



Descriptions of New Species of *Chespirito* Ferreira, Keller & Branham (Coleoptera: Lampyridae: Chespiritoinae) and the First Record for the Subfamily in the United States

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Abstract

Three new species of *Chespirito* Ferreira, Keller and Branham 2020 are described from North America, including the first species from the United States: *Chespirito milleri* **new species** from Arizona, USA, *Chespirito hintoni* **new species** from Mexico state, Mexico and *Chespirito costae* **new species** from Morelo state, Mexico. An updated distribution map and key to males of *Chespirito* is provided along with illustrations of diagnostic characters of the newly described species.

Key words: Neoteny, Paedomorphosis, Elateroidea, Firefly, Nearctic region

Introduction

The Chespiritoinae are one of the most recently recognized subfamilies of Lampyridae. This monogeneric lineage is known only from Mexico and currently only known from three species of *Chespirito* Ferreira, Keller and Branham 2020, all lacking light organs (Ferreira *et al.* 2020). Given the simplified morphology of the lightly sclerotized males, and the fact that females are entirely unknown, members of Chespiritoinae are thought to be affected by the paedomorphic syndrome (Ferreira and Ivie *in press*). Such characteristics are also present in many other Lampyridae groups known or suspected to be affected by the paedomorphic syndrome (Martin *et al.* 2017, 2019; Ferreira *et al.* 2019) and even other Coleoptera families, such as Omethidae, Lycidae, Jurasaidae, Phengodidae and Elateridae, to mention a few emblematic cases (Ivie 2002; Kundera & Bocak 2007; Bocakova *et al.* 2007; Kundera *et al.* 2019; Ferreira 2020; Ferreira and Silveira 2020; Rosa *et al.* 2021; Biffi *et al.* 2021; Roza 2021). During a survey of scientific collections searching for beetles affected by the paedomorphic syndrome, four specimens of *Chespirito* were found, including the first specimens from the United States. A closer examination revealed that these specimens represented undescribed species. Herein we describe and illustrate these new species and provide an updated taxonomic key and distribution maps to all known *Chespirito* species.

Material and methods

BMNH The Natural History Museum, London, United Kingdom (Maxwell V. L. Barclay and Michael Geiser).

MTEC Montana Entomology Collection, Montana State University, Bozeman, Montana, USA (MAI).

SEMC Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA (Zack Falin).

USNM National Museum of Natural History, Smithsonian Institution, currently on long-term enhancement loan at the Entomology and Nematology Department at the University of Florida (Floyd Shockley, Marc Branham).

Specimens were studied under a Leica® Wild M3C stereoscopic microscope with magnification up to 40× and identified using Ferreira *et al.* (2020). Genitalia were dissected after whole specimens were relaxed in hot H₂O and after removal permanently preserved in glycerin in microtubes mounted on the pin under each respective specimen. Morphological terminology follows Lawrence *et al.* (2011). Photos of specimens were taken with a Canon 6D DSLR with a MP-E 65 mm lens and using a Leica M205C Microscope attached to a Canon EOS 6D camera. Images were stacked using Zerene Stacker® version 1.04. Specimens were prepared for scanning electron microscopy (SEM) by dehydration in a graded ethanol series of 50%, 70%, 80%, 95% and absolute ethanol for 15 minutes each, and subsequently placed in acetone. The prepared piece was then set on a stub and coated with Ar and permanently deposited with the specimen from which its part was taken. SEM images were taken with a JEOL JSM-6335-F (FE) in the Natural History Museum of Denmark at the University of Copenhagen. Enhancements to digital images were made in Adobe Photoshop® CC 2020 and Adobe Photoshop® CC for iPad, and plate preparations were made in Adobe Illustrator® CC 2020. The distribution map was generated using the software Google Earth and Quantum GIS 3.16, using the maps available on the website <http://www.naturalearthdata.com>, a free public database of maps.

Results

Chespirito hintoni new species

(Figs. 1A, 1D, 1G, 2A, 3A, 4)

urn:lsid:zoobank.org:act:CA98DBF6-9D0E-46FC-AAD7-42F7375E90D7

Type material (1). Holotype: Real de Arriba; Temescaltepec; Mex. VII-33/ H. E. Hinton; R. L. Usinger; Collectors. / Hinton Coll.; B.M. 1939-583 (BMNH).

