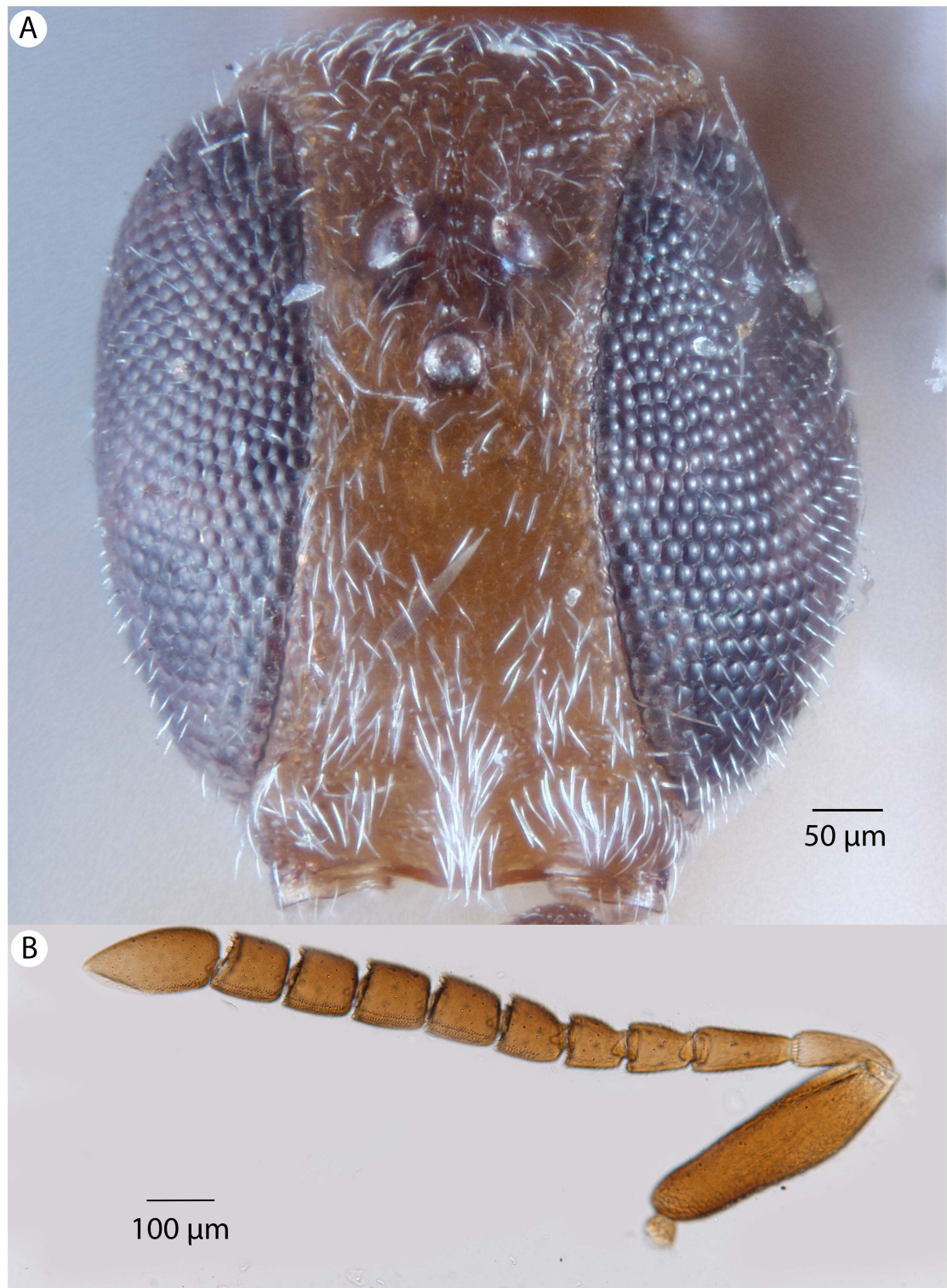


Figure 6. Brightfield image showing the head and female antenna of *Conostigmus babaiax* Dessart 1997. A. Head, anterior view. B. Female antenna.

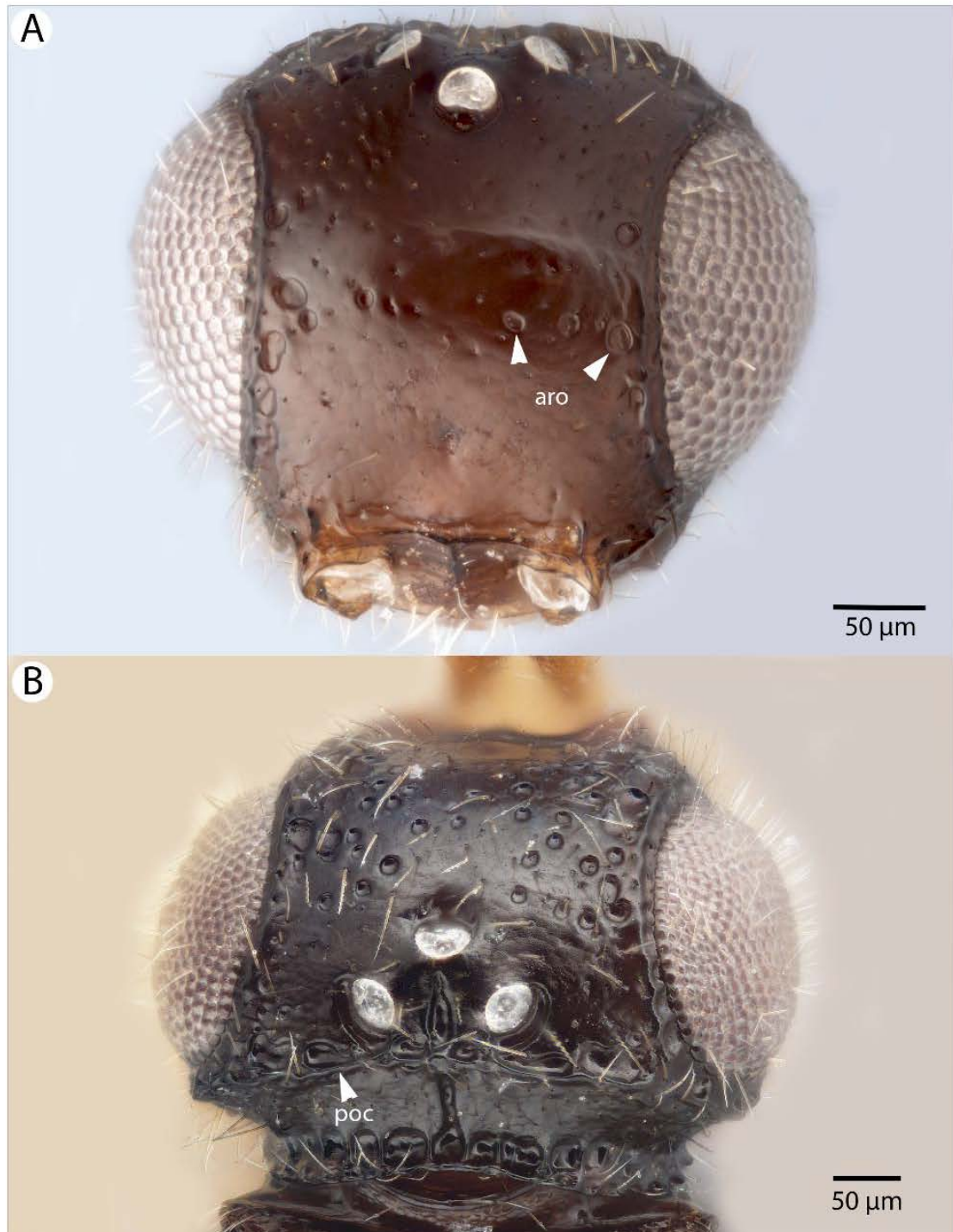


Figure 7. Brightfield image showing the head of *Conostigmus ballescoracas* Dessart 1997. A. Anterior view. B. Dorsal view (ar= randomly sized areolae around setal basis, poc=preoccipital carina).

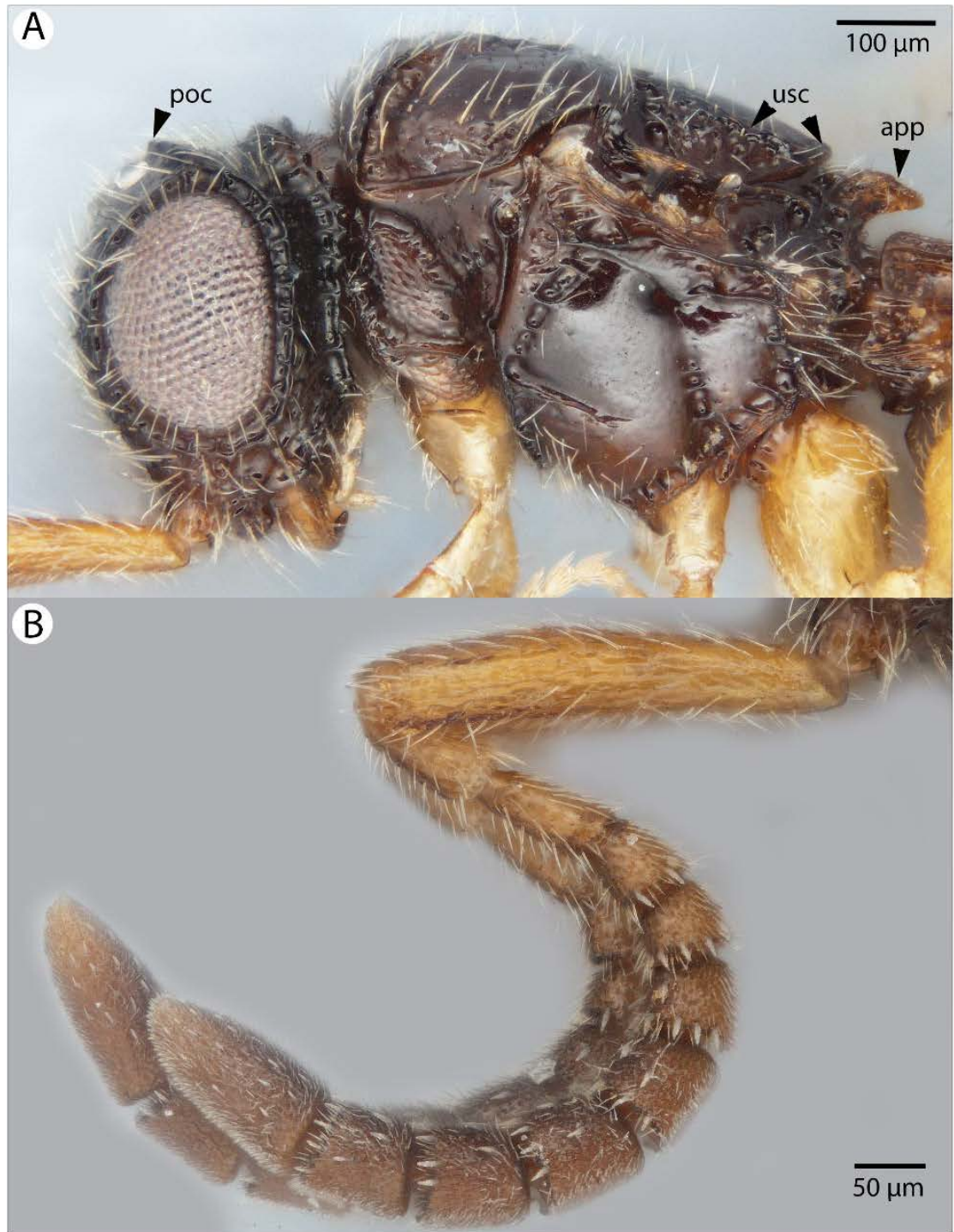


Figure 8. Brightfield image of *Conostigmus ballescoracas* Dessart 1997. A. Head and mesosoma lateral view. B. Female antenna lateral view (poc= preoccipital carina, app= anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex, usc= u-shaped carina surrounding posteriorly and laterally the disc of the mesoscutellum).

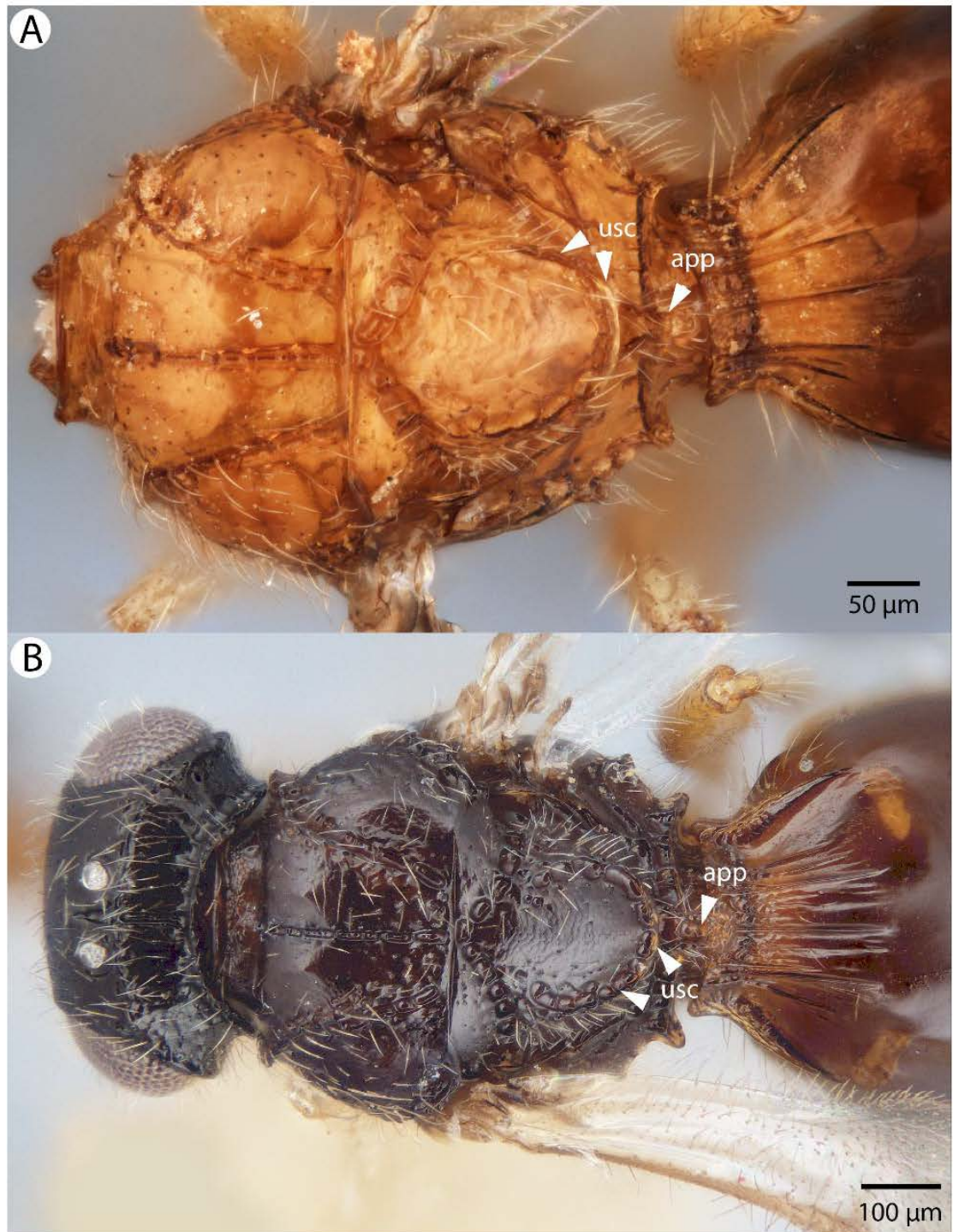


Figure 9. Brightfield image of *Conostigmus ballescoracas* Dessart 1997. A. Mesosoma and anterior metasoma, dorsal view. B. Head, mesosoma and anterior metasoma, dorsal view (app= anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex, usc= u-shaped carina surrounding posteriorly and laterally the disc of the mesoscutellum).

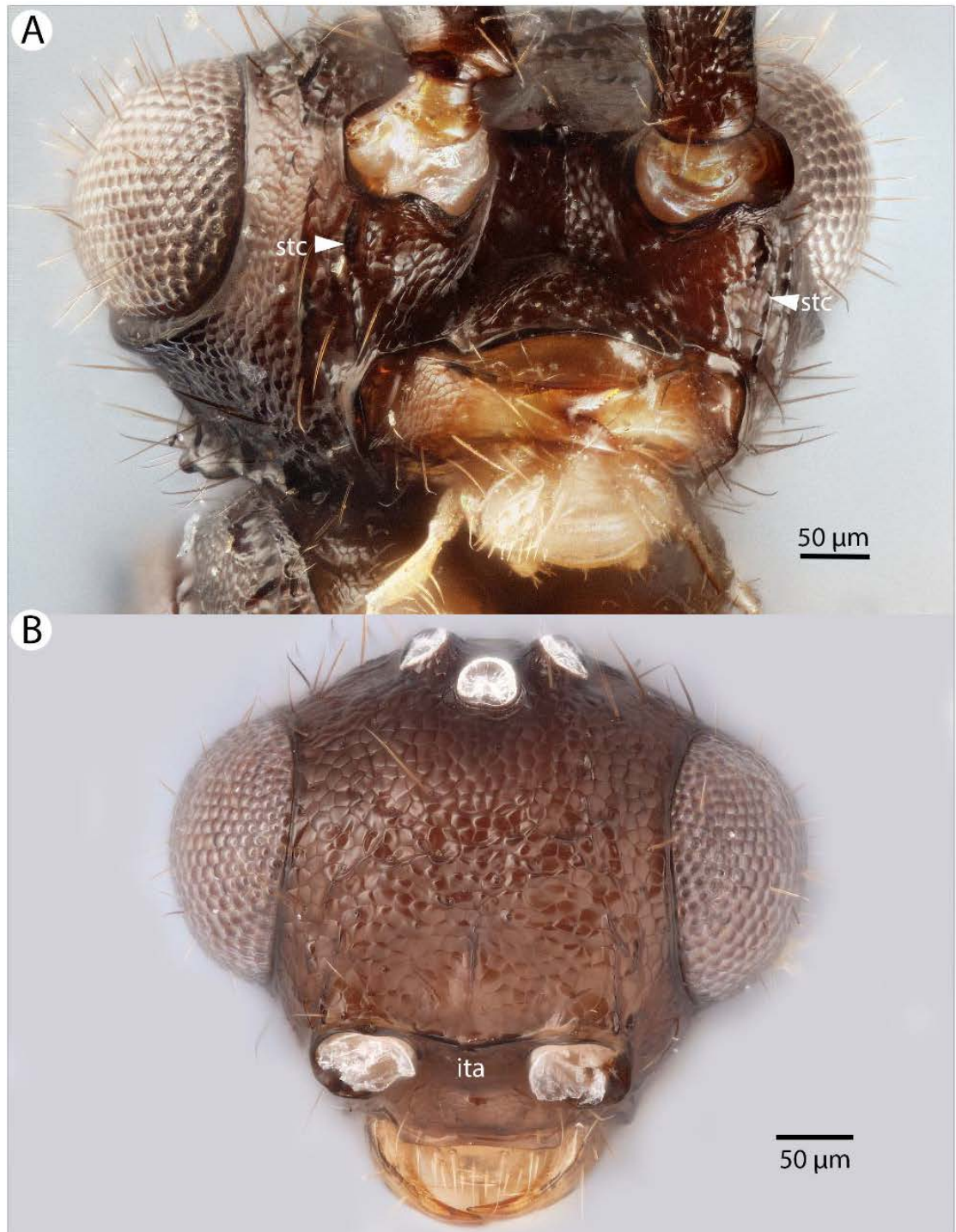


Figure 10. Brightfield image showing the head of *Conostigmus clavatus* Dessart 1997. A. Ventral view. B. Anterior view (stc= subtorular carina, ita=intertorular area).

