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NEW RECORDS OF *CERCERIS TUBERCULATA* (VILLERS, 1787) (HYMENOPTERA: CRABRONIDAE) FROM UKRAINE, WITH NOTES ON ITS PARASITOIDS AND PREY

Present paper reports observations on the digger wasp *Cerceris tuberculata* (Villers, 1787) (Hymenoptera: Crabronidae), listed in Red Data Book of Ukraine, its parasitoids and prey. The observations revealed two parasitoids associated with this wasp: a cuckoo wasp *Hedychrum virens* Dahlbom, 1845 (Chrysididae) and velvet ant *Nemka viduata* viduata (Pallas, 1773) (Mutillidae). The host-parasitoid association of this velvet ant and *C. tuberculata* is provided for the first time. Four species of weevils were registered as a prey of *C. tuberculata*, three of them are given for the first time herein. New records of the species from Zaporizhzhya and Kherson Regions are provided; the species is reported from Zaporizhzhia Region for the first time.

Keywords: Red Data Book of Ukraine, nest aggregation, parasitoid, prey, new records, steppe zone

Introduction

Cerceris tuberculata (Villers, 1787) (Hymenoptera: Crabronidae) is the largest representative of the genus in Europe (17–22 mm long). This species is protected by the Red Data Book of Ukraine (Akimov, 2009). It inhabits steppe biotops mainly, but can be also found at desert regions within the areal of its distribution (Kazenas, 2002).

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There are four described subspecies of *Cerceris tuberculata*: nominative subspecies distributed within Southern Europe, Mediterranean and Iran, ssp. *evecta* Shestakov, 1922 known from China and Mongolia, ssp. *cypria* Beaumont, 1958 described from Cyprus and ssp. *ogotai* Tsuneki, 1971 distributed in Mongolia (Bohart and Menke, 1976; Kazenas, 2002; Rosa and Soon, 2013).

Cerceris tuberculata is known to nest in vertical walls of slopes and drains, preferring clay and sandy or clay grounds (Kazenas, 2002; Semik and Semik, 2002); its nest aggregations can be rather dense, up to 80 nest burrows for 1 m^2 (for details of nest structure see Semik and Semik, 2002).

Large weevils of the subfamily Lixinae (Curculionidae) were reported as the prey of this crabronid wasp. Old records generally refer to the representatives of the genus *Cleonis* Dejean, 1821 (previously gives as *Cleonus* Schönherr, 1826) (Bischoff, 1927; Grandi, 1959, 1961). Fabre (1914) mentioned tree species as a prey of *C. tuberculata*: *Leucophyes pedestris* (Poda, 1761) (as *Cleonus ophthalmicus* (Rossi, 1790)), *Mecaspis alternans* (Herbst, 1795) (as *Cleonus alternans* Herbst, 1795) and *Cleonis albidus* Schoenherr, 1826 (*as Cleonus albidus*); notably that two last species were recorded based only on one specimen each. But, Semik and Semik (2002) specified the prey range of *C. tuberculata* by listing three weevil species, namely *Lixus algirus* (Linnaeus, 1758), *Larinus latus* (Herbst, 1783) and *Leucomigus candidatus* (Pallas, 1771). Furthermore Agnoli and Rosa (2021) added the one more species, *Larinus onopordi* (Fabricius, 1787).

It is noteworthy that the stem borer, *Lixus algirus* is the major insect pest of faba bean in the Mediterranean region (Taadaouit et al., 2021), *Larinus latus* is an agent of biological pest control against *Onopordum* thistles in Australia (Pettit and Briese, 2000), while *Leucomigus candidatus* is protected by the Red Data Book of Ukraine (Akimov, 2009).

Cerceris tuberculata was previously reported from Eastern and Southern regions of Ukraine, namely Sumy, Kharkiv, Luhansk, Odessa, Mykolaiv, Kherson Regions and Crimea (see Protsenko and Gorobchishin, 2015; Stepoviy, 2017; Kavurka *et al*., 2019; Kletonkin, 2019 for known localities and map). Present contribution reports *C. tuberculata* from Zaporizhzhia Region for the first time.

No data on the parasitoids reared from the nests of *C. tuberculata* have never been published.

Nevertheless, Agnoli and Rosa (2021) observed the activity of *Hedychrum virens* Dahlbom, 1845 (Chrysididae) within the nest site of *C. tuberculata* at Karadag Nature Reserve, Crimea, Ukraine. Present contribution confirms the fact of host-parasitoid relations between these wasps. There are no other host records for this cuckoo wasp.

