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SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

Two New Species of *Cryptolestes* Ganglbauer (Coleoptera, Cucujoidea, Laemophloeidae) from the Philippines and Brazil

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Abstract
Two new species of *Cryptolestes* Ganglbauer (Coleoptera, Cucujoidea, Laemophloeidae) are described and illustrated in this paper. *Cryptolestes cervus* **sp. nov.** from the Philippines and *C. subcalabozus* **sp. nov.** from Brazil are compared to their most similar congeners, from which they are distinguished based on the morphology of the male antennal scape. In addition, *Cryptolestes beccarii* (Grouvelle) is here redescribed based on the newly designated lectotype, with commentaries on the variation of the male antennal scape.

Keywords Flat beetles · Neotropical region · Oriental region · Taxonomy · Morphology

Introduction

The lined flat bark beetle genus *Cryptolestes* is a well-known, relatively diverse group of laemophloeids with several species recognized as important stored product pests (Howe and Lefkovitch 1957). The larvae are known to possess thoracic silk glands for the construction of pupal cocoons (Bishop 1959, 1960; Campbell et al. 1989). The genus was revised in the past by Thomas (1988, 2002a, b) and Lefkovitch (1958, 1959, 1962, 1964) and is composed of more than 50 species including the recently described ones (Mukhopadhyay 2016; Hauth and Bremer 2020; Bento 2022).

The purpose of this paper is to describe two new species of *Cryptolestes* with modified male antennal scape from the Philippines and Brazil. The new species are diagnosed, illustrated, and compared to their most similar congeners. In addition, *Cryptolestes beccarii* (Grouvelle 1883) is redescribed based on type material, from which the lectotype is designated. Commentaries on the variation of the male antennal scape in this species are also provided.

Material and methods

Morphological terminology is adopted from Beutel and Lawrence (2005). Total body **length** was measured from the anterior margin of clypeus to the elytral apex, and body **width** was measured at mid-elytra. The body pubescence is considered **inconspicuous** if the length of the setae is less than 0.015 mm and **conspicuous** if more than 0.015 mm. Regarding the conspicuous pubescence, setae are **moderate** if 0.015–0.030 mm and **long** if more than 0.030 mm in length.

Specimen and slide photographs were taken with a Canon EOS 750D camera provided with an MP-E 65 mm macro lens and a Nikon DS-Fi1 camera attached to a Nikon Eclipse 80i microscope, respectively. The produced images were processed and edited using the software programs Helicon Focus (Helicon Soft Ltd.) and Photoshop (Adobe Systems Inc.).

Label data transcription was made in the following format: "//" indicates the start and end of an individual label, whereas "/" indicates a line break of the same label.

The specimens examined in this paper including type-material are deposited in the following institutions:

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MSNG – Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy (Roberto Poggi).
NMB – Naturhistorisches Museum Basel, Basel, Switzerland (Matthias Borer and Isabelle Zürcher).

Results

Cryptolestes beccarii (Grouvelle 1883) (Cucujoidea, Laemophloeidae)

(Figs. 1a–d; 2a, b)

Laemophloeus beccarii Grouvelle 1883: 286, Fig.14; Kessel 1926: 61, 71, 80; Hetschko 1930: 23.

Cryptolestes beccarii; Lefkovitch 1958: 94 (new combination).

