



# Description and phylogenetic analysis of a new firefly genus from the Atlantic Rainforest, with five new species and new combinations (Coleoptera: Lampyridae: Lampyrinae)

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## Abstract

Here, based on phylogenetic analyses of 18 taxa and 57 morphological characters, we propose a new firefly genus, *Costalampys* **gen. nov.**, to accommodate eleven species. Five new species are herein described: *C. bella* **sp. nov.**, *C. capixaba* **sp. nov.**, *C. delicata* **sp. nov.** (designated as type species), *C. joanae* **sp. nov.** and *C. minima* **sp. nov.** In addition, six species are redescribed and transferred from other genera: *C. bisbinotata* (Pic) **comb. nov.**, transferred from *Platylampis* Motschulsky; *C. decorata* (Olivier) **comb. nov.**, transferred from *Ethra* Laporte; *C. pauper* (Olivier) **comb. nov.**, transferred from *Cladodes* Solier; as well as *C. klugii* (Motschulsky) **comb. nov.**, *C. quadriguttata* (Gorham) **comb. nov.**, and *C. tricolor* (Gorham) **comb. nov.**, transferred from *Lucidota* Laporte. *Costalampys* **gen. nov.** is tentatively placed in Lampyrinae, and is diagnosed by: antennae with 11 articles, III–X basally flabellate, lacking dense and upright bristles; clypeus connected to frons by membrane, pygidium rounded; sternum VIII mucronate; phallus with dorsal plate enlarged apically, projecting ventrally and partially embracing the internal sac. Our phylogenetic analyses supported both the monophyly of *Costalampys* **gen. nov.** and the new combinations proposed. However, the relationship among congeneric species was poorly resolved. Finally, we provide illustrations of diagnostic features, distribution maps, as well as a key to *Costalampys* **gen. nov.** species, based on males.

## Keywords

Amydetinae, Psilocladinae, Photinini, *Cladodes*, *Ethra*, *Lucidota*, *Platylampis*

## 1. Introduction

Fireflies (Coleoptera: Lampyridae) are charismatic insects with a surprisingly poorly-defined taxonomy worldwide and across all levels, from subfamilies to species. On one hand, the foundational framework of Lampyrid higher-level classification was developed by the early twentieth century – i.e. before the advent of phylogenetic systematics. This classification was kept largely unchanged (e.g., McDermott 1964, 1966) until fairly recently, when comprehensive analyses brought about new phylogenetic hypotheses that challenged standing lampyrid taxonomy (Branham and Wenzel 2003, Stanger-Hall et al. 2007, Jeng 2008, Martin et al. 2017, 2019). On the other hand, earlier authors, notably Ernest Olivier and Maurice Pic (e.g., Olivier 1907, Pic 1938), relied on few traits, with overly simplistic definitions, that obscured important differences across species (e.g., antennae “ramose” in opposition to “simple” [McDermott, 1964]). Therefore, most subfamilies as traditionally defined (i.e. *sensu* McDermott 1966) lack phylogenetic support, and their definitions have been questioned and substantially changed (Branham and Wenzel 2003, Bocakova et al. 2007, Stanger-Hall et al. 2007, Jeng 2008, Martin et al. 2017, 2019). The same problems extend to genus- and species-level taxonomy, as the vast majority of genera have never had its monophyly tested under a phylogenetic approach (but see Vaz et al. 2020).

A recent study proposed an updated classification of the Lampyridae that reshaped significantly our understanding of the evolution of fireflies – particularly regarding the relationship among taxa where males have flabellate antennae (Martin et al. 2019). Importantly, Martin et al. (2019) – based on a comprehensive taxon sampling and a sound genomic dataset – confirmed that the taxa traditionally placed in Amydetinae were a polyphyletic assemblage of taxa in which males had convergently evolved complex, branched antennae (as previously supposed by earlier authors, e.g., McDermott 1964). For example: *Ethra* Laporte, *Scissicauda* McDermott, and *Cladodes* Solier were found scattered throughout a newly defined Lampyrinae, whereas *Vesta* was found nested within Photurinae. Despite being “branched”, male antennal structure in the latter four taxa is distinct in many regards, including flabellum shape and insertion on the antennomere, as well as the presence of certain bristles (see below).

The overall similarities across sensor morphologies of distantly-related species has been proposed to be associated with changes in the major signal type used in sex communication (e.g., Stanger-Hall et al. 2018). On the other hand, Martin et al. (2019) found *Memoan ciceroi* Silveira & Mermudes, a species with serrate male antennae, to be sister to *Amydetes fastigiata* Illiger, with flabellate male antennae. Interestingly enough, Silveira and Mermudes (2013) had pointed out important similarities between *Memoan* and *Amydetes*, in spite of their differences in antennal morphology. Together, these observations call for the use of a more comprehensive set of

traits in firefly taxonomy, as well as a review of character statements and hypotheses of homology based on recent improvements in phylogenetic epistemology (e.g., Sereño 2007, Vogt 2017).

Phylogenetic studies at and above genus level are particularly lacking for Neotropical firefly fauna – the most species-rich on Earth (Branham 2010) – where taxa often have ill-defined, outdated and overlapping diagnoses. This tangled taxonomy has led to difficulties in classifying and identifying Neotropical firefly taxa. In contrast, phylogenetic studies at and above species level have proven very useful in redefining the taxonomic boundaries of Southeast Asian and Australopacific firefly taxa (reviewed in Ballantyne et al. 2019). Therefore, thorough systematic studies aimed at providing a solid foundation for the Neotropical firefly taxonomy, and facilitating identification, are sorely needed.

Preliminary studies of our group found that some species belonging to four Neotropical lampyrine genera – *Cladodes* Solier, 1849, *Ethra* Laporte, 1833, *Lucidota* Laporte, 1833, and *Platylampis* Motschulsky, 1853 – didn’t fit their current placement but had instead similar morphology, which motivated the present study. These four genera lack comprehensive taxonomic reviews, and their diagnoses partially overlap, especially due to *Lucidota*, which includes over one hundred species with strikingly disparate phenotypes (McDermott 1964, 1966). To further complicate the issue, some species involved were described based on sexually dimorphic traits, exclusively based on a single female (e.g., Pic 1938, see below). However, lampyrid taxonomy was largely built upon few male traits that are usually sexually dimorphic, such as the form of antennal lamellae (e.g., McDermott 1964). These factors contribute to the tangled taxonomy of Neotropical fireflies, and stresses the need for revisionary work.

Here we explore the phylogenetic relationship among several Amydetinae and Lampyrinae taxa, in support of the identification and description of a new genus. After the examination of six species previously classified as *Ethra*, *Cladodes*, *Platylampis* and *Lucidota*, we conclude that these constitute – along with five new species – a previously unknown lineage herein described and named *Costalampys* **gen. nov.** We provide detailed morphological descriptions, illustrations of diagnostic features, and a detailed distribution map for species in this genus, and a key to *Costalampys* **gen. nov.** spp. based on males.

## 2. Material and Methods

### 2.1. Taxon sampling

Lampyrid taxonomy is undergoing important changes regarding higher-level classification (e.g., Martin et al. 2019), which renders taxon sampling rather challenging in groups poorly represented in phylogenies. In addition to having unreliable subfamily definitions, relationships

among genera and their monophyly remain largely unexplored across subfamilies. Therefore, we tried to include in our taxon sampling the type species of genera whose taxonomic placement is at stake (i.e. would involve nomenclatural acts), as well as early-branching taxa, outside Lampyrinae, that are considered more distantly related (e.g., *Psilocladus*, *Amydetes*). For the subfamilial placement of genera, we followed Martin et al. (2019). The whole list, includes taxa from three subfamilies – Lampyrinae Rafinesque, 1815, Amydetinae Olivier, 1907, and Psilocladinae McDermott, 1964 – as well as Lampyridae *incertae sedis* taxa: *Araucariocladus* Silveira & Mermudes, 2017, previously placed in Amydetinae (Silveira and Mermudes 2017) but never properly included in any phylogenetic analysis.

Twenty four species were included in the phylogenetic analysis to investigate the limits and test the monophyly of the new genus, particularly in the context of Lampyrinae. The ingroup includes the following taxa: (i) six new species described herein, tentatively placed in the new genus, (ii) five species whose current placement is at stake, suspected to belong in the new genus: *Cladodes pauper* Olivier, 1899, *Ethra decorata* Olivier, 1888, *Platylampis bisbinotata* Pic, 1943, *L. quadriguttata* Gorham, 1880 and *L. tricolor* Gorham, 1880; (iii) and ten Lampyrinae species representing the genus-level diversity is South American, particularly taxa morphologically similar to the presumed new genus, spanning 10 genera (*Lucidota banoni* Laporte, 1833; *Cladodes flabellatus* Solier, 1849; *Ethra marginata* Gray, 1832; *Scissicauda balena* Silveira, Bocakova & Mermudes, 2016; *S. disjuncta* Olivier, 1896; *Dadophora hyalina* Olivier, 1907, *Uanauna angaporan* Campello-Gonçalves, Souto, Mermudes & Silveira, 2019; *Luciuranus josephi* Silveira, Khamat & Mermudes, 2016; *Dilychnia guttula* Fabricius, 1801; *Ybytyramoan praeclarum* Silveira & Mermudes, 2014). The outgroup included three taxa, supposed to be distantly related to the new genus, in the following groups: Amydetinae (*Amydetes fastigiata* Illiger, 1807), Psilocladinae (*Psilocladus miltoderus* Blanchard in Brullé, 1846), and *incertae sedis* (*Araucariocladus hiems* Silveira & Mermudes, 2017). We also rooted the trees in each of the outgroup taxa, to test if it could change the ingroup relationships, which remained the same. We rooted the trees at *A. fastigiata* because it was never considered congeneric with any of the ingroup taxa (cf. McDermott 1966). Examined material is listed below for the ingroup, and in the Supplementary Material 1 for the outgroup.

## 2.2. Abbreviations

**DZRJ** – Coleção Entomológica Professor José Alfredo Pinheiro Dutra, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; **MZSP** – Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; **DZUP** – Coleção Entomológica Pe. Jesus Santiago Moure, Universidade Federal do Paraná, Curitiba, Brazil; **INPA** – Coleção Sistemática de Entomologia do Instituto Nacional

de Pesquisas da Amazônicas, Manaus, Amazonas, Brazil; **MNHN** – Muséum National d’Histoire Naturelle, Paris, France; **BMNH** – The Natural History Museum, London, United Kingdom; **ZIN** – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia; **ZMB** – Museum für Naturkunde, Berlin, Germany.

## 2.3. Morphology, illustrations and maps

For the type species, whole specimens were soaked in 10% KOH for 24h and then dissected. Tagmas were separated, then appendages, terminalia and genitalia were separated. For the remaining species, the same procedure was applied only to the terminalia and male genitalia. Dissected structures were preserved in glycerin (for pinned specimens) or in 92% ethanol (for specimens preserved in 92% ethanol). The general terminology follows Silveira & Mermudes (2014a) and Silveira et al. (2016a, 2016b), except for ovipositor morphology, for which we follow Lawrence et al. (2011). Photographs and measurements were taken with the Leica DFC450 and Application Suite CV3 multifocus software. The photographs were edited using Adobe Photoshop and the plates were designed with Adobe Illustrator (Adobe Systems). Total length was given by the sum of pronotum and elytron lengths. Distribution maps were built using the program QGIS 2.18.10 (QGIS.org 2017).

## 2.4. Character coding

Characters were coded as binary or multistate, following the logical basis of Sereno (2007). The matrix was constructed in Mesquite v3.2 (Maddison and Maddison 2018). The data matrix can be found in the supplementary file 2. The proposition of homologies was based on direct observations of adult males and females. The following outgroup taxa are known only from adult males, therefore information about females is lacking: *Araucariocladus*, *Amydetes*, *Cladodes*, *Dadophora* and *Ethra*. This is also true for the ingroup species *Costalampys joanae* **sp. nov.** and *Costalampys minima* **sp. nov.**, of which females are unknown. We only included one female-based character, which added only 0.6% of missing data in our analysis.

## 2.5. Phylogenetic analyses

We ran and compared the results of both Parsimony and Bayesian analyses, seeking consistency among them, as there is no consensus regarding which is the best method to infer phylogenies using morphological characters (Goloboff et al. 2008b, 2018, Wright and Hillis 2014, Puttick et al. 2017, O’Reilly et al. 2018, Sansom et al. 2018, Schrago et al. 2018, Smith 2019).

Parsimony analyses were performed with TNT (Goloboff et al. 2008a), under equal weights (EW) and implied weights (IW) (Goloboff 1993). All analyses were

conducted by heuristic searches, TBR branch swapping, 1000 replicates and 100 trees saved by replicate. For the IW analysis, we explored the topologies obtained under different concavity constant values ( $k = 1, 2, 3, 5, 10, 15$ ). The  $k$  values were not chosen with regular intervals because high  $k$  values tend to generate uniform results, similar to the ones of EW analysis (Goloboff et al. 2008b). Therefore, analysis with regular  $k$  intervals may result in bias toward high  $k$  topologies (Mirande 2009). Support was assessed through Symmetric resampling (SR), which is not distorted by implied weights (Goloboff et al. 2003). Absolute Bremer values were calculated to the EW analysis as well.

The topology to evaluate the character evolution was chosen by a sensibility analysis (Giribet 2003), which selects the most stable topology, that is, the one that shows up more times. In addition, generated trees with the synapomorphies were mapped in Winclada, version 1.00.08 (Nixon 2002).

Bayesian Inference was performed on MrBayes 3.2 (Huelsenbeck and Ronquist 2001). The analysis was performed with 10.000.000 generations, trees saved each 1.000 generations, and 10% *burn-in*. The analysis used the evolution model *MKV*, modified from *MK* (Lewis 2001), and was checked for convergence on Tracer v1.6 (Rambaut et al. 2014). Trees were read in FigTree version 1.4 (Rambaut 2009).

### 3. Results

#### 3.1. Morphological characters

The detailed study of the morphology of the taxa included in the analyses allowed us to identify 57 characters: 11 from the head; nine from the thorax; and 37 from the abdomen, 18 of which from the aedeagus. The characters were coded as binary (N=47) or multistate (N=10).

For each character, the following is indicated related to the EW consensus tree: the number of steps (L); the consistency index (CI); and the retention index (RI).

#### Head

- 1 Male antenna, antennomeres III–IX, shape: **(0)** serrate; **(1)** cylindrical (Fig. 6E). L = 3; CI = 0.33; RI = 0.5.
- 2 Male antenna, antennomeres III–IX, single lamella: **(0)** absent; **(1)** present (Fig. 6E). L = 4; CI = 0.25; RI = 0.62.
- 3 Male antenna, antennomeres III–IX, double lamella: **(0)** absent; **(1)** present. L = 1; CI = 1; RI = 1.
- 4 Male antenna, single lamellae insertion, position: **(0)** basal (Fig. 6E); **(1)** apical; **(2)** basically medial, then progressively apical towards antennal apex. L = 2; CI = 1; RI = 1.
- 5 Female antenna, antennomeres III–IX, apical corner, shape: **(0)** almost right-angled; **(1)** projected (Fig. 15C); **(2)** cylindrical. L = 2; CI = 0.5; RI = 0.66.
- 6 Antenna, upright bristles: **(0)** absent (Fig. 6E); **(1)** present. L = 1; CI = 1; RI = 1.
- 7 Clypeus, connection to frons: **(0)** connected by membrane (Fig. 12D); **(1)** connate. L = 1; CI = 1; RI = 1.
- 8 Mandibles, orientation in frontal view: **(0)** overlapping (Fig. 12D); **(1)** crossed. L = 2; CI = 0.5; RI = 0.5.
- 9 Gula, length relative to submentum: **(0)** at least a 1/5 shorter; **(1)** as long as (Fig. 12B); **(2)** at least a 1/5 longer. L = 3; CI = 0.66; RI = 0.83.
- 10 Labium, submentum, shape: **(0)** subcordiform; **(1)** U-shaped; **(2)** triangular (Fig. 12B); **(3)** tongue-shaped. L = 6; CI = 0.5; RI = 0.4.
- 11 Labium, palp, palpomere III, shape: **(0)** digitiform (sides subparallel, apically rounded); **(1)** securiform (sides rounded, apically emarginate); **(2)** triangular (sides divergent, apically straight) (Fig. 12F). L = 2; CI = 1; RI = 1.

#### Thorax

- 12 Pronotum, disc, convexity relative to explanate margins in frontal view: **(0)** flat; **(1)** convex (Fig. 6F). L = 2; CI = 0.5; RI = 0.83.
- 13 Pronotum, lateral expansions, punctures, depth: **(0)** deep; **(1)** shallow (Fig. 6F). L = 3; CI = 0.33; RI = 0.8.
- 14 Pronotum, anterior margin, shape: **(0)** acuminate anteriorly; **(1)** homogeneously rounded (Fig. 6F). L = 2; CI = 0.5; RI = 0.66.
- 15 Pronotum, pronotal lateral expansion width relative to disc: **(0)** less than a third; **(1)** less than half (Fig. 6F). L = 1; CI = 1; RI = 1.
- 16 Prosternum anterior margin, shape: **(0)** straight (Fig. 13B); **(1)** medially sinuose. L = 3; CI = 0.33; RI = 0.66.
- 17 Mesoscutellum, posterior margin, shape: **(0)** rounded (Fig. 13E); **(1)** truncate. L = 1; CI = 1; RI = 1.

#### Elytra

- 18 Elytron, outer margin, shape: **(0)** straight; **(1)** rounded (Fig. 6A). L = 2; CI = 0.5; RI = 0.9.
- 19 Elytron, distinct black outline: **(0)** absent; **(1)** present (Fig. 6A). L = 2; CI = 0.5; RI = 0.9.
- 20 Elytron, medial spot near the elytron suture: **(0)** absent; **(1)** present (Fig. 20A). L = 1; CI = 1; RI = 1.

#### Abdomen

- 21 Terga II–VII, posterior angles, shape: **(0)** acute (Fig. 14B); **(1)** right-angled. L = 3; CI = 0.33; RI = 0.8.
- 22 ♂, sternum VI, lantern: **(0)** absent; **(1)** present (Fig. 6B). L = 6; CI = 0.17; RI = 0.54.
- 23 ♂, sternum VI, lantern, width relative to sternum: **(0)** less than a third (Fig. 6B); **(1)** more than a third. L = 2; CI = 0.5; RI = 0.

- 24 Sternum VIII, size relative to VII: **(0)** as long as (Fig. 6B); **(1)** at least a 1/5 longer. L = 2; CI = 0.5; RI = 0.66.
- 25 Sternum VIII, median third, posterior projection: **(0)** absent (Fig. 6B); **(1)** present (Fig. 14C). L = 4; CI = 0.25; RI = 0.7.
- 26 Sternum IX, position relative to VIII: **(0)** completely covered; **(1)** partially exposed (Fig. 14C). L = 1; CI = 1; RI = 1.
- 27 Pygidium, posterior margin, medial indentation: **(0)** absent (Fig. 14C); **(1)** present. L = 1; CI = 1; RI = 1.
- 28 Pygidium, shape (proportion): **(0)** at least a 1/5 wider than long (Fig. 14C); **(1)** as wide as long (Fig. 6H); **(2)** at least a 1/5 longer than wide. L = 8; CI = 0.25; RI = 0.54.
- 29 Pygidium, lateral margin, shape: **(0)** subparallel; **(1)** rounded (Fig. 14C); **(2)** divergent posteriorly; **(3)** convergent posteriorly. L = 2; CI = 0.5; RI = 0.9.
- 30 Pygidium, posterior corners, length relative to central posterior margin: **(0)** shorter; **(1)** as long as (Fig. 14C). L = 4; CI = 0.25; RI = 0.5.
- 31 Pygidium, lateral corners, degree of development: **(0)** well-developed (Fig. 6H); **(1)** barely conspicuous (Fig. 14C). L = 4; CI = 0.75; RI = 0.8.
- 32 Pygidium, parasagittal sinuosities: **(0)** absent; **(1)** present (Fig. 14C). L = 5; CI = 0.2; RI = 0.5.
- 33 Pygidium, posterior margin, median third, pointed projection: **(0)** absent (Fig. 14C); **(1)** present (Fig. 6H). L = 1; CI = 1; RI = 1.
- 34 Syntergite, anterior margin, emargination: **(0)** absent; **(1)** present. L = 1; CI = 1; RI = 1.
- 35 Syntergite, anterior margin, emargination, shape: **(0)** mild; **(1)** strongly indented. L = 3; CI = 0.33; RI = 0.66.
- 36 Syntergite, sagittal membranous suture: **(0)** absent; **(1)** present (Fig. 14D, E). L = 2; CI = 0.5; RI = 0.88.
- 37 Syntergite, posterior/apical connection with sternum IX: **(0)** separated (Fig. 14D, E); **(1)** fused. L = 1; CI = 1; RI = 1.
- 38 Syntergite, anterior transverse suture: **(0)** absent; **(1)** present (Fig. 14D, E). L = 2; CI = 0.25; RI = 0.88.
- 39 Sternum IX, posterior margin, shape: **(0)** rounded (Fig. 14E); **(1)** acute. L = 1; CI = 1; RI = 1.
- 40 Phallobase, bilateral symmetry: **(0)** absent; **(1)** present (Fig. 14F–H). L = 4; CI = 0.25; RI = 0.25.
- 41 Phallobase, length relative to phallus: **(0)** at least a 1/4 longer; **(1)** as long as. L = 2; CI = 0.5; RI = 0.83.
- 42 Phallus, dorsal plate, median fusion to parameres: **(0)** absent; **(1)** present (Fig. 14F). L = 2; CI = 0.5; RI = 0.75.
- 43 Phallus, dorsal plate, median fusion to parameres, length: **(0)** extending up to a 1/5 of phallus length; **(1)** extending up to half phallus length. L = 1; CI = 1; RI = 1.
- 44 Phallus, dorsal plate, apical half, lateral margins, shape: **(0)** acuminate and rounded (Fig. 14F–H); **(1)** acuminate and straight (Fig. 8K–M); **(2)** sinuose; **(3)** subparallel-sided. L = 5; CI = 0.6; RI = 0.75.
- 45 Phallus, dorsal plate, medial transverse groove: **(0)** absent (Fig. 14F–H); **(1)** present. L = 1; CI = 1; RI = 1.
- 46 Phallus, dorsal plate, length relative to paramere: **(0)** at least a 1/5 longer; **(1)** at least a 1/5 shorter (Fig. 14F–H). L = 4; CI = 0.25; RI = 0.4.
- 47 Phallus, dorsal plate, apical indentation: **(0)** absent (Fig. 14F–H); **(1)** present. L = 3; CI = 0.33; RI = 0.5.
- 48 Phallus, ventral plate: **(0)** absent; **(1)** present (Fig. 16L). L = 3; CI = 0.33; RI = 0.66.
- 49 Phallus, ventral plate, length relative to dorsal plate: **(0)** half as long; **(1)** as long (Fig. 14F–H); **(2)** a third shorter. L = 2; CI = 1; RI = 1.
- 50 Phallus, dorsal plate, overall shape in lateral view: **(0)** straight (Fig. 18I–K); **(1)** bent dorsally (Fig. 14F–H); **(2)** bent ventrally; **(3)** sinuose. L = 5; CI = 0.6; RI = 0.8.
- 51 Phallus, dorsal plate, basal abrupt constriction: **(0)** absent; **(1)** present (Fig. 14F–H). L = 3; CI = 0.33; RI = 0.66.
- 52 Phallus, subapical transversal keel: **(0)** absent; **(1)** present (Fig. 16I). L = 1; CI = 1; RI = 1.
- 53 Phallus, subapical outer teeth: **(0)** absent (Fig. 14F–H); **(1)** present. L = 3; CI = 0.33; RI = 0.
- 54 Paramere, subapical tooth: **(0)** absent; **(1)** present (Fig. 14F–H). L = 2; CI = 0.5; RI = 0.9.
- 55 Paramere, apex, shape in lateral view: **(0)** straight (Fig. 9K–M); **(1)** curved ventrally (Fig. 14F–H). L = 4; CI = 0.25; RI = 0.72.
- 56 Paramere, apex, subapical abrupt constraint: **(0)** absent (Fig. 9K–M); **(1)** present. L = 3; CI = 0.33; RI = 0.6.
- 57 Paramere (lateral view) ventral projection: **(0)** absent; **(1)** present (Fig. 14F–H). L = 2; CI = 0.5; RI = 0.88.

