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(Coleoptera: Curculionidae) Species Associated with
Campanula L. (Campanulaceae) Plants in the Eastern
Black Sea Region of Turkey**

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***MIARUS* SCHOENHERR AND *CLEOPOMIARUS* PIERCE
(COLEOPTERA: CURCULIONIDAE) SPECIES ASSOCIATED WITH *CAMPANULA* L.
(CAMPANULACEAE) PLANTS IN THE EASTERN BLACK SEA REGION OF TURKEY**

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ABSTRACT

The investigation of *Campanula* L. (Campanulaceae) plants in the eastern Black Sea Region of Turkey revealed three new Mecinini weevil species/host plant associations: *Miarus ajugae* (Herbst, 1795) with *Campanula lactiflora* Bieb., *Cleopomiarus distinctus* (Boheman, 1845) with *Campanula alliariaefolia* Willd. and *Campanula rapunculoides* L., and *Cleopomiarus caucasicus* Caldara and Legalov, 2016 with *Campanula trachelium* L. Of these weevil species, *M. ajugae* and *C. caucasicus* are **new records** for the fauna of Turkey. All three weevil species deposit their eggs in the ovary of the flowers and larvae feed on young seeds, where they pupate when mature.

Keywords: bellflower, Curculionoidea, new records, Palearctic

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INTRODUCTION

The weevil genera *Miarus* Schoenherr, 1826 and *Cleopomiarus* Pierce, 1919 (Curculionidae: Curculioninae: Mecinini) are closely related (Caldara 2007; Caldara and Legalov 2016; Jiang *et al.* 2018; Skuhrovec *et al.* 2018), sharing many external morphological characters. However, all adults of *Miarus* can be distinguished from those of *Cleopomiarus* by a few characters, especially of the male, such as the median lobe of the aedeagus bearing apical setae and with high sides at its apical proximity, ventrite 5 being often foveate and dentate, and the uncus of the metatibia being always pointed at the apex. Moreover, in *Miarus* the femora are always unarmed and not globose in both sexes and the pygidium is often foveate in the female (Caldara 2007). It is noteworthy that there are clear differences between these two genera also in the immature stages. In larvae of *Cleopomiarus* the mala has six finger-like dorsal setae of equal length, whereas in *Miarus* two of these setae are distinctly longer than the other four. In pupae

of *Miarus* (vs. *Cleopomiarus*) the setae of the rostrum (three vs. one), head, and pronotum (two dorsal setae vs. one) are longer and darker, and the urogomphi longer and slenderer (Skuhrovec *et al.* 2018).

In the Palearctic region *Miarus* and *Cleopomiarus* are currently represented by 19 species each. Six *Miarus* species and four *Cleopomiarus* species are distributed in Turkey (Alonso-Zarazaga *et al.* 2017).

The host range of both *Miarus* and *Cleopomiarus* is confined to Campanulaceae. Sometimes the same species of *Campanula* L. is reported as the host plant for species of both genera (Caldara 2007). The genus *Campanula* consists of annual, biennial, and perennial species and over 100 species are known in Turkey (Davis *et al.* 1988).

There are little published biological data available for species of *Miarus* and *Cleopomiarus* (Scherf 1964; Skuhrovec *et al.* 2018; Szwaj *et al.* 2018). The aim of this study was to present the results of biological field investigations at Zigana Mountain (Trabzon, Turkey), which revealed the association of adults and immature stages of three

species of these two genera with four *Campanula* species.

MATERIAL AND METHODS

The field surveys were conducted in the eastern Black Sea Region. This is a mountainous territory including the Doğu Karadeniz Mountain ranges. The climate is oceanic with high and regular rainfall during the year. The research area, Zigana Mountain (peak 2,511 m elevation), is located on the border between Gümüşhane and Trabzon provinces. We investigated the northern side of Zigana Mountain Pass (40°40'21"N, 39°26'05"E) within Trabzon province. At this pass, at an elevation of 2,032 m, a tunnel exists for the passage of vehicles. There is a great climatic difference between the two sides. The northern side of this mountain and pass (where research was conducted) is very humid, foggy and rainy during late afternoon almost every day; in contrast, the southern side is usually dry and sunny.

