

RESEARCH

Open Access

Key to species of the genus *Cryptorhopalum* (Coleoptera: Dermestidae) occurring in the Greater Antilles with description of six new species from Hispaniola

Marcin Kadej^{1*} and Jiří Háva²

Abstract

Background: The genus *Cryptorhopalum*, is in the subfamily Megatominae. It is relatively speciose within family Dermestidae and currently contains ca. 149 valid taxa. Most of the species are found in the Neotropical and Nearctic ecozones Mroczkowski (Ann Zool, 26:15–191,1968); Beal (Transact Am Entomol Soc, 111:171–221, 1985a). Although we know so many species of this genus, the knowledge of the biology (including development) is still incomplete and limited.

Results: Six new species of the poorly known genus *Cryptorhopalum*: *C. acevedoi* sp. nov., *C. davidsoni* sp. nov., *C. delacruzii* sp. nov., *C. rawlinsoni* sp. nov., *C. thompsonii* sp. nov., and *C. youngi* sp. nov., all from the Dominican Republic, are described and illustrated; a key to determination of these species is also provided.

Conclusions: Nearctic representatives of *Cryptorhopalum* were divided into three informal species groups: *haplotes*, *quadripunctatum*, and *triste* Beal (Contrib Science Nat Hist Mus Los Angeles County, 306:1–22, 1979); Beal (Transact Am Entomol Soc, 111:171–221, 1985a). Newly found species displayed a mix of characteristics of these groups. Thus, other Neotropical species should be re-examined, and further study of *Cryptorhopalum* is required.

Keywords: Coleoptera; Dermestidae; *Cryptorhopalum*; Taxonomy; New species; Hispaniola; Key to species

Background

The genus *Cryptorhopalum* Guérin-Méneville, 1838 of the Megatominae includes about 149 valid taxa, most of which are found in the Neotropical and Nearctic ecozones (Mroczkowski 1968; Beal 1985a; Háva 2003, 2007, 2009, 2011, 2012). A formal redescription of the genus was published by Beal (1979). The genus is closely related to *Thaumaglossa* Redtenbacher, *Orphinus* Motschulsky, and two other New World genera, *Hemirhopalum* Sharp and *Labrocerus* Sharp (Beal 1961; Kiselyova and McHugh 2006; Kadej and Kitano 2010), and can be distinguished from the above-mentioned genera by the features presented in Table 1. The main generic differences in the morphology of adults within other Nearctic Dermestidae (except

Hemirhopalum, which also has a two-segmented antennal club) are related to the following combination of characters: an ovate, more or less evenly convex body; a two-segmented antennal club, which occupies the antennal fossa excavated in the hypomeron; a posterior margin of the fossa which is bounded by a fine, thread-like carina; and the plane of the hypomeron which continues behind the fossa, although in males of some species, the lateroposterior corner of the fossa reaches the posterior edge of the hypomeron (Beal 1985a). The presence of a two-segmented antennal club (compare to data in Table 1) in both *Cryptorhopalum* and *Hemirhopalum* can make distinguishing between them difficult, and at first glance, it might be difficult to separate these two genera. However, there are some features in the morphology of the body (more or less oval or somewhat egg-shaped in *Cryptorhopalum* vs. elongated and on average larger and respectively longer in size in *Hemirhopalum*) that distinguish them. Moreover, the pubescence (pronotum and

* Correspondence: marcin.kadej@gmail.com

¹Division of Invertebrates Biology, Evolution and Conservation, Department of Evolutionary Biology and Ecology, University of Wrocław, Przybyszewskiego 63/77, Wrocław PL-51-148, Poland
Full list of author information is available at the end of the article

Table 1 Comparison of genera closely related to *Cryptorhopalum*

Genera characters	<i>Cryptorhopalum</i>	<i>Hemirhopalum</i>	<i>Labrocerus</i>	<i>Orphinus</i>	<i>Thaumaglossa</i>
Structure of the antennal club of male	Two-segmented, more or less oval or somewhat egg-shaped, and ultimate and penultimate segments of club subequal in length, or penultimate segment is longer than ultimate	Two-segmented, oval and elongate rather than round, and ultimate and penultimate segments of club subequal in length, or penultimate segment longer than ultimate	Two to eight-segmented	Two-segmented, round or suboval, ultimate segment greatly enlarged and dominates antennal club	Three-segmented, round or subtriangular, ultimate segment greatly enlarged and dominates antennal club
Appendix on the claw	Absent	Absent	Absent	Absent	Present
Distribution	Nearctic and Neotropical	Neotropical	Nearctic	Afrotropic, Indo-Malayan, Australasian, and Oceanic	Nearctic, Neotropical, Afrotropic, and Indo-Malayan

Following Beal (1959, 2003), Ohbayashi (1985), Háva (2004), and Kadej and Kitano (2010).

elytrae mostly covered by distinct hairs, often forming spots or fasciae in *Cryptorhopalum*, while *Hemirhopalum* is mostly naked or with only thin and short pubescence) is useful in identification. Despite these differences, we share Beal's opinion (Beal 1985a) that *Hemirhopalum* needs further study to confirm its taxonomical status as a genus.

Morphological descriptions of the larval stages of the genus exist for only 3 species of the 149 known species worldwide (Rees 1943; Beal 1975; Kiselyova 2002; Kiselyova and McHugh 2006; Háva 2012). The larvae of *Cryptorhopalum* resemble the larvae of *Anthrenus*, and they react similarly to disturbance by 'freezing' and spreading the tufts of the hastisetae inserted in the membranous portions of the posterior terga (Kiselyova and McHugh 2006). Larval stages can be distinguished from those of other Nearctic genera within Dermestidae by the combination of characters given by Beal (1975).

Few revisions of Neotropical species of *Cryptorhopalum* (Reitter 1881; Sharp 1902) or of the Nearctic fauna (Casey 1900; Beal 1979) have been published so far. However, the last general revision of Nearctic species of the genus *Cryptorhopalum* was published by Beal (1985a), which included taxonomic studies, an overview of the ecological characteristics, and descriptions of six new species.

A great number of species were described by Sharp (1902) and Beal (1979, 1985a, 1985b), and that the number continues to increase (Beal 1995; Herrmann and Háva 2011). Although we know so many species of this genus, our knowledge of the biology (including development) is still incomplete and limited. Thus, further investigations of the biology and systematics of this poorly known genus are required (Beal 1985b).

In spite of the fact that numerous species have mainly a Neotropical distribution, so far, only two species have been recorded from French Guiana (Herrmann and Háva 2011), and another four fossil taxa of *Cryptorhopalum* were recorded from the Dominican Republic (Háva and Prokop 2004; Perez-Gelabert 2008; Háva 2012).

The current paper provides detailed morphological descriptions of adults of six species of *Cryptorhopalum*

from Hispaniola. This work is a continuation of three preceding articles about Dominican Dermestidae (Háva and Prokop 2004; Háva and Kadej 2006a, 2006b) and is supplementary to the knowledge of the biodiversity of arthropods of Hispaniola (Perez-Gelabert 2008).

All of the newly described species were found within undetermined material from the Carnegie Museum of Natural History, Pittsburg, PA, USA. The following set of characters is described, illustrated, and discussed for *Cryptorhopalum*: habitus (dorsal and ventral aspects); morphology of the antenna; male genitalia; abdominal sternites VIII, IX, and X; abdominal ventrites I-V; and pygidium. A key to the Neotropical species from the Dominican Republic and adjacent areas is presented.

Methods

Morphological structures were boiled for 3 to 10 min in 10% KOH and placed in distilled water for approximately 1 h to clean and soften the cuticle. All structures were placed on glycerin mounts. Morphological structures were examined with a Nikon Eclipse E 600 phase-contrast microscope (Tokyo, Japan) with a drawing tube and a Nikon SMZ-800 binocular microscope. Photographs were taken with a Canon 500D (Taipei, Taiwan) and a Nikon Coolpix 4500 camera under a Nikon Eclipse 80i and/or a Nikon SMZ-800. Image stacks were processed using Combine ZM (Hadley 2010).

The terminology used in this paper followed Beal (1998) and Lawrence and Ślipiński (2010). Separate labels are indicated by a slash (/). Author's remarks are in square brackets ([]).

All of the specimens were labeled with red, printed labels bearing the text as follows: HOLOTYPE [or PARATYPE, respectively] *genus_name species_name* J. HÁVA & M. KADEJ det. 2012.

Taxonomy

Cryptorhopalum acevedoi sp. nov.

The specimen is shown in Figure 1.

