

*This contribution is published
to honor Dr. Amnon Freidberg,
a scientist, a colleague and a friend,
on the occasion of his 75th birthday.*

A new species of the Neotropical mimetic genus *Cerichrestus* Clark from Costa Rica (Coleoptera: Chrysomelidae: Alticinae): An example of how unknown is biodiversity

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ABSTRACT

A new species (*Cerichrestus freidbergi*) of the mimetic Neotropical genus *Cerichrestus* Clark, 1860, is described from LaSelva Biological Station, Costa Rica. Most known species of this genus are from South America, *C. clarki* Jacoby has been the only species known from Central America (Panama and Costa Rica) and is the most morphologically similar to *C. freidbergi*. This new species differs significantly in color and pattern from *C. clarki*, but very unusually both male and female genitalia show little morphological differences. The article discusses potential mimetic relationships and provides a good example of how many animal taxa are poorly known.

KEYWORDS: Flea beetles, Batesian mimicry, Müllerian mimicry, Neotropical, Costa Rica, Choco, La Selva.

RESUMEN

Una especie nueva (*Cerichrestus freidbergi*) del género mimético neotropical *Cerichrestus* Clark, 1860, es descrita desde la Estación Biológica LaSelva, Costa Rica. La mayoría de las especies conocidas de este género son de América del Sur, *C. clarki* Jacoby ha sido la única especie conocida de América Central (Panamá y Costa Rica) y es la más morfológicamente similar a *C. freidbergi*. Esta especie nueva difiere significativamente en color y patrón de *C. clarki*, pero es muy inusual que los genitales masculinos y femeninos muestren pocas diferencias morfológicas. El artículo discute las posibles relaciones miméticas y proporciona un buen ejemplo de cuántos taxones animales son poco conocidos.

PALABRAS CLAVE: Alticinos, mimetismo batesiano, mimetismo mülleriano, Región Neotropical, Costa Rica, Chocó, La Selva.

INTRODUCTION

Clark (1860) described *Cerichrestus* with *C. balyi* Clark, 1860, from Brazil, as the type species. In the same publication, Clark described 10 species; all except *C. apicalis* Clark, from Colombia, and *C. deyrollei* Clark from French Guinea (Cayenne), were from Amazonas (Brazil). There were other species described in the genus, viz. *C. thamni* from Peru (Baly 1879) (Scherer 1962: 527, transferred this

to *Hypolampsis* Clark, 1860); *C. clarki* from Panama (Jacoby 1886); *C. allardi* from Peru (Duvivier 1889); *C. citrinus* from Guiana (Allard 1894); *C. apicatus* from Ecuador, *C. curvilinea* and *C. jacobyi* from Peru (Bowditch 1915). Since Bowditch (1915) no new species have been described. Another indication that this is a “forgotten” genus is that there are no literature citations for *Cerichrestus* since Bowditch (1915), except for in a few checklists mainly by Furth, and the only citations at all for this genus are the original descriptions of these 17 species. *Cerichrestus* was first recorded in Costa Rica in Furth *et al.* (2003). After almost 30 years collecting, surveying museum collections and analyzing the Alticinae fauna of Mexico, the author has not recorded any *Cerichrestus* there (Furth 2006). Thus, this genus is only known in Central America from Panama and Costa Rica. *Cerichrestus* belongs to the putative tribe/subtribe (depending on what higher classification one follows) Sphaeronychini or Monoplatini (see Furth 2007).

In 1985 the author had an opportunity to spend a month in primary rain forests of Choco, Colombia. From observations during this visit the principles of Batesian and Müllerian mimicry became very apparent to the author through evident mimicry rings involving Chrysomelidae (see Discussion below). Reports of potential mimicry rings involving multiple representatives of Chrysomelidae and other insects have been reported (Gahan 1891; Lindroth 1971; Hespeneheide 1976; Balsbaugh 1988; Balsbaugh & Fauske 1991). Balsbaugh (1988) mentions some Chrysomelidae that are the probable models because they are toxic, such as Clytrinae, Galerucinae, Chrysomelinae (Paropsine leaf beetles), or because of sound production, behavior (e.g., Criocerinae) or presence of eyespots (e.g., Cassidinae).

By chance this study is also an example of how poorly known biological diversity is even at this point in our exploration of the planet. Namely, that this genus *Cerichrestus*, described by Clark in 1860 (currently with 18 recorded species, including the new species in this study) has not been studied at all beyond the original descriptions (1860–1915) despite the fact that at least some species are not rare in certain places. Certainly, this is not unique, i.e., there are many genera of animals especially insects, for which we only know their name and nothing else! We have no idea of their true distribution, biology or ecology, including food plants, biochemistry, closest relatives, genetics, etc. Therefore, despite all the discussions, analyses of species richness, phylogenetics, genomics, etc. of biological diversity, we actually know extremely little about the diversity of life on Earth.

MATERIALS AND METHODS

Most of the specimens cited in this publication were collected and prepared by the parataxonomists of the Arthropods of La Selva project (El Proyecto Artrópodos de La Selva, ALAS). They were collected at La Selva Biological Station (Heredia, Costa Rica) [10°26'N 84°01'W], it is a lowland tropical rainforest of about 1500 hectares with elevations from 50–150 meters with mostly second growth forest of various ages and abandoned pastures and a mean annual rainfall of 4000 mm.