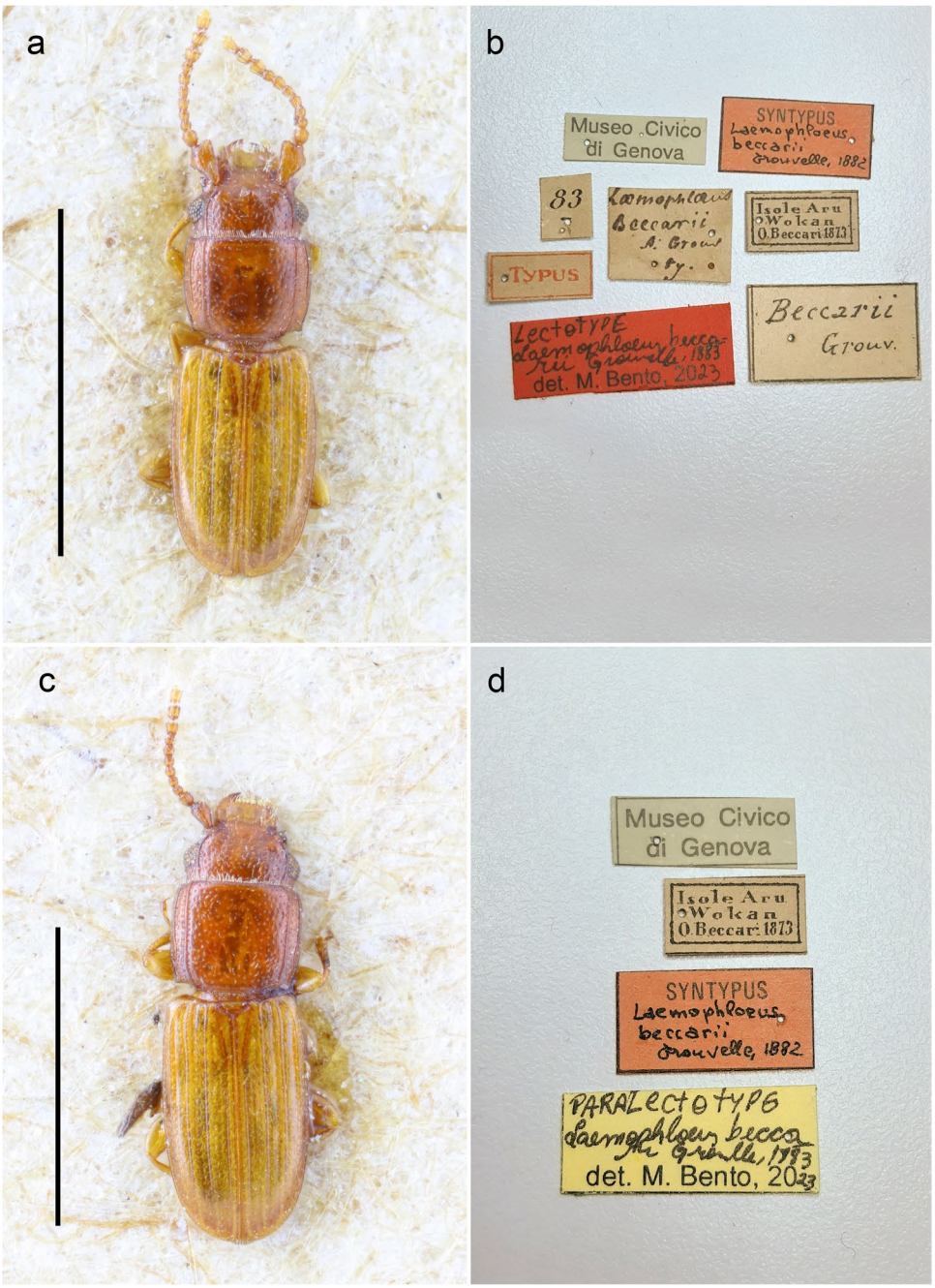

Fig. 1 *Cryptolestes beccarii* (Grouvelle 1883): dorsal view and labels of the (**a**, **b**) lectotype male; and the (**c**, **d**) paralectotype female. Scale: 1 mm

