

## Article

# Description of Three New *Cleptes* Species from Cyprus and Lebanon with Updates and Revisions to the Genus (Hymenoptera, Chrysididae) <sup>†</sup>

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**Abstract:** Three new species of *Cleptes* Latreille, 1802, in the *C. nitidulus* species group are described: *C. sfenthourakisi* Rosa & Makris, sp. nov. (from Cyprus), *C. christi* Rosa & Makris, sp. nov. (Cyprus), and *C. adonis* Rosa & Boustani, sp. nov. (Lebanon). A new synonymy is proposed: *C. ignitus* var. *chevrieri* Frey-Gessner, 1887, syn. nov. of *C. splendidus* (Fabricius, 1794). The two members of the *C. morawitzi* species group, and the single member of the *C. rugulosus* group are transferred to the *C. nitidulus* group. The *Cleptes semenovi* species group is transferred from the subgenus *Chrysoleptes* Móczár, 1962 to the subgenus *Leioleptes* Móczár, 1962, and synonymised with the *C. nitidulus* species group. *Cleptes viridis* Gravenhorst, 1806, is considered *nomen dubium*. An updated checklist of the *C. nitidulus* group is given, including all the species described and synonymised after the latest revision by Móczár.



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**Keywords:** androchromy; new synonymy; *nomen dubium*; taxonomy

## 1. Introduction

*Cleptes* Latreille, 1802 is the largest genus in the subfamily Cleptinae, with 95 recognized worldwide species [1–16], 72 of which occur in the Palaearctic realm only. The subfamily includes two other small genera, *Cleptidea* Mocsáry, 1904 (20 species) and *Lustrina* Kurian, 1955 (1 species), which are respectively distributed only in the Neotropical and in the Oriental realms [17–20]. *Cleptes* are parasitoids of the prepupae of sawflies (Hymenoptera, Symphyta) in the families Tenthredinidae and Diprionidae [1,4,21].

Móczár [2–10] provided extensive data for the establishment of all *Cleptes* species groups, starting from the revision of the *C. nitidulus* species group [2]. He later reintroduced the use of subgenera [3,4], which were synonymised with *Cleptes* by Kimsey and Bohart [1], and included the *C. nitidulus* species group in the subgenus *Leioleptes* Móczár, 1962. We follow Móczár's taxonomic arrangement, although we propose to synonymise some species groups, namely *C. morawitzi*, *C. rugulosus* and *C. semenovi* groups, with the *C. nitidulus* species group based on the examination of type material and other specimens that were not available to the Hungarian author. We here describe three new species of the *C. nitidulus* species group from Cyprus and Lebanon and provide further taxonomic information on other members of this group. Finally, we provide an updated checklist of the members of the *C. nitidulus* species group.

## 2. Materials and Methods

Holotypes of the newly described species are deposited in the Linsenmaier collection housed at the Natur-Museum (Luzern, Switzerland, NMLU). Paratypes are deposited in the private collections of P. Rosa (Bernareggio, Italy, PRC) and C. Makris (Cyprus, CMC). Other

specimens studied in this paper are deposited at: Institute of Biology and Pedology of the National Academy of Sciences of Kyrgyzstan, Bishkek (IBPB); Muséum Histoire Naturelle, Geneva (Switzerland, MHNG) and Zoological Institute of St. Petersburg (Russia, ZIN). Species group is abbreviated into “group” in the following text.

Morphological terminology follows partly Kimsey and Bohart [1] and partly Lanes et al. [22]. Abbreviations used in the descriptions are as follows: F1, F2, F3, etc. = flagellomeres 1, 2, 3, etc., respectively; l/w = length/width ratio; MOD = median ocellus diameter (measured in frontal view); MS = malar space, the shortest distance between base of mandible and lowest margin of compound eye; OOL = oculo-ocellar line, the shortest distance between posterior ocellus and compound eye; P = pedicel; PD = puncture diameter; POL = posterior ocellar line, the shortest distance between posterior ocelli; T1, T2, T3, etc. = metasomal terga 1, 2, 3, etc. Length measure of metascutellum is taken from the antero-median margin to the postero-median margin, and the width is given by the shortest distance between the mesoscutellar troughs.

Type specimens of *Cleptes sfenthourakisi* sp. nov. and *C. christi* sp. nov. were photographed by C. Makris with a Camera Canon EOS 5D Mark III (Canon Inc., Ōta, Tokyo, Japan), with Canon MP-E 65 mm f/2.8 1-5x Macro Photo lens (Canon Inc., Ōta, Tokyo, Japan); images were stacked with software Zerene Stacker (Zerene Systems LLC, Richland, WA, USA) then enhanced with Adobe Photoshop (Adobe Inc., San Jose, CA, USA). Images of *C. semenovi* and *C. adonis* were taken by P. Rosa with a Camera Olympus E-M1 Mark II (Olympus Corporation, Shinjuku, Tokyo, Japan), with Olympus Zuiko 60 mm (Olympus Corporation, Shinjuku, Tokyo, Japan); images were stacked with Helicon Focus 7.7.5 (Helicon Soft Ltd., Oakland, CA, USA) software then enhanced with Adobe Photoshop. Images of *C. morawitzi* were taken with a Camera Nikon D-80 (Nikon Corporation, Minato, Tokyo, Japan) connected to the stereo microscope Tegal SCZ (Tegal, Thailand) and stacked with the software Combine ZP (Alan Hadley, GPL Software, UK).

### 3. Results

#### 3.1. Taxonomy

*Cleptes* Latreille, 1802

*Cleptes* Latreille, 1802: 316. Type species: *Sphex semiaurata* Linnaeus, 1761, by monotypy.

*Cleptes* (*Leiocleptes*) Móczár, 1962

*Leiocleptes* Móczár, 1962: 118 (as subgenus of *Cleptes* Latreille, 1802). Type species: *Cleptes nitidulus* Fabricius, 1793, by original designation.

*Leiocleptes* Móczár: Junior subjective synonym of *Cleptes* Latreille, 1802 according to Kimsey and Bohart, 1991: 53.

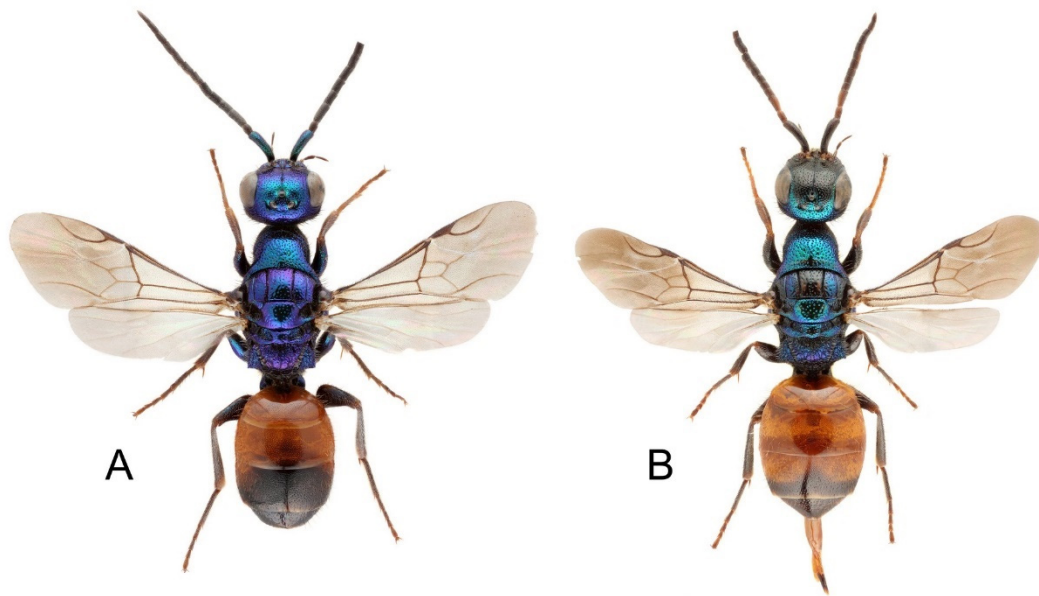
*Leiocleptes* Móczár: Revalidated as subgenus by Móczár, 1997b: 89.

Diagnosis of *Cleptes* (*Leiocleptes*). Pronotum simple (Figures 1, 2 and 3A–C), without median, longitudinal row of pits; without posterior groove, irregular punctures and/or a basal, longitudinal keel; pronotal disc convex, posteriorly connected to mesonotum without any depression; lateral margins of first two metasomal segments, although less evidently sharp than in the subgenus *Oxycleptes* Móczár, 1962; mesopleuron smooth below alar foveae, punctures on anterior margin usually aligned in striae [3].