Some specimens were also borrowed directly from the collections of the Instituto de Biodiversidad (INBio), San Jose, Costa Rica. All ALAS project specimens are part of the INBio collection. The holotype (not INBio bar coded) will be deposited at the United States National Museum of Natural History, Smithsonian Institution (USNM), as it was gifted to the author by the collector in the 1980s. The majority of the barcoded INBio/ALAS paratype specimens will be deposited at El Museo Nacional (MNCR), San Jose, Costa Rica, that has recently taken over all INBio collections. The remainder of the paratypes will be deposited at the USNM and a pair (male and female) at the Museo del Instituto de Zoología Agrícola, Maracay, Venezuela (MIZA), the Natural History Museum, London (NHM), and the Steinhardt Museum of Natural History of Tel Aviv University, Israel (SMNHIAU).

More details about the study site as well as details about the collecting techniques used by the ALAS Project, especially Malaise trapping, are given by Furth *et al.* (2003). A few specimens were collected and donated to the author by Henry Hespeler (University of California Los Angeles, USA – UCLA). Almost all the specimens of *C. freidbergi* listed under the examined material have an INBio/ALAS bar code number (the bottom label), followed by the *verbatim* locality information including latitude and longitude, date, as well as data about collecting method (mostly Malaise traps), ecological data, etc.

In the material examined section, listed are only the INBio bar code numbers and the more specific second label data, because the locality data are essentially identical (La Selva Biological Station). A very few specimens either do not have a bar code or have a slightly different locality label, this will be indicated below under the examined material (paratypes). Different labels are separated by a back slash (\); within a label different lines are separated by a comma (.). Each set of labels per specimen is separated with a period (.).

The images of the male and female genitalia of *C. freidbergi* and *C. clarki* were taken with Zeiss Axio Zoom V 16 scope and IAI AT-200DE digital camera attached to it. The habitus images of *C. clarki* syntypes, *C. ?allardi*, Lycidae, and Lampyridae were taken with Visionary Digital™ BK Lab Imaging system outfitted with the Canon EOS 5D and a MP-E 65mm 1–5× Canon macro-lens. Stacked images were processed in part with Helicon Focus™; final editing was done with Adobe PhotoShop™.

Measurements were made with a Leica M125 under 2.0× magnification using an Achromat 1.0× objective and Leica 25× oculars with a reticle. The reticle was divided into 120 parts and using a Zeiss stage micrometer the measurements were calculated as 1.0 mm = 30 parts/lines, or 0.1 mm equals 3 reticle parts/lines, and 1 line = 0.0333 mm. All measurements of *C. freidbergi* and *C. clarki* (listed under the *C. freidbergi* Diagnosis section below) were made using 10 males and 10 females of each. For the antennomeres, their lengths are given as the actual number of reticle lines at this magnification (i.e., 30 lines per mm) and the left antenna of each was used except in one case of *C. freidbergi* female where the right antennomeres

were measured. Measurements taken are as follows: IOD – inter-ocular distance (minimum/anterior), Lb – length of body (excluding antennae, from vertex to tip of abdomen not distended), Le – length of elytron, Lp – length of pronotum (in the middle), Weh – width at humerus, Wem – width at widest part of elytra, Weye – width of eye (measured across center), Wp – width of pronotum.

Morphological terminology generally follows Konstantinov and Vandenberg (1996) with a few exceptions, especially head characters, from Konstantinov (1998).

The author follows a less popular classification, i.e., Alticinae rather than Alticini, the rationale for this is explained elsewhere (e.g., Furth & Lee 2000; Furth & Suzuki 1998; Mohamedsaid & Furth 2011).

TAXONOMY

Genus *Cerichrestus* Clark, 1860

Cerichrestus freidbergi n. sp.

(Figs 1–6, 13)

LSID: urn:lsid:zoobank.org:act:963CDA79-030D-4330-8952-1F2241974B49.

Etymology: This new species of *Cerichrestus* is named in honor of Dr. Amnon Freidberg (Curator Emeritus of Entomology, SMNHATAU) for his 75th birthday. Probably a majority of the specimens in the SMNHATAU insect collections were collected by Dr. Freidberg. He has been a close colleague of mine since we met in the summer of 1971. We have been together on many field collecting trips all over Israel and adjacent territories. Although he is a Dipterist, we still find many things in common to discuss.

Diagnosis: *Cerichrestus freidbergi* n. sp. is morphologically most similar to *C. clarki* Jacoby, 1886, recorded from Panama and Costa Rica, and the only species recorded outside South America. The new species differs from *C. clarki* primarily through color and pattern (Figs 1, 7). *Cerichrestus clarki* has an elytral black pattern slightly tapered towards elytral base (Figs 7, 13) with a broad median stripe/spot on the apical half (approximately from the suture to stria 7 laterally), a very narrow black stripe along the suture (one stria wide only) to the base then continuing onto the pronotum as a black, median, parallel-sided stripe (equal in width to ca. 3–4 elytral striae), the pronotal stripe is somewhat narrower at the base than apex, i.e., slightly tapered towards the base (not created by arrangement of pubescence). In *C. freidbergi*, the pronotal stripe is lighter in color, hour-glass-shaped and created by the arrangement of pubescence. Other color differences: *C. clarki* often has some of the medial area of the thoracic venter lighter in color (orange) whereas *C. freidbergi* usually has the all-dark thoracic venter; the fore and mid-tibiae of *C. clarki* are usually all dark, whereas *C. freidbergi* usually has the fore and middle tibiae lighter, at least partly yellow. *Cerichrestus clarki* has slightly elevated elytral calli/bossae (mid-basal elevated area, between striae 1–3) giving the appearance of a depressed

area near the suture. The pronotal lateral margins of *C. clarki* are straight-sided, whereas *C. freidbergi* has an apparent bulge in the middle of the lateral margins; the anterolateral angles of *C. clarki* are not pointed forward, whereas *C. freidbergi* has distinct and forwardly pointed anterolateral angles. The new species is larger for most body parts, e.g., the Lb (average) of *C. freidbergi* in males 5.02 mm and females 5.68 mm, whereas in *C. clarki* the Lb (average) in males 4.75 mm and females 5.15 mm (see also measurements for *C. clarki* below). There are no apparent significant morphological differences between *C. freidbergi* and *C. clarki* concerning the male aedeagus, female spermatheca, or female vaginal palpi.