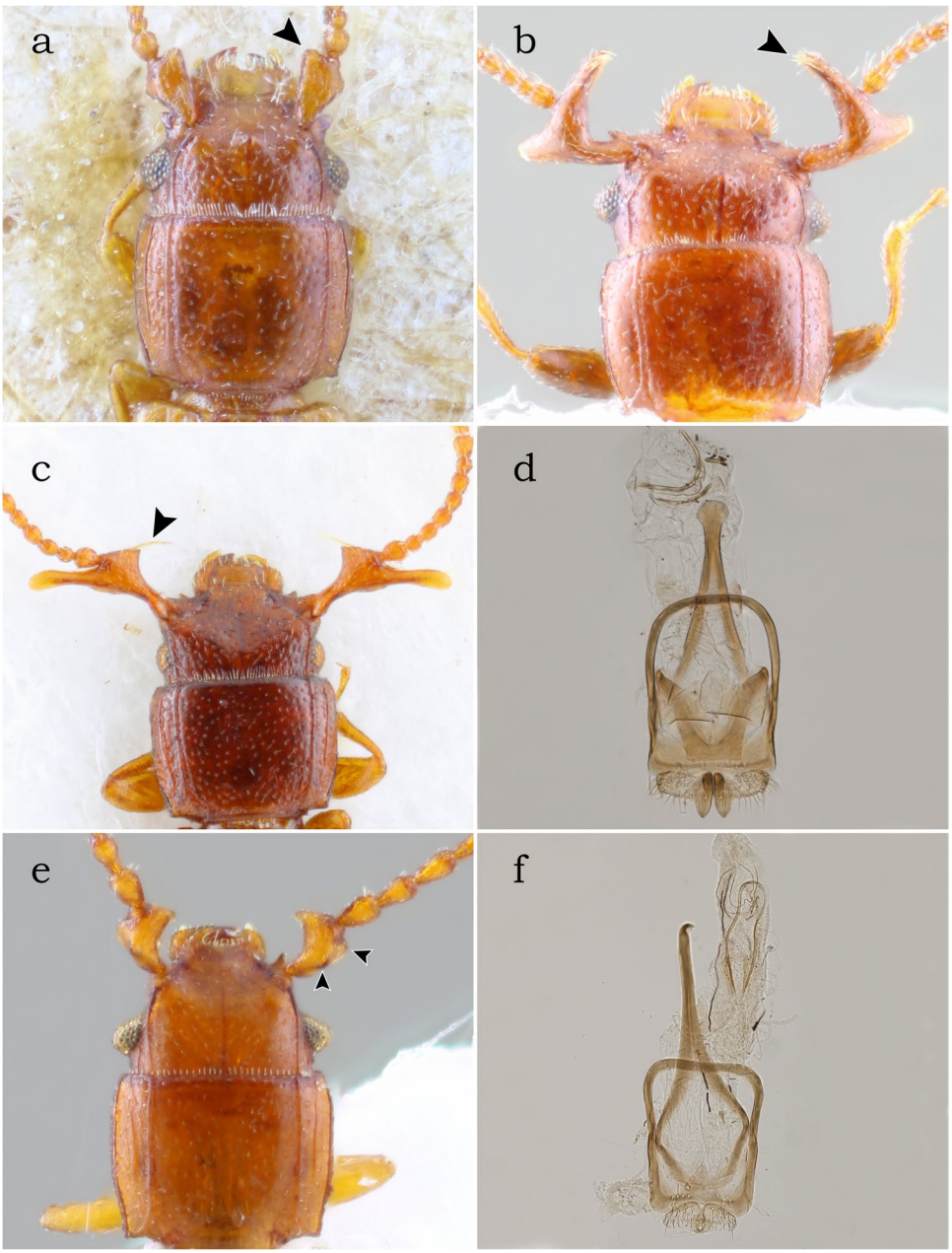

Fig. 2 Comparison of male head and pronotum and male genitalia in *Cryptolestes* spp.: (**a**, **b**) *C. beccarii* (Grouvelle 1883) from (**a**) Indonesia and (**b**) Fiji, with black arrow indicating the internoapical projection of the antennal scape; (**c**, **d**) *C. cervus* **sp. nov.** from the Philippines, with black arrow indicating the internoapical projection of the antennal scape bearing an apical seta; (**e**, **f**) *C. subcalabozus* **sp. nov.** from Brazil, with black arrows indicating the dorsomedial and externoapical projections of the antennal scape