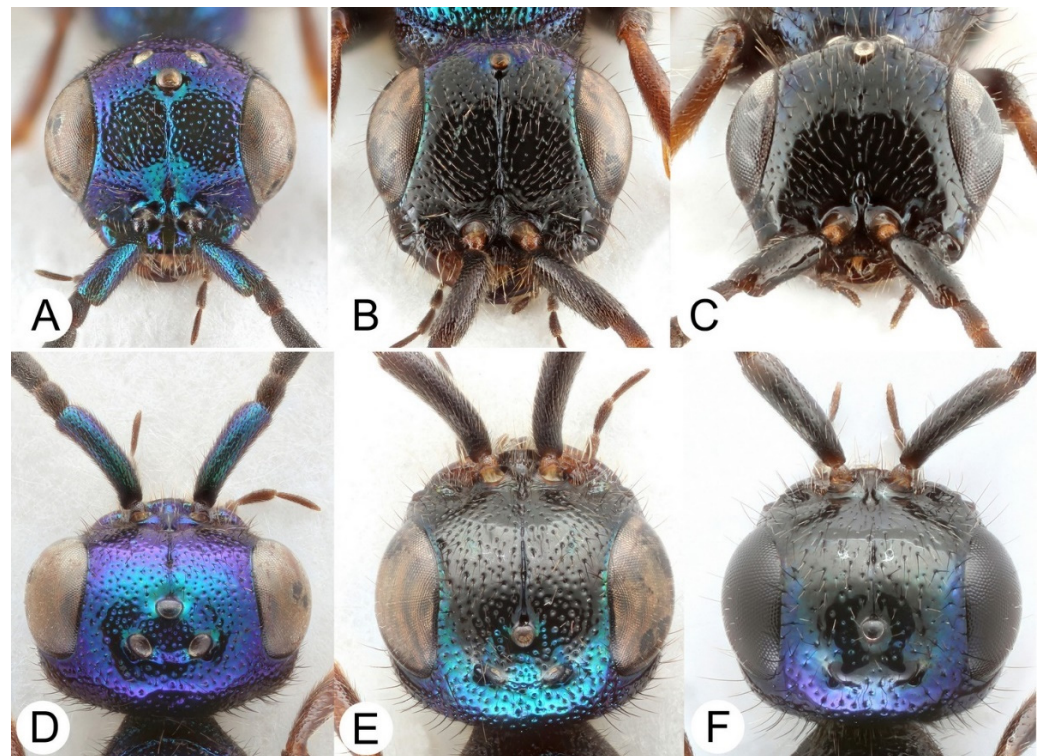
Móczár [3,4] considered five species groups in *Leiocleptes*: *C. alienus*, *C. nitidulus*, *C. morawitzi*, and *C. rugulosus* groups. Here, we consider only two species groups *C. nitidulus* and *C. alienus* (Nearctic, not evaluated in this article, to be revised).

Diagnosis of the *Cleptes* (*Leiocleptes*) *nitidulus* species group. The species included in the *C. nitidulus* group are recognized by the simple pronotum without posterior pit row, longitudinal median sulcus or median basal keel. The metasomal colour is variable; usually, the metasoma is basally yellowish, brownish or reddish and apically blackish with or without metallic segments, but some Asian species have entirely black metasoma (such as *C. morawitzi* Radoszkowski, 1877 [23], *C. helanshanus* Wei, Rosa & Xu, 2013, *C. mareki* Rosa, 2003 and *C. sinensis* Wei, Rosa & Xu, 2013 [14]), or black metasoma laterally and apically

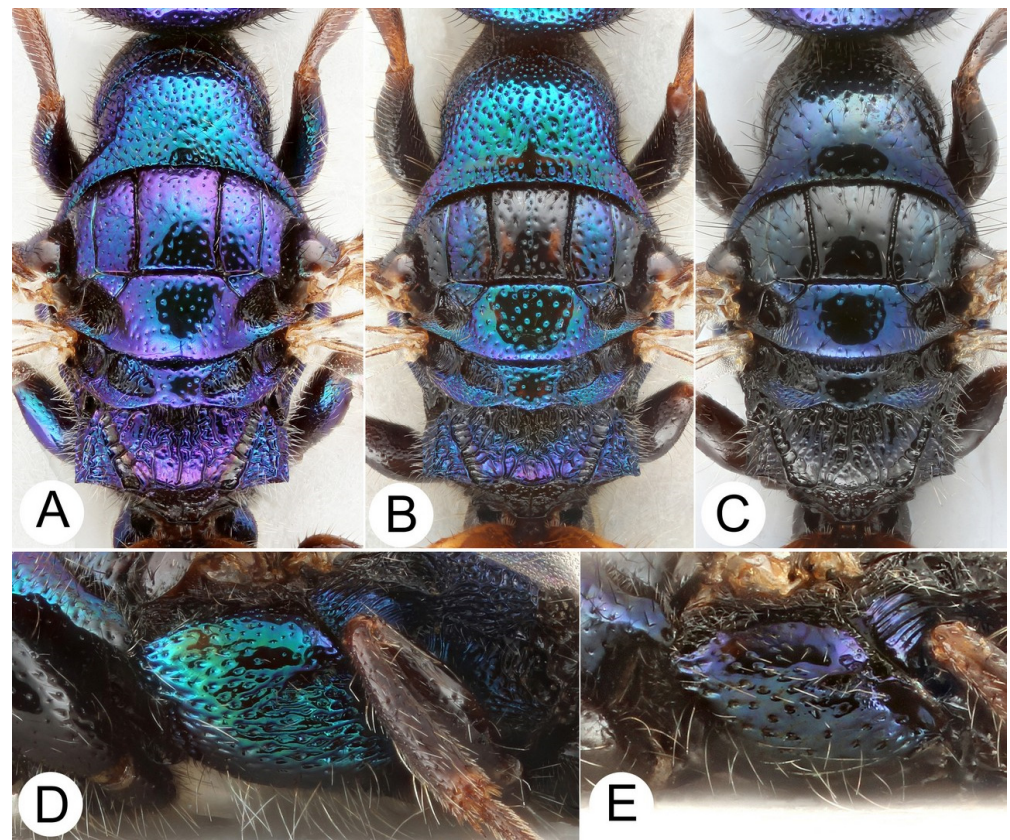
with violet or green highlights (*C. transoxianus* Rosa, 2018 and *C. semenovi* Kuznetzov-Ugamszkii, 1927).



**Figure 1.** *Cleptes sfenthourakisi* sp. nov., habitus, dorsal view. (A) Paratype male, (B) holotype female.



**Figure 2.** (A–C). Head, frontal view. (A) *Cleptes sfenthourakisi* sp. nov., paratype male, (B) *C. sfenthourakisi* sp. nov., holotype female (C) *C. christi* sp. nov., holotype female. (D–F). Head, dorsal view. (D) *C. sfenthourakisi* sp. nov., paratype male, (E) *C. sfenthourakisi* sp. nov., holotype female, (F) *C. christi* sp. nov., holotype female.



**Figure 3.** (A–C). Mesosoma, dorsal view. (A) *Cleptes sfenthourakisi* sp. nov., paratype male (B) *C. sfenthourakisi* sp. nov., holotype female, (C) *C. christi* sp. nov., holotype female. (D,E). Mesopleuron, lateral view (D) *C. sfenthourakisi* sp. nov., holotype female, (E) *C. christi* sp. nov., holotype female.

Until Móczár [3], the distinction with the Nearctic *C. alienus* group was based only on the colour of the metasoma, given as reddish and apically blackish in the *C. nitidulus* group and:

- with basal segments often metallic laterally, and apical segments almost entirely metallic (from Kimsey and Bohart [1])
- with metallic green, blue or purple highlights along lateral margins and (or) also last tergites (except in some specimens, cf. *Cleptes speciosus*). Head and thorax usually blue to purple or bright green to bluish green (male), bronze to copper (in *Cleptes speciosus*, female). T-III rarely with double punctures (from Móczár [3]).

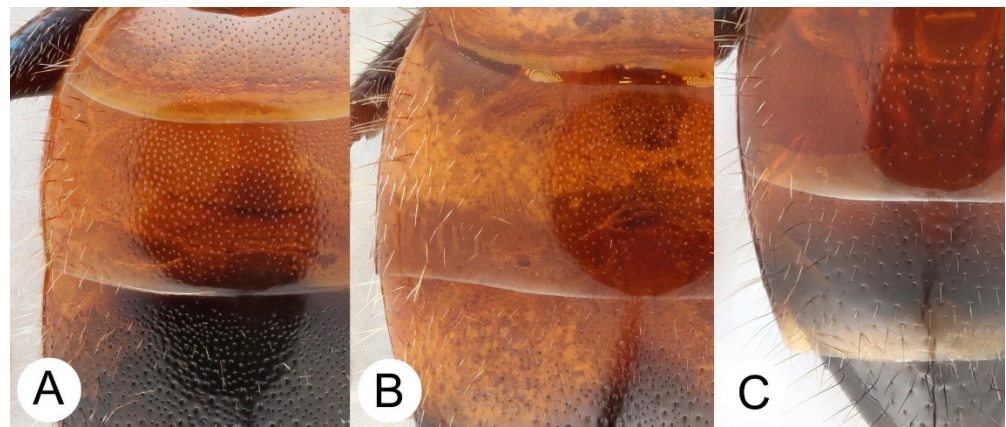
The diagnosis of the *Cleptes asianus* group should therefore be re-evaluated based on morphological characters and not only on body colour. New findings in the last decade have broadened the spectrum of the metasomal colour in members of the *C. nitidulus* group. The analysis of members of the *C. asianus* group is postponed to future research since not all the North American species were available for this study, and this analysis is beyond the scope of this article.