Cerichrestus clarki (Figs 7, 8, 9, 10, 11–13):

Antennomere (#) *average lengths*: Male #1(11), #2(6), #3(13), #4(12), #5(12), #6(11), #7(11), #8(9), #9(9), #10(8), #11(11). Female #1(11), #2(6), #3(13), #4(12), #5(11), #6(10), #7(10), #8(8), #9(8), #10(8), #11(11).

Body part measurements (10 males, 10 females; range in mm [average]): Lb: males 3.86–5.66 [4.75], females 4.73–6.13 [5.15]; Le: males 3.00–4.16 [3.54], females 3.50–4.50 [3.77]; Weh: males 1.50–1.73 [1.70], females 1.80–2.20 [1.86]; Wem: males 1.80–2.20 [1.93], females 2.03–2.43 [2.15]; Lp: males 0.73–1.03 [0.86], females 0.83–1.10 [0.93]; Wp: males 1.07–1.37 [1.18], females 1.23–1.50 [1.31]; Weye: males 0.37–0.50 [0.43], females 0.40–0.53 [0.44]; IOD: males 0.47–0.67 [0.57], females 0.60–0.70 [0.63].

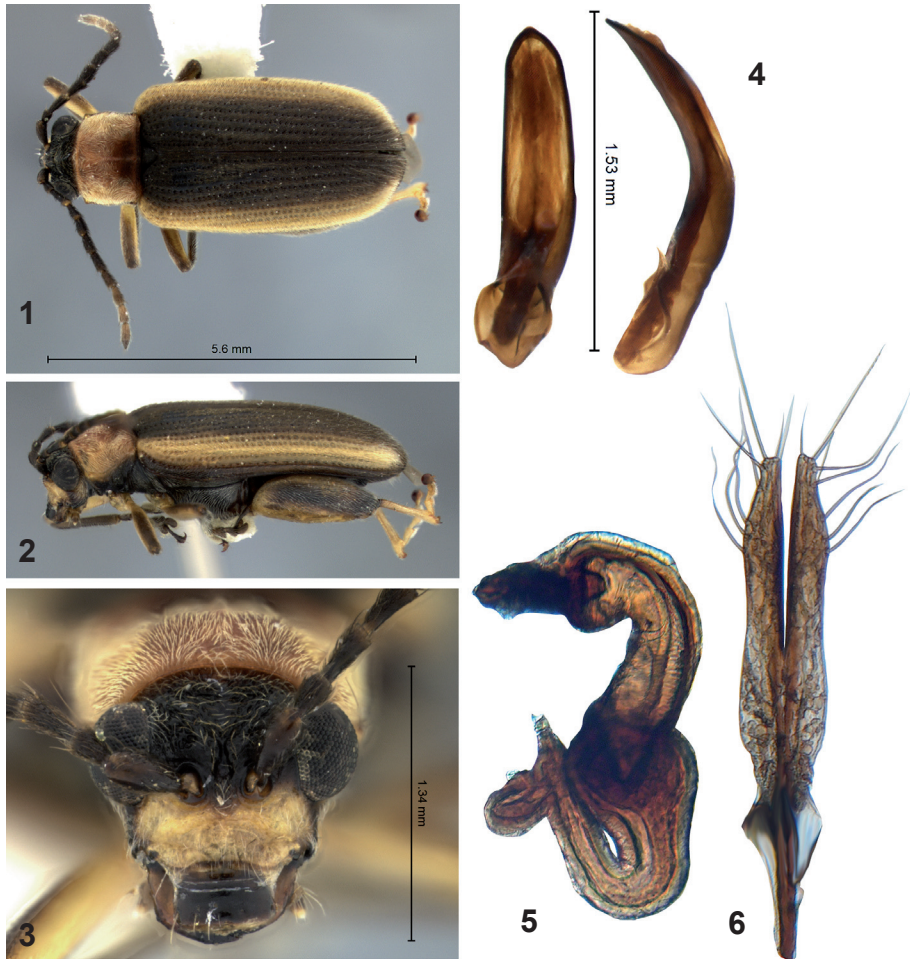
Holotype: Lb: 4.92 mm; Le: 3.77 mm; Weh: 1.67 mm; Wem: 2.05 mm; Lp: 0.95 mm; Wp: 1.18 mm; Weye: 0.36 mm; IOD: 0.51 mm. Antennomeres: #1(12); #2(6); #3(11); #4(13); #5(12); #6(11); #7(12); #8(10); #9(9); #10(10); #11(13).

Description: *Dorsum*: entire dorsum with dense, fine, light-colored pubescence.

Antennae: (Figs 1, 2) color all black except antennomeres 9–11 yellow. Antennomere 1 long, swollen, 2 shortest, 3 twice as long as 2, 4 longest (usually evidently longer than 3), 5–7 subequal (only slightly shorter than 4), 9–11 subequal ca. 75 % of the length of 5–7.

Antennomere (#) *average lengths*: Male #1(12), #2(6), #3(13), #4(13), #5(13), #6(12), #7(11), #8(10), #9(9), #10(9), #11(11). Female #1(12), #2(6), #3(12), #4(12), #5(11), #6(11), #7(10), #8(9), #9(9), #10(8), #11(12).