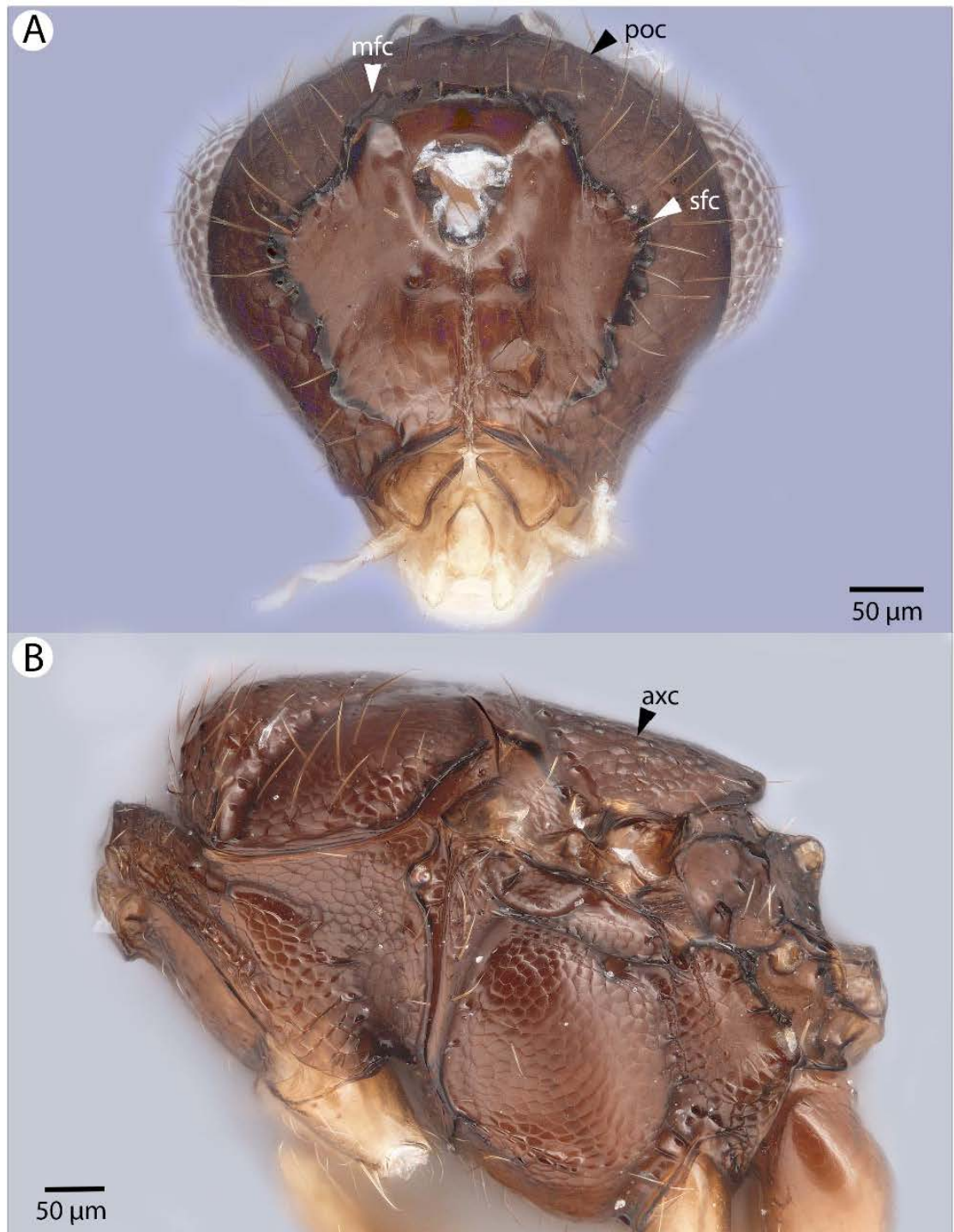


Figure 11. Brightfield image showing the head and mesosoma of *Conostigmus clavatus* Dessart 1997. A. Head, posterior view. B. Mesosoma, lateral view (poc= preoccipital carina, axc= axillular carina, mfc= median flange of occipital carina, sfc= submedial flange of occipital carina).

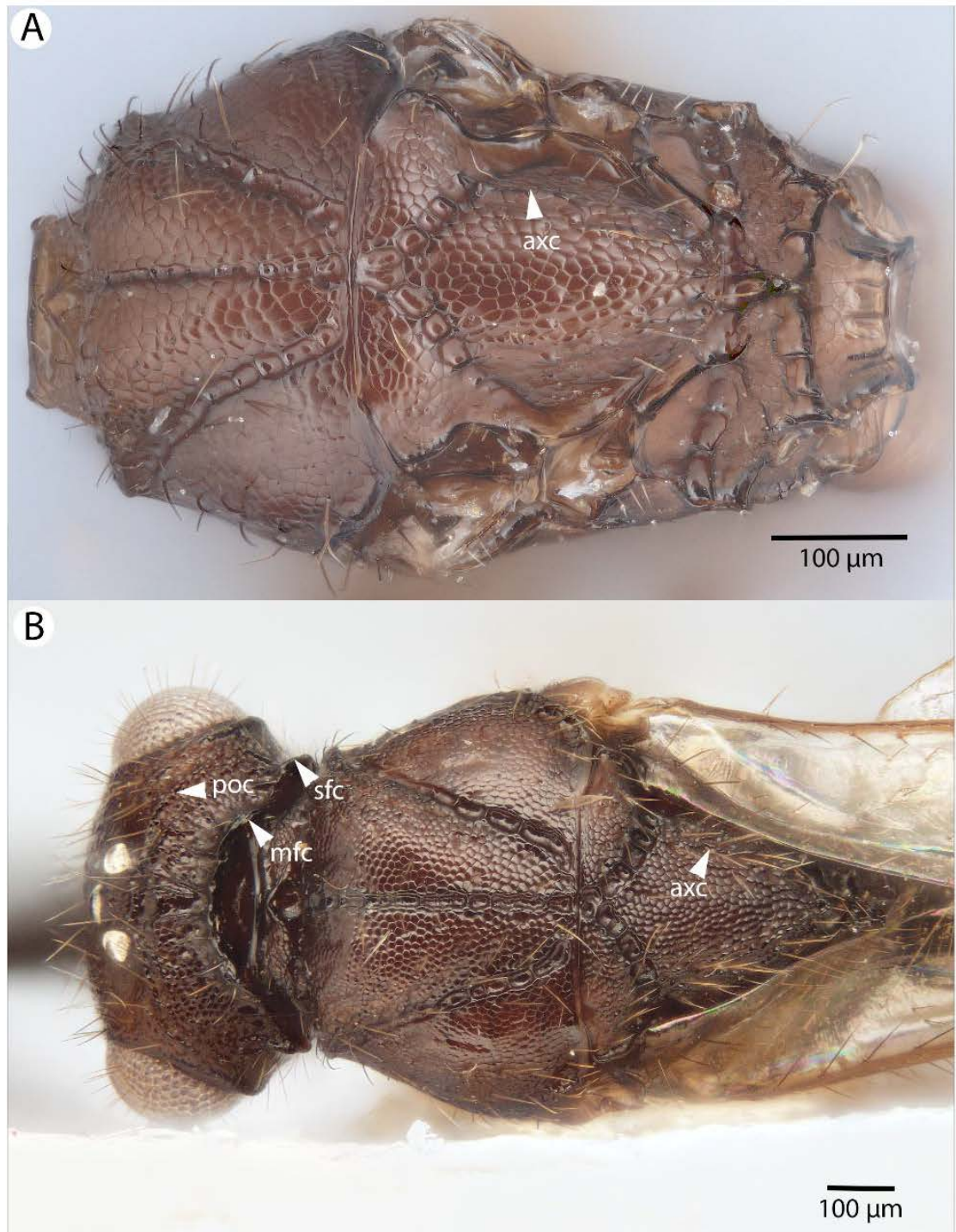


Figure 12. Brightfield image showing the head and mesosoma of *Conostigmus clavatus* Dessart 1997. A. Mesosoma, dorsal view. B. Head and mesosoma, dorsal view (poc= preoccipital carina, axc= axillary carina, mfc= median flange of occipital carina, sfc= submedial flange of occipital carina).



Figure 13. Brightfield image showing the antenna of *Conostigmus clavatus* Dessart 1997. A. Female. B. Male.



Figure 14. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus clavatus* Mikó and Trietsch sp. nov. A. Ventral view B. Dorsal view (ddm=distodorsal margin of cupula, pdc=proximodorsal notch of cupula).

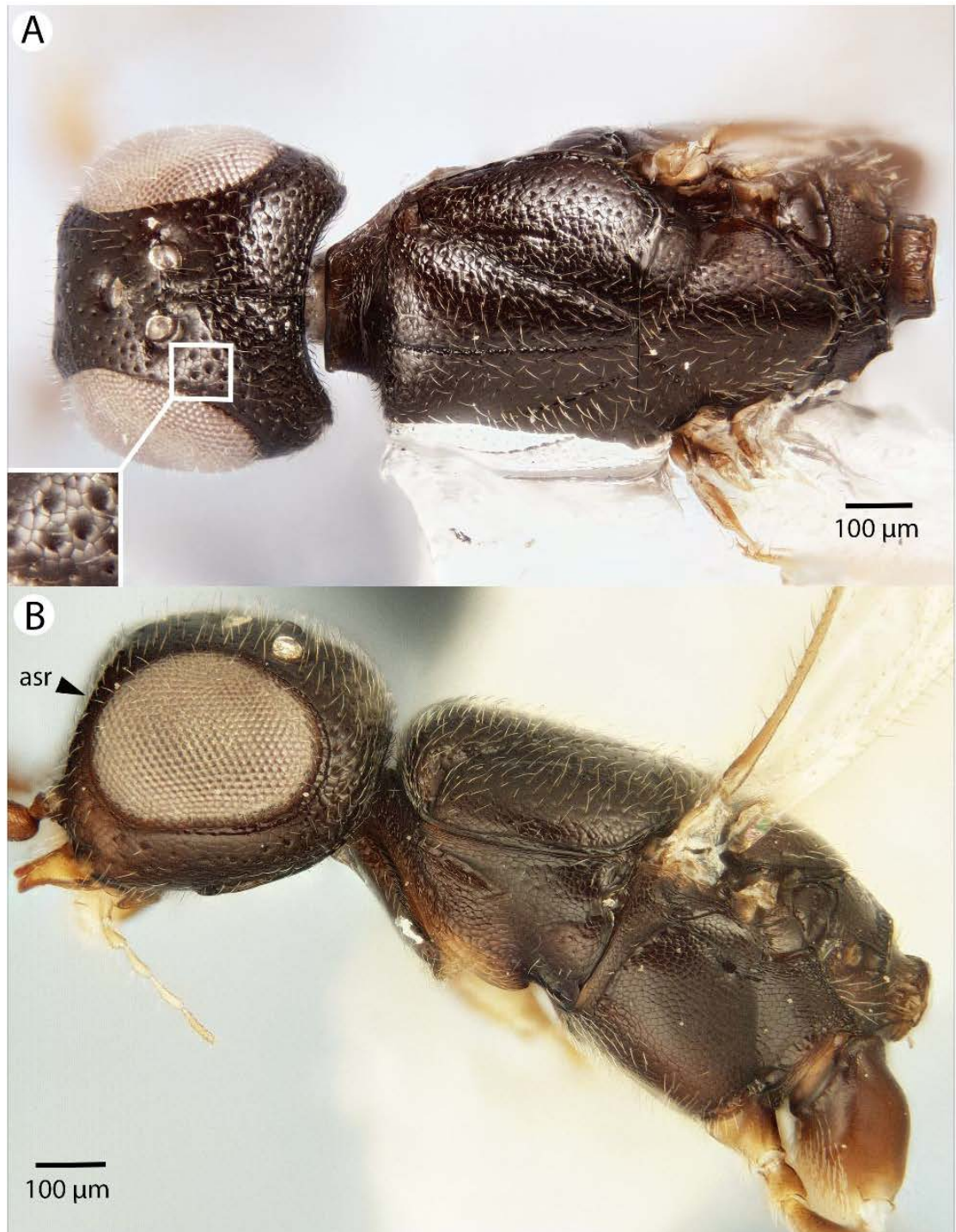


Figure 15. Brightfield image showing the head and mesosoma of *Conostigmus bucephalus* Mikó and *Trietsch* sp. nov. A. Dorsal view. B. Lateral view.

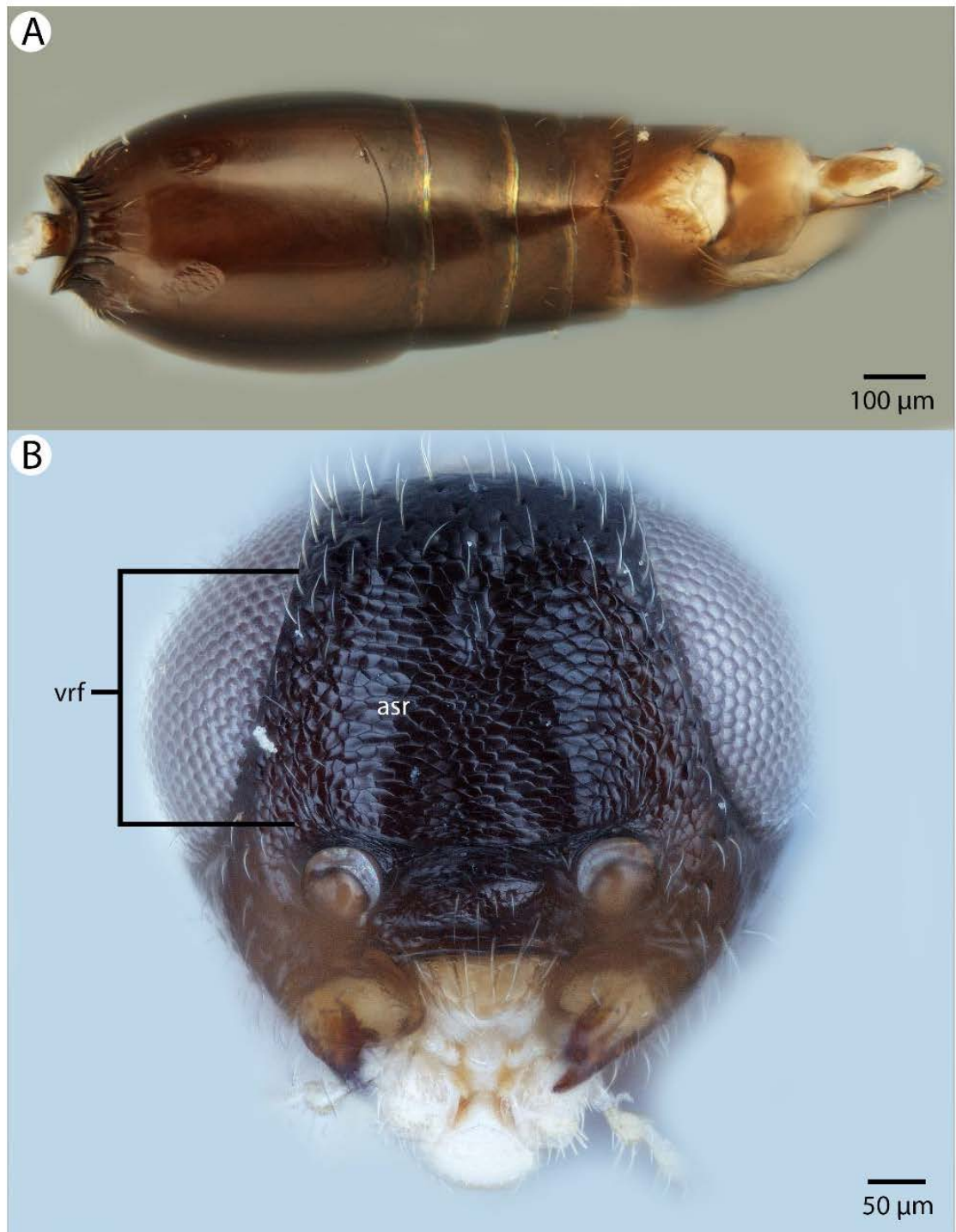


Figure 16. Brightfield image showing the head and metasoma of *Conostigmus bucephalus* Mikó and Trietsch sp. nov. A. Metasoma, dorsal view. B. Head, anterior view (vrf= ventral region on frons, asr= antennal scrobe).

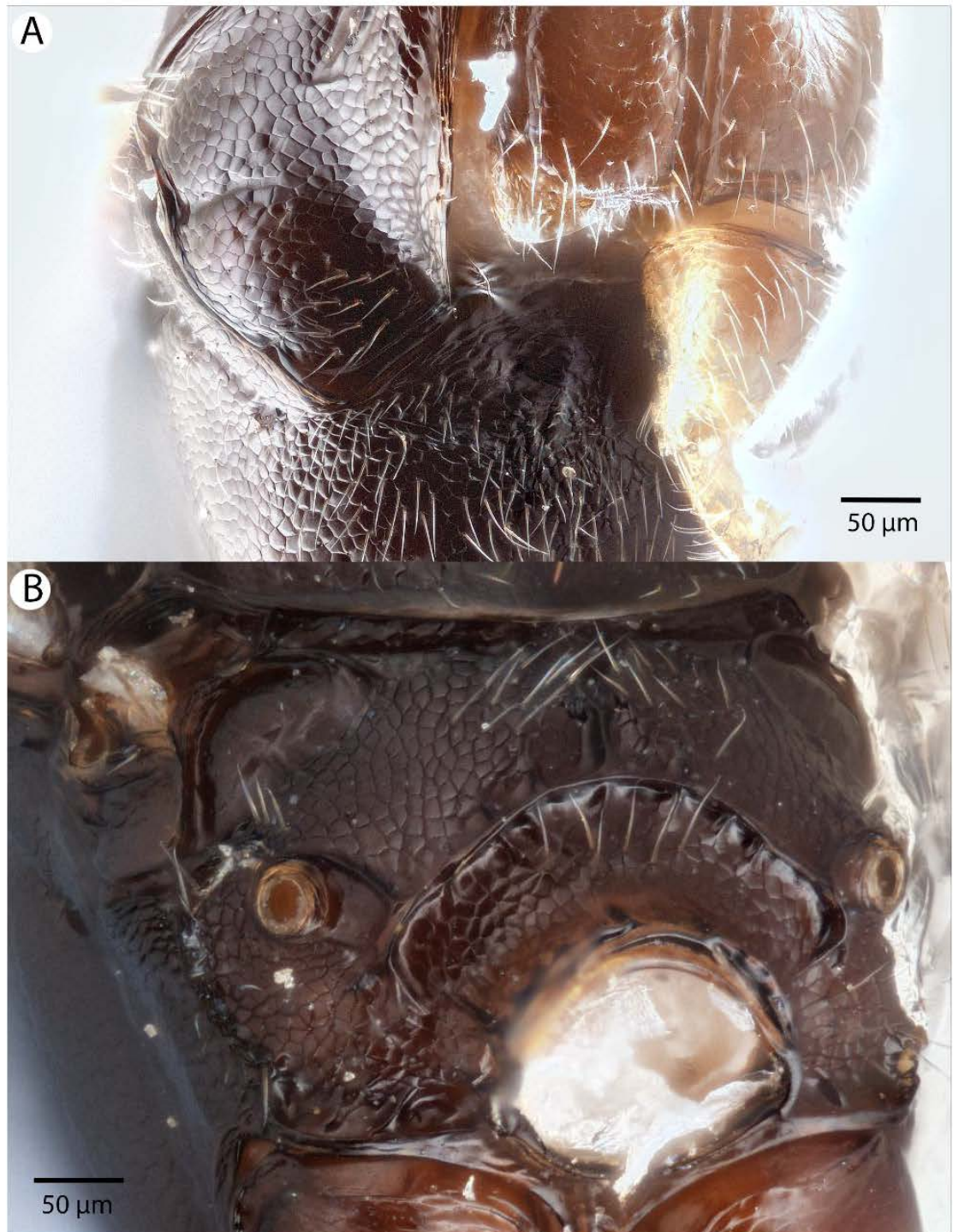


Figure 17. Brightfield image showing the mesosoma of *Conostigmus bucephalus* Mikó and Trietsch sp. nov. A. Pronotum, part of propleuron and part of mesopectus, anterolateral view. B. Part of mesosoma, posterior view (vrf= ventral region on frons with transverse scutes, asr= antennal scrobe).