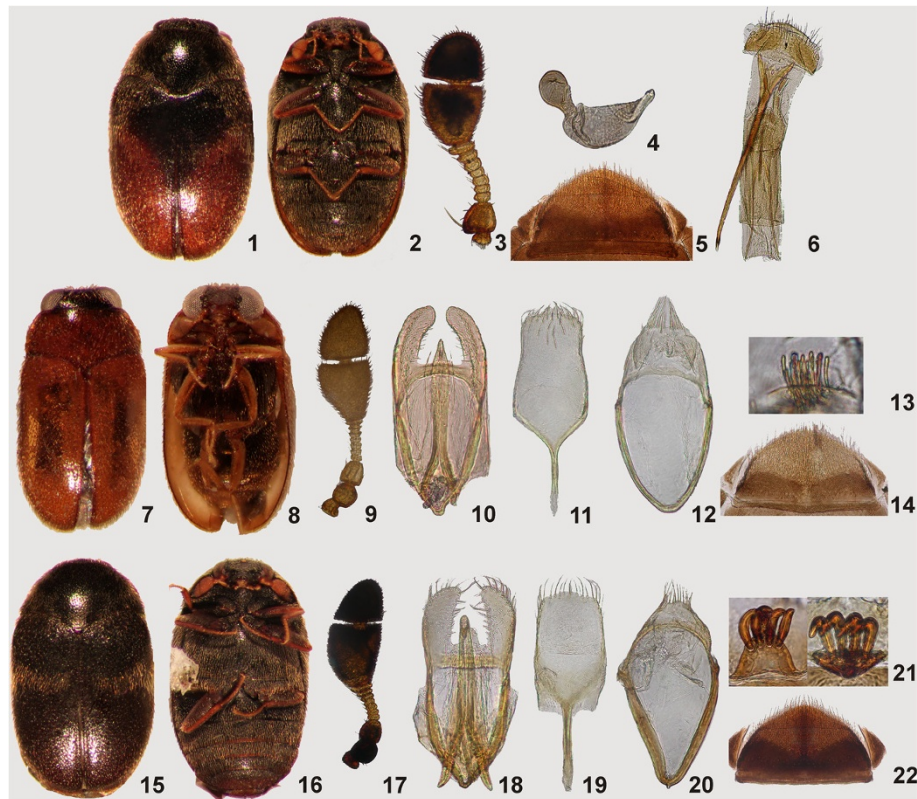


Figure 1 Characteristics of *Cryptorhopalum acevedoi* sp. nov., *Cryptorhopalum davidsoni* sp. nov. and *Cryptorhopalum delacruzii* sp. nov. *Cryptorhopalum acevedoi* sp. nov.: (1) Habitus (dorsal view). (2) Habitus (ventral view). (3) Female antenna (left, ventral view). (4) Spermatheca. (5) Pygidium (dorsal view). (6) Female genitalia. *Cryptorhopalum davidsoni* sp. nov.: (7) Habitus (dorsal view). (8) Habitus (ventral view). (9) Male antenna (left, ventral view). (10) Phallus (ventral view). (11) Abdominal sternite IX. (12) Abdominal sternite X. (13) Cluster of simple setae at middle abdominal sternite VIII. (14) Pygidium (dorsal view). *Cryptorhopalum delacruzii* sp. nov.: (15) Habitus (dorsal view). (16) Habitus (ventral view). (17) Male antenna (left, ventral view). (18) Phallus (ventral view). (19) Abdominal sternite IX. (20) Abdominal sternite X. (21) Posterior median process of abdominal sternite VIII (ventral view of four curved dorsal setae). (22) Pygidium (dorsal view).

Type locality: Dominican Republic: Duarte.

Material examined: Holotype (HT) ♀: Dominican Republic: Duarte, Reserva Loma Quita Espuela El Cadillar, 6.7 km NE San Francisco de Macoris, 19°20' 12"N, 70°08'59"W/280 m, 5 April 2004, collected by R. Davidson, J. Rawlins, and C. Young, weedy regrowth with coffee, cacao, UV light, sample 50313, CMNH-355, 154 (CMNH, Collection of the Carnegie Museum of Natural History (CMNH)) [Left antennomere I remains in the antennal fossa, other antennomeres with terminalia placed in plastic vial with glycerin].

Etymology: The epithet is a patronym honoring the collector of the new species, P. Acevedo (USA).

Diagnosis: The new species closely resembles *C. delacruzii* sp. nov., *C. rawlinsoni* sp. nov., *C. thompsonii* sp. nov., and *C. youngi* sp. nov. It can be distinguished from them by the following characteristics: in *C. acevedoi* sp. nov., a sub-basal band of light-colored pubescence is present on the elytra (1 (Figure 1)), while in *C. rawlinsoni* sp. nov., *C. thompsonii* sp. nov., and *C. youngi* sp. nov., the

pubescence is unicolorous (23, 31, 39 (Figure 2)); in *C. ecevedoi* sp. nov., the integument of the elytron (except the area from the anterior margins for one-fourth the length of the elytron and a slim line along the suture which are black) is brown (1 (Figure 1)), while in *C. delacruzii* sp. nov., the integument of the pronotum and elytron is dark brown (almost black) (15 (Figure 1)), in *C. rawlinsoni* sp. nov., it is dark brown (23 (Figure 2)), and in *C. thompsonii* sp. nov. and *C. youngi* sp. nov., it is dark brown (almost black) (31, 39 (Figure 2)).

Description

1. Body: Ovate, convex, and slightly rounded laterally; dorsal and ventral pubescent recumbent, entirely light golden brown (1, 2 (Figure 1)); length from anterior margin of pronotum to apex of elytron 2.0 mm, median length of pronotum 0.5 mm, maximum width of pronotum 1.05 mm, length of elytron 1.4 mm, maximum width across elytron 1.1 mm. Ratio

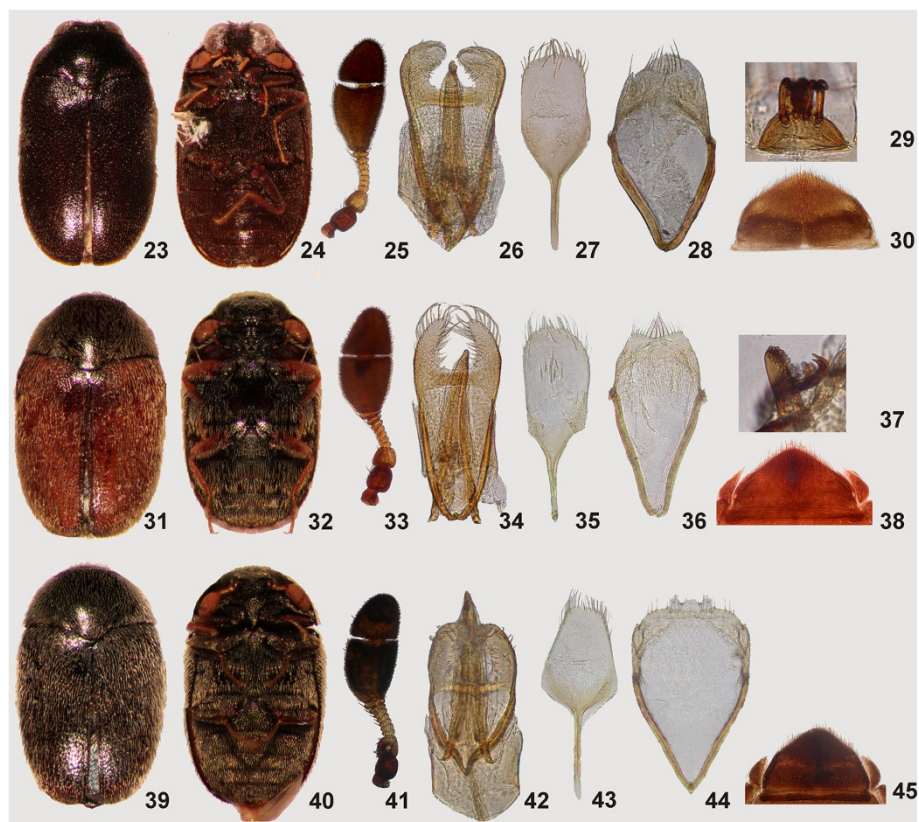


Figure 2 Characters of *Cryptorhopalum rawlinsoni* sp. nov., *Cryptorhopalum thompsonii* sp. nov., and *Cryptorhopalum youngi* sp. nov. *Cryptorhopalum rawlinsoni* sp. nov.: (23) Habitus (dorsal view). (24) Habitus (ventral view). (25) Male antenna (left, ventral view). (26) Phallus (ventral view). (27) Abdominal sternite IX. (28) Abdominal sternite X. (29) Posterior median process of abdominal sternite VIII (ventral view of four curved dorsal setae). (30) Pygidium (dorsal view). *Cryptorhopalum thompsonii* sp. nov.: (31) Habitus (dorsal view). (32) Habitus (ventral view). (33) Male antenna (left, ventral view). (34) Phallus (ventral view). (35) Abdominal sternite IX. (36) Abdominal sternite X. (37) Median process of abdominal sternite VIII (lateral view). (38) Pygidium (dorsal view). *Cryptorhopalum youngi* sp. nov.: (39) Habitus (dorsal view). (40) Habitus (ventral view). (41) Male antenna (left, ventral view). (42) Phallus (ventral view). (43) Abdominal sternite IX. (44) Abdominal sternite X. (45) Pygidium (dorsal view).