### 3.2. Phylogeny

The parsimony analysis of the data matrix (Table 1) under EW resulted in 2 most parsimonious trees (L=145, CI=0.48, RI=0.75), which generated a strict consensus tree (Fig. 1, unambiguous optimization). Note that throughout this section we used the current generic placement (i.e. before the new combinations proposed below). In all topologies, *Costalampys* **gen. nov.** was recovered as a monophyletic group with high support (both in Symmetric resampling [85] and absolute Bremer [11] indices) and based on seven synapomorphies. The synapomorphies supporting *Costalampys* **gen. nov.** in all trees are the following (Fig. 2): Male antenna, antennomeres III–IX, shape: filiform (1:1, homoplastic); Male antenna, antennomeres III–IX, single lamella: present (2:1, homoplastic); Elytron, outer margin, shape: rounded (18:1, homoplastic); Terga II–VII, posterior angles, shape: straight (21:0, homoplastic); Syntergite, anterior margin, emargination, shape: strongly indented (35:1, homoplastic); Phallus, subapical transversal keel: present (52:1, unam-

### Male genitalia

- 40 Phallobase, bilateral symmetry: **(0)** absent; **(1)** present (Fig. 14F–H). L = 4; CI = 0.25; RI = 0.25.
- 41 Phallobase, length relative to phallus: **(0)** at least a 1/4 longer; **(1)** as long as. L = 2; CI = 0.5; RI = 0.83.
- 42 Phallus, dorsal plate, median fusion to parameres: **(0)** absent; **(1)** present (Fig. 14F). L = 2; CI = 0.5; RI = 0.75.
- 43 Phallus, dorsal plate, median fusion to parameres, length: **(0)** extending up to a 1/5 of phallus length; **(1)** extending up to half phallus length. L = 1; CI = 1; RI = 1.
- 44 Phallus, dorsal plate, apical half, lateral margins, shape: **(0)** acuminate and rounded (Fig. 14F–H); **(1)**

**Table 1.** Taxon sampling along with data matrix of morphological characters used in the morphological phylogenetic analyses of *Costalampys* **gen. nov.** (Coleoptera: Lampyridae). \* indicates type-species of the genus. ? indicates missing data and – indicates inapplicable characters.

Taxon	Character					
	000000001	111111112	222222223	333333334	444444445	5555555
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567
<i>Amydetes fastigiata</i> Illiger, 1807	1102?00022	0001000000	1110010011	0000-00001	00-3000120	0000001
<i>Psilocladus miltoderus</i> Blanchard in Brullé, 1846	101--10120	1000000000	10-0010110	1000-00000	00-30100-0	0000000
<i>Lucidota banoni</i> Laporte, 1833	000-000012	2100110000	1100010111	1001010101	1102011103	0000001
<i>Cladodes flabellatus</i> Solier, 1849	1101?00021	2001000000	10-0110010	0001000100	00-10000-0	1000000
<i>Ethra marginata</i> Gray, 1832	1101?00012	1001010000	10-0110210	0001000001	01010000-0	0000000
<i>Scissicauda balena</i> Silveira, Bocakova & Mermudes, 2016	1100000010	2110110110	00-0110201	1101110101	1100010101	1101111
<i>Scissicauda disjuncta</i> Olivier, 1896	0100010010	2010110110	10-1001202	1001101011	1111111112	0000000
<i>Araucariocladus hiems</i> Silveira & Mermudes, 2017	101-?10120	1001000000	00-0010110	1000-00000	00-30100-0	0000000
<i>Dadophora hyaline</i> , Olivier, 1907	000-?000??	2100110000	10-0110211	1001010100	1101010101	1011001
<i>Dilychnia guttula</i> Fabricius, 1801	000-001103	2110100000	1100110011	0001000000	00-1000120	0000110
<i>Uanauna angaporan</i> Campello-Gonçalves, Souto, Mermudes & Silveira, 2019	100-000002	2100101000	10-1010003	1101100001	11010010-1	1010100
<i>Cladodes pauper</i> Olivier, 1899	1100000010	2110110110	00-0110201	1101110101	1100010101	1101111
<i>Ethra decorata</i> Olivier, 1888	1100100010	2110110110	0100110011	1101110101	1100010101	1101001
<i>Luciuranus josephi</i> Silveira, Khattar & Mermudes, 2016	100--00003	2100101000	00-1010113	1101000001	11010110-0	0000000
<i>Lucidota quadriguttata</i> Gorham, 1880	1100100010	2110110111	0100110011	1101110101	1101010100	1101101
<i>Lucidota tricolor</i> Gorham, 1880	1100000010	2110110110	0100110111	1101110101	1100010101	1101111
<i>Lucidota klugii</i> Motschulsky, 1853	110000001?	2100110100	00-0110201	0001110101	1101000101	1101101
<i>Platylampis bisbinotata</i> Pic, 1943	1100100010	2110110111	0100110011	1101110101	1101010100	1101101
<i>Costalampys bella</i> sp.nov.	1100000010	2110110110	0100010101	0111110101	1100010101	1101111
<i>Costalampys capixaba</i> sp.nov.	1100100010	2110110110	0100110011	1101110101	1101010101	1101101
<i>Costalampys delicata</i> sp.nov.	1100000010	2110110110	0100010101	0111110101	1100010101	1101111
<i>Costalampys joanae</i> sp.nov.	1100?00010	2110110110	0100110201	1101110101	1100010101	1101111
<i>Costalampys minima</i> sp.nov.	1100?00010	2110110110	00-0110011	1101110101	1101010100	1101101

biguous); Paramere, apex, shape in lateral view: straight (55:1, homoplastic).

Most of the outgroup relationships (i.e. outside *Costalampys* **gen. nov.** clade) remained consistent between both topologies, with only one polytomy recovered in the consensus tree. The sister group of *Costalampys* **gen. nov.** was *Dadophora hyalina*, followed by *L. banoni*, supported only by absolute Bremer (1). Inside of *Costalampys* **gen. nov.** clade, *L. klugii* was recovered as sister to all other species, followed by *Cladodes pauper* (supported by symmetric resampling [73] and absolute Bremer [6] indices). After, *Costalampys joanae* **sp. nov.** was recovered as a sister group to two clades (supported only by absolute Bremer [1]).

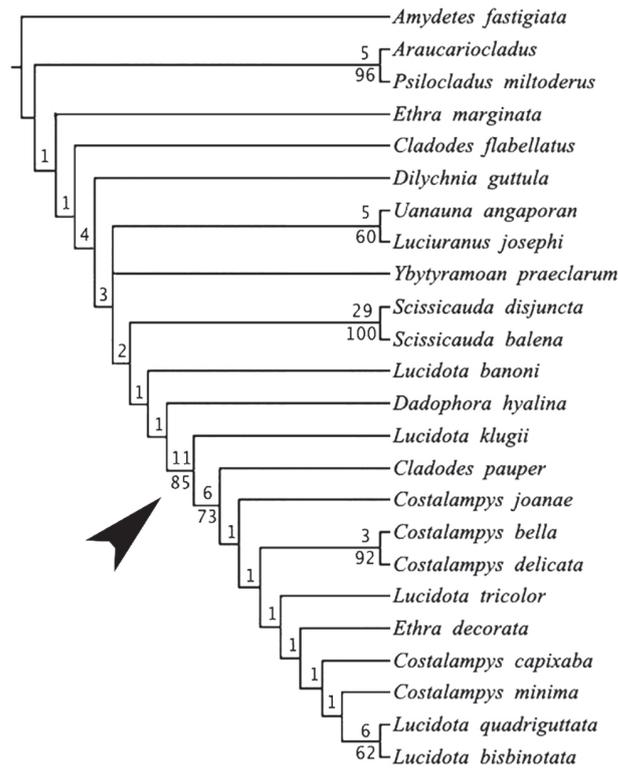
The first clade, composed by *C. bella* **sp. nov.** and *C. delicata* **sp. nov.**, is well supported both by symmetric resampling (92) and absolute Bremer (3). The second is composed by *Lucidota tricolor*, *E. decorata*, *C. capixaba* **sp. nov.**, *C. minima* **sp. nov.** and *L. quadriguttata* plus *L. bisbinotata* (i.e. parenthetical form (*Lucidota tricolor* + (*E. decorata* + (*C. capixaba* **sp. nov.** + (*C. minima* **sp. nov.** + (*L. quadriguttata* + *L. bisbinotata*)))))). This clade and all internal relations are only supported by absolute Bremer (1), with the exception of *L. quadriguttata* + *L. bisbinotata*, which is supported both by Symmetric resampling (62) and absolute Bremer (6).

The parsimony analyses under IW found one most parsimonious tree in each *k* value. The relationship among

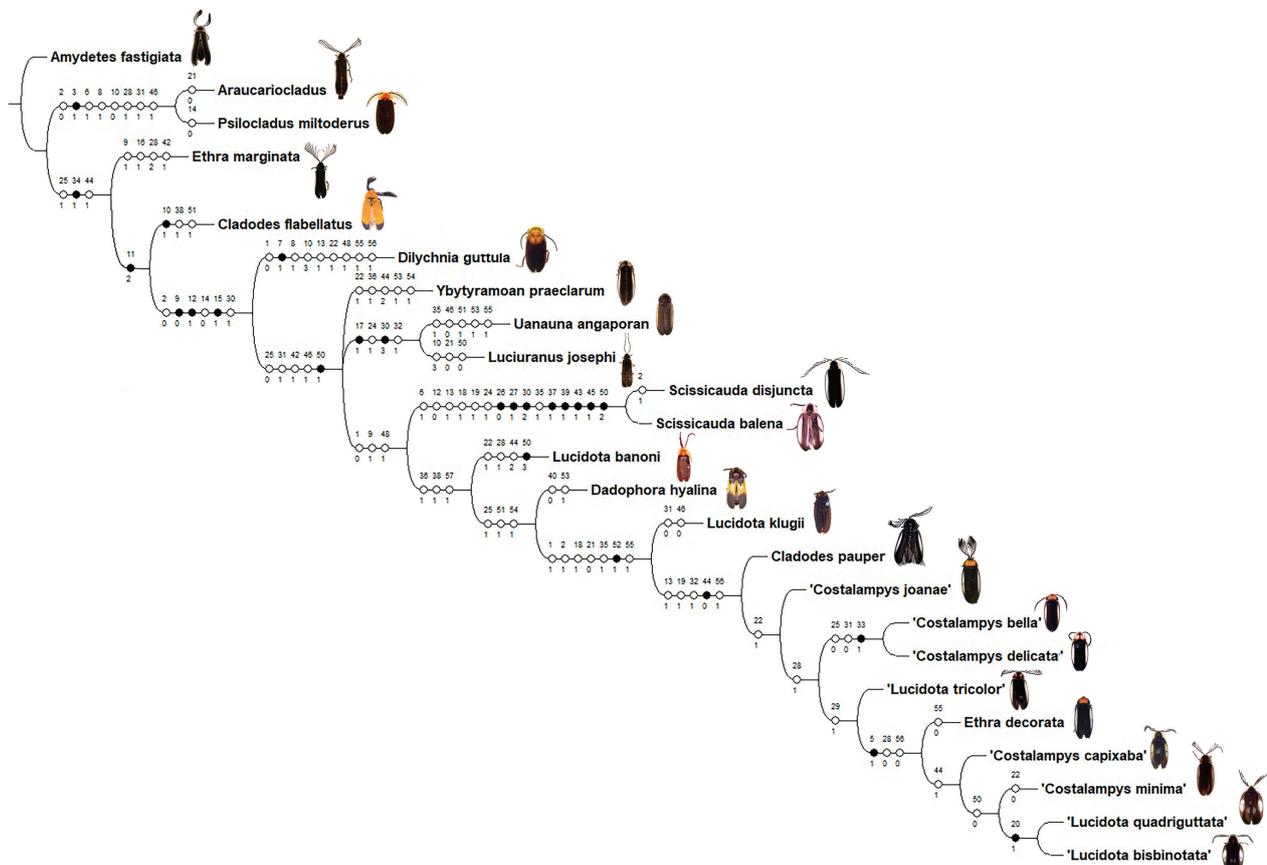
outgroup taxa were consistent across analyses, showing minor differences only on the *k*1 topology. *D. hyalina* was always recovered as sister to *Costalampys* **gen. nov.**, but with low support, and this clade was sister to *L. banoni*. In all analyses *Costalampys* **gen. nov.** was found monophyletic, highly supported by symmetric resampling (>71). The synapomorphies supporting the monophyly of the genus were the same as for the EW analysis in all topologies.

Regarding the ingroup taxa, two topologies were recovered. The first was recovered in the analyses with *k* 1 (but with minor changes on the outgroup relationships), 2, 3 and 5 (Figs 3, 4). In this topology (symmetric resampling [>82]), *L. klugii* was found as the sister group to all other *Costalampys* species, which cluster in two overarching clades. The first clade is composed by (*E. decorata* + (*C. capixaba* **sp. nov.** + (*C. minima* **sp. nov.** + (*L. quadriguttata* + *L. bisbinotata*))))). Two clades within this clade received mild symmetric resampling support: *C. minima* **sp. nov.** + (*L. quadriguttata* + *L. bisbinotata*) [>59]; and *L. quadriguttata* + *L. bisbinotata* (symmetric resampling [>68]).

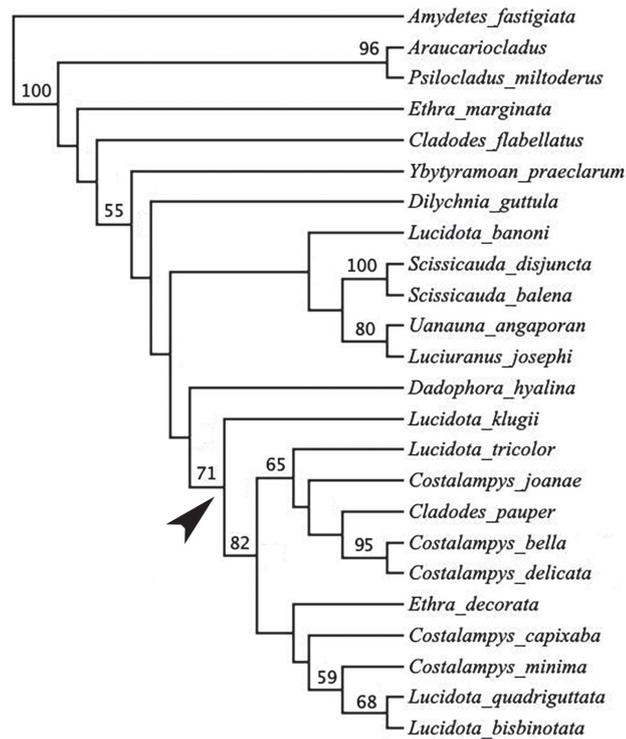
The second clade is composed by *Lucidota tricolor* + (*C. joanae* **sp. nov.** + (*Cladodes pauper* + (*L. tricolor* + (*C. bella* **sp. nov.** + *C. delicata* **sp. nov.**))))), well supported by symmetric resampling [65]. The internal clade of *C. bella* **sp. nov.** and *C. delicata* **sp. nov.** is highly supported in all analyses (by symmetric resampling [>95]).



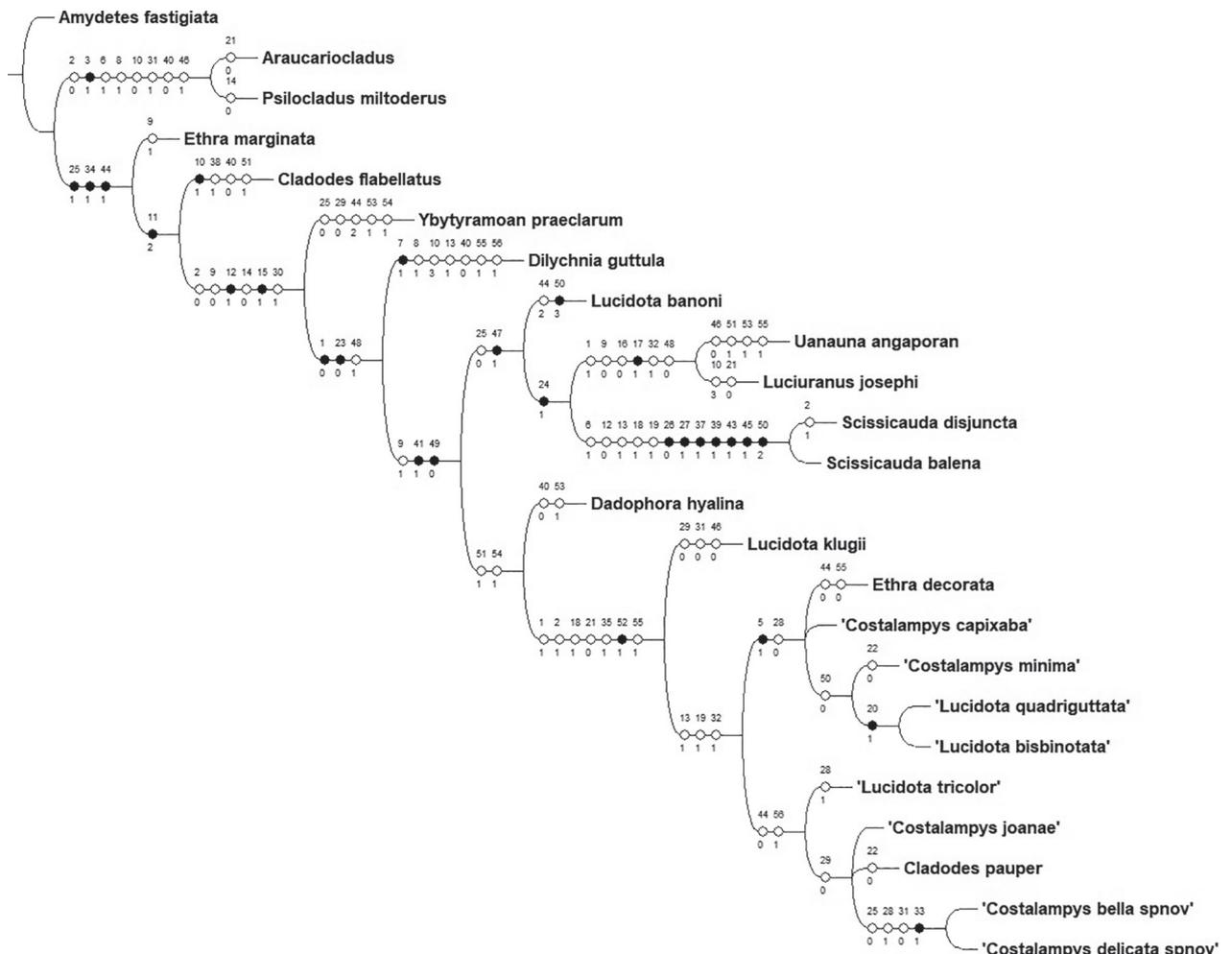
**Figure 1.** Phylogenetic relationship of *Costalampys* gen. nov. found in the consensus of the two most parsimonious trees found on the Equal Weights parsimony analysis. Above and below branches, the absolute Bremer and bootstrap (if >50) supports, respectively. Black arrow points to the node of the *Costalampys* gen. nov. clade.



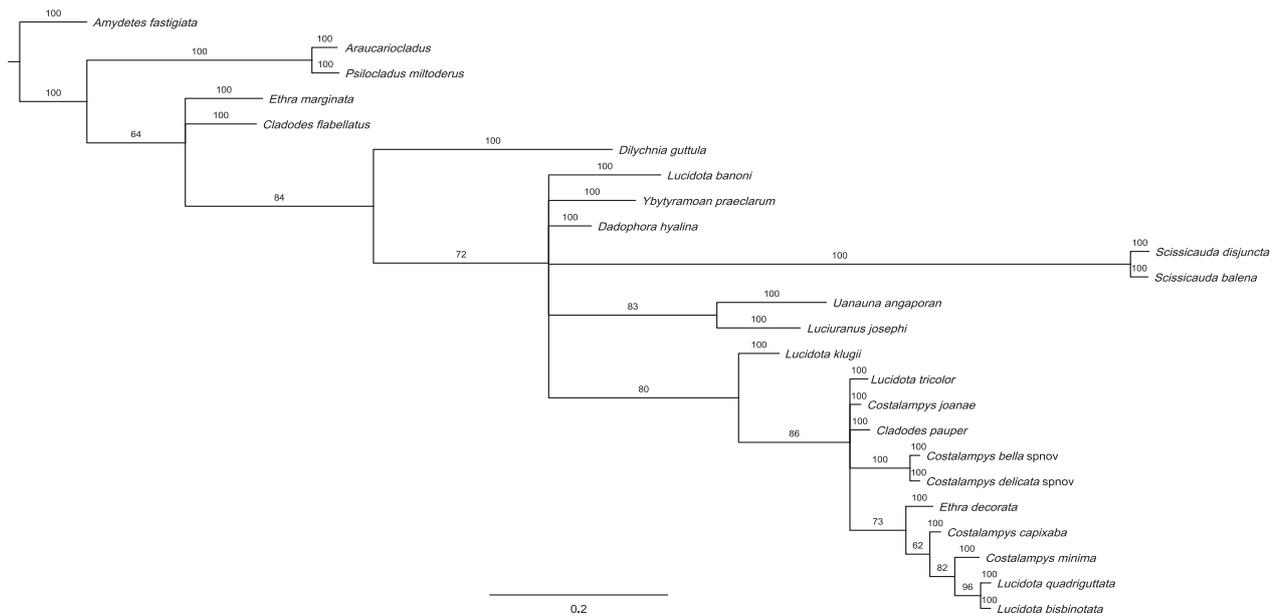
**Figure 2.** Phylogenetic relationship of *Costalampys* gen. nov. found in the consensus of the four most parsimonious trees found on the Equal Weights parsimony analysis. Synapomorphies that are not homoplastic are marked with black circles, while homoplasies are marked with empty circles.



**Figure 3.** Phylogenetic relationship of *Costalampys* gen. nov. found in the IW parsimony analysis (K= 1, 2, 3 and 5). Above the branches are marked the symmetric resampling values (<50).



**Figure 4.** Phylogenetic relationship of *Costalampys* gen. nov. found in the Implied Weights parsimony analysis (K= 1, 2, 3 and 5). Synapomorphies that are not homoplastic are marked with black circles, while homoplastic ones are marked with empty circles.



**Figure 5.** Phylogenetic relationship of *Costalampys* **gen. nov.**, as recovered in the Bayesian analysis. The node posterior probabilities are given at branches.

The second topology was found on the analyses with *k* 10, 15 and is equal to trees found on EW analysis (with a minor change across outgroup taxa in one of EW trees). As both topologies were found the same number of times (three times, with just one with different outgroup topology), we discuss both of them here.

The Bayesian analysis recovered a consensus tree (Fig. 5) with a monophyletic *Costalampys* **gen. nov.** (although with a low posterior probability [80%]) and its inner topology was similar to the presented in the EW parsimony strict consensus. *L. klugii* was found as a sister group to all other *Costalampys* **gen. nov.** species. Then, there is a polytomy with *L. tricolor*; *C. joanae* **sp. nov.**, *Cladodes pauper* and two clades. One formed by (*E. decorata* + (*C. capixaba* **sp. nov.** + (*C. minima* **sp. nov.** + (*L. quadriguttata* + *L. bisbinotata*))))), and another one formed by (*C. bella* **sp. nov.** + *C. delicata* **sp. nov.**). The only highly supported clades are (*L. quadriguttata* + *L. bisbinotata*) (96%) and *C. bella* **sp. nov.** + *C. delicata* **sp. nov.** (100%).

