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Author(s): Andris Bukejs and Maria Lourdes Chamorro
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TWO NEW FOSSIL SPECIES OF *CRYPTOCEPHALUS* GEOFFROY (COLEOPTERA: CHRYSOMELIDAE) FROM BALTIC AND DOMINICAN AMBER

Andris Bukejs and Maria Lourdes Chamorro

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(AB) Institute of Life Sciences and Technologies, Daugavpils University, Vienības 13, Daugavpils, LV-5401, Latvia. (e-mail: carabidae@inbox.lv); (MLC) Systematic Entomology Laboratory, ARS, USDA, c/o National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC-168, Washington, DC 20013-7012, USA. (e-mail: lourdes.chamorro@ars.usda.gov)

AB: urn:lsid:zoobank.org:author:AFE4A2E1-1634-4875-8E82-6BECD499CA03
MLC: urn:lsid:zoobank.org:author:8BD38884-6514-4D9E-BDFB-72A41DB11C2C

Abstract.—Two new species of *Cryptocephalus* Geoffroy (Coleoptera: Chrysomelidae) are described and illustrated from fossil resin: ***Cryptocephalus groehni* sp. nov.** (Baltic amber) and ***Cryptocephalus kheelorum* sp. nov.** (Dominican amber). These are the first described species of Cryptocephalinae from fossil resin. These new fossil species may serve with taxonomic certainty as calibration points in divergence dating estimates.

Key Words: leaf-beetles, Cryptocephalinae, new taxa, fossil resin

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Very few genera in the World surpass the species diversity of *Cryptocephalus* Geoffroy, which includes approximately 1700 species globally (Schöller 2002; Chamorro 2014). It is currently classified in the subtribe Cryptocephalina, tribe Cryptocephalini, with 20 other genera. The tribe includes approximately 3500 species in 5 subtribes. The current classification remains almost intact since Lacordaire (1848) and it is in desperate need of phylogenetic revision.

Information on Cryptocephalini in fossil resin is scanty. Representatives (imago and larvae) of this subfamily are known only from Baltic and Dominican amber (Hope 1836; Helm 1896; Klebs 1910; Spahr 198l; Santiago-Blay 1994; Santiago-Blay and Craig 1994; Santiago-Blay et al. 1996; Poinar 1999; Arillo and Ortuno 2005; Grimaldi and Engel 2005; Chaboo et al. 2009; etc.) and all these records contain a generic or higher taxa attribution, without detailed species descriptions. For example, *Diachus* LeConte and *Cryptocephalus* spp. from Dominican amber (Santiago-Blay et al. 1996) and immatures of Fulcidacini (Dominican amber) and Cryptocephalinae unplaced to tribe (Baltic amber) (Chaboo et al. 2009).

Impression fossils of Cryptocephalinae are more common, with four species known from the Mesozoic [Jurassic; 1

Clytra Laicharting (Clytrini) and 3 *Cryptocephalus* (Cryptocephalini)] and 24 species from the Cenozoic (9 Clytrini and 15 Cryptocephalini) (Santiago-Blay 1994). In the current paper, the new fossil species of *Cryptocephalus* are described from Baltic and Dominican amber. These are the first described species of Cryptocephalinae from fossil resin.

Material and Methods

The materials examined are deposited in following collections:

– collection of Geological-Palaeontological Institute of the University of Hamburg, Germany [GPIH];
– private collection of Lourdes Chamorro [LCLC] to be deposited in the National Museum of Natural History, Washington, DC (USNM).

Cryptocephalus groehni was examined using a Nikon®™ SMZ 745T stereomicroscope and the photographs were taken using a Nikon®™ SMZ 745T stereomicroscope with Nikon®™ DS-Fi1 digital camera. *Cryptocephalus kheelorum* was examined using a Zeiss®™ Discovery v8 and the images were taken with the Macropod®™ (Macroscopic Solutions) and Zerene Stacker®™ was used to obtain the final image.

Baltic amber is mainly found from the southern coasts of the Baltic Sea and usually dated as the Upper Eocene. Although most estimates of the age of Baltic amber have placed it as deriving from the early Middle Eocene (Lutetian) (48.6–40.4 Mya), based largely on K-Ar dating (Ritzkowski 1997), palynological biostratigraphy of the specific region where the sample originated suggests a younger, Priabonian age (37.2–33.9 Mya) (Aleksandrova and Zaporozhets 2008). A detailed discussion of the stratigraphic basis for the age of Baltic amber deposits can be found in Perkovsky et al. (2007). According to Turkin (1997), Baltic amber was produced by *Pinus succinifera* (Conw.) Schub., which together with oak in the Eocene dominated the humid mixed forest cover of Northern and Central Europe. More recent work on the chemical composition of Baltic amber has also suggested that trees within the family Araucariacea or Sciadopityaceae might be candidates for the production of this amber deposit (Langenheim 2003; Wolfe et al. 2009; Lambert et al. 2014).