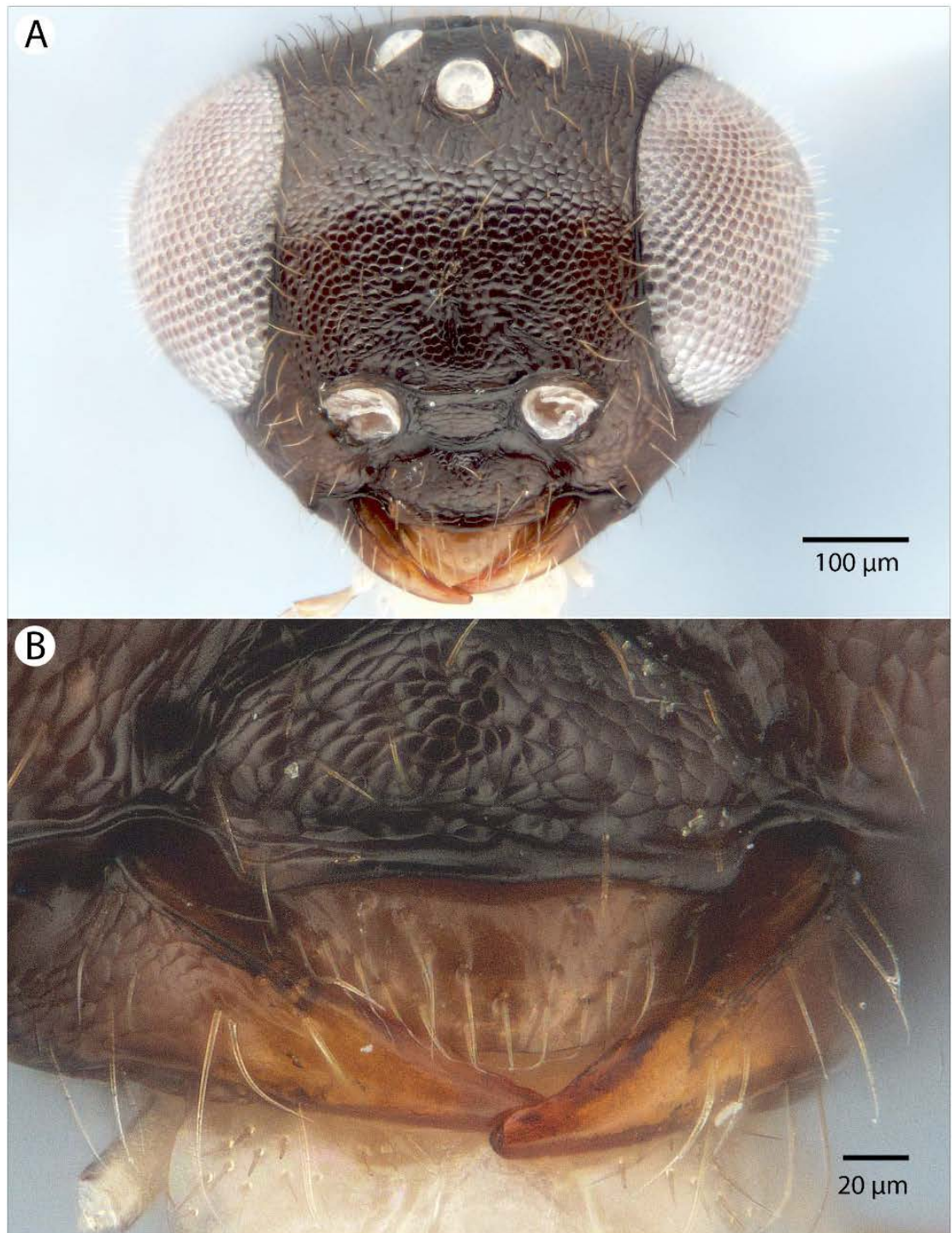


Figure 18. Brightfield image showing the head of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov. A. Head, anterior view. B. Mandible, labrum and clypeus, anteroventral view.

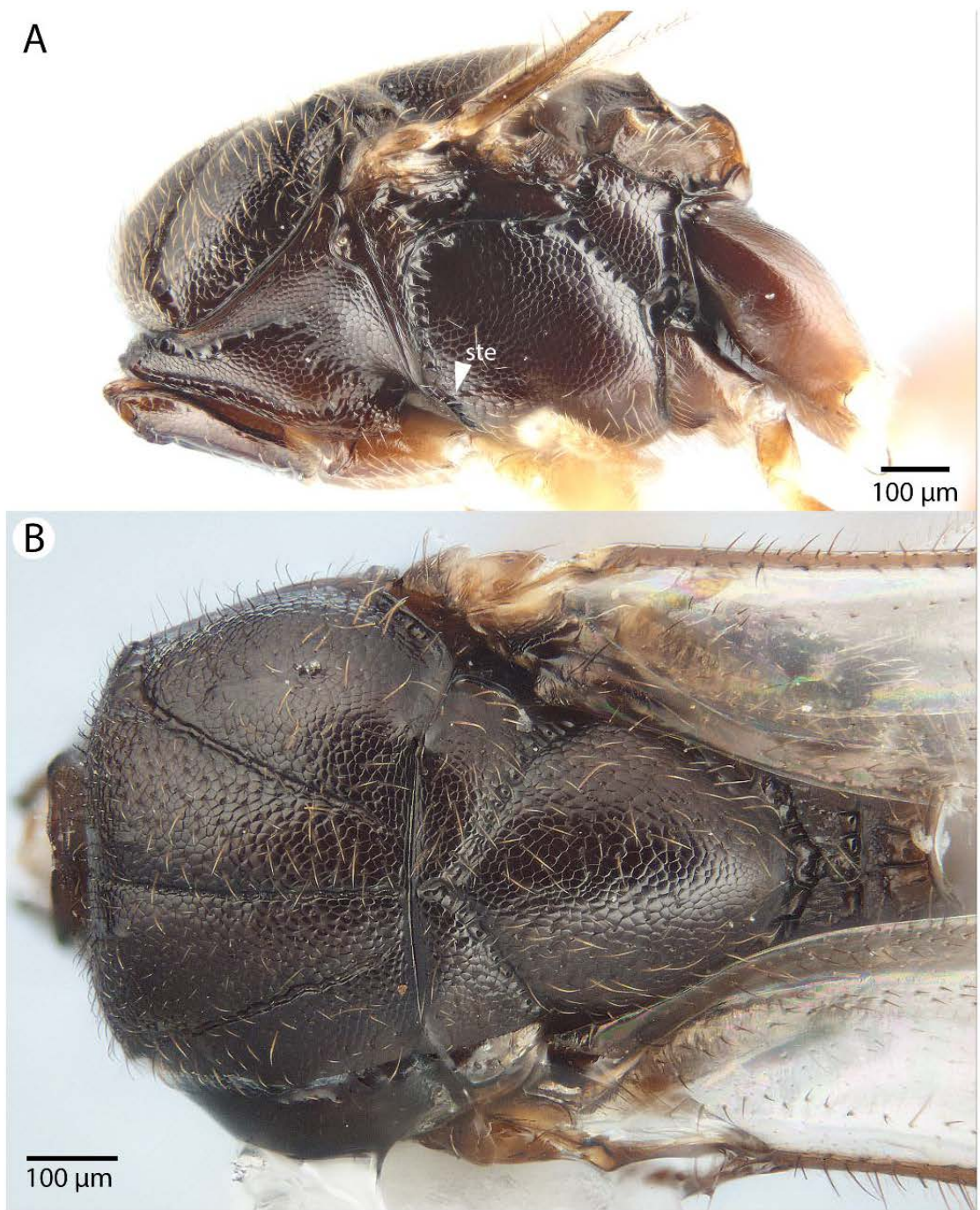


Figure 19. Brightfield image showing the mesosoma of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov. A. mesosoma, lateral view. B. Mesosoma, dorsal view (ste= sternaulus).



Figure 20. Brightfield image showing the antenna of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov. A. Male. B. Female.

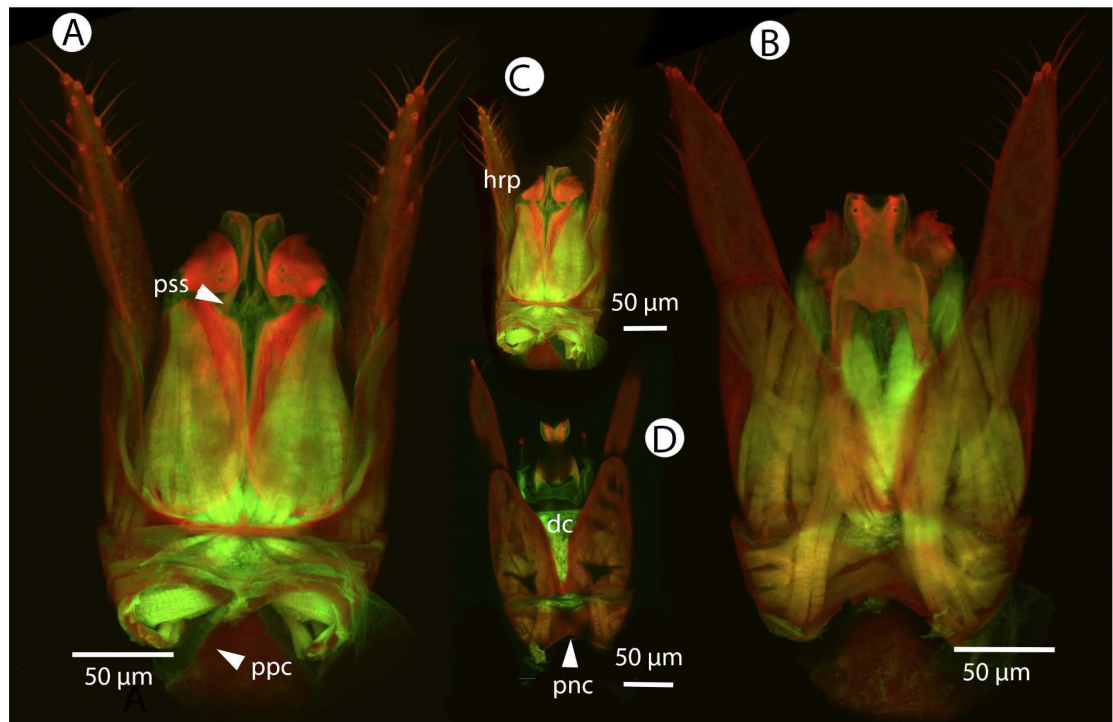


Figure 21. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus fianarantsoaensis* Mikó and Trietsch sp. nov. A. Ventral view. B. Dorsal view. C. Lateroventral view. D. Dorsal view partially rendered (ppc= proximolateral projection of cupula, pdc=proximodorsal notch of cupula, hrp= harpe, dc= Dorsomedian conjunctiva of the gonostyle/volsella complex, aps= apical parossicular seta).

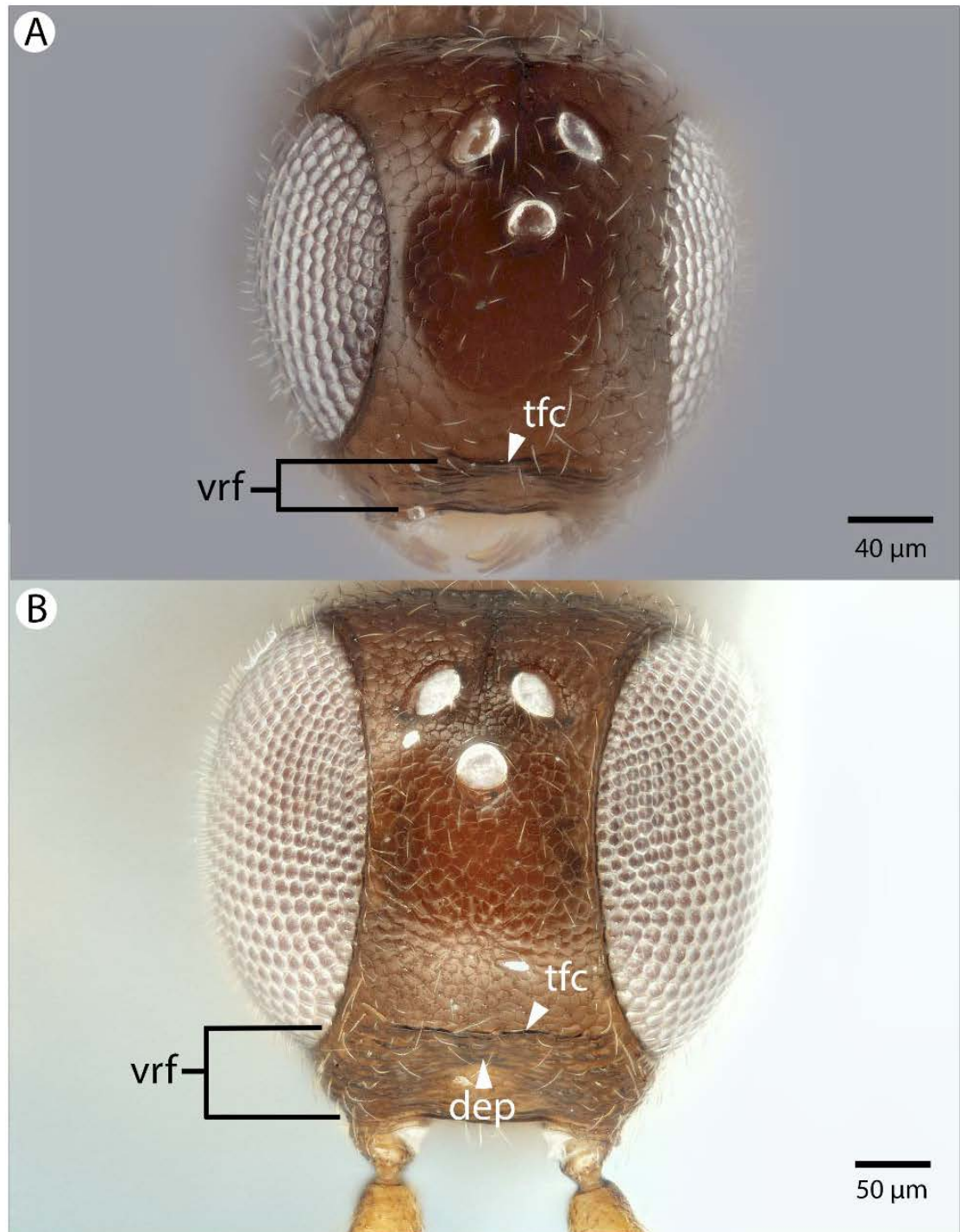


Figure 22. Brightfield image showing the head of *Conostigmus longulus* Dessart 1997, anterior view A. Smaller specimen. B. Larger specimen (tfc=transverse frontal carina, vrf=ventral region of frons, dep=depression surrounding frontal pit).



Figure 23. Brightfield image showing the antenna of *Conostigmus longulus* Dessart 1997, lateral view
A. Female. B. Male.

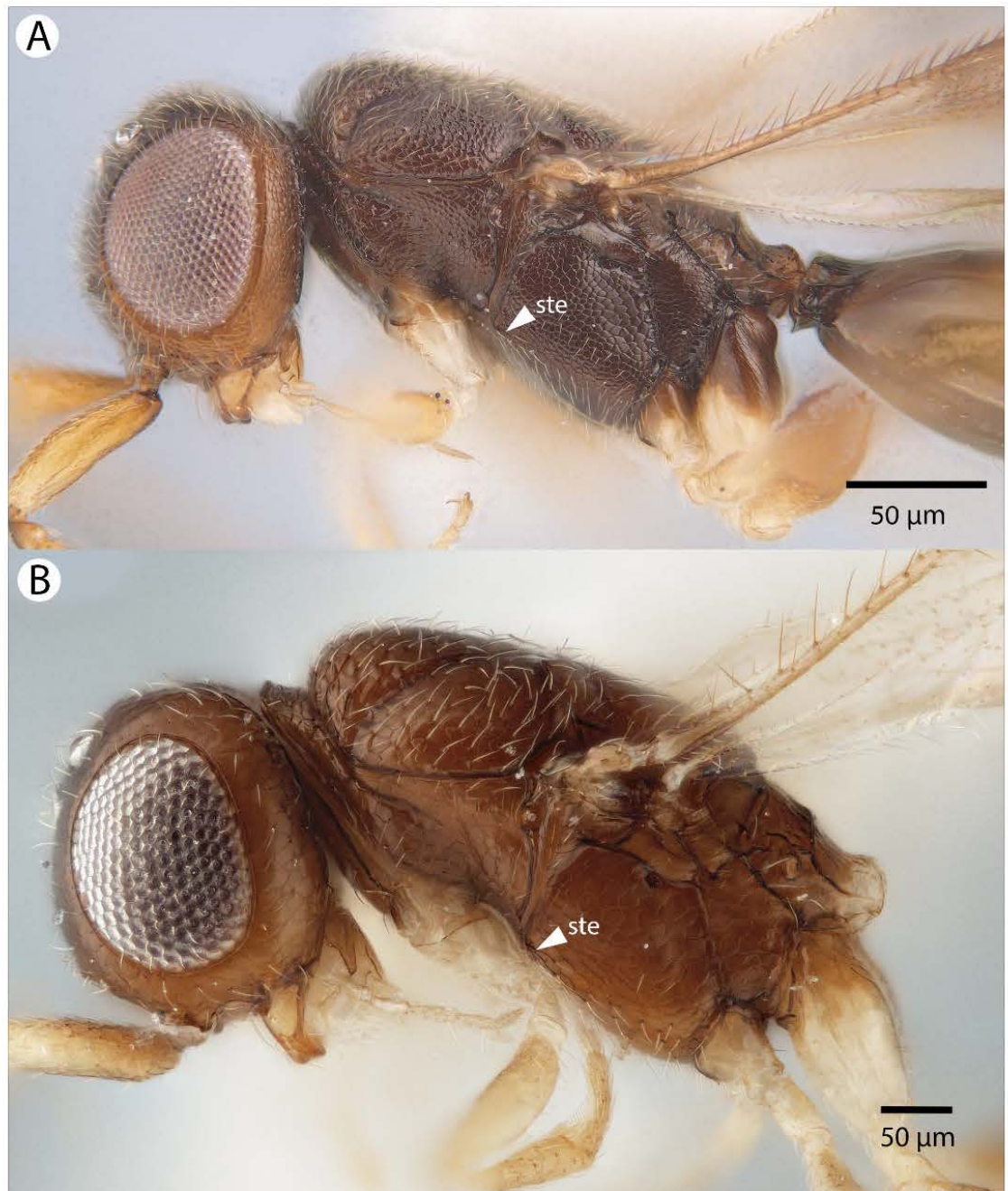


Figure 24. Brightfield image showing the head and mesosoma of *Conostigmus longulus* Dessart 1997, anterior view A. Larger specimen. B. Smaller specimen.