### 3.2. New Species Description

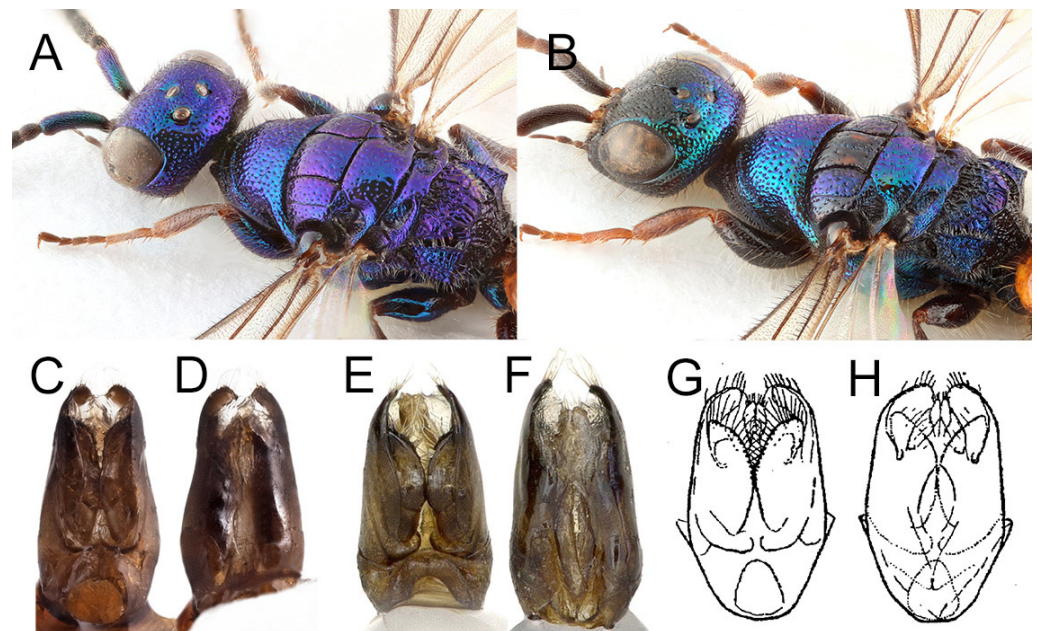
#### 3.2.1. *Cleptes (Leiocleptes) sfenthourakisi* Rosa & Makris, sp. nov.

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Figures 1A,B, 2A,B,D,E, 3A,B,D, 4A,B and 5A–D.



**Figure 4.** Metasoma, dorsal view. (A) *Cleptes sfenthourakisi* sp. nov., paratype male, (B) *C. sfenthourakisi* sp. nov., holotype female, (C) *C. christi* sp. nov., holotype female.



**Figure 5.** *Cleptes sfenthourakisi* sp. nov., mesosoma, postero-lateral view. (A) Male paratype, (B) female holotype. (C–H). Genital capsules, ventral and dorsal views. (C,D) *C. sfenthourakisi* sp. nov., (E,F) *C. splendidus* Fabricius, (G,H) *C. femoralis* Móczary (from [24]).

#### Type Material

Holotype: female, Cyprus: Larnaka Salt Lake, near Hala Sultan Tekke, 34°53'17'' N 33°36'15'' E, 26.v.2012, leg. C. Makris (NMLU). Paratypes: one male, five females, same locality, 27.v.2012 (NMLU, PRC, CMC).

Diagnosis. The female is recognised by an androchrome colour pattern, with blue head and mesosoma, and black face; deep and dense punctation on mesosoma and metasoma; double punctation on T3. The male is recognised by a combination of diagnostic features, such as shape of genitalia with elongate apex of gonostylus, metascutellum subsquare, propodeal projections with straight lateral side, metallic tibiae.

Description. *Female*. Body length 7.3–7.5 mm (holotype 7.3 mm, Figure 1B).

*Head*. Vertex with small, deep, dense punctures, with even interspaces (1–3 PD); face medially with sparser punctures (2–3 PD), laterally closer; clypeus apically emarginate, with straight, protruding medial truncation, with right angle and without teeth at corners; frontal sulcus broad and deep, almost complete from anterior ocellus to clypeal margin (Figure 2B), deeper and broadened below anterior ocellus and before clypeal margin;

ocellar triangle isosceles, without distinct post-ocellar sulcus, but with slight depression (Figure 2E) more or less visible in the paratypes; lateral pits of posterior ocelli deep, elongated ( $1.0 \times \text{MOD}$ ), as large as  $0.5 \times \text{MOD}$ ;  $\text{MS} = 1.6 \times \text{MOD}$ ;  $\text{POL} = 1.6 \times \text{MOD}$ ;  $\text{OOL} = 2.2 \times \text{MOD}$ .  $\text{P:F1:F2:F3} = 1.0:1.5:0.6:0.6$ .

*Mesosoma*. Pronotum unmodified; with deep punctures larger than those on the vertex; dorsally with relatively large, polished interspaces, becoming narrower at the sides; punctures smaller along the posterior margin; mesoscutum and mesoscutellum with shallow and relatively small punctures, with polished, large interspaces (1–3 PD) (Figure 3B); notauli and parapsidal lines deep and complete; upper mesopleuron with wide polished interspaces (Figure 3D), and small, shallow punctures; deep, short scrobal pit (Figure 3D); large and transversally confluent punctures postero-medially; metanotum with large axillary trough irregularly and longitudinally wrinkled; metascutellum subsquare; metapleuron transversely wrinkled; dorsal surface of propodeum short, as long as the mesoscutellum, irregularly reticulate, with sharp ridges (Figure 3B); posterior propodeal projections subparallel, with straight angle.

*Metasoma*. T1 almost impunctate, with shallow, sparse, and tiny punctures medially; T2 basally densely micropunctate (Figure 4B); T3 with double punctation with small dots among punctures in the first two-thirds, with shallow and sparse punctures in the apical third; T4 with large punctures and polished interspaces; all terga with impunctate stripe along posterior margin.

*Colouration*. Face and large part of frons medially dull black; rest of the head metallic blue dorsally (Figure 2B); mesosoma blue with blackish areas on median area of mesoscutum and declivitous part of propodeum (Figure 1B); some specimens show small discoloured brown areas on pronotum and mesonotum; metasoma orange on T1–T2 and basally on T3; apical half of T3 and T4 black without metallic reflection. Pedicel and F1 foxy, other antennal articles brown; tegulae non-metallic brown; legs dark brown to black without metallic reflections on femora; fore tibia light brown; fore tarsi testaceous.

*Vestiture*. On head with long ( $1.5 \times \text{MOD}$ ) and thick black setae, clearer to yellowish on mandibles; mesosoma laterally with relatively long (up to  $2.0 \times \text{MOD}$ ), dark grey setae on pronotum and mesonotum; with dense, long and whitish setae on lower mesopleuron; femora with elongate, erect and appressed, greyish setae; metasoma laterally and posteriorly, with long (up to  $3 \times \text{MOD}$ ) sparse, erect, greyish setae on T3 mixed with short, whitish and appressed setae.

*Male*. Body length: 7.0 mm. Similar to female in size and body punctation, with deep and dense punctures on mesosoma and metasoma (Figure 1A); metascutellum, metapectal-propodeal complex and posterior propodeal projections similar to female with lateral side straight. Sexual dimorphic characters: fore body uniformly blue and largely black T3 (Figure 1A); face, seen in frontal view (Figure 2A), narrowed medially, and convergent apically, with shorter malar spaces ( $0.8 \times \text{MOD}$ ); fully black flagellomeres, distinctly elongate, with  $\text{F2-F11 l/w} = 2$  (Figure 1A).

*Variability*. Two female paratypes show two slight sub-basal pronotal depressions, thus generating a weak postero-median keel, which has to be considered as a visual effect and not a sort of keel as in the *Cleptes satoi* group.

*Distribution*. Cyprus.

*Etymology*. The specific name is dedicated to Spyros Sfenthourakis (Professor of Ecology and Biodiversity, Dept. of Biological Sciences, University of Cyprus) who discovered the new species.

*Habitat*. The collecting site is 5–7 m above sea level (Figure 6A). The specimens were collected on flowers of the Apiaceae *Opopanax hispidus* in May (Figure 6B). The habitat is a field border with *Crataegus azarolus*, *Convolvulus dorycnium* and *Prosopis farcta*; in this site, flowering plants which attract cuckoo wasps are *Ferula communis*, flowering in February–April and *Opopanax hispidus* flowering in May–June.