Dominican amber is the fossil resin of leguminous trees *Hymenaea protera* Poinar, 1991 (Fabaceae) (Poinar & Poinar 1999; Langenheim 2003). Dominican amber is hypothesized to be from the Early Miocene (Burdigalian) with an estimated age of 20-15 Mya (Itturralde-Vinenet and MacPhee 1996; Chaboo et al. 2009).

Terminology follows Jolivet et al. (2014) for the median lobe.

Systematic Palaeontology

Family Chrysomelidae Latreille, 1802
Subfamily Cryptocephalinae Gyllenhal, 1813
Tribe Cryptocephalini Gyllenhal, 1813
Subtribe Cryptocephalina Gyllenhal, 1813
Genus *Cryptocephalus* Geoffroy, 1762

The two species under consideration belong to *Cryptocephalus* on the basis of a combination of characters: (1) non-serrate antennae, (2) posterior margin of pronotum with crenulation, not bordered, (3) pronotum vaulted, (5) elytra with regularly punctate striae, and (6) the pronotal/elytral ratio. *Achaenops* Suffrian, 1857 (Achaenopina) shares many of the previously stated characters except for the crenulate posterior margin of the pronotum.

Cryptocephalus (subgenus incertus) **groehni Bukejs & Chamorro sp. nov.**

(Figs. 1–5)

