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ANTS (HYMENOPTERA: FORMICIDAE) OF THE EASTERNMOST PART OF BIELE KARPATY MTS AND ADJACENT AREA

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Abstract: The fauna of ants was studied at 73 sites distributed within the easternmost part of Biele Karpaty Mts and adjacent area (north-west Slovak Republic). All discovered areas with xerothermophilous grasslands, which were scarce in the investigated area, were included. The sites also comprised other natural habitats, e.g., wetlands, as well as ruderal ones disturbed by human activities. In total, 75 ant species were discovered there, including numerous rarely found ones inhabiting xerothermous forest-steppes, e.g., *Lasius myops* Forel, 1894, *Lasius reginae* Faber, 1967, *Proceratium melinum* (Roger, 1860), and *Strumigenys argiola* (Emery, 1869). Some other poorly recorded species within the Slovak Republic were also discovered, i.e., *Lasius sabularum* (Bondroit, 1918), *Leptothorax gredleri* Mayr, 1855, and *Tetramorium immigrans* Santschi, 1927. Noteworthy records are represented also by arboricolous species known to nest in dead tree parts too, i.e., *Lasius bicornis* (Förster, 1850), and *Lasius citrinus* Emery, 1922. Faunistic data are listed by species, containing all confirmed study sites. A summary of available past records is provided for some of the discovered species. This study is enriched by data on the biology of ant species, which were obtained during this study, e.g., swarming dates, nest construction, and colony demography.

Key words: faunistic, *Lasius reginae*, *Lasius bicornis*, ecology, Javorníky Mts, Slovakia, Považské podolie Val.

INTRODUCTION

The past studies of myrmecofauna within the Biele Karpaty Mts and its adjacent area were well summarised by BEZDĚČKA & BEZDĚČKOVÁ (2010). The earliest references to individual findings are documented in ZÁLESKÝ (1939); more complex studies were carried out by LABUDA (1970), BEZDĚČKA (1992), BEREC (1997), to a large extent by DEVÁN (2005, 2006a, b, c, 2008b, 2009b, c), and by DEVÁN (2008). Some additional single records can be found dispersed within various papers, e.g., ŠILHAVÝ (1935) mentioning three ant species from Kvašov and Vršatec villages, and SEIFERT (2012) mentioning one finding of *Bothriomyrmex corsicus* Santschi, 1923 from Mikušovce village. This study focuses exclusively on the easternmost part of the Biele Karpaty Mts and adjacent area covering the

Javorníky Mts and Považské podolie Val. (Fig. 1). The study sites in the Biele Karpaty Mts were in the surroundings of inhabited areas Zárieče (Klecenec), Zubák, Dohňany, Horná Breznica, Hrabovka (Púchov), Keblie (Púchov), Lednica, Streženice, and Medné. The localities covered by adjacent part of the Javorníky Mts were situated near inhabited areas Dešná (Lysá pod Makytou), Lysá pod Makytou, Zárieče, Zbora, Mostište, Ihrište, Dohňany, and Hrabovka (Púchov). Within the adjacent part of Považské podolie Val. were included sites in proximity of village Streženice, and town district Horné Kočkovce (Púchov). Forest-steppe localities with xerothermophilous grasslands are rare in the investigated area, span small areas, and most of them are abandoned without any conservation management, leading to succession process and forest development (Figs 2A, C, D, 3).

MATERIAL AND METHODS

Description of study sites

A list of the study sites (Fig. 1) with their descriptions is presented below. Each site is described by its unique identification number (1), altitude (Z-coordinate) [m a.s.l.] (2), coordinates (Y,X) [decimal degrees] (3), geomorphological unit it

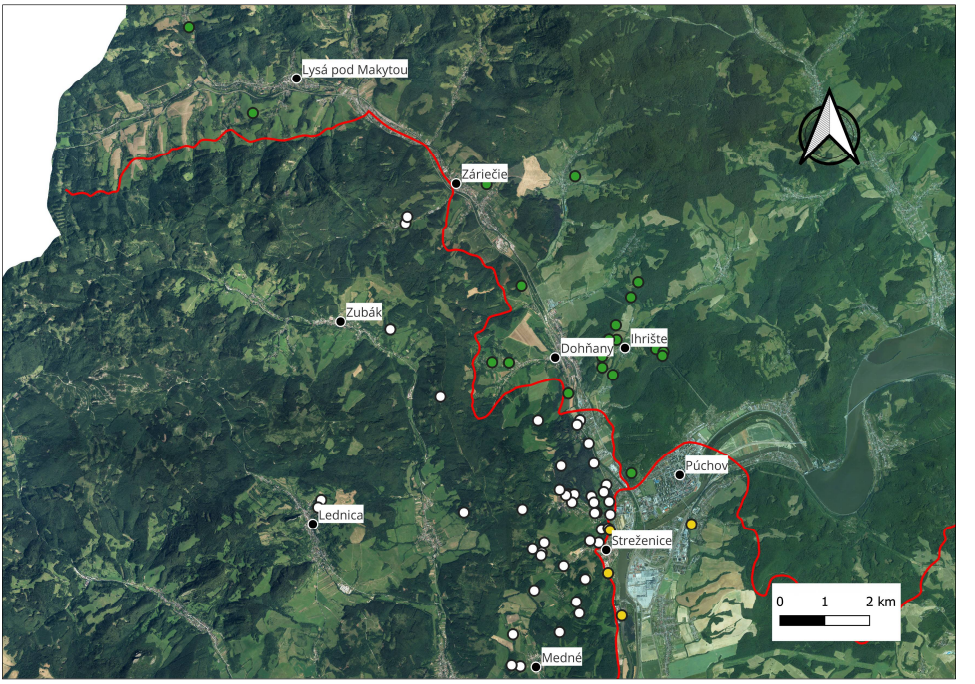

Fig. 1. Overview of collecting sites: White points (46) indicate sites within the Biele Karpaty Mts, green points (22) mark sites in the Javorníky Mts, and yellow points (5) show sites in the Považské Podolie Valley. Red lines outline the boundaries of the geomorphological units. Picture was created using QGIS software.

belongs to (4), administrative affiliation into the cadastral territory it belongs to (5), and by the biotope (6). The altitude refers to 2D point of the "Y,X" coordinates. The attribute n. 3 represents approximate value and refer to the most prominent site's part. The accuracy of the coordinates is given by the number of their decimal digits (4). Sites are in descending order based on the "Y" coordinate, meaning that they are sorted from the northernmost one.

1) 404; 49.2064°,18.1644°; Javorníky; Lysá pod Makytou; Subsoil: unknown. Small concrete surface serving as a base for a bridge over a stream. Stone-lined stream and solitary trees in its surroundings.

2) 476; 49.1902°,18.1862°; Javorníky; Lysá pod Makytou; SE facing and very steep hillside. Subsoil: sandstone. Grassland biotope with occasional stones on the ground surface.

3) 401; 49.1830°,18.2859°; Javorníky; Zbora; Subsoil: unknown. Stands of old *Tilia platyphyllos* trees with much dead bark on their trunks, and adjacent area of abandoned cemetery with dead wood.

4) 402; 49.1800°,18.2591°; Javorníky; Mestečko; Non-overgrown abandoned quarry with S facing slopes. Subsoil: limestone. Surfaces with bare rocks, gravelly substrate, and occasional xerothermous grasslands.

5) 401; 49.1720°,18.2360°; Biele Karpaty; Zárieče; S facing and very steep hillside. Subsoil: limestone. Afforested xerotherm mainly with approximately 70-year-old *Pinus sylvestris* stands, but still with small clearings. Rocky soils, subsoil protruding from the soil in large extent, much of bare stony surfaces. The area directly borders with a small stream called Klecenecký potok which flows directly under the hillside and is notched to the subsoil (Fig. 2A).

6) 393; 49.1705°,18.2354°; Biele Karpaty; Zárieče; SE facing slope of a small hill. Subsoil: limestone. Xerothermophilous grasslands with occasional stones on the ground surface.

7) 454; 49.1630°,18.3079°; Javorníky; Mostište; S facing slope. Subsoil: limestone. Sparse *Pinus sylvestris* forest with undergrowth of grass-herbal vegetation, occasional stones, and partially burned ground surfaces.

8) 325; 49.1602°,18.2724°; Javorníky; Dohňany; SE facing terrain depression. Subsoil: sandstone. Grasslands and shrubs with occasional stones on the surface, on an unmanaged small area.

9) 362; 49.1597°,18.3061°; Javorníky; Ihrište; S facing and very steep hillside. Subsoil: limestone. Xerotherm with much rock on the ground surface but overgrown with bushes and trees.

10) 450; 49.1539°,18.3022°; Javorníky; Ihrište; SE facing slope of a hill. Subsoil: limestone. Small forest clearing with much rock on the surface.

11) 404; 49.1524°,18.3092°; Javorníky; Ihrište; Subsoil: unknown. Country road and adjacent mowed grass areas.

12) 382; 49.1510°,18.3029°; Javorníky; Ihrište; Subsoil: unknown. Extensive grasslands with old apple trees and much dead wood.

13) 419; 49.1509°,18.3006°; Javorníky; Ihrište; E facing hillside. Subsoil: limestone. Small forest clearing with grasslands and many stones on the ground surface.

14) 457; 49.1498°,18.3150°; Javorníky; Ihrište; SE facing and very steep hillside. Subsoil: sandstone. Forest clearings with much of bare soil surfaces and stones on the ground.