Figure 25. Brightfield image showing the head and mesosoma of *Conostigmus longulus* Dessart 1997, anterior view A. Larger specimen. B. Smaller specimen.

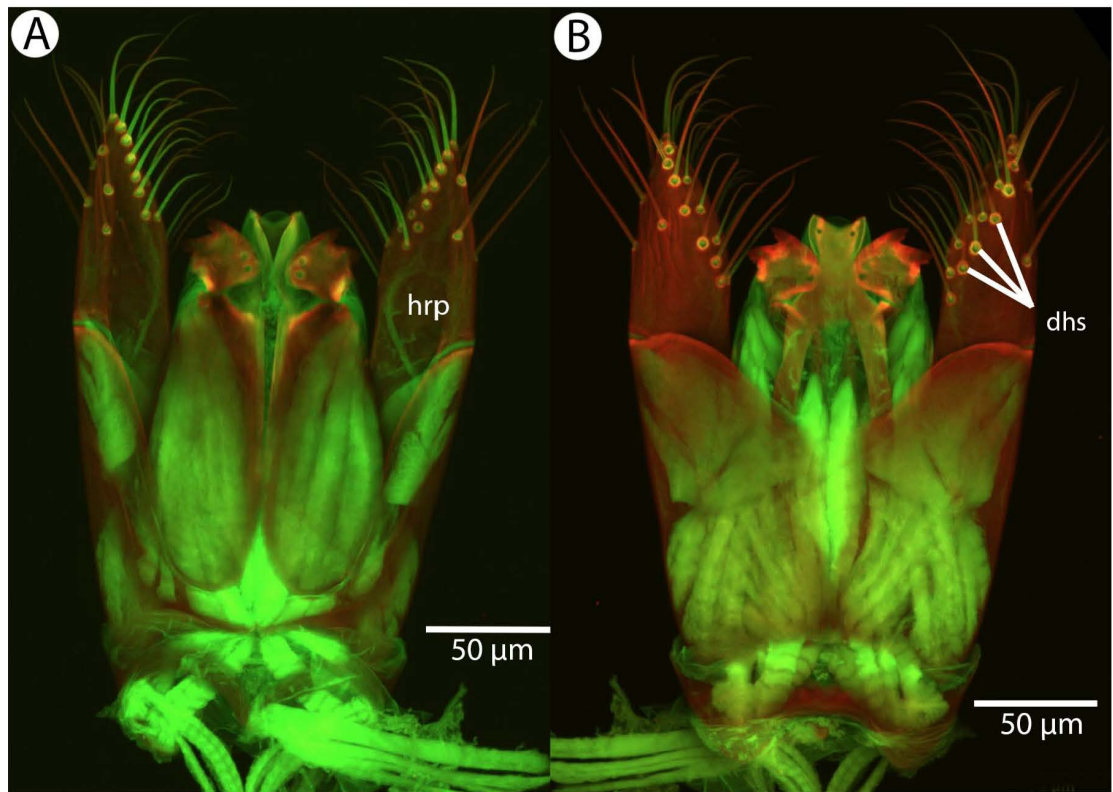


Figure 26. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus longulus* Dessart 1997. A. Ventral view. B. Dorsal view (hrp=harpe, dhs=dorsomedial setae of harpal setal ring).



Figure 27. Brightfield image showing the antenna of *Conostigmus lucidus* Mikó and *Trietsch* sp. nov., lateral view. A. Female. B. Male.

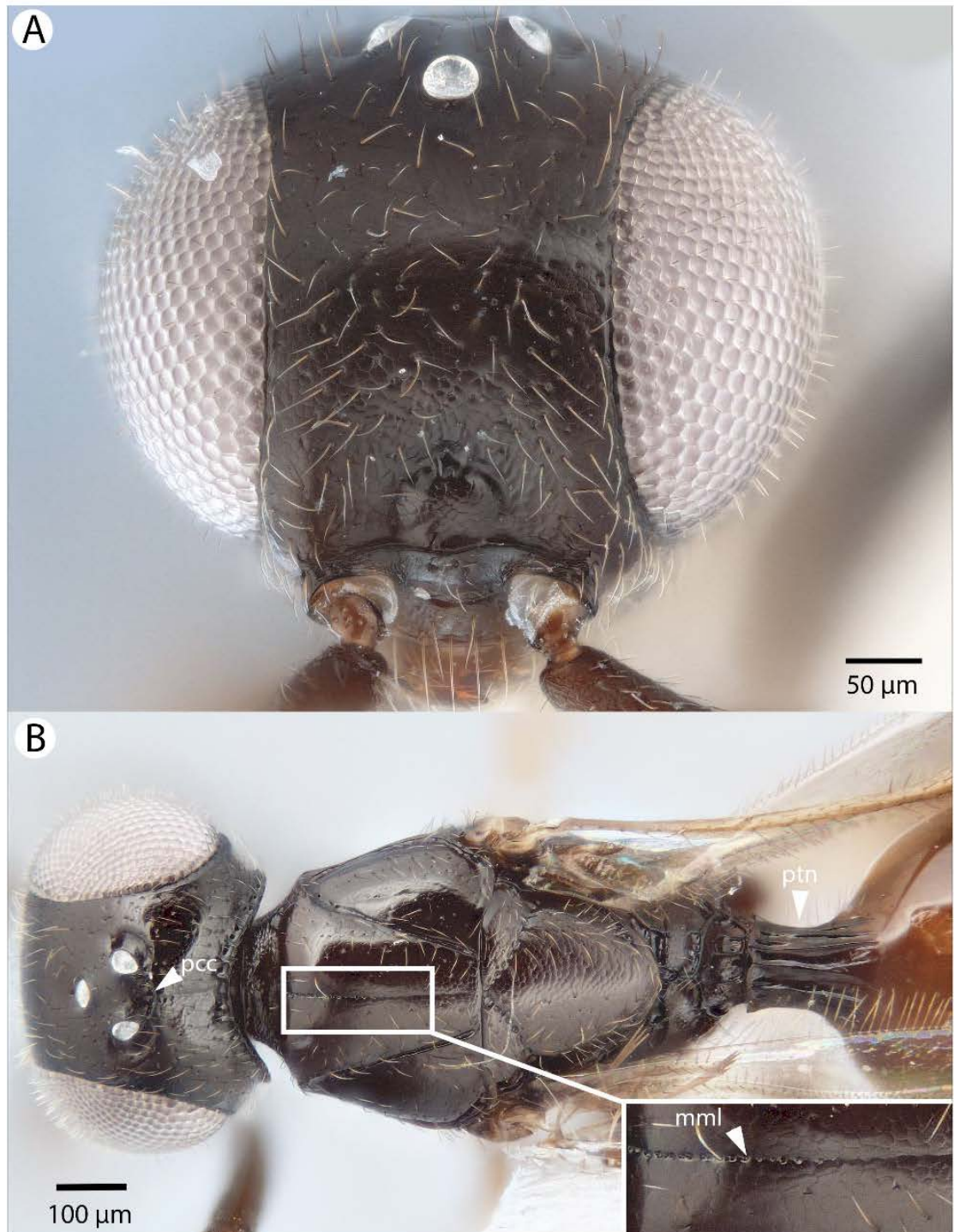


Figure 28. Brightfield image showing the head and mesosoma of *Conostigmus lucidus* Mikó and *Trietsch* sp. nov. A. Head, anterior view. B. Head and mesosoma, dorsal view (mml= median mesoscutal line).

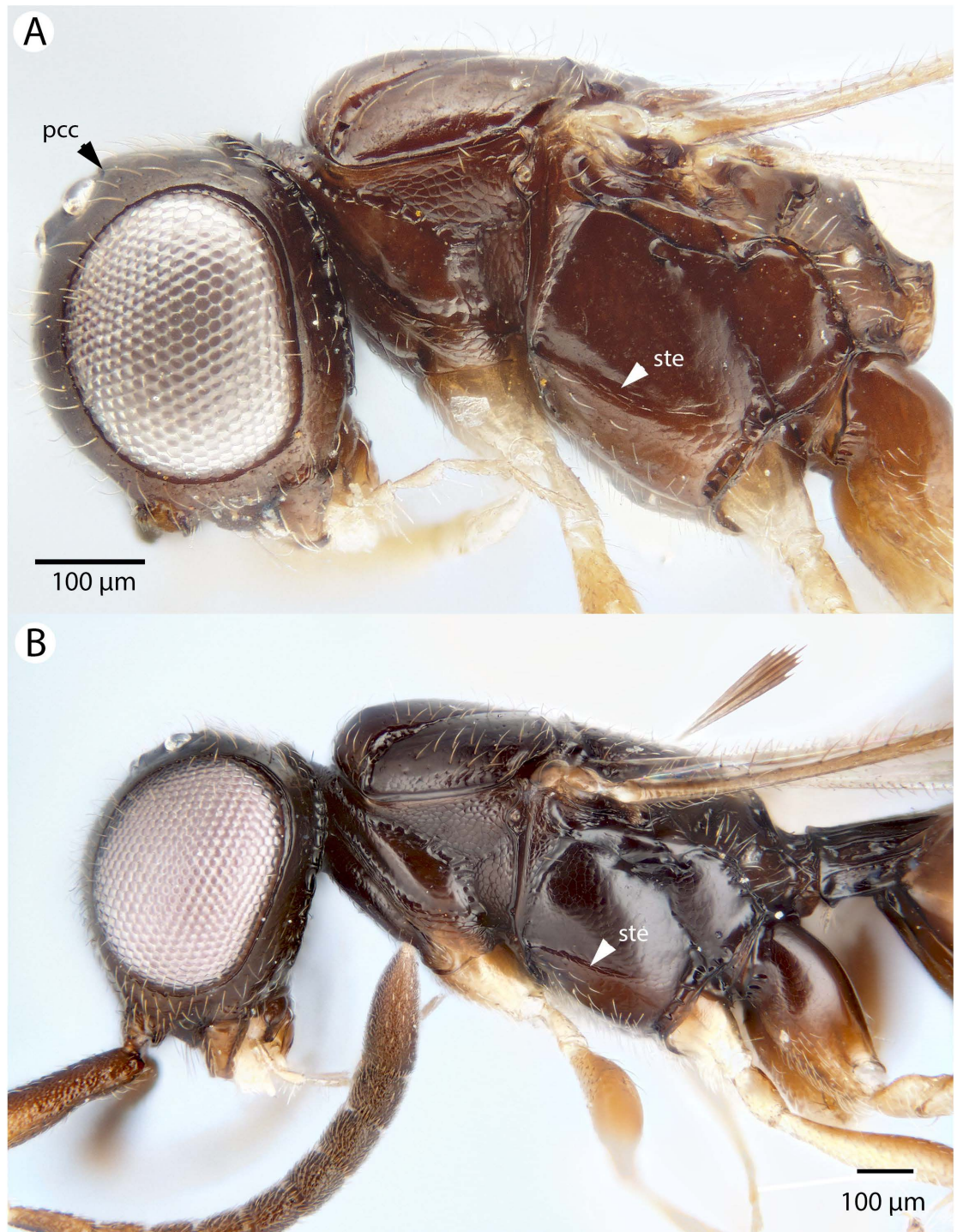


Figure 29. Brightfield image showing the head and mesosoma of *Conostigmus lucidus* Mikó and Trietsch sp. nov., lateral view. A. Smaller specimen. B. Larger specimen (ste= sternaulus).

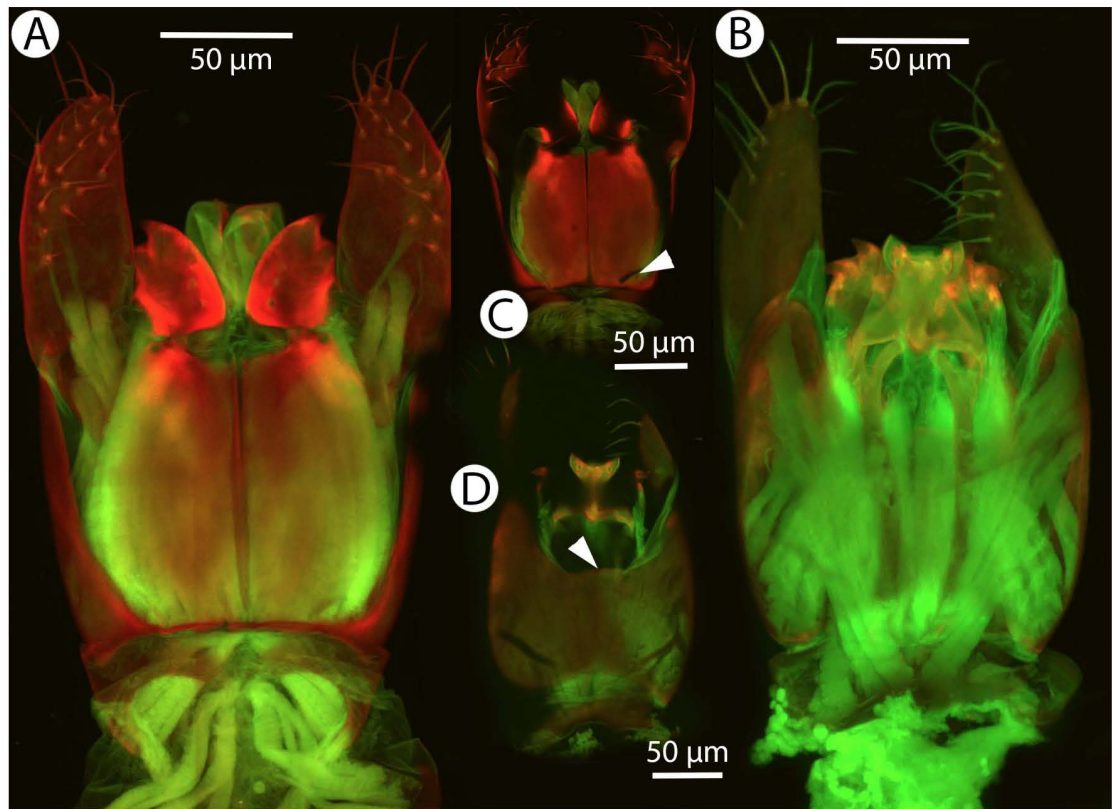


Figure 30. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus lucidus* Mikó and Trietsch sp. nov. A. Ventral view. B. Dorsal view. C. Ventral view, partially rendered. D. Dorsal view, partially rendered. (Arrow on C. showing bridge connecting parossiculus with gonostyle, on D. showing lack of dorsomedian connectiva of gonostyle/volsella complex).

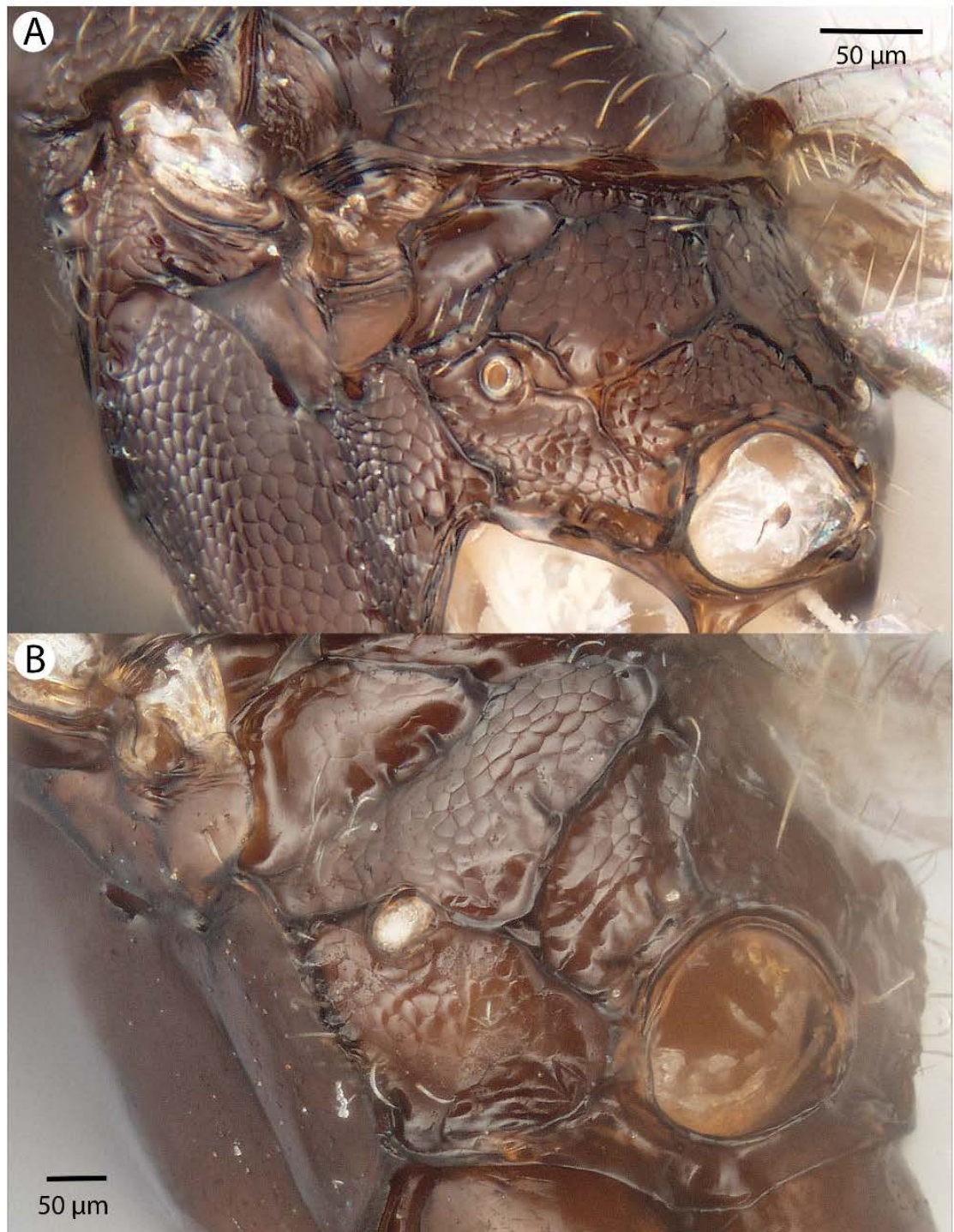


Figure 31. Brightfield image showing the mesosoma of *Conostigmus* species, posterolateral view. A. *Conostigmus missyhazenaе* Mikó and Trietsch sp. nov. B. *Conostigmus lucidus* Mikó and Trietsch sp. nov.

