

**Short scientific note**

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## First record of ergatandromorphous *Temnothorax turcicus* (Santschi, 1934) in Slovakia (Hymenoptera: Formicidae)

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**Abstract**

Various morphological malformations have always attracted the attention of naturalists. One of the iconic ones is gynandromorphy, in which an individual shows both male and female traits. Although this phenomenon is considered common across the insect kingdom, the level of scientific knowledge is still poor in ants – one of the most studied groups of arthropods. In this study, we present the discovery of a worker ant [of the rare thermophilic species *Temnothorax turcicus* (Santschi, 1934)] from the territory of Slovakia, part of whose head bears the characteristics of a male. Observations of a live individual affected in this way were also made. Additionally, the location where this specimen was found is currently the northernmost known distribution point of this species in Europe.

**Key words:** ants, gynandromorph, developmental defects, chimeric mosaic, distribution.

**Introduction**

Gynandromorphy is a type of mutation where individuals display a mosaic of distinctly male and female tissues or cell populations. In most cases, this phenomenon is caused by an event occurring in mitosis during early development. There are several mechanisms thought to lead to the creation of such monstrosities, including hybridization, bacterial and viral infections, anomalous fertilization events, temperature variation, or loss of expression of sex loci in certain cells (Drescher & Rothenbuhler 1963; Berndt & Kremer 1982, 1983; Clements 1992; Kamping et al. 2007; Michez et al. 2009; Yoshizawa et al. 2009; Werner 2012). Gynandromorphism occurs almost across the entire animal kingdom, but most records are among insects (Cui & Cui 2003). It does not avoid ants either, where it has been detected in more than 30 genera (Skvarla & Dowling 2014; Gjershaug et al. 2016; Schifani et al. 2020). Due to the caste system in social living hymenopterans, several subcategories are also distinguished: queen-male (gynandromorphs), worker-male (ergatandromorphs or androergatomorphs), and soldier-male (dinergatandromorphs).

With a few exceptions, records of various forms of mosaic chimera are relatively rare in the wild, and gynandromorphy is thought to occur in approximately one in 10,000 individuals (Williams 2010; Sample 2011; Skvarla & Dowling 2014). This ratio could favor the study of socially living ants, which live in numerous colonies, are a relatively well-studied group of organisms, and are collected by experts in high numbers (e.g., in the context of ecological research). Despite this, only some findings from the territory of Slovakia or the Czech Republic are documented in the literature. Probably the last research was published more than 30 years ago by Bezděčka (1990), who, in addition to his observations of *Myrmica rugulosa* Nylander, 1849 and *Myrmica sabuleti* Meinert, 1861, also summarized historical records: *Camponotus ligniperda* (Latreille, 1802) recorded by František Klapálek in 1896, followed by finding of *Myrmica rubra* (Linnaeus, 1758) by Vladimír Novák in 1943, *Myrmica scabrinodis* Nylander, 1846 by Karel Samšiňák in 1949, and *Polyergus rufescens* (Latreille, 1798) observed by Ján Horák in 1957.

This study presents the first finding of ergatandromorphism in Slovakia, which occurred in the rare thermophilic ant species *Temnothorax turcicus* (Santschi, 1934).

*T. turcicus* is a small, arboreal, thermophilic ant species which is widely distributed in the Mediterranean region. Its nests were observed in dry branches of oaks (typically placed in the lower portion of the crown) and smaller bushes (Wagner et al. 2011). It does not occur in the Czech Republic (Werner et al. 2018) and is considered rare in Slovakia.

## Material and methods

The ant sample was obtained by collecting the entire colony, which was transferred from the wild for laboratory breeding. The ant nest was located in an oak branch on the ground at the edge of a deciduous forest. After transfer, the colony was placed in a plastic container, and three workers were captured and deposited in 99 % ethanol. Determination of the samples was performed based on Wagner et al. (2011) and Seifert (2018). During a routine inspection and counting of individuals in the colony, an unusual individual was detected. After several hours of observation, it was also captured and placed in 96 % ethanol. To capture the observations of living ant individuals, a Canon EOS 80D body with a Canon EF 100MM F/2.8L Macro is Usm (Canon, Tokyo, Japan) combined with Raynox DCR-250 macro lens was used. Digital photographs of ergatandromorphous individual were taken using a Canon EOS 5D Mark II camera attached to Zeiss Axio Zoom.V16 stereoscope using temporary preparation. Image stacks were produced manually, combined using Zerene Stacker software and edited in Adobe Photoshop CC.