Field investigations with biological observations for confirmation of the feeding habits of immature stages were conducted during the summer of 2019 from mid-June to the beginning of August, in irregular gaps once every two to three weeks. Adult samples were collected by an umbrella and aspirator from plants. For immature stage investigation, plants with flowers were cut, put in separate plastic bags by plant species and brought to the laboratory. Flowers were cut in thin slices with a lancet under a microscope. Detected immature stages were observed and digital images taken with a Canon DSRL 70D camera mounted on a Leica Z16APO Macroscope and using the Canon EOS Utility software. The digital images were then imported into Adobe Photoshop CS 6.0 for stacking. The collection is preserved in the Biodiversity Science Museum of Atatürk University, Erzurum. The host plants were identified according to Davis *et al.* (1988).

RESULTS

Miarus ajugae (Herbst, 1795)

(Figs. 1A–C)

Material Examined. TURKEY: Trabzon Prov., Zigana Mountain, Hamsiköy, Zitaş Road, 40°40'21"N, 39°26'05"E, 1,700 m, 14.7.2019, 46♂, 35♀, N. Gültekin leg.

Diagnosis. Length 2.5–3.1 mm. Dorsal vestiture comprising recumbent whitish to brown, seta-like scales. Rostrum in male shorter than pronotum, in female a little longer than in male, curved in lateral view. Pronotum transverse, with rounded sides. Elytra short, with basal margin distinctly directed forward

in lateral half, weakly curved at sides. Femora slender, without tooth. Ventrite 5 in male with deep median fovea and with two robust teeth posterolaterally to fovea; pygidium in male weakly gibbous in upper half and weakly depressed in lower half; in female with shallow fovea. Body of penis with endophallus containing two elongate sclerites, two pairs of small sub-oval sclerites bearing spines and positioned caudally to the ventral and dorsal elongate sclerites, and two other small median sclerites, one fork-shaped and the other subcylindrical.

Remarks. In Turkey *M. ajugae* could be confused with *Miarus monticola* Petri, 1912 and *Miarus rotundicollis* Desbrochers des Loges, 1893. However, there are good distinctive characters: apart from the shape of the penis, in the males of these two species ventrite 5 has a shallower fovea and distinctly smaller teeth than in *M. ajugae*.

Distribution. Austria, Belgium, Bosnia-Herzegovina, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Macedonia, Montenegro, Moldova, Norway, Poland, Romania, Russia, Serbia, Slovakia, Sweden, Switzerland, Armenia, Iran, Mongolia, North Korea, South Korea, Syria (Alonso-Zarazaga *et al.* 2017), Turkey (present finding; **new record**).

Plant Association. According to literature, adults and immature stages of *M. ajugae* were collected on various species of *Campanula* (*Campanula bononiensis* L., *Campanula carpathica* Jacq., *Campanula glomerata* L., *Campanula latifolia* L., *Campanula macrorrhiza* Gay ex DC, *Campanula media* L., *Campanula patula* L., *Campanula persicifolia* L., *Campanula rapunculoides* L., *Campanula rapunculus* L., *Campanula rhomboidalis* L., *Campanula rotundifolia* L., *Campanula trachelium* L.), *Phyteuma* (*Phyteuma orbiculare* L., *Phyteuma spicatum* L.), and *Adenophora liliifolia* (L.) A. DC. (Caldara 2007; Skuhrovec *et al.* 2018; Smreczyński 1976).

We collected *M. ajugae* on *Campanula lactiflora* Bieb. (Fig. 1D) in the eastern Black Sea Region in open areas within forest habitats. This plant is native to Turkey and the Caucasus and was never previously reported as a host plant of *Miarus*. It is also the first known host plant for *M. ajugae* recorded from Turkey.

Cleopomiarus distinctus (Boheman, 1845)

(Figs. 2A–C)

Material Examined. TURKEY: Trabzon Prov., Zigana Mountain, Hamsiköy, Zitaş Road, 40°40'21"N, 39°26'05"E, 1,700 m, 13.7.2019, 12♂, 6♀, N. Gültekin leg.