15) 480; 49.1493°,18.2337°; Biele Karpaty; Zubák; SE facing hillside. Subsoil: limestone. Forest-steppe with xerothermous grasslands and shrubs, also with much rock on the ground surface.

16) 447; 49.1492°,18.3176°; Javorníky; Ihrište; SW facing slope. Subsoil: sandstone. Forest clearings with much of bare soil surfaces.

17) 436; 49.1486°,18.3173°; Javorníky; Ihrište; SE facing slope of hill. Subsoil: limestone. Light *Pinus sylvestris* forest with rocky soil and grass-herbal undergrowth.

18) 326; 49.1484°,18.2896°; Javorníky; Dohňany; SW facing slope of a hill. Subsoil: claystone. Surroundings of a branched and little-used country road with mostly bare ground surfaces and grasslands; in connection with forest ecotone.

19) 399; 49.1475°,18.2989°; Javorníky; Ihrište; Subsoil: limestone. Forest clearing with xerothermophilous grass-herbal vegetation and much of stones on the ground surface.

20) 354; 49.1451°,18.2993°; Javorníky; Ihrište; E facing and very steep slope of a hill. Subsoil: limestone. Xerothermophilous grasslands with occasional shrubs and stones (Fig. 2D).

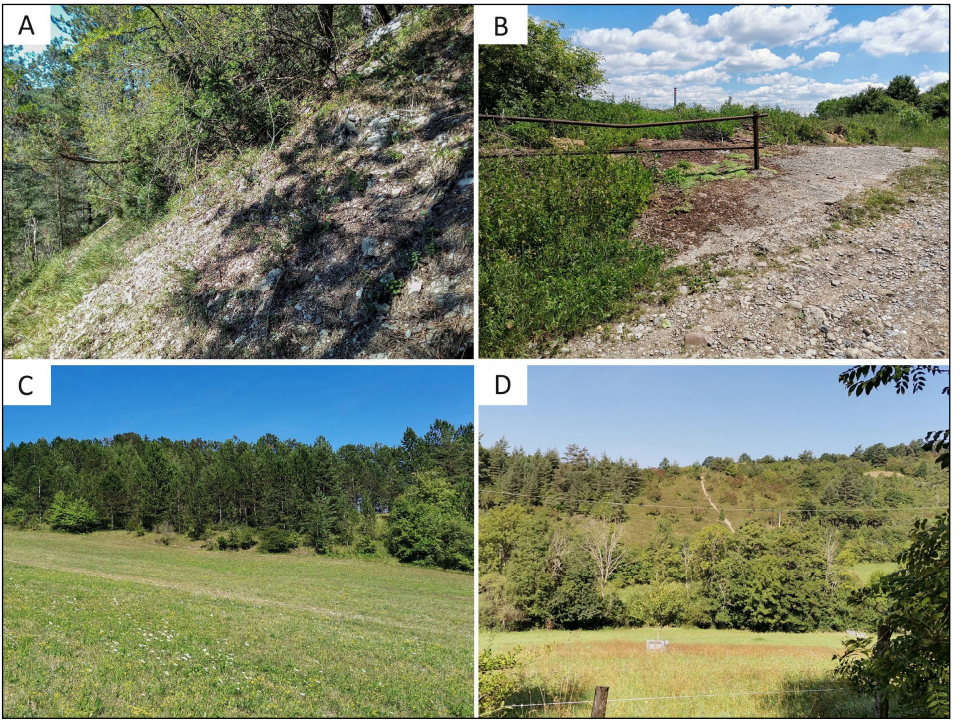

Fig. 2. Biotopes at study sites. **A:** Forest clearing on a steep hillside – habitat of *Camponotus piceus* and *Plagiolepis pygmaea*. Photo: September 2019. **B:** Older concrete surface with limited vegetation, and gravel-sand of a country road – habitat of *Tetramorium immigrans*. Photo: June 2022. **C:** Forest-steppe in succession stage – habitat of *Tetramorium caespitum*, *Camponotus aethiops*, and *Formica gagates*. Photo: July 2022. **D:** Forest-steppe with xerothermophilous grasslands on a steep hillside, and adjacent pasture in lowland of a stream. Photo: September 2023.

21) 350; 49.1445°,18.2706°; Javorníky; Dohňany; S oriented slope of a hill. Subsoil: limestone. Light *Pinus sylvestris* forest with larger stones surpassing the ground surface.

22) 422; 49.1443°,18.2656°; Javorníky; Dohňany; SW to SE facing and very steep slope and upper-situated less steep area. Subsoil: limestone. Rocky hill with xerothermophilous grass-herbal vegetation.

23) 350; 49.1439°,18.3026°; Javorníky; Ihrište; Subsoil: unknown. *Tilia* stands in shaded forest area.

24) 300; 49.1394°,18.2895°; Javorníky; Dohňany; E oriented slope of an uphill. Subsoil: sandstone. Small area in proximity of a little-used country road where occurs occasional stones on the ground surface.

25) 645; 49.1366°,18.2509°; Biele Karpaty; Dohňany; Upper-situated area. Subsoil: sandstone. The crest of a hill containing a country road and its surrounding – mixed forest, and grass areas made up after forest logging. Semi-shaded area.

26) 276; 49.1343°,18.2938°; Biele Karpaty; Vieska-Bezdedov; Subsoil: unknown. Agricultural and mowed grass areas with single older deciduous trees close to the river.

27) 456; 49.1335°,18.2810°; Biele Karpaty; Vieska-Bezdedov; Upper-situated area. Subsoil: limestone. Top of a rocky hill with much rock on the surface and occasional xerothermophilous grass-herbal vegetation.

28) 280; 49.1333°,18.2932°; Biele Karpaty; Vieska-Bezdedov; Subsoil: unknown. Edge of deciduous forest with many native rocks on the ground surface (a natural part of this site), and adjacent tree-free area with human-brought gravel and other geological material, also railway embankment. Partially ruderal area disturbed by human activities.

29) 301; 49.1298°,18.2972°; Biele Karpaty; Vieska-Bezdedov; Subsoil: claystone. Pasture with lower grass-herbal vegetation cover.

30) 300; 49.1259°,18.2992°; Biele Karpaty; Vieska-Bezdedov; SE facing slope of a hill. Subsoil: sandstone. *Pinus sylvestris* forest clearings with grass-herbal vegetation cover.

31) 422; 49.1248°,18.2893°; Biele Karpaty; Púchov; S to SE slope. Subsoil: limestone. Abandoned overgrown quarry with stones on the surface, and small clearing.

32) 344; 49.1245°,18.3109°; Javorníky; Púchov; S facing slope. Subsoil: limestone. Abandoned quarry with many stones, primarily overgrown with shrubs, but areas with grass-herbal vegetation cover exist.

33) 277; 49.1218°,18.3035°; Biele Karpaty; Púchov; Subsoil: unknown. Old *Acer* stands with much dead bark on their trunks.

34) 302; 49.1203°,18.3028°; Biele Karpaty; Púchov; Subsoil: unknown. Older apple tree stands in a row, which are extensively managed.

35) 312; 49.1200°,18.2895°; Biele Karpaty; Streženice; Subsoil: unknown. Edge of mixed forest.

36) 367; 49.1194°,18.2992°; Biele Karpaty; Púchov; S to SW facing slope of a hill. Subsoil: sandstone. Surrounding approximately 350 meters long little used country road going approximately in line with the hill's ridge. There are edges of *Pinus sylvestris* forest (including older stands) and southwards-situated originally steppe area affected by succession process, afforestation, and forest development (Fig. 3A).

37) 324; 49.1193°,18.2940°; Biele Karpaty; Púchov; S facing slope of a hill. Subsoil: limestone. Extensively managed grass-herbal area with fruit trees and forest ecotone (*Pinus sylvestris*).

38) 320; 49.1193°,18.2919°; Biele Karpaty; Púchov; S facing slope of a hill. Subsoil: limestone and sandstone. Mixed forest (also with some older *Quercus* stands), surroundings of a little-used country road containing bare soil surfaces, and forest edge. Area with stones on the ground surface.

39) 306; 49.1190°,18.2915°; Biele Karpaty; Púchov; Subsoil: unknown. Mowed grass area.

40)306; 49.1186°,18.3047°; Biele Karpaty; Púchov; Subsoil: unknown. Managed and overgrown orchards.

41) 320; 49.1180°,18.3002°; Biele Karpaty; Púchov; S facing slope of a hill. Subsoil: sandstone. Mixed forest with occasional clearings.

42) 297; 49.1176°,18.2935°; Biele Karpaty; Streženice; Subsoil: unknown. Garden with young fruit trees and mowed grass area.

43) 280; 49.1162°,18.3012°; Biele Karpaty; Púchov; Subsoil: unknown. Little-used country road and its surrounding containing mowed grass area, shrub growths, and dead wood of old trees.

44) 276; 49.1160°,18.3007°; Biele Karpaty; Streženice; Subsoil: unknown. Surrounding of a small stream where are young tree stands and shrubs.