Etymology. The species is named for Howard Everest Hinton (1912–1977) one of the coleopterists of the twentieth century, who was born and raised in Mexico, and collected the unique holotype. In a coincidence, he started his university education at the same institution as one of us (MAI), Modesto Junior College in Modesto, California.

Diagnosis. *Chespirito hintoni* can be separated from other *Chespirito* by the combination of a unicolorous brownish pronotum and elytra (Fig. 1A) (vs. the yellow pronotal disc in *C. ballantynae*), the pronotum not constricted medially (Fig. 1A) (vs. constricted in *C. zaragozai*), the last three abdominal segments distinctly yellow (Fig. 1D, 1G, 2A) (vs. dark brown in *C. lloydi* or not distinctly yellow in *C. zaragozai*) and by having ventrite 8 notched medially (Fig. 1D) (vs. entire in *C. lloydi*, *C. milleri* and *C. costae*) and tergite 8 entire, round apically (Fig. 1G) (vs. tergite VIII notched apically in *C. milleri*).

Description. General color dark brown (Figs. 1A); mandibles and last three abdominal segments yellow (Figs. 1D, 2A); tarsi and metaventrite slightly lighter than remaining ventrites of the body. Head as long as wide, nearly covered by pronotum, only anterior 1/4 visible (Fig. 1A). Antenna short and stubby, when extending posteriorly barely surpassing humeral region (Fig. 1A). Pronotum not constricted medially; anterior angles round; posterior margin bisinuate (Fig. 1A); with median longitudinal carina strongly visible throughout (Fig. 1A). Elytra ca. 4× length of pronotum; moderately dehiscent; basally subparallel (Fig. 1A); with two weakly developed elytral costae (Fig. 1A). Scutellar shield round posteriorly (Fig. 1A). Tergite VIII entire, apically round (Fig. 1G). Posterior margin of abdominal ventrite 7 with a deep V-shaped notch (Fig. 1D); ventrite 8 elongate, fusiform, longer than wide, medially notched apically (Fig. 1D). Male genitalia with median lobe stout, slightly fusiform, apically rounded, in ventral view bearing paired strut-like structure (Fig. 3A); parameres apically rounded (Fig. 3A), 1/5 shorter than median lobe; phallobase missing.

Length (exposed portion of head+pronotum+elytra): 3.2 mm. **Width (across humerus):** 0.7 mm.

Distribution. Mexico state, Mexico (Fig. 4).

Chespirito costae new species

(Figs. 1B, 1E, 1H, 2B, 3B, 4)

urn:lsid:zoobank.org:act:AB3256F6-C0C1-4007-B287-75D58751751D

Type material (1). Holotype: Cuernavaca; Mor., Mex/ VIII-6-1938; L. J. Lipovksy (SEMC).

Etymology. The species is named after Professor Cleide Costa, VSF's MSc advisor and colleague of MAI, in recognition of her many contributions to the study of immature Coleoptera, including fireflies and other bioluminescent beetles.

Diagnosis. *Chespirito costae* is morphologically similar to *Chespirito milleri* herein described, being easily separated from it by possessing the last tergite entire, apically round (Fig. 1H) (vs. posteriorly notched in *C. milleri*), the elytra insertion entirely black (Fig. 1B) (vs. yellow in *C. milleri*) and by the shape of the male genitalia (Fig. 3B).

Description. General color dark brown (Figs. 1B), mandibles and last three abdominal segments yellow (Figs. 1E, 1H). Head as long as wide, posterior 2/3 covered by pronotum (Fig. 1B). Antennae when extended posteriorly reaching apical third of elytra (Fig. 1B). Pronotum not constricted medially; anterior angles round; posterior margin bisinuate (Fig. 1B); median longitudinal carina strongly visible throughout (Fig. 1B). Elytra ca. 3.2× length of pronotum; weakly dehiscent; basally subparallel (Fig. 1B); with two weakly developed elytral costae (Fig. 1B). Scutellar shield posteriorly round (Fig. 1B). Abdomen with tergite VIII entire, apically round (Fig. 1H); ventrite 7 with shallow notch posteriorly (Fig. 1E); ventrite 8 elongate, fusiform, longer than wide, entire, not notched apically (Fig. 1E). Male genitalia with median lobe stout, fusiform, apically fan-shaped, round, in ventral view bearing paired strut-like structure, divergent apically (Fig. 3B); parameres bulb-shaped, apically round (Fig. 3B), 1/5 shorter than median lobe; phallobase small, longer than wide, posteriorly rounded (Fig. 3B).