**Figure 6.** (A) Type locality of *Cleptes sfenthourakisi* sp. nov. (B) Flowers of *Opopanax hispidus* with a specimen of *C. sfenthourakisi* sp. nov.

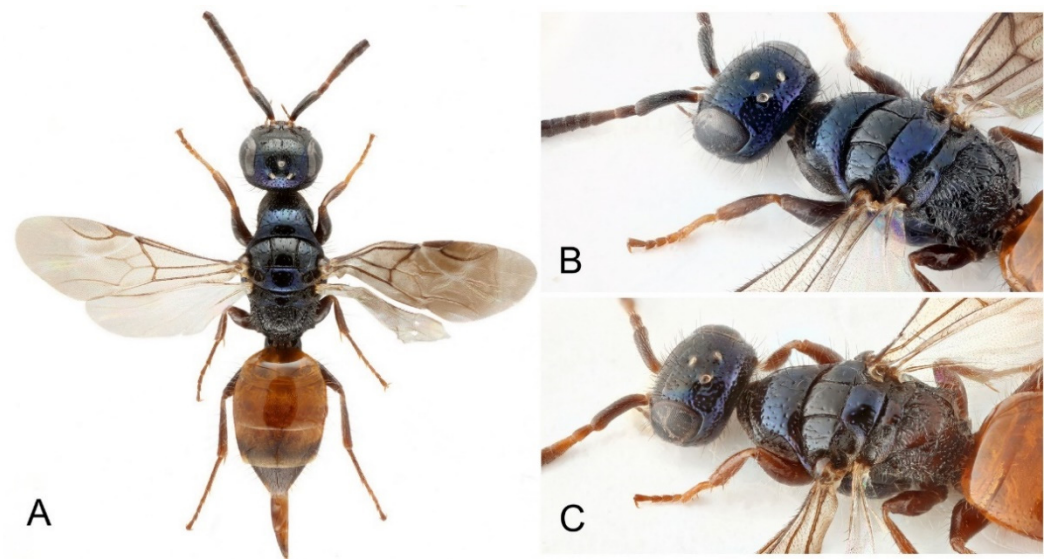
Comparative diagnosis. *Cleptes sfenthourakisi* sp. nov., *C. christi* Rosa & Makris, sp. nov. and *C. adonis* Rosa & Boustani, sp. nov. females show an androchrome colour pattern, with blue head and mesosoma. Nevertheless, the fully black face without metallic reflections is apparently a distinctive character of the female, because the male face is usually concolour with the rest of the head. The androchrome colouration separates these three species from all the other females of *Leiocleptes* from the Palaearctic Region. Other females show large part of mesosoma red, violet, coppery, non-metallic orange or black. Androchrome females are rarely observed in the Palaearctic area (see below, in the *C. aerosus* and *C. dahlbomi* groups) and are more frequent in the Oriental groups (e.g., *C. asianus* and *C. fudzi* groups), yet these groups belong to different subgenera, distinct from *Leiocleptes* by the pronotal structure [4].

*Cleptes sfenthourakisi* sp. nov. female can be separated from *C. christi* Rosa & Makris, sp. nov. female by the following combination of characteristics: larger dimensions (7.3 mm vs. 4.5 mm); deeper and denser punctation on mesosoma (Figure 3B) (vs. shallower and sparser (Figure 3C)); denser punctation on T2 and T3 (Figure 4B) (vs. sparser (Figure 4C)); face with a deep medial sulcus extended from anterior ocellus to clypeus (Figure 2B) (vs. barely visible only before anterior ocellus (Figure 2C)); posterior propodeal projections straight, expanded at base, right angled (vs. narrow, subparallel). *Cleptes sfenthourakisi* sp. nov. can be separated from *Cleptes adonis* Rosa & Boustani, sp. nov. by the antennae with pedicel and F1 light brown, and the rest of flagellomeres brownish (vs. all flagellum dark black); metascutellum subsquare,  $l/w = 1.2$  (vs. metascutellum subrectangular,  $l/w = 1.4$ ); posterior propodeal angles with straight sides, subparallel, apically right angled (vs. laterally sinuous, with angles apically pointed, divergent).

Males of *C. christi* sp. nov. and *C. adonis* sp. nov. are unknown. The male of *Cleptes sfenthourakisi* sp. nov. is similar to other two species distributed in the East Mediterranean and Middle East: *Cleptes splendidus* Fabricius, 1794 and *C. femoralis* Mocsáry, 1890 for the general habitus, colouration and even, simple punctation of the third tergum; the females of these two species can be easily separated from the female of *C. sfenthourakisi* sp. nov. by the forebody colouration, red with golden or violet areas. The male of *C. sfenthourakisi* sp. nov. can be separated from the male of *C. femoralis* by the metallic femora and tibiae (vs. yellowish to brownish meso-, meta-femora, and tibiae); and it can be separated from the male of *C. splendidus* by subsquare metascutellum (vs. subrectangular) and propodeal ridges less elaborated and sharp. The male of *C. sfenthourakisi* sp. nov. can be separated from the males of both species by the shape of the genital capsule: compare Figure 5C,D with Figure 5C,E,G,H, in which the apex of the gonostylus is elongate and curved and the upper inner margin of volsellae is distinctly angled and not gently curved.

### 3.2.2. *Cleptes (Leiocleptes) christi* Rosa & Makris, sp. nov.

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 Figures 2C,F, 3C,E, 4C and 7



**Figure 7.** *Cleptes christi* sp. nov., holotype, female. (A) Habitus, dorsal view, (B) female holotype, mesosoma, postero-lateral view, (C) *C. christi* sp. nov., paratype, female, mesosoma, postero-lateral view.

#### Type material

Holotype: female, Cyprus: Pafos District, near Eledio, 34°48'41'' N 32°34'32'' E, 10.v.2020, leg. C. Makris (NMLU). Paratype: 1 female, same locality, 30.v.2020, leg. C. Makris (CMC).

Diagnosis. *Cleptes christi* Rosa & Makris, sp. nov. is recognisable by dark blue colour pattern of head and mesosoma; small-sized body (4.5 mm); shallow and sparse punctation pattern over body. The male is unknown.

Description. *Female*. Body length 4.5 mm (Figure 7A).

*Head*. Vertex with small, shallow, sparse punctures and wide interspaces (2–4 PD); face with sparse punctures; clypeus apically emarginate, with straight, protruding medial truncation, with right angle and without teeth at corners; frontal sulcus as fine line on frons and with deep fovea at base of toruli; ocellar triangle isosceles, without post-ocellar sulcus; lateral pits of posterior ocelli deep, rounded, small, as large as  $0.3 \times \text{MOD}$  (Figure 2F);  $\text{MS} = 2.5 \times \text{MOD}$ ;  $\text{POL} = 2.0 \times \text{MOD}$ ;  $\text{OOL} = 2.4 \times \text{MOD}$ .  $\text{P:F1:F2:F3} = 1.0:1.2:0.6:0.5$ .

*Mesosoma*. Pronotum unmodified; with shallow, small punctures, similar to those on vertex, with wider polished interspaces (4–8 PD); mesoscutum and mesoscutellum with similar shallow and small punctures; with polished, wide interspaces (4–6 PD) (Figure 3C); notauli deeply impressed; parapsidal lines barely impressed; with rugose axillary trough, not irregularly wrinkled; upper mesopleuron impunctate, medially and anteriorly with sparse punctures not aligned; deep, short scrobal pit (Figure 3E); metascutellum shallowly punctate; dorsal surface of propodeum short, slightly longer than mesoscutellum length, irregularly and shallowly reticulate, with ridges barely visible (Figure 3C). Posterior propodeal projections elongate, subparallel and with right angle.

*Metasoma*. T1 impunctate; T2 medially micropunctate; T3 with larger, shallow punctures and without tiny dots on interspaces; punctation over metasoma is progressively deeper from T2–T4; all terga with impunctate stripe along posterior margins (Figure 4C).

*Colouration*. Face and most of frons dull black; rest of the dorsal head metallic blue to violet; mesosoma blue to violet, blackish on mesoscutum and propodeum; metasoma orange on T1, T2 and T3; black without metallic reflection on apical half of T3 and T4; antenna light brown on P and F1, rest of antennal articles brown; tegula non-metallic brown; legs dark brown to black without metallic reflections on femora; foretibia brownish, lighter; tarsi testaceous.

*Vestiture*. Vertex with long (up to  $2.0 \times \text{MOD}$ ), sparse, erect setae; black setae on face, vertex, and temples, greyish setae on occiput and gena; pronotum and mesonotum



with long (up to  $3.0 \times \text{MOD}$ ), black setae; greyish, shorter setae on rest of lateral and ventral mesosoma, and propodeum; latero-posterior border of T3, with thick, long (up to  $3.0 \times \text{MOD}$ ), erected, greyish setae, darker on T3 and T4; meso- and metaleg with sparse, thick, dark, erect, and long setae on outer side, with short, appressed whitish setae on inner side.

Male. Unknown.

Distribution. Cyprus.

