



FIRST RECORD OF *CRYPTOPONE OCHRACEA* (MAYR, 1855) (HYMENOPTERA: FORMICIDAE) IN SLOVAKIA WITH NOTES ON ITS NESTING BIOLOGY

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Abstract: A long-term effort to find one of the most mysterious ants in Central Europe have paid off. *Cryptopone ochracea* (Mayr, 1855) was found in the southeast of Slovakia and is the 118th recorded species of the native myrmecofauna. This research also brings new faunistic data on the occurrence of rare *Proceratium melinum* (Roger, 1860) and *Strumigenys argiola* (Emery, 1869) in the same habitat. Presented data were also complemented by two recent observations in Hungary, which provided partial information on the biology of the *C. ochracea* nuptial flights. In one of these observations, five gynes were obtained, which were subsequently kept in captivity. In four cases, the successful establishment of an ant colony was documented.

Key words: ants, Ponerinae, species distribution, faunistics, colony founding, nuptial flight

INTRODUCTION

More than a hundred years of the faunistic survey of ants in Slovakia resulted in a list of 117 native and 2 non-native species (WERNER & WIEZIK 2007, DEVÁN 2008, SUVÁK 2011, BEZDĚČKA & TEĚÁL 2013, WIEZIK & WIEZIKOVÁ 2013, SEIFERT & GALKOWSKI 2016, WAGNER *et al.* 2017, KLESNIAKOVÁ *et al.* 2018, SEIFERT 2018, SUVÁK 2021). The occurrence of several other species is probable (e.g. *Formica aquilonia* Yarrow, 1955; *Formica fuscocinerea* Forel, 1874; *Formica lugubris* Zetterstedt, 1838; *Lasius austriacus* Schlick-Steiner, 2003; *Myrmica karavajevi* (Arnol'di, 1930) or *Myrmica constricta* Karavaiev, 1934), but so far they are just waiting to be discovered. Secrets of many ant species may also be revealed in the coming years also by revising species complexes using modern scientific methods (e.g. SEIFERT & SCHULTZ 2021).

One of these species is *Cryptopone ochracea*, which until recently was considered one of the rarest ant species in Central Europe (BÁTHORI *et al.* 2022).

The genus *Cryptopone* Emery, 1893 includes at least 23 valid species, of which *C. ochracea* is the only one occurring in Europe (SCHMIDT & SHATTUCK 2014, BÁTHORI *et al.* 2022, BRANSTETTER & LONGINO 2022). According to the recent phylogenetic study (BRANSTETTER & LONGINO 2022), *C. ochracea* is related to Nearctic *Cryptopone gilva* (Roger, 1863) and both lineages were probably separated in late Miocene (6.3 million years ago).

Workers of the genus *Cryptopone* are perfectly adapted to foraging in the soil. They show morphological characters typical of this lifestyle including small size (body length 1.7–6.1 mm), slender body shape, depigmentation, greatly reduced or absent eyes and mesotibiae armed with traction setae. Queens are slightly larger versions of the workers with ocelli and larger eyes combined with modified thorax typical of alate specimens (SCHMIDT & SHATTUCK 2014). Due to its cryptobiotic habits, biology of most members of this genus is unknown. Several studies (e.g. WHEELER 1933, TERAYAMA 1999, RADCHENKO 2005, YAMAGUCHI *et al.* 2017) reported observations of *Cryptopone* nesting in various microhabitats i.e. in leaf litter, soil cavities, rotting wood, termite nests, or even in pores of dead fungi. In this environment, they are probably predators of small arthropods.

Cryptopone ochracea is no exception – details about its ecology, nesting biology or food preferences are largely unknown. Although Europe is notorious for its rich myrmecological history, this species appears somewhat mythical in the literature published to date. Based on a study in Hungary (BÁTHORI *et al.* 2022), it seems that in Central Europe it prefers nesting in the lowlands – both in natural and synanthropic environments. Its northernmost range extends to about 48°N.

In this study we present the first record of *Cryptopone ochracea* from Slovakia. We also added basic climate data to the two observations of nuptial flights in Hungary and described the successful establishment of a colony by four gynes under artificial conditions.

MATERIAL AND METHODS

Distribution data

This study extends the knowledge about distribution of *Cryptopone ochracea* in Slovakia and Hungary by individual sampling. At the same time, it provides new faunistic data on rare accompanying ant species detected in its habitat. Presented findings are sorted by date. All newly found specimens were determined using the identification key in SEIFERT (2018) and were stored in 96% ethanol. A recent distribution map (see BÁTHORI *et al.* 2022) was used for an updated overview.