Diagnosis. Length 2.2–3.0 mm. Dorsal vestiture comprising subrecumbent, whitish to light brown, seta-like scales. Rostrum in male long, in female very long, weakly curved in lateral view, cylindrical,

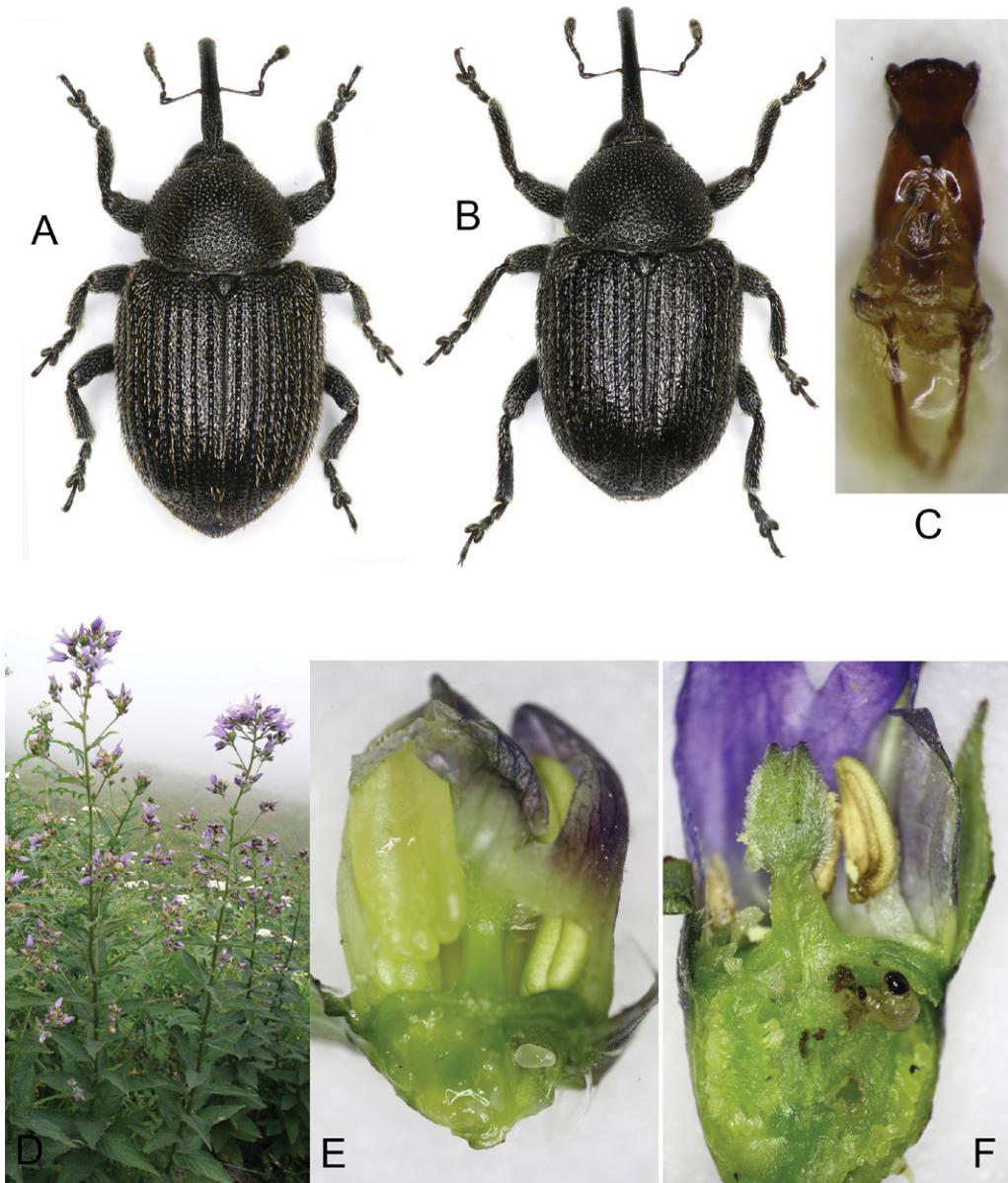


Fig. 1. *Miarus ajugae* and host plant. A) Adult male, dorsal view, B) Adult female, dorsal view, C) Aedeagus, dorsal view, D) *Campanula lactiflora*, host plant, E) Egg, deposited in the ovary of a flower, F) Larva feeding in ovary with young seeds.

of same width from base to apex. Pronotum distinctly transverse, subconical, with rounded sides. Elytra distinctly globose, short, slightly longer than wide, weakly wider than pronotum, at base distinctly directed forward from interstria 5 to humeri, with rounded sides. Metafemur with small tooth, uncus of metatibia in male distinctly enlarging at apex and

directed outward. Body of penis gradually narrowed from base to apex.