### 3.3. Systematics

#### Lampyridae

#### Lampyrinae

#### *Costalampys* **gen. nov.** Silveira, Roza, Vaz & Mermudes

Figs 6–22

<http://zoobank.org/EA121C9A-5C41-4D42-B238-5213A549EA4F>

**Type species.** *Costalampys delicata* **sp. nov.**, by original designation.

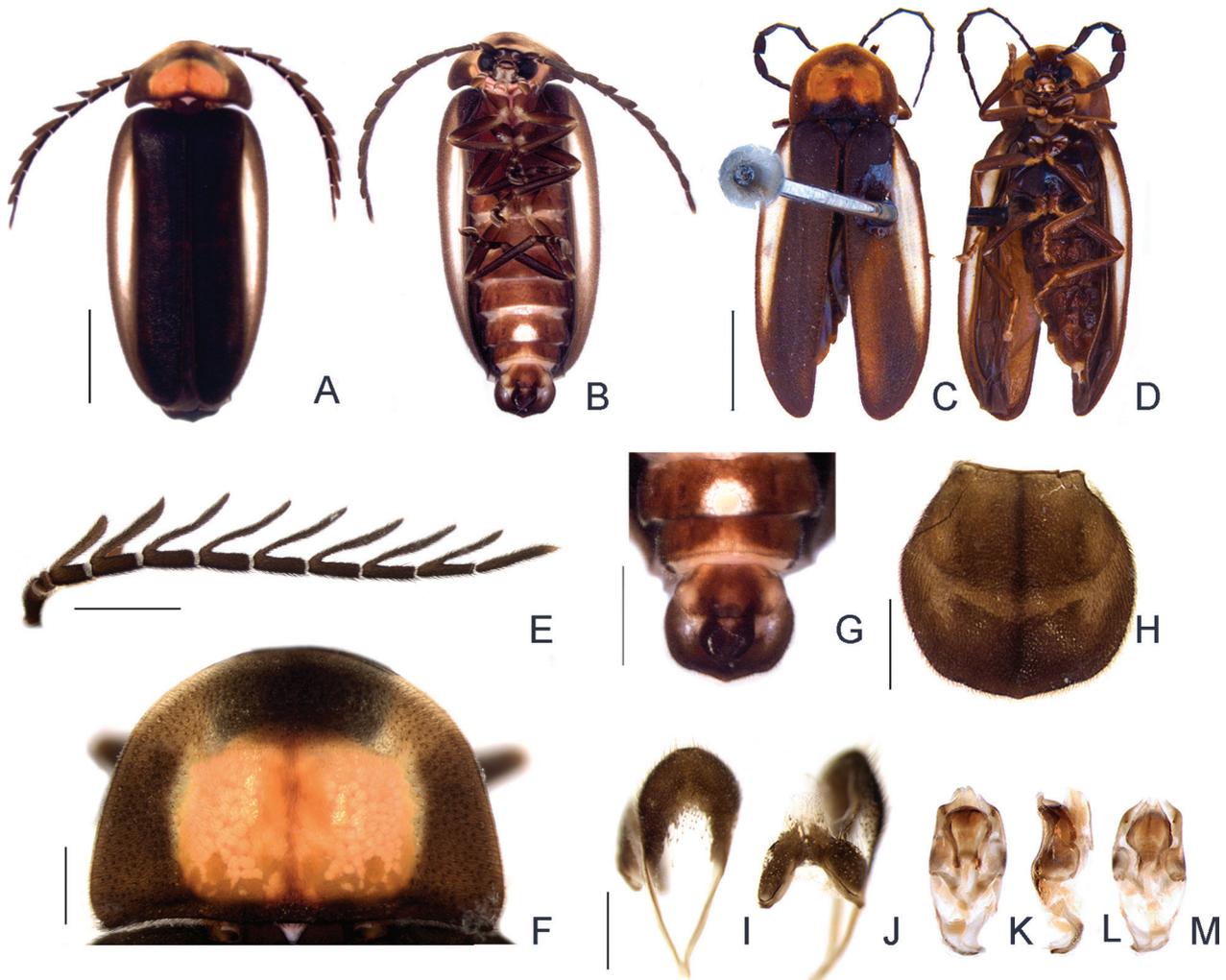
**Etymology.** *Costalampys* is proposed in honor of our dear Professor and friend, the entomologist Dr. Cleide Costa, which greatly influenced our lives and the study of beetles. Gender feminine.

**Diagnosis.** Antenna with 11 antennomeres, covered in decumbent, short and thin bristles (Fig. 11A–B, 12L), antennal socket wide, about half as wide as eye, close-set, reniform, antennifer process conspicuous (Fig. 12A–F). Maxillary palpomere IV fusiform (Fig. 12A–F). Labial palpomere III securiform, with sides divergent posteriorly (Fig. 12A–F). Pronotum roughly semilunar, with a marginal row of wider, deep punctures; disc convex in lateral view; hypomeron with ventral margin sinuose (Fig. 13A–D). Abdominal terga with posterior angles almost right-angled to slightly produced (Fig. 14A). Tibial spurs present. Male with antennomeres III–X cylindrical and basally flabellate, lamellae up to five times longer than antennomere, sternum IX exposed, apically rounded (Fig. 14C). Phallus with dorsal and ventral plates; dorsal plate basally fused to parameres, with a subapical transverse keel, without transverse groove, apically rounded or acute, not indented (Fig. 16I–L). Female with antennae compressed and serrate (Fig. 15C).

**Description.** **Head** (Figs 11A, B, 12A–F). Entirely covered by pronotum (Fig. 11A, B); Head capsule about a 1/3× longer than wide (in dorsal view, Fig. 12A), lateral margins slightly convergent posteriorly (Fig. 12A), slightly longer than tall (in lateral view, Fig. 12C). Frons slightly prominent and swollen (Fig. 12C). Antennal sockets reniform, 1/2 as wide as eye; antennifer process conspicuous (Fig. 12A–D). Vertex somewhat convex, posterior margin bisinuose (Fig. 12A, B). Antenna with 11 antennomeres, scape constricted proximally, pedicel almost as long as wide and constricted medially, antennomeres III–X subequal in length, with decumbent bristles; Frontoclypeus

slightly curved anteriorly (Fig. 12C). Labrum connected to frontoclypeus by membrane; about 3× wider than long, anterior margin straight to somewhat rounded, sclerotized or evanescent (Fig. 12D). Mandibles long and slender, monotonically arcuate, apex acute, internal tooth absent, external margin very sparsely setose at basal 1/2, bristles very thin and bright, barely visible (Fig. 12A–D). Maxilla with cardo well-sclerotized, triangular; stipe oblong in ventral view, internal margin slightly curved, posterior margins truncate, palp with four palpomeres; palpomere III triangular (dorsal view); IV lanceolate, with internal margin covered with minute, dense bristles, 2–3× longer than III (Fig. 12A–D). Labium with mentum well-sclerotized and bristled, completely divided sagittally, forming two plates, each plate elliptic, with inner margin almost straight, outer margin rounded; submentum sclerotized and bristled, subcordiform, elongate; palp with three palpomeres, palpomere III securiform, sides divergent, apical margin slightly curved (Fig. 12A–D). Gular sutures conspicuous; gular bar transverse and strongly emarginate posteriorly, as wide as submentum greater width. Occiput pyriform, about a 1/3× as wide as head posterior width (Fig. 12F). Tentorium long and slender, just slightly curved backwards, projected internally at basal 1/3, projection internally rounded (Fig. 12I–K). **Thorax (Fig. 13A–L).** Pronotum semilunar, posterior angles somewhat acute; disc slightly wider than long in dorsal view, convex, regularly punctured, punctures small and bristled; with a line of distinct deep marginal punctures; pronotal expansions well developed, anterior expansion maximal length almost half as long as disc, posterior expansion slightly sinuose, especially where disc meets lateral expansion, and by median line; slightly wider than humeral distance (Fig. 13A–D); lateral expansions straight in posterior view (Fig. 13C–D). Hypomeron slightly over 2× longer than tall (Fig. 13C). Prosternum about 4× as wide as its major length (Fig. 13B). Proendosternite apically clavate, as long as core prosternum major length (Fig. 12B, D). Mesoscutellum with posterior margin rounded (Fig. 13E). Elytra ellipsoid, 3–4× longer than wide, pubescent, secondary pubescence present, with a line of conspicuous punctures all over sutural and lateral margins (Fig. 11 A, B). Hind wing well-developed, posterior margin sinuose, slightly over 2× wider than long, r3 almost as long as r4, radial cell 2.5× wider than long, almost reaching anterior margin, costal row of setae inconspicuous (Fig. 13L); CuA2 crossvein absent, mp-cu crossvein present; RP+MP1+2 as long as 3/4× r4 length, reaching distal margin, J indistinct (Fig. 13L). Alinotum slightly wider than long, lateral margins slightly convergent posteriorly, posterior margin slightly curved; prescutum extending slightly beyond than half metascutum length (Fig. 13E); rounded area of scutum weakly sclerotized, scutum-prescutal plates sclerotized and extending ridges to alinotum posterior margin; metascutellum glabrous. Mesosternum weakly sclerotized, posterior margin medially acute (Fig. 13F, G). Mesoepimeron connate to metasternum (Fig. 13G). Mesosternum-mesepisternum suture barely visible (Fig. 13G). Mesepisternum-mesoepimeron suture conspicuous (Fig. 13F, G). Metasternum

strongly depressed by mesocoxae, anterior medial keel prominent up to anterior one third, discrimen reaching basal 1/2 of metasternum length, lateral margins divergent posteriorly up to lateral-most part of metacoxa, then convergent posteriorly, posterior margin bisinuose (Fig. 13F, G). Profemur about as long as protibia, meso and metafemora slightly shorter than respective tibiae (Fig. 13I–K). Tibial spurs present (Fig. 13I–K). Tarsomere I about 2× longer than II, II 2× longer than III, III subequal in length to core IV, IV bilobed, lobes reaching two thirds V length, V with claws simple, without inner teeth (Fig. 13I–K). Mesendosternum with two parasagittal projections directed outwards, irregularly alate (Fig. 13I–K). Metendosternum spatulate, roughly rhomboid, diamond-shaped (2× longer than wide, median projection acute anteriorly and posteriorly, with two acute lateral laminae) (Fig. 13H). **Abdomen (Fig. 14A–H).** Tergum I with anterior margin membranous (Fig. 14A), laterotergite membranous, roughly rectangular, with sparse bristles (Fig. 14A); spiracle elliptical, obliquely attached to thorax, more vertically so (Fig. 14A). Terga II–VII with posterior corners almost right-angled to slightly projected, somewhat rounded, posterior margins somewhat rounded (Fig. 14A, B). Sterna II–IX visible (Fig. 14B), VI often bearing a rounded lantern, of variable size. Spiracles dorsal, at sternum anterior th (Fig. 14A, B). Sternum VIII with lateral “larval” lanterns, posterior margins medially sinuose or mucronate (Fig. 14A, B). Pygidium with posterior margin centrally rounded (Fig. 9H) or almost truncate (Fig. 17H), sometimes posteriorly mucronate (Fig. 14C) posterior corners weakly produced or barely present. **Male.** Antennomeres III–X cylindrical and flabellate, with lamellae long and slender, of variable length, apical antennomere at least slightly longer than subapical one (Fig. 12L). Syntergite consisting of paired lateral plates convergent posteriorly (putatively tergite IX or paraprotect), median transversal suture absent, anterior margin mildly to strongly convergent (Fig. 14D, E); not posteriorly fused to sternum IX. Sternum IX roughly symmetric, posterior margin rounded. Phallus (Fig. 14F–H) with a dorsal and a ventral plate; dorsal plate basally fused to parameres, without a transverse groove apically rounded or acute, not indented), curved dorsally or straight (in lateral view), with a subapical transversal keel; ventral plate elongate, with sides straight. Paramere slightly longer than dorsal plate, with a ventral subapical tooth. **Female (Fig. 15D–I).** Antenna compressed and serrate, with apical corners almost right-angled or projected and acute (Fig. 15A–C). Sternum VIII as long as wide, spiculum ventrale long and slender, 3/4× as long as sternum (Fig. 15D, E). Internal genitalia with a slightly sclerotized, elongate spermatophore-digesting gland, almost twice as long and slightly wider than the spermatheca, which is membranous and globose (Fig. 15F–I). Ovipositor short, valvifers free and slightly curved, slightly over 2× longer than coxite; proximal plates sclerotized, fused medially in a somewhat C-shaped structure (with sides straight and convergent apically, medially straight anteriorly, posterior margin slightly curved), coxites apically free (i.e. not fused), coxital baculi well-developed, sclerotized,



**Figure 6.** *Costalampys bella* sp. nov. **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Male terminal segments, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, Ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E; G); Scale bar: 0.5 mm (F; H–M).

apically convergent; styli as long as  $1/4\times$  coxite length, well-sclerotized; proctiger well-developed, formed by two elongate plates, convergent apically, laterotergite rudimentary, subquadrate in ventral view, weakly sclerotized, barely attached to valvifers (Fig. 15 F,G).

**Biology.** Five species of *Costalampys* gen. nov. have been observed active during daytime, namely *C. decorata* (Olivier, 1888) comb. nov., *C. delicata* sp. nov., *C. joanae* sp. nov., *C. pauper* (Olivier, 1899) comb. nov., and *C. tricolor* (Gorham, 1880) comb. nov. Males and females were observed perching on leaves of understory bushes and growing trees (as in Fig. 10). Males will sustain the antennae erect and pointed out towards the wind current, very similar to other firefly taxa with flabellate antennae, like many *Ethra* Laporte, 1833, *Amydetes* Illiger, 1807 and *Cladodes* species (L. Silveira pers. ob.). Given the similarity in overall morphology, it is likely that other *Costalampys* gen. nov. species in the genus are also diurnal. Where observed, lanterns are functional, and individuals will glow if disturbed. Other roles of bioluminescence (e.g., in courtship) are unknown.

**Distribution.** In the Atlantic rainforest, with occasional records in adjacent Caatinga patches.

**Remarks.** *Costalampys* gen. nov. superficially resembles the neotropical genera *Psilocladus* (type genus of Psilocladinae), *Amydetes* (type genus of Amydetinae), and *Ethra* (Lampyrinae) due to the branched antennae. *Costalampys* gen. nov. was found closer to lampyrine taxa in all our analyses, and never clustered with *Amydetes* (Amydetinae) or *Psilocladus* (Psilocladinae). Therefore, *Costalampys* gen. nov. is here tentatively placed as Lampyrinae, notwithstanding the lack of definitive diagnostic characters for the Lampyrinae (cf. Jeng 2008, Martin et al. 2019). While the tribal classification within Lampyrinae remains unsteady (Martin et al. 2019), we place *Costalampys* gen. nov. as *incertae sedis* within the subfamily.

Males of *Costalampys* gen. nov. especially resemble those of *Ethra* (Lampyrinae), and specimens we now recognise as *Costalampys* were often found in collections identified as *Ethra* (L. Silveira, unpublished results). However, *Costalampys* gen. nov. can be distinguished

from *Ethra* by: antennal lamellae (Fig. 12L) basally inserted (apically inserted in *Ethra*); labial palpi (Fig. 12A–F) with sides apically divergent (parallel-sided in *Ethra*); and pygidium with sides rounded (Fig. 14C) (straight in *Ethra*). Females of all *Ethra* spp. remain unknown.

*Costalampys* **gen. nov.** shares several similarities with *Scissicauda* McDermott 1964, such as: antennal sockets large and close-set; maxillary palp with palpomere IV large and fusiform, submentum cordiform, pronotum semilunar, proendosternite apically clavate, elytral outline ellipsoid; metaendosternite elongate, rhomboid; abdominal sternum II bearing paired vitreous spots medially; aedeagus with phallus bearing dorsal and ventral plates, dorsal plate enlarged apically, projecting ventrally and partially embracing the internal sac. It is also noteworthy that the genotypic *S. disjuncta* also has basally flabellate antennae, although its bristles are long and erect (Silveira et al. 2016b). However, *Costalampys* differs from *Scissicauda* by: pronotal disc strongly convex in lateral view (almost flat in *Scissicauda*); hypomeron strongly sinuose (mildly sinuose in *Scissicauda*); sternum VIII as long as VII, posterior margin medially mucronate or slightly sinuose (at least a 1/5× longer, and posterior margin strongly sinuose in *Scissicauda*); sternum IX visible (concealed in *Scissicauda*); male pygidium rounded posteriorly, sometimes mucronate (with sides divergent and posterior margin strongly indented in *Scissicauda*); phallus with dorsal plate without a transverse medial groove (present in *Scissicauda*); internal female genitalia with spermatheca (absent in *Scissicauda* [based on the type species *S. disjuncta*]), ovipositor in *Scissicauda* [based on the type species *S. disjuncta*]).

### *Costalampys bella* sp. nov. Silveira, Roza, Vaz & Mermudes

Figs 6A–M, 22

<http://zoobank.org/A000A6C7-7902-4A1B-ADE8-E3F33B-97BAC2>

**Diagnostic description.** Overall brown. Pronotal disc of variable color, from having paired pink spots to entirely pink (Fig. 6A, C, F), pronotal expansions dark brown, often brighter at anterior corners. Elytron (Fig. 6A, C) dark brown with a pale-yellow longitudinal stripe as long as about 4/5× elytron length. Legs dark brown, except for trochanters, which are light brown. Sternum VIII with lateral vitreous spots. Pygidium brown (Fig. 6H).

Pronotum (Fig. 6F) with sides almost straight, mildly divergent posteriorly. **Male.** Total length = 8.4–8.8 mm (aver. 8.6 mm); Pronotal length = 1.8 mm; Pronotal width = 2.6–2.7 mm (aver. 2.65 mm); Elytral length = 6.0–6.6 mm (aver. 6.3 mm); Elytral width = 1.7–1.8 mm (aver. 1.75 mm). Antennomere III (Fig. 6E) with lamella about 1.5× longer than core antennomere. Sternum VI (Fig. 6B, G) with a small lantern, occupying the medial 1/6 of sternum length, not reaching its anterior margin. Sternum VIII with posterior margin medially sinuose. Pygidium (Fig. 6H) with sides rounded, posterior corners

barely visible, posterior margin medially mucronate. Syntergite (Fig. 6I) boomerang-shaped (with anterior margin strongly curved). Phallus with dorsal plate bent dorsally (lateral view), with sides rounded at apical half, slightly convergent apically. Paramere (Fig. 6K–M) apex curved ventrally, ventral projection (lateral view) well developed, almost right-angled. **Female** (Fig. 6C, D). Total length = 7.6 mm; Pronotal length = 1.5 mm; Pronotal width = 2.2 mm; Elytral length = 6.3 mm; Elytral width = 1.6 mm. Antennomeres III–X with apical corners almost right-angled, not projected, sterna VI and VII lacking lanterns.

**Remarks.** *Costalampys bella* sp. nov. (Fig. 6A, B) is similar to *C. delicata* sp. nov. (Fig. 11A, B) *C. joanae* sp. nov. (Fig. 16A, B), *C. tricolor* (Gorham, 1880) **comb. nov.** (Fig. 21A, B), and *C. decorata* (Olivier, 1888) **comb. nov.** (Fig. 9A, B), in the dorsal color pattern (overall brown or dark brown, with pronotal disc broadly pink, and with an elongate pale-yellow spot on elytron). *C. bella* sp. nov. is unique among the aforementioned species by the sides of pronotum almost straight in both sexes (rounded in the others), the lack of lanterns in females (present in the others), and antennomere III lamella 1.5 longer than core antennomere in males (as long as [*C. delicata* sp. nov.], or 2× [*C. tricolor* (Gorham, 1880) **comb. nov.**], 2.5× [*C. decorata* (Olivier, 1888) **comb. nov.**] or 4× longer [*C. joanae* sp. nov.] than core antennomere in the others). *Costalampys bella* sp. nov. is most similar to *C. tricolor* (Gorham, 1880) **comb. nov.**, but can be further distinguished from it by the male pygidium with posterior margin mucronate (rounded in *C. tricolor* (Gorham, 1880) **comb. nov.**).

**Etymology.** *Bella* is a Latin adjective that means “beautiful”.

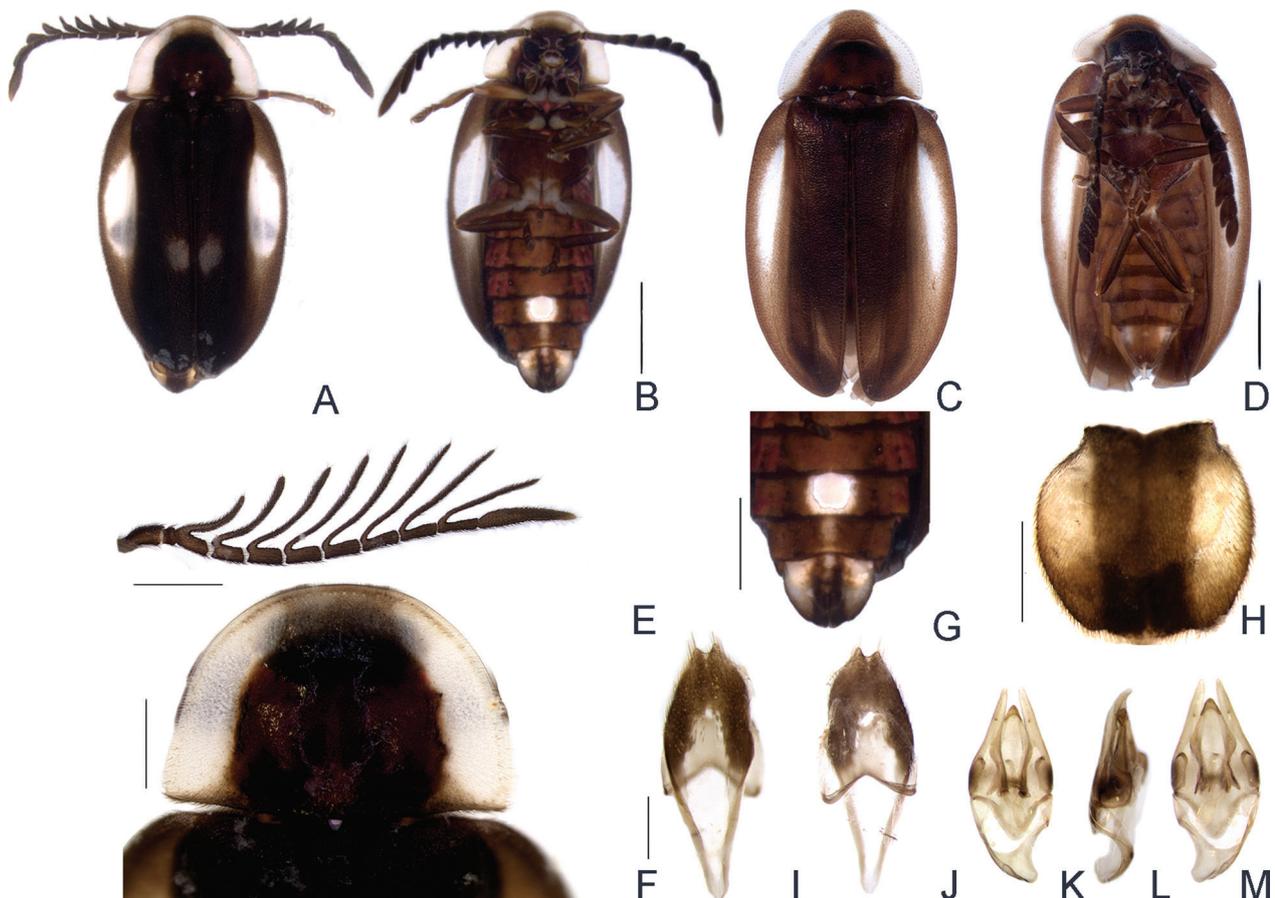
**Types.** *Holotype:* BRAZIL: Rio de Janeiro: 1 ♂, Itatiaia, Itatiaia National Park, Malaise Pensario P2 (22°25'59.6"S, 44°37'39.7"W, 1280 m), 1 ♂, I.2014, R. Monteiro col. (DZ RJ). *Paratype:* 2 ♂, same label as holotype, but XII.2014 (DZ RJ). BRAZIL: São Paulo: 1 ♀, São Luiz do Paraitinga, Serra do Mar State Park, Núcleo Sta. Virgínia, Malaise trap, Ponto 1, 23°19'27.1"S, 45°05'38.4"W, 22.XI.2010, N.W. Perieto & eq. Col. (DZ RJ).