Hedychrum virens is a large cuckoo wasp (if compared to other species of the family known from Ukraine) and the biggest elampine chrysidid in Europe (Agnoli and Rosa, 2021). The species is locally distributed within the warm regions of Mediterranian (Linsenmaier, 1959, 1968; Rosa and Soon, 2013).

The case of parasitoidism of the velvet ant *Nemka viduata viduata* (Pallas, 1773) (Mutillidae) on *C. tuberculata* has not been reported previously. The

list of confirmed hosts for this parasitoid comprised digger wasps *Bembecinus tridens* (Fabricius, 1781), *Stizus continuus* (Klug, 1835), and *Bembix bidentata* Vander Linden 1829 (Hymenoptera: Crabronidae: Bembecinae) (Grandi, 1961; Tormos et al., 2003; Tormos, 2009).

Nemka viduata viduata is an West Palaearctic taxon (in chorological pattern), rather common in sandy coastal areas (Palmerini, 2013). It was previously reported for Ukraine as a whole (Lelej and Yildirim, 2009), and for its separate regions, including Mykolaiv and Kharkiv Regions (Stepoviy, 2017).

Materials and methods

Observations have been performed in natural habitat of *C. tuberculata* on June 22 and 26, 2019. The studied area covered a 30 m long section of the sand and clay road passing through the halophyte steppe on bank of Malyi Utluk River in vicinity of Shelyuhy village, N46.546134 E035.199960 (Zaporizhzhya Region, Ukraine). The observations had been carried out from 11.00AM to 5.00 PM each day. Visual observations had been mainly performed. We also made the notes on behavior of studied crabronid wasp and its natural enemies. Several specimens of revealed parasitoids were fixed with 96% ethanol for further study and identification (four exemplars for each species). The specimens of *C. tuberculata* had only been observed visually, because this is a rare insect species protected by the Red Book of Ukraine (Akimov, 2009). We also collected two paralyzed specimens of weevil *L. candidatus* than were carried and then thrown away by the crabronid wasp; no living specimens of this protected species were collected. Photos of specimens and habitats were taken with Canon SX30IS.

Additionally, *C. tuberculata* was recorded in several other places within Kherson and Zaporizhzhya Regions, but nesting sites were not found and observations on the behavior have not been performed. This additional visual records are labeled as follows: one imago (female), Ukraine, Kherson Region, Chaplynka district, vicinity of Novovolodymyrivka village, steppe area along Syvash Gulf, 46.24005 33.81210, Martynov A.V. leg., 10—16.07.2020; 7 imagoes on flowers of Asteraceae, Ukraine, Zaporizhzhya Region, vicinity of Lymans'ke village, steppe area on bank of Molochnyi Estuary, 46.42770 035.34116, Martynov A.V. et Martynova K.V. leg., 20—25.08.2019; one imago (female), Ukraine, Zaporizhzhya Region, vicinity of Shelyuhy village, forest belt near field and fallow, 46.54832 035.18648, Martynov A.V. leg., 17.06.2019.

Part of the records of the species mentioned in the contribution was uploaded as dataset on biodiversity on GBIF (Martynov & Putchkov 2021).

Results

The observations revealed two parasitoids associated with *C. tuberculata*: a cuckoo wasp *Hedychrum virens* and velvet ant *Nemka viduata viduata*. We also registered a weevil *Leucomigus candidatus* (Curculionidae) protected by

the Red Data Book of Ukraine (Akimov, 2009) as the one of prey items of this crabronid wasp at the studied habitat. Other three weevil species, *Asproparthenis carinata* (Zoubkoff, 1829), *Coniocleonus nigrosuturatus*, (Goeze, 1777) and *Cleonis nigra* (Scopoli, 1763), are registered as the prey of *C. tuberculata* for the first time.

Thus, the host-parasitoid association with cuckoo wasp *H. virens* is herein confirmed based on ethological observations. The activity of velvet ant *N. viduata* within the nest site of *C. tuberculata* also suggests the existence of host-parasitoid relations between these wasps.