Remarks. This is one of the most variable species in terms of the color of the dorsal vestiture (which varies from whitish gray to light brown), the density of the elytral scales (sometimes completely covering the integument), and the length of the rostrum. The

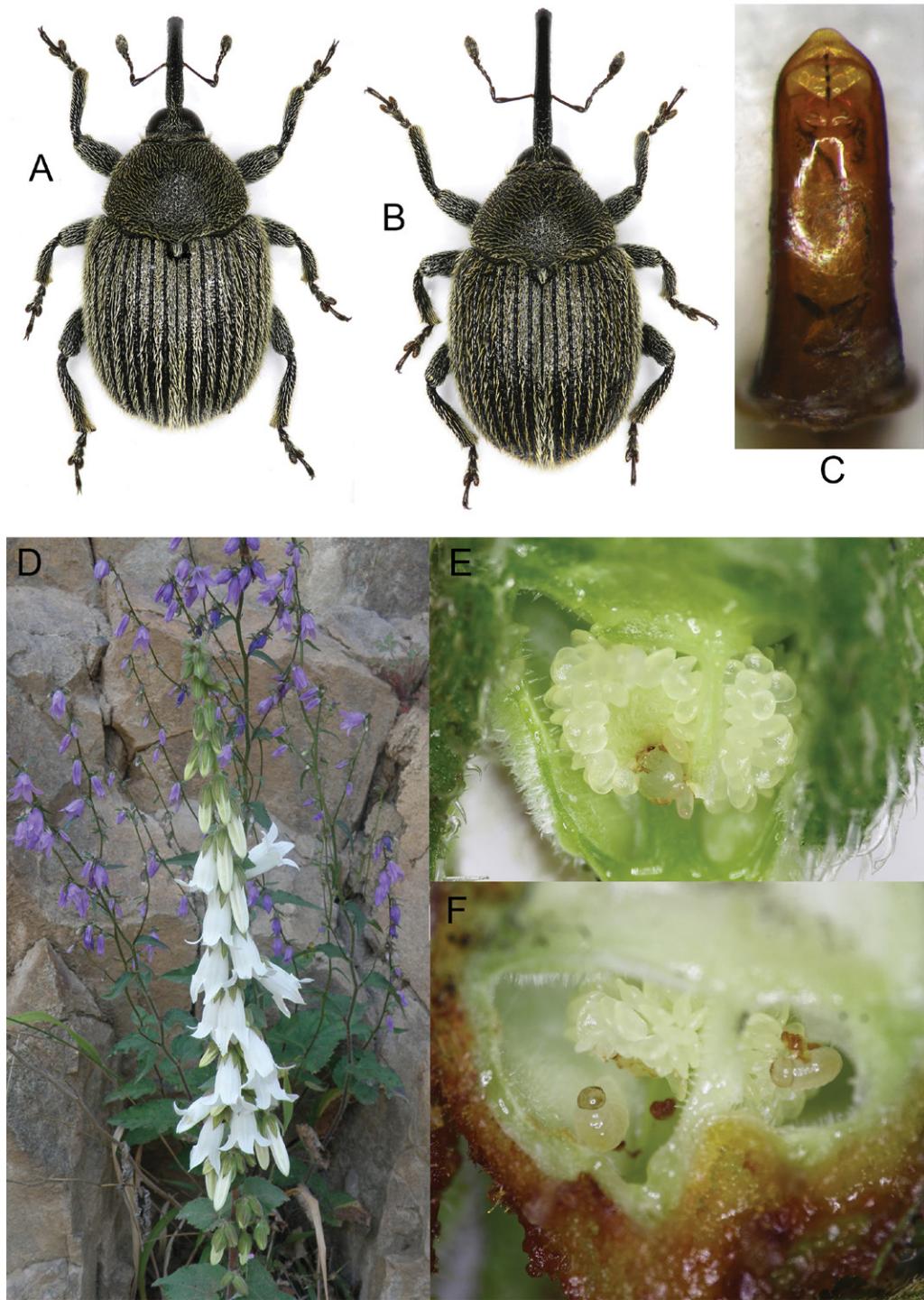


Fig. 2. *Cleopomiarus distinctus* and host plants. A) Adult male, dorsal view, B) Adult female, dorsal view, C) Aedeagus, front view, D) *Campanula alliariaefolia* (white) and *Campanula rapunculoides*, host plants, E) Egg, deposited in the ovary of a flower, F) Larvae feeding in ovary with young seeds.

