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First record of a mass swarming behavior of *Chauliognathus vestitus* Champion, 1914 (Coleoptera: Cantharidae) with comments on other *Chauliognathus* from Colima, México

Primer registro de *Chauliognathus vestitus* Champion, 1914 con comentarios sobre otros *Chauliognathus* (Coleoptera: Cantharidae) de Colima, México

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ABSTRACT

In this work we document a case of mass swarming of the Mexican soldier beetle *Chauliognathus vestitus* Champion, 1914 from El Terrero locality, within the Sierra de Manantlan Biosphere Reserve, in Colima, Mexico. Two other species of soldier beetles — *Chauliognathus togatus* Waterhouse, 1878 and *Chauliognathus* sp.— were observed at El Terrero, coexisting with *C. vestitus*, but their numbers were considerably lower. An updated list of *Chauliognathus* species from the state of Colima is included. Our observations are the record, to our knowledge, of the second cantharid species exhibiting a mass flying behavior among more than 450 described *Chauliognathus* in the world, and the first record of this behavior among soldier beetles in the American continent.

Key words: soldier beetles; mass flying adults; tropical dry forest; Sierra de Manantlan Biosphere Reserve.

RESUMEN

En este trabajo documentamos el caso de un vuelo en enjambre del escarabajo soldado mexicano, *Chauliognathus vestitus* Champion, 1914, en la localidad de El Terrero, dentro de la Reserva de la Biósfera de la Sierra de Manantlán, Colima, México. Otras dos especies de escarabajos soldado —*Chauliognathus togatus* Waterhouse, 1878 y *Chauliognathus* sp.— fueron observadas en El Terrero en coexistencia con *C. vestitus*, aunque su número fue considerablemente menor. Se incluye una lista actualizada de las especies de *Chauliognathus* del estado de Colima, México. Nuestras observaciones documentan, según nuestro conocimiento, la segunda especie de cantárido que exhibe una conducta de vuelo en masa entre más de 450 especies de *Chauliognathus* descritas en el mundo, y el primer registro de esta conducta entre miembros de escarabajos soldados en el continente americano.

Palabras clave: escarabajo soldado, adultos de vuelo en masa, bosque tropical caducifolio, Reserva de la Biósfera Sierra de Manantlán.

The species of the genus *Chauliognathus* Hentz, 1830 are diurnal beetles that inhabit open sunny fields in temperate and tropical forests, and are often associated with vines, herbaceous and shrub vegetation (Miskimen 1972; Pérez-Hernández 2018). Adults can be found during the rainy season usually feeding on nectar, pollen, and other floral structures from their host plants (Miskimen 1972; Ramsdale 2002; Pérez-Hernández 2018), and occasionally also preying upon lepidopteran larvae and adults of other beetle families (Fender 1962). Up to date, there are 47 species of *Chauliognathus* recorded from Mexico (Delkeskamp 1977, Pérez-Hernández et al. in prep.), ten of which recorded from the state of Colima (Champion 1914, Miskimen 1966, Pérez-Hernández and Zaragoza-Caballero 2015).

Most *Chauliognathus* species are conspicuous beetles. Under good conditions —e.g. warm weather in open areas with rich food sources— adults exhibit highly abundant, sta-

tioned aggregations usually confined to small areas (about 100 square meters) around patches of their host plants in blossom (Machado and Araujo 2001; Hawkeswood and Dunn 2011). In particular, the swarming behavior (in the sense of thousands or tens of thousands adult individuals flying together at a single spot) is an uncommon phenomenon in Cantharidae and it has been recorded only in a single species: the Australian *Chauliognathus lugubris* (Fabricius, 1801) (syn. *Chauliognathus pulchellus* (Macleay, 1826) (McKeown 1951; McKeown 1952; Hawkeswood and Turner 2008; Hawkeswood and Dunn 2011). In this work, we present the first record of a mass swarming behavior among members of Cantharidae in the American continent, with a list of species of *Chauliognathus* for the state of Colima, including the extension ranges for *Chauliognathus vestitus* Champion, 1914 and *Chauliognathus togatus* Waterhouse, 1878 species.

