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GENUS *CLAVIGER* PREYSSLER, 1790 (COLEOPTERA: STAPHYLINIDAE: PSELAPHINAE) IN THE LOW BESKID MTS. (POLAND) – NEW SITES AND HOST AFFILIATION

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ABSTRACT: In the area of Poland there occur two species of the genus: *Claviger longicornis* P.W.J. Müller, 1818 and *Claviger testaceus* Preyssler, 1790. Both species are rare in Poland. Beetles of the genus *Claviger* are specialized myrmecophiles and are dependent on their host ants throughout the whole life cycle. During the field research, which were conducted in the Low Beskid Mts. (South-Eastern Poland), new sites of both species were found. *C. longicornis* was recorded in a colony of *Lasius sabularum* (Bondroit, 1918) and this is the first record of this ant as its host. In addition, population of this species in ant colony was extremely large and correlated in time with the presence of sexual generation of ants. Transfer of beetles into artificial nest of *Lasius niger* and an attempt of rearing in laboratory conditions was unsuccessful and finished after 36 days. *C. testaceus* was recorded in a colony of *Lasius flavus* (Fabricius, 1781), which is the most common host of this species.

KEY WORDS: *Claviger longicornis*, *C. testaceus*, *Lasius sabularum*, new records, myrmecophily, parasitism, behaviour.

Introduction

Claviger Preyssler, 1790 is a genus of beetles in the family Staphylinidae Latreille, 1802 and subfamily Pselaphinae Latreille, 1802. 38 species and subspecies are described, classified into two subgenera (Löbl and Besuchet 2004). In the area of Poland there occur two species: *Claviger (Clavifer) longicornis* P.W.J. Müller, 1818 and *Claviger (Claviger) testaceus* Preyssler, 1790 (Borowiec et al. 2010). Beetles of the genus *Claviger* are specialized myrmecophiles and are dependent on their host ants throughout the whole life cycle (Borowiec et al. 2010). These insects are obligatorily myrmecophilous species (symphiles *sensu* Wasmann 1896, myrmecoxenes by Wheeler 1910 or true guests by Donisthorpe 1927). Members of the genus *Claviger* are closely associated with ants, living within their nests, feeding on food obtained from workers and possibly even relying on ants with respect to dispersion. They are featured by many morphological and anatomical adaptations to myrmecophily, such as the reduction of the eyes and mouthparts or development of specialized glandular system (Cammaerts 1974). The genus *Claviger* occurs in North Africa (Morocco and Algeria), in almost whole of Europe, Georgia, Turkey and Iran. Both species of *Claviger* occurring in Poland are most widely distributed members of the genus and occur in almost whole of Europe (Löbl and Besuchet 2004). Detailed information on the occurrence of both species in Poland can be found in the article by Borowiec et al. (2010). Both species are also considered rarities in Poland and *C. longicornis* is classified under VU (vulnerable) in The Polish Red Data Book of Animals (Pawłowski et al. 2002).

The aim of the study is to present the new data on the occurrence of *C. testaceus* and *C. longicornis* in Poland and provide additional data on the biology and host affiliation of *C. longicornis*, with review of known facts on the biology of both species.

Materials and methods

The field research was conducted in the area of the Low Beskidy Mountains, and concerned the ant fauna. Discovering the myrmecophilous beetles was an additional result of the study. During the research, the method of detailed searching of the field was applied e. g. by excavating stones, tree bark, *etc*. The collected specimens of ants and beetles were put into plastic tubes and preserved in 70% ethanol.

Specimens of ants and beetles were mounted with the standard method: glued on carton boards and placed on entomological pin. Some individuals of collected beetles were kept alive, for further rearing.

In laboratory, ca. 15 living individuals of *C. longicornis* were put in a simple artificial colony of *L. niger*. Standard-sized test tubes filled with water and plugged with a cotton was pushed down so that the cotton becomes wet. Tubes were placed in plastic container (19.5 × 12.5 × 13.5 cm) filled with sand. Walls of container were secured with talc in order to prevent ants from escaping. The colony was nourished from a single founding queen collected directly after nuptial flight about a year before conducting the observations. Colony contained ca. 150 workers, larvae and a queen. Ants were fed *ad libitum* with honey, cricket parts and slices of apple. The colonies were kept at 25±3°C and relative air humidity 35% and 12h:12h (light:dark) photoperiod in rearing room provided by Faculty of Biology and Environmental Protection in University of Silesia. Before introduction of *C. longicornis* the ant colonies haven't been used in any experiments. Observations were carried out for 36 days after the introduction of beetles on daily basis.

Results

Specimens of *Claviger longicornis* and *C. testaceus* have been collected on licalities presented below.