Etymology. The specific name *christi* (masculine noun in genitive) is dedicated to Christos Makris, the son of one of the authors, C. Makris.

Habitat. The two specimens of *Cleptes christi* Rosa & Makris, sp. nov. were collected in May on leaves of *Quercus coccifera calliprinos*, near the village Eledio in Pafos District. The habitat is a sparse shrubland on gypsum formation dominated by *Quercus coccifera calliprinos*, wild olive trees (*Olea europaea*), *Pistacia terebinthus* and *Crataegus azarolus* (Figure 8).



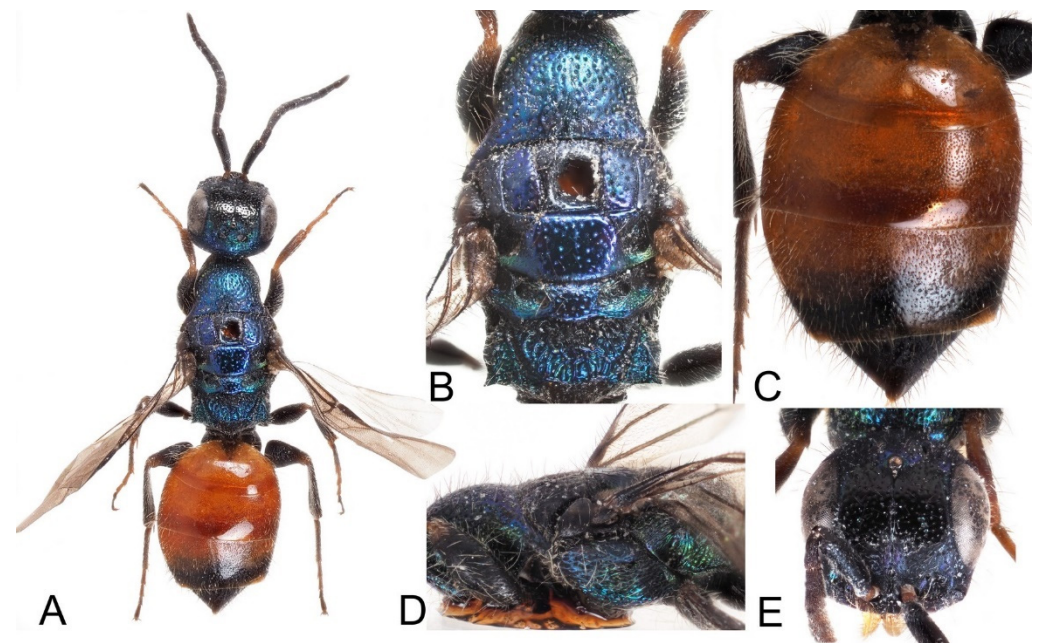
**Figure 8.** Type locality of *Cleptes christi* sp. nov.

Comparative diagnosis. The female of *Cleptes christi* sp. nov. is characterized by androchrome colouration, shallow and sparse punctation and small size. These features distinguish *C. christi* sp. nov. from all the other species of *Leiocleptes*. The female is somehow similar to *C. sfenthourakisi* Rosa & Makris, sp. nov. and *C. adonis* Rosa & Boustani, sp. nov. for the colour pattern. It can be separated from the latter two species by: smaller dimensions (4.5 mm vs. 7.0–7.5 mm) (Figure 7A); shallower and sparser punctation on mesosoma (Figures 2C, 3C and 4C) (vs. mesosoma punctation deeper and denser, particularly on pronotum); T1 polished (vs. medially punctate); T3 with sparse, shallow punctures (vs. double punctation, with tiny dots on interspaces); mesopleuron with sparse punctures (vs. medially larger and transversally aligned); posterior propodeal projections narrow, subparallel (vs. sinuous at sides, with divergent pointed angles in *C. adonis* Rosa & Boustani sp. nov., and more expanded at base in *C. sfenthourakisi* Rosa & Makris, sp. nov.); lateral pits of posterior ocelli small and rounded (vs. elongate); face with a trace of medial sulcus, on frons and before toruli (Figure 2C) (vs. deep medial sulcus extended from anterior ocellus to clypeus).

### 3.2.3. *Cleptes (Leiocleptes) adonis* Rosa & Boustani, sp. nov.

LSID: urn:lsid:zoobank.org:act:6FAFE17D-8559-4E19-A410-6DECB074252F

Figure 9



**Figure 9.** *Cleptes adonis* sp. nov., holotype, female. (A) Habitus, dorsal view, (B) mesosoma, dorsal view, (C) metasoma, dorsal view, (D) mesosoma, lateral view, (E) head, frontal view.

#### Type Material

Holotype: female, Lebanon: Horch Ehden, Al Bayada, WGS84, 34°17'57'' N 35°58'52'' E, 1686 m, 12.vi.2019, leg. X. Van achter, yellow pan trap, XVA19–0837 (NMLU).

Diagnosis. *Cleptes adonis* sp. nov. female is recognised by fully black antennae; androchrome colouration, metasoma without metallic reflections; metascutellum subrectangular; posterior propodeal angles sinuous laterally, with apically pointed angles. The male is unknown.

Description. *Female*. Body length 7.2 mm (Figure 9A).

*Head*. Vertex with small, deep, dense punctures and narrow polished interspaces (1 PD); face medially with sparser punctures (2–3 PD); clypeus apically emarginate, with straight, protruding medial lobe, with right angle and without teeth at corners; frontal sulcus broad and deep, complete from anterior ocellus to clypeal margin, deeper and broadened below anterior ocellus and before toruli; ocellar triangle isosceles, with post-ocellar line as weak depression; lateral pits of posterior ocelli deep, elongated, as large as  $0.5 \times \text{MOD}$ ;  $\text{MS} = 1.7 \times \text{MOD}$ ;  $\text{POL} = 1.7 \times \text{MOD}$ ;  $\text{OOL} = 2.4 \times \text{MOD}$ . P:F1:F2:F3 = 1.0:1.4:0.8:0.6.

*Mesosoma*. Pronotum unmodified; with deep punctures slightly larger than those on vertex and polished interspaces (1–2 PD), punctures denser laterally and smaller along posterior margin; mesoscutum and mesoscutellum with similar punctures, with polished, large interspaces (1–3 PD); notauli and parapsidal lines deep and complete; upper mesopleuron with wide polished interspaces (2–3 PD), punctures small and shallow; deep, short scrobal pit (Figure 9D); metanotum with large axillary trough irregularly and longitudinally wrinkled; metascutellum subrectangular ( $l/w = 1.4$ ), metapleuron transversely, deeply striate, with small punctures amongst striae; dorsal surface of propodeum short, as long as mesoscutellum length, irregularly reticulate (Figure 9B); posterior propodeal projections convex laterally with pointed and divergent angles (Figure 9B).

*Metasoma*. T1 with tiny, shallow and sparse punctures; T2 densely micropunctate; T3 with double punctation with small dots among punctures in the first 2/3rds, with sparse punctures in the apical third; all terga with impunctate stripe along posterior margin (Figure 9C).

*Colouration*. Face and most of frons dull black; rest of the head metallic blue; mesosoma blue with darker median area of mesoscutum and black propodeal declivity; T1, T2 and basal half of T3 orange; apical half of T3 and T4 dark brown without metallic reflection.

Antennal articles fully black. Tegula non-metallic brown; legs dark brown to black without metallic reflections on femora; fore tibia brownish, light; fore tarsi yellowish, mid- and hind tarsi dark brown.

*Vestiture.* Long ( $1.5 \times \text{MOD}$ ) and thick black setae on head, becoming clearer to yellowish on mandibles; mesosoma with long (up to  $2.0 \times \text{MOD}$ ), dark grey setae on pronotum and mesonotum laterally; dense, short and whitish setae on mesopleuron and propodeum laterally; elongate, erect, greyish setae on femora; metasoma laterally and posteriorly with long (up to  $3 \times \text{MOD}$ ) sparse, erect, greyish setae; T3 with pubescence of variable size, short setae among long ones, whitish and appressed.

Male. Unknown.

Distribution. Lebanon.

*Etymology.* The specific epithet is named after Adonis, the god of beauty and desire in Greek mythology. Originally, he was a god worshiped in the area of Phoenicia (modern-day Lebanon), and later adopted by the Greeks. The species name was chosen for the beauty of this *Cleptes*.

*Habitat.* The locality is in the buffer zone of Horch Ehden Nature Reserve, in the Montane Mediterranean (Sub-alpine) vegetation level, with sparsely wooded areas and with mainly *Quercus* sp. and *Prunus ursina*, transitioning towards the Oro-Mediterranean (Alpine) with bare soil in the background (Figure 10). The herbaceous cover of the site is dominated by *Vicia tenuifolia* earlier in spring and by *Medicago* sp. at the time of the specimen collection in July.