### *Costalampys bisbinotata* (Pic, 1943) **comb. nov.**

Figs 7A–M, 22

*Platylampis bisbinotata* Pic, 1943:2 (desc.); McDermott, 1966:74 (cat.).

**Diagnostic description.** Overall dark brown. Pronotal disc (Fig. 7F) dark brown, lacking vittae, pronotal expansions variable, from having anterior small vittae to almost entirely pale yellow, except by posterior margin, which is outlined in brown, blending with the dark brown disc color. Elytron (Fig. 7A, C) dark brown or brown, with a pale-yellow longitudinal stripe about 1/2 as long as elytra, usually with a roundish pale yellow spot at posterior



**Figure 7.** *Costalampys bisbinotata* (Pic) **comb. nov.** **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Male terminal segments, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, Ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E; G); Scale bar: 0.5 mm (F; H–M).

3/4 of elytral length, reaching inner suture, as wide as about 1/3× elytral width. Legs (Fig. 7B, D) dark brown, except for trochanters and, sometimes, metacoxa, which are light brown. Sternum VIII with lateral vitreous spots. Pygidium (Fig. 7H) with medial 1/5 brown, with lateral pale-yellow stripes in males, entirely brown in females.

Pronotum (Fig. 7F) with sides rounded, divergent posteriorly. **Male.** Total length = 7.8 mm; Pronotal length = 1.9 mm; Pronotal width = 2.8 mm; Elytral length = 6.2; Elytral width = 2.0 mm. Antennomere III (Fig. 7E) with lamella about 2× longer than core antennomere. Sternum VI (Fig. 7G) with lantern of moderate size, occupying the medial 1.4 of the sternum, reaching its anterior margin. Sternum VIII with posterior margin bisinuose. Pygidium (Fig. 7H) with sides rounded, posterior corners weakly developed, posterior margin variably rounded to almost straight. Syntergite (Fig. 7I, J) with anterior margin mildly curved. Phallus (Fig. 7K–M) with dorsal plate almost straight in lateral view, with sides straight and acuminate at apical half. Paramere apex curved ventrally, ventral projection (lateral view) inconspicuous. **Female.** Total length = 8.0–8.7 mm (aver. 8.35 mm); Pronotal length = 1.8–2.1 mm (aver. 1.95 mm); Pronotal width = 2.6–3.0 mm (aver. 2.8 mm); Elytral length = 6.3–6.7 mm (aver. 6.5 mm); Elytral width = 1.9–2.0 mm (aver. 1.95 mm).

Antennomeres III–X with apical corners projected, pointed, sterna VI and VII lacking lanterns.

**Remarks.** *Platylampis* Motschulsky, 1853 is currently a consortium of morphologically very disparate species, with no clear-cut definition to accommodate all its species (cf. Silveira et al. 2019). We did not include the type species *P. latiuscula* Motschulsky, 1853 in our phylogenetic analyses because we had no permission to dissect any specimen of that species – internal traits constitute an important part of our character list (see section 3.1). However, we did study the external morphology of *P. latiuscula* Motschulsky, 1853, and were able to contrast its morphology with that of *P. bisbinotata* Pic, 1943. It becomes evident that the latter is more similar to *Costalampys* spp. than to *P. latiuscula* Motschulsky, 1853. Specifically, *P. latiuscula* Motschulsky, 1853 males have serrate antennae, terga VI and VII with posterior corners well-developed, projected posteriorly and pointed, sternum VII with posterior margin medially notched, sternum IX with posterior margin strongly acuminate, pygidium with well-developed posterior corners, and with central portion acuminate. However, *C. bisbinotata* (Pic, 1943) **comb. nov.** males have flabellate antennae with basally branching lamellae, terga VI and VII with pos-

terior corners just slightly produced, sternum VII with posterior margin medially straight, sternum IX with posterior margin rounded, pygidium with weakly developed posterior corners, and with central portion rounded – all of which are defining characters of *Costalampys* **gen. nov.** (see above). Along with our phylogenetic analyses, these observations support the transfer of *P. bisbinotata* Pic, 1943 to *Costalampys* **gen. nov.**, therefore *C. bisbinotata* (Pic, 1943). Pic (1943) has not given an etymology for *P. bisbinotata*, but it could mean “with four spots” (i.e. two times double spots) in Latin, referring to its color pattern.

*Costalampys bisbinotata* (Pic, 1943) **comb. nov.** is similar to *C. capixaba* **sp. nov.** and *C. quadriguttata* (Gorham, 1880) **comb. nov.** in the pronotal color pattern (overall dark brown; pronotal disc dark brown, lacking vittae, pronotal expansions somewhat translucent anteriorly, almost entirely pale yellow, except by posterior margin, which is outlined in brown, blending with the dark brown disc color). It differs from both species by the lack of lanterns in females (present on sternum VI in the others). *Costalampys bisbinotata* (Pic, 1943) **comb. nov.** differs from *C. capixaba* **sp. nov.** by the shorter elytral pale-yellow stripe in both sexes (about 1/2 as long as elytra), and pygidium with lateral translucent spots in males (elytral stripe as long as about 4/5× elytral length, lanterns present in females, and male pygidium entirely brown in *C. capixaba* **sp. nov.**). *Costalampys bisbinotata* (Pic, 1943) **comb. nov.** differs from *C. quadriguttata* (Gorham, 1880) **comb. nov.** by the sternum VIII and pygidium medially dark brown in both sexes (entirely translucent in *C. quadriguttata* (Gorham, 1880) **comb. nov.**).

*Costalampys bisbinotata* (Pic, 1943) **comb. nov.** was described from Brazil (Pic, 1943), and the syntype examined was collected in Brazilian state of Bahia (without further details). Here we provide for the first time detailed information on the temporal and geographic occurrence of the species.

**Types.** *Syntype*: BRAZIL: Bahia: 1 female (MNHN, col. M. Pic).

**Material examined.** BRAZIL: Bahia: 1♂, Camacan, R.P.P.N. Serra Bonita, Alojamento, 15°23'16"S, 39°33'58.6"W, 757 m, Varredura, 28–29.II.2012, D. Takiya col. (DZRJ); Uruçuca: 1♀, P.E. Serra do Conduru, Mirante 2, Malaise trap, 11–13.III.2015, L. Silveira, Khattar & Vaz col. (DZRJ); Serra do Conduru, Parque Estadual Serra do Conduru, Malaise PESC 2, 1♂, 09–14.III.2015, L. F. Silveira et al. col. (DZRJ).

### *Costalampys capixaba* **sp. nov.** Silveira, Roza, Vaz & Mermudes

Figs 8A–M, 22

<http://zoobank.org/C639496F-3DA3-4F39-A5AA-DF-D2AE5B01DD>

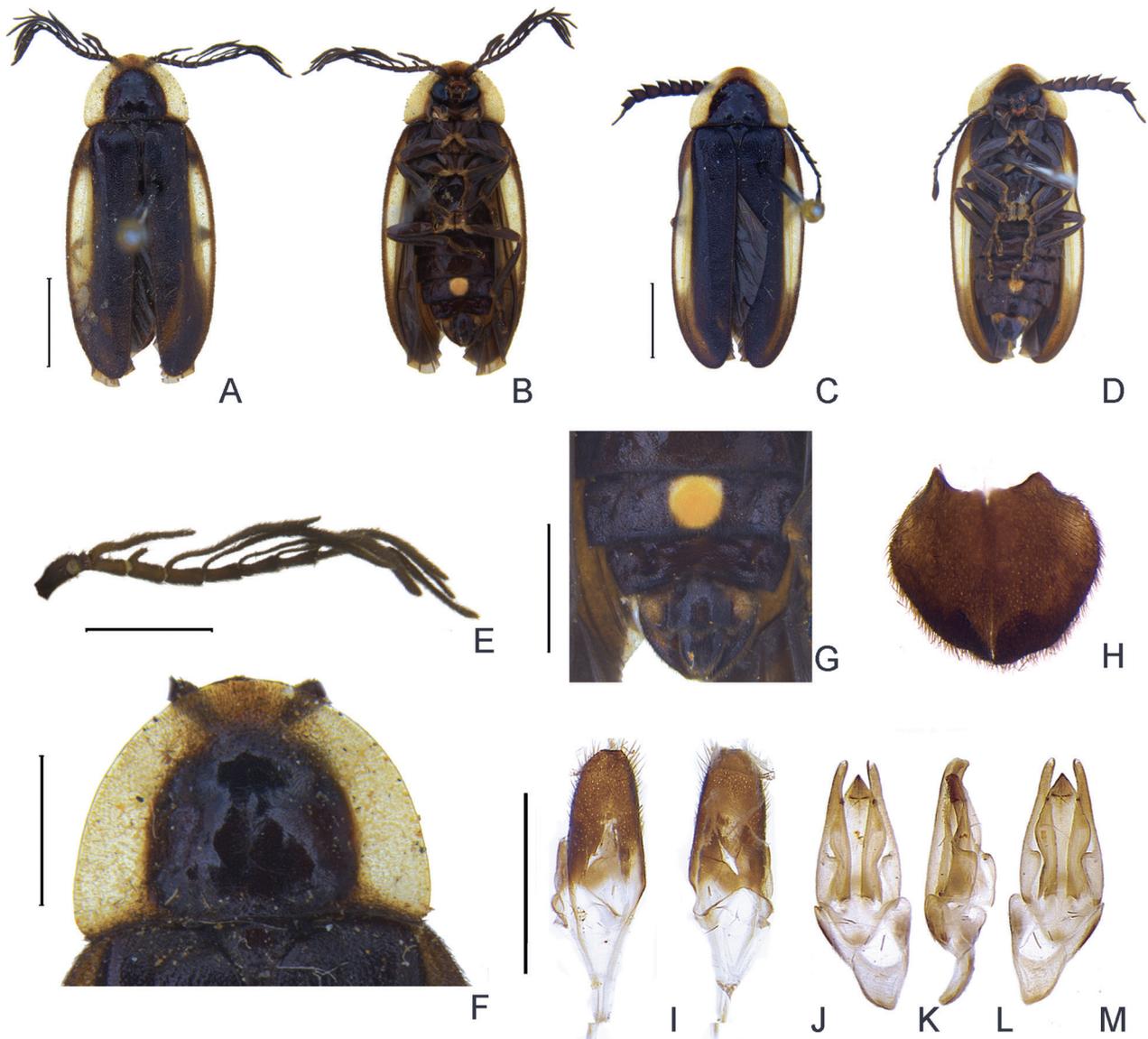
**Diagnostic description.** Overall dark brown. Pronotal disc (Fig. 8F) dark brown, lacking vittae, pronotal expansions almost entirely pale yellow dark brown, except by

posterior margin, which is outlined in brown, blending with the dark brown disc color. Elytron (Fig. 8A, C) dark brown or brown, with a pale-yellow longitudinal stripe about as long as 3/5× elytral length. Legs (Fig. 8B–D) dark brown, except for trochanters, which are light brown. Sternum VIII (Fig. 8G) with lateral vitreous spots. Pygidium (Fig. 8H) entirely brown.

Pronotum (Fig. 8F) with sides rounded, divergent posteriorly. **Male.** Total length = 7.3–8.1 mm (aver. 7.7 mm); Pronotal length = 1.6–1.8 mm (aver. 1.7 mm); Pronotal width = 2.4–2.6 mm (aver. 2.5 mm); Elytral length = 5.8–6.0 mm (aver. 5.9 mm); Elytral width = 1.5–1.6 mm (aver. 1.55 mm). Antennomere III (Fig. 8E) with lamella almost 3× longer than core antennomere. Sternum VI (Fig. 8B, G) with a lantern of moderate size, occupying the medial 1.4 of the sternum, reaching its anterior margin. Sternum VIII (Fig. 8G) with posterior margin bisinuose. Pygidium (Fig. 8H) with sides rounded, posterior corners barely visible, posterior margin rounded. Syntergite (Fig. 8I, J) with anterior margin mildly curved. Phallus (Fig. 8K–M) with dorsal plate almost straight in lateral view, with sides straight and acuminate at apical half. Paramere apex curved ventrally, ventral projection (lateral view) inconspicuous. **Female** (Fig. 8C, D). Total length = 8.3–8.7 mm (aver. 8.5 mm); Pronotal length = 1.6–1.8 mm (aver. 1.7 mm); Pronotal width = 2.5–2.7 mm (aver. 2.6 mm); Elytral length = 6.2–6.6 mm (aver. 6.5 mm); Elytral width = 1.9–2.0 mm (aver. 1.95 mm). Antennomeres III–X with apical corners projected, pointed, Sternum VI (Fig. 8D) with a small lantern, occupying the medial 1/6 of the sternum, reaching its anterior margin.

**Remarks.** *Costalampys capixaba* **sp. nov.** is similar to *C. bisbinotata* (Pic, 1943) **comb. nov.** and *C. quadriguttata* (Gorham, 1880) **comb. nov.** in the pronotal color pattern (overall dark brown; pronotal disc dark brown, lacking vittae, pronotal expansions somewhat translucent anteriorly, almost entirely pale yellow, except by posterior margin, which is outlined in brown, blending with the dark brown disc color), but can be distinguished from both species by the more elongate elytral pale yellow stripe (as long as 4/5× elytral length in *C. capixaba* **sp. nov.**, versus 1/2 as long, in the other mentioned species), and the pygidium entirely brown in males (at least partially translucent in the others). Other traits that distinguish *C. capixaba* **sp. nov.** from *C. quadriguttata* (Gorham, 1880) **comb. nov.** are the elytron without a roundish pale-yellow spot at posterior 3/4, reaching inner suture (present, and about as wide as a 1/3 of elytra in *C. quadriguttata* (Gorham, 1880) **comb. nov.**) and the sternum VII entirely dark brown in both sexes (with a central translucent spot in *C. quadriguttata* (Gorham, 1880) **comb. nov.**). Finally, *C. capixaba* **sp. nov.** can also be discriminated from *C. bisbinotata* (Pic, 1943) **comb. nov.** by the presence of a rounded lantern on sternum VI in females (absent in *C. bisbinotata* (Pic, 1943)).

**Etymology.** *Capixaba* is the Portuguese gentile name for the Brazilian state of Espírito Santo, where the species occurs. Noun in apposition.



**Figure 8.** *Costalampys capixaba* sp. nov. **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Male terminal segments, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, Ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E–M).

**Types.** *Holotype*: BRAZIL: Espírito Santo: 1♂, Santa Teresa, 5.XI.1964, Claudionor Elias col. (DZUP). *Paratype*: 1♀, same data as holotype, except 5.XI.1964 (DZUP); 1♀, same data as holotype, except 26.X.1964 (DZUP); 1♂, same data as holotype, except 29.X.1966, C.T. & C. Elias col. (DZUP); 1♂, same data as holotype, except 16.XI.1967, C.T. & C. Elias col. (DZUP).

***Costalampys decorata* (Olivier, 1888) comb. nov.**

Figs 9A–M, 22

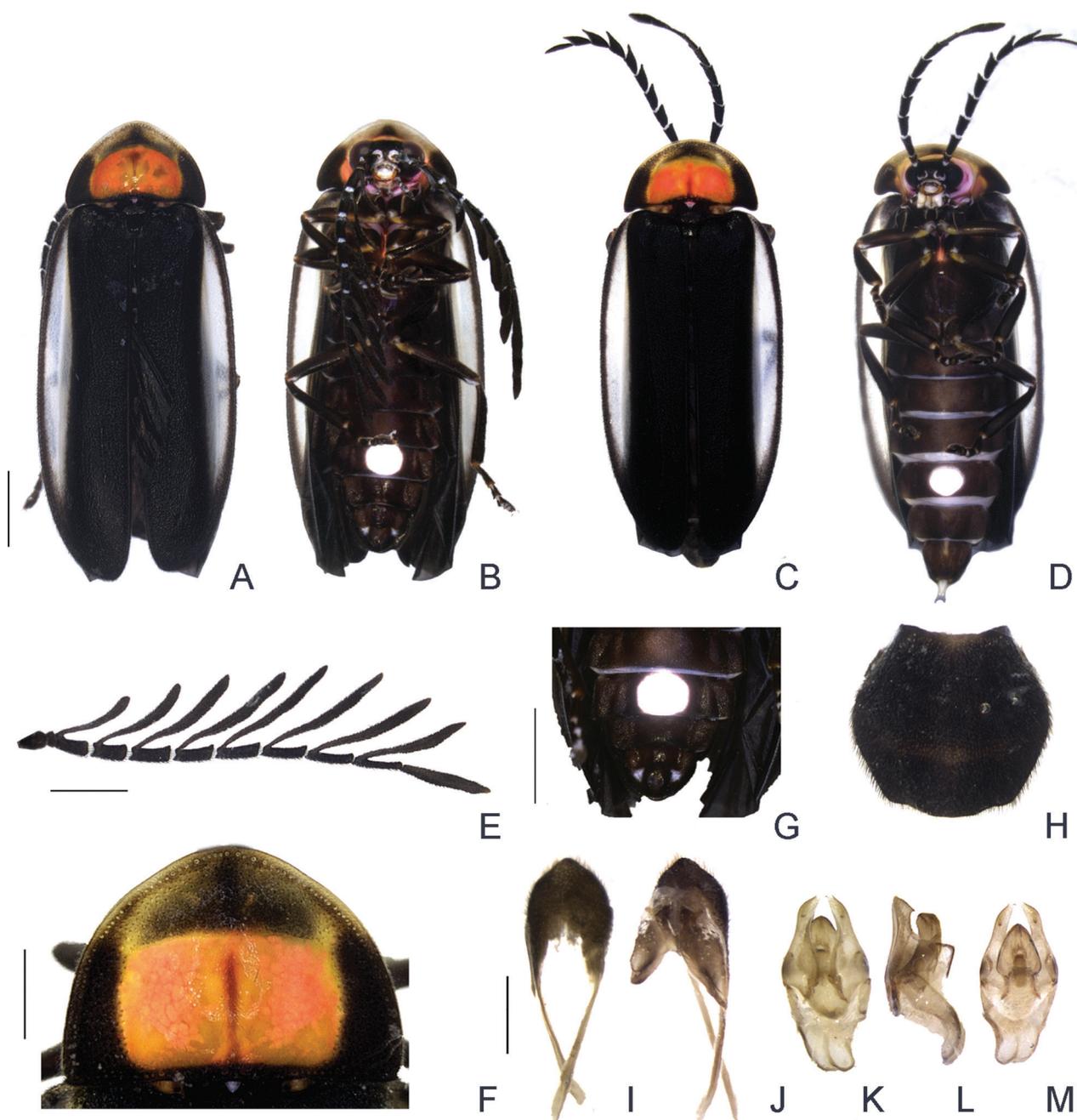
*Ethra decorata* Olivier, 1888: 40 (desc.); Blackwelder 1945:353 (cat.); McDermott 1966:86 (cat.).

*Ethra decorata* var. *circumscripta* Olivier, 1909:223 (desc.); Blackwelder 1945:353 (cat.); McDermott 1966:86 (cat.).

*Lucidota oculata diversicollis* Pic, 1938:27 (desc.); Blackwelder 1945:354 (cat.); McDermott 1966:67 (cat.).

**Diagnostic description.** Overall black. Pronotal disc (Figs 9F, H, 10) entirely pink or orangish, sometimes as two almost contiguous spots occupying most disc, pronotal expansions from entirely black to entirely testaceous, mildly translucent anteriorly. Elytron (Fig. 9A, C) black, with a pale-yellow longitudinal stripe about  $4/5 \times$  as long as elytra. Legs (Fig. 9B, D) dark brown to black, except for trochanters, which are brown. Sternum VIII entirely dark brown, without lateral vitreous spots. Pygidium (Fig. 9H) entirely dark brown.

Pronotum (Fig. 9F) with sides rounded, divergent posteriorly. **Male.** Total length = 12.4–12.9 mm (aver. 12.65 mm); Pronotal length = 2.2–2.6 mm (aver. 2.4 mm); Pronotal width = 3.5–3.8 mm (aver. 3.65 mm); Elytral length = 9.5–10.3 mm (aver. 9.9 mm); Elytral width = 2.1–2.5 mm (aver. 2.3 mm). Antennomere III (Fig. 9E) with lamella about  $2.5 \times$  longer than core antennomere. Sternum VI (Fig. 9B) with a lantern of moderate size,



**Figure 9.** *Costalampys decorata* (Olivier) **comb. nov.** **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Male terminal segments, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, Ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D; G–H); Scale bar: 0.5 mm (I–M).

occupying the medial 1.3 of the sternum, reaching its anterior margin. Sternum VIII (Fig. 9G) with posterior margin bisinuose. Pygidium with sides rounded, posterior corners weakly developed, posterior margin rounded to almost straight. Syntergite (Fig. 9I, J) boomerang-shaped (with anterior margin strongly curved). Phallus (Fig. 9K–M) with dorsal plate curved dorsally in lateral view, with sides straight and acuminate at apical half. Paramere apex almost straight, ventral projection (lateral view) well-developed, almost right-angled. **Female** (Fig. 9C, D). Total length = 12.9–13.3 mm (aver. 13.1 mm); Pronotal length = 2.3–2.7 mm (aver. 2.5 mm); Pronotal width = 3.6–3.9 mm (aver. 3.75 mm); Elytral length = 9.0–9.6 mm (aver.

9.3 mm); Elytral width = 2.4–2.7 mm (aver. 2.55 mm). Antennomeres III–X with apical corners projected, pointed, Sternum VI (Fig. 9D) with moderate lanterns, occupying the medial 1.3 of the sternum, almost reaching its anterior margin.

**Remarks.** Olivier (1888) described *Ethra decorata* based on specimens from Brazil (Petrópolis, Rio de Janeiro State), and mentioned that the specimens had testaceous pronotal expansions. Later on, Olivier (1909) described a variant of *Ethra decorata* with darker pronotal expansions, which he named “var. *Circumcincta*”, but didn’t mention any type locality – the holotype examined is

from Brazil, Minas Gerais. The latter variant must be deemed as a subspecies according to ICZN article ICZN Art. 45.6.4, therefore *Ethra decorata circumcincta* Olivier, 1909 (according to Art. 5.2). After analyzing a larger series of *C. decorata* (Olivier, 1888) **comb. nov.** (including type material of both subspecies), we found out that some individuals in the same population had pronotal expansions of variable color – some were testaceous, and others were dark brown to varying degrees. Therefore, we synonymize here both subspecies, *Ethra decorata decorata* Olivier, 1888, and *Ethra decorata circumcincta* Olivier, 1909, the former having priority over time.

Pic (1938) published a study about mimicry across firefly species from Brazil, including some new taxa. He noted that a new variety (i.e. a subspecies, see above), *Lucidota oculata diversicollis* Pic, 1938 was very similar to *Ethra decorata* Olivier, 1888, but with different antennae, among other traits. The holotype of *Lucidota oculata diversicollis* Pic, 1938 is a female specimen, conspecific of *Ethra decorata*. Hence, after the study of the type material, we synonymize *Lucidota oculata diversicollis* Pic, 1938 with *Ethra decorata*, which has priority over time. After our phylogenetic analyses (see section 3.2), we transfer *Ethra decorata* to *Costalampys* **gen. nov.**, therefore *Costalampys decorata* (Olivier, 1888) **comb. nov.**

In the same aforementioned work on mimicry, Pic (1938) described a second subspecies of *E. decorata*, which he named *Ethra decorata schneideri* Pic, 1938. After the study of the holotype, we synonymize it with *Lucidota tricolor* Gorham, 1880, which we transfer to *Costalampys* **gen. nov.** (see below) in this paper.