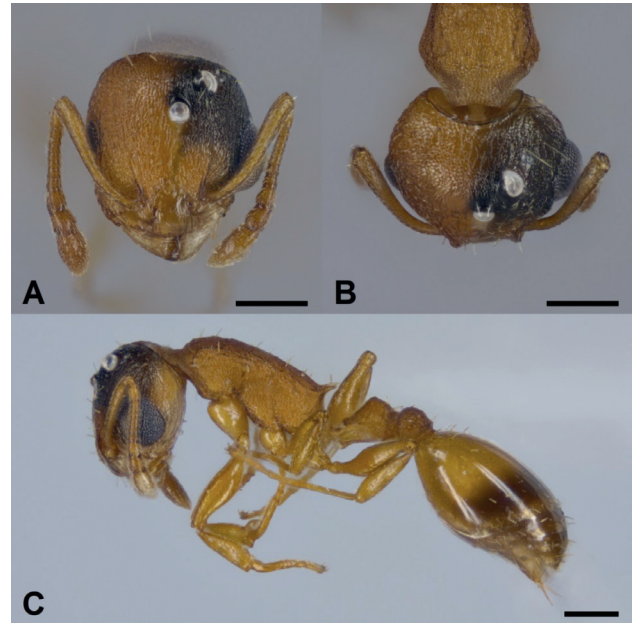
## Results and discussion

**SLOVAKIA** (western portion): Dolné Srnie env., 257 m, 48.800N, 17.825E, 24 Mar 2023, 1 ex. (Fig. 1), coll. et det. Lukáš Jancík, rev. Adrián Purkart, hand-collected ant colony (ca. 100 individuals) gathered from an oak branch.

The data reported above for *Temnothorax turcicus* establishes the northernmost known limit of its distribution in Europe (Wagner et al. 2011).

As can be seen in Fig. 1, a partial gynandromorphism affected only a smaller section of the individual's head. The affected area is typically darker in color, like the males of this ant species, and also has a significantly larger eye. At the same time, two of the three high-aperture ocelli (eye spots) are present. The mutation partially affected the anchoring of the mandible and its shape. The ventral side of the head, together with the labial palps, maxillary palps, and hypostome, was not modified. To preserve the integrity of the material, the extent of the mutation was not investigated internally. However, since we obtained live material, it was possible to make several observations of the individual's behavior and compare it with other ants

of the same nest (Fig. 2). Manifestations typical of worker ants were observed – the ergatandromorph showed care for eggs and larvae, explored the new environment of the laboratory nest together with other workers and clustered next to the queen when threatened. Such activities are not typical for male ants, so we think that the internal structure of the male-tissue malformation range was not affected in the brain, and therefore the behavior of the worker (female) was preserved.



**Fig. 1** – Habitus of ergatandromorphous *Temnothorax turcicus* (scale = 250  $\mu$ m): **A**, head, frontal view; **B**, head, dorsum; **C**, specimen, profile. (Photo: Samuel Krémárik).



**Fig. 2** – Ergatandromorphous specimen of *Temnothorax turcicus* (right) compared with “normal” worker specimen (left) (Photo: Adrián Purkart).

The observation of gynandromorphs in ants of the genus *Temnothorax* was documented for the first time in 1903 by the North American entomologist William Morton Wheeler in the species *Temnothorax obturator* (Wheeler W.M., 1903) (Wheeler 1903). More than a hundred years later (Skvarla & Dowling 2014), this phenomenon was detected in the species *Temnothorax curvispinosus* (Mayr, 1866), also from North America. In Europe, a single record was published from Norway (Gjershaug et al. 2016), where the authors found bilateral gynandromorphism in the related ant genus *Leptothorax kutteri* Buschinger, 1965. It is not clear whether such individuals of ants were found so infrequently or whether they are just unpublished and stored in collections.

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