Meteorological data

Samples associated with direct observation of ant swarming behaviour were supplemented with weather parameters from the nearest meteorological stations. Following the studies of different authors (e.g. BOOMSMA & LEUSINK 1981, DEPA 2006, STAAB & KLEINEIDAM 2014, PURKART et al. 2021), we summarised variables, which were possible to obtain: date, time, precipitation (mm), air temperature (°C), maximum air temperature (°C), average relative humidity (%), wind speed (km/h) and sea level pressure (hPa) – each measured 2 m above the ground surface. These data were obtained from www.ogimet.com (accessed 29.8.2022).

Laboratory observations

Observations started on 26 October 2021 by housing a five *C. ochracea* gynes in artificial setups according to the methods described by PURKART et al. (2021). The ants were fed *ad libidum* once a week with springtails (*Folsomia candida* Willem 1902), dead litter beetle larvae (*Alphitobius diaperinus* Panzer, 1797), dead webspinner juveniles (*Embia* cf. *savignyi* Westwood, 1837) and house cricket (*Acheta domestica* (Linnaeus, 1758)) legs. Sugared water or honeydew was not provided. The laboratory nest was held in the dark at temperature ranging from 20 to 25°C. Interesting observations about the lifestyle and behaviour of these ants are recorded in the form of short notes. To capture the observations of captive colony, a Canon EOS 70D with a Canon EF 100MM F/2.8L Macro is Usm (Canon, Tokyo, Japan) was used in combination with a Raynox DCR-250 macro lens.

RESULTS

Material examined:

- C Hungary: Dunaújváros (46°57'52"N, 18°56'10"E; Fig. 1), 97 m a. s. l., 28.9.2021, *Cryptopone ochracea*, 5 alate gynes, leg. K. Gyárfás, det. et coll. F. Repta, captured by hand collecting on soil surface in a garden
- SW Hungary: Szigetvár (46°03'08"N 17°47'02"E; Fig. 1), 118 m a. s. l., 13.8.2022, *Cryptopone ochracea*, 1 alate gyne, leg. A. Hegedus, det. F. Repta, captured by hand collecting on soil surface in a garden
- SE Slovakia: Ruská (48°31'39"N, 22° 8'26"E; Fig. 1), 102 m a. s. l., 4.9.2022, *Cryptopone ochracea*, 1 gyne (Fig. 2), leg. det. et coll. F. Repta, captured under a large bag with substrate in a garden of a family house
- SE Slovakia: Ruská (48°31'39"N, 22° 8'26"E, 102 m a. s. l., 4.9.2022, *Proceratium melinum*, 2 alate males, leg. det. et coll. F. Repta, individual collection
- SE Slovakia: Ruská (48°31'39"N, 22° 8'26"E, 102 m a. s. l., 5.9.2022, *Strumigenys argiola*, 1 gyne, leg. det. et coll. F. Repta, captured under a wooden palette in a garden of a family house