MATERIAL AND METHODS

On November 7th and 10th, 2020, from 11:00 to 13:00 h, the second author observed the behavior of some individuals belonging to species of genus *Chauliognathus* on the road to El Terrero, Colima, Mexico (5.8 km NE from the Colima-Minatitlan highway, N 19° 26.385', W -103° 58.819', 1215 m asl; Fig. 1), a locality within the Sierra de Manantlán Biosphere Reserve. The reserve holds a variety of ecosystems, from coniferous and deciduous oak forests to mesophilic mountain and tropical dry forests (Jardel *et al.* 1996). The site where the observations were done is mainly covered with tropical dry forest and elements of secondary vegetation, follows along the base of a mesa slope, and exhibits shallow rocky soils, i.e., leptosol soil type. On one of its slopes the site has also a large conspicuous area covered with *Otatea acuminata* (Munro) C.E. Calderón & Soderstr., which formed a visible intrusion in the middle of the tropical dry forest. The climatic conditions were sunny, with warm and dry weather.

For the identification of the collected specimens, we used the works of Gorham (1881), Champion (1914) and Miskimen (1966), except for one species which we only had photographs of. We also compiled ecological and distributional data of *Chauliognathus* species from Colima through published works (Gorham 1881, Champion 1914, Miskimen 1966, Pérez-Hernández and Zaragoza-Caballero 2015, Pérez-Hernández 2018), and from specimens deposited at the National Insect Collection (CNIN) of the National Autonomous University of Mexico (UNAM). Specimens collected at El Terrero, Colima will be deposited at the CNIN as well.

RESULTS AND DISCUSSION

Adult soldier beetles that exhibited the flying mass behavior at El Terrero, Colima were identified as *C. vestitus*. Adult individuals of two other *Chauliognathus* species were also active on the ground where the *C. vestitus* mass swarming occurred: *C. togatus*, and *Chauliognathus* sp. (Fig. 2). However, the numbers of these last two were

significantly lower than those of *C. vestitus*.

Mass swarming behavior of *Chauliognathus vestitus* Champion, 1914

During the first visit in early November, the second author (EGS) observed tens of thousands of *Chauliognathus vestitus* adults actively flying in the morning at El Terrero locality, along an extension of approximately 1.7 km on the road of highway 3 to El Terrero (Fig. 2, Suppl. Material video 1). Thousands of soldier beetles were either flying or actively walking over humid ground, rocks and crevices at the sides of the road (See Suppl. Material video 1; the video is also available through <http://www.iies.unam.mx/laboratorios/interacciones-bioticas-habitats-alterados/videos/>). It seemed that they were just emerging because after a couple of minutes some individuals that were walking on the ground lifted up into the air using herbaceous vegetation as a substrate. Most individuals were flying over ruderal herbs, grass, or foliage of other plants, reaching almost 10 meters high (Suppl. Material video 1, <http://www.iies.unam.mx/laboratorios/interacciones-bioticas-habitats-alterados/videos/>). A few hours later EGS returned to the same site, at approximately 16:00 h, and the massive swarm of soldier beetles was not active any longer. The site was again visited in December, and any activity of *C. vestitus* was observed.

During the observations, any mating behavior of *C. vestitus* was observed. However, previous works have documented *Chauliognathus* copulation usually occurring between 16:00 and 18:00 h, and some days after emergence (Bailey *et al.* 1984; Pérez-Hernández 2018). It is therefore possible that we were not able to observe such behavior because it was too early in the day, or soldier beetles were in their emergence period.

Only one other soldier beetle species—the plague soldier beetle *C. lugubris*—has been previously recorded forming occasional mass flying swarms at different localities in Australia, and such phenomenon seems to be associated with both to location of blossoming host plants and mating behavior of that soldier beetle species