Length (exposed portion of head+pronotum+elytra). 2.61 mm. **Width (across humerus):** 0.7 mm.

Distribution. Morelo state, Mexico (Fig. 4).

Chespirito milleri new species

(Figs. 1C, 1F, 1I, 2C–E, 3C, 4)

urn:lsid:zoobank.org:act:455A8698-915B-4DF3-8869-664DB7357779

Type material (2). **Holotype:** ARIZONA: Cochise Co.; Huachuca Mts., 5700'; Ramsey Can. 7.viii-93; B&B Valentine, colls. (USNM). **Paratype:** ARIZONA: Cochise Co.; Huachuca Mts., 5700'; Ramsey Can. 7.viii-93; B&B Valentine, colls. (MTEC).

Etymology. The species is named after Richard S. Miller (1945–2021), who first identified these specimens as a new genus and species but never described them. Rich worked primarily on Lycidae but was knowledgeable about a wide range of beetles and other insects, including all other 'cantharoids'. Rich was a close friend and colleague of MAI and a role model and source of inspiration to VSF.

Diagnosis. *Chespirito milleri* can be separated from other *Chespirito* spp. by the combination of a dorsally unicolorous pronotum and elytra (Fig. 1C) (vs. pronotal disc in *C. ballantynae* yellow), the pronotum not constricted medially (Fig. 1C) (vs. constricted in *C. zaragozai*), the last three abdominal segments distinctly yellow (Fig. 1F, 1I) (vs. dark brown in *C. lloydi* or not distinctly yellow in *C. zaragozai*) and by having ventrite 8 posteriorly entire and apically round (Fig. 1F) (vs. notched in *C. zaragozai*) and tergite VIII posteriorly notched (Fig. 1I) (vs. tergite VIII entire in *C. costae* and *C. hintoni*).

Description. General color dark brown (Figs. 1C), mandibles, elytral insertions, trochanters, tarsi and last three abdominal segments yellow (Figs. 1C). Head as long as wide; posterior 2/3 covered by pronotum (Fig. 1C). Antennae when extending posteriorly reaching apical third of elytra (Fig. 1C). Pronotum not constricted medially; anterior angles round; posterior margin bisinuate (Fig. 1C); median longitudinal carina strongly visible throughout (Fig. 1C). Elytra 3.2× length of pronotum, moderately dehiscent, basally subparallel (Fig. 1C), with two weakly developed elytral costae (Fig. 1C). Scutellar shield posteriorly round (Fig. 1C). Abdominal tergite VIII with distinct median notch (Fig. 1I); ventrite 7 shallowly notched posteriorly (Fig. 1F, 2D); ventrite 8 elongate, fusiform, longer than wide, entire posteriorly (Fig. 1F). Male genitalia with median lobe stout, fusiform, apically round, in ventral view bearing paired strut-like structure, divergent apically (Fig. 3C); parameres apically acuminate, acute (Fig. 3C), 1/2 shorter than median lobe; phallobase small, longer than wide, posteriorly rounded (Fig. 3C).

Length (exposed portion of head+pronotum+elytra). 3.3 mm. **Width (across humerus):** 0.9 mm.

Distribution. Known only from the Huachuca Mountains in southeast Arizona, USA (Fig. 4).