- of width (across humeri) to length (of pronotum and elytra combined) is 1.0:1.81.
2. Head: Visible from above; integument of head is black; sparsely punctured. Eyes are brown, large, and convex with internal, deep emargination at one-third length of the eye. Median ocellus is present. Frons and clypeus are covered with light gold pubescence. Antenna has 11 antennomeres. Antennal club is ovate, with two antennomeres (3 (Figure 1)); antennomere I is dark brown, while antennomeres II to XI are light brown. Antennal club is ovate and shorter than the flagellum; relative length of terminal antennomere to length of penultimate antennomere is nearly 1.2:1.0 (0.65:0.55). Ratio of width to length of antennomere X is 1.0:1.0; the ratio of width to length of antennomere XI is 1.2:1.0.
 3. Thorax: Prosternal process is transversally flat, without median carina. Metasternum has very fine,

- short, diagonal stria originating at margins behind the mesocoxae.
4. Pronotum and elytron: The integument of the pronotum is black and covered with golden-light pubescence; the integument of the elytron (except the area from the anterior margins for one-fourth length of elytron and slim line along suture which are black) brown, covered with light gold pubescence, among which also with irregular brown pubescence. Scutellum triangular, black (1 (Figure 1)). Antennal fossa conforming to shape of antennal club and occupying about one-half of area of hypomeron. Ratio of length of antennal fossa to length of lateral margin of pronotum (hypomeron) is 1.0:2.1. Antennal fossa at lateroposterior margin not reaching posterior margin of hypomeron. Cavities of antennal fossa densely and shallowly punctured. Distinct and visible subtriangular area between lateroanterior margin of hypomeron

(close to eye) and antennal fossa. Lateral margin of pronotum slightly is dilated above antennal fossa. Pronotal dorsal rim of antennal fossa is slightly visible from above.

5. Legs: Dorsal surface is covered with light gold pubescence. Trochanters, coxae, and femora are dark brown; tibiae and tarsi are brown (brighter than other parts). Tibiae has distinct, but small, short, strong, black setae; tibia spinose on dorsal margin (which resembles tibial teeth). Tarsus has two slightly curved claws.
6. Ventrites I to V: Integument is brown to dark brown with light golden pubescence (2 (Figure 1)). Visible ventrite I has two oblique striae on each side extending from anterior margin of ventrite beneath trochanters for three-fourth length of segment. Visible ventrite V has no foveae on dorsum (compare to Beal 1979, p. 13).
7. Female genitalia is illustrated in images (4) and (6) in Figure 1.
8. Pygidium: Basal part from margin to one-third length of pygidium is brown and has two or three transverse lines of points of insertion of setae; remaining area is light brown with brown, slightly prominent setae. Apical part is slightly narrowed (5 (Figure 1)).

Remarks: Male unknown.

Distribution: Dominican Republic.

Cryptorhopalum davidsoni sp. nov.

For the following discussion, please see images (7) to (14) in Figure 1, (46) in Figure 3, and (51) in Figure 4.

Type locality: Dominican Republic: La Altagracia.

Material examined: Holotype ♂: Dominican Republic: La Altagracia, Parque del Este, 2.9 km SW Boca de Yuma, 11 m, 18°21'51"N, 68°37'05"W, 28 May 2004/

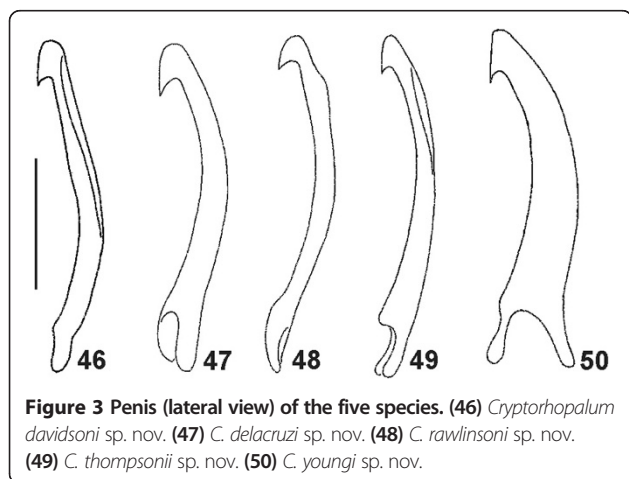


Figure 3 Penis (lateral view) of the five species. (46) *Cryptorhopalum davidsoni* sp. nov. (47) *C. delacruzii* sp. nov. (48) *C. rawlinsoni* sp. nov. (49) *C. thompsonii* sp. nov. (50) *C. youngi* sp. nov.

collected by C. Young, J. Rawlins, J. Fetzner, and C. Nuñez, semihumid dry forest, limestone, UV light, sample 52114, CMNH-395,250 (CMNH) [Left antennomere with terminalia in plastic vial with glycerin].

Paratypes (PT) 2 ♂♂: same data as for holotype (CMNH); 4 ♂♂: Dominican Republic: La Altagracia, Parque del Este, 2.9 km SW Boca de Yuma, 11 m, 18°21'51"N, 68°37'05"W, 28 May 2004/collected by C. Young, J. Rawlins, J. Fetzner, and C. Nuñez, semihumid dry forest, limestone, UV light, sample 52114 (CMNH); 15 ♂♂, 1 ♀: Dominican Republic: La Altagracia, Parque del Este, Caseta Guaraguao, 4.4 km SE Bayahibe, 18°19'59"N, 68°48'42"W, 3 m, 26 to 27 May 2004/collected by C. Young, J. Rawlins, J. Fetzner, and C. Nuñez, semihumid forest near sea, limestone, UV light, sample 51114 (11 CMNH, 3 Collection of Private Entomological Laboratory and Collection (JHAC), 2 collection of Marcin Kadej (MK)); 3 ♂♂: Dominican Republic: Duarte, Reserva Loma Quita Espuela El Cadillar, 6.7 km NE San Francisco de Macoris, 19°20'12"N, 70°08'59"W/280 m, 5 April 2004/collected by R. Davidson, J. Rawlins, and C. Young, weedy regrowth with coffee, cacao, UV light, sample 50313 (CMNH); 2 ♂♂: Dominican Republic: Pedernales, 23.5 km N Cabo Rojo, 18°06'N, 71°38'W, 540 m, 20 July 1990/collected by C.W. Young, J.E. Rawlins, and S. Thompson (CMNH). Non-type material studied: Dominican Republic, Barahona, October 2003, native collector, (six species), JHAC.

Etymology: The epithet is a patronym honoring the curator of Coleoptera at CMNH, Dr. Robert L. Davidson.

Diagnosis: The new species closely resembles *C. rawlinsoni* sp. nov. It can be distinguished from it by the following characteristics: in *C. davidsoni* sp. nov., the integument of the pronotum and elytron is light brown (7 (Figure 1)), while in *C. rawlinsoni* sp. nov., it is dark brown (23 (Figure 2)). In *C. davidsoni* sp. nov., the median process of the abdominal sternite VIII in the male is absent (only a cluster of simple setae is present in the middle (13 (Figure 1); 51 (Figure 4)), while in *C. rawlinsoni* sp. nov., a distinct median process is present (29 (Figure 2); 54–56 (Figure 4)). In *C. davidsoni* sp. nov., the bridge of the parameres is not arcuate to the apices of the parameres and is as broad as two-thirds of the width of the penis at its widest part; the apex of the parameres is slightly curved inward (10 (Figure 1)). In *C. rawlinsoni* sp. nov., the bridge of the parameres is slightly arcuate to the apices of the parameres, as broad as one-half of the width of the penis at its widest part, and the apex of the parameres is distinctly curved inward (26 (Figure 2)).

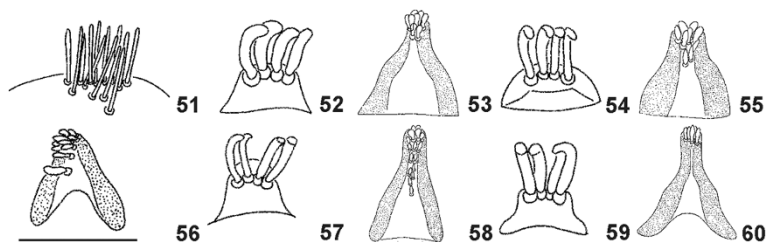


Figure 4 Details of the abdominal sternite. (51) *Cryptorhopalum davidsoni* sp. nov. (cluster of simple setae at middle abdominal sternite VIII). (52) *C. delacruzii* sp. nov. (posterior median process, ventral view of four curved dorsal setae). (53) *C. delacruzii* sp. nov. (apical process, ventral view). (54) *C. rawlinsoni* sp. nov. (posterior median process, ventral view of four curved dorsal setae). (55) *C. rawlinsoni* sp. nov. (apical process, ventral view). (56) *C. rawlinsoni* sp. nov. (apical process, lateroventral view). (57) *C. thompsonii* sp. nov. (posterior median process, ventral view of four curved dorsal setae). (58) *C. thompsonii* sp. nov. (apical process, ventral view). (59) *C. youngi* sp. nov. (posterior median process, ventral view of four curved dorsal setae). (60) *C. youngi* sp. nov. (apical process, ventral view).