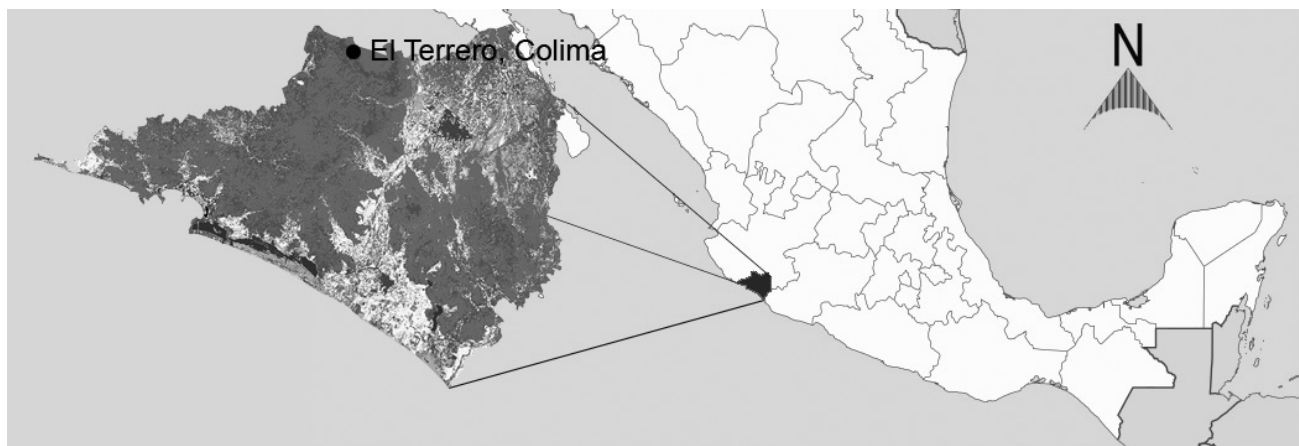


Figure 1. Map showing the location of El Terrero, Colima, Mexico, where a mass swarm of *Chauliognathus vestitus* was observed in November, 2020.