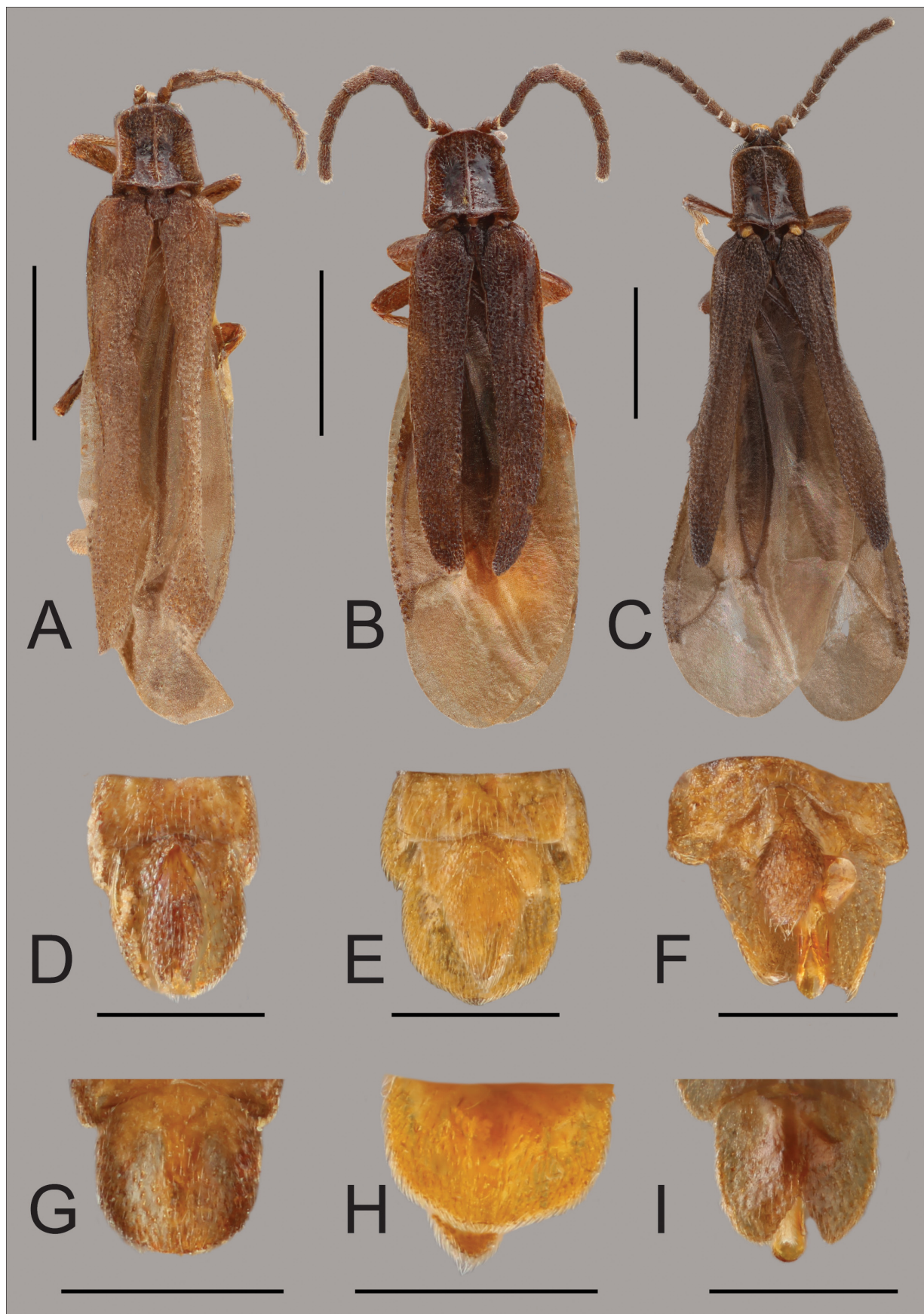


FIGURE 1. Dorsal habitus of *Chespirito* species. A) *C. hintoni*. B) *C. costae*. C) *C. milleri*. Ventral view of last three abdominal tergites (6–8). D) *C. hintoni*. E) *C. costae*. F) *C. milleri*. Dorsal view of last three abdominal ventrites. G) *C. hintoni*. H) *C. costae*. I) *C. milleri*. Scale bars: 1 mm.