Olivier (1888) does not give an explicit etymology for *decorata*, but we assume it was based on the Latin word for “decorated” or “adorned”.

*Costalampys decorata* (Olivier, 1888) **comb. nov.** is similar to *C. delicata* **sp. nov.**, *C. joanae* **sp. nov.**, *C. tricolor* (Gorham, 1880) **comb. nov.**, and *C. bella* **sp. nov.**, in the dorsal color pattern (overall brown or dark brown, with pronotal disc broadly pink, and with an elongate pale-yellow spot on elytron). *C. decorata* (Olivier, 1888) **comb. nov.** is unique among the aforementioned species by having more well-developed lanterns – both in males and females – which occupy the medial 1/3 of the sternum, reaching or almost reaching the anterior margin of the sternum. The sternum VI lantern is never longer than 2/3× sternum length, or wider than 1/5× sternum width in the other similar species given above.

*Costalampys decorata* (Olivier, 1888) **comb. nov.** was previously reported for the Brazilian states of Rio de Janeiro and Minas Gerais. Here, we expand the geographic range to the states of Espírito Santo and São Paulo, and provide for the first time detailed information of temporal occurrence of the said species.

**Types.** *Syntype* of *Ethra decorata* Olivier, 1888: BRAZIL: Rio de Janeiro: 1♂, Sahlberg col. (MNHN – col. E. Olivier). *Holotype* of *Ethra decorata circumcincta* Olivier, 1888: BRAZIL: Minas Gerais: 1 male (MNHN – col. E. Olivier). *Holotype* of *Lucidota oculata diversicollis* Pic, 1938: BRAZIL: 1 female (MNHN – col. M. Pic)



**Figure 10.** *Costalampys decorata* (Olivier) **comb. nov.**, male in natural environment (in Brazil: SP, Votorantim). Photo author: Enio Branco.

**Material examined.** BRAZIL: Espírito Santo: 1♀, Santa Tereza, V. Alegre, 13–17.III.67, C & C.T. Elias leg. (DZUP); Rio de Janeiro: 1♀, Angra dos Reis, Ilha Grande, Vila do Abraão, 22–24.IX.2017, L. Silveira col. (DZRJ); 1♂, Angra dos Reis, Pico do Papagaio, 200–400 m, 22–24.IX.2017, L. Silveira col. (DZRJ); 2♂, Angra dos Reis, P.E. Ilha Grande, Trilha Pico do Papagaio, active search [around noon], 750 m, 29.VII.2017, L. Silveira col. (DZRJ); 1♂, PE Ilha Grande, Malaise trap, 23°08′49.9″S, 44°10′51.5″W, 336 m, IX.2017, L. Silveira, S. Vaz, R. Queiroz & L. Campello col. (DZRJ); 1♀, PE Ilha Grande, Malaise 450B (24°08′47″S, 44°11′10.5″W, 444 m), IX.2017, L. Campello, L. Silveira & R. Queiroz col. (DZRJ); 1♂, PE Ilha Grande, Malaise IG2A, 23°09′12.4″S, 44°11′24.1″W, 720 m, VIII.2017, L. Campello, L. Silveira & R. Queiroz col. (DZRJ). 1♂, Rio de Janeiro, P.N da Tijuca, Malaise trap, 22°56.792′S, 43°17.504′W, 815 m, X.2016, L. Silveira, S. Vaz & B. Clarkson col. (DZRJ); 1♂, P.N. da Tijuca, Próx. a Bom Retiro, Malaise 02 (22°34′10.8″S, 43°10′36.4″W, 784 m), 01.IX–04.X.2016, L. Silveira and B. Clarkson col. (DZRJ); 2♂, P. N. da Floresta da Tijuca, Trilha Bom Retiro-Cocanha, 24.IX.2016, L. Silveira & S. Vaz col. (DZRJ); 1♀, 07.I.2017, active search [around noon], L. Silveira col. (DZRJ). — *From photography:* BRAZIL: São Paulo: 1♂, Votorantim, 25.11.2011 (Photo: Enio Branco, Fig. 10).

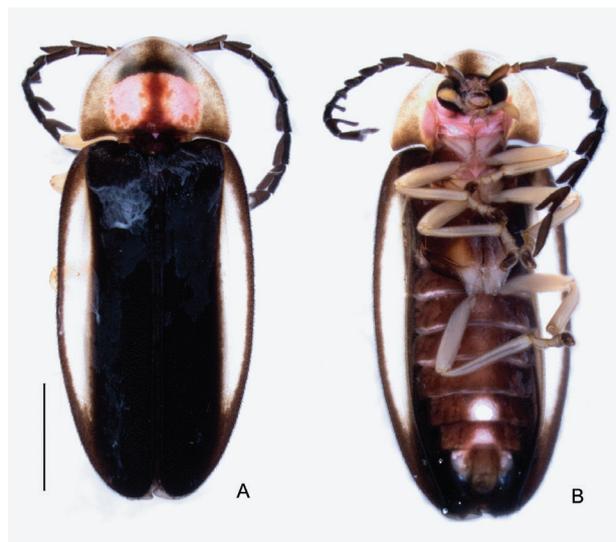
### *Costalampys delicata* **sp. nov.** Silveira, Roza, Vaz & Mermudes

Type species.

Figs 11–15, 22

<http://zoobank.org/02F44F1D-A868-4019-AB42-C3B8BF-CE7E0F>

**Diagnostic description.** Overall brown. Pronotal disc (Fig. 13A) pink, usually with a large black line in the middle, pronotal expansions variably dark brown to almost entirely testaceous. Elytron (Fig. 11A, B) dark brown with a pale yellow longitudinal stripe about 4/5× as long



**Figure 11.** *Costalampys delicata* sp. nov. **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view. Scale bar: 2 mm (A–B).

as elytron. Legs pale yellow. Sternum VIII (Fig. 14C) with lateral vitreous spots. Pygidium brown.

Pronotum (Fig. 13A) with sides rounded and divergent posteriorly. Sternum VI (Fig. 14A) with a small lantern, occupying the medial 1.6 of the sternum, not reaching its anterior margin. **Male.** Total length = 9.1–9.9 mm (aver. 9.5 mm); Pronotal length = 1.8 mm; Pronotal width = 2.5–2.7 mm (aver. 2.6 mm); Elytral length = 6.1–6.5 mm (aver. 6.3 mm); Elytral width = 1.6–1.7 mm (aver. 1.65 mm). Antennomere I with lamella as long as core antennomere. Sternum VIII with posterior margin medially sinuose. Pygidium (Fig. 14C) with sides rounded, posterior corners barely visible, posterior margin medially mucronate. Syntergite boomerang-shaped (with anterior margin strongly curved). Phallus with dorsal plate bent dorsally (lateral view), with sides rounded and acuminate at apical half. Paramere apex curved ventrally, ventral projection (lateral view) well developed, almost right-angled. **Female.** Total length = 9.9–11.0 mm (aver. 10.45 mm); Pronotal length = 2.1–2.2 mm (aver. 2.15 mm); Pronotal width = 3.0–3.3 mm (aver. 2.6 mm); Elytral length = 7.4–7.8 mm (aver. 7.6 mm); Elytral width = 2.1–2.2 mm (aver. 2.15 mm). Antennomeres (Fig. 15A–C) III–X with apical corners almost right-angled, not projected.

**Remarks.** The type species *Costalampys delicata* sp. nov. is similar to *C. bella* sp. nov., *Costalampys joanae* sp. nov., *C. tricolor* (Gorham, 1880) comb. nov., and *C. decorata* (Olivier, 1888) comb. nov., in the dorsal color pattern (overall brown or dark brown, with pronotal disc broadly pink, and with an elongate pale-yellow spot on elytron). *C. delicata* sp. nov. is unique among the aforementioned species by the pale-yellow legs in both sexes (overall brown or dark brown in the others), and antennomere III with lamella short, as long as core antennomere in males (at least 1.5 longer in the others).

**Etymology.** *Delicata* is a Latin adjective that means delicate.

**Types.** *Holotype:* BRAZIL: Rio de Janeiro: 1♂, Teresópolis, P.N. Serra dos Órgãos, Malaise trap, PVE9B (22°26'57.8"S, 43°0'13.7"W, 1,236 m), I.2016, L. Silveira col. (DZRJ). *Paratype:* BRAZIL: Rio de Janeiro: 1♂, Paraty, P.N. Serra da Bocaina, Estr. Paraty-Cunha, 1514 m, 23.I.2010, Mattos, I. & Mermudes col. (DZRJ); 1♀, Teresópolis, P.N. Serra dos Órgãos, Trilha da Pedra do Sino, Cach. Vêu da Noiva, 29–31.I.2014, active search [morning ~10am], L. Silveira col. (DZRJ); 1♀, P.N. Serra dos Órgãos, I.2014, PENSARIOP2 (22°26'48"S, 43°00'42.6"W, 1050 m), 1♂, Malaise trap, R. Monteiro col. (DZRJ); Teresópolis, P.N. Serra dos Órgãos, Represa Beija-Flor, 14–17.I.2015, active search [afternoon ~3pm], L. Silveira col. (DZRJ); 1♂, P.N. Serra dos Órgãos, Malaise trap, PVE7B (22°27'24.8"S, 42°59'7.2"W, 952 m), I.2015, L. Silveira col. (DZRJ); 1♂, 2♀, PVE9A (22°26'55.1"S, 43°00'16.4"W, 1246 m), XII.2015, Silveira & Khatarr col. (DZRJ); 1♀, Teresópolis, P.N. Serra dos Órgãos, I.1969, Porter & Garcia col. (DZUP).

### *Costalampys joanae* sp. nov. Silveira, Roza, Vaz & Mermudes

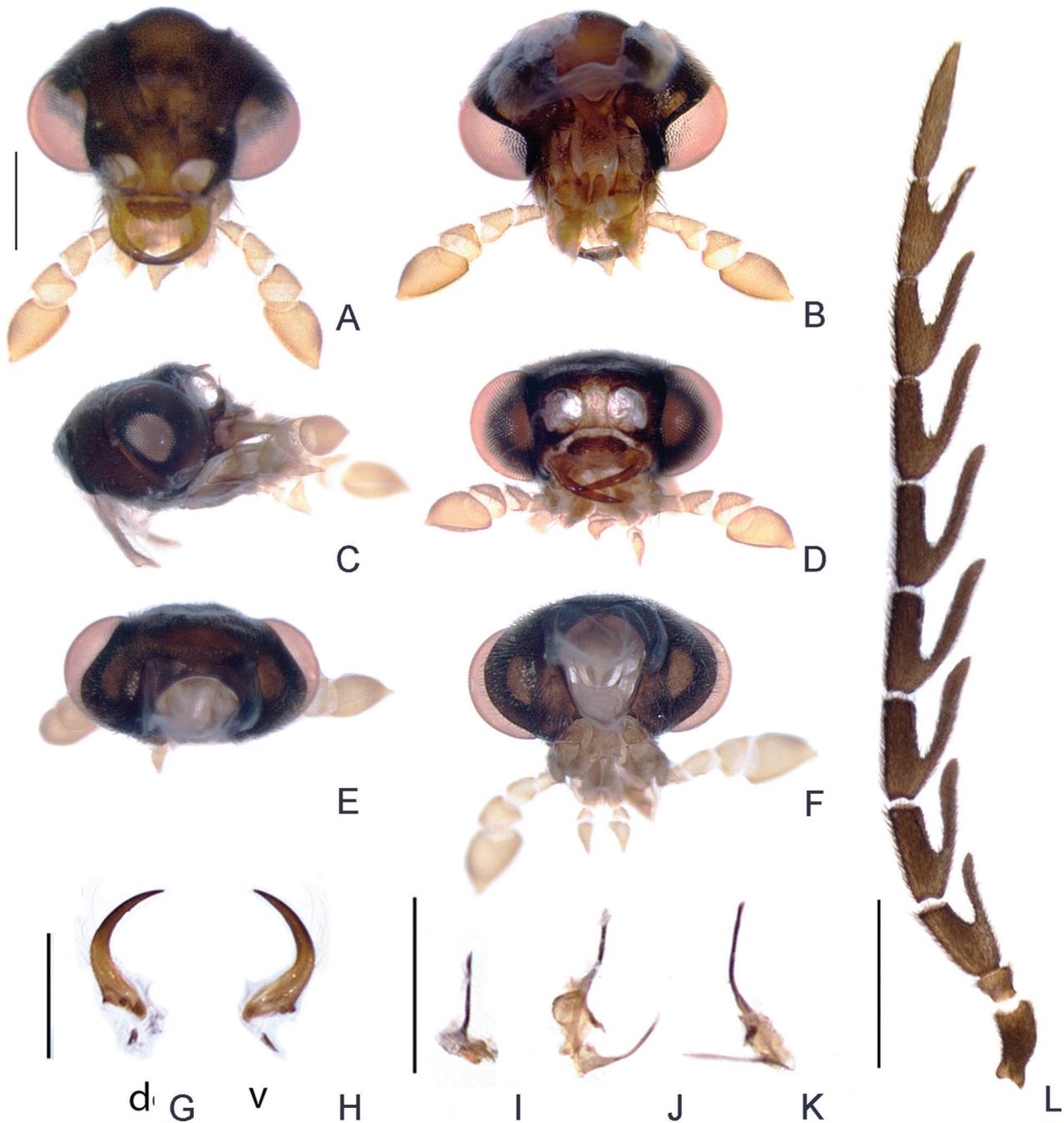
Figs 16A–L, 22

<http://zoobank.org/33861BDB-15D5-4204-8C60-7CCFBB-B320E5>

**Diagnostic description.** Entirely dark brown to black, except by paired pink vittae on pronotal disc (Fig. 16A), as about as long as 1/2× disc length, as wide as 1/3× disc width. Elytron (Fig. 16A) dark brown to black, without any pale-yellow longitudinal stripe. Legs (Fig. 16B) dark brown to black. Sternum VIII entirely dark brown, without lateral vitreous spots. Pygidium (Fig. 16F) entirely dark brown.

Pronotum (Fig. 16D) with sides rounded, divergent posteriorly. **Male.** Total length = 10.6 mm; Pronotal length = 2.2 mm; Pronotal width = 3.6 mm; Elytral length = 8.4 mm; Elytral width = 2.3 mm. Antennomere III (Fig. 16C) with lamella about 4× longer than core antennomere. Sternum VI (Fig. 16B) with a small lantern, occupying the medial 1/6 of the sternum, not reaching its anterior margin. Sternum VIII (Fig. 16E) with posterior margin bisinuose. Pygidium (Fig. 16F) with sides rounded and abruptly converging posteriorly from basal third on, posterior corners barely visible, posterior margin rounded, somewhat acuminate. Syntergite (Fig. 16G,H) boomerang-shaped (with anterior margin strongly curved). Phallus (Fig. 16I–L) with dorsal plate curved dorsally in lateral view, with sides rounded at apical half, slightly convergent apically. Paramere apex almost straight, ventral projection (lateral view) moderately developed, almost right-angled. **Female.** Unknown.

**Remarks.** *Costalampys joanae* sp. nov. is similar to *C. delicata* sp. nov., *C. decorata* (Olivier, 1888) comb. nov., *C. tricolor* (Gorham, 1880) comb. nov., and *C. bella* sp. nov., in the dorsal color pattern (overall brown or dark brown, with pronotal disc broadly pink, and with an elon-



**Figure 12.** *Costalampys delicata* sp. nov., male head. **A**, Head capsule, dorsal view; **B**, Head capsule, ventral view; **C**, Head capsule, lateral view; **D**, Head capsule, frontal view; **E**, Head capsule, posterior view; **F**, Head capsule, occipital view; **G**, Mandible, dorsal view; **H**, Mandible, ventral view; **I**, Tentorium, dorsal view; **J**, Tentorium, frontal view; **K**, Tentorium, lateral view; **L**, antenna, lateral view. Scale bar: 0.5 mm (A–K); Scale bar: 1.0 mm (L).

gate pale-yellow spot on elytron). *Costalampys joanae* sp. nov. is unique among the aforementioned species by having a longer antennomere III lamella, which is about 4× longer than core antennomere, as well as sides of pygidium strongly convergent posteriorly (homogeneously rounded in the other species).

**Etymology.** *Joanae* is named after JRMM's daughter, Joana. Noun in genitive case.

**Type.** *Holotype*: BRAZIL: Rio de Janeiro: 1♂, Teresópolis, P.N. Serra dos Órgãos, Trilha para abrigo do Açú,

09.I.2014, active search [afternoon], P.M. Souto col. (DZRJ).

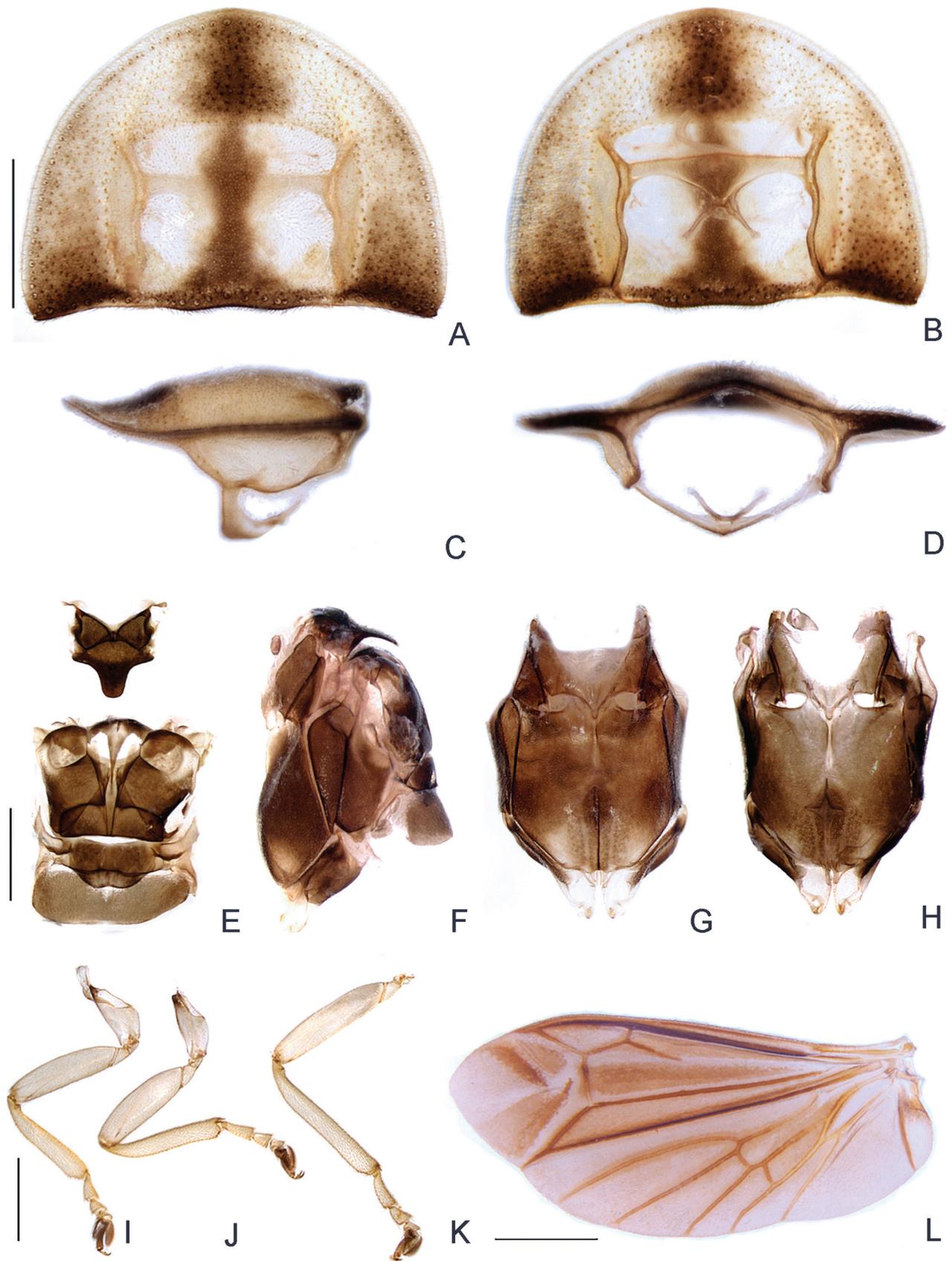
***Costalampys klugii* Motschulsky, 1853 comb. nov.**

Figs 17A–M, 22

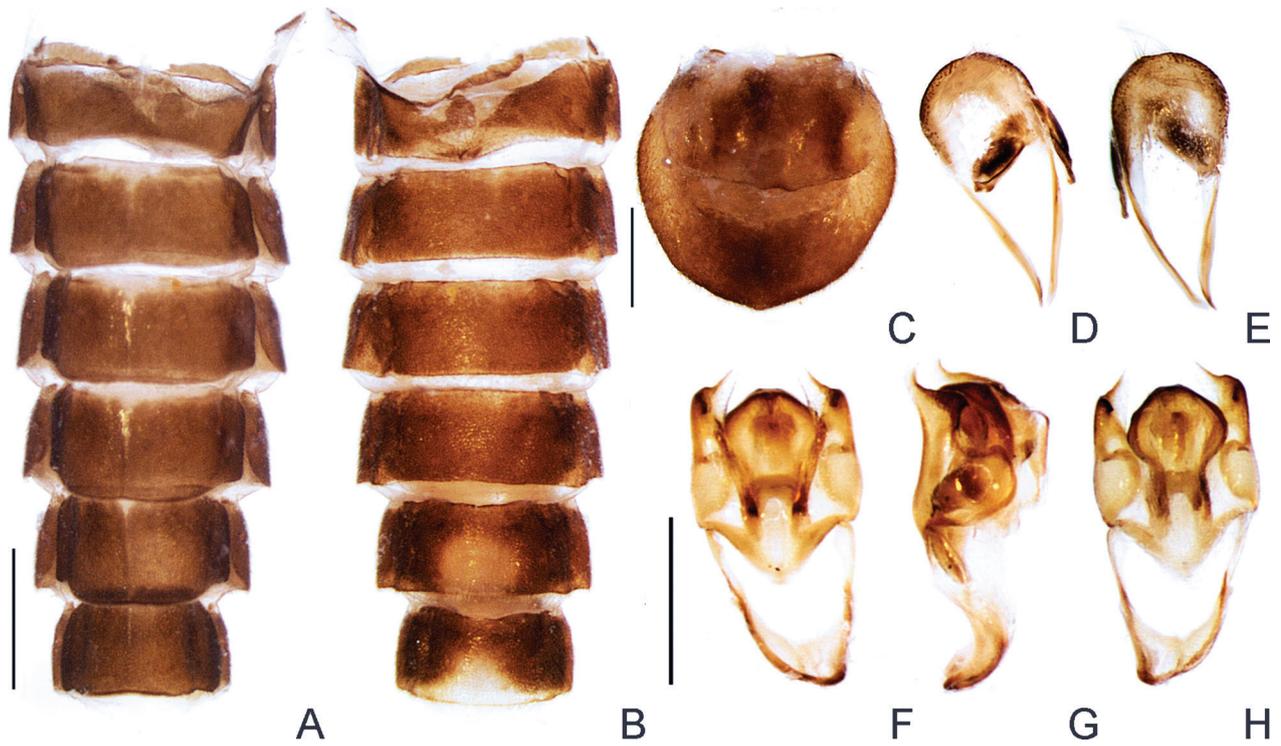
*Lychmuris klugii* Motschulsky, 1853:4 (desc.); Lacordaire 1857:319 (rev.); Olivier, 1911:54 (rev.).