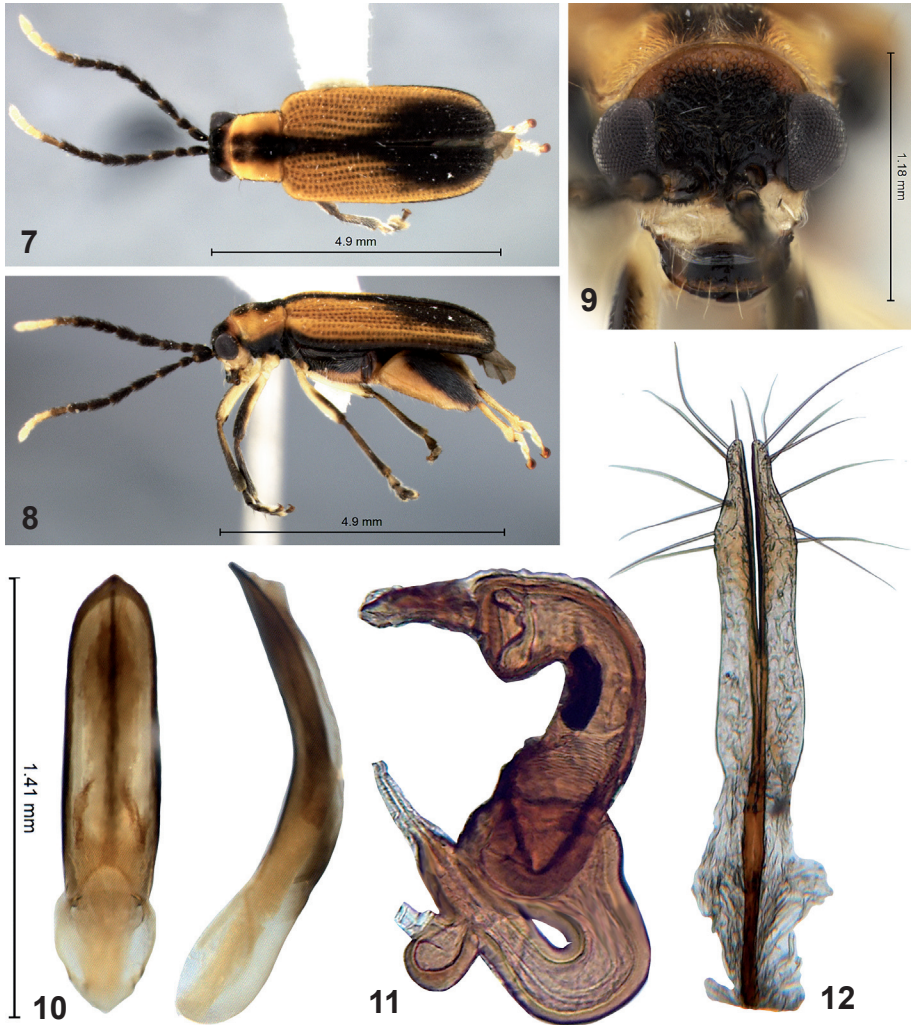
Head: vertex (Fig. 3) black (especially between eyes), basally lighter (orange), densely and coarsely punctured, with sparse pubescence. Antennal calli only slightly raised with distinct midfrontal sulcus between calli. Frontal ridge black, anterofrontal ridge and clypeus yellow (appearing as almost a transverse yellow band). Labrum black, apical margin with 3 long setae on each side of midline. Frontal ridge short with midfrontal sulcus apparent. Frontal ridge distinctly elevated, anterofrontal ridge protruding forward (beyond clypeus) such that clypeus appears depressed or concave (especially visible in lateral view). Mandibles dark brown. Maxillae yellow, palpi yellow, with penultimate segment usually darker, greatly swollen, apical segment sometimes darkened, much smaller, tapered apically, basal segment yellow. Ventrally head and mouthparts mostly yellow. Eyes spherical, protruding or bulging.



Figs 1–6: *Cerichrestus freidbergi*: (1, 2) habitus, dorsal (1) and lateral (2) views; (3) head, frontal view; (4) aedeagus, left – ventral view, right – lateral view; (5) spermatheca; (6) vaginal palpi.

Body part measurements (10 males, 10 females; range in mm [average]): Lb: males 4.70–5.27 [5.02 average], females 5.1–6.16 [5.68]; Le: males 3.46–4.0 [3.77], females 3.86–4.70 [4.27]; Weh: males 1.67–1.97 [1.83], females 1.87–2.33 [2.09]; Wem: males 1.9–2.2 [2.12], females 2.33–2.96 [2.56]; Lp: males 0.87–1.0 [0.92], females 0.90–1.20 [1.0]; Wp: males 1.13–1.37 [1.26], females 1.37–1.63 [1.47]; Weye: males 0.4–0.5 [0.42], females 0.40–0.47 [0.45]; IOD: males 0.57–0.63 [0.60], females 0.60–0.73 [0.66].

Pronotum (Fig. 1): orange/brown, with apparent mid-longitudinal, hourglass-shaped (wider basally) darker orange/brown band; subquadrate in shape; basally distinctly narrower than base of elytra, width subequal to width of head including



Figs 7–12: *Cerichrestus clarki*: (7, 8) habitus, dorsal (7) and ventral (8) views; (9) head, frontal view; (10) aedeagus, left – ventral view, right – lateral view; (11) spermatheca; (12) vaginal palpi.

eyes; anterior one-third with apparent transverse band of dense, yellow setae [color pattern appears to be a result of the direction and density of the pubescence]. Posterior two-thirds slanted downwards with less apparent pubescence medially and laterally. Slight but evident sublateral depressions both sub-basally and sub-apically, almost contiguous. Lateral margins somewhat straight-sided but with slight bulge outward at middle. Antero- and posterolateral angles each with a pore and long seta, anterolateral angles noticeably pointed outward from lateral margins.



Fig. 13: *Cerichrestus clarki*, probable syntypes, dorsal view of male (left) and female (right), Panama, Bugaba.