Claviger longicornis: UTM: EV29, Bednarka, 22 X 2013, more than 100 exx., in a decaying stump (Fig. 1); northern, steep slope of the hill Ostrzeż, 365 m a.s.l., mixed forest, GPS: N: 49°38'30'' E: 21°20'55''; ant host species: *Lasius* (*Chthonolasius*) *sabularum* (Bondroit, 1818). In the nest of ants there were very

numerous individuals of sexual generation – the males were much more numerous than the females. Some specimens of beetles were attached to the bodies of sexual individuals of ants.

Fig. 1. Tree stump with the colony of *L. sabularum* with *C. longicornis.*

During the attempt of rearing, the positive reaction of ants was observed – workers transported beetles in their mandibles to the center of the nest and intensively palpated them with their antennae. The beetles were constantly trying to escape out of the ant nest but were instantly caught and carried back towards the nests by ant workers. It cannot be stated whether the escape behavior of beetles was expressed due to the inappropriate conditions in artificial nest or because of the inappropriate ant species. In summary the attempt of rearing the beetle with *L. niger* was unsuccessful, all individuals of *C. longicornis* died by 36 days after the introduction to nest and the observations were ceased.

Claviger testaceus: EV17, Wysowa-Zdrój, 01 V 2014, 2 exx, meadow, under a stone (Fig. 2); 654 m a.s.l. slightly inclined, south – western slope, GPS: N: 49°25’32’’ E: 21°12’03’’; ant host species: *Lasius flavus* (Fabricius, 1782).

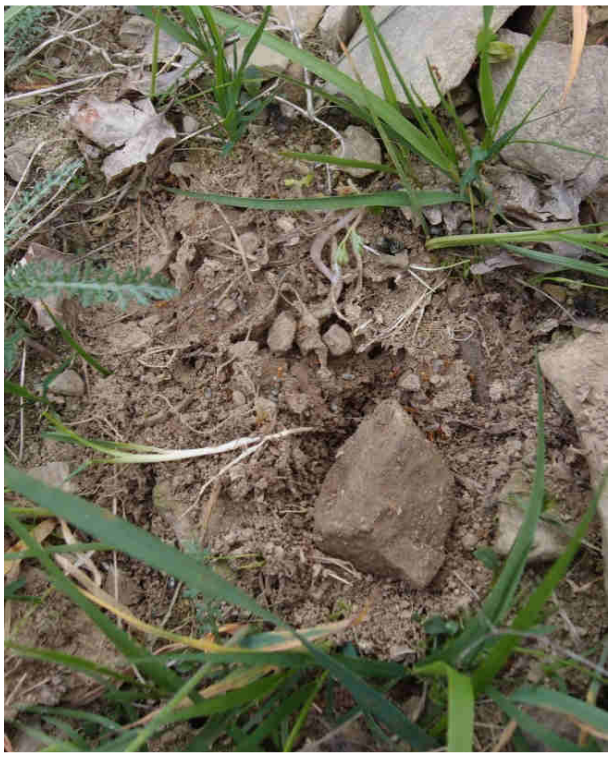

Fig. 2. Ant nest of *L. flavus* with *C. testaceus.*

Review of the biology of Claviger longicornis

The biology of this species is similar to that of *C. testaceus* (see below), although the information on this species is much more limited. The main host is *Lasius* (*Chthonolasius*) *umbratus* (Nylander, 1846) and the beetle is occasionally found with *Lasius* (*Ch.*) *mixtus* (Nylander, 1846) – both species being temporary social parasites. It has been rarely reported with other species of the genus - of a subgenus *Lasius*: such as *L. niger* and *L. brunneus* (Latreille, 1798) (Borowiec et al. 2010). Hlaváč and Lackner (1998) report the aggregation of ca. 60 individuals of *C. longicornis* observed in the nest of *L. brunneus* on 30th September in Slovakia. *C. longicornis* also had been collected with *Lasius* (*Dendrolasius*) *fuliginosus* (Latreille, 1798), however *L.* (*D.*) *fuliginosus*is known to found new colonies as a temporary social parasite of *Lasius* (*Ch.*) *umbratus*. Thus, these reports were probably from nests where the previous host died off (Borowiec et al. 2010).