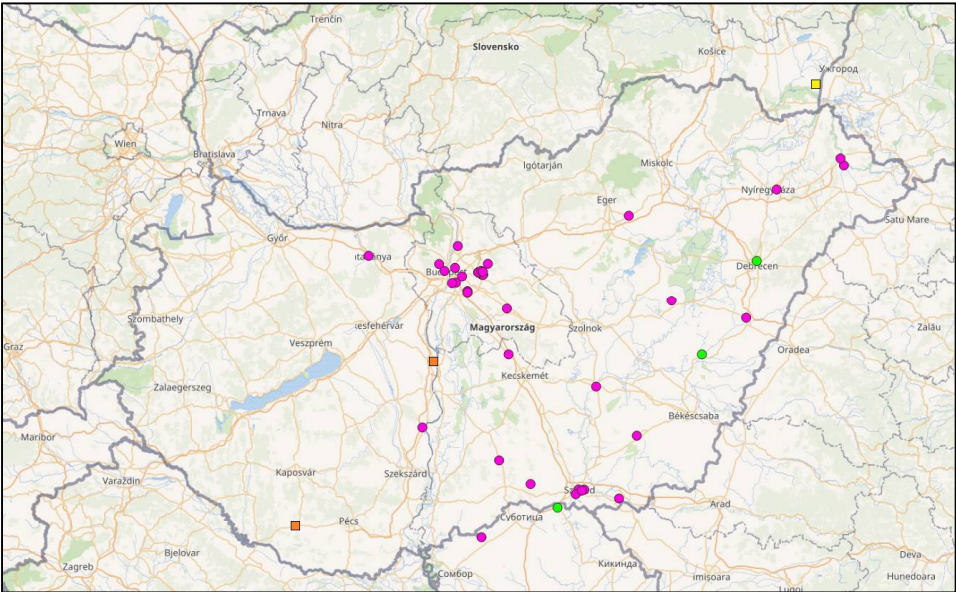


Figure 1. Updated distribution map of *Cryptopone ochracea*: faunistic data from Hungary and Serbia provided by BÁTHORI et al. 2022 (magenta [recent data] and green [historical data] circles), new data from Hungary (orange squares) and Slovakia (yellow square).



Figure 2. *Cryptopone ochracea* gyne with characteristic brownish colour.
(Photo: Filip Repta)

Nuptial flight ecology

Two observations of nuptial flights in Hungary were recorded (Tab. 1). Based on the obtained data, this phenomenon occurred two times, on 13 August and 28 September. The following climatic data (see Material and methods) were recorded at the time of observation: air temperature 19.3 and 23.8 °C; maximum air temperature 19.9 and 24.6 °C; average relative humidity 60 and 84 %; wind speed 7.2 km/h; precipitation 0 mm and sea level pressure 1013.1 and 1017.5 hPa, respectively.

Table 1. Observations of nuptial flights and meteorological data. The time given is UTC+2.

Locality	Day	Time	T	Tmax	Hr	Ws	P	Pr
Dunaújváros	28.9.2021	15:00	23.8	24.6	60	7.2	1017.5	0
Szigetvár	13.8.2022	15:00	19.3	19.9	84	7.2	1013.1	0

Abbreviations: T – air temperature (°C), Tmax – maximum air temperature (°C), Hr – average relative humidity (%), Ws – wind speed (km/h), P – sea level pressure (hPa), Pr – precipitation (mm).

Nesting biology

All 5 gynes originated from the locality Dunaújváros (see Material examined) and were placed in the separate laboratory nests on 26.10.2021. They were labelled as Q 1-5. Individual milestones in the process of colony establishment are written in the form of irregular notes. The numbers of individual eggs, larvae and pupae may not be accurate as it was sometimes not possible to observe the entire brood through the dirty glass:

31. October 2021

All gynes were fed by springtails, which were actively hunt in soil cavities.

Q1 - first egg has appeared

Q2 - no brood

Q3 - no brood

Q4 - no brood

Q5 - no brood

11. November 2021

Q1 - 6 eggs

Q2 - 2 eggs

Q3 - no brood

Q4 - 1 egg

Q5 - no brood

25. November 2021

All gynes fed on a cricket leg that was placed near their chamber.

Q1 - 9 eggs and 1 larvae

Q2 - 10 eggs

Q3 - 1 egg

Q4 - 4 eggs

Q5 - 7 eggs

12. December 2021

Q1 - 1 egg, 4 larvae and 1 pupa

Q2 - 13 eggs and 4 larvae

Q3 - 13 eggs

Q4 - 5 eggs and 2 larvae

Q5 - 10 eggs and 1 larvae

2. January 2022

Q1 - 5 egg, 4 larvae and 1 pupa

Q2 - 1 eggs, 4 larvae and 2 pupae

Q3 - 4 larvae

Q4 - 4 larvae

Q5 - 4 larvae and 1 pupa

7. January 2022

Q5 has died. Her brood was offered to gyne Q1, but it was refused. The brood was then inserted close to the chamber of gyne Q4, which accepted it and included it into her brood. The dead Q5 specimen was later stored in 96% ethanol.

17. January 2022

Q1 - 8 eggs, 3 larvae, 3 pupae and 1 freshly hatched worker
Q2 - 2 eggs, 5 larvae and 3 pupae
Q3 - 2 eggs, 1 larva and 3 pupae
Q4 - 4 eggs, 3 larvae and 4 pupae

1. February 2022

Q1 - 3 eggs, 11 larvae, 2 pupae and 1 worker (Fig. 3)
Q2 - 8 eggs, 4 larvae, 1 pupa and 1 worker
Q3 - 6 eggs and 3 pupae
Q4 - 2 larvae, 4 pupae and 1 worker

22. February 2022

Q1 - 12 eggs, 8 larvae, 4 pupae and 3 workers
Q2 - 10 eggs, 5 larvae, 2 pupae and 3 workers
Q3 - 6 larvae, 1 pupa and 3 workers
Q4 - 4 eggs, 7 larvae, 1 pupa and 3 workers