Type material. Lectotype male (Fig. 1a, b) (here designated) deposited at **MSNG**, labeled: "Isole Aru / Wolcan / O. Beccari 1873" (white, printed) // "Beccarii / Grouv." (white, handwritten) // "TYPUS" (white, printed) // Laemophloeus / Beccarii / A. Grouv. / Ty." (white, handwritten) // "83" (printed) // "Museo Civico / di Genova" (light green, printed) // "SYNTYPUS / Laemophloeus / beccarii / Grouvelle 1882" (red, printed and handwritten) // "LECTOTYPE / Laemophloeus becca- / rii Grouvelle 1882 / det. Bento 2023" (red, handwritten and printed). **Paralectotype** (Fig. 1c, d), labeled: "Isole Aru / Wolcan / O. Beccari 1873" (white, printed) // "Museo Civico / di Genova" (light green, printed) // "SYNTYPUS / Laemophloeus / beccarii / Grouvelle 1882" (red, printed and handwritten) (♀, **MSNG**); "PARALECTOTYPE / Laemophloeus becca- / rii Grouvelle 1882 / det. Bento 2023″ (yellow, handwritten and printed).

Non-type material. Fiji, Taveuni Island, Waiyevo, 23.XI.1923, Dr. H. S. Evans (leg.) (1 ♂, 15 ♀, BMNH).

Diagnosis. Head acutely projected in front of eyes in both sexes. Male frons with a small, tooth-like central tubercle. Male antennal scape widely variable, from triangular and weakly expanded to strongly projected, bearing a large external projection as well as a large, flattened internoapical projection with an apical tuft of short setae (Fig. 2a, b).

Redescription of lectotype male (Figs. 1a, b; 2a). Length 1.2 mm, width 0.45 mm. **Coloration.** Head and

pronotum dark reddish brown; elytra and venter light brown. **Head** large, somewhat pentagonal, 1.4 times wider than long and medially shorter than pronotum, with dorsal and ventral surface inconspicuously pubescent, with short pale setae inserted in deep punctures. Frons very wide, with a small tooth-like, central tubercle; punctures smaller than an eye facet, separated from each other by 2 puncture diameters; surface smooth between punctures; interocular width 5.5 times wider than transverse eye diameter. Lateral sides acutely projected anteriad of eyes; projection slightly curved. Clypeus with anterior margin truncate. **Antennae** distinctly shorter than half the body. Scape much shorter than pronotum, dorsoventrally flattened, subtriangular in dorsal view, unprojected. Pedicel globose, not projected, slightly larger than segments 3–8. Segments 9–11 subglobose, larger than preceding flagellomers and forming a distinct club. **Pronotum** subrectangular, slightly wider than long; surface moderately setose, with short pale setae. Secondary sublateral lines strongly defined between sublateral line and lateral margin, reaching around posterior third. Anterior angles obtuse. Posterior angles weakly acute and slightly produced posteriorly. **Elytra** 3.2 times longer than wide, with sides strongly declivous; surface sparsely setose. **Thoracic venter.** Procoxal cavities posteriorly open. Prosternal process broad, twice wider than long, with apical margin slightly curved. **Abdomen.** Intercoxal process of ventrite 1 broad, as wide as metacoxa, with apical margin almost straight.

Paralectotype female. Length 1.4 mm. Width 0.5 mm. The paralectotype female is very similar to the male except for the antennal scape unmodified and short (Fig. 1c), and the central tubercle of frons inconspicuous.

Distribution. Indonesia: Aru Island. Fiji: Taveuni Island (new record).