Description

1. Body: Slightly convex and subovate, dorsal and ventral pubescent recumbent, entirely brown; surface of integument sparsely punctured (7, 8 (Figure 1)); HT: length from anterior margin of head to apex of elytron is 1.85 mm, median length of pronotum is 0.45 mm, maximum width of pronotum is 0.9 mm, length of elytron is 1.25 mm, maximum width across elytron is 0.95 mm; PT: length from anterior margin of head to apex of elytron is 1.5 to 2.85 mm, median length of pronotum is 0.3 to 0.7 mm, maximum width of pronotum is 0.65 to 1.4 mm, length of elytron is 1.0 to 2.0 mm, maximum width across elytron is 0.7 to 1.6 mm. Ratio of width (across humeri) to length (of pronotum and elytra combined) is 1.0:1.95.
2. Head: As viewed from above, integument light brown and sparsely punctured; eyes silver, large, convex, with internal, deep emargination at one-third length of eye (8 (Figure 1)). Median ocellus is present. Frons and clypeus are covered with dark brown pubescence. Antenna has 11 antennomeres. Antennal club has two antennomeres (9 (Figure 1)); antennomere I is brown, antennomeres II to XI is light brown. Antennal club is ovate, only slightly shorter than flagellum; relative length of terminal antennomere to length of penultimate antennomere is 1:1 (0.65:0.65). Ratio of width to length of antennomere X is 1.0:1.2 (0.55:0.65); ratio of width to length of antennomere XI is 1.0:1.3 (0.5:0.65).
3. Thorax: Prosternal process transversely flat, without median carina. Metasternum has very fine, short, diagonal stria originating at margins behind mesocoxae. Ventral surfaces of integument are dark brown, sparsely punctured, and covered by brown pubescence.
4. Pronotum and elytron: Surfaces of integument of pronotum and elytron are light brown, only margins

along suture are dark brown; entire area is sparsely punctured and covered by brown pubescence (7 (Figure 1)). Scutellum is triangular, small, and poorly marked, with dark brown margins. Antennal fossa is conforming to the shape of antennal club and occupying nearly entire area of hypomeron. Ratio of length of antennal fossa to length of lateral margin of pronotum (hypomeron) is 1.0:1.1. Antennal fossa at lateroposterior margin is nearly reaching the posterior margin of hypomeron. Cavities of antennal fossa are densely and shallowly punctured. Lack of distinct and visible subtriangular area between lateroanterior margin of hypomeron (close to eye) and antennal fossa. Lateral margin of pronotum is slightly dilated above antennal fossa. Pronotal dorsal rim of antennal fossa along nearly entire pronotal margin and visible from above.

5. Legs: Light brown and covered with brown pubescence on dorsal surface (8 (Figure 1)). Tibiae has small but distinct, short, strong, black setae; tibia spinose on dorsal margin (which only looks like tibial teeth, but is not). Tarsus with two slightly curved claws.
6. Ventrites I to V: Surfaces of integument are light brown, sparsely punctured, and covered by light brown (light golden) pubescence (8 (Figure 1)). Visible ventrite I with two oblique striae on each side extending from anterior margin of ventrite beneath trochanters for two-fifth length of segment.
7. Phallus: Symmetrical (10 (Figure 1)). Ratio of length of penis to length of parameres is 1.0:1.2. Penis long above phallobase (basal furcae) with anteriorly directed spine, not reaching apices of parameres, but slightly extending beyond bridge, apex of penis in lateral view appears hook-like, acute, and strongly curved (46 (Figure 3)); bridge of parameres slightly arcuate to apices of parameres, poorly sclerotized, as broad as one-half of width of penis at its widest part; parameres has numerous scattered, short, erect setae

on inner subapical parts; apex of parameres is slightly curved inward; stalks of phallobase are parallel.

8. Abdominal sternites VIII to X: Abdominal sternite VIII of male has no extended median process, only cluster of simple setae at middle present (13 (Figure 1); 51 (Figure 4)). Lateral long apophyses of abdominal sternite VIII are absent. Abdominal sternite IX appears like a spatula with slight constriction at one-third length of lateral margins; numerous prominent setae are located on apical margin and on lateral margins to one-third their length, a few setae are also present on central part of flat area below apex (11 (Figure 1)). Abdominal sternite X is illustrated in image (12) in Figure 1.
9. Pygidium: Basal part from margin to one-third length of pygidium is brown, with two or three transverse lines of short setae; remaining area is light brown with densely located, slightly prominent, but longer setae. Apical part is slightly narrowed (14 (Figure 1)).

Distribution: Dominican Republic.

***Cryptorhopalum delacruzii* sp. nov.**

Please see images (15) to (22) in Figure 1, (47) in Figure 3, and (52) and (53) in Figure 4 for reference.

1. *Type locality:* Dominican Republic: Pedernales.
2. *Material examined:* Holotype ♂: Dominican Republic: Pedernales, Sierra de Baoruco, Aceitillar, 25.2 km ENE Pedernales, 18°05'29"N, 71°31'16"W, 1272 m, 14 June 2003/collected by C. Young, J. Rawlins, R. Davidson, P. Acevedo, and M. de la Cruz; dense broadleaf forest, pine, yellow pan trap, sample 42262, CMNH-358,759 (CMNH) [Abdominal ventrite II is broken in its central area; left antenna with terminalia is placed in plastic vial with glycerin].
3. *Etymology:* The epithet is a patronym honoring the collector of the new species, M. de la Cruz (USA).
4. *Diagnosis:* The new species closely resembles *C. acevedoi* sp. nov., *C. rawlinsonii* sp. nov., *C. thompsonii* sp. nov., and *C. youngi* sp. nov. It can be distinguished from them by the following characteristics: in *C. delacruzii* sp. nov., a sub-basal band of light-colored pubescence is present on the elytra (15 (Figure 1)), while in *C. rawlinsonii* sp. nov., *C. thompsonii* sp. nov., and *C. youngi* sp. nov., the pubescence is unicolorous (23, 31, 39 (Figure 2)). In *C. delacruzii* sp. nov., the integument of the pronotum and elytron is dark brown (almost black) (15 (Figure 1)), while in *C. acevedoi* sp. nov., the integument of the elytron (except the area from the

anterior margins for one-fourth of the length of the elytron and a slim line along the suture which are black) is brown (1 (Figure 1)). In *C. delacruzii* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part; the ratio of the length of the penis to the length of the parameres is 1.0:1.1. The penis does not extend above the apices of the parameres (18 (Figure 1)). In *C. rawlinsonii* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part; the ratio of the length of the penis to the length of the parameres is 1.0: 1.1, and the penis does not extend above the apices of the parameres (26 (Figure 2)). In *C. thompsonii* sp. nov., the bridge of the parameres is as broad as two-fifths of the width of the penis at its widest part; the ratio of the length of the penis to the length of the parameres is 1.0:1.2, and the penis does not extend above the apices of the parameres (34 (Figure 2)). In *C. youngi* sp. nov., the bridge of the parameres is as broad as one-fifth of the width of the penis at its widest part; the ratio of the length of the penis to the length of the parameres is 1.0:0.85, and the penis extends above the apices of the parameres (42 (Figure 2)).

Description

1. *Body:* Ovate and slightly convex, dorsal and ventral pubescent recumbent, light gold and brown; surface of integument is dark brown (almost black) and sparsely punctured (15, 16 (Figure 1)); length from anterior margin of pronotum to apex of elytron is 2.45 mm, median length of pronotum is 0.55 mm, maximum width of pronotum is 1.3 mm, length of elytron is 1.7 mm, and maximum width across elytron is 1.45 mm. Ratio of width (across humeri) to length (of pronotum and elytra combined) is 1.0:1.7.
2. *Head:* Visible from above; integument is dark brown (almost black) and sparsely punctured; eyes are brown, large, convex, with internal, very slight (almost invisible) emargination at one-third length of eye. Median ocellus is present (16 (Figure 1)). Frons and clypeus are covered with dark brown pubescence. Antenna has 11 antennomeres. Antennal club has two antennomeres (17 (Figure 1)); antennomere I is dark brown, while the antennomeres II to XI are light brown. Antennal club is only longer than flagellum; relative length of terminal antennomere to length of penultimate antennomere is 1.0:1.25 (0.8:1.0). Ratio of width to length of antennomere X 1.0:1.1 (0.9:1.0); ratio of width to length of antennomere XI 1.0:0.8 (0.9:0.8).
3. *Thorax:* Prosternal process transversely flat, without median carina. Metasternum has very fine, short,

diagonal stria originating at margins behind mesocoxae. Ventral surfaces of integument are dark brown, sparsely punctured, and covered with brown and light brown pubescence.

4. Pronotum and elytron: Surfaces of integument of pronotum and elytron are dark brown (almost black); entire area is sparsely punctured and covered with brown pubescence, except elytron which has a distinct sub-basal band formed by light gold hairs (located at one-third length of total elytral length). Scutellum is triangular, small, and poorly marked (15 (Figure 1)). Antennal fossa conforming to shape of antennal club and occupying nearly entire area of hypomeron. Ratio of length of antennal fossa to length of lateral margin of pronotum (hypomeron) is 1.0:1.55. Antennal fossa at lateroposterior margin is not reaching posterior margin of hypomeron (16 (Figure 1)). Cavities of antennal fossa are densely and shallowly punctured. Lateral margin of pronotum is slightly dilated above antennal fossa. Barely visible subtriangular area is present between lateroanterior margin of hypomeron (close to eye); antennal fossa is small (difficult to see). Pronotal dorsal rim of antennal fossa is slightly visible from above.
5. Legs: Dark brown, except tarsi (light brown), covered with brown pubescence on dorsal surface (16 (Figure 1)). Tibiae has small but distinct, short, strong, black setae; tibia spinose on dorsal margin (which resembles tibial teeth). Tarsus has two slightly curved claws.
6. Ventrites I to V: Surfaces of integument are dark brown, sparsely punctured, and covered with light brown (light golden) pubescence (16 (Figure 1)). Visible ventrite I has two oblique striae on each side extending from anterior margin of ventrite beneath trochanters for nine-tenths length of segment.
7. Phallus: Symmetrical (18 (Figure 1)). Ratio of length of penis to length of parameres 1.0:1.1. Penis long above phallobase with anteriorly directed spine, not reaching apices of parameres, but extending beyond bridge; apex of penis in lateral view is acute and strongly hook-like (47 (Figure 3)); bridge of parameres is not arcuate to apices of parameres, poorly sclerotized, and as broad as two-thirds of width of penis at its widest part; parameres has numerous scattered, relatively long, erect setae apically, on apex and inner apical part; stalks of phallobase are parallel.
8. Abdominal sternites VIII to X: Abdominal sternite VIII of male has four curved dorsal setae of posterior median process (21 (Figure 1), 52 (Figure 4)) inserted above ventral peg-like setae. Apical process appears as in image (53) in Figure 4.