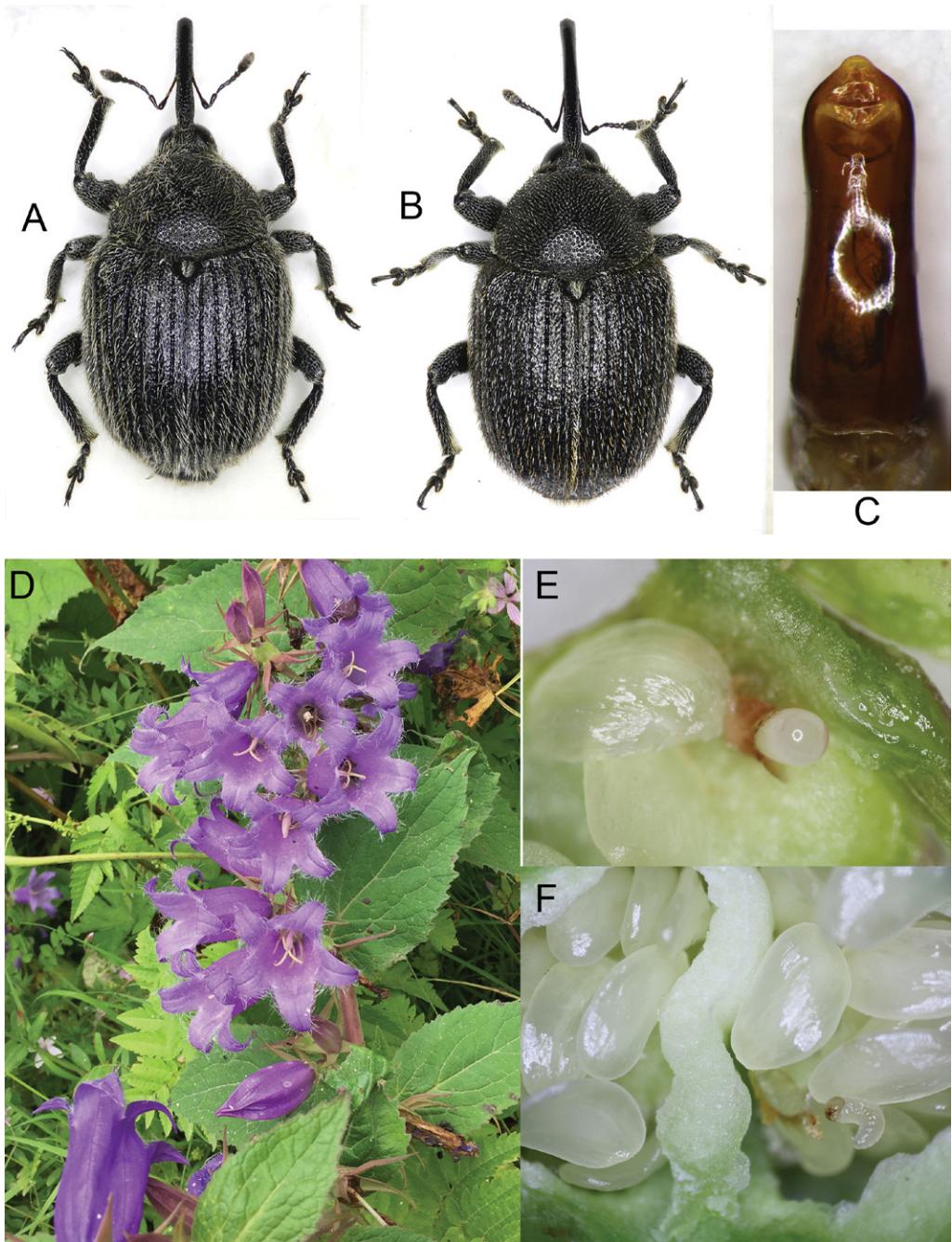


Fig. 3. *Cleopomiarus caucasicus* and host plant. A) Adult male, dorsal view, B) Adult female, dorsal view, C) Aedeagus, front view, D) *Campanula trachelium*, host plant, E) Egg, deposited in the ovary of a flower, F) Larva feeding in ovary with young seeds.

latter character is especially variable in the females of Anatolian populations, which need further detailed biological and molecular studies (Caldara and

Legalov 2016). This species is similar to *C. caucasicus*, with which it shares the enlarged uncus of the male metatibia. Apart from this character, the two

species clearly differ in the shape of the rostrum and that of the penis.