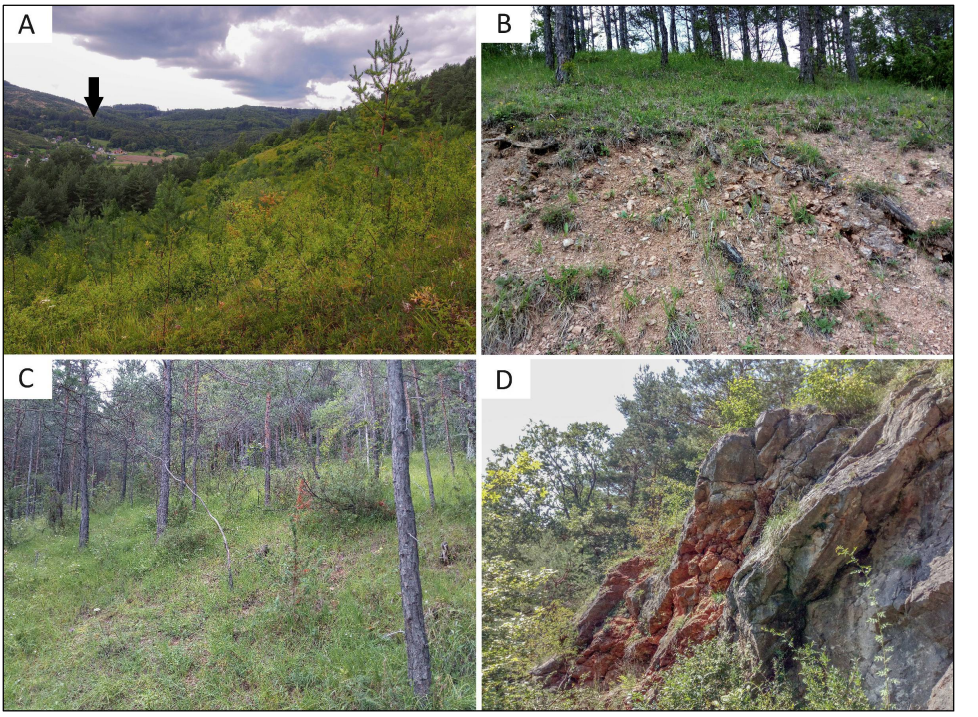

Fig. 3. Biotopes at study sites. **A:** Forest-steppe in succession stage with lots of shrubs and young forest stand. Photo: August 2017. **B:** Mostly bare surface of rocky soil – habitat of *Tetramorium moravicum*. Photo: May 2018. **C:** Young *Pinus sylvestris* forest and grass-herbal undergrowth on rocky soil – habitat of *Lasius paralienus*, *Ponera testacea*, and *Temnothorax interruptus*. Photo: August 2018. **D:** Bare rocky surfaces – habitat of *Temnothorax nigriceps*. Photo: August 2018.

45) 281; 49.1159°,18.3055°; Biele Karpaty; Púchov; S slope and E very steep slope. Subsoil: limestone. Small forest-steppe area with xerothermophilous grass-herbal vegetation, also with stones on the surface. Detected floral species are *Corylus avellana*, *Pinus sylvestris*, *Robinia pseudoacacia*, and *Ophrys apifera*.

46) 427; 49.1155°,18.2784°; Biele Karpaty; Streženice; N facing slightly steep slope. Subsoil: sandstone. Approximately 15-year-old mixed forest with much dead wood after logging but also with remains of older spruce stands. Forest road for logging mechanisms and tourists (Fig. 3A – the arrow).

47) 290; 49.1154°,18.3304°; Považské podolie; Púchov; Subsoil: unknown. Light *Tilia* stands at a cemetery.

48) 479; 49.1139°,18.2613°; Biele Karpaty; Horná Breznica; Subsoil: unknown. Spruce monoculture within an intensively managed forest.

49) 494; 49.1138°,18.2170°; Biele Karpaty; Lednica; S facing slope of a hill. Subsoil: limestone. Stony biotope with much larger rocks, xerothermophilous grass-herbal vegetation, and shrubs.

50) 274; 49.1132°,18.3053°; Biele Karpaty; Streženice; E very steep slope. Subsoil: limestone. Forest-steppe with xerothermophilous grasslands and occasional stones on the ground surface.

51) 264; 49.1128°,18.3058°; Považské podolie; Streženice; Subsoil: unknown. Small area with grasslands and occasional fruit trees in proximity of a road.

52) 334; 49.1128°,18.3033°; Biele Karpaty; Streženice; S to SE slope of a hill. Subsoil: limestone and sandstone. Overgrowing forest-steppe with many stones on the ground surface. Small areas with xerothermophilous grasslands exist.

53) 466; 49.1123°,18.2163°; Biele Karpaty; Lednica; Subsoil: limestone. Pasture with low and sparse xerothermophilous grass-herbal vegetation cover, shrubs, and occasional stones on the ground surface.

54) 260; 49.1109°,18.3113°; Považské podolie; Streženice; Subsoil: unknown. *Tilia* stands on a riverside.

55) 334; 49.1103°,18.3000°; Biele Karpaty; Streženice; SE slope of a hill. Subsoil: limestone. Forest-steppe with many stones on the ground surface.

56) 302; 49.1099°,18.3027°; Biele Karpaty; Streženice; W slope of a hill. Subsoil: limestone. Overgrowing forest-steppe with xerothermophilous grasslands partially covered with rocky grounds. Partially afforested with *Pinus nigra* (Fig. 2C).

57) 369; 49.1091°,18.2861°; Biele Karpaty; Streženice; Subsoil: unknown. Wetland with a flowing spring in non-forest.

58) 391; 49.1076°,18.2829°; Biele Karpaty; Streženice; Subsoil: unknown. Wetland with a flowing spring in non-forest.

59) 358; 49.1071°,18.2854°; Biele Karpaty; Streženice; Subsoil: unknown. Small stream and its surrounding deciduous stands which border with mowed grass areas.

60) 361; 49.1065°,18.2856°; Biele Karpaty; Streženice; Subsoil: unknown. Wetland in non-forest.

61) 326; 49.1048°,18.2923°; Biele Karpaty; Streženice; SE slope of a hill. Subsoil: claystone and limestone. Forest-steppe with stones on the ground surface and partially with rocky soils. Dominant tree species is *Pinus sylvestris*. *Juniperus communis* is

abundantly present among the bushes. The site is partially influenced by rock mining in the past, and a country road crosses it (Fig. 3B, C).

62) 267; 49.1042°,18.3065°; Považské podolie; Streženice; Subsoil: unknown. Older concrete surface containing gaps with soil and vegetation humus, partially covered with grass-herbal vegetation. Ruderal biotope disturbed by human activities (Fig. 2B).

63) 267; 49.1041°,18.3063°; Biele Karpaty; Streženice; Subsoil: unknown. Older concrete surface containing gaps with soil and vegetation humus, partially covered with grass-herbal vegetation. Also, side of a country road. Ruderal biotope disturbed by human activities (Fig. 2B).

64) 393; 49.1027°,18.2995°; Biele Karpaty; Streženice; Subsoil: unknown. Extensively managed pasture with older solitary trees.

65) 382; 49.0996°,18.2845°; Biele Karpaty; Streženice; S facing hillside with a fine slope. Subsoil: limestone. Light deciduous forest with much rocks on the ground surface.

66) 433; 49.0979°,18.2975°; Biele Karpaty; Streženice; Subsoil: limestone. Abandoned quarry with shrubs and much rocks on the ground surface.

67) 252; 49.0959°,18.3117°; Považské podolie; Streženice; Subsoil: unknown. Riverside with non-forest vegetation, and gravel-sandy soils. Ruderal area disturbed by flooding and human activities consisting of moving the soils.

68) 469; 49.0957°,18.2986°; Biele Karpaty; Streženice; Upper-situated area. Subsoil: limestone. Top of a rocky hill with much of the rock on the surface and occasional xerothermophilous grass-herbal vegetation.

69) 446; 49.0915°,18.2932°; Biele Karpaty; Horenice; S facing slope. Subsoil: limestone. Abandoned quarry with many stones, partially overgrown with shrubs and trees, and with the presence of xerothermophilous grass-herbal vegetation cover (Fig. 3D).

70) 408; 49.0902°,18.2790°; Biele Karpaty; Medné; SE facing slope of a small hill. Subsoil: limestone. Stony place where is located a small clearing in surrounding of a developing forest.

71) 320; 49.0871°,18.2904°; Biele Karpaty; Horenice; S facing steep hillside. Subsoil: limestone. Small xerothermous area with grass-herbal vegetation cover in the vicinity of a forest.

72) 416; 49.0842°,18.2794°; Biele Karpaty; Medné; SE facing slope of a hill. Subsoil: limestone. Stony place overgrown with bushes in surrounding of a developing forest.

73) 369; 49.0841°,18.2821°; Biele Karpaty; Medné; Subsoil: limestone. Area of a few square meters, where are occasional above-ground larger stones, grass-herbal vegetation cover, and shrubs.

Description of methods and material processing

The altitudinal data come from the map layer of relief model DMR 5.0 accessed via the web GIS client (https://zbgis.skgeodesy.sk/); they refer to Baltic heights after adjustment (1957). The positional coordinates (latitude,longitude) refer to the EPSG:4326 coordinate reference system. Naming, classifying, and boundaries of the geomorphological units (all kinds of units) follow KOČICKÝ & IVANIČ (2011). The terms Biele Karpaty Mts, Javorníky Mts, and Považské podolie Val. are considered as the Biele Karpaty geomorphological unit, the Považské podolie

geomorphological unit, and the Javorníky geomorphological unit, respectively, in whole paper.