Lateral long apophyses of abdominal sternite VIII are absent. Abdominal sternite IX is spatula-like with prominent setae located on apical margin and lateral margins to one-fourth of their length (19 (Figure 1)). Abdominal sternite X as illustrated in (20 (Figure 1)).

9. Pygidium: Basal part from margin to one-half length of pygidium is brown with two or three transverse lines with short setae; remaining area is light brown with densely located, slightly prominent, but longer setae. Apical part is slightly narrowed (22 (Figure 1)).

Distribution: Dominican Republic.

Cryptorhopalum rawlinsoni sp. nov.

In this section, please refer to images (23) to (30) in Figure 2, (48) in Figure 3, and (54) to (56) in Figure 4.

Type locality: Dominican Republic: Bahoruco.

Material examined: Holotype ♂: Dominican Republic: Bahoruco, 5.8 km SW Neiba, eastern playa of Lago Enriquillo, 18°25'17"N, 71°26'38"W/5 m, 3 April 2004, collected by J. Rawlins, R. Davidson, and C. Young, salt scrub on sandy playa, hand-collected, sample 50143/CMNH-355,109 (CMNH) [Left antenna with terminalia was placed in plastic vial with glycerin].

Paratypes 6 ♂♂: same data as for holotype (4 CMNH, 2 JHAC); 8 ♂♂: Dominican Republic: La Altagracia, Parque del Este, Caseta Guaraguao, 4.4 km SE Bayahibe, 18°19'59"N, 68°48'42"W, 3 m, 26 to 27 May 2004/collected by C. Young, J. Rawlins, J. Fetzner, and C. Nuñez, semihumid forest near sea, limestone, UV light, sample 51114 (6 CMNH, 1 JHAC, 1 MK); 1 ♂: Dominican Republic: San Juan, 8 km NE Vallejuelo, 690 m, 18°42'N, 71°16'W/30 August 1995, collected by J. Rawlins, G. Onore, and R. Davidson, arid thorn-scrub/woodland (CMNH); 1 ♂: Dominican Republic: Monte Cristi, 5 km NNE Botoncillo, 50 m, 19°46'N, 71°24'W/29 to 30 November 1992, collected by R. Davidson, M. Klingler, S. Thompson, and J. Rawlins, arid thorn-scrub (CMNH); (1 ♂): Dominican Republic: Pedernales, 9.5 km N Cabo Rojo, 18°02'N, 71°39'W, 35 m, 19 July 1990, collected by J. Rawlins, C.W. Young, and S.A. Thompson (CMNH); 2 ♂♂: Dominican Republic: Pedernales, Cabo Rojo, sea level, 17°55'N, 71°39'W, 21 October 1991/collected by J. Rawlins, R. Davidson, C. Young, and S. Thompson, edge of salt-marsh (CMNH); 1 ♂: Dominican Republic: Pedernales, 14.5 km N Cabo Rojo, 165 m, 18°03'N, 71°39'W/26 to 27 September 1991, collected by C. Young, S. Thompson, R. Davidson, and J. Rawlins, arid thorn-scrub (CMNH).

Etymology: The epithet is a patronym honoring the collector of the new species, J. Rawlins (USA).

Diagnosis: The new species closely resembles *C. acevedoi* sp. nov., *C. delacruzii* sp. nov., *C. thompsonii* sp. nov., and *C. youngi* sp. nov. It can be distinguished from them by the following characteristics: in *C. rawlinsoni* sp. nov., pubescence is unicolorous (2 (Figure 2)), while in *C. acevedoi* sp. nov. and *C. delacruzii* sp. nov., a sub-basal band of light-colored pubescence is present on the elytra (1, 15 (Figure 1)). In *C. rawlinsoni* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.1, and the penis does not extend above the apices of the parameres (26 (Figure 2)). In *C. delacruzii* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.1, and the penis does not extend above the apices of the parameres (18 (Figure 1)). In *C. thompsonii* sp. nov., the bridge of the parameres is as broad as two-fifths of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.2, and the penis does not extend above the apices of the parameres (34 (Figure 2)). In *C. youngi* sp. nov., the bridge of the parameres is as broad as one-fifth of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:0.85, and the penis extends above the apices of the parameres (42 (Figure 2)).

Description

1. Body: Ovate and slightly convex, dorsal and ventral pubescent recumbent, dark brown (only in light seems to be light brown); surface of integument is dark brown (almost black) and sparsely punctured (23, 24 (Figure 2)); HT: length from anterior margin of pronotum to apex of elytron is 3.0 mm, median length of pronotum is 0.7 mm, maximum width of pronotum is 1.5 mm, length of elytron is 2.2 mm, and maximum width across elytron is 1.7 mm; PT: length from anterior margin of pronotum to apex of elytron is 2.05 to 3.15 mm, median length of pronotum is 0.5 to 0.8 mm, maximum width of pronotum is 0.95 to 1.55 mm, length of elytron is 1.3 to 2.05 mm, and maximum width across elytron is 1.05 to 1.75 mm. Ratio of width (across humeri) to length (of pronotum and elytra combined) is 1.0:1.8.
2. Head: Visible from above; eyes are silver, large, convex, with internal, deep emargination at one-third length of eye. Median ocellus is present (24 (Figure 2)). Frons and clypeus are covered with dark brown pubescence. Deep and distinct cavity on frons (between eyes) is present. Antenna has 11 antennomeres. Antennal club has two antennomeres (25 (Figure 2)); antennomere I is dark brown, antennomeres I to XI are light brown. Antennal club is ovate and shorter than flagellum; relative length of terminal antennomere to length of penultimate antennomere is nearly 1:1 (0.9:1.0). Ratio of width to length of antennomere X is 1.0:1.2 (0.55:0.65), ratio of width to length of antennomere XI 1.0:0.8 (0.9:0.8). Dorsal and ventral surfaces of integument are dark brown, sparsely punctured, and covered by dark brown pubescence.
3. Thorax: Prosternal process transversely flat, without median carina. Metasternum has very fine, short, diagonal stria originating at margins behind mesocoxae. Ventral surfaces of integument are dark brown, sparsely punctured, and covered by brown and dark brown pubescence.
4. Pronotum and elytron: Surfaces of integument are dark brown, sparsely punctured, and covered by dark brown pubescence. Lateral margin of pronotum is dilated above antennal fossa and slightly visible from above. Scutellum is small and poorly marked (23 (Figure 2)). Antennal fossa conforming to shape of antennal club and occupying nearly entire area of hypomeron. Ratio of length of antennal fossa to length of lateral margin of pronotum (hypomeron) is 1.0:1.5. Antennal fossa at lateroposterior margin nearly reaches posterior margin of hypomeron (24 (Figure 2)). Cavities of antennal fossa are densely and shallowly punctured. Small but visible subtriangular area is present between lateroanterior margin of hypomeron (close to eye) and antennal fossa. Pronotal dorsal rim of antennal fossa is very slightly visible from above.
5. Legs: Covered on dorsal surface with brown pubescence. Trochanter and femur are brown. Tibiae are light brown (24 (Figure 2)), with small but distinct, short, strong, black setae; tibia spinose on dorsal margin (which only looks like tibial teeth, but is not). Tarsus is light brown with two slightly curved claws.
6. Ventrites I to V: Surfaces of integument dark brown, sparsely punctured covered by dark brown pubescence (24 (Figure 2)). Visible ventrite I with two oblique striae on each side extending from anterior margin of ventrite beneath trochanters for three-fourths length of segment.
7. Phallus: Symmetrical (26 (Figure 2)). Ratio of length of penis to length of parameres is 1.0:1.1. Penis is long above phallobase with anteriorly directed spine, not reaching apices of parameres, but extending

beyond bridge; apex of penis in lateral view is hook-like, acute, and strongly curved (48 (Figure 3)). Bridge of parameres is not arcuate to apices of parameres, poorly sclerotized, as broad as two-thirds of width of penis at its widest part; parameres have numerous scattered, relatively long, erect setae apically and with shorter, erect setae on apex and inner apical part; stalks of phallobase are parallel. Apex of parameres is distinctly curved inward.

8. Abdominal sternites VIII to X: Abdominal sternite VIII of male has four curved dorsal setae of posterior median process (29 (Figure 2), 54 (Figure 4)) inserted above ventral peg-like setae. Apical process appears as in images (55) and (56) in Figure 4. Lateral long apophyses of abdominal sternite VIII are absent. Abdominal sternite IX is spatula-like; numerous prominent setae located on apical margin and on lateral margins to one-fifth of their length. A few setae also are present on central part of flat area below apex (27 (Figure 2)). Abdominal sternite X appear as illustrated in (28 (Figure 2)).
9. Pygidium: Basal part from margin to one-third length of pygidium is brown with three or four transverse lines of short setae; remaining area is light brown with densely located, slightly prominent, but longer setae. Apical part is slightly narrowed (30 (Figure 2)).