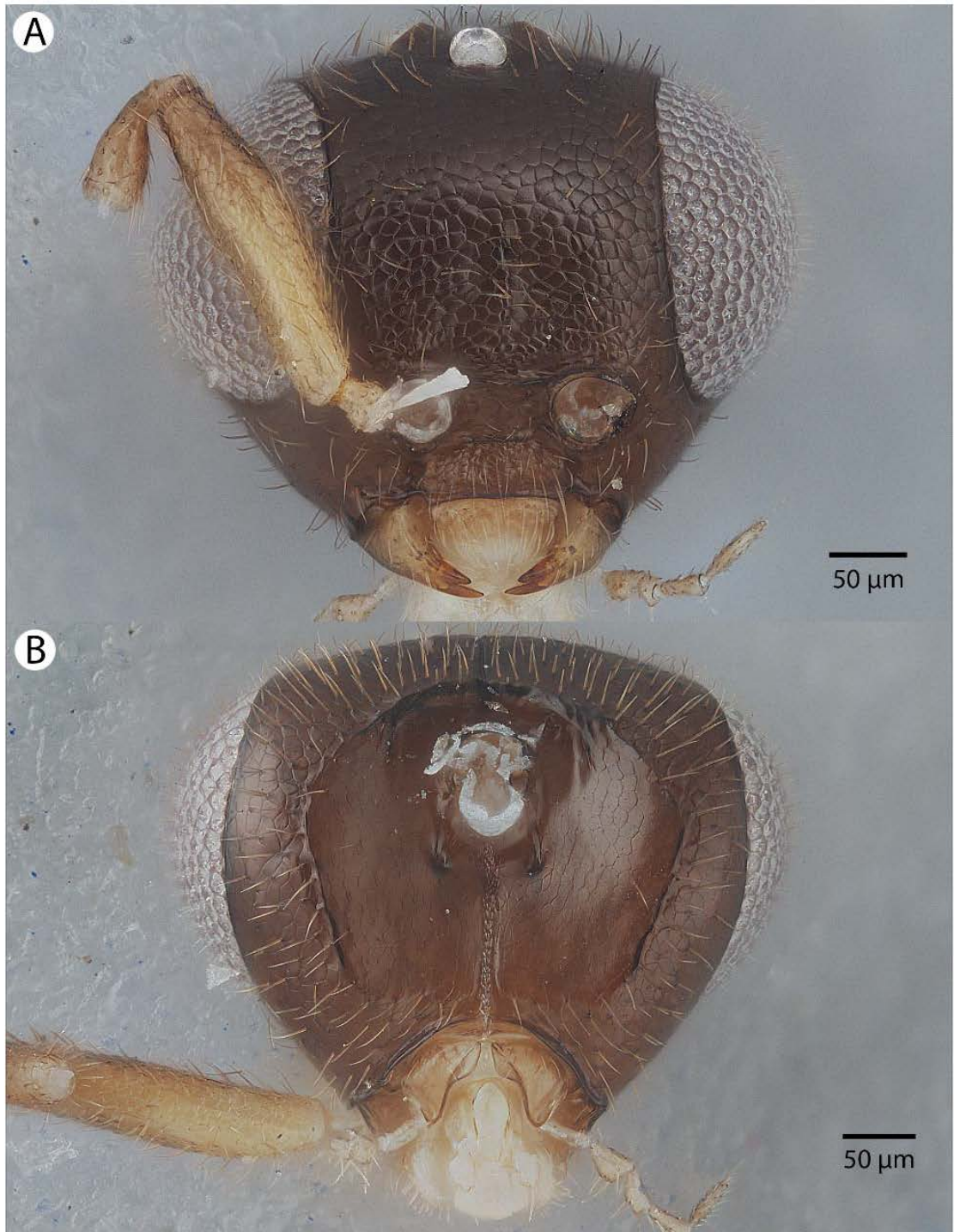


Figure 32. Brightfield image showing the head of *Conostigmus macrocupula* Mikó and Trietsch sp. nov. A. Anterior view. B. Posterior view.

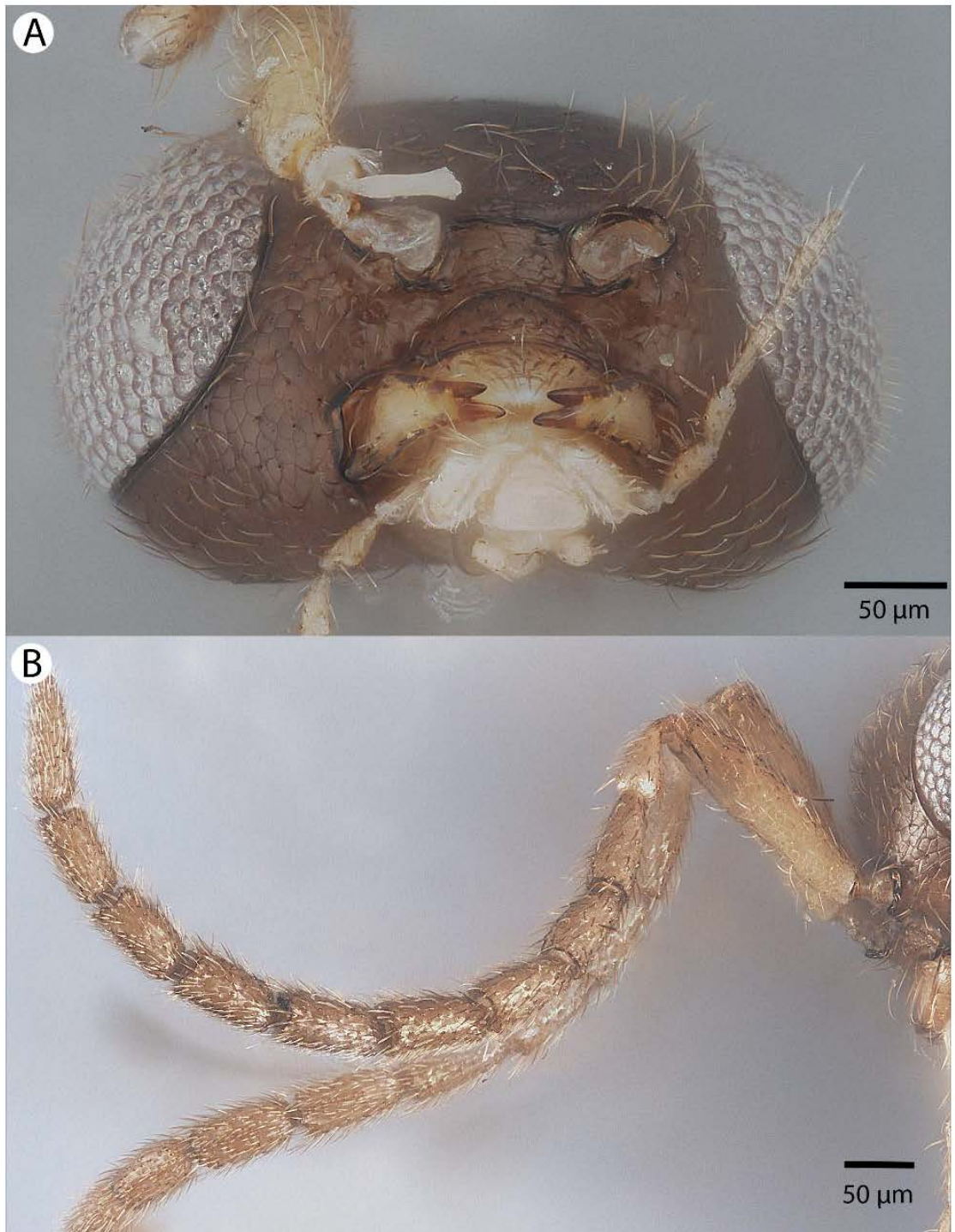


Figure 33. Brightfield image showing the head and antenna of *Conostigmus macrocupula* Mikó and Trietsch sp. nov. A. Head, ventral view. B. Antenna, lateral view.

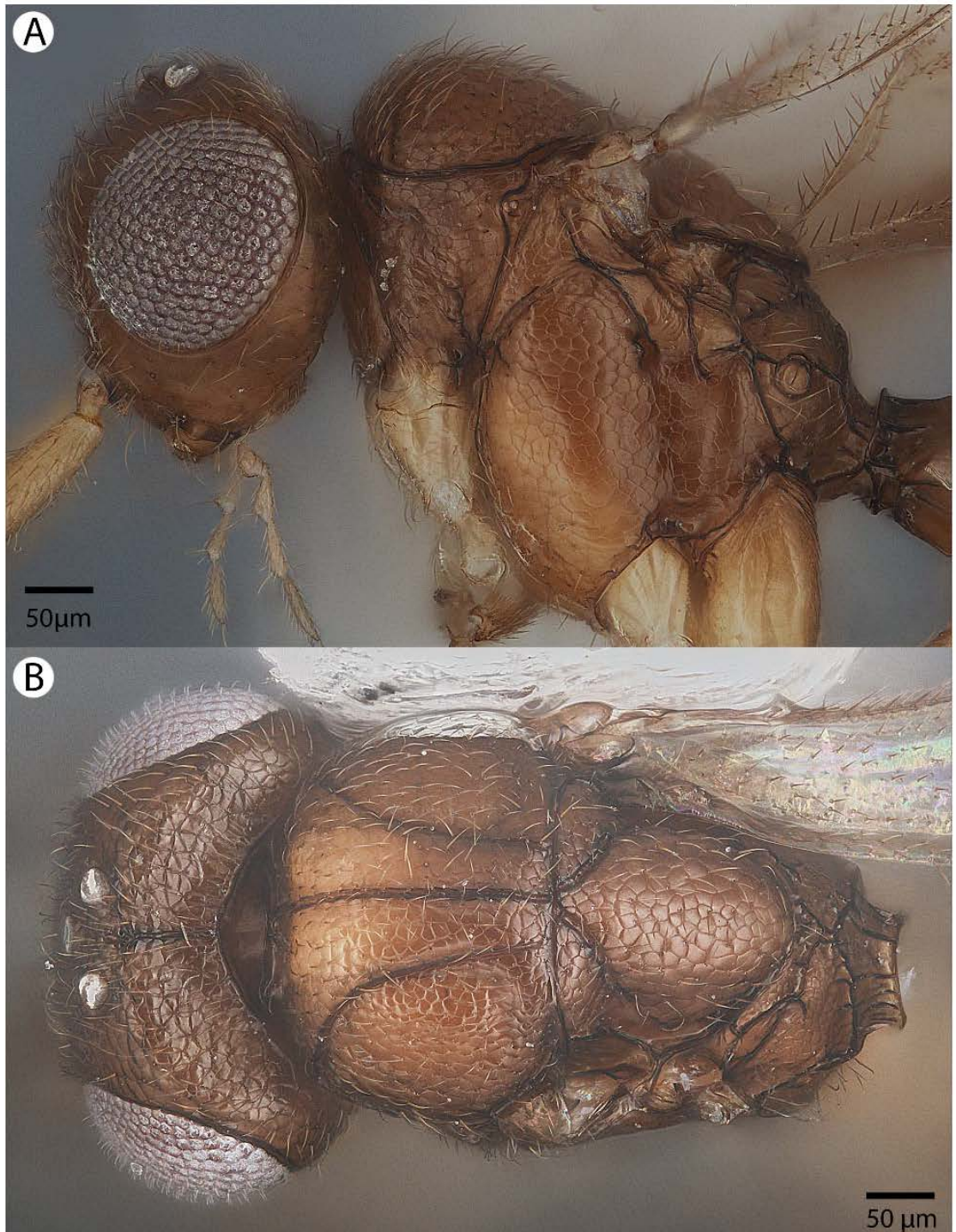


Figure 34. Brightfield image showing the head and mesosoma of *Conostigmus macrocupula* Mikó and *Trietsch* sp. nov. A. Lateral ventral view. B. Dorsal view.

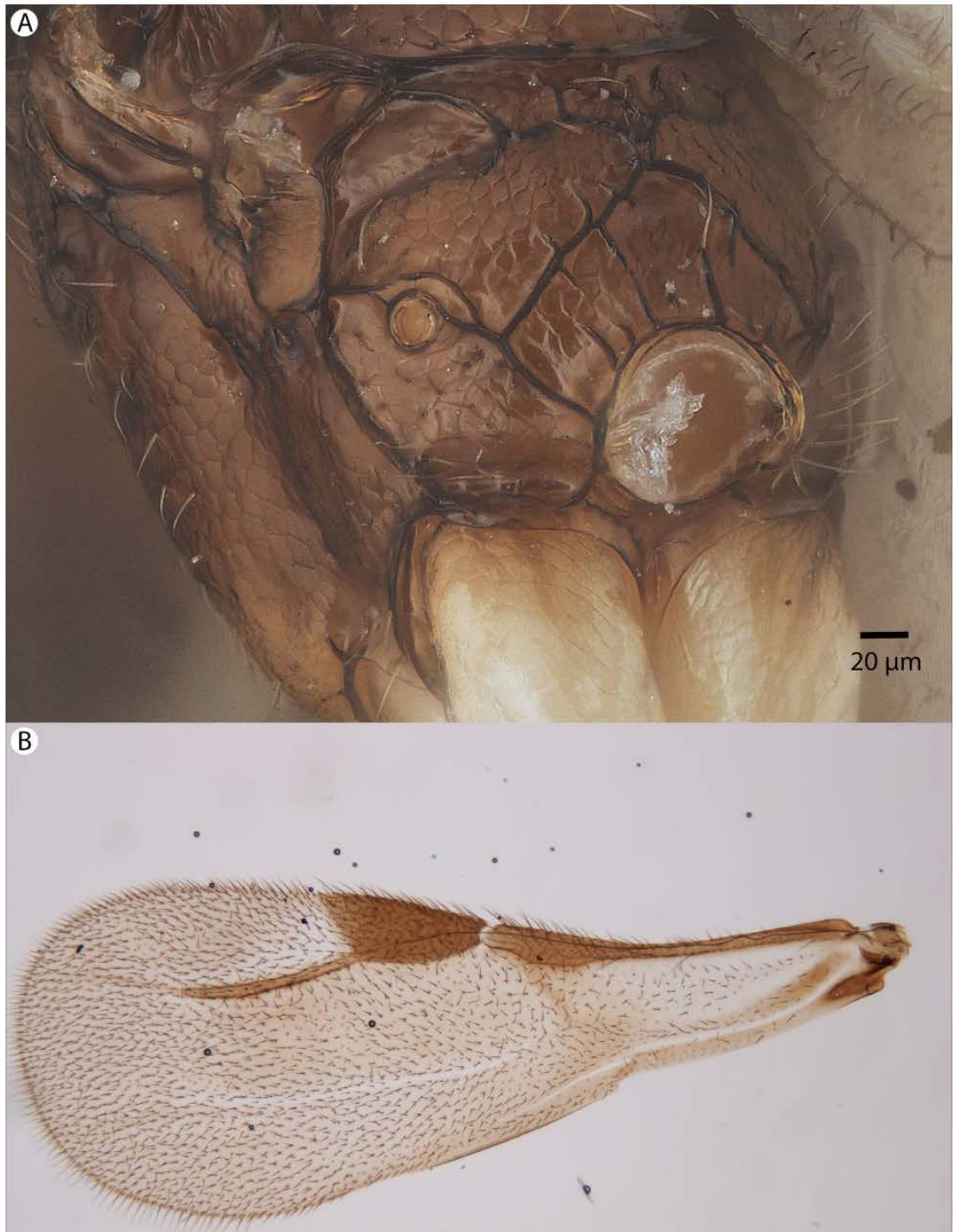


Figure 35. Brightfield image showing the mesosoma and wing of *Conostigmus macrocupula* Mikó and Trietsch sp. nov. A. Mesosoma, posterolateral view. B. Fore wing.

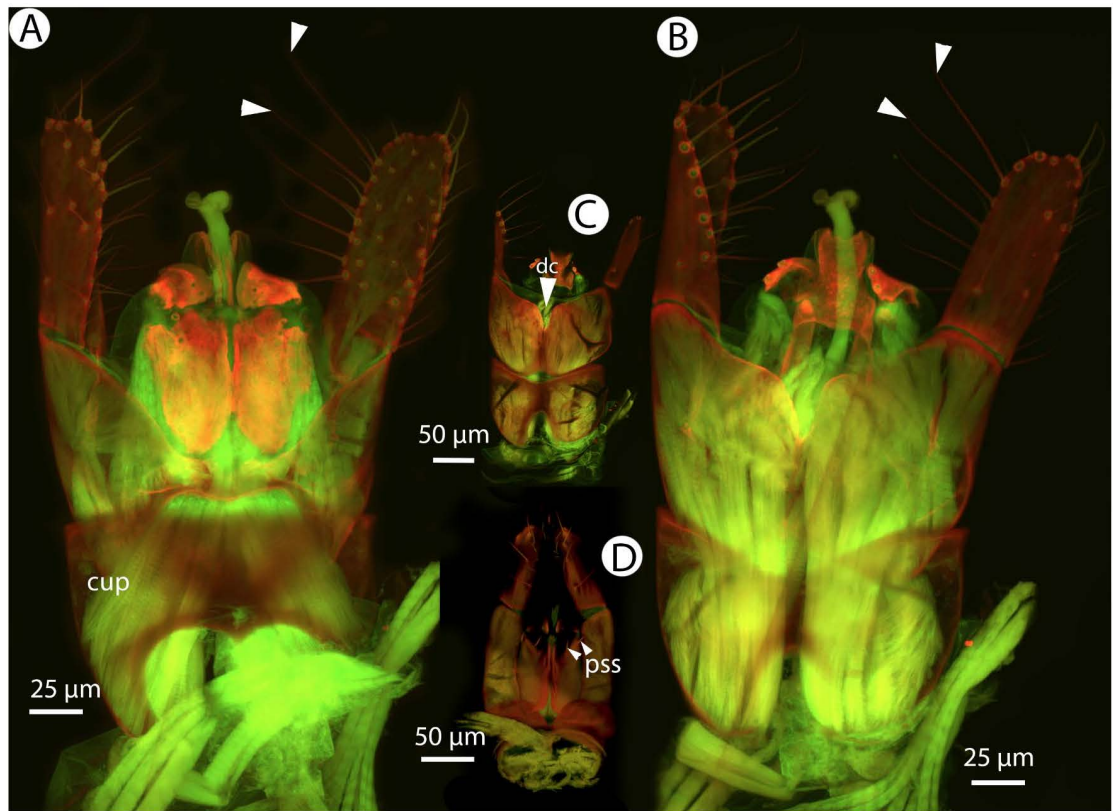


Figure 36. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus macrocupula* Mió and Trietsch sp. nov. A. Ventral view. B. Dorsal view (cup= cupula, pss= parosicula setae, dc= dorsomedial conjunctiva of gonostyle/volsella complex).