*Lucidota klugi* (sic) Blackwelder, 1945:354 (cat. – misspelling).

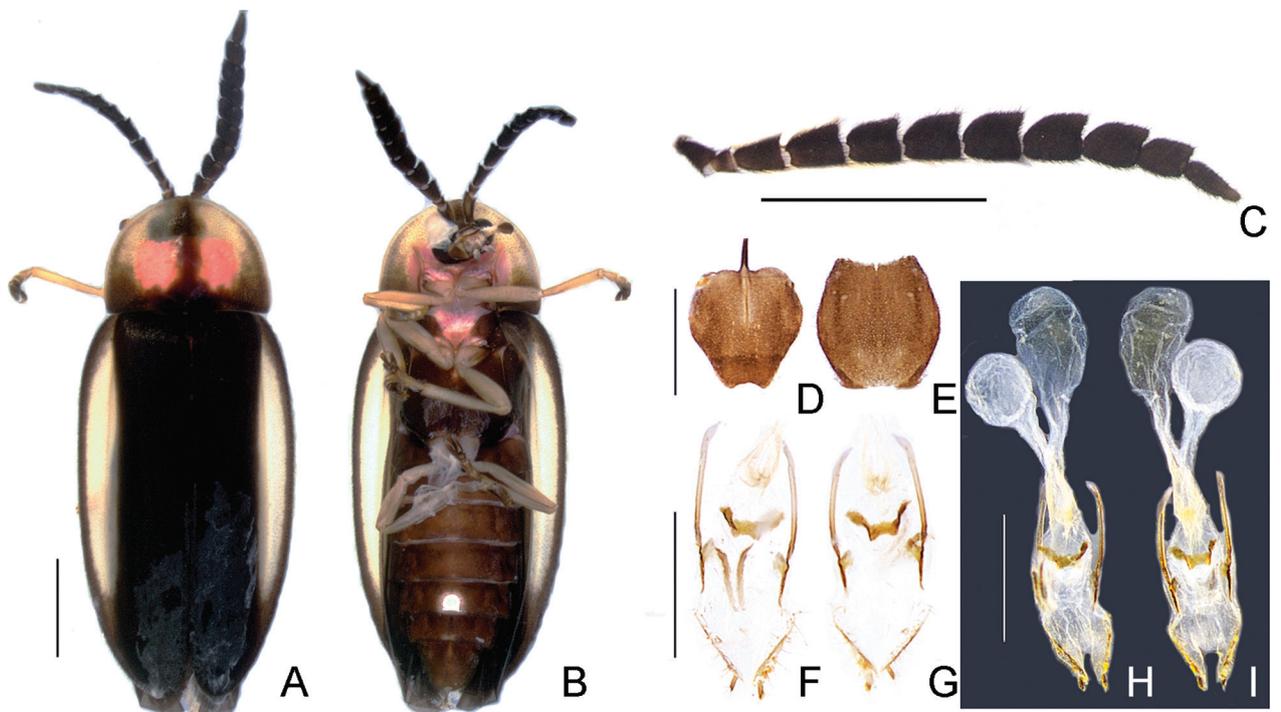
*Lucidota klugii* (Motschulsky, 1853:354); Gorham 1880:16 (rev.); Olivier 1907:20 (cat.); McDermott 1966:67 (cat.).



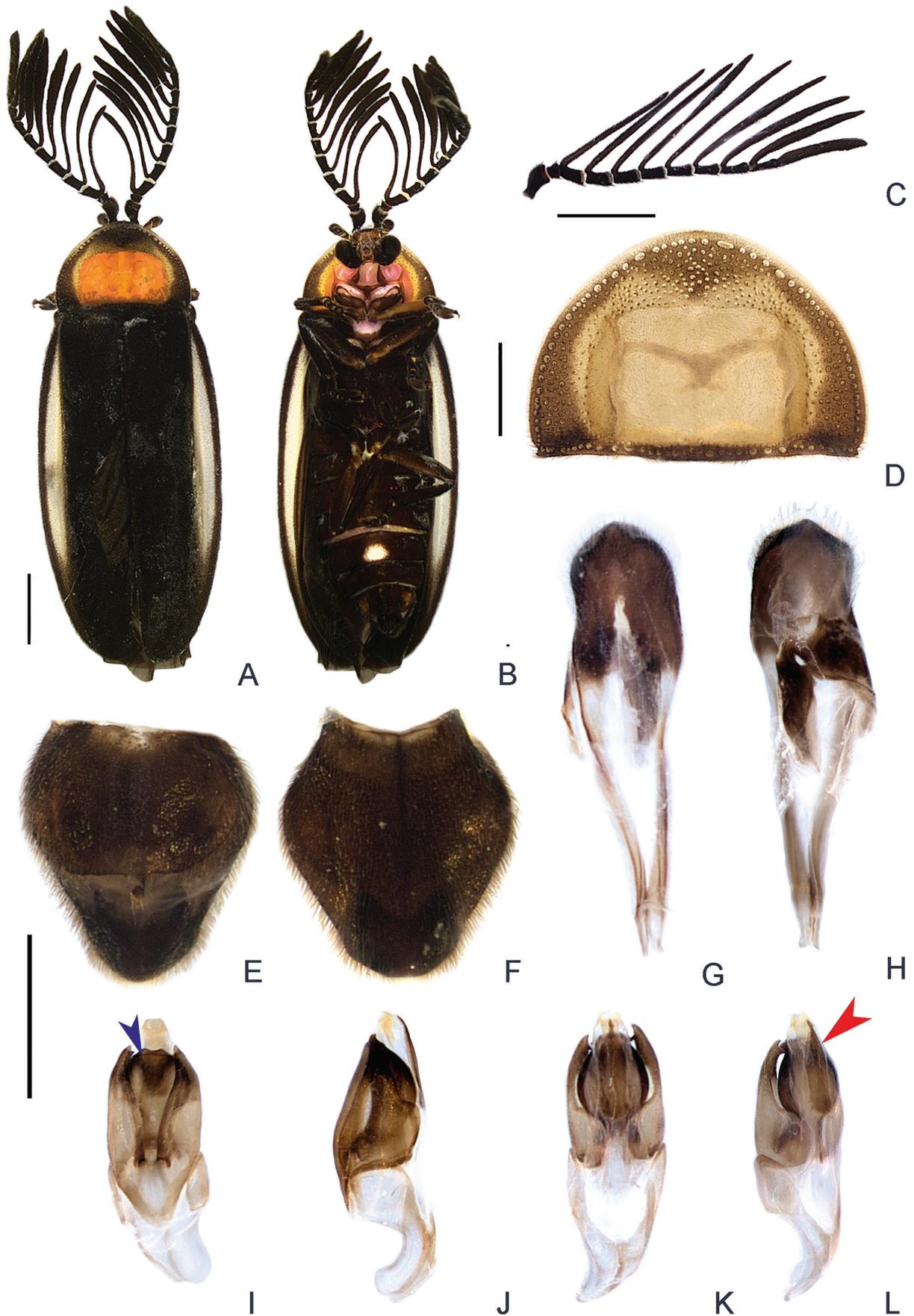
**Figure 13.** *Costalampys delicata* sp. nov. **A**, Male prothorax, dorsal view; **B**, Male prothorax, ventral view; **C**, Male prothorax, lateral view; **D**, Male prothorax, posterior view; **E**, Mesoscutellum and alinotum, dorsal view; **F**, Pterothoracal sclerites, lateral view; **G**, Pterothoracal sclerites, ventral view; **H**, Pterothoracal sclerites, lateral view; **I**, Proleg, lateral view; **J**, Mesoleg, lateral view; **K**, Metaleg, lateral view; **L**, Right wing, dorsal. Scale bar: 1 mm (A–K); Scale bar: 2.0 mm (L).



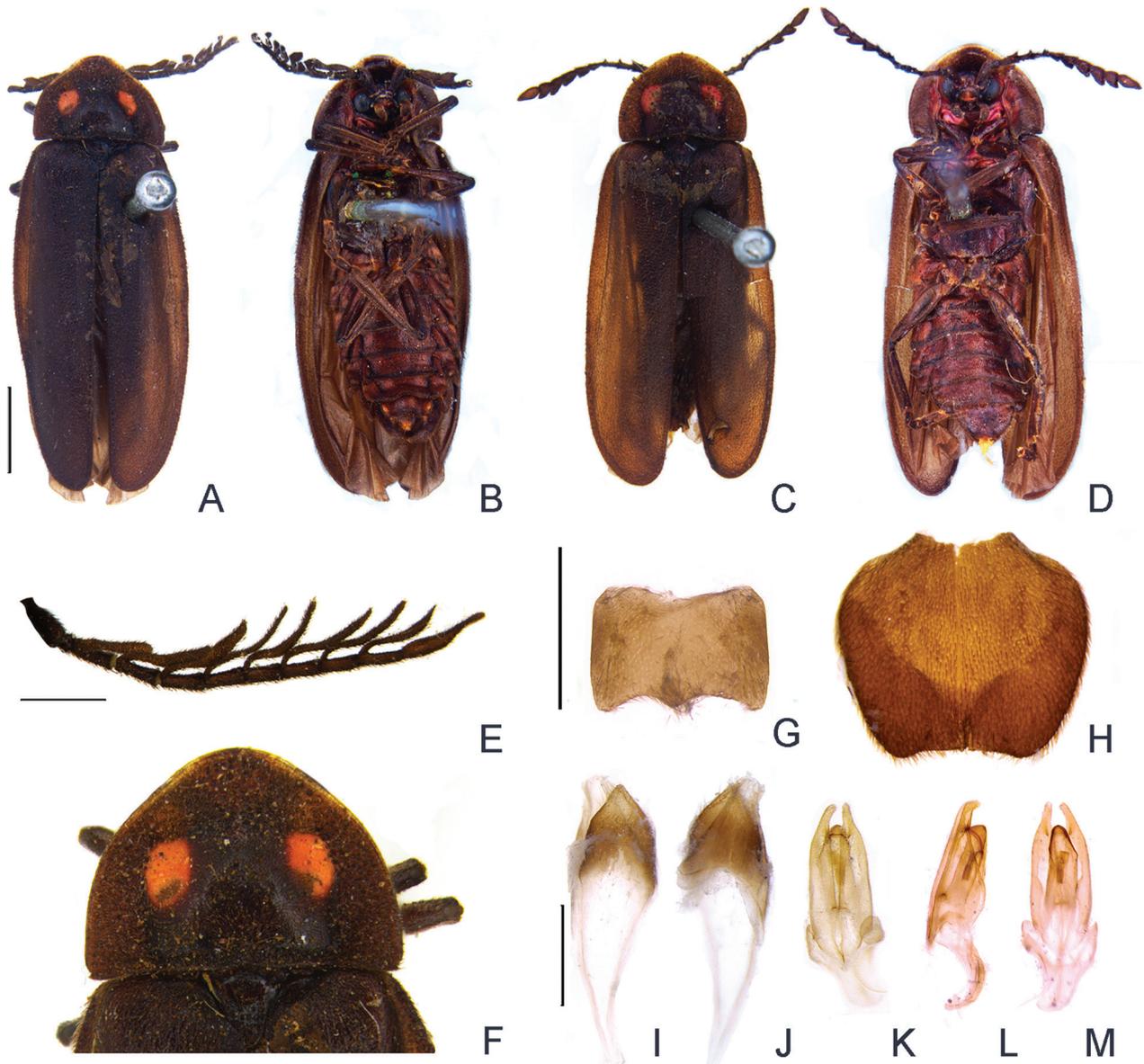
**Figure 14.** *Costalampys delicata* sp. nov. **A**, Abdominal sclerites, dorsal view; **B**, Abdominal sclerites, ventral view; **C**, Pygidium, dorsal view; **D**, Syntergite, dorsal view; **E**, Sternite IX, ventral view; **F**, Aedeagus, dorsal view; **G**, Aedeagus, lateral view; **H**, Aedeagus, ventral view. Scale bar: 0.5 mm (A–H).



**Figure 15.** *Costalampys delicata* sp. nov. **A**, Female habitus, dorsal view; **B**, Female habitus, ventral view; **C**, Female antenna, lateral view; **D**, Sternum VIII, ventral view; **E**, Pygidium, Dorsal view; **F**, Ovipositor, dorsal view; **G**, Ovipositor, lateral view; **H**, Internal genitalia, dorsal view; **I**, Internal genitalia, ventral view. Scale bar: 2 mm (A–C); Scale bar: 1.0 mm (D–I).



**Figure 16.** *Costalampys joanae* sp. nov. **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Male antenna, lateral view; **D**, Male pronotum, dorsal view; **E**, Sternum IX, ventral view; **F**, Pygidium, dorsal view; **G**, Syntergite, dorsal view; **H**, Sternum IX, Ventral view; **I**, Aedeagus, dorsal view, blue arrow pointing to the transverse keel on the dorsal plate; **J**, Aedeagus, lateral view; **K**, Aedeagus, ventral view; **L**, Aedeagus, oblique view, red arrow pointing to the ventral plate. Scale bar: 2 mm (A–C); Scale bar: 1.0 mm (D–L).



**Figure 17.** *Costalampys klugii* (Motschulsky) **comb. nov.** **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Sternum IX, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E–M).

**Diagnostic description.** Overall dark brown to black. Pronotal disc (Fig. 17F) either with paired orangish or pinkish vittae on anterior corners, or entirely orangish or pinkish, pronotal expansions sometimes with a fine testaceous outline surrounding the disc, otherwise dark brown to black. Elytron (Fig. 17A, D) dark brown to black. Legs dark brown to black, except for trochanters and femora, which are lighter ventrally. Sternum VIII (Fig. 17G) entirely dark brown, without lateral vitreous spots. Pygidium (Fig. 17H) entirely dark brown.

Pronotum (Fig. 17F) with anterior margin slightly acuminate, sides rounded, divergent posteriorly. Sternum VI (Fig. 17B) without lanterns. **Male.** Total length = 10.3–10.9 mm (aver. 10.6 mm); Pronotal length = 2.0–2.2 mm (aver. 2.1 mm); Pronotal width = 3.2–3.3 mm (aver. 3.25 mm); Elytral length = 8.4–8.6 mm (aver. 8.5 mm); Elytral width = 2.0–2.1 mm (aver. 2.05 mm). An-

tennomere III (Fig. 17E) with lamella 1.5–2× longer than core antennomere. Sternum VIII (Fig. 17G) with posterior margin bisinuate. Pygidium (Fig. 17H) with sides rounded, posterior corners weakly developed, posterior margin truncate. Syntergite (Fig. 17I, J) with anterior margin mildly curved. Phallus (Fig. 17K–M) with dorsal plate almost straight in lateral view, with sides straight and acuminate at apical half. Paramere apex curved ventrally, ventral projection (lateral view) weakly developed, rounded. **Female** (Fig. 17C, D). Total length = 10.3 mm; Pronotal length = 2.2 mm; Pronotal width = 3.0 mm; Elytral length = 8 mm; Elytral width = 2.0 mm. Antennomeres III–X (Fig. 17C, D) with apical corners slightly projected and pointed.

**Remarks.** *Lychnuris klugii* was described by Motschulsky (1853: 4), who wrongly attributed the species authorship

to Dejean. Indeed, Dejean (1833) cited *Lychnuris klugii* in his second catalog, but without a description, making it therefore a *nomen nudum* (cf. Bousquet and Bouchard 2013). The correct authorship of the species belongs to Motschulsky (1853), who in first provided a description for *Lychnacris klugii*. Motschulsky (1853) lists the species for Southern Brazil, without further details.

McDermott's catalog (1966) cites Motschulsky, 1853: 28 as a first mention of *Lychnuris klugii*, but this is inaccurate in two ways. On one side, the first citation of *Lychnuris klugii* was indeed on a "page 28", but in 1852, not 1853. However, we interpret that in Motschulsky 1852: 28, *L. klugii* is a *nomen nudum*, as the synopsis given regards the genus *Lychnuris* Dejean, 1833 (valid *vide* Bousquet & Bouchard, 2013), not the species. The correct reference of the species description, as listed above, is Motschulsky, 1853: 4.

Gorham (1880) transferred *Lychnacris* to *Lucidota* Laporte, 1833. Since then, it was transferred to *Lychnuris* by Olivier (1911), and back to *Lucidota* by McDermott (1966). After our phylogenetic analysis (see section 3.2), we transfer *Lucidota klugii* (Motschulsky, 1853) to *Costalampys* **gen. nov.**, therefore *Costalampys klugii* (Motschulsky, 1853) **comb. nov.**

*Costalampys klugii* Motschulsky, 1853 **comb. nov.** is very unique among other *Costalampys* spp. in lacking an elongate elytral pale-yellow spot. The paired pink vittae usually seen in the pronotum is often found as well in *C. tricolor* (Gorham, 1880) **comb. nov.**, from which *C. klugii* Motschulsky, 1853 **comb. nov.** can be distinguished by the lack of an elongate, elytral pale-yellow stripe, and lack of lanterns on sternum VI (both traits present in *C. tricolor* (Gorham, 1880) **comb. nov.**).

**Types.** *Holotype*: BRAZIL: 1♂, Without other data (ZIN).

**Material examined.** BRAZIL: 2 males and 2♀, Without other data, #31532 (ZMB); Santa Catarina: 1♂, Seara [Nova Teutonia], XII.1935, B. Pohl. col (MZSP).

### *Costalampys minima* sp. nov. Silveira, Roza, Vaz & Mermudes

Figs 18A–K, 22

<http://zoobank.org/17B4A394-21B5-4D29-8356-F4DD63DAA779>

**Diagnostic description.** Overall brown. Pronotal disc (Fig. 18D) brown, with light brown vittae, expansions testaceous, mildly translucent anteriorly. Elytron (Fig. 18A) light brown, without any pale-yellow longitudinal stripe. Legs (Fig. 18B) brown, except for trochanters, which are light brown. Sternum VIII (Fig. 18F) entirely translucent. Pygidium entirely dark brown or with paired translucent, elongate spots a 1/3× as wide as pygidium.

Pronotum (Fig. 18D) with sides rounded, divergent posteriorly. **Male.** Total length = 5.4–6.3 mm (aver. 5.85 mm); Pronotal length = 1.0–1.3 mm (aver. 1.15 mm); Pronotal width = 1.7–2.0 mm (aver. 1.85 mm); Elytral length = 4.7–5.0 mm (aver. 4.85 mm); Elytral width = 1.2–1.4

mm (aver. 1.3 mm). Antennomere III with lamella about 2.x longer than core antennomere. Sternum VI and VII (Fig. 18B, E) with translucent spots about 1/2× as long and 1/6× as wide as sterna, lanterns rudimentary. Sterna VI and VII (Fig. 18B, E) with minute, central translucent round spots that look like rudimentary lanterns. Sternum VIII with posterior margin bisinuose. Pygidium with sides rounded, posterior corners weakly developed, posterior margin rounded to almost straight. Syntergite (Fig. 18G, H) boomerang-shaped (with anterior margin strongly curved). Phallus (Fig. 18I–K) with dorsal plate curved almost straight in lateral view, with sides straight and acuminate at apical half. Paramere apex curved ventrally, ventral projection (lateral view) rudimentary. **Female.** unknown.

**Remarks.** *Costalampys minima* sp. nov. is unique among its congeners by the color pattern (described above).

**Etymology.** *Minima* is a Latin adjective that means tiny.

**Types.** *Holotype*: BRAZIL: Rio Grande do Norte: 1♂, Baía Formosa, RPPN Mata Estrela, Entrada na estrada, RN2014-04, 6°22'27,5"S, 35°1'24,8"W, 24–25.VI.2014, DMT col. (DZRJ). *Paratype*: BRAZIL: Piauí: 7♂, P. N. Sete Cidades, Piracuruca, Riacho da piedade, Pi-004 (4°6'34"S, 41°43'39"W), 169 m, Malaise trap, 21–24.IV.2012, Rafael et al. col. (DZRJ); 1♂, Piracuruca, P. N. de Sete Cidades, Abaixo da cachoeira do Riachão, Pi-002 (4°6'28"S, 41°40'13"W, 171 m), Pennsylvania trap, Takiya col. (DZRJ).

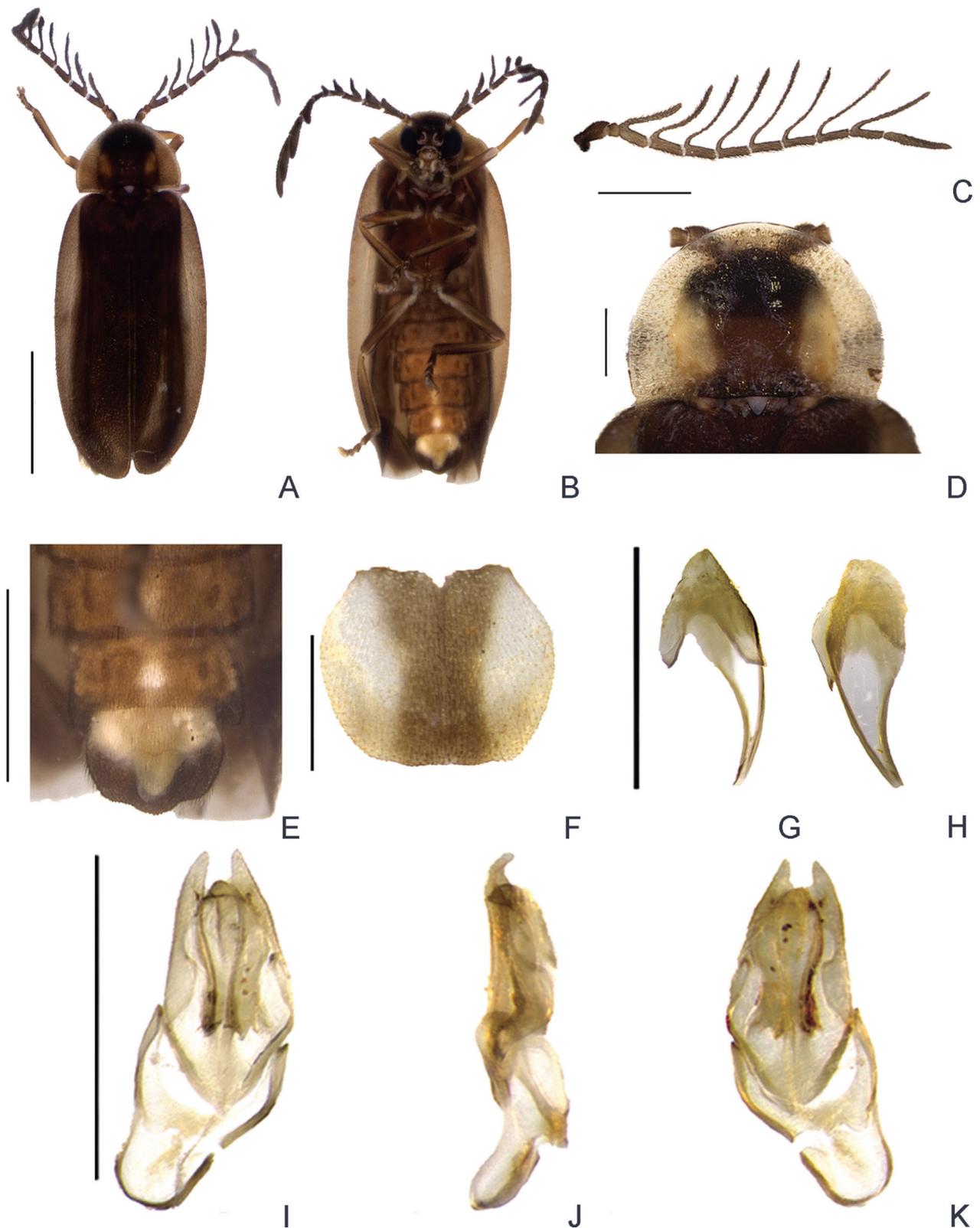
### *Costalampys pauper* (Olivier, 1899) **comb. nov.**

Figs 19A–M, 22

*Cladodes pauper* Olivier, 1899:90 (desc.); Blackwelder 1945:352 (cat.); McDermott 1966:82 (cat.).