**Figure 10.** Type locality of *Cleptes adonis* sp. nov. with the collector X. Van achter.

*Comparative diagnosis.* *Cleptes adonis* sp. nov. is similar to *C. sfenthourakisi* Rosa & Makris, sp. nov. It can be separated by antennae fully black (vs. antennae with pedicel and flagellomere I light brown, and the rest of flagellomeres brownish); metascutellum subrectangular,  $l/w = 1.4$  (vs. metascutellum subsquare,  $l/w = 1.2$ ); posterior propodeal angles sinuous at sides, with angles pointed, divergent (vs. posterior propodeal angles with straight sides, subparallel, apically right angled). It can be separated from the other known *Cleptes* species from Lebanon, *C. libanoticus* Linsenmaier, 1959, by subgeneric features, such

as the pronotum with a basal transverse groove, and the colouration with entirely metallic green head, and T3, T4 with blue highlights (see pictures in Rosa et al. [25]).

### 3.3. Changes on the Species Groups

Móczár [2] provided a revision for the *Cleptes nitidulus* group, including a key to 25 species. He described two new species, proposed three synonymies, reinstated two species previously synonymized, and designated some lectotypes. A few months later, Móczár [3] reintroduced the subgeneric system, included the *C. nitidulus* and the *C. alienus* groups (with three Holarctic species) in the subgenus *Leiocleptes* Móczár, 1962 and established other two new groups: *C. morawitzi* and *C. rugulosus* groups, based on specimens previously included in the *C. nitidulus* group. He also revalidated *C. splendidus* (Fabricius, 1794), synonymized *C. consimilis* du Buysson, 1887 and provided a key to the *Leiocleptes* groups. Finally, Móczár [6] completed the revision of the subgenus *Leiocleptes* with an additional supplement, including new synonyms and corrections for taxa of the *nitidulus* group.

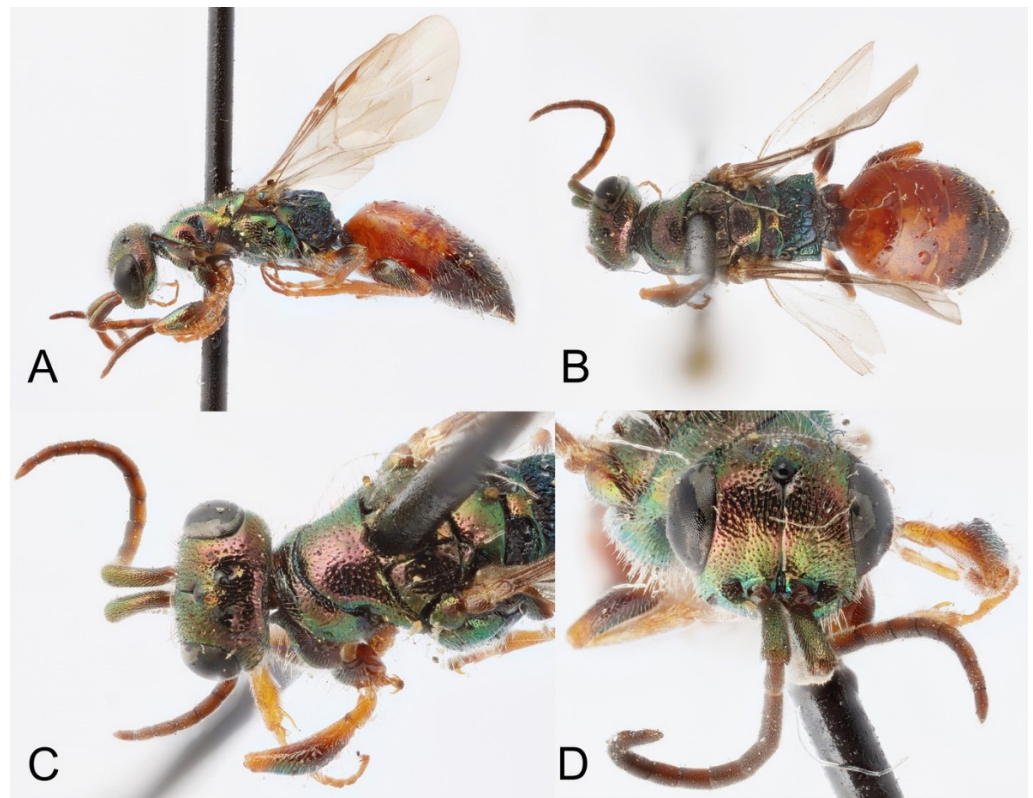
After Móczár's revision [2,3,6], six other species were described in the *C. nitidulus* group: *C. laevifacies* Linsenmaier, 1999, from Morocco; *C. mareki* Rosa, 2003, from China; *C. hungaricus* Móczár, 2009, from Hungary; *C. helanshanus* Wei, Rosa & Xu, 2013 and *C. sinensis* Wei, Rosa & Xu, 2013, from China; *C. transoxianus* Rosa, 2018, from Kazakhstan. Lastly, Rosa [26] described the male and illustrated specimens of *C. dauriensis* Móczár, 1997a from Mongolia, and Rosa et al. [25] illustrated all *Cleptes* types described by Linsenmaier, including members of the *C. nitidulus* group.

We transfer the two members of the *C. morawitzi* group and the single member of the *C. rugulosus* group to the *C. nitidulus* group. The *Cleptes semenovi* group is transferred from the subgenus *Chrysocleptes* to the subgenus *Leiocleptes*, *C. nitidulus* group; *C. viridis*, one of the two members of the *C. semenovi* group, is considered as a *nomen dubium* (see below).

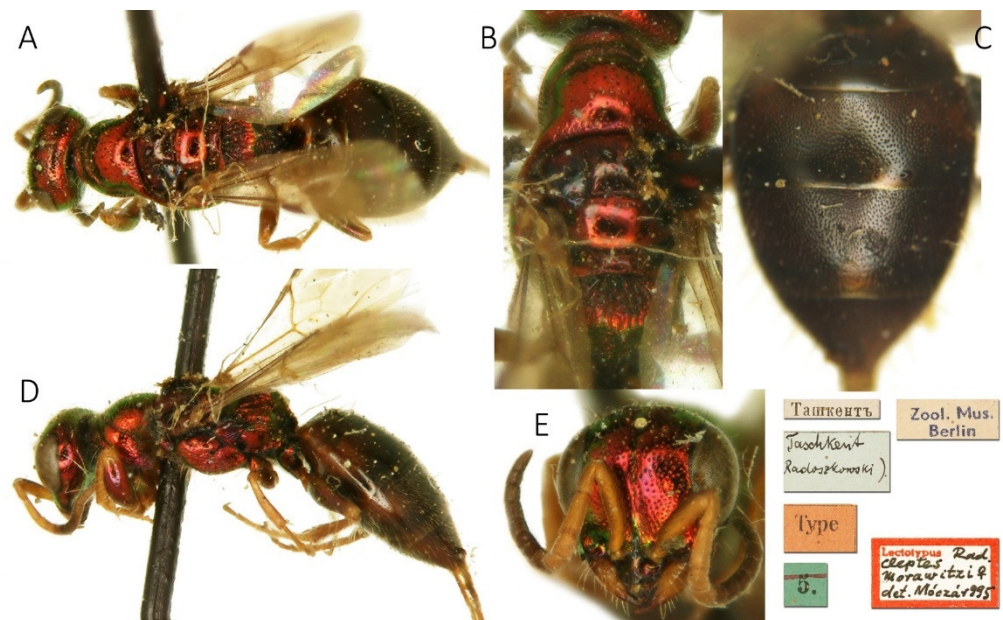
#### 3.3.1. The Case of *Cleptes morawitzi* and *C. rugulosus* Groups

Móczár [3] subdivided the subgenus *Leiocleptes* into four species groups: *Cleptes nitidulus*, *C. alienus*, *C. morawitzi*, and *C. rugulosus* groups. Nearctic species in the *C. alienus* group are not discussed here.

Móczár [3] included two species in the newly established *C. morawitzi* group: *C. canadensis* Kimsey, 1987 (Figure 11) and *Cleptes morawitzi* (Figure 12). He characterized this group based on inconsistent characters, such as the metasoma colouration without metallic highlights (as in most of the species in the *C. nitidulus* group); head and mesosoma unicolour; posterior propodeal angle stumpy and third metasomal tergum without double punctures. The metasomal colour is different in the two species, being fully black in *C. morawitzi* and largely yellowish in *C. canadensis*; head and mesosoma are shiny, metallic red in *C. morawitzi* but coppery, with greenish reflections, in *C. canadensis*, with contrasting bluish propodeum; the posterior propodeal angles are variable, as observed in Central Asian specimens belonging to undescribed species of the *C. morawitzi* group with pointed propodeal angle (unpubl. data).



**Figure 11.** *Cleptes canadensis* holotype, male. (A) Habitus, lateral view, (B) habitus, dorsal view, (C) mesosoma, dorsal view, (D) face, frontal view.



**Figure 12.** *Cleptes morawitzi* lectotype, female. (A) Habitus, dorsal view, (B) mesosoma, dorsal view, (C) metasoma, dorsal view, (D) habitus, lateral view, (E) head, frontal view; labels.