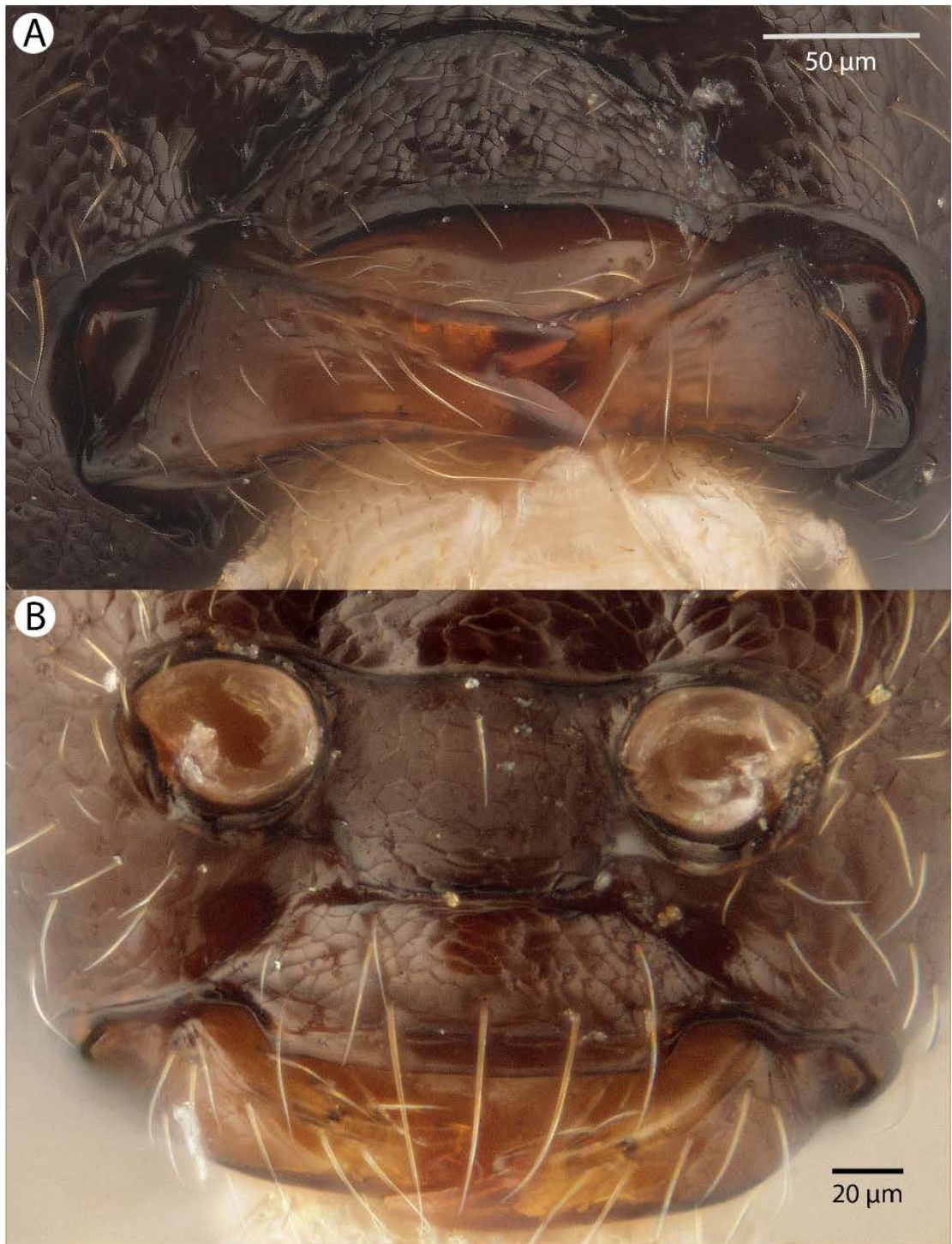


Figure 37. Brightfield image showing the intraspecific variability in mandible structure of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov.

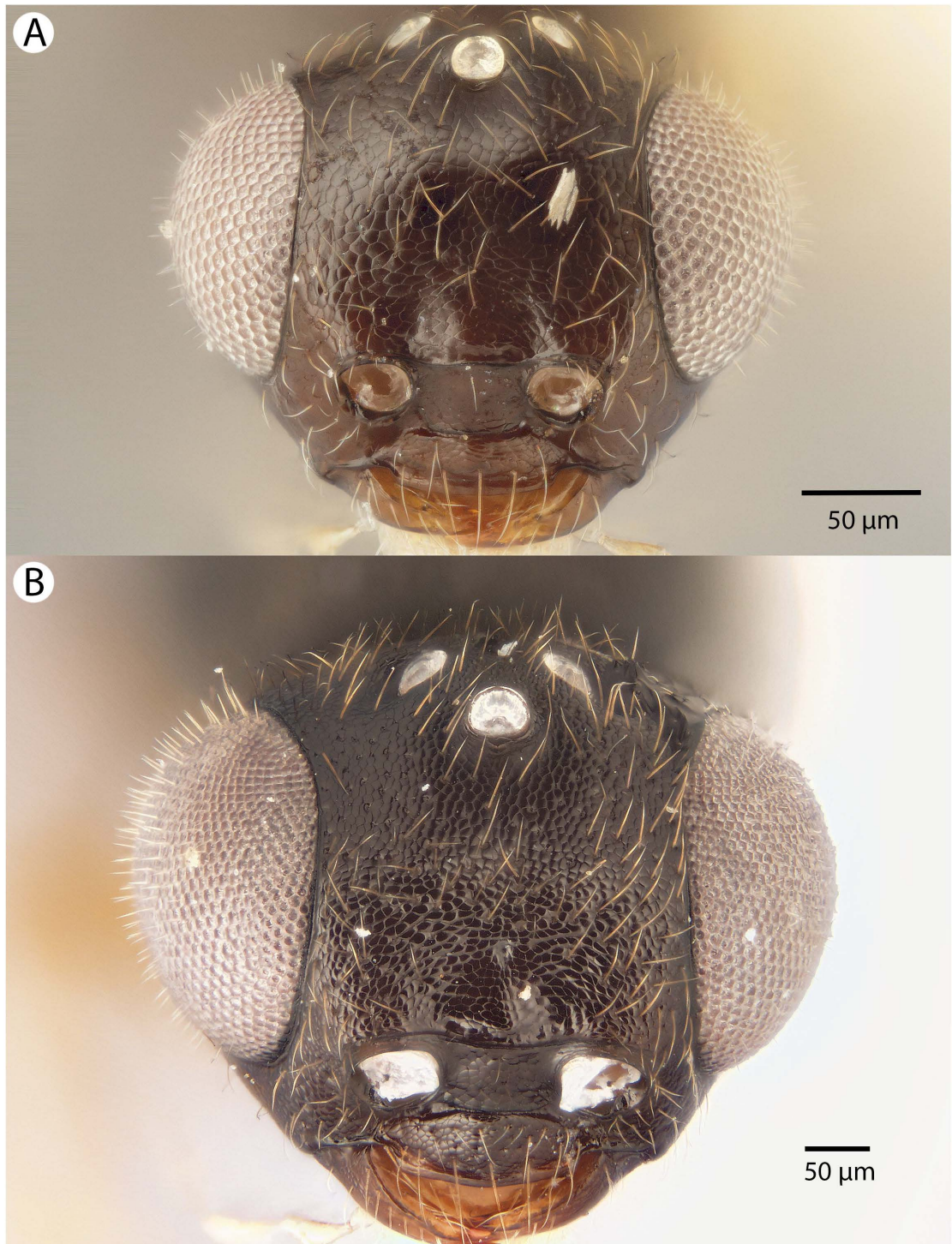


Figure 38. Brightfield image showing the intraspecific variability in anterior head morphology of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov.

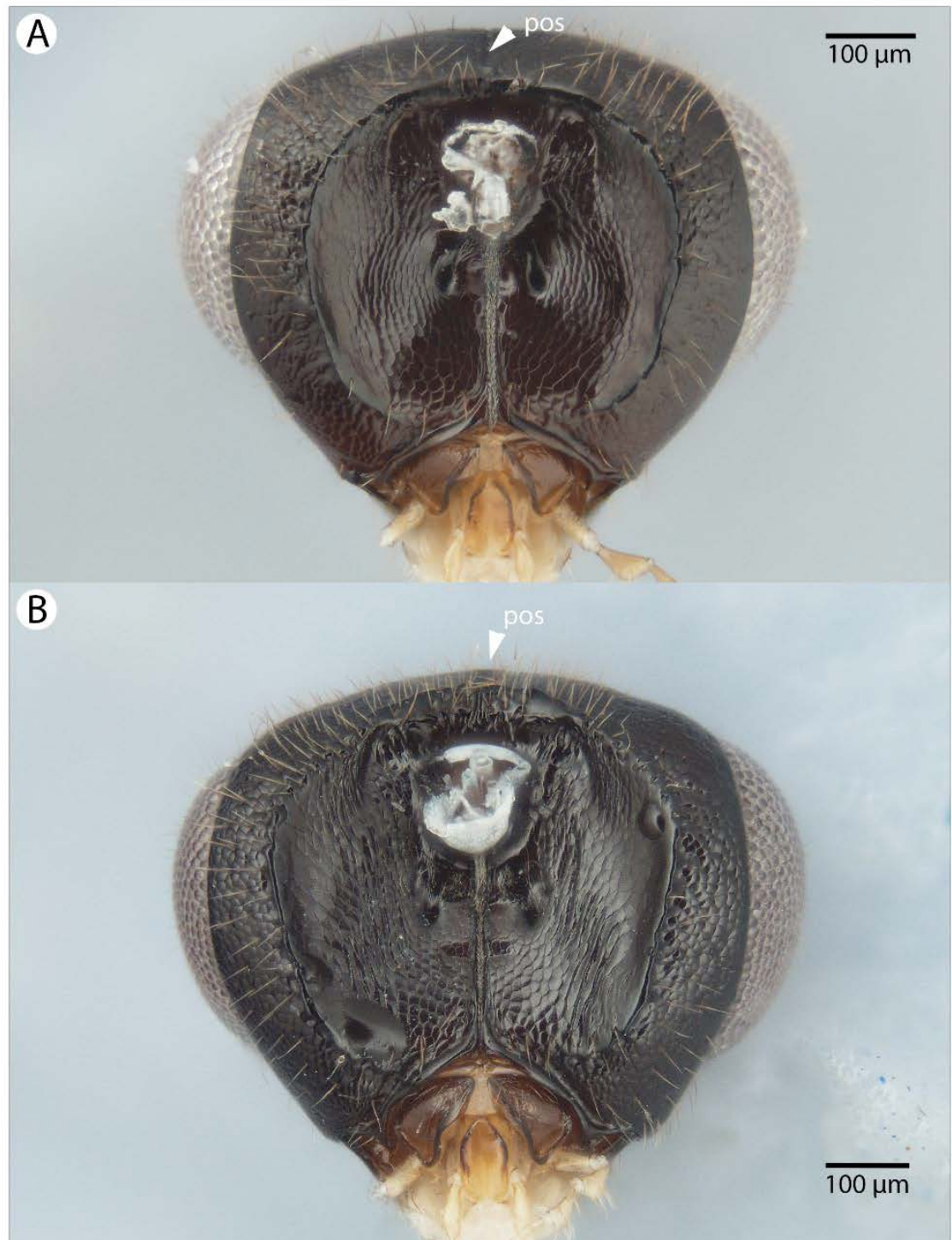


Figure 39. Brightfield image showing the head of *Conostigmus* species, posterior view A. *Conostigmus madagascariensis* Mikó and Trietsch sp. nov. B. *Conostigmus fanarantsoaensis* Mikó and Trietsch sp. nov. (pos=preoccipital furrow).



Figure 40. Brightfield image showing the antenna of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov. A. Male. B. Female.

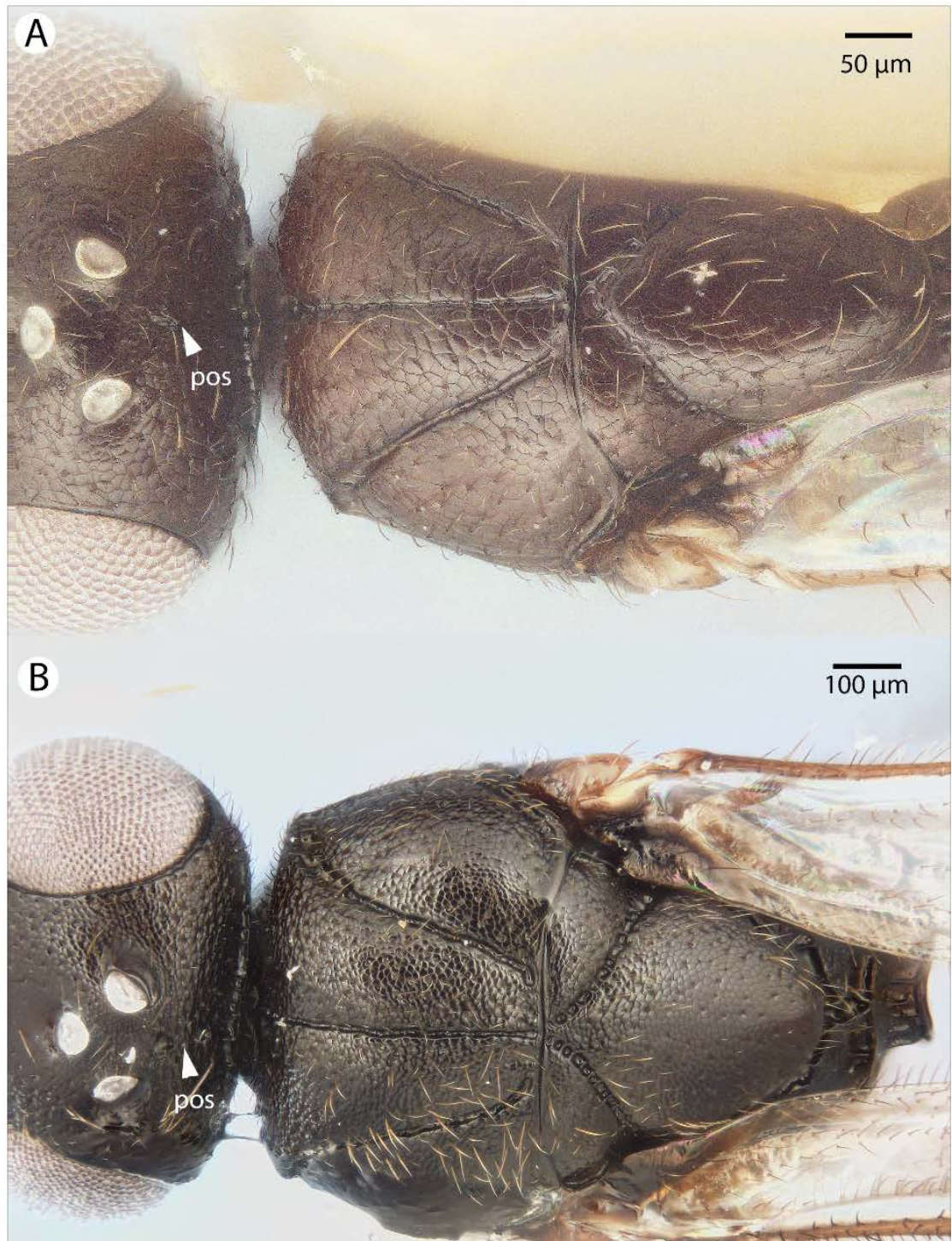


Figure 41. Brightfield image showing the intraspecific variability of the mesosoma of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov., dorsal view. A. Smaller specimen. B. Larger specimen (pos= postocellar sulcus).

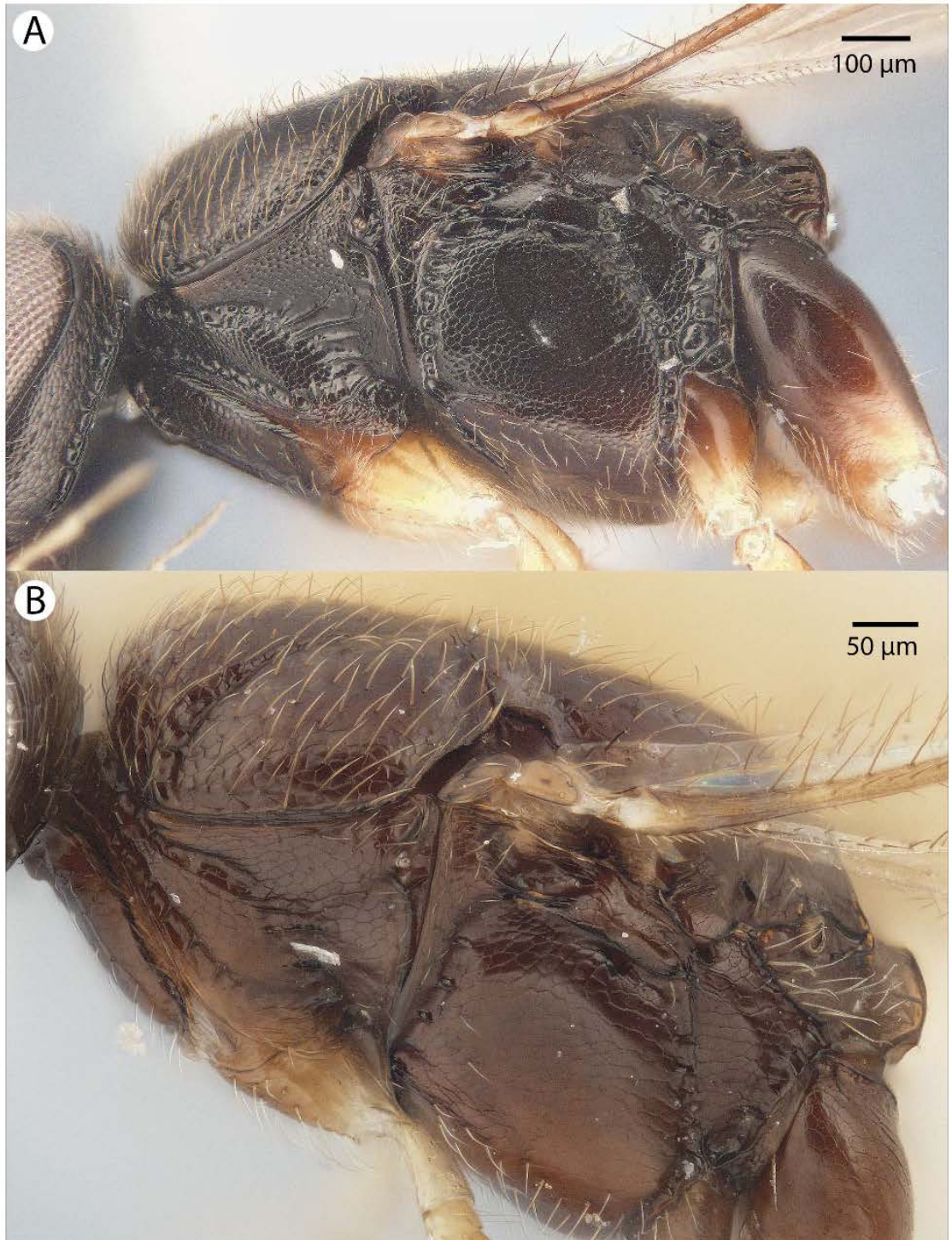


Figure 42. Brightfield image showing the intraspecific variability of the mesosoma of *Conostigmus madagascariensis* Mikó and Trietsch sp. nov., lateral view. A. Larger specimen. B. Smaller specimen.