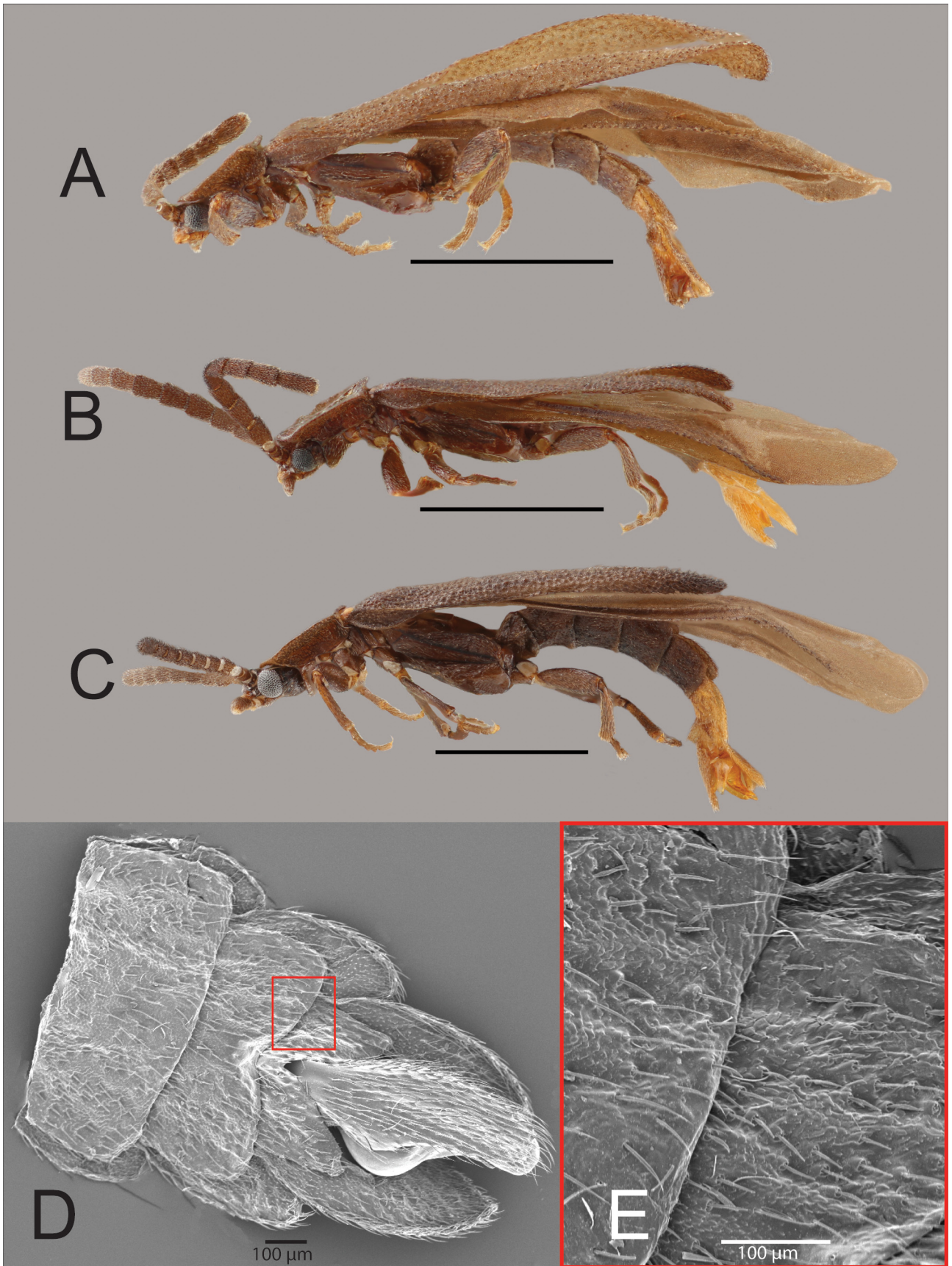


FIGURE 2. Lateral habitus of *Chespirito* species. A) *C. hintoni*. B) *C. costae*. C). *C. milleri*. Apically notched and bifurcated ventrite 7 in detail. D–E) *C. milleri*. Scale bars: A–C = 1 mm, D–E = 100 µm.