Remarks. According to Lefkovitch (1958), who analyzed a large series of *C. beccarii*, this species showed a great deal of variation in the form of the male antennal scape, which in extreme forms may be strongly projected at apex, bearing a large external projection as well as a large, flattened internoapical projection with an apical tuft of setae (Fig. 2b). Lefkovitch (1958) stated: "A long series of this Pacific Island species has shown the range of variation which may occur in the form of the male scape. The smallest male shows a first segment hardly longer than that of the female but having indications of lateral processes". Later in the same work, he declares: "In the Laemophloeinae, the heterogeny of a secondary sexual character has been inadvertently used by previous workers as the basis of the description of new species…One can imagine such a situation arising in *C. beccarii* (Grouvelle) if that species were more widely distributed in areas of the world inhabited by entomologists". Lefkovitch (1958) expressed his justification for considering males with major and smaller scapes as representing a cline. However, some important differences between these extremes of variation were observed: 1) the types of *C. beccarii* have pronotum with well defined, almost complete secondary sublateral lines, whereas in the single major male from Fiji analyzed in this study the sublateral lines are completely absent; and 2) the smaller, unprojected male scape represented by the lectotype has no apical tuft of setae, which is present in the male with larger, projected scape. Here, since the lack of material prevented this issue from being addressed, the concept of *C. beccarii* adopted in this paper agrees with that of Lefkovitch (1958) until new morphological data from male aedeagus and endophallus support or refute his hypothesis. Herein, a couple of syntypes of *Cryptolestes beccarii* were found at **MSNG**, the male of which is designated as the lectotype of this species as it was illustrated in the original description by Grouvelle (1883: Fig. 14) (ICZN 1999: Recommendation 74B). The male lectotype (here designated) has the antennal scape weakly expanded, triangular-shaped, and without projections (Fig. 2a).

Cryptolestes cervus, **sp. nov.**

(Figs. 2c, d; 3a, b)

Type material. Holotype male (dissected) deposited at **NMB**, labeled: "PALAWAN I. 300 m / CLEOPATRA Needle N. P. / TANABANK Riv. Val. / 20.-22.12.1990, Bolm lgt." (white, printed) // "Coll. NMB" (yellow, printed). **Paratypes**, same data as holotype (2 ♀, **NMB**).

Etymology. The specific epithet is a Latin word for "deer" and refers to the projected male antennal scape of this species.

Diagnosis. Head acutely projected in front of eyes in both sexes (Fig. 2c; 3a). Frons flat, without a central tubercle (Fig. 2c). Male antennal scape as in Fig. 2c, with a short internal projection bearing a single thick, long seta.

Description of holotype male (Figs. 2c, d; 3a). Length 1.4 mm, width 0.4 mm. **Coloration.** Head and pronotum dark reddish brown; elytra and venter light brown. **Head** large, somewhat pentagonal, 1.2 times wider than long and medially shorter than pronotum, with dorsal and ventral surface inconspicuously pubescent, with short pale setae inserted in deep punctures. Frons very wide, with anterior half slightly depressed; punctures smaller than an eye facet, separated from each other by 2 puncture diameters; surface smooth between punctures; interocular width 9.3 times transverse eye diameter. Lateral sides acutely projected anteriad of eyes. Clypeus with anterior margin truncate. **Antennae** slightly longer than half the body. Scape elongate, as long as pronotum, with a long, thumb-shaped posteroapical projection, and a short, acute anteroapical projection bearing a long, thick apical seta. Pedicel globose, not projected, slightly larger than segments 3–8. Segments 9–11 larger than preceding flagellomers and forming a loose club, each slightly longer than wide. **Pronotum** subrectangular, slightly