Scutellum: triangular and black.

Elytra: elongate-rectangular, parallel-sided; humeral calli evident but not bulging; punctation striate with one sutural short stria and 10 distinct striae of medium coarse punctures. Color black centrally with sublateral, longitudinal, yellow/orange stripe [6 specimens with this yellow sublateral stripe melanized indicated in the material examined section], extreme lateral and epipleural areas black, extending to apex and joining narrowed medial black band. In dorsal view wide (from suture to striae 6) solid black, median, longitudinal stripe parallel-sided with lateral yellow longitudinal stripes much narrower (Figs 1, 2).

Venter: usually entirely black or dark brown, sometimes abdominal sternites lighter (yellow) with sparse, fine pubescence; front coxal cavities closed; front coxae yellow, prominent, bulging, sub-conical. Male 5th sternite only with slight medial, apical, rounded lobe, often difficult to see unless apical sternite separated from apical tergites (7 and 8), 8th tergite with apparent medial, V-shaped, apical invagination (notch), often curled ventrally over apex of 5th sternite. Female: apex of 5th sternite, 7th, 8th tergite continuously rounded or slightly pointed.

Legs (Fig. 2): fore and middle tibiae usually black dorsally, usually lighter (yellow) ventrally, rarely all yellow, hind tibia yellow; fore and middle femora yellow, usually darkened dorsally; metafemora with ventral half to two-thirds yellow, darkened dorsally. Male first foretarsal segment not swollen or enlarged. Metatarsal length more than two-thirds as great as metatibial length; apical metatarsal segment dark brown, very globosely swollen; foretarsus ca. 40–50 % as long as foretibiae;

middle tarsi ca. 60 % as long as middle tibiae; metatibial apex enlarged with inner (medial) lobe extended, somewhat rounded but with short teeth, with outer/lateral large prominent dark spine metatibial apex, also with ca. 6 or more serrate teeth; metatibia with dorsal margins sulcate. Metatarsi inserted subapically onto metatibiae. Tarsi dark brown.

Genitalia: Male: aedeagus, symmetrical in ventral view (Figs 4), although in ventral view it appears rotated slightly left giving a somewhat asymmetrical impression: Female: spermatheca as in Fig. 5. Vaginal palpi as in Fig. 6.

Holotype: ♂ (no bar code) **Costa Rica**: Prov. Heredia, F. La Selva, 3 km S Pto Viejo, 10°26'N 84°01'W \ 30 iii 1980, H.A. Hespenheide [USNM].

Paratypes: **Costa Rica**: ♂♂: INBioCR10022622011 \ 29 Mayo 2000, Bosques secundario \ M/19/749. INB0003664474 \ 21 Marzo 2004, Malaise, M/27/789. INBIO1002227132 \ M/01/471, 16 Octubre 1995, Parcelas sucesionales. INBioCR1002231360 \ M/02/484, 01 Noviembre 1995, Bosque secundario. No INBioALAS bar code - \ Malaise Trap, 1–2-year, Second Growth Forest edge \ 24–25 iv 1989, H. A. Hespenheide. INBIOCR1002621769 \ 15 Mayo 2000, Bosque secundario, M/19/748. INB0003663912 \ 09 Marzo 2004, Malaise, M/20/772. [No bar code] - \ 29 iii 1988, H. A. Hespenheide. INBIOCR1002268538 \ M/18/712, 09 Julio 1998, Borde suampo. INBIOCR1002231465 \ M/18/720, 29 Octubre 1997, Borde suampo. INBIOCR1002621607 \ 10 Enero 2000, Bosque secundario, M/19/739. INBIOCR1001244606 \ 27 vii 1997, H. A. Hespenheide. INBIOCR1002064388 \ 1 Junio 1993, M/11/117, Bosque secundario. INBIOCR1002256182 \ 2 Marzo 1993, M/01/016. Parc sucesionales. INBIOCR1002067932 \ 1 Abril 1993, M/04/051, Bosque primario. INBIOCR1002726684 \ 15 Noviembre 1999, Bosque secundario, M/19/735. INBIOCR1002267964 \ 03 Agosto 1993, M/01/164, Parcelas sucesionales. INBIOCR1002267667 \ 15 Marzo 1994, M/01/376, Parcelas sucesionales. INBIOCR1002268531 \ M/18/721, 12 Noviembre 1998, Borde suampo. INBIOCR1002268640 \ M/18/711, 25 Junio 1998, Borde suampo. INBIOCR1002268667 \ M/18/710, 12 Junio 19998, Borde suampo. INBIOCR100226954 \ M/01/384, 04 Abril 1994, Parcelas sucesionales. INBIOCR100227514 \ M/13/662, 31 Mayo 1996, Bosque secundario. INBIOCR1002268564 \ M/18/718, 01 Octubre 1998, Borde suampo. INBIOCR1002268642 \ M/18/711, 25 Junio 1998, Borde suampo. INBIOCR100229474 \ M/11/285, 01 Diciembre 1993, Bosque secundario. INB003652895 \ Project ALAS, Malaise, 15 Dic 1993, M/01/292. INB0003653277 \ Project ALAS, Malaise, 15 Dic 1993, M/11/313. INB0003652980 \ Project ALAS, Malaise, 15 Dic 1993, M/01/304. INB0003652632 \ Project ALAS, Malaise, 15 Dic 1993, M/04/155. INB0003653819 \ Project ALAS, Malaise, 15 Dic 1993, M/13/163. INB0003653397 \ Project ALAS, Malaise, 15 Dic 1993, M/05/352. INBIOCR1002726748 \ 06 Marzo 2000, Bosque secundario, M/19/743. INBIOCR1002621609 \ 10 Enero 2000, Bosque secundario, M/19/739. INBIOCR100261814 \ 27 Diciembre 1999, Bosque secundario, M/19/738. INBIOCR1002622013 \ 29 Mayo 2000, Bosque secundario, M/19/749. INBIOCR100261768 \ 15 Mayo 2000, Bosque secundario, M/19/748. INBIOCR1002621688 \ 12 Junio 2000, Bosque secundario, M/19/750. INBIOCR1002621588 \ 17 Abril 2000, Bosque secundario, M/19/746. INBIOCR1002621611 \ 10 Enero 2000, Bosque secundario, M/19/739. INBIOCR1002621610 \ 10 Enero 2000, Bosque secundario, M/19/739. INBIOCR1002067933 \ 1 Abril 1993, M/04/051, Bosque primario. INBIOCR1002231586 \ M/11/381, 15 Marzo 1994, Bosque secundario. [No bar code] - 12 August 1996 \ C. L. & S. L. Staines, lab compound. INBIOCR1002284934 \ 14 August 1996 \ C. L. & S. L. Staines, STR2000-5200m. [No bar code] - 20 iv 1989, H.A. Hespenheide \ Malaise Trap, Second Growth. INBIOCR1001246199 \ Locality: STR 0-400m, Date:20/1/95, Host: Coll. Ronald Vargas C. [No bar code] - \ 7 iv 1989, H.A. Hespenheide \ Malaise Trap, Second Growth. [No bar code] - 29 vii 1976, E. M. Fisher.