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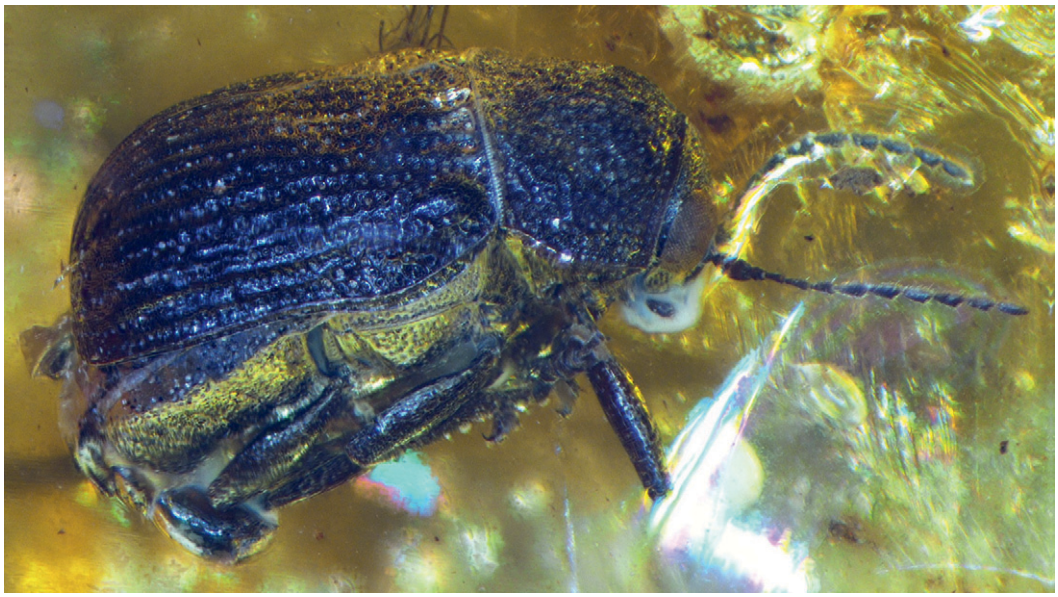
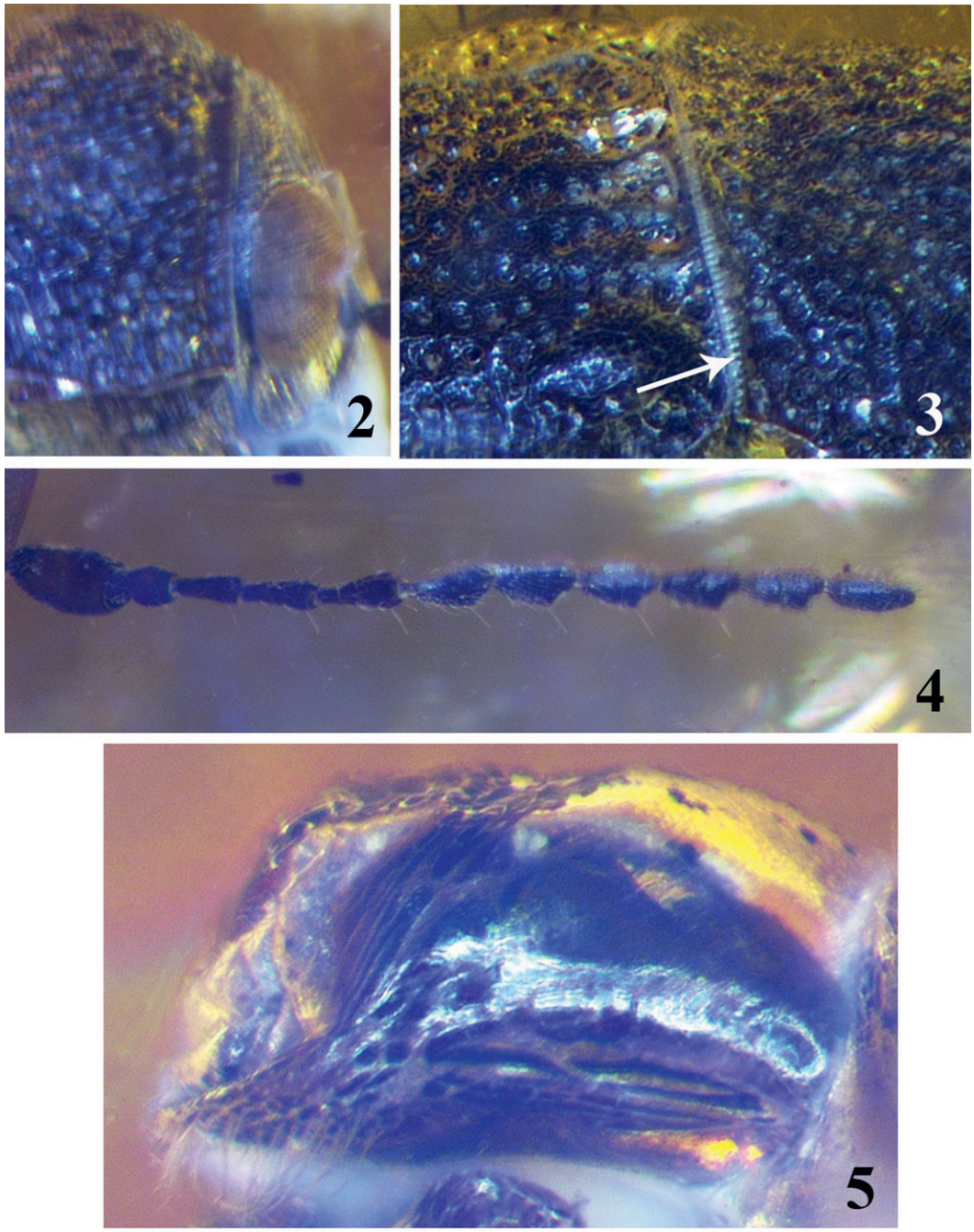


Fig. 1. *Cryptocephalus groehni* sp. nov., holotype, lateral view of habitus.

Diagnosis.—*Cryptocephalus groehni* sp. nov. is most similar to the following species based on the presence of a strongly punctate pronotum, elytra with punctures arranged in regular striae, and distinctly convex interstriae: *Cryptocephalus* (*Burlinius*) *punctiger* Paykull, 1799; *C.* (*Cryptocephalus*) *parvulus* Müller, 1776; and *C.* (*Cryptocephalus*) *janthinus* Germar, 1824. However, this new species can be distinguished from these and all other *Cryptocephalus* species by larger and denser pronotal punctations, and the shape of the median lobe (Fig. 5). *Cryptocephalus janthinus* and the new fossil species have an anterior lobe with a short and broad anterior part, a generally angled apex with a wide median orifice, however, *C. groehni* sp. nov. differs from *C. janthinus* and all other species of the genus in the mucronate shape of the dorsal margin of the median lobe, greatly sinuate in lateral view, and a narrowed, almost digitate ventral, apical flap covering the median orifice (Fig. 5). The uncommonly short antennae of the male, present in species such as *C. ergenensis* Morawitz, 1863 and Achaenopina, is also diagnostic.