Examination of the *C. morawitzi* type series (Figure 12; Rosa et al. [23]) and other undescribed Central Asian species of this group, found in Berlin and St. Petersburg, shows a broad variability for all the diagnostic characters given in the diagnosis of the group. At the same time, *C. canadensis* (Figure 11) seems to be similar to other species included in the

*nitidulus* group, i.e., *C. dauriensis* (compare Figure 1 in Rosa [26]). Therefore, we include these two species in the *C. nitidulus* group.

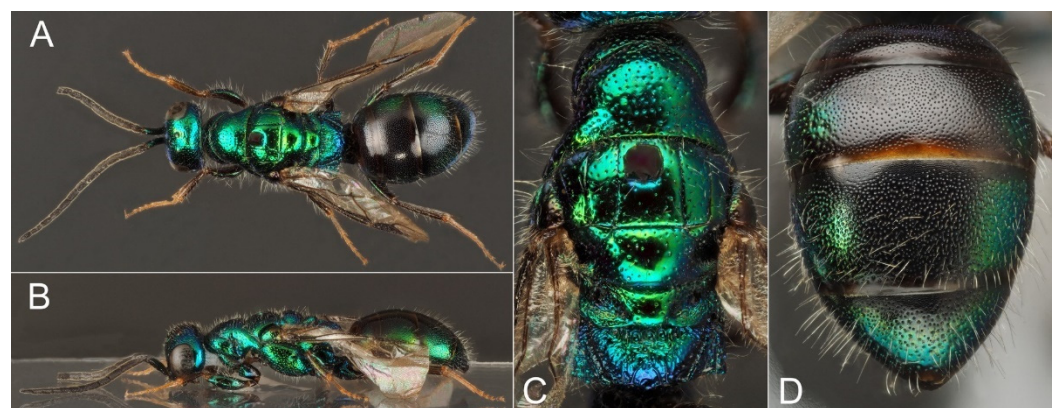
The *Cleptes rugulosus* group was proposed based on a single species with coarse punctation on mesosoma, without any other morphological diagnostic character, and with colouration similar to other common species in the *nitidulus* group, i.e., *C. ignitus* (Fabricius, 1787). We consider the coarse punctation of the mesosoma a diagnostic character valid for species identification only and consider *C. rugulosus* as another member of the *C. nitidulus* group.

### 3.3.2. The Case of *Cleptes semenovi* Group

Móczár [4] revalidated the subgenus *Chrysocleptes* Móczár, 1962 previously synonymized with *Cleptes* Latreille, 1802 by Kimsey and Bohart [1] based on two features: the unmodified pronotum and the metallic metasoma. He subdivided the subgenus into two species group: the *C. putoni* group, based on a single species with entirely metallic metasoma, and the *C. semenovi* group, including two species, *Cleptes semenovi* Kuznetsov-Ugamszkii, 1927 and *Cleptes viridis* Gravenhorst, 1807, based on the laterally extensively metallic metasoma.

Móczár [4] was unable to examine any type or specimen of the *C. semenovi* group, based the diagnosis of the newly established group on the short original descriptions only. According to him: “This group includes two species at present: *Cleptes semenovi* Kuznetsov-Ugamszkii, 1927 and *Cleptes viridis* Gravenhorst, 1807. The type material is unknown for both species. Unfortunately, the diagnosis of *viridis* is very short. However, *semenovi* was compared by the author with *C. dahlbomi* Semenov; otherwise it would belong to *Leiocleptes* subgenus because of the simple pronotum. The body of both species is nearly entirely concolourous and with metallic highlights. The simplest solution to separate these is to form an isolated group, being in equal distance from the other groups and subgenera”.

We identified a specimen collected in Kazakhstan from IBPB as *Cleptes semenovi* (Figure 13). Members of the *C. semenovi* group show the same diagnostic characters of members in the *C. nitidulus* group, with metallic colouration at sides of metasoma, as in the case of *C. transoxianus* described from Central Asia, with red and purplish colour instead of green. We consider the colouration of *C. semenovi* as a diagnostic character for species identification in the *C. nitidulus* group. Any distinct morphological character is observed to consider *C. semenovi* a member of a different group or subgenus.



**Figure 13.** *Cleptes semenovi* female from Kazakhstan. (A) Habitus, dorsal view, (B) habitus, lateral view, (C) metasoma, dorsal view, (D) metasoma, dorsal view.

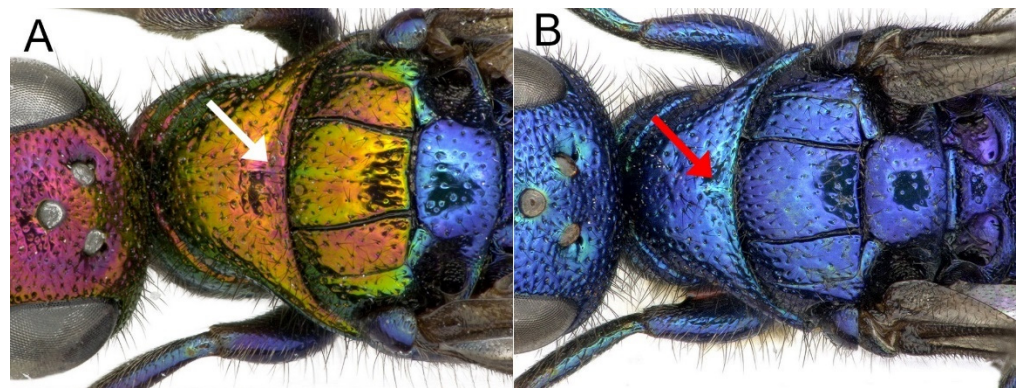
We consider the second member of this group, *Cleptes viridis* Gravenhorst, 1807 *nomen dubium* because the type depository is unknown [1,4], the description is too short to recognise this species, and the type locality is not given. Therefore, it is not possible to have reliable identification and designation of a neotype.

Based on the above observations on *Cleptes semenovi*, we here synonymise the *C. semenovi* group with the *C. nitidulus* group.

### 3.3.3. The *Cleptes putoni* Species Group

This group was established by Móczár [4] based on the simple pronotum and the fully metallic colouration of the metasoma. *Cleptes putoni* du Buysson, 1886 is the only member of the species group and the type species of the subgenus *Chrysoleptes* Móczár, 1962. The metallic pattern could be related to the ecology of this species. As explained by Rosa [27], *Cleptes putoni* is the most eurizonal *Cleptes*, and the only one repeatedly observed in dry, xerothermic habitats, entering in nests in clay walls. The metallic and heavily sclerotised metasomal cuticle is likely a response to the incremental risk of body dehydration in dry environments, in comparison to other *Cleptes* species which live in wet environments, in forests or in the vegetation.

We do not consider the metallic metasomal colouration as a diagnostic character for species groups; however, other diagnostic characters should be taken into consideration for its taxonomic placement. The pronotum is described as simple or at most hardly depressed posteriorly [4]. However, both sexes show an additional postero-medial keel (Figure 14A,B), more evident in the male, which was not cited by Móczár [4]. This characteristic, well visible in the neotype, combined with the extremely shortened pronotum of both sexes, place *C. putoni* out from the *C. nitidulus* group and the *Leioleptes* subgenus. Pauli et al. [28] confirmed by means of molecular analyses that *C. putoni* belongs to a separate clade from the *C. nitidulus* group, and we still consider this species group and its inclusion in a separated subgenus to be valid. A molecular comparison with specimens in the *Cleptes* (*Cleptes*) *satoi* group is needed for a better understanding of the real placement of this species and species group, because they share short pronotum and postero-medial keel, which are diagnostic characters for the *C. satoi* group.



**Figure 14.** *Cleptes putoni*, mesosoma, dorsal view. (A) Female, (B) male.

### 3.4. Proposed Synonyms in the *Cleptes nitidulus* Group

During our research on *Cleptes*, we collected some new taxonomic data related to members of the *C. nitidulus* species, some of which were not mentioned in the catalogues of Kimsey and Bohart [1] and/or Móczár [2,3,6]. The remarks are listed under the original combination.

#### 3.4.1. *Cleptes afra* var. *medina* du Buysson in André, 1891

*Cleptes afra* var. *medina* du Buysson in André, 1891: 79. Holotype female; Spain: Sierra Morena, leg. Medina (depository unknown).

Remarks. Taxon not mentioned in Móczár's revisions [2,3,6]. Gogorza [29] described *Cleptes perezii*, another Spanish taxon closely related to the northern African *C. afer* Lucas, 1849. Du Buysson [30] synonymised *C. perezii* with *C. afer* and described a female as *C. afra* var. *medina*. *C. perezii* and *C. medina* most likely belong to the same taxon, and we here

consider *C. afra* var. *medina* du Buysson in André, 1891 as a possible synonym of *C. perezii* Gogorza, 1887, waiting for the examination of the type materials. The current subspecific status of this taxon has still to be evaluated.