**Diagnostic description.** Overall dark brown to black, except abdominal terga and sterna (Fig. 19B), which are dark brown. Pronotal disc (Fig. 19F) entirely black, pronotal expansions dark brown to black, often with anterior corners slightly lighter. Elytron (Fig. 19A) dark brown to black, with a pale-yellow longitudinal stripe about 4/5× as long as elytra. Legs dark brown to black. Sternum VIII (Fig. 19G) entirely dark brown, without lateral vitreous spots. Pygidium (Fig. 19H) entirely dark brown.

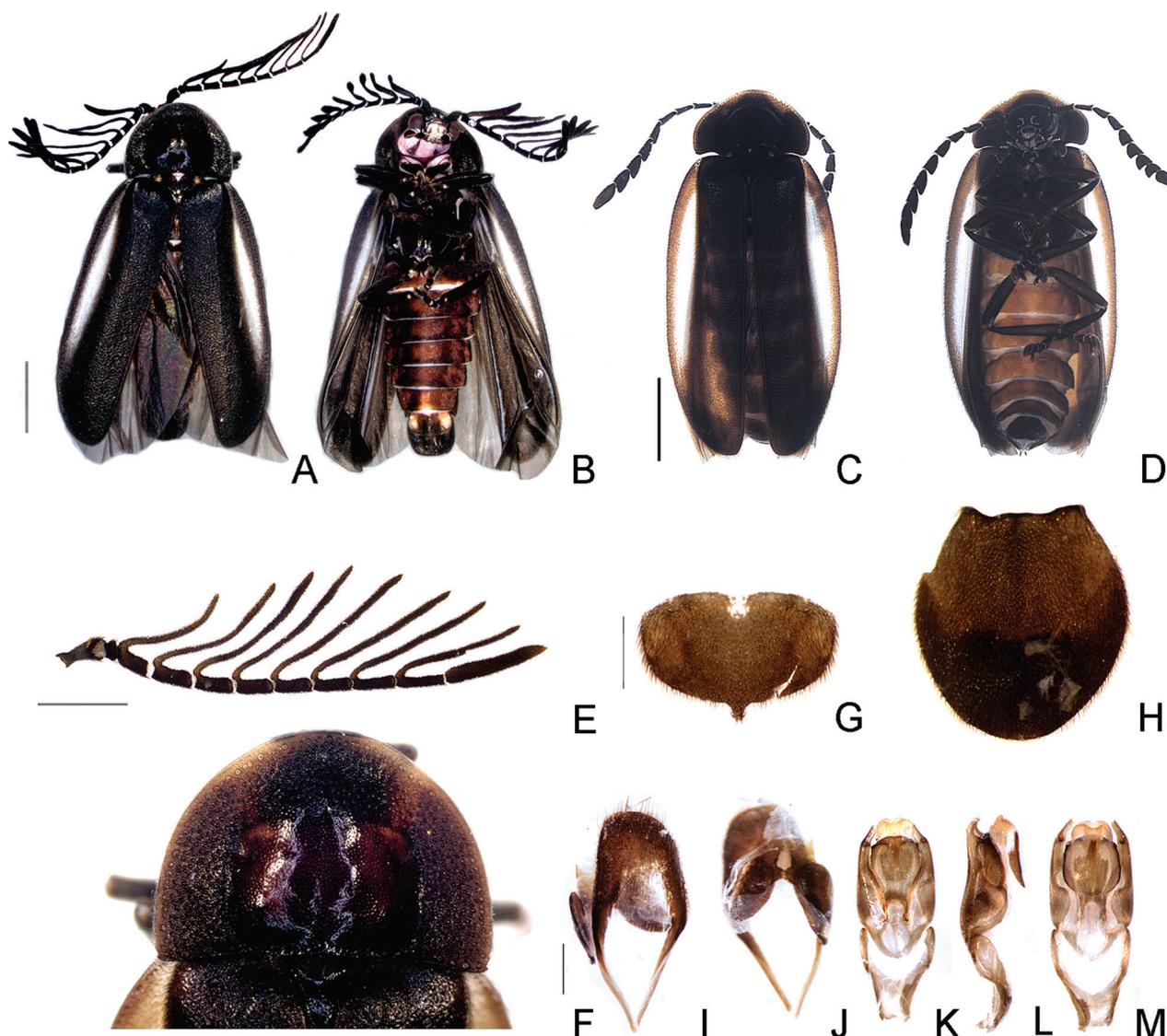
Pronotum (Fig. 19F) with sides rounded, divergent posteriorly. Sternum VI without lanterns. **Male.** Total length = 8.9–11.3 mm (aver. 10.1 mm); Pronotal length = 2.3–2.7 mm (aver. 2.5 mm); Pronotal width = 1.8–3.3 mm (aver. 2.55 mm); Elytral length = 7.3–8.8 mm (aver. 8.05 mm); Elytral width = 1.8–2.2 mm (aver. 2.0 mm). Antennomere III (Fig. 19E) with lamella 3× longer than core antennomere. Sternum VIII with posterior margin mucronate. Pygidium (Fig. 19H) with sides rounded, posterior corners barely visible, posterior margin rounded to almost straight. Syntergite (Fig. 19I,J) boomerang-shaped (with anterior



**Figure 18.** *Costalampys minima* sp. nov. **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Male antenna, lateral view; **D**, Male pronotum, dorsal view; **E**, Male terminal segments, ventral view; **F**, Pygidium, dorsal view; **G**, Syntergite, dorsal view; **H**, Sternum IX, Ventral view; **I**, Aedeagus, dorsal view; **J**, Aedeagus, lateral view; **K**, Aedeagus, ventral view. Scale bar: 2 mm (A–B); Scale bar: 1.0 mm (C; E); Scale bar: 0.5 mm (D; F–K).

margin strongly curved). Phallus (Fig. 19K–M) with dorsal plate curved dorsally in lateral view. Paramere apex almost straight, ventral projection (lateral view) moderately developed, almost right-angled. Paramere

apex curved ventrally, ventral projection (lateral view) moderately developed, rounded to almost right-angled. **Female** (Fig. 19C, D). Total length = 11.0–11.3 mm (aver. 11.15 mm); Pronotal length = 1.7–1.8 mm (aver.



**Figure 19.** *Costalampys pauper* (Olivier) **comb. nov.** **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Sternum IX, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, Ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E); Scale bar: 0.5 mm (G–K).

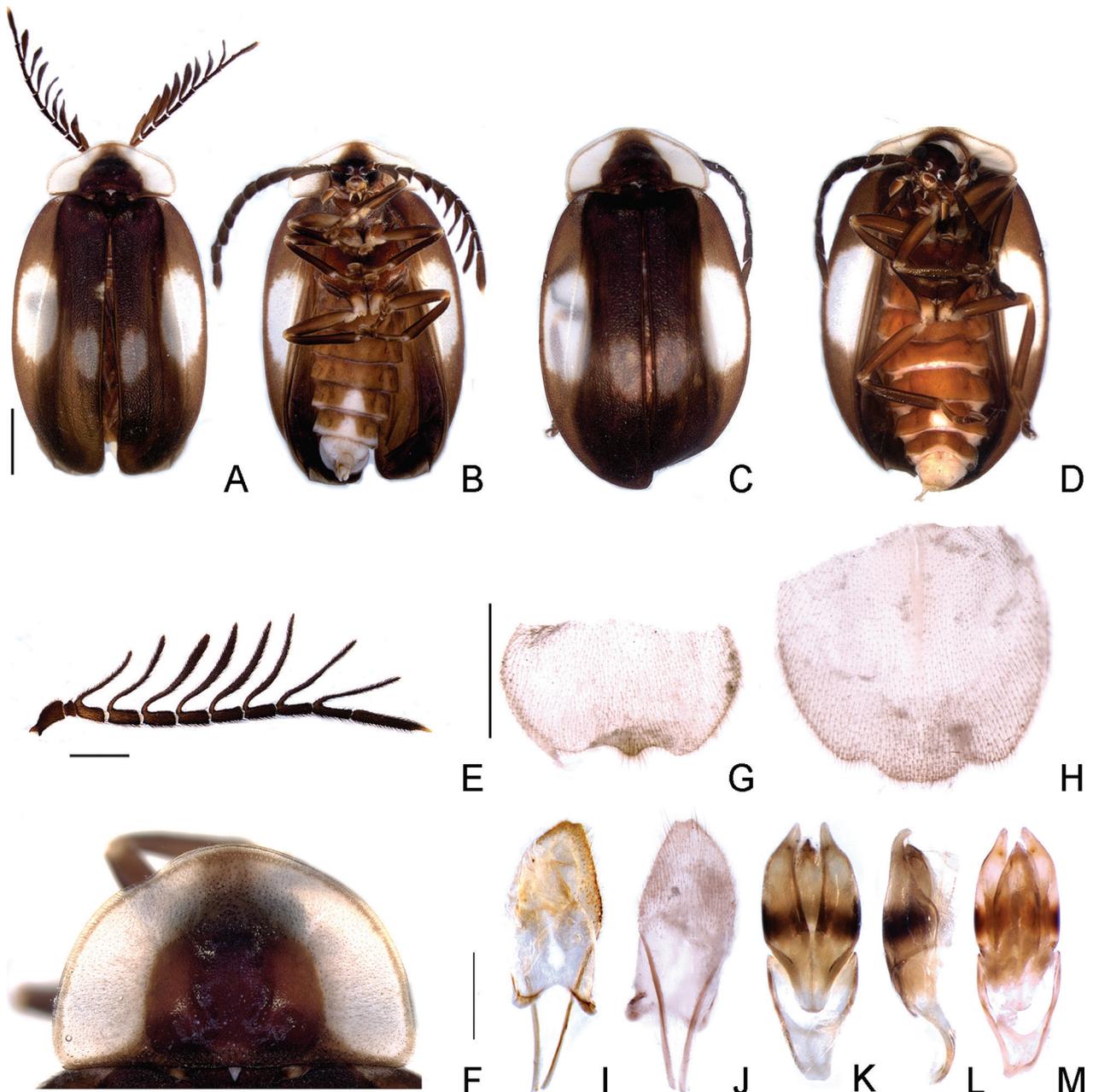
1.75 mm); Pronotal width = 2.7–2.8 mm (aver. 2.75 mm); Elytral length = 7.2–8.7 mm (aver. 7.95 mm); Elytral width = 2.0–2.5 mm (aver. 2.25 mm). Antennomeres (Fig. 19C, D) III–X with apical corners almost right-angled, not projected and pointed.

**Remarks.** Olivier (1899) described *Cladodes pauper* from Brazil – the syntype we studied is from Teresópolis, Rio de Janeiro, Brazil. In addition to Teresópolis, in the *Serra dos Órgãos* mountain range, we found previously unreported populations at the *Serra da Mantiqueira* and *Maciço da Pedra Branca* mountain ranges, in the states of Rio de Janeiro and Minas Gerais. Our study provides detailed geographic information for the first time, and expands considerably the known range of the species. After our phylogenetic analysis (see section 3.2), we transfer *Cladodes pauper* to *Costalampys* **gen. nov.**, therefore *Costalampys pauper* (Olivier, 1899). Olivier (1899) didn't provide an etymology for *pauper*, but

we assume it was based on the Latin word for “poor”. Because Olivier (1899) originally placed it in *Cladodes* Solier, 1849, *Cladodes pauper* would be relatively smaller than the remaining species in this genus, therefore “poor”.

*Costalampys pauper* (Olivier, 1899) is unique among *Costalampys* spp. by the pronotum entirely dark brown to black and sternum VI without lantern, in both sexes. *C. pauper* is also unique in being restricted to relatively cooler climates, either at sites of relatively higher elevation (>1200m) during the Austral Spring season, or at lower elevations (~600m), during Austral Winter. These observations suggest that this species might be adapted to climates substantially cooler than its congeners, which deserves further scrutiny.

**Types.** *Syntype*: BRAZIL: 1 male (MNHN, col. E. Olivier). Label is written “Brésil intér.”, which we interpret as “interior”, “country side” of BRAZIL.



**Figure 20.** *Costalampys quadriguttata* (Gorham) **comb. nov.** **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Sternum IX, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E–M).

**Material examined.** BRAZIL: Minas Gerais: 1♂, Itamonte, Travessia de Itatiaia para Maringá, 25–29.XI.2010, Carvalho col. (DZRJ); 1♂, Itamonte, gramado [on grass], 19–21.XI.2009, active search [afternoon], L. Silveira col. (DZRJ); Rio de Janeiro: 1♂, 1♀, Itatiaia, P. N. Itatiaia, P5 (22°25′01,0″S, 44°38′32,9″W, 1846 m), Malaise trap, XII.2013, R. Monteiro col. (DZRJ); 1♂, P. N. Itatiaia, Travessia Rui Braga, 2200 m, 21.XI.2013, L. Silveira col. (DZRJ); 1♂, P.N. Itatiaia, P7 (22°23′38,9″S, 44°39′59,7″W, 2255 m), Malaise trap, 21.XI.2013, R. Monteiro col. (DZRJ); 2♂, 3♀, P.N. Itatiaia, P5 (22°25′01,0″S, 44°38′32,9″W, 1846 m), Malaise trap, R. Monteiro col (DZRJ); 1♂, Rio de Janeiro, P.E. Pedra Branca, Taquara, Trilha da Padaria (~400m), Crepúsculo, PiT-LED, 07.VII.2018, A. L. D. Ferreira (DZRJ); 1♂, 1♀, Teresópolis, P.N. Serra dos Órgãos, Trilha do Sino, 1650–1900 m, 14–15.XI.2015, L. Silveira col. (DZRJ).

***Costalampys quadriguttata* (Gorham, 1880)  
comb. nov.**

Figs 20A–M

*Lucidota quadriguttata* Gorham, 1880:21 (desc.); Olivier, 1886:8 (dist.); Blackwelder, 1945:354 (cat.); McDermott, 1966:69 (cat.).

**Diagnostic description.** Overall dark brown. Pronotal disc (Fig. 20A, F) dark brown, lacking vittae, pronotal expansions somewhat translucent anteriorly, almost entirely pale yellow, except by posterior margin, which is outlined in brown, blending with the dark brown disc color. Elytron (Fig. 20B) brown, with a pale yellow longitudinal stripe

about  $1/3\times$  as long as elytra, with a roundish spot at posterior  $3/4$ , reaching inner suture, about a  $1/3\times$  as wide as elytra. Legs brown, except for trochanters and metacoxa, which are light brown. Sternum VIII (Fig. 20G) entirely translucent. Pygidium (Fig. 20H) entirely translucent.

Pronotum (Fig. 20F) with sides rounded, divergent posteriorly. **Male.** Total length = 11.1–11.9 mm (aver. 11.5 mm); Pronotal length = 2.5 mm; Pronotal width = 4.0–4.2 mm (aver. 4.1 mm); Elytral length = 9.0 mm; Elytral width = 2.9–3.0 mm (aver. 2.95 mm). Antennomere III (Fig. 20E) with lamella about  $2\times$  longer than core antennomere. Sternum VI (Fig. 20B) with lantern of moderate size, occupying the medial 1.4 of the sternum, almost reaching its anterior margin. Sterna VI and VII (Fig. 20B) with minute, central translucent round spots that look like rudimentary lanterns. Sternum VIII with posterior margin bisinuose. Pygidium (Fig. 20H) with sides rounded, posterior corners weakly developed, posterior margin variably rounded to almost straight. Syntergite (Fig. 20I,J) with anterior margin mildly curved. Phallus (Fig. 20K–M) with dorsal plate almost straight in lateral view, with sides straight and acuminate at apical half. Paramere apex curved ventrally, ventral projection (lateral view) weakly developed, angle rounded. **Female** (Fig. 20C,D). Total length = 14.5 mm; Pronotal length = 2.6 mm; Pronotal width = 4.4 mm; Elytral length = 9.6 mm; Elytral width = 3.1 mm. Antennomeres III–X with apical corners projected, pointed, sterna VI (Fig. 20D) lanterns small, occupying the central 1.4 of sternum, not reaching anterior margin, sternum VII (Fig. 20D) with a feeble lighter spot, possibly a rudimentary lantern.

**Remarks.** Gorham (1880) *Lucidota quadriguttata* from Bahia, Brazil: The author didn't give an explicit etymology for the species, but we assume it was based on the Latin word for "with four spots", referring to its color pattern. *Costalampys quadriguttata* (Gorham, 1880) **comb. nov.** is similar to *C. bisbinotata* (Pic, 1943) **comb. nov.** and *C. capixaba* **sp. nov.** in the pronotal color pattern (overall dark brown; pronotal disc dark brown, lacking vittae, pronotal expansions somewhat translucent anteriorly, almost entirely pale yellow, except by posterior margin, which is outlined in brown, blending with the dark brown disc color), but differs from both in having the pygidium, as well as sterna VIII and IX, entirely translucent in both sexes (dark brown in both sexes of *C. capixaba* **sp. nov.**, partially translucent in *C. bisbinotata* (Pic, 1943) **comb. nov.** males, entirely dark brown in females), and sternum VII with a medial translucent spot in males (absent in the other species).

*Costalampys quadriguttata* (Gorham, 1880) **comb. nov.** was previously reported for the Brazilian State of Bahia. OLIVIER (1886) mentioned specimens collected by E. Gounelle in "Salobro", currently Canavieiras, BA (cf. Aguiar et al. 2014), which we found in his collection at MNHN (see below). Pierre Émile Gounelle was an engineer and entomologist who worked for the French Ministry of the Colonies, and traveled to Brazil on several occasions (Papavero 1971, Lourteig 1986). On his first trip, among other places, Gounelle visited "Salobro" between June and July, 1885 (Papavero 1971), which was a pop-

ular destination for its diamond mines at that time (e.g., Aguiar et al. 2014). Here, we expand the known range of the species to the State of Pernambuco, and also give more detailed locality data within the state of Bahia.

**Types.** *Syntype:* BRAZIL: Bahia: 1 male (MNHN, col. Gorham).

**Material examined.** BRAZIL: 1♀, without other data (MNHN). Pernambuco: 1♀, Caruaru, IV.1972, Alvarenga leg. (DZUP); Caruaru, 900 m, MAI.1972, Joaquim Lima leg. (DZUP); Bahia: 1♀, without other data (MNHN, col. Olivier); 1♂, Camacan, R.P.P.N. Serra Bonita, Córrego abaixo do alojamento, 15°23'16"S, 39°33'50,5"W, 661 m, Malaise trap, 28–29.II.2012, D. Takiya & M. L. Monné col. (DZRJ); 2♂, Camacan, R.P.P.N. Serra Bonita, Alojamento, 15°23'16"S, 39°33'58,6"W, 757 m, Sweep, 28–29.II.2012, D. Takiya col. (DZRJ); 2♂, "Salobro"[currently Canavieiras], 06.07.1885, E. Gounelle col. (MNHN, col. Olivier).

### *Costalampys tricolor* (Gorham, 1880) **comb. nov.**

Figs 21A–M, 22

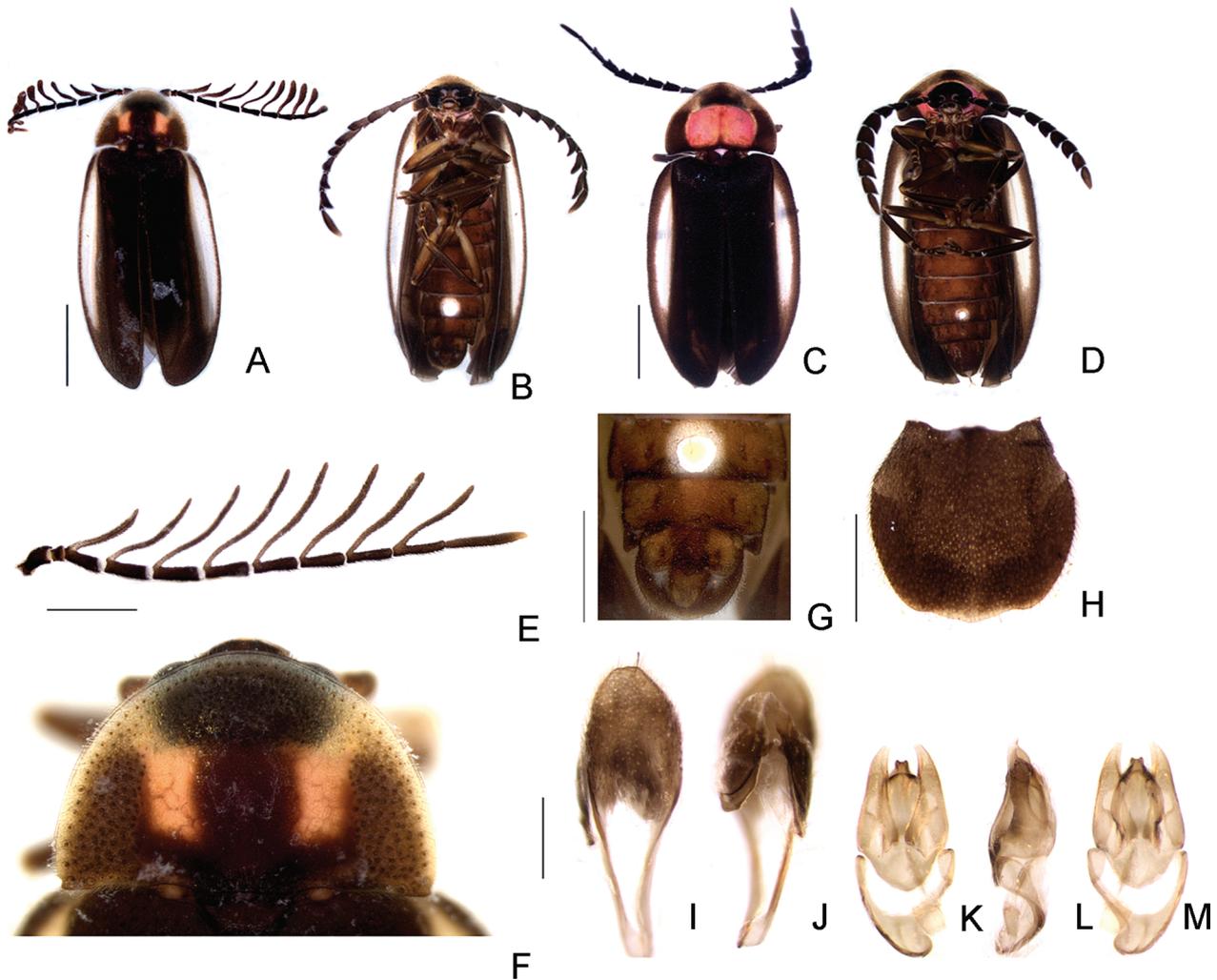
*Lucidota tricolor* Gorham, 1880:21 (desc.); Blackwelder, 1945:355 (cat.); McDermott, 1966:69 (cat.).

*Lucidota oculata* Olivier, 1886: 4 (desc.); Pic, 1938:27 (key); Blackwelder, 1945:354 (cat.); McDermott, 1966:67 (cat.).

*Eihra decorata schneideri* Pic, 1938:27 (desc.); Blackwelder, 1945:353 (cat.); McDermott, 1966:86 (cat.).

**Diagnostic description.** Overall dark brown. Pronotal disc (Fig. 21A, F) from having paired pink spots to entirely pink, pronotal expansions dark brown, often brighter at anterior corners. Elytron (Fig. 21A, C) dark brown with a pale yellow longitudinal stripe about  $4/5\times$  as long as elytron. Legs (Fig. 21B) dark brown, except for trochanters and femora, which are light brown. Sternum VIII (Fig. 21G) brown, without lateral vitreous spots. Pygidium (Fig. 21H) brown.