Description.—Body length 3.8 mm; cylindrical, convex dorsally and ventrally; dark brown, profemora and basal half of antennae slightly paler, reddish-brown; dorsum glabrous, ventral side and legs covered with fine, short pale recumbent pubescence.

Head hypognathous, with fine, dense punctation; vertex evenly weakly convex. Eyes with distinct facets, relatively small, evenly convex, inner margin weakly emarginated; vertical diameter 2 times as great as transverse diameter. Antennae 11-segmented; covered with fine recumbent pubescence, with few longer erect setae apically; short, reaching basal 1/5 of elytra; scape longest and widest, cylindrical, about 2.2



Figs. 2–5. *Cryptocephalus groehni* sp. nov., holotype. 2, Details of forebody, lateral view. 3, Bases of elytra and pronotum. Arrow = posterior margin of pronotum with fine crenulation. 4, Right antenna. 5, Aaedeagus, lateral view.

times as long as wider; pedicel short, subspherical, about 1.3 times as long as wide; antennomeres 3-4 thin, cylindrical, about 2.7 times as long as wide; antennomere 5 weakly dilated distally; antennomeres 6-10 distinctly dilated distally, about 1.5 times wider than antennomere 5; antennomere 11 spindle-shaped with pointed apex. Relative length ratios of antennomeres 1-11 equal to 13-5-7-8-9-11-10-10-10-10-10.

Pronotum convex, transverse, widest medially, narrowed anteriad and posteriad; anterior margin with narrow, transverse impression. Posterior margin weakly sinuate, anterior margin straight (in dorsal view), lateral margins rounded; lateral and anterior margins with narrow bordering, posterior margin not bordered, with fine crenulation. Posterior angles slightly obtuse, with short, erect pale seta; anterior angles nearly straight with short, erect pale seta. Base of pronotum nearly as wide as elytral base. Pronotal punctuation relatively large (nearly as large as elytral punctures in basal half), deep and dense, distance between punctures smaller than diameter of a puncture; interspaces distinctly convex.

Scutellum small, triangular, weakly elevated at apex; covered with fine punctures. Elytra about 2.5 times length of pronotum; convex, nearly parallel; basal margin narrowly bordered. Elytral punctures large, dense and deep; arranged in regular striae (only near scutellum and at humeri punctures weakly confused), striae distinct throughout entire length of elytra; in basal half punctations distinctly larger and denser than at apices; distance between punctures in striae equal to 0.5-1.0 times diameter of a puncture; interstriae distinctly convex, shagreened; distance between striae approximately 1.0-2.5 times diameter of a puncture. Humeral calli well developed. Elytral apices separately rounded. Hind wings present. Pygidium with fine, dense punctures.

Ventral surface covered with small, dense punctures, interspaces between them shagreened. Procoxae round, procoxal cavity widely close posteriorly; mesocoxae oval; metacoxae transverse, elongated. Prohypomera depressed in posterior half and distinctly elevated anteriorly. Epipleura oblique (well visible in lateral view), wide anteriorly and gradually narrowing posteriorly, reaching elytral apex; covered with small punctures. Metaventrite convex posteriorly and weakly depressed at anterior margin. Metepisternum about 6 times as long as wide, weakly widened anteriorly, anterior margin oblique, posterior margin almost straight, exterior lateral margin distinctly sinuate, internal lateral margin almost straight. Abdomen with five visible ventrites; ventrite 1 longest. Relative length ratios of ventrites 1–5 equal to 13:8:5:5:10.

Legs robust, relatively short; covered with small punctures and shagreened. Femora spindle-shaped, weakly widened medially; tibiae straight, parallel-sided; femora and tibiae nearly equal in length. Claws relatively large, free, simple.

Aedeagus (Fig. 5). Anterior lobe with short, broad anterior part, generally angled apex with wide median orifice, dorsal margin of median lobe mucronate, greatly sinuate in lateral view, with narrowed, almost digitate ventral, apical flap covering median orifice.

Type material.—Holotype: “C 7996”, “Holotype / *Cryptocephalus groehni* sp. nov. / des. Bukejs A. & Chamorro L.” [red printed label]; sex male. Deposited in collection of Geological-Palaeontological Institute of the University of Hamburg, Germany [GPIH] as separate collection of Carsten Gröhn. A complete

beetle with partly exposed aedeagus and hind wings; ventral side of the specimen partly obscured by a "milky" opacity. The specimen is embedded in a small, subrectangular amber piece (length about 30 mm, width 23 mm) containing many little cracks. There are also two specimens of Nematocera (Diptera), one specimen of Opiliones, few stellate hairs, small gas vesicles and small pieces of organic material in the examined amber piece. The amber was not subjected to any fixation.