Melanistic form: INBIOCR1002231466; M/17/684, 02 Octubre 1997, Bosque primario. INBIOCR1002731912; M/18/720, 29 Octubre 1997, Borde suampo. INB0003688017; 24 Febrero 2004, Interception, TN/27/008. INB0003681228; 06 Abril 2004, Malaise, M/27/799.

♀♀: INBIOCR1002621925 \ 07 Febrero 2000, Bosque secundario, M/19/741. INBIOCR1002621844 \ 24 Diciembre 1998, Bosque secundario, M/18/724. INBIOCR1002227163 \ M/11/420, 01 Agosto 1995, Bosque secundario. INBIOCR1002227371 \ M/18/701, 01 Febrero 1998, Borde suampo. INBIOCR1002231568 \ M/04/351, 15 Febrero 1994, Bosque primario. INBIOCR1002231464 \ M/18/720, 29 Octubre 1997, Borde suampo. INB0003688463 \ 18 Abril 2004, Interception, TN/27/028.

INBIOCR1002268532 \ M/18/721, 12 Noviembre 1998, Borde suampo. INBIOCR1002622012 \ 29 Mayo 2000, Bosque secundario, M/19/749. INBIOCR1002621770 \ 15 Mayo 2000, Bosque secundario, M/19/748. INBIOCR1002268547 \ M/18/713, 23 Julio 1998, Borde suampo. INBIOCR1002268533 \ M/18/721, 12 Noviembre 1998, Borde suampo. INBIOCR1002268565 \ M/18/718, 01 Octubre 1998, Borde suampo. INBIOCR1002621612 \ 10 Enero 2000, Bosque secundario, M/19/739. INBIOCR1002621771 \ 15 Mayo 2000, Bosque secundario, M/19/748. INBIOCR1002256181 \ 2 Marzo 1993, M/01/016, Parc sucesionales. INBIOCR10020657931 \ 1 Abril 1993, M/04/051, Bosque primario. INBIOCR1002726531 \ 21 Febrero 2000, Bosque secundario, M/19/742. INBIOCR1002727282 \ 01 Noviembre 1999, Bosque secundario, M/19/734. INBIOCR1002727425 \ 30 Noviembre 1999, M/19/736, Bosque secundario. INBIOCR1001243309 - *no second label [primary locality label includes - Dec 1992]*. INBIOCR100268201 \ 01 Mayo 1993, M/13/092, Bosque secundario. INBIOCR1002284935 \ *primary locality label* - 12 August 1996 \ C. L. & S. L. Staines, lab compound. INBIOCR100227781 \ M/13/470, 29 Septiembre 1995, Bosque secundario. INBIOCR1002231316 \ M/13/518, 01 Diciembre 1995, Bosque secundario. INBIOCR1002231463 \ M/18/720, 29 Octubre 1997, Borde suampo. INBIOCR1002233916 \ M/18/714, 01 Agosto 1998, Borde suampo. INBIOCR1002227456 \ M/18/719, 14 Octubre 1998, Borde suampo. INBIOCR1002227454 \ M/18/719, 14 Octubre 1998, Borde suampo. INBIOCR1002231588 \ M/11/381, 15 Marzo 1994, Bosque secundario. INB0003651967 \ Project ALAS, Malaise, 1 Mar 1994, M/01/360. INBIOCR1002621689 \ 12 Junio 2000, Bosque secundario, M/19/750. INBIOCR1002268549 \ M/18/713, 23 Julio 1998, Borde suampo. INBIOCR1002227588 \ M/13/650, 15 Mayo 1996, Bosque secundario. INBIOCR1002268638 \ M/18/711, 25 Junio 1998, Borde suampo. INBIOCR1002268639 \ M/18/711, 25 Junio 1998, Borde suampo. INBIOCR1002268648 \ M/18/682, 25 Junio 1998, Borde suampo. INBIOCR1002233915 \ M/18/714, 01 Agosto 1998, Borde suampo. INBIOCR1002227365 \ M/18/709, 28 Mayo 1998, Borde suampo. INBIOCR1002226955 \ M/01/384, 04 Abril 1994, Parcelas sucesionales. INB0003652964 \ Project ALAS, Malaise, 1 Nov 1993, M/04/251. INB0003653929 \ Project ALAS, Malaise, 14 Aug 1993, M/02/181. INB0003653974 \ Project ALAS, Malaise, 14 Jun 1993, M/04/127. INBIOCR1002621687 \ 12 Junio 2000, Bosque secundario, M/19/750. INB0003663785 \ 09 Mar 2004, Malaise, M/27/779. [No bar code] - 17 August 1996, INBio-OET \ C. L. & S. L. Staines, sweeping edge of soccer field. [No bar code] - 8 iv 1989, H.A. Hespeneide \ Malaise Trap, Second Growth. [No bar code] - 8 iv 1989, H.A. Hespeneide \ Malaise Trap, Second Growth. [No bar code] - 24-25 iv 1989, H.A. Hespeneide \ Malaise Trap, Second Growth. [No bar code] - iv-v 1993, P. Hanson, Malaise Trap. INB0003234538 \ 18 vi 1991, H.A. Hespeneide.