Distribution. Austria, Belgium, Bulgaria, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Spain, Switzerland, China, South Korea, Turkey (Alonso-Zarazaga *et al.* 2017; Caldara and Legalov 2016), Norway (Steinert *et al.* 2018).

Plant Association. According to literature, this species has been collected on various species of *Campanula*: *Campanula cervicaria* L., *C. glomerata*, *Campanula incurva* Auch., *C. latifolia*, *C. persicifolia*, *C. rapunculus*, *C. rhomboidalis*, *Campanula thyrsoides* L., and *C. trachelium* in central Europe (Caldara and Legalov 2016; Hoffmann 1958; Skuhrovec *et al.* 2018; Smreczyński 1976). The larvae are seed feeders developing inside seed capsules of Campanulaceae (Caldara and Legalov 2016).

We collected *C. distinctus* on two *Campanula* species never previously reported as host plants: *Campanula alliaritifolia* Willd. (native to Turkey and the Caucasus) and *C. rapunculoides* (Fig. 2D) (widely distributed in southern and central Europe, Anatolia and the Caucasus) in the eastern Black Sea Region in open areas within forest habitats. According to Caldara and Legalov (2016), nothing was known about its host plants in Turkey hitherto. Therefore, with this current finding, we have also determined two host plants from Turkey for the first time.

***Cleopomiarus caucasicus* Caldara and
Legalov, 2016**
(Figs. 3A–C)

Material Examined. TURKEY: Trabzon Prov., Zigana Mountain, Hamsiköy, Zitaş Road, 40°40'21"N, 39°26'05"E, 1,700 m, 14.7.2019, 5♂, 4♀, N. Gültekin leg.

Diagnosis. Length 2.7–3.7 mm. Vestiture on dorsum comprising subrecumbent to suberect, whitish to light brown, seta-like scales. Rostrum in male nearly as long as pronotum, in female longer than pronotum, moderately curved in lateral view. Pronotum transverse, subconical, with rounded sides. Elytra globose, short, slightly longer than wide, at base moderately directed forward from interstria 5 to humeri, with somewhat rounded sides. Mesofemur with minute tooth, metafemur with distinct tooth, uncus of metatibia in male with apex enlarged and directed outward. Body of penis narrowed at middle third.

Remarks. This taxon is closely related to *Cleopomiarus graminis* (Gyllenhal, 1813), a species with very wide Palearctic distribution but unknown from Turkey until now (Caldara and Legalov 2016). From *C. graminis*, *C. caucasicus* differs in the

metatibial uncus of the male ending with a broad apex and the shape of the penis, especially at its more pointed apical part. In Turkey *C. caucasicus* may be confused with *C. distinctus* (see Remarks under that species).

Distribution. Armenia (Alonso-Zarazaga *et al.* 2017; Caldara and Legalov 2016). Turkey, present finding; this is a **new record** for the fauna of Turkey.

Plant Association. *Campanula trachelium* (Fig. 3D), with a wide Eurasian distribution, was determined as the host plant of *C. caucasicus* for the first time, in fact representing the first host plant record for this weevil species.

BIOLOGICAL FINDINGS

Our observations detected that the biology of the three studied species are very similar to each other, emphasizing even more the close relationship between *Miarus* and *Cleopomiarus*. Adults usually feed on flower buds from their bottom side including the receptacle tissue, floral organs, sepals, and young stems, drilling into these parts with their rostrum. More than one adult is often found inside a single flower. In response to feeding damage on the bottom of the young buds in particular, and on the stems, the plants secrete yellowish-brown, wet, sticky drops from each drilled hole. If the feeding holes are many, the secretion covers the majority of the buds at their basal half. Over time, these secretions become dry and turn pale brown in color. Females deposit eggs individually in the ovary locules between very young seeds, opening a space to insert the egg (Figs. 1E, 2E, 3E). The egg is asymmetrical, pear-shaped, pale yellowish in color (Fig. 2E), and difficult to distinguish from young seeds. Larvae feed on young seeds (Figs. 1F, 2F, 3F) and one to four larvae can be found inside a single capsule, but usually only one of them reaches the mature stage. Pupation also takes place inside the capsule.

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