The field study took place from 2014 to 2024. At the study sites, individuals and nests were searched for by routine field inspection, which consisted of browsing vegetation cover, vegetation humus, soil surfaces, tree trunks, stony surfaces, rock crevices, and upper soil layer. To reach some poorly accessible places, such as cavities in the rock, under bark, nest parts in stony ground, or soil under deeply embedded stones, a geological hammer, and other equipment were necessary to deploy (FI – field inspection). Individuals collected directly in the field were moved into a transport container using a manual or electronic exhaustor, tweezer, brush, or simply with hands. Litter sifting (LS) and pitfall traps (PT) were also used to collect material. The sifted material was processed to extract the individuals – it was browsed manually under light, or a Tullgren funnel was used. Pitfall traps were exposed at three study sites during the vegetation seasons – n. 36, n. 45, and n. 52 in year(s) 2018; 2018, 2021, 2022, 2023; and 2018, respectively. These traps were using containers which had input diameter 3.5 cm, volume 40 ml, and cylindrical shape (years 2018, and 2021), or containers which had input diameter 7 cm, and volume 300 ml (years 2022, and 2023). Fixing liquid consisted of a solution of 2% formaldehyde. All the study sites were attempted to be investigated thoroughly, however, not the same effort was put into all of them. Single findings outside them (the systematic survey was not conducted at these places) that fall under the overall area of investigation may also be included in the results. The determinations of specimens followed primarily keys by SEIFERT (2018). Keys and descriptions of Kutter (1977, 1978), SEIFERT (1983), CZECHOWSKI et al. (2012), SALATA & BOROWIEC (2013), and WAGNER et al. (2017) were used too. All the determinations were conducted by the author (some of them were reviewed). The used nomenclature follows SEIFERT (2018) and other recent studies (CSŐZS et al. 2023, 2024, KIRSCHNER et al. 2023), which do not contradict each other. Some of the specimens were integrated into the author's collection, and some of them were provided to other myrmecologists, i.e., Dr. Bernhard Seifert, Petr Werner, and Dr. Adrián Purkart. Camera lens Olympus M.ZUIKO DIGITAL ED 30mm f/3.5 was used to take Figs 3A, 5A–C, 7B, C, 8, 9B, 11B, C. Figs. 5D, 6B–D, 7D, 9C, D, 10, 11A, D, 12 were taken using a super macro camera lens Yasuhara Nanoha x5. Figs 5D, 6B–D, 7D, 9C, D, 12 were focus-stacked using Helicon Focus software (version 8.1.0) from focus-bracketed photos taken with that lens and Olympus STF-8 macro flash. Multiple pictures composed into a single figure are ordered chronologically from right to left, based on the dates of their creation. All photos were taken by the author.

For each species, faunistic data gathered during the survey are provided (Data), facultatively are present the additional data (Additional finding(s)) and the main notes. The Data contain chronological records which are ordered and

structured as follows: date of collection (format "DD.MM.YY"), ID of site, collecting method, number of captured individuals for each caste (w(w) – worker(s), g(g) – gyne(s), and m(m) – male(s)), and facultatively a short note. If the method is individual one (FI), then the collection is from a single ant colony, if it is not mentioned otherwise. Moreover, the FI collection originates directly from a single nest or close nest(s)'s surroundings, if it did not contain only sexual individuals. The short note can be of various character, e.g., a note regarding determination or a note on the circumstances of the finding. The Additional findings are structured similarly to the Data, except for sites that do not exist, so there are listed coordinates and geomorphological units instead.

RESULTS AND DISCUSSION

Dolichoderinae

Bothriomyrmex corsicus Santschi, 1923

Data: 05.06.14, 52, FI, 110 ww, colony nesting in rocky soil; 12.06.18–30.07.18, 45, PT, 1 g.

Dolichoderus quadripunctatus (Linnaeus, 1771)

Data: 17.11.18, 37, FI, 1 g, nested and establishing a new colony (without workers); 05.05.19, 59, FI, 20 ww.

Tapinoma erraticum (Latreille, 1798)

Data: 14.08.17, 38, FI, 100 ww, 1 g; 15.03.18, 36, FI, 10 ww; 07.08.18, 27, FI, 1 w; 11.08.18, 68, FI, 3 ww, unknown whether from a single colony; 19.08.18, 22, FI, 1 w; 30.08.18, 32, FI, 5 ww; 16.09.18, 50, FI, 4 ww, unknown whether from a single colony; 18.04.19, 61, FI, 1 w; 21.04.19, 16, FI, 2 ww, unknown whether from a single colony; 16.07.19, 4, FI, 5 ww; 23.07.19, 29, FI, 1 w; 06.08.19, 20, FI, 3 ww, 5 gg; 17.05.20, 14, FI, 1 w; 15.07.20, 19, FI, 1 w; 28.06.21, 18, FI, 10 ww; 13.08.21, 15, FI, 4 ww, 1 g; 14.06.21–22.08.21, 45, PT, 15 ww; 02.10.21, 6, FI, 1 w; 25.06.22, 10, FI, 5 ww; 28.06.22, 2, FI, 1 w; 02.07.22, 66, FI, 20 ww; 05.07.23, 21, FI, 1 w; 26.05.24, 42, FI, 1 g, after dispersal.

Tapinoma subboreale Seifert, 2011

Data: 16.07.19, 4, FI, 2 gg, unknown whether from a single colony, after dispersals (?).

The gynes were found during a single visit at the site; they were actively moving on the ground surface, and both were found up to 5 metres from each other. Their small abdomens and the late date when they were found compared with the known swarming period (SEIFERT 2018) suggest that they were not found immediately after their nuptial flights. Most likely, they were already establishing new colonies and left their mother chambers due to a lack of nutrition or

disturbances. Such finding suggests the occurrence of their mother colony/colonies at the site. Targeted attempts to find a nest or workers failed; only the *T. erraticum* was found there.

Formicinae

Camponotus aethiops (Latreille, 1798)

Data: 27.07.17, 52, FI, 5 ww, 2 mm; 27.08.18, 61, FI, 1 w; 17.03.19, 52, FI, 5 ww; 13.04.19, 52, FI, 10 ww; 18.04.19, 61, FI, 5 ww; 21.04.20, 16, FI, 2 ww; 06.08.20, 20, FI, 1 w; 18.08.20, 18, FI, 3 ww, 3 gg; 03.03.21, 56, FI, 2 ww; 28.06.21, 56, FI, 30 ww; 26.03.22, 71, FI, 8 ww; 17.06.22, 46, FI, 3 ww; 25.06.22, 10, FI, 3 ww; 26.06.22, 13, FI, 1 w.

Camponotus fallax (Nylander, 1856)

Data: 25.04.20, 59, FI, 10 ww, 1 g, 1 m; 23.06.23, 37, FI, 20 ww.

Camponotus herculeanus (Linnaeus, 1758)

Data: 24.08.17, 46, FI, 1 w; 04.10.17, 45, FI, 1 w; 03.07.18, 46, FI, 11 gg, unknown whether from a single colony, after dispersal; 14.08.21, 46, FI, 7 ww, unknown whether from a single colony.

Camponotus ligniperda (Latreille, 1802)

Data: 22.08.17, 36, FI, 4 ww; 08.07.18, 52, FI, 20 ww; 30.03.19, 14, FI, 1 w; 08.09.19, 38, FI, 15 ww; 14.09.19, 5, FI, 2 ww; 10.09.21, 61, FI, 4 ww; 25.06.22, 10, FI, 7 ww; 05.05.23, 37, FI, 1 w; 18.05.23, 13, FI, 3 ww.

Camponotus piceus (Leach, 1825)

Data: 12.04.18, 45, FI, 4 ww; 23.05.18, 61, FI, 2 ww, unknown whether from a single colony; 11.08.18, 68, FI, 7 ww, 1 m; 19.08.18, 22, FI, 2 ww; 14.04.19, 45, FI, 5 ww, 4 mm; 18.04.19, 61, FI, 2 ww, unknown whether from a single colony; 21.04.19, 16, FI, 10 ww; 06.08.19, 20, FI, 1 w; 17.08.19, 20, FI, 5 ww, 3 gg; 14.09.19, 5, FI, 2 ww; 09.05.20, 56, FI, 10 ww; 15.07.20, 19, FI, 1 ww; 18.08.20, 18, FI, 1 w; 28.06.21, 18, FI, 1 w; 26.03.21, 71, FI, 11 ww; 29.05.21, 10, FI, 1 ww; 26.06.22, 13, FI, 1 ww; 05.07.23, 21, FI, 1 w.

The site n. 5 represents the northernmost known distributional point so far in the Slovak Republic (ZÁLESKÝ 1939, BELÁKOVÁ 1956, DRDULOVÁ & ZLATOŠOVÁ 1980, KOŽÍŠEK 1986, KOŽÍŠEK 1989, DRDULOVÁ 1991, BEREC 1997, AMBROS et al. 1998, DEVÁN 2005, DEVÁN 2006b, WIEZIK 2007, DEVÁN 2008a, b, c, WIEZIK 2008a, c, WIEZIK et al. 2010, WIEZIK & WIEZIKOVÁ 2012, SUVÁK 2021, JANCÍK & PURKART 2024, MARKO et al. 2024, JANCÍK, PURKART, unpub. data).