Host *Cerceris tuberculata* (Villers, 1787) (Hymenoptera: Crabronidae). We could observe the large nests aggregation of *C. tuberculata*: more than 80 nest entrances were registered at sandy and clay road (Fig. 1A, B.). The nests were unevenly located, with groups situated at the open middle part of the road, at the road boundary and among the vegetation surrounding the road (Fig. 1C, D). The nest aggregation was generally sparse, the distance between nests varied considerably, but exceeded 30 cm in most of cases. The nest entrances had approximately 15 mm in diameter.

Numerous females of *C. tuberculata* were observed demonstrating similar acts of behavior: (i) staying in the nest burrow with head facing the entrance; (ii) flying away for hunting to neighboring steppe areas; (iii) carrying the 'preparalized' weevils to the nest entrance; (iv) paralyzing the specimens of weevils by injecting venom to the thorax ventrally (Fig. 1F); (v) dragging the paralyzed prey into the nest.

Four species of weevils were used as a prey by *C. tuberculata* within the observed habitat: *Asproparthenis carinata*, *Coniocleonus nigrosuturatus*, *Cleonis nigra* and *Leucomigus candidatus.* Most common as prey was weevil *Asproparthenis carinata* that develops on plants of the subfamily Chenopodioideae. The representatives of this subfamily were numerous within surrounding halophyte steppe. Obviously, *C. tuberculata* is hunting mainly near the nests.

It is noteworthy, that females of *C. tuberculata* used to hold and drag the weevils by grasping their rostrum with mandibles and leaning against the large protuberance on clypeus (Fig. 1E, F).

We had also registered several males of *C. tuberculata* at the nest site. They were flying above the surrounding vegetation and sporadically landed on flowering plants or soil. The males avoided to attend the nests.

Parasitoid *Hedychrum virens* Dahlbom, 1845 (Hymenoptera: Chrysididae). We had registered numerous females of *H. virens* at the study area with the aggregation of host nests. Parasitoids had been flying from one nest entrance to another one, tending to reveal the temporary abandoned nest burrow (while female of *C. tuberculata* gone hunting for prey). Females of *H. virens* preferred to stay close to the nest even if the host wasp had been entering it, or staying inside, or carrying the prey inside. In several cases we could see that *C. tuberculata* females noticed the parasitoid and demonstrated the "busy" movements, but they always chose to handle with prey item than to drive away the females of *H. virens*.