Remarks: One female specimen is very similar to *C. rawlinsoni* sp. nov. but differs in the coloration of the pubescence and the punctations on the dorsal surfaces. For the proper determination of that specimen, more material was required from the following locality: Dominican Republic: Samana, Samana Peninsula 8 km S of Las Galeras, Punta Balandra, 35 m, 19°11'N, 69°14'W/ 10 October 1991, collected by C. Young, S. Thompson, R. Davidson, and J. Rawlins, semiarid scrub-forest on limestone bluffs (CMNH).

Distribution: Dominican Republic.

***Cryptorhopalum thompsonii* sp. nov.**

The specimen and features of *Cryptorhopalum thompsonii* sp. nov. can be seen in images (31) to (38) in Figure 2, (49) in Figure 3, and (57) and (58) in Figure 4.

Type locality: Dominican Republic: Pedernales.

Material examined: Holotype ♂: Dominican Republic: Pedernales, Cabo Rojo, in swimming pool, 10 m, 19 July 1987/collected by J. Rawlins, R. Davidson, CMNH-375,147 (CMNH) [Left antenna and right middle leg with terminalia are placed in plastic vial with glycerin].

Etymology: The epithet is a patronym honoring a member of the expedition and the collector of the new species, S. Thompson (USA).

Diagnosis: The new species closely resembles *C. acevedoi* sp. nov., *C. delacruzii* sp. nov., *C. rawlinsoni* sp. nov., and *C. youngi* sp. nov. It can be distinguished from them by the following characteristics: in *C. thompsonii* sp. nov., the pubescence is unicolorous (31 (Figure 2)), while in *C. acevedoi* sp. nov. and *C. delacruzii* sp. nov., a sub-basal band of light-colored pubescence is present on the elytra (1, 15 (Figure 1)). In *C. thompsonii* sp. nov., the bridge of the parameres is as broad as two-fifths of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.2, and the penis does not extend above the apices of the parameres (34 (Figure 2)). In *C. delacruzii* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.1, and the penis does not extend above the apices of the parameres (18 (Figure 1)); in *C. rawlinsoni* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part, and the ratio of the length of the penis to the length of the parameres is 1.0:1.1 (26 (Figure 2)). In *C. youngi* sp. nov., the bridge of the parameres is as broad as one-fifth of the width of the penis at its widest part; the ratio of the length of the penis to the length of the parameres is 1.0:0.85, and the penis extends above the apices of the parameres (42 (Figure 2)).

Description

1. Body: Ovate and slightly convex, dorsal and ventral pubescent recumbent, light golden brown; surface of integument is dark brown (almost black) or light brown and sparsely punctured (31, 32 (Figure 2)); length from anterior margin of pronotum to apex of elytron is 1.95 mm, median length of pronotum is 0.6 mm, maximum width of pronotum is 1.1 mm, length of elytron is 1.3 mm, and maximum width across elytron is 1.2 mm. Ratio of width (across humeri) to length (of pronotum and elytra combined) is 1.0:1.6.
2. Head: Visible from above; integument is dark brown (almost black) and sparsely punctured; eyes are brown, large, convex, with internal, slight emargination at one-third length of eye. Median ocellus present (32 (Figure 2)). Frons and clypeus are covered with light golden brown pubescence. Antenna has 11 antennomeres. Antennal club has three antennomeres (33 (Figure 2)); antennomere I is dark brown, while antennomeres II to XI are light brown. Antennal club is ovate, nearly as long as the length of flagellum; relative length of terminal antennomere to length of penultimate antennomere

- is 1.0:1.2 (0.7:0.9). Ratio of width to length of antennomere X is 1.0:1.0 (0.8: 0.9); ratio of width to length of antennomere XI is 1.0:1.0 (0.8:0.7).
3. Thorax: Prosternal process is transversely flat and without median carina. Metasternum has very fine, short, diagonal stria originating at margins behind mesocoxae. Ventral surfaces of integument are dark brown, sparsely punctured, and covered by brown and light brown pubescence.
 4. Pronotum and elytron: Surfaces of integument of pronotum are dark brown (almost black); integument of elytron is brown except for slim line along suture (dark brown). Entire area is sparsely punctured and covered by light golden brown pubescence (31 (Figure 2)). Scutellum is triangular, dark brown, small, and poorly marked. Antennal fossa conforms to the shape of antennal club and occupying nearly the entire area of hypomeron. Ratio of length of antennal fossa to length of lateral margin of pronotum (hypomeron) is 1.0:1.7. Antennal fossa at lateroposterior margin does not reach posterior margin of hypomeron (32 (Figure 2)). Cavities of antennal fossa are densely and shallowly punctured. Small subtriangular area is present between lateroanterior margin of hypomeron (close to eye) and antennal fossa but almost invisible. Pronotal dorsal rim of antennal fossa is very slightly visible from above due to being densely covered with pubescence.
 5. Legs: Dark brown, except tarsi (light brown), and covered with brown pubescence on dorsal surface. Tibiae have small but distinct, short, strong, black setae; tibia spinose on dorsal margin (which resembles tibial teeth). Tarsus has two slightly curved claws.
 6. Ventrites I to V: Surfaces of integument are dark brown, sparsely punctured, and covered by light brown (light golden) pubescence (32 (Figure 2)). Visible ventrite I has two oblique striae on each side extending from anterior margin of ventrite beneath trochanters for three-fourths length of segment.
 7. Phallus: Symmetrical (34 (Figure 2)). Ratio of length of penis to length of parameres is 1.0:1.2. Penis (along above phallobase with anteriorly directed spine, not reaching apices of parameres, but slightly extending beyond bridge, apex of penis in lateral view is hook-like, acute, and strongly curved (49 (Figure 3)); bridge of parameres is not arcuate to apices of parameres, poorly sclerotized, as broad as two-fifths of width of penis at its widest part; parameres with numerous, scattered, long, erect setae on apical, subapical, and inner parts; apex of parameres is slightly curved inward; stalks of phallobase are parallel.

8. Abdominal sternites VIII to X: Abdominal sternite VIII of male has four curved dorsal setae of posterior median process (37 (Figure 2), 57 (Figure 4)) inserted above ventral peg-like setae. Apical process appears as in image (58) in Figure 4. Lateral long apophyses of abdominal sternite VIII are absent. Abdominal sternite IX appears like a spatula. Numerous prominent setae are located on apical margin and on lateral margins to one-sixth of their length; a few setae also present on central part of flat area below apex (35 (Figure 2)). Abdominal sternite X appears as illustrated in image (36) in Figure 2.
9. Pygidium: Entire area is uniformly brown; sub-basal, transverse, two or three carina-like lines with short setae are present; long and densely located setae are limited only to apical rhombic-like area (38 (Figure 2)).

Distribution: Dominican Republic.

***Cryptorhopalum youngi* sp. nov.**

Please refer to images (39) to (45) in Figure 2, (50) in Figure 3, and (59) and (60) in Figure 4 to view the features of this species.

Type locality: Dominican Republic: Pedernales.

Material examined: Holotype ♂: Dominican Republic: Pedernales, Sierra de Baoruco, Aceitillar, 25.2 km ENE Pedernales, 18°05'29"N, 71°31'16"W, 1272 m, 14 June 2003/collected C. Young, J. Rawlins, R. Davidson, P. Acevedo, M. de la Cruz, dense broadleaf forest, pine, yellow pan trap, sample 42262, CMNH-359,272 (CMNH) [Left antenna with terminalia was placed in plastic vial with glycerin; head and pronotum have been separated from body during dissection]. Paratype 1 ♂: same data as for holotype (CMNH).

Etymology: The epithet is a patronym honoring the collector of the new species, C. Young (USA).

Diagnosis: The new species closely resembles *C. acevedoi* sp. nov., *C. delacruz* sp. nov., *C. rawlinsoni* sp. nov., and *C. thompsonii* sp. nov. It can be distinguished from them by the following characteristics: in *C. youngi* sp. nov., the pubescence is unicolorous (39 (Figure 2)), while in *C. acevedoi* sp. nov. and *C. delacruz* sp. nov., a sub-basal band of light-colored pubescence is present on the elytra (1, 15 (Figure 2)). In *C. youngi* sp. nov., the bridge of the parameres is as broad as one-fifth of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:0.85, and the penis extends above the apices of the parameres (42 (Figure 2)). In *C. delacruz* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.1, and the penis does not extend above the apices of

the parameres (18 (Figure 2)); in *C. rawlinsoni* sp. nov., the bridge of the parameres is as broad as two-thirds of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.1, and the penis does not extend above the apices of the parameres (26 (Figure 2)). In *C. thompsonii* sp. nov., the bridge of the parameres is as broad as two-fifths of the width of the penis at its widest part, the ratio of the length of the penis to the length of the parameres is 1.0:1.2, and the penis does not extend above the apices of the parameres (34 (Figure 2)).