Camponotus vagus (Scopoli, 1763)

Data: 19.08.18, 46, Fl, 1 w; 21.04.19, 16, Fl, 1 w, 2 gg; 08.06.21, 43, Fl, 30 ww; 09.06.21, 43, Fl, 7 ww; 14.08.21, 46, Fl, 35 ww; 14.08.21, 46, Fl, 10 ww.

Four colonies were discovered at the site n. 46. A unique situation occurred there – a colony of this thermophilous species and a colony of *C. herculeanus* were nesting in proximity of tens meters. It is an example of the penetration of a thermophilous species into the mountains of Biele Karpaty Mts, where it met with an oligothermic one. Such a situation is characteristic for hills in Biele Karpaty Mts and was already understood by BEZDĚČKA (1992).

Colobopsis truncata (Spinola, 1808)

Data: 18.11.18, 37, Fl, 20 ww; 17.03.19, 36, Fl, 10 ww, 1 g; 16.04.20, 59, Fl, 10 ww.

Formica cinerea Mayr, 1853

Data: 24.03.19, 67, Fl, 45 ww.

Formica cunicularia Latreille, 1798

Data: 06.05.22, 42, Fl ,30 ww; 06.07.22, 11, Fl, 4 ww.

Formica exsecta Nylander, 1846

Data: 16.07.17, 39, Fl, 1 g, after dispersal, fully winged, at 14:07h.

The gyne was transported into the laboratory to potentially start its laboratory keeping (Fig. 4). Attempts to find colonies of this species were unsuccessful. Suitable micro-localities with extensive pasture existed a few hundred meters away. Unfortunately, these were private and inaccessible plots of land. The gyne's mother nest probably occurred within either these sites or within the broader area of the Biele Karpaty Mts. Populations of this species declined across its distributional range during the past decades due to intensified land use (SIEFERT 2018). The second known largest polydomous supercolony in the Europe was found in the Slovak Republic (WIEZIK et al. 2017). Several sites with confirmed occurrences are known so far within the Biele Karpaty Mts – 48.8949°,17.7991° (Natural Monument Grúň), 49.0399°,18.1557° (Natural Reserve Drieňová), 48.9698°,17.9486° (Natural Monument Včelíny), 48.8189°,17.4398° (Natural Monument Bučkova Jama), and 49.0588°,18.1369° (Natural Monument Krivoklátske lúky) (DEVÁN 2009c).

Formica fusca Linnaeus, 1758

Data: 11.04.20, 58, Fl, 3 ww; 01.05.21, 36, Fl, 3 ww; 05.11.21, 72, Fl, 10 ww.

Fig. 4. The gyne of *Formica exsecta* in an interaction with a callow "host" worker of *Formica rufibarbis* after they were put together into a keeping facility. The gyne carries subgenus-specific notched vertex of head, what is in contrast with the worker which it has roundly shaped. Photo: July 2017.

Formica gagates Latreille, 1798

Data: 06.04.19, 36, FI, 40 ww; 21.03.20, 36, FI, 8 ww; 22.03.20, 37, FI, 80 ww; 03.03.21, 56, FI, 2 ww; 06.04.21, 37, FI, 40 ww; 14.06.21–22.08.21, 45, FI, 15 ww; 07.07.22, 45, FI, 4 ww, 4 gg, 6 mm; 17.04.23, 38, FI, 4 ww.

Discovered nests had always above-ground mounds consisting of soil particles and dry pieces of herbs. The mounds had diameters of its bases from 25 to 40 cm and heights from 10 to 25 cm. Some of the colonies also had their chambers located under stones. Numerous records are available from the Slovak Republic (Petricskó 1892, Mocsáry 1897, Chyzer 1902, Záleský 1939, Sadil 1953, Belláková 1956, 1961, Labuda 1970, Drdulová 1979, 1991, Kožíšek 1986, Randuška 1995, Ambros et al. 1998, Holecová et al. 2003, Deván 2005, 2006a, b, c, 2007, 2008a, c, 2009a, b, Wiezik 2007, 2008a, b, c, Wiezik & Wieziková 2007, 2012, Deván 2008, Majzlan & Deván 2009, Wiezik et al. 2010, Purkart 2016, 2017, 2018, 2020, 2023a, Červená et al., 2018, Červená et al. 2020, Pavlíková 2020, Suvák 2021, Marko et al. 2024). The northernmost known distributional point of this species

in the Slovak Republic was near the town Púchov (LABUDA 1970) at 49.13° (latitude), however, it was not considered by SEIFERT (2018), who mentioned the northernmost sites at "48.2°N". This species was not confirmed for the Labuda's site during the time of this survey, and most probably has disappeared from there due to the habitat change.

Formica polyctena Förster, 1850

Data: 15.07.18, 48, FI, 30 ww, polydomous colony with at least 15 nests; 16.04.19, 31, FI, 60 ww.

Formica pratensis Retzius, 1783

Data: 22.08.17, 36, FI, 6 ww, 2 mm; 13.01.18, 50, FI, 10 ww; 25.01.18, 36, FI, 11 ww.

Formica rufa Linnaeus, 1761

Data: 30.04.21, 40, FI, 90 ww.

Formica rufibarbis Fabricius, 1793

Data: 30.03.18, 42, FI, 2 ww; 24.04.21, 36, FI, 20 ww.

Formica sanguinea Latreille, 1798

Data: 24.08.17, 46, FI, 20 ww; 06.07.18, 36, FI, 10 ww.

Formica truncorum Fabricius, 1804

Data: 23.07.17, 38, FI, 1 g, after dispersal, wingless; 25.05.18, 43, FI, 1 g, after dispersal, wingless, at 17:45h; 27.05.18, 43, FI, 1 g, after dispersal, wingless; 19.07.20, 3, FI, 6 ww; 14.08.21, 46, FI, 60 ww, 1 m.

The gyne, which was found as the first one at the site n. 43, was put under laboratory conditions to simulate the natural process of establishing a new colony of this temporally socially parasitic species. It was assigned a few dozen pupae of *Formica fusca* workers from a foreign colony and fed by sugar water (JANCÍK & DISNEY 2020). Some of the pupae were eaten by the gyne a few days after installation of the laboratory keeping (JANCÍK & DISNEY 2020). This observation represented unusual behaviour, compared with a few (4) similar situations when the colony-establishing gynes did not eat the pupae (JANCÍK, unpub. data). The keeping revealed that the gyne was infested by a brood of a parasitic fly species. These flies in the developmental stage of larva were eating nutrients from the inner of the gyne, possibly explaining the eating of the pupae. These larvae emerged from the gyne (from an unknown body part), pupated quickly, and later reached the adult stage. Adults were taken from the keeping

facility and subsequently investigated by R. H. L. Disney, resulting in description of the species *Aenigmatias exreginae* Jancík & Disney, 2020 (Diptera, Phoridae) (JANCÍK & DISNEY 2020). The gyne laid its first egg on June 24, 2018, but another freshly emerged larva of the parasitic fly appeared on June 27. Therefore, the ability to lay eggs was not prevented by the presence of the parasite in the gyne's body. The gyne survived this infestation, was even able to lay eggs, and successfully created first generation of workers.

Lasius alienus (Förster, 1850)

Data: 11.03.18, 36, FI, 8 ww; 08.07.18, 52, FI, 5 ww; 14.10.18, 14, FI, 10 ww; 20.10.18, 14, FI, 20 ww; 16.03.19, 52, FI, 8 ww; 21.04.19, 16, FI, 14 ww; 22.04.19, 17, FI, 5 ww; 10.03.20, 32, FI, 10 ww; 15.08.20, 68, FI, 10 ww; 15.09.20, 9, FI, 5 ww, 5 mm; 24.04.21, 36, FI, 30 ww; 30.06.21, 52, FI, 20 ww; 13.08.21, 15, FI, 10 ww, 2 mm; 03.10.21, 36, FI, 30 ww; 07.08.22, 52, FI, 1 g, after dispersal and nested.

Lasius bicornis (Förster, 1850)

Data: 09.05.16, 42, FI, 1 g, after dispersal, fully winged, at 9:26h; 11.05.21, 42, FI, 1 g, after dispersal, wingless, at 9:02h; 01.05.24, 35, FI, 1 g, after dispersal, fully winged, at 9:21h.

This species is little known (SEIFERT 2018). There are few findings from the Slovak Republic, most of them refer to catches of alates after their dispersals (MOCSÁRY 1897, CHYZER 1902, https://www.antweb.org – specimen CASENT0280461, KOŽÍŠEK 1985a, 1989, DEVÁN 2006b, WIEZIK 2008b, KLESNIAKOVÁ et al. 2016, PAVLÍKOVÁ 2020, JANCÍK, PURKART, unpub. data).

Species was found three times; each time, they were gynes after dispersals. Targeted attempts to find nests or workers failed. When a suitable habitat was found, only different ant species were discovered in proximity to trees – *L. brunneus*, *L. fuliginosus*, or *L. umbratus*, or even no ant species of that genus. Findings of single gynes at sites n. 42 (in years 2016, and 2021), and n. 35 (in the year 2024) do not confirm this species for these sites in the sense of colony occurrence. The nests or workers were not found at these sites after thorough searches, therefore, their mother colonies (or single colony) probably existed outside them. The sites' surroundings of diameter 1 km included many older solitary trees (mostly fruit ones) located within private gardens, representing suitable habitats for this species (SEIFERT 2018). The gynes probably dispersed from there, or from more distant places within the Biele Karpaty Mts.