Biology of the new host – Lasius (Ch.) sabularum (Bondroit, 1918)

This is a rarely encountered species of the subgenus *Chthonolasius* Ruzsky. It is a West-European species known from northern, central and southern Europe. In Poland known so far only from three sites - one localized in Lower Silesia (Borowiec 2011), one in Eastern Beskidy Mountains (Taszakowski et al. 2013) and one in the Stołowe Mountains (Salata 2014). *L.* (*Ch.*) *sabularum* is an oligotope of habitats of deciduous forests. Nests in the soil, under stones and in suburban habitats. Sexuals (males and females) found in the nests from late August to late October, sometimes also in spring, which suggests their occasional overwintering in nests. Temporal social parasite of *Lasius* (*Lasius*) species, predominately *L. niger* (Czechowski et al. 2012)

Review of the biology of Claviger testaceus

C. testaceus is one of the best studied myrmecophilous beetles. *Lasius* (*C.*) *flavus* (Fabricius, 1781) is the main host of *C. testaceus* with *Lasius* (*Lasius*) *niger* (Linnaeus, 1758) and *Lasius* (*L.*) *alienus* (Förster, 1850) as occasional hosts, but there are also reports of *Formica fusca* Linnaeus, 1758 as a host (Donisthorpe 1927, Borowiec et al. 2010). This species seems to mimic an insect corpse rather than to integrate into the colony structure (Borowiec et al. 2010). Such strategy enables easy access to regurgitated food as well as to larval secretions and obviously to insect corpses harvested by the colony.

C. testaceus is mainly fed by the hosts, obtaining liquid food that the ants regurgitate on their mouthparts, as well as stealing food during trophallaxis between hosts. It is also able to suck the content of ant eggs, feed on larval secretions and excreta as well as on insect cadavers present in the nests (Borowiec et al. 2010). Regurgitation of ingluvial food from hosts' workers is stimulated by allomone secreted on labral (cephalic) and Wasmann (abdominal) glands of *Claviger*. Thus mechanical stimulation of the donor is not necessary (Cammaerts 1992). However, regurgitation is always preceded by licking of beetle's mouthparts and trichomes (Cammaerts 1996). The movement pattern of the donor's cephalic alimentary pump during regurgitations on the mouthparts of *Claviger* varies from patterns expressed during trophallaxis with fellow ants, hence highly reassembles those expressed during regurgitation on harvested insect cadavers. Also a slight fraction of workers regurgitates (in addition to food), small amount of unknown fluid both on cadavers and individuals of *Claviger* (Cammaerts 1996).

The workers transport and deposit the *Claviger* guest beetle within the nest to the same place as an insect corpse to be eaten by the brood (Cammaerts 1999a). The workers may deposit various decaying objects of insect origin, as well as living larvae, onto the beetle itself, just as they may do to an insect cadaver. In societies not nourishing the brood with dead insects, immobilized *Claviger* beetles and insect corpses are not deposited on to the larvae, but kept among the workers or rejected, mainly on the refuse (Cammaerts 1996). When the colony is disturbed workers grab the beetles with mandibles and carry them to the nest, additionally beetles actively seek ants. It was observed that the beetles had precedence in transportation over brood, however the same precedence applied to cadavers. The origin of this behavior remains unknown (Osterloff 1889, Cammaerts 1999b, Borowiec et al. 2010).

Discussion

L. (*Ch.*) *sabularum* was for the first time recorded as a host of *C. longicornis*. The abundance of the beetle in the host nest is very interesting, because it has never been recorded in such dense and numerous populations within a single ant nest. The colony of *L. sabularum* was very numerous, and during observations, there were sexual individuals present in the nest: males and females, also in great number. Some specimens of beetles were attached to the body of sexual individuals of ants. It is in concordance with the earlier observations of *C. testaceus*, in which the beetles were sometimes found clinging onto

gynes and males of *L. flavus* which led to suggestions that this wingless and blind beetle may rely on dispersion by ant sexuals (Borowiec et al. 2010).

Its seems that the beetles move towards the surface of the ant nest during the season of the nuptial flights of their hosts, where they aggregate in huge numbers. It is connected with their assumed dispersal mode on ant gynes. It would lead to a conclusion that the presence of such aggregation in the nest of *L. brunneus* at the end of September (Hlaváč and Lackner 1998), indicates the infestation of these ant nests by parasitic ant of the subgenus *Chthonolasius*. *L. brunneus* has its nuptial flights in June and July, so it would be too late for *C. longicornis* to disperse with the sexuals of this species, unless sexuals of *Chthonolasius* were present deep in the nest. The nuptial flights of *Chthonolasius* spp. usally take place in late summer and in autumn (Czechowski et al. 2012) which is concordant with the presented observations.

It is speculated that the individuals of *Claviger* spp. remain in ant brood chambers, which are their source of food (Cammaerts 1999b). Due to restless behavior of beetles in laboratory, a detailed observation of regurgitation modes, as presented by Cammaerts (1995, 1996) could not be conducted and this behavior requires further observations.

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