26. March 2022

Q1 - 15 eggs, 12 larvae, 1 pupa and 5 workers
Q2 - 11 eggs, 11 larvae and 3 workers
Q3 - 8 larvae, 1 pupa and 3 workers
Q4 - 4 eggs, 6 larvae and 3 workers

31. October 2022

Q1 - 8 eggs, 5 larvae and 12 workers
Q2 - 9 eggs, 6 larvae, 2 pupae and 7 workers (Fig. 4)
Q3 - 1 larva and 5 workers
Q4 - 4 larvae and 7 workers

Additional observations

C. ochracea inhabits not only soil cracks, but also actively build their own passages and cavities. The chambers created are approximately 8 millimetres wide and 3 millimetres deep (Fig. 4). Brood is stored there and divided into piles depending on the stage. Workers enter the surrounding area via narrow corridors, where they actively hunt for small arthropods. Workers can develop a relatively high speed while chasing their prey. Springtails were often caught simply without the use of a stinger. When the workers bring their prey to the nest, the other individuals are immediately in rapture and go hunting to a place with a food source. If the nest is disturbed, the workers actively defend it – for example by biting the tweezers. After establishing a colony, the queen rarely leaves the nest chambers. When disturbed, workers gather around the queen, and lick her around the metapleural glands. The workers sometimes try to drag queen to another place by pulling her mandibles. Brood in danger is not prioritised for safety. Immobility or other similar forms of defensive behaviour by ant individuals were not observed. This species cannot climb smooth surfaces.



Figure 3. *Cryptopone ochracea* nest chamber with a queen (larger), first hatched worker and brood. (Photo: Filip Repta)



Figure 4. An approximately one year-old nest of *Cryptopone ochracea* with a distinct system of multiple chambers and passages. (Photo: Adrián Purkart)

DISCUSSION

The list of native ant species known from Slovakia has been extended to 118. The locality of discovery of *Cryptopone ochracea* was the garden of a family house in the village Ruská, where the second author of this study also recorded the occurrence of *Strumigenys argiola* (PURKART et al. 2021). *S. argiola* was repeatedly recorded here, and another rare cryptic ant species, *Proceratium melinum*, was also found in this ant assemblage. Together, they extended the list of detected ant species in the Latorica Protected Landscape Area and its surroundings (SUVÁK 2021) to 75. The village Ruská is a border village with Ukraine. As the nature of the area is very similar in its surroundings, it is likely that distribution of *C. ochracea* extends as far as Uzhhorod, or further north to the Eastern Slovakian Plain. The results presented in the study by BÁTHORI et al. (2022) indicate that the species is also spread around the borders of Slovakia and Hungary in the west. Similar to *S. argiola*, *C. ochracea* does not hesitate to occupy diverse microhabitats of the synanthropic environment.

To a lesser extent, it was also possible to outline the ecology of nuptial flights. It has been confirmed that this event takes place in the environment of Central Europe, in the second half of summer, or until the beginning of autumn. This time of year is also typical for nuptial flights of other ant species with a similar lifestyle (SEIFERT 2018, PURKART et al. 2021). However, two observations are not sufficient to assess under which conditions this phenomenon occurs. It is obvious that alates do not fly out of their nests during heat waves, but probably at the time of an incoming cold front that interrupts a period of warmer days. Since only wingless gynes were detected, the time of observation may not exactly coincide with the time of nuptial flight. Therefore, a more detailed study is needed to understand this phenomenon in *C. ochracea*.

Young gynes of *C. ochracea* establish their colonies similarly to other Central European Ponerinae. For nesting, they use simple cavities in the soil, which adapt to the sealing of the substrate crevices with soil particles. They mostly use one exit to reach the surrounding area. They usually leave the nest cavity several times a day to catch various small prey. The first eggs are laid a few days after the nest chamber is established. Larvae are fed by depositing dead prey near them. Various changes in the number of eggs and larvae over time indicate cannibalism. Based on the records, the duration of the worker's development can be estimated at approximately 70 to 80 days. The development of the cocoon took about 35 days under the described conditions. As the substrate is used in a laboratory nest of this type, some events in the later stages of rearing in captivity could not be observed closely through the dirty glass. The difference to natural conditions is also the absence of hibernation. In any case, four successfully established *C. ochracea* colonies had a number of 5-12 workers in one year of observation.

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