Laboratory keeping was used to find out more about the biology of this cryptic species. The gynes collected in the years 2021 and 2024 were used for this purpose. Since having gynes of socially parasitic species at the time immediately after their dispersals, the most complicated activities during the laboratory keeping are required at its beginning – establishing of a new colony. This involves

establishing a friendly relationship between the gyne and host colony members. It is unknown what host species is used in the nature, but *L. brunneus* is the presumed host because it shares the same habitat (SEIFERT 2018). It is also unknown whether the parasitic gyne is capable of taking over the queen-right host colony, or only orphaned colony (GIEHR et al. 2019).

The gyne found in 2021 (Fig. 5A, D) was assigned 15 adult workers originated from a queen-right colony of *L. brunneus*. Establishing the relationship was not successful, and the gyne suffered much harm from non-kin workers. Therefore, the laboratory keeping was terminated.

Keeping of the gyne found in 2024 firstly required signs of its fertility since it was found as a fully winged individual, indicating that it may not have been mated, and if this was true, then the keeping would be irrelevant. It was offered with sugar water, and the gyne accepted it immediately after it was placed in the laboratory conditions. To find out the fertility signs, the gyne was put on an open surface and exposed to strong light. It was not trying to fly off, instead it was trying to put off its wings using the hind legs. This was the sign that it was mated, so that the keeping started. Gyne needed the host workers, but to avoid the mistake of 2021, these workers had to be freshly hatched when they lacked "loyalty" to their mother colony. Based on the experience of ant-keeping hobbyists, such workers, combined with pupae of other workers from the same colony, are considered an ideal mixture to help the gyne smoothly establish its own colony. This material was not available immediately after the gyne was incorporated in the laboratory. Therefore, it was supplied with *Lasius brunneus* adult (not freshly hatched) workers from a foreign queen-right colony. Only four individuals were used, fewer than in 2021, and they were added to the gyne one by one at hourly intervals. The gyne was attacked by these workers, and it lost part of its funiculus. When one of the four workers was bitten into the gyne for more than 10 seconds, the gyne simply killed the worker by its mandibles (one worker was added afterward). Gyne was observed to antennate a worker's body surface, and then it rubbed its antennae with forelegs, which subsequently rubbed with mandibles, and the thorax. On May 2, 2024 – the second day in the laboratory, the gyne appeared to be stable, located in proximity of the "host" workers, and all the individuals seemed to be calm. The activity of adding the four workers aimed to increase the chance that the gyne survive until a freshly hatched workers and pupae were available. It is likely that gynes of most of the *Chthonolasius* species – which do not use the low-temperature strategy for the colony penetration (SEIFERT 2018) – die within few days if they fail to get workers which would take care about them since their body reserves are poor. This behaviour was observed for *Lasius umbratus* (Nylander, 1846) (JANCÍK, unpub. data). The gyne was fully winged on May 2, 2024; its attempts to put off wings did not lead to success. That day, they were put off manually because the gyne

could stick to the surface within the keeping facility, which could potentially cause its death. Freshly hatched workers and pupae from a foreign colony of *L. brunneus* (Poland) were available on May 9, 2024, and were continuously added to the current keeping from that day till May 14, 2024, when the laboratory keeping contained the gyne, approximately 100 adult workers, and about 250 pupae.

Gyne was observed to produce one of its first eggs on May 20, 2024. The new colony contained at least 300 eggs on May 31, 2024. That time, the queen was physogastric during the period of depositing its eggs, what can be well compared with the other gyne, at a time after dispersal (Fig. 5A, B). Unexpectedly, the queen died between June 4, and June 5 as strongly physogastric (Fig. 5C). It was found motionless in a chamber of the artificial nest, being in proximity of host workers which were taking care of it. The cause of its death was unknown; generally, probably physogastric gynes are susceptible to any negative influences that are causing their deaths. One similar case was observed with queen of

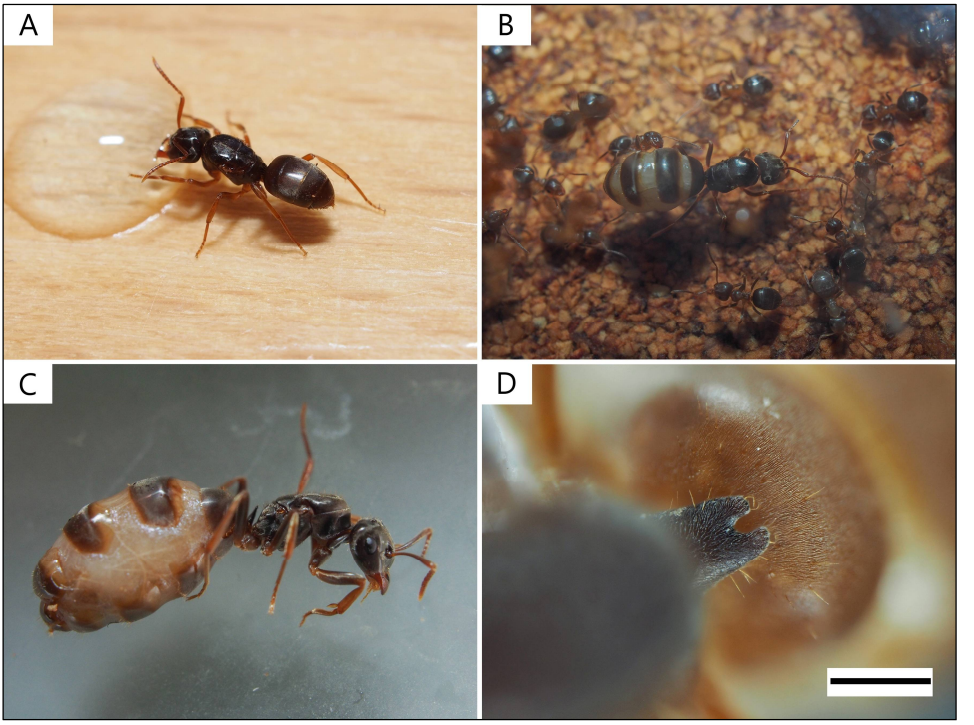

Fig. 5. Two gynes of *Lasius bicornis* – **A, D:** gyne found in the year 2021, **B, C:** gyne found in the year 2024. **A:** Wingless gyne with small abdomen, being after dispersal, is drinking given sugar water. Photo: May 2021. **B:** Gyne in proximity of workers of *Lasius brunneus* in laboratory keeping. Photo: May 2024. **C:** Physogastric gyne several hours after its dead. Photo: June 2024. **D:** Frontal view of petiolus showing species-specific signs. Scale bar: 0.4 mm. Photo: August 2024.

Anergates atratulus (Schenck, 1852) (PURKART 2023b). The laboratory keeping was not terminated by this incident, but the queen was extracted and put into ethanol. Other colony members remained in the keeping facility, aimed to continue with the development of the first generation of *L. bicornis* individuals from the eggs. Colony contained exclusively larvae within all the brood on July 7, 2024. Workers were fed by sugar water, and proteins *ad libidum* from the May 9, 2024. Temperature conditions varied from 20°C to 30°C and mostly copied natural ones in place of finding of the gyne, during all the time of laboratory keeping. Disappearing of larvae and their slow growth was observed from the July 7 to August 11. No pupae were created till that day. The host workers continued to take care of this offspring after the queen died – fed it and protected it when there was any disturbance to the nest, as was observed during regular daily checks. The reason for either the defect development of the larvae or less-probably its killing by the workers (not observed) appears unknown. The laboratory keeping was terminated on August 18, 2024, containing only approximately 40 middle-sized larvae among the brood.

Lasius brunneus (Latreille, 1798)

Data: 01.08.17, 38, FI, 10 ww; 08.07.18, 52, FI, 5 ww; 26.06.22, 12, FI, 40 ww; 13.05.23, 37, FI, 5 ww; 01.05.24, 35, FI, 10 ww.

Lasius citrinus Emery, 1922

Data: 26.05.19, 42, FI, 1 g, after dispersal, fully winged, at 8:16h

Attempts to find nests or workers at study sites failed. The gyne was dispersed from its mother nest, which was probably located within the Biele Karpaty Mts, and probably not at the site where it was found. Known records from the Slovak Republic were partly summarised by MARKO et al. 2024, additional data were recorded by ZÁLESKÝ (1939), BEZDEČKA (1996a), DEVÁN (2006a, b, 2007, 2008a, b), MAJZLAN & DEVÁN (2009), WIEZIK & WIEZIKOVÁ (2010), PAVLÍKOVÁ (2020), and PURKART (2023a).

Lasius emarginatus (Oliver, 1792)

Data: 17.03.18, 52, FI, 20 ww; 17.03.18, 52, FI, 20 ww; 10.09.20, 36, FI, 5 ww.

Lasius flavus (Fabricius, 1782)

Data: 27.08.18, 61, FI, 5 ww; 14.04.19, 45, FI, 10 ww; 22.04.19, 17, FI, 5 ww; 12.05.20, 36, FI, 4 ww; 12.06.22, 42, FI, 4 ww; 28.06.22, 2, FI, 22 ww.

Lasius fuliginosus (Latreille, 1798)

Data: 26.09.17, 38, FI, 5 ww.