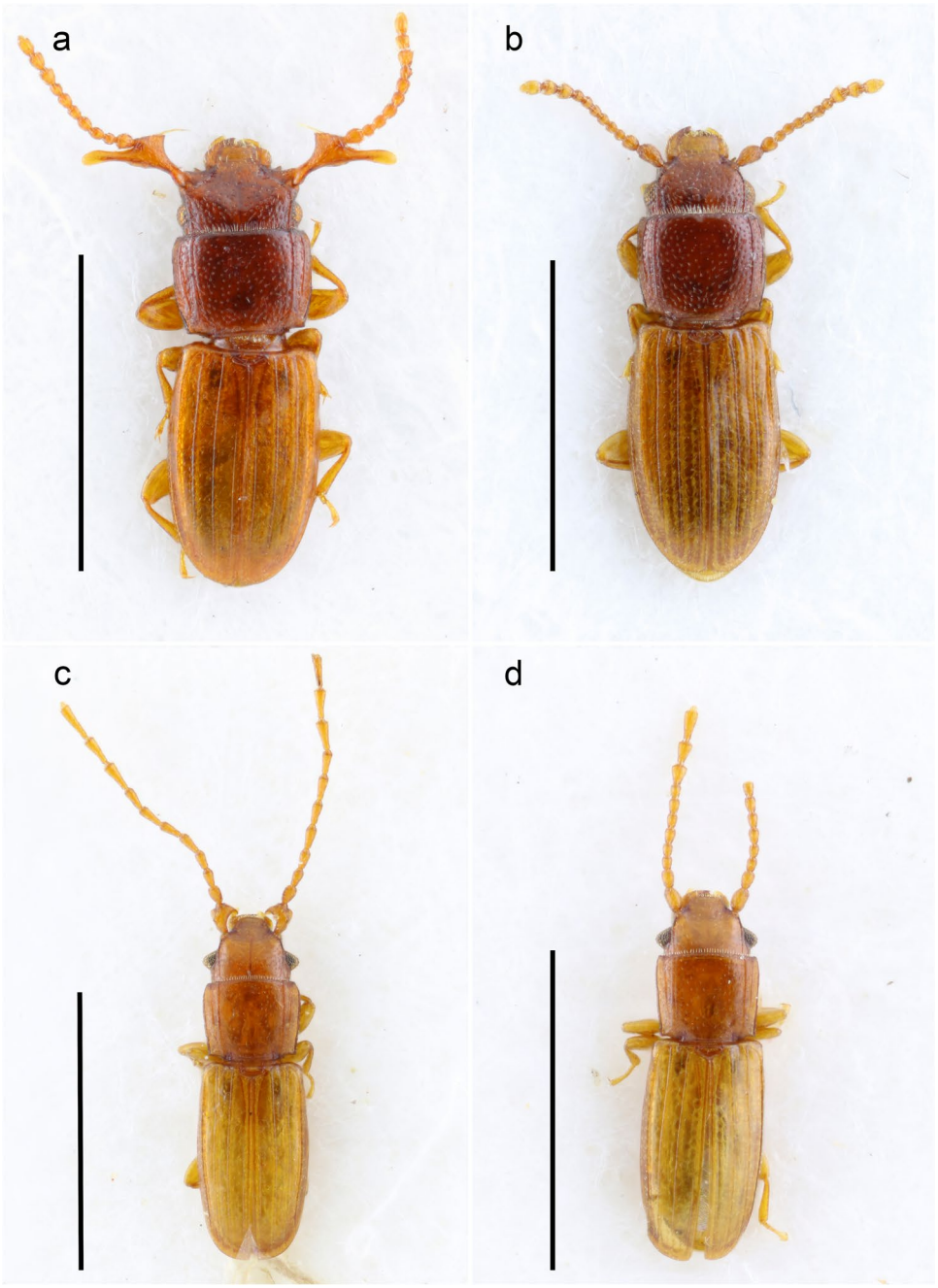

Fig. 3 *Cryptolestes* spp. nov.: (**a**) holotype male and (**b**) paratype female of *C. cervus* **sp. nov.** in dorsal view; (**c**) male and (**d**) paratype female of *C. subcalabozus* **sp. nov.** Scale: 1 mm