Description

1. Body: Ovate and slightly convex, dorsal and ventral pubescent recumbent, light golden brown; surface of integument is dark brown (almost black) and sparsely punctured (39, 40 (Figure 2)); HT: length from anterior margin of pronotum to apex of elytron is 2.0 mm, median length of pronotum is 0.6 mm, maximum width of pronotum is 1.1 mm, length of elytron is 1.7 mm, and maximum width across elytron is 1.15 mm; PT: length from anterior margin of pronotum to apex of elytron is 2.5 mm, median length of pronotum is 0.75 mm, maximum width of pronotum is 1.35 mm, length of elytron is 1.65 mm, and maximum width across elytron is 1.5 mm. Ratio of width (across humeri) to length (of pronotum and elytra combined) is 1.0:1.8.
2. Head: Visible from above; integument is dark brown (almost black) and sparsely punctured; eyes are large, brown, convex, with internal, slight emargination at one-third length of eye. Median ocellus is present (40 (Figure 2)). Frons and clypeus are covered with light gold pubescence. Antenna has 11 antennomeres. Antennal club has two antennomeres (41 (Figure 2)); antennomere I is dark brown, while antennomeres II to XI are light brown. Antennal club is ovate, longer than flagellum; relative length of terminal antennomere to length of penultimate antennomere is 1.0:1.4 (0.7:1.0). Ratio of width to length of antennomere X is 1.25:1.0 (0.8:1.0); ratio of width to length of antennomere XI is 1.1:1.0 (0.8:0.7).
3. Thorax: Prosternal process is transversely flat and without median carina. Metasternum has very fine, short, diagonal stria originating at margins behind mesocoxae. Ventral surfaces of integument are dark brown, sparsely punctured, and covered with brown and light brown pubescence.
4. Pronotum and elytron: Surfaces of integument of pronotum and elytron are dark brown (almost black); entire area is sparsely punctured and covered with light gold pubescence (40 (Figure 2)).
5. Legs: Dark brown, except tarsi (light brown), and covered with brown pubescence on dorsal surface. Tibiae have small but distinct, short, strong, black setae; tibia spinose on dorsal margin (which resembles tibial teeth). Tarsus with two slightly curved claws.
6. Ventrites I to V: Surfaces of integument are dark brown, sparsely punctured, and covered with light brown (light gold) pubescence (40 (Figure 2)). Visible ventrite I with two oblique striae on each side extending from anterior margin of ventrite beneath trochanters almost to posterior margin of segment.
7. Phallus: Symmetrical (42 (Figure 2)). Ratio of length of penis to length of parameres is 1.0:0.85. Penis long above phallobase with anteriorly directed spine, extending above apices of parameres and bridge; apex of penis in lateral view looks like a hook, acute, and strongly curved (50 (Figure 3)). Bridge of parameres is not arcuate to apices of parameres, poorly sclerotized, and as broad as one-fifth of width of penis at its widest part; parameres with numerous scattered, long, erect setae on apical, subapical, and inner parts; apex of parameres is slightly curved inward; stalks of phallobase are parallel.
8. Abdominal sternites VIII to X: Abdominal sternite VIII of male has curved dorsal setae of posterior median process (59 (Figure 4)) inserted above ventral peg-like setae. Apical process appears as in image (60) in Figure 4. Lateral long apophyses of abdominal sternite VIII are absent. Abdominal sternite IX has spatula-like appearance with slightly narrowed apex; numerous prominent setae are located on apical margin and on lateral margins to one-third their length (43 (Figure 2)). Abdominal sternite X appears as illustrated in image (44) in Figure 2.
9. Pygidium: Entire area is uniformly brown; sub-basal, transverse, two or three carina-like lines with short setae are present; densely located long setae are limited to apical rhombic-like area (45 (Figure 2)).

Distribution: Dominican Republic.

Table 2 Some morphological characters of the newly described *Cryptorhopalum* species

Species character	<i>C. acevedoi</i> sp. nov.	<i>C. davidsoni</i> sp. nov.	<i>C. delacruz</i> i sp. nov.	<i>C. rawlinsoni</i> sp. nov.	<i>C. thompsonii</i> sp. nov.	<i>C. youngi</i> sp. nov.
Form of body (ratio of width to length)	Ovate (1:1.81) (1 (Figure 1))	Subovate (1:1.95) (7 (Figure 1))	Ovate (1:1.7) (15 (Figure 1))	Ovate (1:1.8) (23 (Figure 2))	Ovate (1:1.6) (31 (Figure 2))	Ovate (1:1.7) (39 (Figure 2))
Number of oblique striae on basal half of ventrite I extending from beneath each trochanter	2	2	2	2	2	2
Pubescence on elytra	Bicolored: one sub-basal band of light-colored pubescence present (1 (Figure 1))	Unicolorous (7 (Figure 1))	Bicolored: one sub-basal band of light-colored pubescence present (15 (Figure 1))	Unicolorous (23 (Figure 2))	Unicolorous (31 (Figure 2))	Unicolorous (39 (Figure 2))
Morphology of abdominal sternite VIII of male	No data (male unknown)	Median process absent (only cluster of simple setae present in middle) (13 (Figure 1), 51 (Figure 4))	Distinct median process present (21 (Figure 2); 52, 53 (Figure 4)), lateral apophyses absent	Distinct median process present (29 (Figure 2), 54–56 (Figure 4)), lateral apophyses absent	Distinct median process present (37 (Figure 2); 57, 58 (Figure 4)), lateral apophyses absent	Distinct median process present (59–60 (Figure 4)), lateral apophyses absent

Key to the species of the genus *Cryptorhopalum* from the Greater Antilles

1. (2) Form of body is subovate (7 (Figure 1)); body and antennae are brown; male antenna (9 (Figure 1)); ninth abdominal sternite (11 (Figure 1)); phallus (10 (Figure 1))
.....
C. davidsoni sp. nov.
2. (1) Form of body ovate.
3. (10) Elytral pubescence bicolored.
4. (5) Elytra black with two large yellow circular spots; (Antilles Island: St. Lucia; Brazil; French Guiana; Guatemala; Honduras; Peru; Trinidad; Venezuela)
.....
C. quadripunctatum Guérin-Méneville, 1838
5. (4) Elytra without yellow circular spots.
6. (7) Elytra without transverse bands or spots (1 (Figure 1)); female antenna (3 (Figure 1))
.....
C. acevedoi sp. nov.
7. (6) Elytra with bands or spots.
8. (9) Elytra covered with white or gray pubescence with one large apical black spot reaching suture; (Antilles Island: St. Lucia; Colombia; French Guiana; Panama; Peru; Venezuela)
.....
C. orbiculosum Reitter, 1881
9. (8) Each elytron with 1 transverse, narrow band (15 (Figure 1)); male antenna (17 (Figure 1)); ninth abdominal sternite (19 (Figure 1)); phallus (18 (Figure 1))
.....
C. delacruzii sp. nov.
- 10.(3) Elytral pubescence unicolored.
- 11.(14) Apical part of parameres very broad.
- 12.(13) Body dark brown (23 (Figure 2)); antennae dark brown (25 (Figure 2)); ninth abdominal sternite (27 (Figure 2)); phallus (26 (Figure 2))
.....
C. rawlinsoni sp. nov.
- 13.(12) Body light brown, antennae light brown; (Bahamas) *C. thomasi* Háva, 2011
- 14.(11) Apical part of parameres thin (slender).
- 15.(16) Body brown (31 (Figure 2)); male antenna (33 (Figure 2)); ninth abdominal sternite (35 (Figure 2)); bridge of parameres as broad as two-fifths of width of penis at its widest part, ratio of length of penis to length of parameres is 1.0:1.2, penis not extending above apices of parameres (34 (Figure 2))
.....
..... *C. thompsonii* sp. nov.
- 16.(15) Body black (39 (Figure 2)); male antenna (41 (Figure 2)); ninth abdominal sternite (43 (Figure 2));

bridge of parameres as broad as one-fifth of width of penis at its widest part, ratio of length of penis to length of parameres is 1.0:0.85, penis extending above apices of parameres (42 (Figure 2))
.....
..... *C. youngi* sp. nov.

Results and discussion

The newly described species have Neotropical distributions as do most *Cryptorhopalum* species (Mroczkowski 1968; Beal 1985a; Háva 2003, 2012). A large number of New World species were mostly described by Pic (1916a, 1916b, 1923, 1927, 1936, 1942, 1954). Unfortunately, most of those descriptions are brief and limited in detail. Thus, they are virtually useless for comparisons between taxa, and the species' identities might be problematic and difficult. Thus, a revision of the Neotropical taxa (including investigation of systematics) of this speciose, but poorly known genus is needed (Beal 1985b). In addition, very little is currently known about how the species live, and their biology, ecology, and development also require in-depth studies in the future.

Results of taxonomic studies by Beal (1979, 1985a) of Nearctic species of the genus might be helpful in a revisionary study of Neotropical species. Beal (1979, 1985a) divided Nearctic representatives of *Cryptorhopalum* into three informal species groups: *haplotes*, *quadripunctatum*, and *triste*. This division was based on the form of the body (elongate in *haplotes* vs. ovate in *quadripunctatum/triste*), the presence of oblique striae on the basal 1/2 of ventrite I (2 in *quadripunctatum* vs. 1 in *triste*), pubescence on the elytra (sub-basal, sub-apical, and apical bands of light pubescence present in *quadripunctatum* vs. unicolored pubescence of elytra present in *triste*), and the morphology of abdominal sternite VIII (without a median process, but with long lateral apophyses in *quadripunctatum* vs. a distinct median process and the lack of lateral apophyses in *triste*).

Conclusions

Based on the characteristics shown in Table 2, neither of the newly found species could easily be classified into any of those three species groups. Interestingly, they all displayed a mix of characteristics rather than one definitive characteristic that would put them into any of the *haplotes*, *quadripunctatum*, or *triste* group. Thus, other Neotropical species should be reexamined, and further study of *Cryptorhopalum* is required.