Lasius jensi Seifert, 1982

Data: 03.07.18, 46, FI, 1 g, after dispersal, wingless; 12.06.18–30.07.18, 36, PT, 2 gg; 14.06.21–26.07.21, 45, PT, 3 gg; 06.08.21, 36, FI, 1 g, after dispersal; 14.06.21–23.08.21, 45, PT, 1 g; 10.07.23, 51, FI, 1 g, after dispersal.

Targeted attempts to find a nest or workers (mainly on site n. 36) failed. Findings of 3 and 4 gynes after dispersals at sites n. 36, and n. 45, respectively, probably point to existence of their mother nests at these sites. This probability is increased by the fact that there were collected at least two gynes in a single pitfall trap at the latter site. The very first finding at the site n. 46 probably refers to dispersal from a more distant place (e.g., site n. 36) since no typical habitat existed there. Finding at the site n. 51 can refer to the existence of mother colony at the neighbour site n. 50, concluding from the habitats. Data of this study suggest this species to be the only *Chthonolasius* Ruzsky, 1912 species which inhabited xerothermophilous grasslands within the investigated area. This species was reported from a certain site within the Biele Karpaty Mts only once, excluding this study (BEREC 1997). Also, available records show that it was rarely found within the Slovak Republic in the past (BEREC 1997, WIEZIK 2008a, KLESNIAKOVÁ et al. 2016, PURKART 2016, PURKART 2020, 2023a, SUVÁK 2021, MARKO et al. 2024). However, more findings (and more localities) are known, mostly based on gynes after dispersals, from recent years (JANCÍK, PURKART, unpub. data). The site n. 36 represented the northernmost known distributional point of this species within the Slovak Republic.

Lasius mixtus (Nylander, 1846)

Data: 12.11.20, 40, FI, 7 ww; 02.04.21, 40, FI, 2 ww; 29.04.21, 40, FI, 20; 30.04.21, 40, FI, 20 ww, 19.09.24, 35, FI, 1 g, after dispersal, fully winged, at 10:20 h.

The gyne was found on the second day after a period of cold and rainy weather had ended, what corresponds with data known for this species (SEIFERT, 2018).

Lasius myops Forel, 1894

Data: 04.06.22, 52, FI, 300 ww; 12.06.22, 52, FI, 200 ww; 18.07.22, 52, FI, 20 ww; 18.07.22, 52, FI, 2 mm, males were pupae; 18.07.22, 52, FI, 3 gg, gynes were pupae; 18.07.22, 52, FI, 125 mm, males were pupae; 18.07.22, 52, FI, 140 mm, males were pupae; 27.08.22, 52, FI, 50 ww, 18 mm; 09.09.23, 52, FI, 24 ww, 4 gg, 2 mm.

All specimens originated from a single colony; if they were extracted as pupae, then they were put under laboratory conditions to develop into the adult stage. This species can be correctly determined by even 2 workers (SEIFERT 1983). The investigated colony was determined to species using each caste separately

– based on more than 30 workers, 2 gynes, and 30 males (Fig. 6), to maximize the reliability of the determination. Adult alates were present in the colony at the typical time following the known data (SEIFERT 2018). Colony members were extracted directly from the soil where they were nesting near a rock and in the rock crevices.

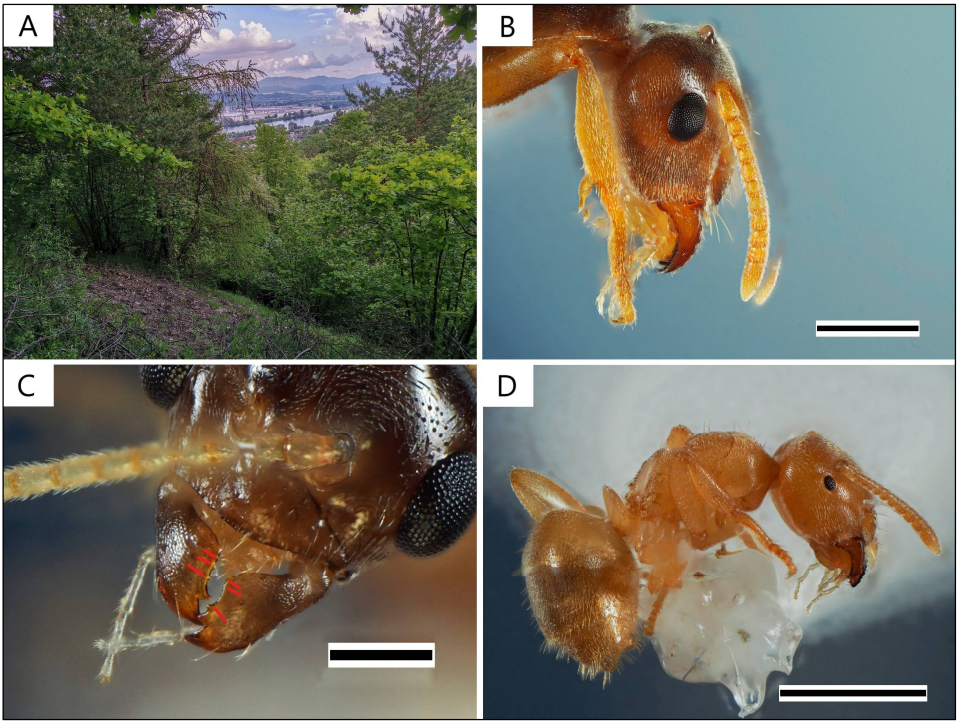

Fig. 6. Colony of *Lasius myops*. **A:** Nesting place (Váh river further in the photo). Photo: June 2022. **B:** Lateral view of gyne's head, showing yellowish coloration on its hind beyond eye. Scale bar: 0.7 mm. Photo: August 2024. **C:** Mandibles of male – masticatory borders carry apical and subapical (not highlighted) teeth and smaller teeth (highlighted). Scale bar: 0.2 mm. Photo: August 2024. **D:** Lateral view of a medium-to-big-sized worker. Scale bar: 1.0 mm. Photo: August 2024.

This species is rarely found in xerothermic places within the Central Europe (SEIFERT 2018). Also, it was rather rarely recorded within the Slovak Republic in the past (LABUDA 1970, KOŽÍŠEK 1986, DEVÁN 2006d (?), 2008, SUVÁK 2021, JANCÍK, PURKART, unpub. data). The site n. 52 represented the northernmost known distributional point of this species within the Slovak Republic. The record of DEVÁN (2006d) referring to a single worker could not be enough for precise determination (SEIFERT 1983). Therefore, it is considered unreliable, as far the specimen could be also the sister species – *L. flavus*. Furthermore, there was a finding of a single worker at the site n. 52 already on July 08, 2018. This worker

had signs of *L. myops,* but it was insufficient to confirm the species. Based on that record, subsequent thorough search for additional individuals (and the whole colony) was successful.

Lasius niger (Linnaeus, 1758)

Data: 16.07.17, 39, FI, 5 ww; 14.03.18, 44, FI, 25 ww; 05.04.21, 60, FI, 3 ww; 16.08.21, 23, FI, 5 ww; 05.11.21, 73, FI, 7 ww; 26.05.24, 62, FI, 10 ww.

Lasius paralienus Seifert, 1992

Data: 02.07.18, 61, FI, 3 ww; 27.18.18, 61, FI, 10 ww, 1 g, 2 mm; 22.09.18, 36, FI, 14 ww; 30.10.18, 61, FI, 60 ww, 1 g; 06.03.19, 55, FI, 10 ww; 07.03.19, 61, FI, 5 ww; 18.04.19, 61, FI, 10 ww; 17.03.20, 61, FI, 20 ww; 15.08.20, 36, FI, 120 ww; 10.09.20, 36, FI, 5 ww, 55 mm; 11.09.20, 20, FI, 10 ww; 21.04.21, 36, FI, 10 ww; 28.06.21, 18, FI, 8 ww; 28.06.21, 56, FI, 60 ww; 23.07.21, 30, FI, 8 ww; 02.10.21, 6, FI, 20 ww; 29.05.22, 10, FI, 4 ww; 26.06.22, 13, FI, 5 ww; 07.07.22, 53, FI, 7 ww.

Lasius platythorax Seifert, 1991

Data: 24.06.15, 25, FI, 10 ww; 15.07.18, 48, FI, 15 ww; 25.08.19, 10, FI, 1 g, after dispersal and nested (without workers); 31.03.21, 36, FI, 2 ww; 29.04.21, 56, FI, 90 ww; 14.06.21–22.08.21, 45, PT, 15 ww; 05.11.21, 72, FI, 20 ww.

Lasius reginae Faber, 1967

Data: 14.08.17, 36, FI, 10 ww, 8 gg; 28.06.18, 36, FI, 10 ww; 28.08.18, 36, FI, 5 ww, 2 gg; 26.09.18, 36, FI, 10 ww; 27.09.18, 36, FI, 11 ww; 05.10.18, 36, FI, 17 ww; 06.10.18, 36, FI, 6 ww; 08.10.18, 36, FI, 12 ww, 3 gg, 1 m; 09.10.18, 36, FI, 3 ww; 17.10.18, 36, FI, 7 ww, 30 gg, 40 mm.