Type strata.—Baltic Amber, Upper Eocene, Prussian Formation.

Type locality.—Baltic Sea coast, Yantarny village [formerly Palmnicken], the Sambian [Samland] peninsula, Kaliningrad Region, Russia.

Etymology.—Patronymic, the species name is dedicated to Carsten Gröhn (Glinde, Germany).

Cryptocephalus (subgenus incertus) *kheelorum* Chamorro & Bukejs sp. nov.

(Figs. 6–7)

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Diagnosis.—*Cryptocephalus kheelorum* sp. nov. is close to several extant species with small body size from the Caribbean region, such as *Cryptocephalus xerampelinus* Suffrian, 1852 and *Cryptocephalus splendidus* Suffrian, 1852, but it is unique in the presence of the paired parallel longitudinal pale vittae on the elytra.

Description.—Body length 2.8 mm; cylindrical, convex dorsally and ventrally; dark, each elytron with two longitudinal pale vittae near anterior margin, glabrous, punctation not visible because of structure of amber near the specimen.

Head hypognathous, vertex flat. Eyes with distinct facets, large, convex, reniform, almost meeting dorsally, with deep triangular canthus. Antennae 11–segmented, not serrate, long, reaching beyond half of specimen; antennomeres elongate and subequal in length except pedicel.

Pronotum convex, anteriorly vaulted, transverse, widest in basal 1/4. Posterior margin bisinuate, anterior margin entire (in dorsal view), lateral margins rounded; lateral and anterior margin with narrow bordering, posterior margin crenulate. Posterior angles obtuse. Base of pronotum as wide as elytral base. Pronotal punctation not evident.

Scutellum not visible due to specimen condition. Elytra about 2.5 times length of pronotum; convex, nearly parallel. Elytral punctures and striation not visible due to condition of surface; apparently smooth (striae weak). Humeral calli rounded. Elytral apices separately rounded. Hind wings present.

Intercoxal prosternal process wide; mesocoxae oval. Abdomen with five visible ventrites; ventrite 1 nearly as long as ventrites 2–5 combined; ventrite 5 with large suboval fovea.

Legs moderately long. Femora and tibiae subequal in length; femora spindle-shaped, weakly widened medially; tibiae parallel-sided, almost straight. Protarsi not dilated. Claws simple.

Type material.—Holotype: Holotype / *Cryptocephalus kheelorum* sp. nov. / Dominican Republic, La Toca mines (SE of Santiago) / des. Chamorro L. & Bukejs A." [red printed label]; sex female. Deposited in USNM. A complete beetle

Figs. 6–7. *Cryptocephalus kheelorum* sp. nov., holotype. 6, Dorsal view of habitus. 7, Ventral view of habitus.

with partly exposed hind wing; gas vesicle coming from the anus and another gas vesicle on the right side between the pro- and mesothoracic legs. The specimen is embedded in a small, subrectangular amber piece (length 30 mm, width 23 mm). When photographed this piece was in almost perfect condition with just a few surface cracks, however after it was left in water for more than 24

hours after photographing it broke in two at 2/3 of its length and the surface became highly cracked. Only the pictures taken when the amber piece was intact are included in the paper. The now smaller section of the broken amber piece also contains a Nematocera (Diptera) and both pieces contain small air bubbles and small pieces of organic matter.

Type strata.—Dominican amber, Upper Eocene to Lower Miocene.

Type locality.—Dominican Republic, La Toca mines (SE of Santiago).

Etymology.—The epithet of this new species is in honor of the Kheel family who showed great hospitality to the junior author during her expeditions to the Dominican Republic in 2005 and 2006 and for their significant contributions to the sustainable development, conservation, and scientific discovery in the Dominican Republic.

Discussion

Fossils are routinely included as calibration points in molecular phylogenies to estimate minimum evolutionary age of particular lineages and behaviors (e.g. McKenna et al. 2009; Buffington et al. 2014; Misof et al. 2014). The placement of fossils on nodes in a phylogeny is usually based on potentially competing morphological synapomorphies of extinct and extant taxa, which may significantly bias age estimation (Rutschmann et al 2007; Brady 2011). The availability of highly detailed fossils, such as those in amber and ones here described in *Cryptocephalus*, diminishes the possibility for multiple assignments and uncertainty. Furthermore, well-preserved fossils may be analyzed simultaneously in total evidence studies that include morphological and molecular data thereby allowing the algorithm to infer placement on the tree.

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