Pronotum with sides rounded, divergent posteriorly. **Male.** Total length = 9.5–10.7 mm (aver. 10.1 mm); Pronotal length = 1.9–2.1 mm (aver. 2.0 mm); Pronotal width = 3.0–3.0 mm; Elytral length = 7.3–8.1 mm (aver. 7.6 mm); Elytral width = 1.9–2.0 mm (aver. 1.95 mm). Antennomere III (Fig. 21E) with lamella about  $2\times$  longer than core antennomere. Sternum VI (Fig. 21B, G) with lantern of moderate size, as wide as 1.4 sternum, almost reaching its anterior margin. Sternum VIII (Fig. 21G) with posterior margin bisinuose. Pygidium (Fig. H) with sides rounded, posterior corners weakly developed, posterior margin rounded to almost straight. Syntergite (Fig. 21I, J) boomerang-shaped (with anterior margin strongly curved). Phallus (Fig. 21K–M) with dorsal plate bent dorsally (lateral view), with sides rounded at apical half, with an acute apical projection, medially notched. Paramere apex curved ventrally, ventral projection (lateral view) well developed, almost right-angled. **Female** (Fig. 21C, D). Total length = 9.4–10.8 mm (aver. 10.1 mm); Pronotal length = 1.9–2.5 mm (aver. 2.2 mm); Pronotal width = 2.9–3.6 mm (aver. 3.25 mm); Elytral length = 7.4–8.4



**Figure 21.** *Costalampys tricolor* (Gorham) **comb. nov.** **A**, Male habitus, dorsal view; **B**, Male habitus, ventral view; **C**, Female habitus, dorsal view; **D**, Female habitus, ventral view; **E**, Male antenna, lateral view; **F**, Male pronotum, dorsal view; **G**, Sternum IX, ventral view; **H**, Pygidium, dorsal view; **I**, Syntergite, dorsal view; **J**, Sternum IX, Ventral view; **K**, Aedeagus, dorsal view; **L**, Aedeagus, lateral view; **M**, Aedeagus, ventral view. Scale bar: 2 mm (A–D); Scale bar: 1.0 mm (E; G); Scale bar: 0.5 mm (F; H–M).

mm (aver. 7.9 mm); Elytral width = 1.8–2.0 mm (aver. 1.9 mm). Antennomeres III–X with apical corners almost right-angled, not projected, sterna VI with a small lantern, as wide as 1.6 sternum, not reaching anterior margin.

**Remarks.** Gorham (1880) described *Lucidota tricolor* from Brazil, but provided no further provenance data, based on a male specimen provided by the French naturalist Chevrolat. Gorham (1880) didn't give an explicit etymology for *Lucidota tricolor*, but we assume it was based on the Latin word for “with three colors”, referring to its color pattern. Olivier (1886) described *Lucidota oculata* based on a single female specimen from Matosinhos, Minas Gerais, Brazil: The said author didn't give an explicit etymology for *Lucidota oculata*, but we assume *oculata* comes from the Latin adjective that means “with eyes”, referring to the pronotal spots.

Pic (1938) described *Ethra decorata schneideri* from Brazil, without further details. The holotype of *Ethra decorata schneideri* Pic, 1938 is presumed here based on a specimen in M. Pic's collection (MNHN) that was labeled as “*Lucidota oculata* E Ol” and “var. *Schneideri*”.

We based our inference on the combination of the following observations: (i) the aforementioned specimen in Pic's collection was labeled as “type”; (ii) we found no description of a species or variety named *L. oculata* var. *Schneideri* Pic; and (iii) Pic described *Ethra decorata* var. *schneideri* in a paper about mimetism among some lampyrid species with similar dorsal color pattern, including both *Lucidota oculata* Olivier and *Ethra decorata* Olivier (Pic 1938), and his description given for his new variety fits the latter, but not the former. Furthermore, Pic (1938) regarded *Lucidota* spp. as having antennae long and compressed but with no lamellae, whereas *Ethra* spp. had flabellate antennae (a trait found in the presumed holotype). Together, these observations support our inference that our presumed holotype of *Ethra decorata* var. *schneideri* is the holotype, that nevertheless was mislabeled. The latter must be deemed as a subspecies according to ICZN article ICZN Art. 45.6.4, therefore *Ethra decorata schneideri* Pic, 1938 (according to Art. 5.2).

After the study of the type materials, we synonymize here *Lucidota oculata* Olivier, 1886 and *Ethra decora-*

*ta schneideri* Pic, 1938 with *Lucidota tricolor* Gorham, 1880, which has priority over time. After our phylogenetic analysis, we transfer *Lucidota tricolor* Gorham, 1880 to *Costalampys* **gen. nov.** (see section 3.2).

*Costalampys tricolor* (Gorham, 1880) **comb. nov.** is most similar to *C. bella* **sp. nov.**, as the two species share a similar dorsal color pattern (overall brown or dark brown, with pronotal disc with paired pink vittae to broadly pink, and with an elongate pale-yellow spot on elytron). It differs from *C. bella* **sp. nov.** by the rounded sides of pronotum in both sexes (almost straight in *C. bella* **sp. nov.**), the pygidium with posterior margin rounded to almost straight in males (mucronate in *C. bella* **sp. nov.**), as well as by the presence of lanterns in sternum VI in the females (absent in *C. bella* **sp. nov.**).

*Costalampys tricolor* (Gorham, 1880) **comb. nov.** was previously known from Brazil, without further details. Here, we provide more detailed information on the geographic and temporal occurrence of the species.

**Types.** *Holotype* of *Lucidota tricolor* Gorham, 1880: BRAZIL: 1♂, #292 (MNHN, col. Gorham; formerly in col. Chevrolat col). With label handwritten “tricolor Chev. sec. Chev.” (in the species original description, Gorham [1880] thanks Chevrolat for the “specimen described”). *Holotype* of *Lucidota oculata* Olivier, 1886: BRAZIL: Minas Gerais: 1♀, Matosinhos, 03.04.1885, Gounelle col. (MNHN, col. E. Olivier). *Holotype* of *Ethra decorata schneideri* Pic, 1938: BRAZIL: Rio de Janeiro: 1♂, Teresópolis, F. Schneider col. (MNHN, col. M. Pic) (see remarks above).

**Material examined.** BRAZIL: Minas Gerais: 1♀, Bocaina de Minas, Ribeirão Santa Casa, prox. Cachoeira da Raposa, 22°18'24.7"S,

44°33'54"W, 1294 m, M&M col. (DZRJ); 1♀, Itajubá, R.B.M. Serra dos Toledos, coleta diurna, 08.XI.2015, Rosa & Ladenthin col. (DZRJ); 1♂, 16.II.–17.III.2017, Rosa & Lopes col. (DZRJ); 1♀, São Roque de Minas, P.N. Serra da Canastra, Malaise trap, Mata ciliar, Ponto 1, 3♂, 14–19.XII.2013, Melo & Rosa col. (DZRJ). Rio de Janeiro: 1♂, Angra dos Reis, PE Ilha Grande, Malaise trap, P450A (23°08'47.2"S, 44°11'09.4"W), 441 m, IX.2017, L. Campello, L. Silveira & R. Queiroz col. (DZRJ); 1♀, Itatiaia, P.N. Itatiaia, PENSARIOP2 (22°25'59.6"S, 44°37'39.7"W, 1280 m), Malaise trap, I.2015, R. Monteiro col. (DZRJ); 1♂, 1♀, Teresópolis, P.N. Serra dos Órgãos, 03–05.XI.2014, 1200 m, active search [afternoon], L. Silveira col. (DZRJ). Paraná: 1♂, Curitiba, 28–XII.1976, V. Graf col. (DZUP); 1♂, Curitiba, 12.69, Mielke col. (DZUP); 1♀, Tijucas do Sul, Vossoroca, 25.I, Pe. Moure & Marinoni col. (DZUP); 1♀, Ponta Grossa, Jardim Carvalho, 25°4'39.15"S, 50°9'24"W, 05.I.2014, Nascimento, E.A. col. (UECO); 1♂, Ponta Grossa, Parque Nacional dos Campos Gerais, Morro do Castelo, 25°6'13.90"S, 49°56'36.38"W, 15.I.2014, Nascimento, E.A. & eq. col. (UECO); 1♂, 1♀, Ponta Grossa, em copula [in copula], 12.55, M. Vilella col. (DZUP); Rio Grande do Sul: 1♂, 1♀, Caxias do Sul, Vila Oliva, in copula, 19.2.49 (MAPA); 1♂, Esmeralda, 12.XII.1978, C. J. Becker leg. (MCZ).

### Checklist of *Costalampys* gen. nov.

- C. bella* **sp. nov.**
- C. bisbinotata* (Pic, 1943) **comb. nov.**
- C. capixaba* **sp. nov.**
- C. decorata* (Olivier, 1888) **comb. nov.**
- C. delicata* **sp. nov.**
- C. joanae* **sp. nov.**
- C. klugii* (Motschulsky, 1853) **comb. nov.**
- C. minima* **sp. nov.**
- C. pauper* (Olivier, 1899) **comb. nov.**
- C. quadriguttata* (Gorham, 1880) **comb. nov.**
- C. tricolor* (Gorham, 1880) **comb. nov.**

### 3.4. Key to species of *Costalampys* gen. nov. based on male specimens

- 1 Elytron with a long, lateral submarginal pale yellow stripe ..... 2
- 1' Elytron without a long, lateral submarginal pale yellow stripe ..... 10
- 2 Sternum VI and VII without lanterns ..... *C. pauper* (Olivier, 1899) **comb. nov.**
- 2' Sternum VI and/or VII with lanterns that are variably developed ..... 3
- 3 Pronotal disc without orangish or pinkish vittae, lateral expansions pale yellow or testaceous; elytron with lateral margin pale yellow on the medial third, sometimes with a medial pale-yellow spot ..... 4
- 3' Pronotal disc with orangish or pinkish vittae, contiguous or separated, lateral expansions pale yellow; elytron with lateral margin pale yellow, black in the apical 1/4, never with a medial pale-yellow spot ..... 6
- 4 Sternum IX translucent; ventral projection of paramere with corner apically obtuse .....  
..... *C. quadriguttata* (Gorham, 1880) **comb. nov.**
- 4' Sternum IX mostly brown; ventral projection of paramere with corner almost right-angled ..... 5
- 5 Elytral disc usually with a pale yellow spot at apical 3/5, pale yellow longitudinal stripe at lateral expansion 1/2× as long as elytra; pygidium brown, with lateral longitudinal stripes pale yellow .....  
..... *C. bisbinotata* (Pic, 1943) **comb. nov.**
- 5' Elytral disc without any pale-yellow spot at apical 3/5, pale yellow longitudinal stripe at lateral expansion 3/5× as long as elytra; pygidium entirely brown ..... *C. capixaba* **sp. nov.**
- 6 Sternum VI with lantern large, occupying the medial 1/5 of the abdominal segment, reaching the anterior margin of it ..... *C. decorata* (Olivier, 1888) **comb. nov.**
- 6' Sternum VI with a small lantern, not reaching the anterior segment ..... 7
- 7 Legs pale yellow ..... *C. delicata* **sp. nov.**
- 7' Legs light to dark brown ..... 8

- 8 Branches of antennomere 1.5 longer than core antennomere; pronotum with sides almost straight, mildly divergent posteriorly ..... *C. bella* sp. nov.
- 8' Branches longer than 1.5 longer than core antennomere; pronotum with sides rounded, strongly divergent posteriorly ..... 9
- 9 Branches of antennomere 2–3× longer than core antennomere ..... *C. tricolor* (Gorham, 1880) comb. nov.
- 9' Branches of antennomere 4–5× longer than core antennomere ..... *C. joanae* sp. nov.
- 10 Pronotum slightly acuminate anteriorly, elytron black, sternum VI and VII without lanterns ..... *C. klugii* (Motschulsky, 1853) comb. nov.
- 10' Pronotum rounded anteriorly (not acuminate), elytron brown, sternum VI and/or VII with small translucent spots, possibly associated with rudimentary lanterns ..... *C. minima* sp. nov.

## 4. Discussion

Here we proposed a new genus of lampyrid fireflies, based on a phylogenetic analysis of five new and six previously described species – all of them are reviewed for the first time since their original descriptions.

### 4.1. Phylogeny of *Costalampys* gen. nov.

*Costalampys* gen. nov. is monophyletic, although the relationship among tips was sensitive to the parameters selected (Figs 1–5; see **Results**). The relationship between species in the genus changed moderately between analyses. The sister species to all other *Costalampys* gen. nov. was *C. klugii*, and the clades (*C. bella* sp. nov. + *C. delicata* sp. nov.) and (*C. capixaba* sp. nov. + (*C. minima* sp. nov. + (*C. quadriguttata* + *C. bisbinotata*))). The position of *C. decorata*, *C. joanae* sp. nov., *C. pauper* and *C. tricolor* was different in EW and IW (low K values topology) trees, suggesting that the relationships between these species and the others in the genus were mostly based on homoplastic features (as IW downweights homoplastic traits (Goloboff et al. 2018)).

As expected, the Bayesian analysis (Fig. 5) generated results slightly more similar to the EW parsimony, considering that MKv model considers equal weights across characters. The topologies generated by parsimony (Figs 1, 3) had better resolution compared with the Bayesian tree (Fig. 5). Indeed, Bayesian analyses tend to be more accurate, but with lower resolutions – especially in small datasets, as the present study (Puttick et al. 2017, O'Reilly et al. 2018, Schrago et al. 2018). Since accuracy without any resolution is not helpful, parsimony analyses may sometimes be preferred over Bayesian analyses for small datasets (Sansom et al. 2018).

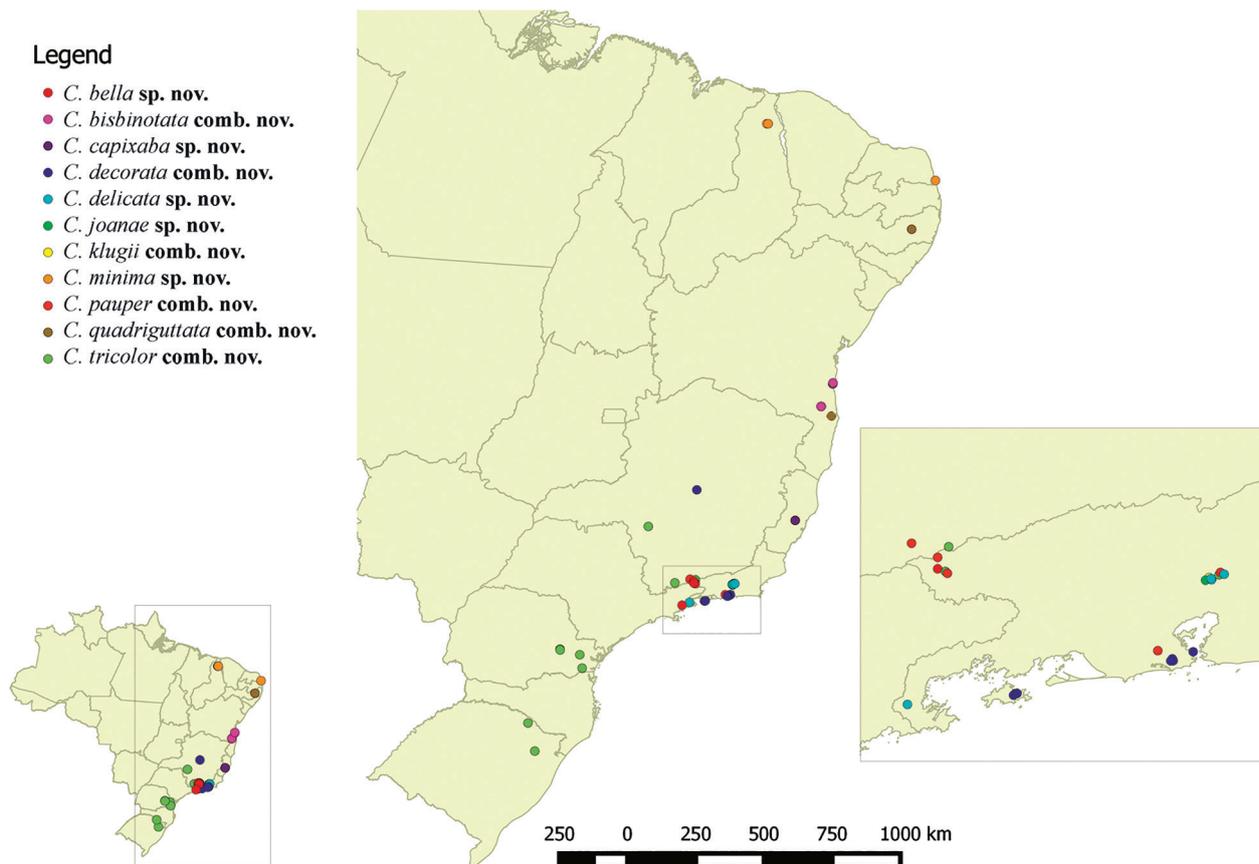
All the three methods we used (Bayesian, EW and IW parsimony analyses) are useful in inferring phylogenies, the difference between their respective results being sensitive to the parameters used and character to taxon ratio (Smith 2019). The debate around the most appropriate method of inferring phylogenies is ongoing, and the lack of studies employing empirical analyses instead of simulations stresses that we might be far from reaching a consensus (exceptions are works by Schrago et al.

(2018) and Sansom (2018), which have found opposing results).

Even though we had a rather limited taxon sampling family-wise, we included all taxa morphologically similar to *Costalampys* gen. nov. (particularly *Scissicauda* McDermott, 1964, *Ethra* Laporte, 1833 and *Lucidota* Laporte, 1833). Interestingly, *Costalampys* species were never found to be sister to any of the latter three genera. Instead, the poorly known *Dadophora hyalina* Olivier, 1907 was recovered as sister to *Costalampys* gen. nov. in all our analyses. Surprisingly, males of *D. hyalina* Olivier, 1907 are superficially very different from those of *Costalampys* gen. nov. species. For example, males of *D. hyalina* Olivier, 1907 have antennae with twelve antennomeres, III–X being cup-shaped, and subparallel-sided pronotum and elytra. On the other hand, males in *Costalampys* gen. nov. species have basally flabellate antennae with eleven antennomeres, and pronotum and elytra with rounded sides (except for *C. bella* sp. nov., which has pronotum with sides almost parallel-sided). Yet, *D. hyalina* Olivier, 1907 and *Costalampys* gen. nov. share several traits, particularly in their aedeagus, for example: dorsal plate curved dorsally, shorter than paramere, the latter bearing a well-developed ventral projection and a subapical tooth. It is noteworthy that genitalic characters are currently unknown for most Neotropical taxa, or may show little difference between species in lampyrid genera (e.g., *Amydetes* (cf. Silveira and Mermudes 2014a)). In *Costalampys* gen. nov., however, these characters influenced the analysis considerably, which shows the importance of including firefly genitalia in taxonomic phylogenetic studies (as seen, for example, in Ballantyne et al. (2019)). Unfortunately, females of *D. hyalina* remain unknown, which precludes comparisons between these and females of *Costalampys* species is not possible.

### 4.2. Biogeography of *Costalampys* gen. nov.

*Costalampys* gen. nov. is roughly circumscribed within the domains of the Atlantic Rainforest (but see below, and Fig. 22), a much-threatened biome and biodiversity hotspot (Myers et al. 2000, Ribeiro et al. 2009, Mittermeier et al. 2011, Scarano and Ceotto 2015). In fact, less than 11.7% of its original extent remains (of which only 9% is protected), and even these fragmented patches of forest



**Figure 22.** Distribution map of *Costalampys* gen. nov. species.

are very often embedded in a matrix of intense agriculture or densely inhabited cities (Ribeiro et al. 2009, Scarano and Ceotto 2015). Although native Brazilians had already mildly transformed the landscape by using food resources (Gaspar et al. 2008), these currently isolated patches were mostly connected until early 1500s, when European settlers started extensive logging and conversion of forests into pasture (Dean 1996). The replacement of native forest for agriculture or urban areas was intensified in the nineteenth and twentieth centuries (Scarano and Ceotto 2015).

Two species, *C. quadriguttata* and *C. minima* sp. nov., had populations recorded in forested patches of the Caatinga biome, in addition to areas of Atlantic Rainforest. *C. quadriguttata* was recorded in areas of Agreste formation (e.g., Caruaru, Pernambuco State) – ecotones between Caatinga and Atlantic rainforest, characterized by a warm and sub-humid forest climate (Alvares et al. 2013), although increasingly drier (Pereira et al. 2017) – but also in typical areas of Atlantic Rainforest, with more humid climate (Camacan and Canavieiras, both in Bahia State) (Alvares et al. 2013). On its turn, *C. minima* sp. nov. was collected in a forested area at Sete Cidades National Park, in the State of Piauí (within the Caatinga biome), in addition to coastal sites of Rio Grande do Norte state (National Heritage Private Reserve [RPPN, acronym in Portuguese] Mata Estrela, Baía Formosa), within the Atlantic Rainforest biome.

All our analyses recovered a weakly supported monophyletic clade consisting of all four species occurring

from the margins of the Doce River and northwards (*C. capixaba* sp. nov. + (*C. minima* sp. nov. + (*C. quadriguttata* + *C. bisbinotata*))). This area encompasses a major refugium within the Atlantic Rainforest that remained evergreen throughout the Pleistocene (Carnaval and Moritz 2008, Martins 2011). If true, this finding would provide meaningful hints on the evolutionary biogeography of this lineage.

Interestingly enough, *Costalampys* species have rather narrow geographic ranges for fireflies with winged females. For example, the South American *Cratomorphus cossyphinus* is common throughout continental marshes Eastern to the Andes (Campos et al. 2018), and the Nearctic *Photinus pyralis* and *Ellychnia corrusca* are common throughout Southern and Eastern North America (Faust 2017, Lower et al. 2018). In sharp contrast, *Costalampys* species are limited to narrow ranges, either certain mountain slopes Southwards to the Doce River (e.g., *C. delicata*, *C. decorata*), or coastal plains Northwards to the Doce River (*C. quadriguttata*, *C. bisbinotata*). These restricted ranges are more common among firefly taxa with presumed larviform females, like *Amydetes* and *Ybytyramoan* (cf. Silveira and Mermudes 2014a, 2014b). Assuming the distribution of *Costalampys* species is not limited by dispersal, stenotopic niches (i.e., narrow environmental preferences) might explain their restricted ranges – although limited sampling can not be ruled out.

## 5. Conclusions

Our contribution is part of a series of revisionary studies aiming at obtaining a deeper knowledge about neotropical fireflies, by combining museum research, new collections and field data, along with phylogenetic analyses. We redescribed, after studying the type material, then transferred certain previously described species to *Costalampys* **gen. nov.** from genera as disparate as *Ethra*, *Cladodes*, *Lucidota*, and *Platylampis*, underlining the poor state of neotropical lampyrid taxonomy. Although we might be far from having a complete picture about the species-level diversity within *Costalampys* **gen. nov.**, our study sets a solid framework for future studies in the genus. Finally, our study paves the way to the use of phylogenetic analysis in comprehensive systematic studies of Neotropical firefly taxa.

## 6. Authors' contributions

L.F.L.S. has collected several specimens for the study, sampled malaise trap material and visited institutions. L.F.L.S., A.S.R. and S.V. have described and illustrated the genus and all species, elaborated the identification key, and designed and produced the figure plates. S.V. has made the distributional map for the species of the genus. L.F.L.S., A.S.R. and J.R.M.M. have discussed and coded all morphological characters. L.F.L.S. and A.S.R. have run the analyses. All authors have discussed all results and reviewed the entire manuscript.

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## Supplementary material

### File 1

**Authors:** da Silveira LFL, Roza AS, Vaz S, Mermudes JRM (2021)

**Data type:** .docx

**Explanation note:** Supplementary Material I. Material examined of the outgroup taxa.

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**Link:** <https://doi.org/10.3897/asp.79.e67185.suppl1>

### File 2

**Authors:** da Silveira LFL, Roza AS, Vaz S, Mermudes JRM (2021)

**Data type:** .tnt

**Explanation note:** Character matrix.

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