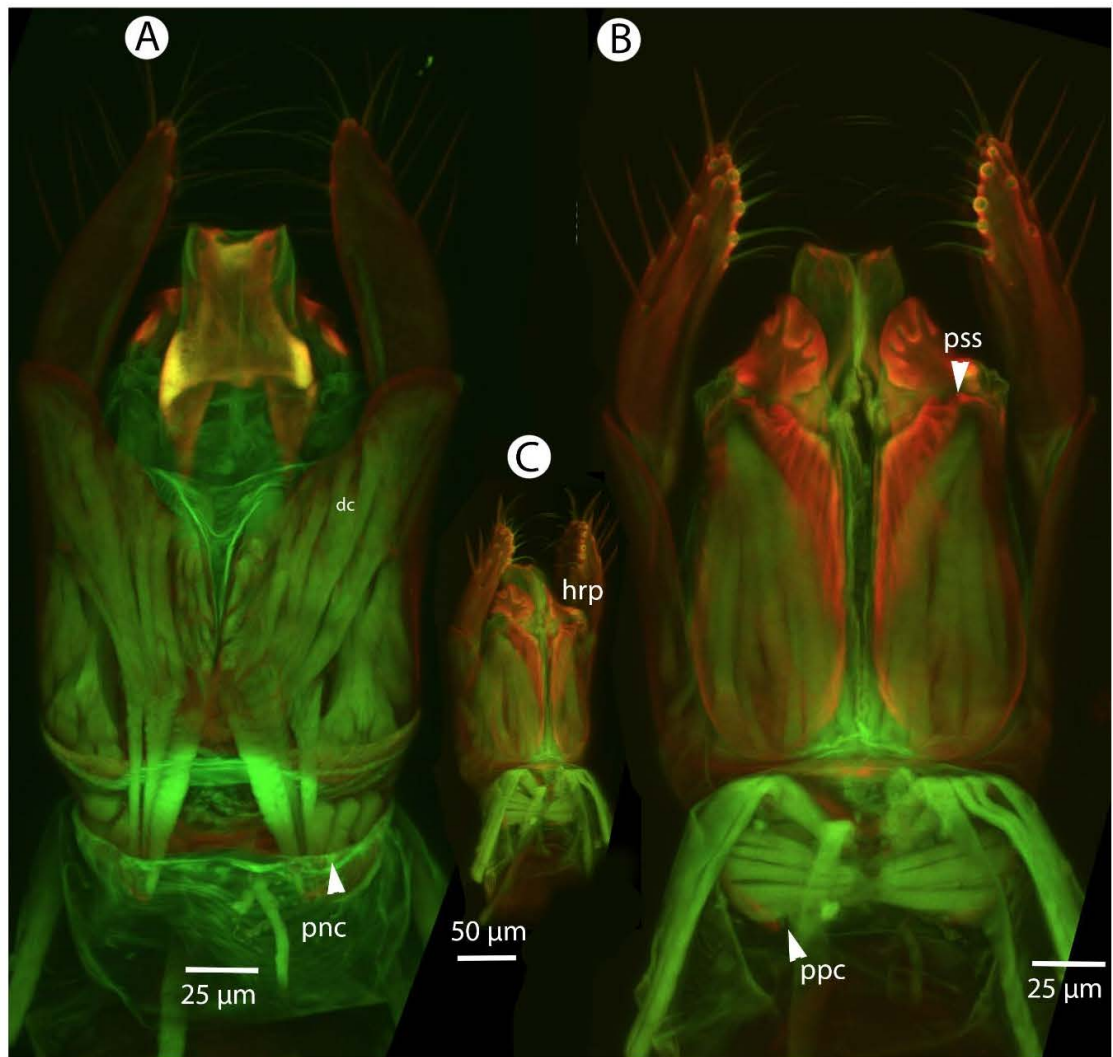


Figure 43. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus madagascariensis* Mió and *Trietsch* sp. nov. A. Ventral view. B. Dorsal view (dc=dorsomedian conjunctiva of gonostyle/volsella complex, hrp=harpe, pdc=proximodorsal notch of cupula, ppc=proximolateral projection of cupula, pss= parossicular seta).

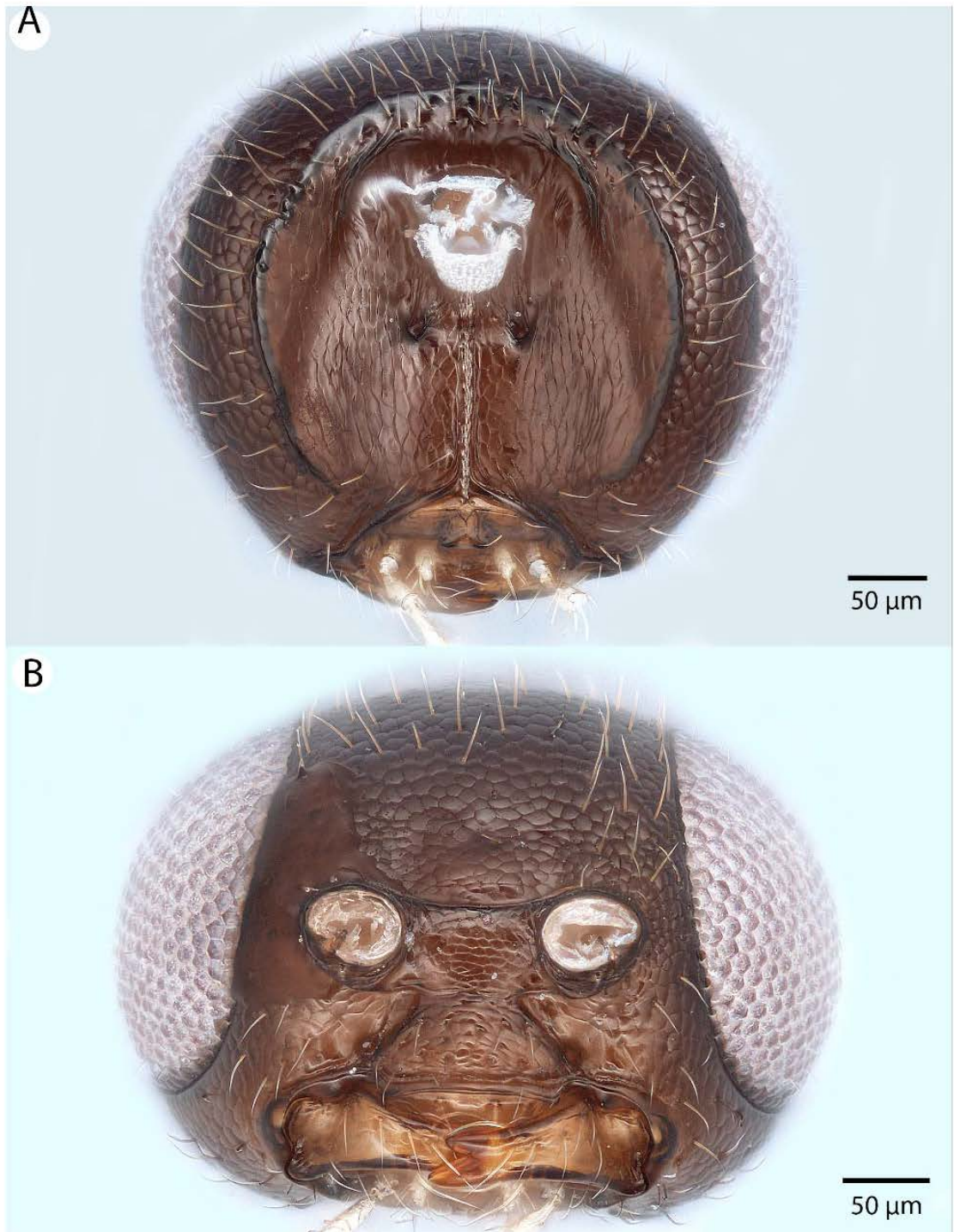


Figure 44. Brightfield image showing the head of *Conostigmus missyhazenaе* Mikó and Trietsch sp. nov. A. Posterior view. B. Ventral view.



Figure 45. Brightfield image showing the antenna of *Conostigmus missyhazena* Mikó and Trietsch sp. nov. A. Male. B. Female.

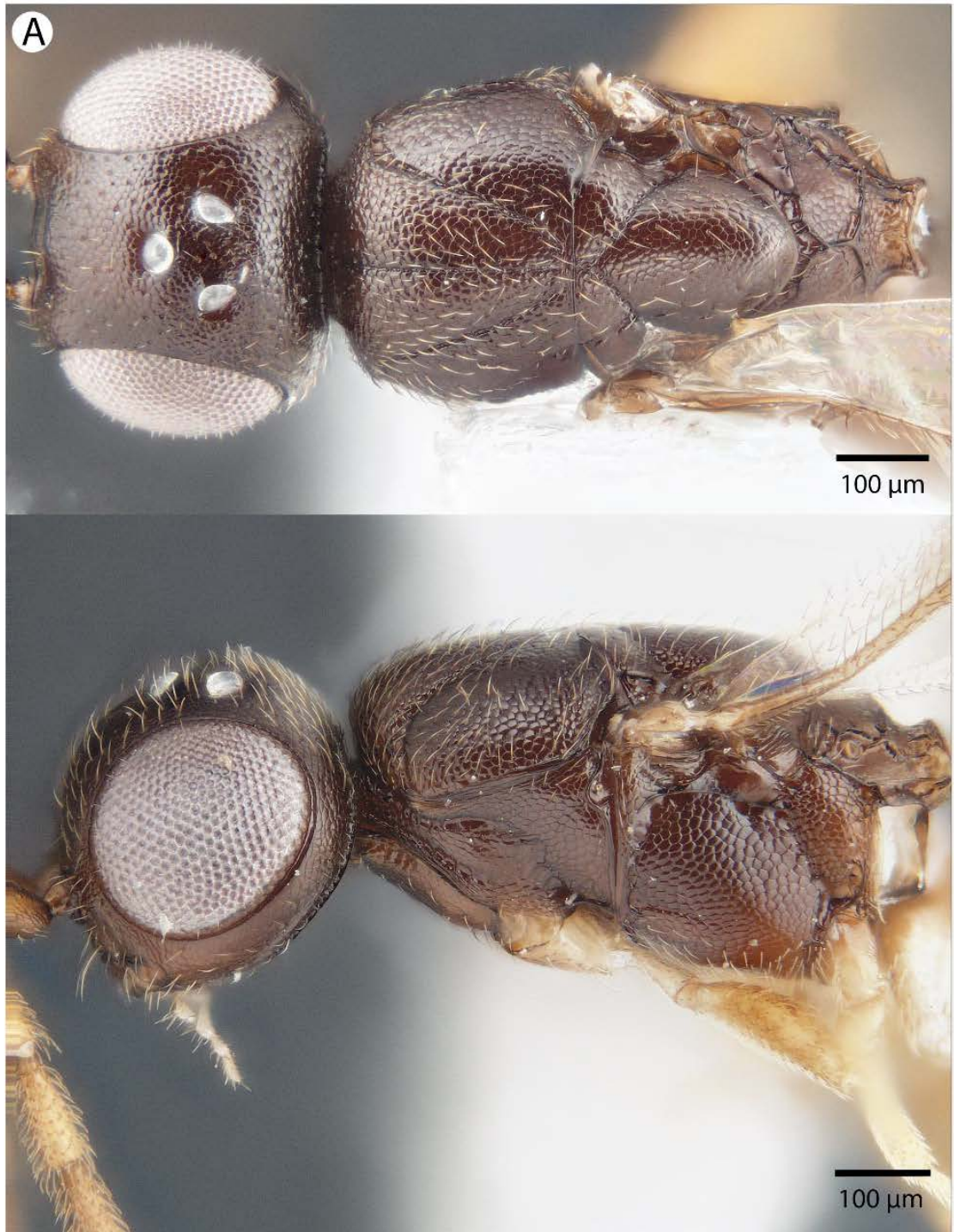


Figure 46. Brightfield image showing the head and mesosoma of *Conostigmus missyhaezanae* Mikó and Trietsch sp. nov. A. Dorsal view. B. Lateral view.



Figure 47. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus missyhazena* Mió and Trietsch sp. nov. A. Ventral view. B. Dorsal view (hrp=harpe, dhs=dorsomedial setae of harpal setal ring).

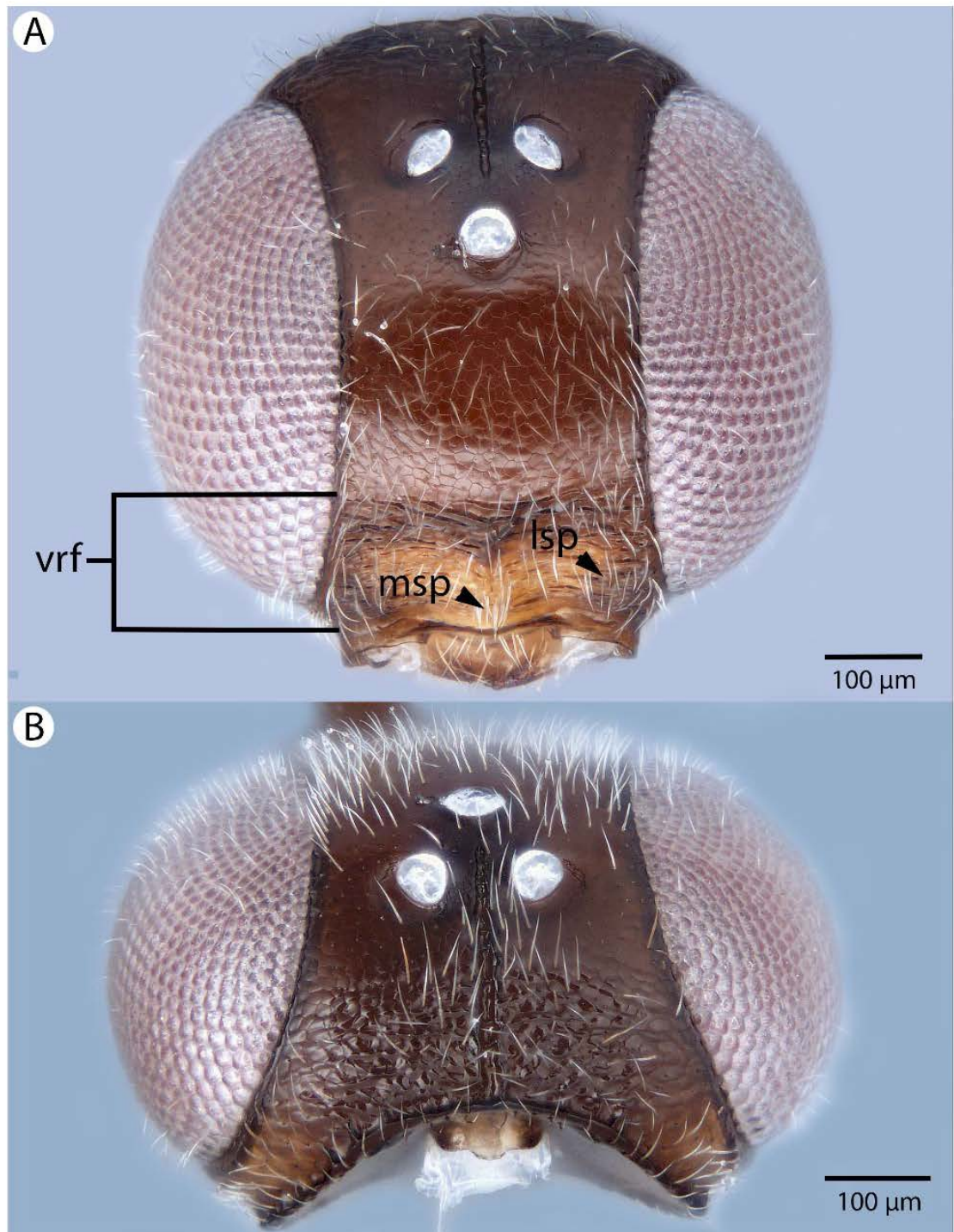


Figure 48. Brightfield image showing the head of *Conostigmus pseudobabaiax* Mikó and *Trietsch* sp. nov. A. Anterior view. B. Dorsal view.



Figure 49. Brightfield image showing the antenna of *Conostigmus pseudobabaiax* Mikó and Trietsch sp. nov. A. Female. B. Male.

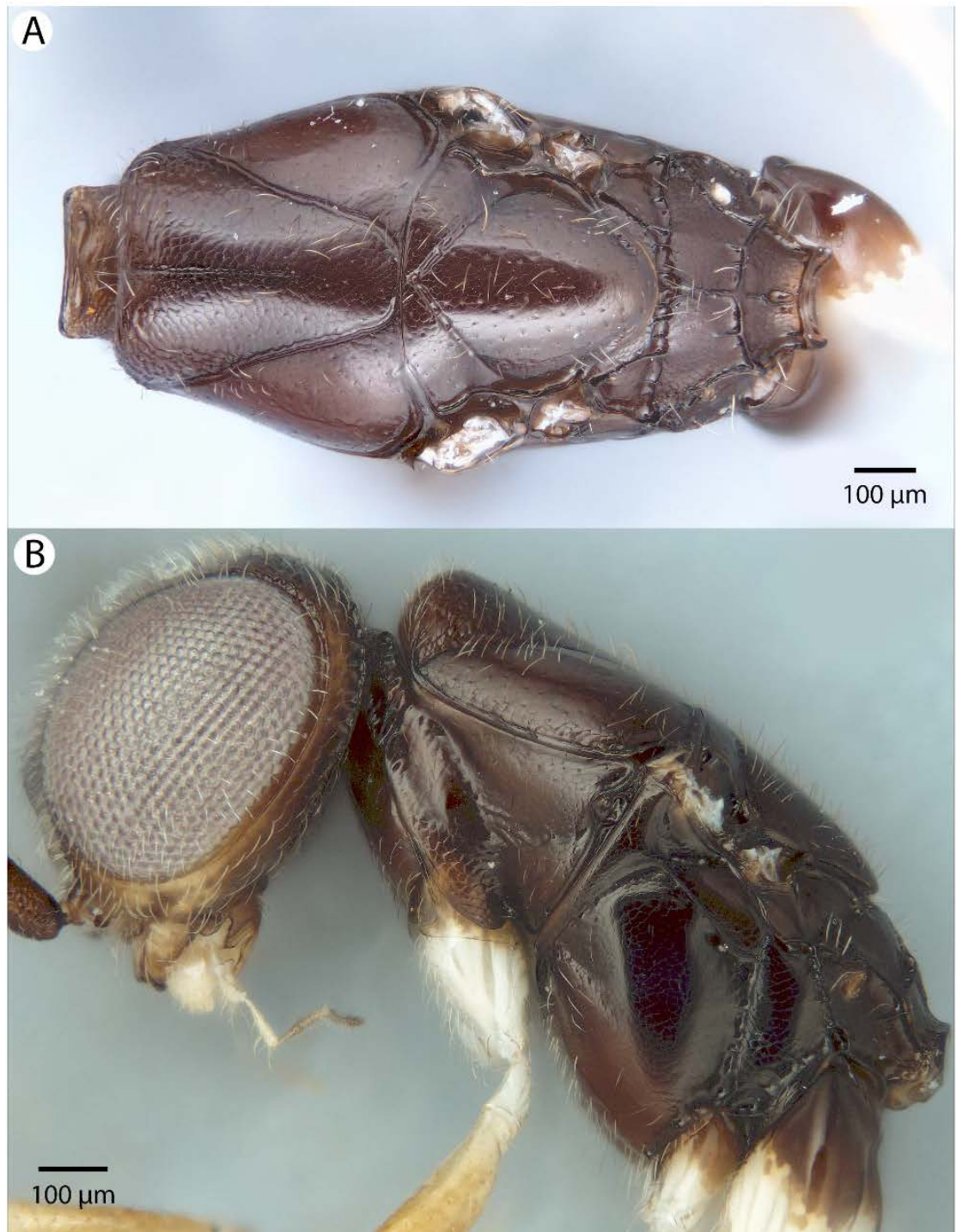


Figure 50. Brightfield image showing the head and mesosoma of *Conostigmus pseudobabaiax* Mikó and Trietsch sp. nov. A. Mesosoma, dorsal view. B. Head and mesosoma, lateral view.