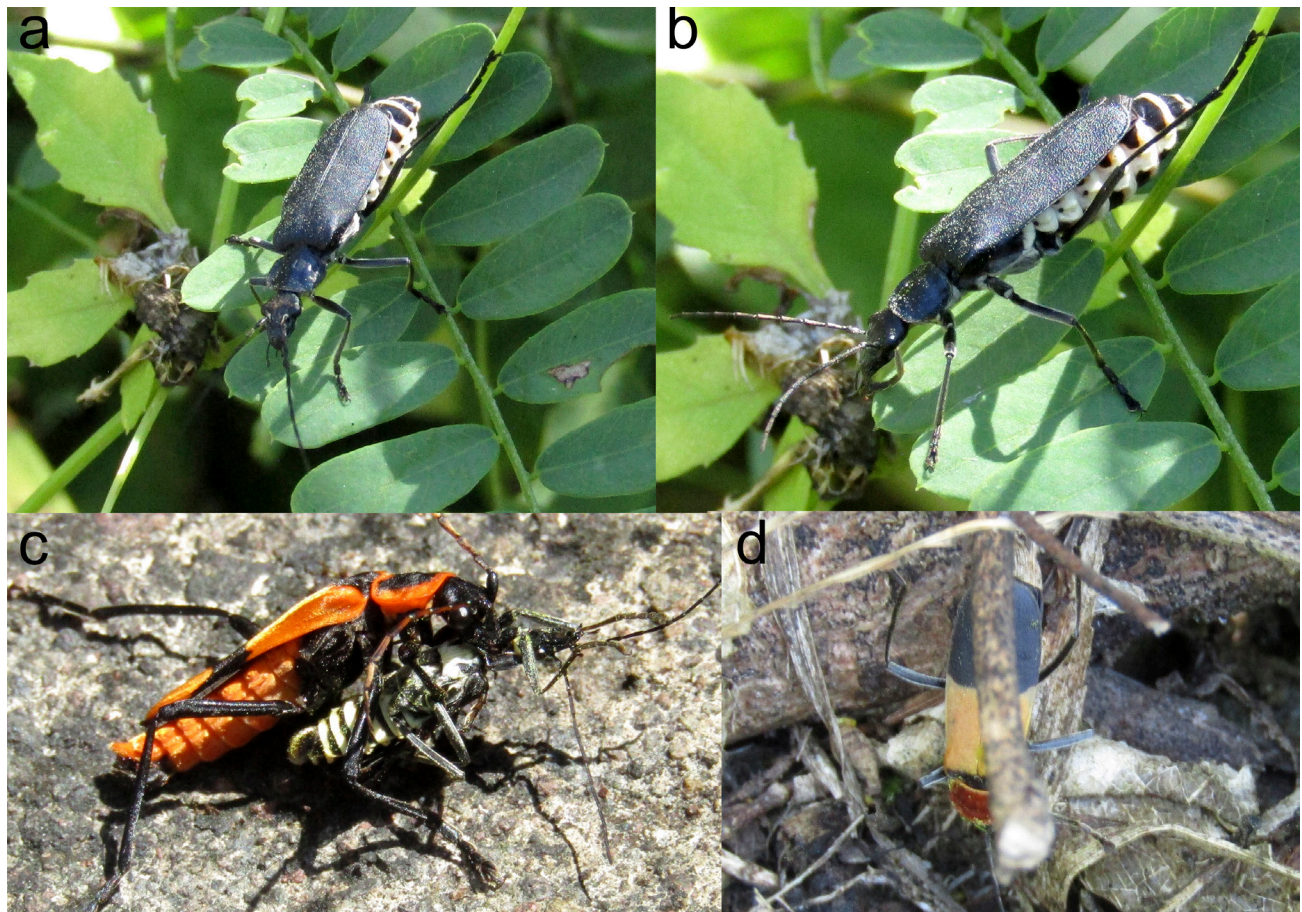


Figure 2. Different *Chauliognathus* species observed at El Terrero, Sierra de Manantlán, Colima, Mexico, during a *Chauliognathus vestitus* Champion, 1914 mass swarming: a, b, a female of *C. vestitus* Champion, 1914; c, a male of *C. togatus* Waterhouse, 1878 preying upon another male of *C. vestitus*; d, a specimen of *Chauliognathus* sp. Gorham, 1881. Photos: Enrique González Soriano.

(Hawkeswood and Turner 2008; Hawkeswood and Dunn 2011). It has been estimated that *C. lugubris* mass flying swarms reach about 200,000 individuals (Hawkeswood and Dunn 2011), and they have been recorded to last as much as three months. Small congregations have also been seen associated with herbs during the weeks after mass swarming (McKeown 1952).

We have no more information regarding factors associated with *C. vestitus* mass flying swarm formation from El Terrero, but we think they could likely be the same as those suggested for *C. lugubris*. A deeper exploration of the biology and natural history of this soldier beetle species is necessary in order to better understand its phenological and behavioral patterns, as well as the ecological impact that a high number of soldier beetles are causing on their host plants and other interacting species.

Feeding behavior and phenology notes of *Chauliognathus* from El Terrero, Colima

Although the second author did not observe it directly, a number of *C. vestitus* soldier beetles at El Terrero seemed to be feeding on flowers or floral sources, because their heads

and pronotum were densely covered with yellow pollen grains. He did not observe attraction for any particular host plant species visible, and no blossoming plant species was particularly abundant during the days of the observations. However, it is likely that *C. vestitus* soldier beetles were feeding on a variety of host plants since that feeding behavior has been previously reported for other congeneric species in Mexico (Pérez-Hernández 2018).

Chauliognathus togatus adults, the other species found at El Terrero, have been associated with Asteraceae host plants of which they consume nectar and pollen (Miskimen 1966, Pérez-Hernández 2018, added as *C. profundus* LeConte, 1858). The following species have been also recorded as their host plants: *Bidens odorata* var. *odorata* Cav., *Melampodium divaricatum* (Rich.) DC., *Tridax coronopifolia* (Kunth) Hemsl., *Sanvitalia procumbens* Lam. (Pérez-Hernández 2018, as *C. profundus*). At El Terrero locality one individual of *C. togatus* was observed preying upon a *C. vestitus*, which represents the first record of this behavior for *C. togatus*. Individuals of the *Chauliognathus* sp. were actively walking over the ground and also seemed to be associated with herb plants.

We did not have any other information concerning the active period of *C. vestitus* at El Terrero aside from that of the days of our observations; however, previous works have shown that *C. vestitus* exhibits a short active period (for about one month) in Santiago Dominguillo, Oaxaca (Pérez-Hernández and Zaragoza-Caballero 2016). On the other hand, *C. togatus* has been recorded active from July to October during the rainy season (Pérez-Hernández and Zaragoza-Caballero 2016). Synchronous emergence of congeneric *Chauliognathus* species from tropical dry forests has been suggested as a phenological strategy to avoid predation (Machado and Araújo 2001; Pérez-Hernández and Zaragoza-Caballero 2016), especially if such strategy is accompanied by aposematic coloration as for the *Chauliognathus* of the “yellow-black” complex in South America (Machado and Araújo 2001). However, *C. vestitus* displays a uniformly dorsal black coloration, with only the margin of abdominal ventrites yellow, which may imply a less effective aposematism in comparison to other soldier beetle species. It is likely that the mass swarm of this species is by itself an effective defense strategy against predators; however, further studies are needed to understand the ultimate function of that behavior.