#### 3.4.2. *Cleptes chevrieri* Frey-Gessner, 1887

*Cleptes ignitus* var. *chevrieri* Frey-Gessner, 1887: 30. Syntypes females; Switzerland: Champel (Geneva).

Remarks. Taxon not mentioned in Móczár's revisions [2,3,6], yet Móczár [24] synonymized *Cleptes chevrieri* Frey-Gessner, 1887 with *C. consimilis* du Buysson, 1887. Linsenmaier [31,32] revalidated *C. chevrieri* and proposed *C. consimilis* du Buysson, 1887 as its synonym. In Geneva, we examined the two females syntypes cited by Frey-Gessner [33]. They are conspecific with *C. splendidus* (Fabricius, 1794). Since we follow Móczár's species interpretation, we propose *C. ignitus* var. *chevrieri* Frey-Gessner, 1887 syn. nov. of *C. splendidus* (Fabricius, 1794). In fact, Móczár [2,3,6] already synonymized the following species with *C. splendidus*: *C. caucasicus* Semenov-Tian-Shanskij, 1920, *C. chyzeri* Mocsáry, 1889, *C. consimilis* Buysson, 1887, *C. hyrcanus* Semenov-Tian-Shanskij, 1920.

#### 3.4.3. *Cleptes nitidula* var. *nigricans* du Buysson, 1901

*Cleptes nitidula* var. *nigricans* du Buysson, 1901: 97. Holotype male, Greece (Vienna).

Remarks. Not mentioned in Kimsey and Bohart [1] neither Móczár's papers [2,3,6]. As mentioned by Rosa et al. [34], this taxon was correctly described, and the name is available. The original description is short: "Diffère du type par l'abdomen entièrement noir, sauf sur la base du premier segment.—Graecia, Oertzen". This taxon could be a valid species.

#### 3.4.4. *Cleptes perezii* Gogorza, 1887

*Cleptes perezii* Gogorza, 1887: 30. Syntypes males; Spain: Real Casa de Campo (Madrid).

*Cleptes perezii*: du Buysson in André 1891. Incorrect subsequent spelling.

Remarks. Gogorza [29] described *Cleptes perezii* based on two male specimens: "Solo poseo en mi colección dos ♂ recogidos en el mes de Junio, sobre unas umbelas de Thapsia, en la Real Casa de Campo". Kimsey and Bohart [1] listed the holotype in Madrid, yet this specimen cannot be considered as either the holotype or the lectotype by inference of a "holotype" according to the Code (ICZN [35]: Article 74.5).

### 3.5. Updated Checklist of the *Cleptes nitidulus* Species Group

1. *Cleptes adonis* Rosa & Boustani, sp. nov.—Lebanon
2. *Cleptes afer* Lucas, 1849—North Africa, Turkey
3. *Cleptes afer perezii* Gogorza, 1887—Spain  
= ? *Cleptes afra* var. *medina* du Buysson in André, 1891
4. *Cleptes anceyi* du Buysson, 1891—Algeria, Tunisia, Morocco
5. *Cleptes blaisdelli* Bridwell, 1919—west USA, north-west Mexico
6. *Cleptes canadensis* Kimsey, 1987—Canada
7. *Cleptes christi* Rosa & Makris, sp. nov.—Cyprus
8. *Cleptes dauriensis* Móczár, 1997a—Mongolia, East Russia
9. *Cleptes doii* Tsuneki, 1959—Korea
10. *Cleptes femoralis* Mocsáry, 1890—Greece, Caucasus, Russia, Turkey  
= *Cleptes antakyensis* Linsenmaier, 1968
11. *Cleptes helanshanus* Wei, Rosa & Xu, 2013—China
12. *Cleptes hungaricus* Móczár, 2009—Hungary
13. *Cleptes ignitus* (Fabricius, 1787)—south-east Europe, North Africa, Russia, West Asia, Turkey, Palestine
14. *Cleptes insidiosus* du Buysson, 1891—Caucasus
15. *Cleptes kurdasicus* Móczár, 1968—Turkey
16. *Cleptes laevifacies* Linsenmaier, 1999—Morocco



17. *Cleptes maroccanus* Linsenmaier, 1987—Morocco
18. *Cleptes mareki* Rosa, 2003—China
19. *Cleptes mayeti* du Buysson, 1891—Algeria (possible synonym of *C. afer* Lucas, 1849)
20. *Cleptes morawitzi* Radoszkowski, 1877—Central Asia
21. *Cleptes muti* Móczár, 1968—Turkey
22. *Cleptes nitidulus* (Fabricius, 1793)—Europe, Russia, Turkey  
= *Cleptes thoracicus* Laporte in Guérin-Méneville, 1835  
= *Cleptes fallax* Mocsáry, 1889
23. *Cleptes nyonensis* Móczár, 1997a—Switzerland [not France]
24. *Cleptes obsoletus* Semenow, 1891—Russia (Sarepta), South-east Asia
25. *Cleptes putoni* du Buysson, 1886—south and central Europe to Turkey, Jordan
26. *Cleptes rugulosus* Linsenmaier, 1968—Palestine, Syria
27. *Cleptes scutellaris* Mocsáry, 1889—Hungary, Austria, south Europe, Turkey, Israel
28. *Cleptes scutellaris gurunensis* Linsenmaier, 1987 (possible synonym of *C. anceyi* du Buysson, 1891)
29. *Cleptes semiatrus* Linsenmaier, 1959—Palestine
30. *Cleptes semicyaneus* Tournier, 1879—Europe, Russia, Ukraine  
= *Cleptes elegans* Mocsáry, 1901  
= *Cleptes nitidulus* var. *erdosi* Móczár, 1951
31. *Cleptes semenovi* Kuznetzov-Ugamszkii, 1927—Central Asia: Kazakhstan (new record), Uzbekistan
32. *Cleptes sfenthourakisi* Rosa & Makris, sp. nov.—Cyprus
33. *Cleptes sinensis* Wei, Rosa & Xu, 2013—China
34. *Cleptes splendidus* (Fabricius, 1794)—Europe, North Africa, Georgia, Russia, Turkey, Israel, Iran  
= *Cleptes caucasicus* Semenov-Tian-Shanskij, 1920  
= *Cleptes chyzeri* Mocsáry, 1889  
= *Cleptes consimilis* du Buysson, 1887  
= *Cleptes hyrcanus* Semenov-Tian-Shanskij, 1920  
= *Cleptes ignitus* var. *chevrieri* Frey-Gessner, 1887 syn. nov.
35. *Cleptes syriacus* du Buysson, 1887—Israel, Turkey
36. *Cleptes transoxianus* Rosa, 2018—Kazakhstan

#### 4. Discussion

The three newly described species, *Cleptes adonis* Rosa & Boustani, sp. nov., *C. christi* Rosa & Makris, sp. nov. and *C. sfenthourakisi* Rosa & Makris, sp. nov. show an unusual androchrome colouration of the female. Androchromy is when the female has a similar colour pattern to the male (from ancient Greek “andréios/ἀνδρεῖος”, meaning masculine, and “chroma/χρῶμα, meaning colour). They represent the first case of this colour pattern observed in the West Palaearctic species of the *C. nitidulus* group. This chromatism is extremely rare in West Palaearctic species and it was previously recorded only for *Cleptes (Maculosicleptes) schmidtii* Linsenmaier, 1968, a member of the *C. dahlbomi* group and *C. (Holcocleptes) libanoticus* Linsenmaier, 1959 a member of the *C. aerosus* group (see pictures of the type in Rosa et al. [25]).

In the *C. nitidulus* group, the female of *C. mareki* Rosa, 2003 (from China) is mainly black, with bluish reflections on pronotum, metanotum and mesopleuron, similarly coloured as the male, which is more blue on the head and mesosoma. Some members of the *C. nitidulus* group have both sexes with a red to bronze head and mesosoma: *C. morawitzi*, *C. canadensis* and *C. dauriensis*. In other species of the *C. nitidulus* group, the male is currently unknown (e.g., *C. semenovi* and *C. transoxianus*) and may have the same female colouration.

In other species groups, both sexes share the same red forebody colouration, namely in the *C. (Holcocleptes) aerosus* group (*C. aerosus* Förster, 1853; *C. flammifer* Semenow, 1892; *C. radoszkowskii* Mocsáry in Radoszkowski, 1889), and in the *C. juengeri* group (*C. juengeri* Linsenmaier, 1994). A different situation is found in Oriental groups, such as in the *C.*

(*Cleptes*) *asianus* group and the *C. (Holcocleptes) fudzi* group, in which both sexes are fully metallic blue, including the metasoma.

## 5. Conclusions

The recent findings of two outstanding species in one Mediterranean island, where both professional entomologists, such as G.A. Mavromoustakis and amateur collectors that were active over the past seventy years, show how low the taxonomic knowledge of this genus is.

**Author Contributions:** Conceptualization, P.R.; methodology, P.R., C.M. and M.B.; writing—original draft preparation, P.R.; writing—review and editing, P.R., C.M. and M.B. All authors have read and agreed to the published version of the manuscript.

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