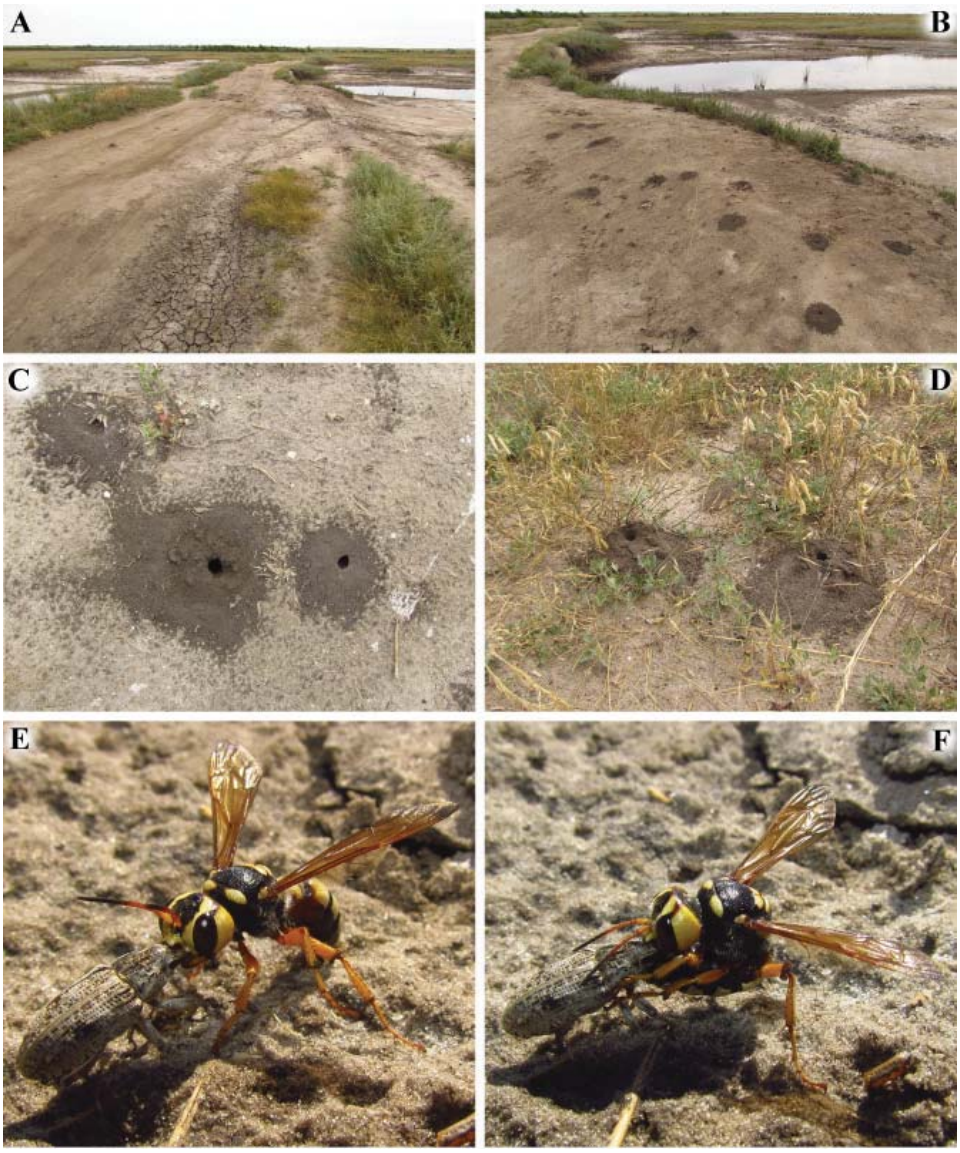

Fig. 1. *Cerceris tuberculata* (Villers, 1787), its habitat and behavior: *A* — total view of habitat; *B* — aggregation of nests; *C* — nests at open area; *D* — nests among vegetation; *E* — female holding the weevil before paralyzing; *F* — female paralyzing the weevil

The adults of this cuckoo wasp were active during all time of observations. They could be easily noticed because of the large body size (ca. 13–15 mm long) and frequent short flights with numerous landings among the nest entrances.

No males of *H. virens* had been found within the study site during the days of research. The sexual dimorphism of this parasitoid wasp is expressed in the body coloration (and features of morphology): females have green-blue and red parts of the thorax vs males with thorax entirely green-blue. Therefore, the

sexes of *H. virens* could be easily differed even during the field observations, especially considering their large body size.

Parasitoid *Nemka viduata viduata* (Pallas, 1773) (Hymenoptera: Mutillidae). Numerous specimens of the velvet ant *N. viduata viduata* were also recorded among the nests of crabronid wasp *C. tuberculata*. In contrast to cuckoo wasp discusses above, both sexes of the velvet ant were active within the study area. Wingless females have been 'running' among the nest burrows of the host wasp, while winged males preferred to visit flowering plants and only rarely landed at the boundary of the road containing the nest aggregation. The features of behavior that we could observe for *N. viduata viduata* corresponded to the data minutely described by Palmerini (2013).

The females of the velvet ant were almost as numerous as the specimens of cuckoo wasp *H. virens*, but they moved much more slowly and their activity was shifted to the end of the day.

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НОВІ ЗНАХІДКИ *CERCERIS TUBERCULATA* (VILLERS, 1787) (HYMENOPTERA: CRABRONIDAE) У МЕЖАХ УКРАЇНИ, ІЗ ДАНИМИ ЩОДО ПАРАЗИТОЇДІВ ТА ЗДОБИЧІ

В цій роботі наведено дані спостережень за осою *Cerceris tuberculata* (Villers, 1787) (Hymenoptera: Crabronidae), що внесено до Червоної книги України, його паразитоїдами та здобиччю. В результаті досліджень виявлено два види паразитоїдів, що асоційовані із *Cerceris tuberculata:* оса-блискітка *Hedychrum virens* Dahlbom, 1845 *(Chrysididae)* та оса-німка *Nemka viduata viduata* (Pallas, 1773) (Mutillidae). Хазяїно-паразитний зв'язок між даною мутилідою та *C. tuberculata* нами виявлено вперше. У якості здобичі церцеріса горбкуватого нами відмічено чотири види довгоносиків, три з яких — вперше. Наведено нові реєстрації *C. tuberculata* з території Запорізької та Херсонської областей; для Запорізької області вид наведено вперше.

Ключові слова: Червона книга України, агрегація гнізд, паразитоїд, здобич, нові знахідки, степова зона.