Melanistic form: INBIOCR1002268680 \ M/18/708, 14 Mayo 1998, Borde suampo. INBIOCR1002731587 \ 11 Mayo 2000, Goethalsia meinantha, FOT/49/26.

Distribution and phenology: Costa Rica, Heredia. All months of the year.

Host: Unknown.

DISCUSSION

Generally, the author does not like to rely only on color patterns for separating of species; however, in this unusual case there are relatively few morphological distinguishing characters (see Diagnosis above). In the author's several decade experience with the morphological taxonomy of flea beetles (Alticinae), this is the first time where both male and female genitalia cannot be used to separate two species that are morphologically similar. However, a flea beetle colleague of mine with global knowledge has recently mentioned a similar experience with the genitalia of this group (i.e., "Monoplatini/Sphaeronychini") (A. Konstantinov, pers. comm., 2019). Gerhard Scherer, one of the greatest flea beetle scientists of all time, said the following about *Cerichrestus*: "Uniform morphological characters for this genus are hard to find, so that only the yellow coloration on the thoracic sides must suffice. This yellow coloration is coupled with a uniform habitus however: flat, thin,

shagreened. The head shape, usually a very usable character in the Alticinae, is very variable here” (Scherer 1983: 14). Nevertheless, there are a few other differences such as the apparent presence of elytral calli in *C. clarki* not apparent in *C. freidbergi*, slight differences in the pronotal lateral margins, anterolateral angles, and body size (see Diagnosis above).

In the late 1980s Dr. Henry Hespenheide (UCLA) sent the author some specimens from La Selva Biological Station, which he had collected in the 1980s, as a gift. Possibly Dr. Hespenheide noticed the potential mimetic aspect of these beetles, especially because of his interest in mimicry (Hespenheide 1976). However, he only said that he was interested to know if the author could identify them. At the time the author had been working primarily on the Palearctic fauna of Alticinae and was unfamiliar with the Neotropical fauna. However, because of these few specimens from Costa Rica the author began to visit the Museum of Comparative Zoology (Harvard University) and to use the F.C. Bowditch Collection there to identify these specimens. This foray into the Neotropical Alticinae led the author to become more immersed in the Neotropical fauna to the point he joined the ALAS project by agreement to retain duplicates of even morphospecies and this led to his studying the Neotropical Alticinae extensively for almost three decades.

The author collected *Cerichrestus* at La Selva in 1995 and 2003, especially at the 5-year successional plots that is the same location at La Selva Biological Station as some of the paratypes of *C. freidbergi*, e.g., those labeled “Parcelas sucesionales” (see material examined above). In fact, the *Cerichrestus* obtained by the author then primarily originated from the 5th year (i.e., 5 years of growth) part of this successional experimental plot area (pers. observ.), indicating a “preference” for older forests versus younger-growth and/or more disturbed habitats.

Mimicry

The present example may be a case of Batesian mimicry even though virtually nothing is known about this specific system. It seems to be part of a “mimicry ring” where several species of different insect families (possibly primarily beetles) appear to have the same or very similar external color patterns. Part of the problem of determining whether this is Batesian or Müllerian mimicry is that we do not know anything about the biology of these species and especially which might be distasteful to predators. There are nice discussion and illustrations of mimicry in Wickler (1968), a review of the literature about mimicry in insects (Rettenmeyer 1970), and general classifications of mimicry (Pasteur 1982).

In the case of *Cerichrestus* the external colors of all species are normally some combination of yellow/red/orange and black, an aspect critical to Batesian mimicry (Rettenmeyer 1970). Here it is assumed that all species of *Cerichrestus* are Batesian mimics, but, of course, there is always a possibility that such a mimicry ring is Müllerian mimicry, especially since we know nothing about the palatability of these insect, their presumed models, or even for the species of *Cerichrestus*. Another basic tenant of Batesian mimicry is that the model and the mimics must live in the