Abbreviations

CMNH: Collection of the Carnegie Museum of Natural History; JHAC: Collection of Private Entomological Laboratory and Collection; MK: Collection of Marcin Kadej, Department of Evolutionary Biology and Ecology, Division of Invertebrates Biology, Evolution and Conservation collection, Univ. of Wrocław, Poland; HT: holotype; PT: paratype.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

MK carried out the dissection, performed the taxonomical analysis, drafted the manuscript, and participated in the design of the study and coordination. JH participated in the taxonomical analysis and drafted the manuscript (a key). All authors read and approved the final manuscript.

Acknowledgments

We would like to thank to R.L. Davidson (CMNH, USA) for loaning material for this study and to the anonymous reviewers for critically reading the paper. This study was funded by the Department of Evolutionary Biology and Ecology, University of Wrocław (project no. 1069/M/KBEE/2013).

Author details

¹Division of Invertebrates Biology, Evolution and Conservation, Department of Evolutionary Biology and Ecology, University of Wrocław, Przybyszewskiego 63/77, Wrocław PL-51-148, Poland. ²Department of Forest Protection and Entomology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences, Kamýcká 1176, Prague 6, Suchbátka CZ-165 21, Czech Republic.

Received: 22 August 2012 Accepted: 1 February 2013

Published: 8 August 2013

References

- Beal RS (1959) A key to the Nearctic genera of Dermestidae. *Coleopt Bull* 13:99–101
- Beal RS (1961) Insects of Micronesia. *Coleoptera: Dermestidae*. In: Bernice P (ed) *Insects of Micronesia*, vol 16(3) Bishop Museum. HI, Honolulu, pp 109–131
- Beal RS (1975) Description of adult and larval stages of a new species of *Cryptorhopalum* from Arizona and Mexico (*Coleoptera: Dermestidae*). *Proc Entomol Soc Wash* 77:228–233
- Beal RS (1979) Systematic of the species of *Cryptorhopalum* (*Coleoptera: Dermestidae*) occurring in California. *Contrib Science Nat Hist Mus Los Angeles County* 306:1–22
- Beal RS (1985a) A taxonomic revision of the Nearctic species of *Cryptorhopalum* (*Dermestidae: Coleoptera*). *Transact Am Entomol Soc* 111:171–221
- Beal RS (1985b) Two new species of *Cryptorhopalum* (*Coleoptera: Dermestidae*) from the Virgin Islands. *Entomol News* 96:19–23
- Beal RS (1995) Taxonomic notes and distributional data on Nearctic species of *Cryptorhopalum* (*Coleoptera: Dermestidae*) with description of a new southwestern U. S. *Species Entomol News* 106:169–177
- Beal RS (1998) Taxonomy and biology of Nearctic species of *Anthrenus* (*Coleoptera: Dermestidae*). *Transact Am Entomol Soc* 124:277
- Beal RS (2003) Annotated checklist of Nearctic Dermestidae with revised key to the genera. *Coleopt Bull* 57:391–404
- Casey TL (1900) Review of the American Corylophidae, Cryptophagidae, Tritomidae and Dermestidae with other studies. *J NY Entomol Soc* 8:51–172
- Háva J (2003) World catalogue of the Dermestidae (*Coleoptera*). *Studie a Zprávy Oblastního Muzea Praha-východ v Brandýse nad Labem a Staré Boleslavi*, vol 1. Brandýs nad Labem, District Museum Prague-East, p 196
- Háva J (2004) World keys to the genera and subgenera of Dermestidae (*Coleoptera*), with descriptions, nomenclature and distributional records. *Acta Musei Nationalis Pragae, Series B, Natural History* 60:149–164
- Háva J (2007) Contribution to the species of *Cryptorhopalum* (*Coleoptera: Dermestidae*) described by David Sharp from the Neotropical region - Part 1. *Entomol Prob* 37:83–86
- Háva J (2009) Contribution to the species of *Cryptorhopalum* (*Coleoptera: Dermestidae*) described by David Sharp from the Neotropical region - Part 2. *Balt J Coleopterol* 9:129–133
- Háva J (2011) A contribution to knowledge of the Dermestidae (*Coleoptera*) from the Bahamas with descriptions of two new species from Great Inagua Island. *Calodema* 188:1–7
- Háva J (2012) Dermestidae of the world (*Coleoptera*). An interactive manual, <http://www.dermestidae.wz.cz>. Accessed 11 Jan. 2012
- Háva J, Kadej M (2006a) New data on the occurrence of Dermestidae (*Coleoptera*) from Hispaniola. Part 1. Genus *Dermestes* I. *Pismo Entomol* 75:375–377
- Háva J, Kadej M (2006b) Three new of Dermestidae (*Coleoptera*) from Hispaniola. Part 2. Genus *Trogoderma*. *Pol. Pismo Entomol* 75:379–389
- Háva J, Prokop J (2004) New fossil dermestid-beetles (*Coleoptera: Dermestidae*) from the Dominican amber, with an appendix listing known fossil species of this family. *Acta Soc Zool Boh* 68:173–182
- Hadley A (2010) Combine ZM software, new version., <http://www.hadleyweb.pwp.blueyonder.co.uk/CZP/News.htm>. Accessed 22 Jun 2013
- Herrmann A, Háva J (2011) Contribution to the knowledge of the genus *Cryptorhopalum* Guérin-Méneville, 1838 (*Coleoptera: Dermestidae: Megatomini*) from French Guiana. *Stud Rep Taxon Ser* 7:145–150
- Kadej M, Kitano T (2010) A taxonomic study on the genus *Orphinus* Motschulsky, 1858 of Korean Peninsula (*Coleoptera, Dermestidae, Megatomini*). *Ann Zool* 60:215–219
- Kiselyova T (2002) Description of the larval and pupal stages of *Cryptorhopalum triste* Le Conte (*Coleoptera: Dermestidae*), with notes on biology and rearing. *Coleopt Bull* 56:41–49
- Kiselyova T, McHugh J (2006) A phylogenetic study of Dermestidae (*Coleoptera*) based on larval morphology. *Syst Entomol* 31:469–507
- Lawrence JF, Šlipiřínski A (2010) 6.1. Dermestidae Latreille, 1804. In: Kristensen NP, Beutel RG (eds) *Leschen RAB, Beutel RG, Lawrence JF (eds) Coleoptera, beetles. Morphology and systematics (Elateroidea, Bostrichiformia, Cucujiformia partim)*, vol 2, *Handbook of Zoology. A natural history of the phyla of the Animal Kingdom*, vol 4. *Arthropoda: Insecta*. Part 38. Walter de Gruyter, Berlin, Germany, pp 198–206
- Mroczkowski M (1968) Distribution of the Dermestidae (*Coleoptera*) of the world with a catalogue of all known species. *Ann Zool* 26:15–191
- Ohbayashi N (1985) Dermestidae. In: Kurosawa T, Hisamatsu S, Sasaji H, Kurosawa T, Hisamatsu S, Sasaji H (eds) *Colored illustrations of the Coleoptera of Japan*. III. Hoikusha Public, Osaka, p 500
- Perez-Gelabert DE (2008) Arthropods of Hispaniola (Dominican Republic and Haiti): a checklist and bibliography. *Zootaxa* 1831:1–530
- Pic M (1916a) Diagnoses spécifiques. *Mélanges Exotico-Entomologiques* 17:8–20
- Pic M (1916b) Diagnoses génériques et spécifiques. *Mélanges Exotico-Entomologiques* 18:2–20
- Pic M (1923) Nouveautés diverses. *Mélanges Exotico-Entomologiques* 40:3–32
- Pic M (1927) Nouveautés diverses. *Mélanges Exotico-Entomologiques* 48:1–32
- Pic M (1936) Nouveaux Coléoptères du Musée zoologique de Hambourg. *Entomologisches Nachrichtenblatt* 10:193–196
- Pic M (1942) *Opuscula martialis VII. L'Échange, Revue Linnéenne Numéro special*, p 16
- Pic M (1954) Ptinidae, Anobiidae, Dermestidae, Byrrhidae (Col). *Beiträge zur Fauna Perus, Jena* 4:176–178
- Rees BE (1943) Classification of the Dermestidae (larder, hide and carpet beetles) based on larval characters, with a key to North American genera. *United States Department of Agriculture. Misc Publ Entomol Soc Am* 51:1–18
- Reitter E (1881) Die aussereuropäischen Dermestiden meiner Sammlung. Mit 70 Diagnosen neuer Arten. *Verh. Naturf. Ver. Brünn* 19:27–60
- Sharp DS (1902) Dermestidae. In: Godman F, Salvin O (eds) *Biologia Centrali-Americana. Insecta. Coleoptera*, vol II. Part 1. Dulau, London, pp 642–669

doi:10.1186/1810-522X-52-5

Cite this article as: Kadej and Háva: Key to species of the genus *Cryptorhopalum* (*Coleoptera: Dermestidae*) occurring in the Greater Antilles with description of six new species from Hispaniola. *Zoological Studies* 2013 **52**:5.

Submit your manuscript to a SpringerOpen® journal and benefit from:

- Convenient online submission
- Rigorous peer review
- Immediate publication on acceptance
- Open access: articles freely available online
- High visibility within the field
- Retaining the copyright to your article

Submit your next manuscript at ► springeropen.com