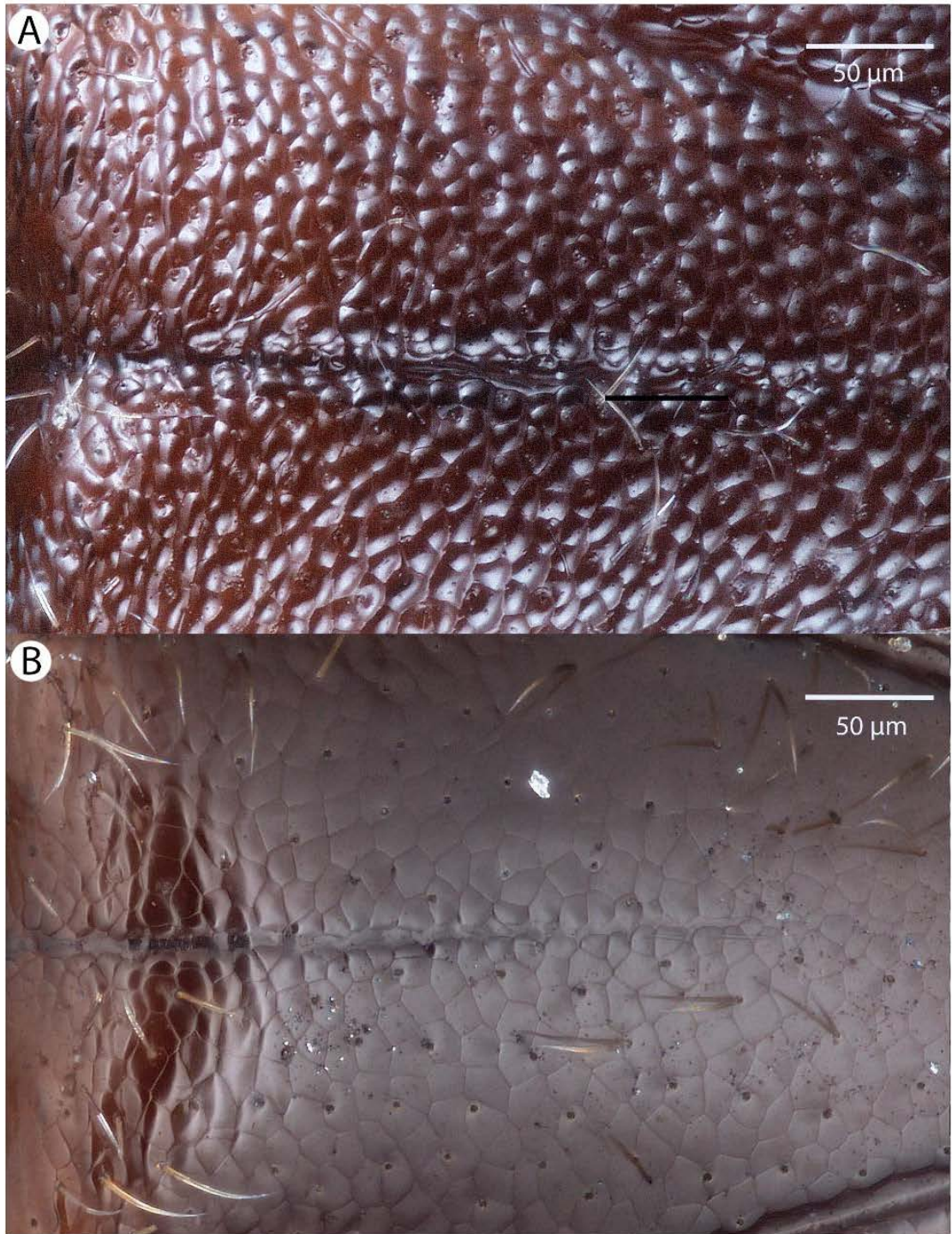


Figure 51. Brightfield image showing the middle anteromesoscutum of *Conostigmus* species, dorsal view. A. *Conostigmus toliaraensis* Mikó and Trietsch sp. nov. B. *Conostigmus pseudobabaiax* Mikó and Trietsch sp. nov.



Figure 52. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus pseudobabaiax* Mikó and Trietsch sp. nov. A. Ventral view. B. Dorsal view (dhs=dorsomedial setae of harpal setal ring, gvs=gonostyle/volsella complex, hrp=harpe, pdc=proximodorsal notch of cupula).



Figure 53. Brightfield image showing the antenna of *Conostigmus toliaraensis* Mikó and Trietsch sp. nov. A. Female. B. Male.

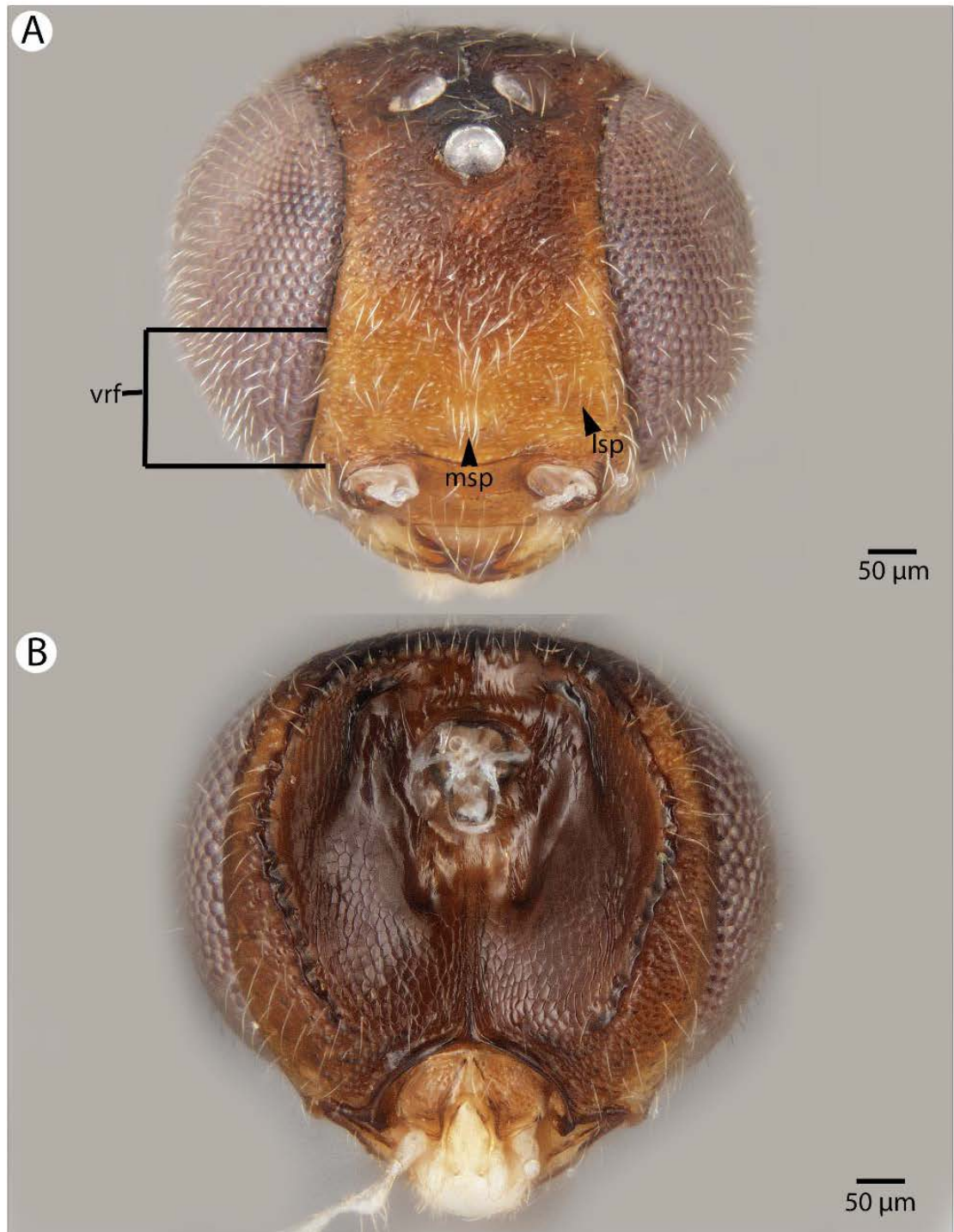


Figure 54. Brightfield image showing the head of *Conostigmus toliaraensis* Mikó and *Trietsch* sp. nov. A. Anterior view. B. Posterior view.



Figure 55. Brightfield image showing the mesosoma of *Conostigmus toliaraensis* Mikó and Trietsch sp. nov., dorsal view (mml= median mesoscutal line).

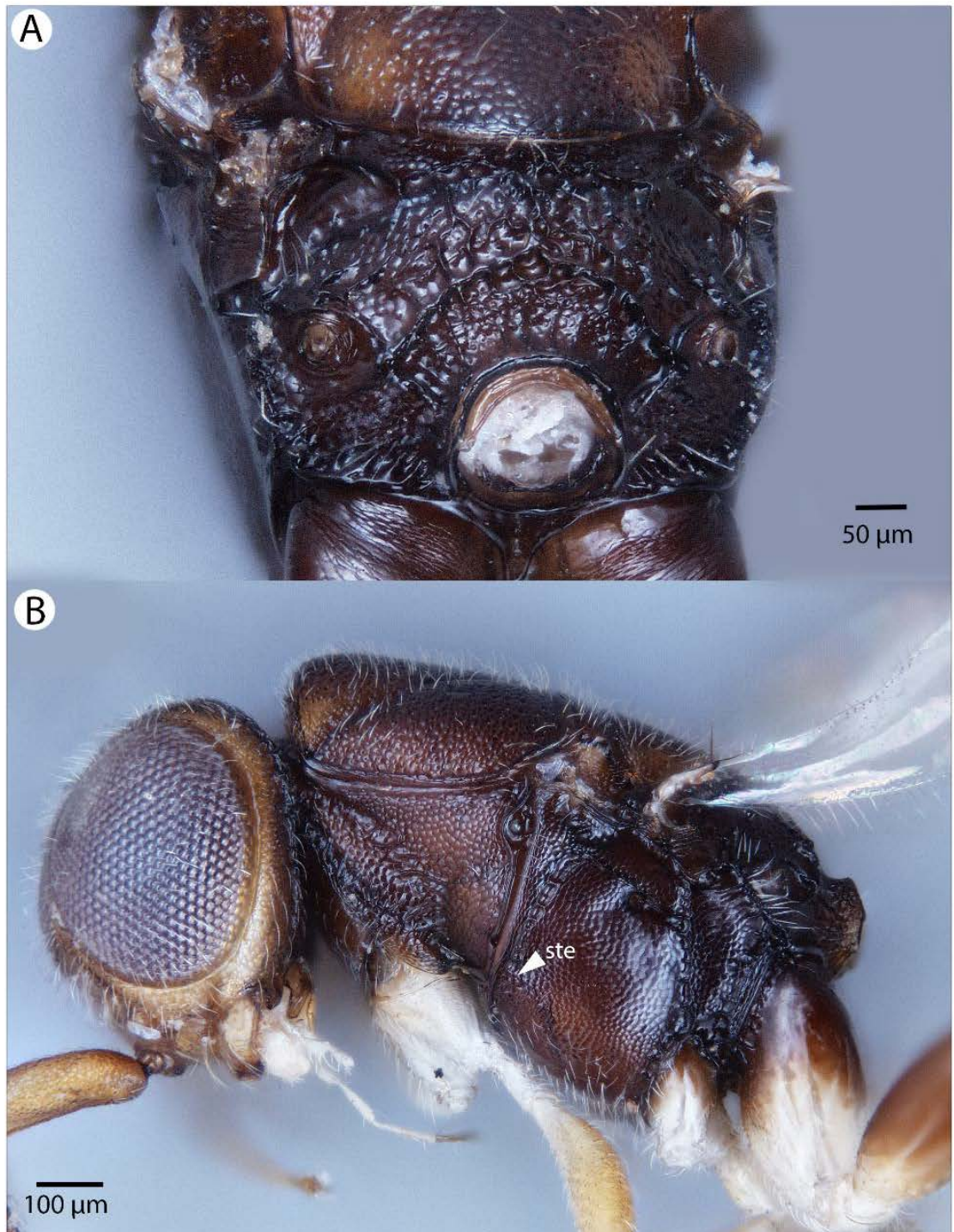


Figure 56. Brightfield image showing the head and mesosoma of *Conostigmus toliaraensis* Mikó and Trietsch sp. nov. A. Mesosoma, posterior view. B. Head and mesosoma, lateral view. (ste=sternaulus).

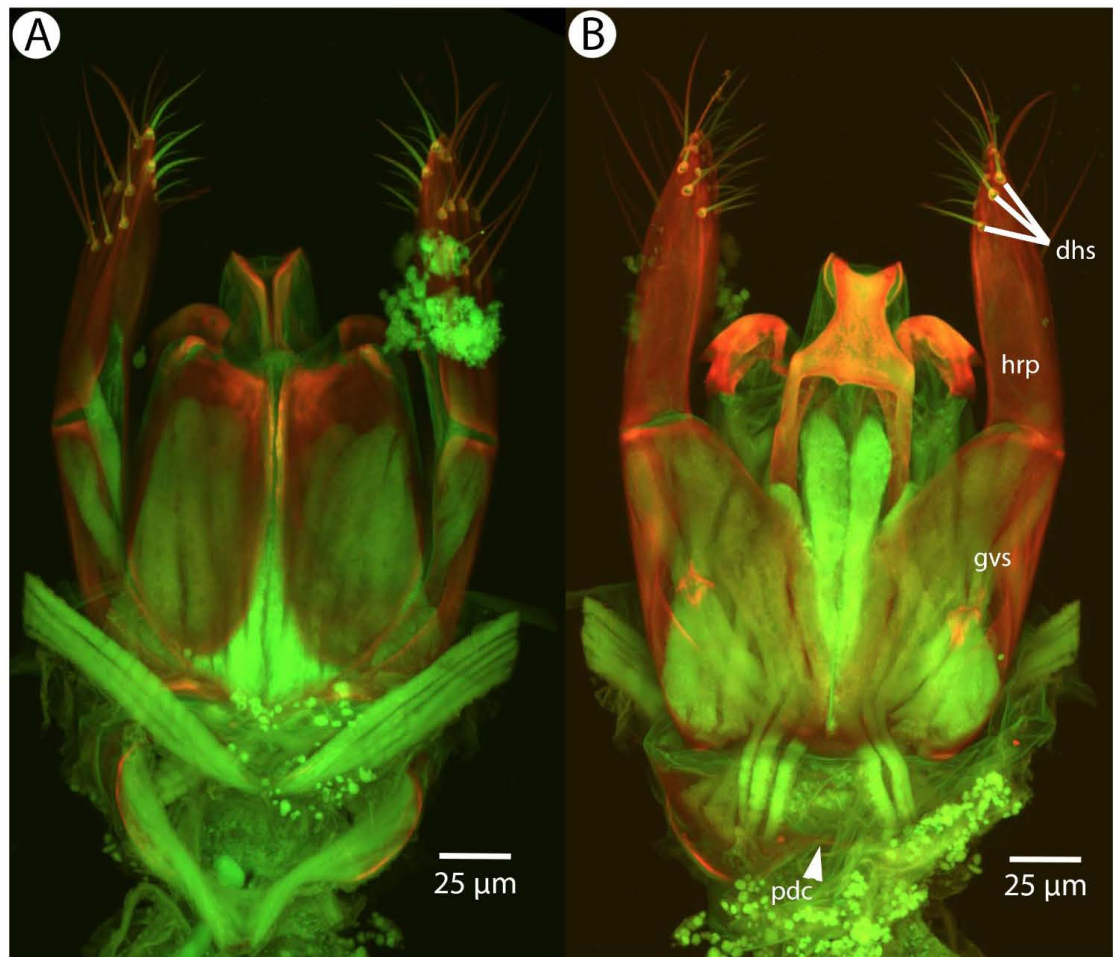


Figure 57. CLSM volume rendered micrographs showing the male genitalia of *Conostigmus toliaraensis* Mikó and Trietsch sp. nov. A. Ventral view B. Dorsal view (hrp=harpe, dhs=dorsomedial setae of harpal setal ring, gvs=gonostyle/volsella complex, pdc=proximodorsal notch of cupula).

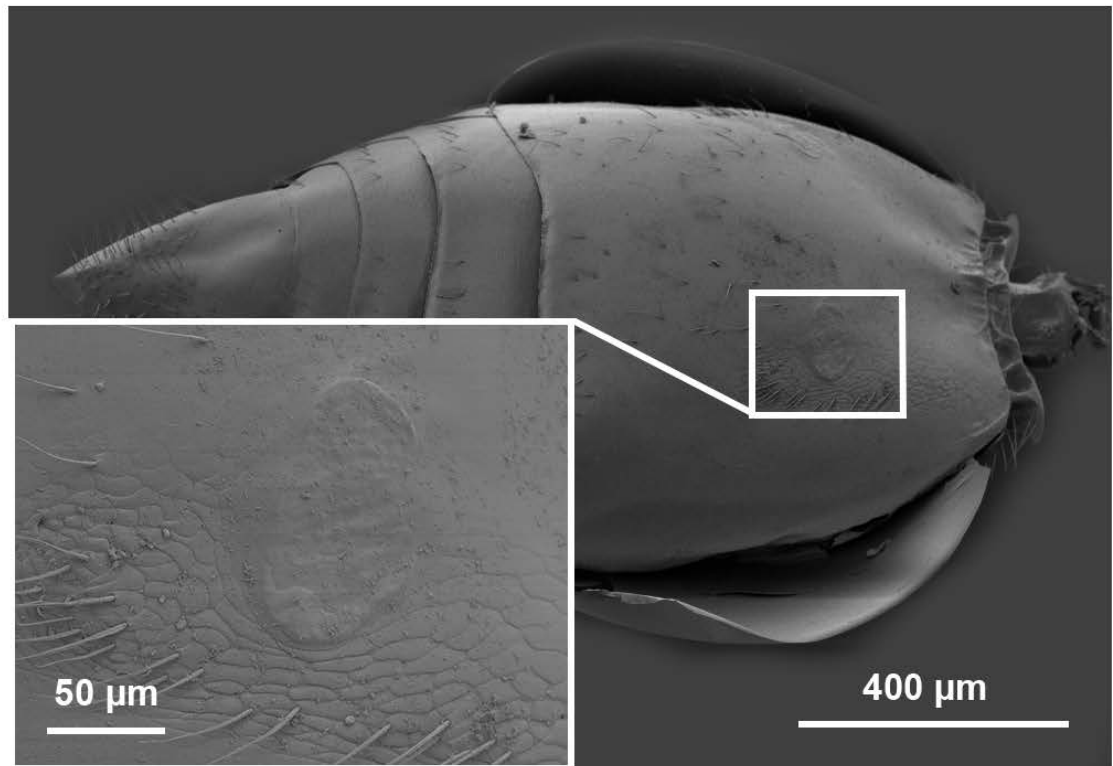


Figure 58. SEM micrograph of the metasoma of *Trichosteresis glabra* (Boheman 1831) in ventral view showing scutes corresponding to a possible exocrine gland.