same area at the same time (Rettenmeyer 1970), which was the case at the sites in Choco, Colombia. Rettenmeyer (1970) also points out that in some cases of mimicry the position of live specimens in nature as well as their behavior may be important factors in mimicry, and we have no idea if these factors are involved in the *Cerichrestus* mimicry rings in Colombia or elsewhere. In Wickler (1968, fig. 2) there are examples of chrysomelids involved in Müllerian mimicry rings with coccinellids, both unpalatable, and roaches that are palatable. Wickler (1968, fig. 19) illustrates mimicry rings (presumably Müllerian) involving species of Lycidae with 4 or 5 similarly appearing insects from several orders, this is somewhat similar to the situation the author encountered in Choco, Colombia, in 1985. During the author's visit to Choco he was able to collect a few specimens of *Cerichrestus*, only one species of this genus (*C. apicalis*) had previously been recorded from that country. While collecting there it became apparent that there was some sort of mimicry ring involving species of several other subfamilies of the Chrysomelidae (e.g., Galerucinae *sensu stricto* or Galerucini *auctorum*, Clytrinae, etc.) that had a "typical" orange and black color pattern to other mimicry rings known around the world (see Wickler 1968), similar to the color pattern of certain other Coleoptera, e.g., Lycidae. Of course, also because virtually nothing is known about the food plants of any of these Colombian taxa, it is not possible to presume which members of such a mimicry ring are distasteful. At this site in Choco, other species of *Cerichrestus* (one species, provisionally determined as *C. ?allardi*) were collected that are quite similar to species of Lycidae (Coleoptera) (see Figs 14, 15). At the same site an undescribed species of *Cerichrestus* was collected and within a few days a species of *Lucidota* Laporte (Lampyridae: Coleoptera) (M. Branham, pers. comm., 2019) (see Figs 16, 17). These are good examples of the kind of mimicry ring in which presumably all species of *Cerichrestus* are involved.

Many species of Lycidae are well-known to be models in various mimicry rings because of their distastefulness due to acetylenic acid/lycidic acid that is the probable toxic chemical in *Calopteron reticulatum* (Fabricius, 1775) (Eisner *et al.* 2008). The lycid pertinent to this study (Fig. 15, collected by the author together with a presumed mimic—*C. ?allardi* (Fig. 14)—in Choco, Colombia) has been tentatively identified as a species (perhaps undescribed) of *Cartagonum* Pic or even an undescribed species of *Calopteron* Laporte (the latter genus apparently being taxonomically a mess) (V. Ferreira, pers. comm., 2019), and it could very well be distasteful and even related to *C. reticulatum*.

Polymorphism

Among the examined material for *C. freidbergi* six specimens (four males and two females) of the 103 specimens listed, or less than 6 %, are apparently melanistic, in that the normal elytral sublateral, yellow/orange, longitudinal stripe is dark (black), i.e. the entire elytra appear black. There are several possible explanations for this. These apparent melanistic specimens basically were collected in the same locations and seasons as normally patterned *C. freidbergi*; therefore, this color difference is



Figs 14–17: (14) *Cerichrestus ?allardi* (Duvivier), mimic, habitus, dorsal view, Colombia, Choco; (15) Lycidae (*Cartagonum* sp.), ?model, habitus, dorsal view, Colombia, Choco; (16) *Cerichrestus* sp., mimic, habitus, dorsal view; (17) Lampyridae (*Lucidota* sp.), ?model, habitus, dorsal view.

not seasonal. Polymorphism in some lepidopteran mimicry is important (Wickler 1968; Rettenmeyer 1970); however, it is certainly not clear that these melanics of *C. freidbergi* are true polymorphs that might indicate a tendency towards an evolutionary shift in the color pattern. Although many Alticinae have quite variable color patterns (Furth 2017), in the case of mimicry such polymorphism or variability could also be disadvantageous if either the model or other mimics in the ring have a relatively constant pattern. Therefore, the consistent color pattern differences, especially dorsally, between *C. freidbergi* and *C. clarki* may have even more significance. Of course, it is possible that the darkened elytral color of these six specimens may have been caused by some different dietary consumption. It is also possible that during the process of trapping and killing these specimens they were exposed to some chemicals that darkened the normally yellow elytral stripes. Additionally, there may have been conditions during the processing of these specimens, or even afterwards while drying, that caused these elytral areas to change color chemically, such as the greasing that often occurs in Lepidoptera, beetles, and other insects stored in different conditions.

Example of little-known biodiversity

Although the lack of knowledge about *Cerichrestus* is by no means unusual, it is a good example of a situation that is not so well-known, especially to non-entomological taxonomists. Even though there have until now been 16 described species in this genus, except for a few checklists reiterating their distribution by country (e.g., Heikertinger & Csiki 1940; Seeno & Wilcox 1982; Furth & Savini 1996), essentially nothing other than the original description has been written about them; therefore, *Cerichrestus* is a good example of how little is actually known about much/most animal biodiversity! In fact, without trying to make an entire research project from it, a wild guess might be that for a majority of the described species of animals, i.e., insects, especially beetles (Coleoptera) that is close to 25 % of the known species of animals, it may be that nothing more is known than their scientific name. Additionally, even those where a few papers have cited these scientific names in checklists, nomenclatural changes, determination keys, etc., we know nothing about their biology, their true distribution/biogeography, ecology, phylogeny, genetics, etc. To speculate further, this ignorance may also be apart of the misunderstanding by non-entomologists about how difficult it is to assign names to insect taxa, leading to restrictive collecting regulations, application of conservation practices, checklists or surveys of geographical areas or ecological subjects, administrator's requests, etc., because it can take insect taxonomists orders of magnitude more time to accomplish such requested information.

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Cerichestus ?allardi mimic and *Cartagonum* (Lycidae) model, and *Cerichestus* sp. mimic and *Lucidota* sp. (Lampyridae) model, all from Choco, Colombia. I am also very much indebted to Dr. Angel Solis of the Instituto Nacional de Biodiversidad (INBio) in San Jose, Costa Rica for the loan of specimens. Dr. Jack Longino (University of Utah, USA) encouraged and allowed me to participate in the ALAS project that was supported by National Science Foundation grants BSR-9025024, DEB-9401069, DEB-9706976, and DEB-0072702. I also very much appreciate help from Dr. Marc Branham (University of Florida, Gainesville, USA) to identify the Lampyridae specimen from Colombia as *Lucidota* sp. and Mr. Vinicius S. Ferreira (University of Montana, USA) for the identification of the lycid (*Cartagonum* sp.) from Colombia. I also thank Dr. M. Schmitt and an anonymous referee for their useful comments.

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