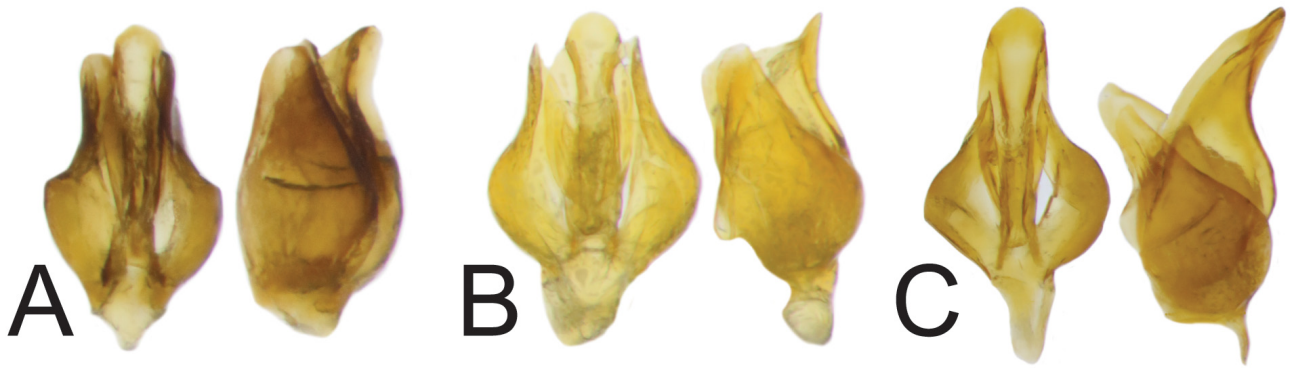


FIGURE 3. Male genitalia, ventral and lateral view. A) *C. hintoni*. B) *C. costae*. C). *C. milleri*.