wider than long; surface moderately setose, with short pale setae. Secondary sublateral line strongly defined between sublateral line and lateral margin, completely effaced at posterior third. Anterior angles obtuse. Posterior angles weakly acute and slightly produced posteriorly. **Elytra** 3 times longer than wide, with sides strongly declivous; surface sparsely setose. **Thoracic venter.** Procoxal cavities posteriorly open. Prosternal process broad, twice wider than long, with apical margin slightly curved. **Abdomen.** Intercoxal process of ventrite 1 broad, as wide as metacoxa, with apical margin almost straight. **Genitalia** (Fig. 2d). Tegmen broadly rounded at base; apex with a few setigerous punctures at middle. Median lobe with an acute, basally directed lateral projection on each side. Parameres moderately setose, setae thick; median region with two glabrous, subtriangular lobes strongly sclerotized at base and longitudinally striated at apex. Endophallus (incomplete) with a filament-shaped sclerite.

Female ($n = 2$). Length 1.4–1.5 mm. Width 0.4 mm. Females are very similar to males except for the antennal scape unmodified, short and unprojected (Fig. 3b).

Type locality. PHILIPPINES: Palawan.

Remarks. Male specimens of *C. cervus* **sp. nov.** can be confused with those of *C. beccarii* (Grouvelle 1883) because of the head acutely projected in front of eyes as well as the antennal scape strongly projected, which according to Lefkovitch (1958) represents an extreme of variation within *C. beccarii*. However, males of *C. cervus* **sp. nov.** can be distinguished by the frons flat, without a central tubercle (central tubercle present in males of *C. beccarii*), and the general form of the antennal scape, which has a short internal projection bearing a single thick, long seta (long internal projection bearing a tuft of thin, short setae in *C. beccarii*).

Cryptolestes subcalabozus, **sp. nov.**

(Figs. 2e, f; 3c, d)

Type material. Holotype male deposited at **INPA**, labeled: "BRAZIL: Am. / Reserva Ducke / 26 km NE Manaus / Hurtado, J. C. G." (white, printed) // "Tree No 47 / Tray No.1" (white, printed) // BMNH {E} / 2003–84" (white, printed) // "Eschweilera / wachenheimii / 16.iii.1996" (white, printed). **Paratypes** with same data as holotype, but "Tree No. 43 / Tray No. 4" // "02.v.1996" (♀, **BMNH**); "Tree No. 77 / Tray No.4" // 23.vi.1996" (♀, **INPA**); "Tree No. 108 / Tray No.3" // 30.vii.1995" (♂, **INPA**); "Tree No. 43 / Tray No.10" // 02.v.1996" (♀, **INPA**); "Tree No. 24 / Tray No.8" // 01.ix.1995" (♂, **BMNH**); "Tree No. 42 / Tray No.8" // 23.vi.1996" (♀, **BMNH**); "Tree No. 108 / Tray No.1" // 01.iv.1996" (♂, **BMNH**); "Tree No. 42 / Tray No.9" // 23.vi.1996" (♀, **BMNH**); "Tree No. 42 / Tray No.6" // 23.iv.1996″ (♂, **INPA**); "Tree No. 105 / Tray No.4″ // 21.viii.1995″ (♀, ♂, **BMNH**); "Tree No. 43 / Tray No.10″ // 15.viii.1995″ (2 ♀, **INPA**); "Tree No. 77 / Tray No.7″ // 16.x.1995″ (♀, ♂, **INPA**); "Tree No. 42 / Tray No.5″ // 20.vii.1995″ (♀, **INPA**); "Tree No. 108 / Tray No.1″ // 30.vii.1995″ (♀, **BMNH**); "Tree No. 108 / Tray No.8″ // 01.iv.1996″ (3 ♀, **BMNH**); "Tree No. 105 / Tray No.7″ // 01.v.1996″ (♀, **INPA**); "Tree No. 77 / Tray No.5″ // 23.vi.1996″ (♂, **INPA**).

Etymology. This species is named "*subcalabozus*" because of its similarity with the Neotropical species *C. calabozus* Thomas 1988.

Diagnosis. Eyes conical, strongly protruding laterally (Figs. 2e; 3c, d). Male antennal scape subtriangular in dorsal view, with a small dorsomedial tooth; apex with a wide, flattened, strongly concave internal projection, and a small, tooth-like external projection (Fig. 2e).