An updated species list of *Chauliognathus* from the state of Colima, Mexico

1. *Chauliognathus constrictus* Champion, 1914
2. *Chauliognathus corvinus* Gorham, 1885
3. *Chauliognathus dispar* Champion, 1914
4. *Chauliognathus distinguendus* Waterhouse, 1878
5. *Chauliognathus flavomarginatus* Champion, 1914
6. *Chauliognathus forreri* Gorham, 1885
7. *Chauliognathus hieroglyphicus* Gorham, 1885
8. *Chauliognathus histrio* Gorham, 1881
9. *Chauliognathus limbicollis* LeConte, 1858
10. *Chauliognathus nigriceps* Gorham, 1881
11. *Chauliognathus nigrocinctus* Gorham, 1881
12. *Chauliognathus togatus* Waterhouse, 1878
13. *Chauliognathus scutellaris* LeConte, 1853
14. *Chauliognathus vestitus* Champion, 1914

Distributional notes of *Chauliognathus* from El Terrero

Chauliognathus vestitus is a species endemic to Mexico, known almost only for a few specimens deposited in entomological collections. It was described from five specimens recorded from Oaxaca (Champion 1914), and decades after its description four more specimens were also reported from Tlaltenango, Zacatecas (Miskimen 1966). Another ten specimens were collected in 1998 from Santiago Dominguillo, Oaxaca (Pérez-Hernández and Zaragoza-Caballero 2016). In this work, we recorded *C. vestitus* for the first time from El Terrero, Colima, Mexico. Other localities where this species has been recorded are Huatulco, Oaxaca (photograph reported in Naturalista 2020); Guelatao, Oaxaca (1 specimen) and Tres Marias, Morelos (3 specimens), all deposited at the National Insect Collection (CNIN), at

the National Autonomous University of Mexico (UNAM). Miskimen (1966) had previously suggested that the range of *C. vestitus* could be extended from Jalisco to Oaxaca. Our record from Colima confirms the extension range for this species. The altitudinal range for *C. vestitus* goes from 100 to 2130 m asl, and it can be found from tropical dry forests to savannas and deserts (Pérez-Hernández and Zaragoza-Caballero 2016; Miskimen 1966).

Chauliognathus togatus is a species endemic to Mexico, with low abundance where it has been observed but well distributed throughout the country. It has been recorded from Colima, Guerrero, Morelos, Oaxaca (Miskimen 1966, Pérez-Hernández and Zaragoza-Caballero 2016, erroneously added as *Chauliognathus profundus* LeConte, 1858), Aguascalientes, Chihuahua, Guanajuato, Hidalgo, Jalisco, Michoacan, Puebla, Queretaro, and San Luis Potosi (CNIN 2018, Naturalista 2020). Its altitudinal range goes from 300 to 2500 m asl, and it can be found from cultivated areas to tropical dry forest and xerophilous scrubs (Miskimen 1966, Pérez-Hernández 2018).

There are more than 450 species of *Chauliognathus* distributed in the Nearctic, Neotropical, and Australian biogeographic regions (Delkeskamp 1977), and only one species (*C. lugubris*) has been previously observed displaying a mass swarming behavior. Our work represents the first report of mass swarming behavior in a second *Chauliognathus* species, and it also the first report of this behavior in the Americas. However, the biology and behavior of most soldier beetles is unknown. Therefore, it is very likely that other *Chauliognathus* display this behavior.

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Supplementary Material Video 1

Supplementary Material Video 1. Record of a mass swarm of the Mexican soldier beetle *Chauliognathus vestitus* from El Terrero, Colima, Mexico. This video is also available through <http://www.iies.unam.mx/laboratorios/interacciones-bioticas-habitats-alterados/videos/>