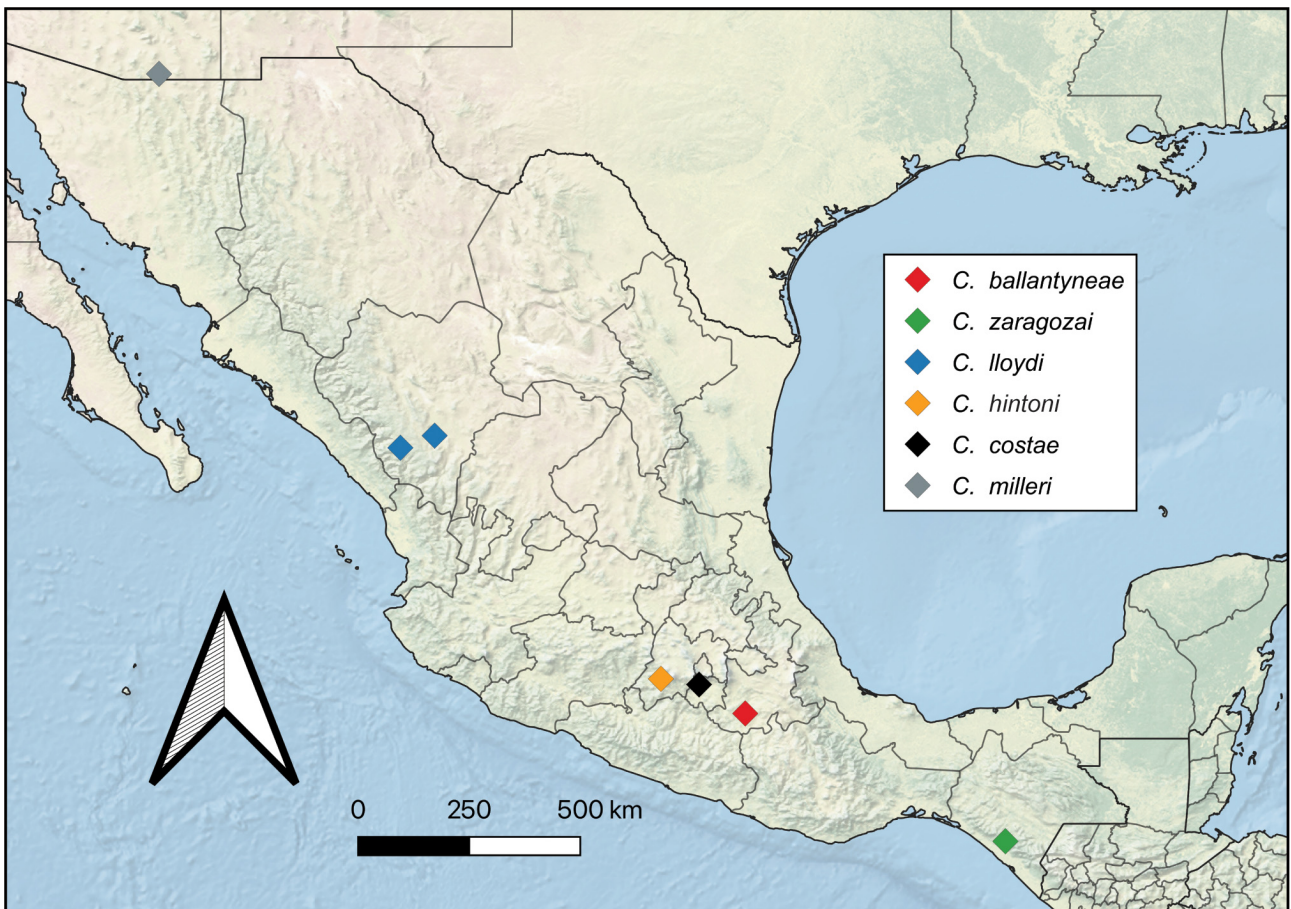


FIGURE 4. Distribution map of *Chespirito* species.

An updated key to the males of *Chespirito*

- 1. Pronotum with disc yellow, median longitudinal carina absent *Chespirito ballantyneae*
- 1'. Pronotum completely dark brown, strong median longitudinal carina present 2
- 2. Ventrite 8 entire, apically acuminate or round (Figs. 1E, 1F) 3
- 2'. Ventrite 8 apically notched and bifurcated (Fig. 1D) 5
- 3. Apical three abdominal ventrites dark brown *Chespirito lloydi*
- 3'. Apical three abdominal ventrites yellow 4
- 4. Apex of last visible tergite distinctly notched medially (Fig. 1I) *Chespirito milleri* new species

- 4'. Apex of last visible tergite round (Fig. 1H) *Chespirito costae* **new species**
 5. Pronotum strongly constricted medially; elytra strongly dehiscent; antennae moderately long, surpassing elytral basal third when extended posteriorly *Chespirito zaragozai*
 5'. Pronotum not constricted medially (Fig. 1A); elytra not dehiscent (Fig. 1A); antennae short and stubby, barely surpassing humeral region when extending posteriorly (Fig. 1A) *Chespirito hintoni* **new species**

Discussion

Like most lineages affected by the paedomorphic syndrome, little is known about the biology and distribution of Chespiritoinae, and the only study on these rarely collected beetles is their original description and phylogenetic study by Ferreira *et al.* (2020). Furthermore, Chespiritoinae is a non-bioluminescent lampyrid (e.g., *Brachylampis* Van Dyke 1939, *Cheguevaria Kazantsev* 2007, *Lucidota* Laporte 1833 *partim*, *Pseudolychnuris* Motschulsky 1853, *Pyropyga* Motschulsky 1853 (McDermott 1964; Branham and Wenzel 2003, Ferreira *et al.* 2019)), a group for which even less is known, especially when compared to bioluminescent lineages. Our closer examination of the ventral surface of the last three abdominal segments (ventrites 6–8) of *C. milleri* (Figs. 2D, 2E) found no evidence to support the existence of any light organs, such as the presence of photocytes (Bay *et al.*, 2013), which reinforces the hypothesis that Chespiritoinae is a non-bioluminescent lineage within the Lampyridae. The lack of light organs in *Chespirito* might suggest diurnal life history for the adult males, and possibly the use of pheromones to find mates. Branham and Wenzel (2003) hypothesized that non-bioluminescence is generally found in either basal firefly taxa or some derived lineages due to subsequent losses. The phylogenetic analysis in Ferreira *et al.* (2020) placed *Chespirito* basally within Lampyridae supporting the hypothesis by Branham and Wenzel (2003). The fact that specimens of this subfamily were only recently identified and described from scientific collections once again highlights and validates how important such collections are, not only for taxonomic and faunistic studies, but also evolutionary and ecological studies that heavily rely on the generated taxonomic knowledge.

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Authors contributions

VSF and OK conceived the study. VSF wrote the paper with contributions from OK and MAI. VSF prepared all plates. All authors reviewed and agreed with the final version of this study.

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