Description, male (Figs. 2e, f; 3c) ($n = 8$). Length 1.2–1.3 mm, width 0.4 mm. **Coloration.** Head and pronotum light reddish brown; elytra and venter light testaceous. **Head** large, somewhat pentagonal, 1.2 times wider than long and medially shorter than pronotum, with dorsal and ventral surface inconspicuously pubescent, with short pale setae inserted in shallow, barely visible punctures. Eyes somewhat conical, strongly protruding laterally. Frons very wide, with anterior half not depressed; punctures smaller than an eye facet, separated from each other by more than 2 puncture diameters; surface smooth between punctures; interocular width 5.1 times transverse eye diameter. Lateral sides not projected anteriad of eyes. Clypeus with anterior margin truncate. **Antennae** much longer than half the body. Scape somewhat triangular in dorsal view, 1.2 times longer than wide at apex; shorter than pronotum and as long as antennomeres 2 and 3 combined, strongly curved inwards, with a small dorsomedial tooth; apex with wide, flattened internal projection, and a small, tooth-like external projection. Pedicel oblong, 1.8 times longer than wide, not projected, slightly shorter than segments 3–8. Segments 9–11 elongate, longer than preceding flagellomers and forming a loose club. **Pronotum** subrectangular, slightly wider than long; surface moderately setose, with short pale setae. Secondary sublateral line strongly defined between sublateral line and lateral margin, reaching around posterior half. Anterior angles obtuse. Posterior angles weakly acute and slightly produced posteriorly. **Elytra** 3.6 times longer than wide, with sides strongly declivous; surface sparsely setose. **Thoracic venter.** Procoxal cavities posteriorly open. Prosternal process broad, twice wider than long, with apical margin slightly curved. **Abdomen.** Intercoxal process of ventrite 1 broad, as wide as metacoxa, with apical margin almost straight. **Genitalia** (Fig. 2f). Tegmen subquadrate at base and slightly constricted at middle; apex sparsely setose, with setae moderate in size; apical angles glabrous. Median lobe expanded at middle, weakly angulated laterally, without projections. Parameres small, separately subtriangular, distinctly narrower than tegmen, with apex weakly hooked; surface moderately covered with short setae. Endophallus with an apical, filament-shaped sclerite surrounded by small, tooth-like asperites.

Female ($n = 15$). Length 1.1–1.2 mm. Width 0.4 mm. Females are very similar to males except for the antennal scape unmodified, short and unprojected, with apex weakly tilt inwards (Fig. 3d).

Type locality. BRAZIL. Amazonas: Manaus.

Remarks. Cryptolestes subcalabozus sp. nov. may be confused with the Neotropical species *C. calabozus* Thomas 1988 because of the form of the male antennal scape, which is subtriangular and bears external and internal projections. However, in *C. subcalabozus* **sp. nov.** the male scape is strongly concave inwards, with a dorsomedial tooth and a short, obtuse external projection, whereas in *C. calabozus* the male scape is relatively larger, weakly concave inwards, with no dorsomedial tooth and with a large, acute external projection. In addition, the new species has small, conical, laterally protruding eyes in both sexes (large, rounded eyes in *C. calabozus*).

All the specimens composing the type series of this species were collected for a canopy study using fogging machines in the Reserve Ducke, Manaus, Brazil (pers. comm. Marcio Oliveira, INPA).

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Nomenclature Zoobank Registration number: http://zoobank.org/urn:lsid:zoobank.org:pub:ED0C72EA-045F-4CD5-80EB-EC4E2162DC06.

Author's Contributions MB wrote the manuscript and all of the authors contributed substantially by providing critical reviews and adding intellectual content to the final version.

Data Availability The data that support the findings of this study are openly available within this article as well as in the entomological collections of public institutions mentioned in the text.

Declarations

Conflicts of Interest The authors declare no conflict of interest.

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