This species was so far reported three times in the Slovak Republic (WERNER 1978, KOŽÍŠEK 1985b, 1987). One colony was found during this survey (Figs. 7, 8) at site n. 36 which currently represents the northernmost known distributional point of this species in this country. The nest was discovered on August 14, 2017, on the margin of the country road. There it was situated near a large root of a living *Pinus sylvestris* tree in a forest ecotone, and was surrounded by low and sparse xerothermophilous grass-herbal vegetation. It had small inconsistent above-ground mound consisting of soil particles, up to 10 cm of high, and diameter of up to 30 cm. The workers were taking care about subterranean root-sap suckers as was observed when the nest was inspected internally. This species and its sibling one (*Lasius carniolicus* Mayr, 1861) can be easily distinguished from the other yellowish *Lasius* Fabricius, 1804 spp. with no magnification, even in the field. Gynes have very small body sizes, approximately the same as workers' (Fig. 7C). Also, this species is well-distinguishable by its strong citronella odor released by the colony members when they are endangered. This odor is

exceptionally strong and unmistakable with any secretion of other yellowish *Lasius* spp. The workers of these two sister species (subgenus *Austrolasius* Faber, 1967) have typically roundly shaped head sides over mandibles (Fig. 7D). Sexuals were flying off from stems near the nest during swarming (Fig. 7A); they flew off in the direction of the sun and were never found near the nest up to 30 meters after the swarming, even despite their huge number. Flew-offs were observed on September 26, 2017, at 15:11h–17:01h, and on September 16, 2019, at 15:27h–17:27h. The sexuals were many times observed to be only situated on the ground surface of the nest, or near the surface, but the swarming did not occur during that day. Meteorological data were not obtained from the nearest meteorological station Beluša for these dates, because the station had outages at those times (SHMÚ pers. comm.). The maximum year-round reproduction capacity was estimated to be at least 5,000 sexuals – based on their numbers observed when they were flying off. Freshly mated and dispersed gynes are

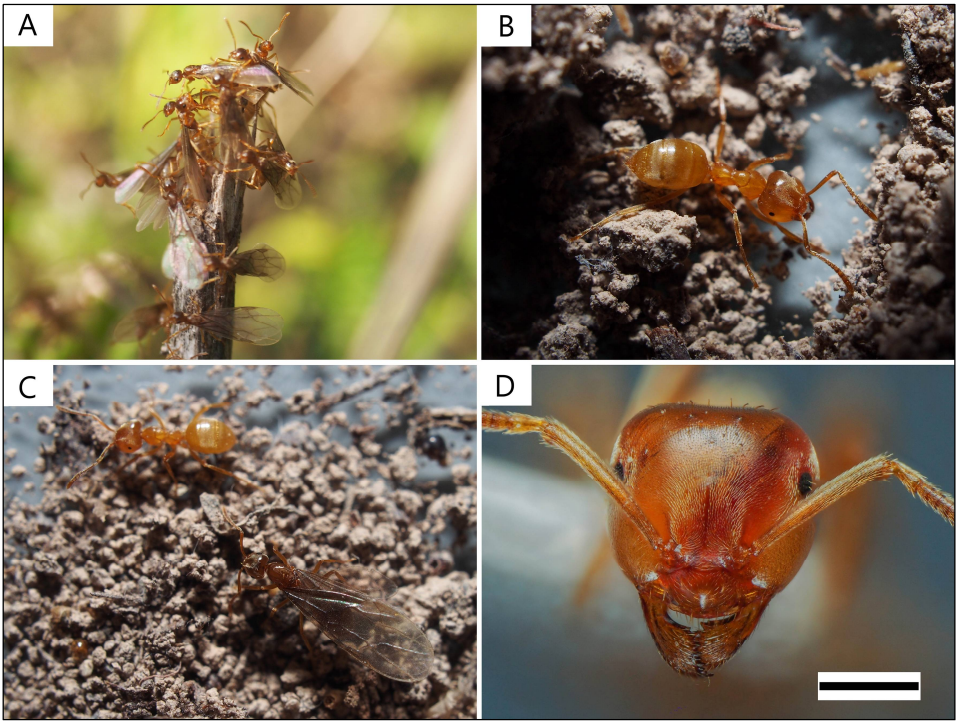

Fig. 7. Colony of *Lasius reginae*. **A:** Accumulation of gynes on a dry stem near their nest, before they will fly off to swarming. Photo: September 2017. **B:** Overall view of a worker. Photo: July 2022. **C:** Gyne and worker showing their similar body sizes. Photo: September 2022. **D:** Frontal view of worker's head showing subgenus-specific and species-specific signs. Scale bar: 0.4 mm. Photo: August 2024.

trying to find adoption in *Lasius alienus* colonies (SEIFERT 2018), as this species is a temporal social parasite. Colonies of *L. alienus* and sibling *L. paralienus* were nesting in proximity of the nest up to 20 metres.

Fig. 8. Colony of *Lasius reginae* in nest after removing a nest-covering stone; workers are taking care about pupae and larvae. Photo: June 2020.

Lasius sabularum (Bondroit, 1918)

Data: 18.04.21, 65, FI, 1 w; 28.04.21, 41, FI, 50 ww, rev. Seifert, under a stone and close to the base of an *Acer* tree; 14.06.21, 41, FI, 9 ww; 29.06.21, 65, FI, 20 ww, under a stone; 14.08.21, 41, FI, 20 ww; 29.06.23, 28, FI, 40 ww, under a stone and close to the base of a tree. Additional finding: 26.03.22, 49.0846°,18.2151°, Biele Karpaty Mts, FI, 30 ww, in tunnels in soil of a ground-surpassing mound.

Based on available data, this species was discovered for the first in the Slovak Republic by Bezděčka (SEIFERT 1988), other published records come from JANCÍK & PURKART (2024), and MARKO et al. (2024). This survey revealed its permanent presence (colony existence) directly (colony findings) at all four study sites. Fig. 9.

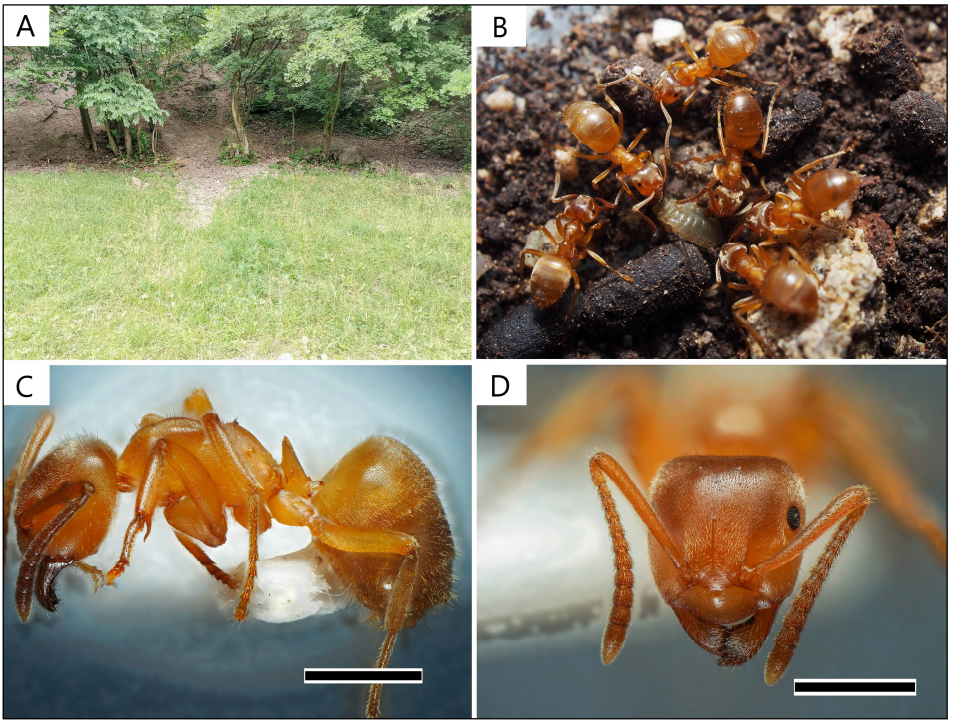

Fig. 9. Colony of *Lasius sabularum* from the site n. 28. **A:** Place and habitat of the colony. Photo: June 2023. **B:** Few workers accumulated around a root aphid. Photo: June 2023. **C:** Lateral view of worker. Scale bar: 1.0 mm. Photo: August 2024. **D:** Frontal view of worker's head. Scale bar: 0.8 mm. Photo: August 2024.

Lasius umbratus (Nylander, 1846)

Data: 18.10.18, 37, FI, 10 ww; 23.03.19, 38, FI, 10 ww; 18.04.19, 61, FI, 10 ww; 19.04.19, 45, FI, 9 ww; 09.11.20, 36, FI, 60, morpha Umbrata and morpha Compacta, rev. Seifert; 01.04.21, 36, FI, 123 ww; 10.04.21, 36, FI, 32 ww, morpha Umbrata and morpha Compacta, rev. Seifert; 11.04.21, 36, FI, 60 ww, morpha Umbrata and morpha Compacta; 27.05.21, 36, FI, 40 ww; morpha Umbrata and morpha Compacta; 12.06.21, 36, FI, 600 ww, morpha Umbrata and morpha Compacta; 15.07.21, 36, FI, 20 ww, 20 gg; 01.11.21, 56, FI, 10 ww; 05.11.21, 73, FI, 20 ww; 17.06.22, 49, FI, 200 ww; 25.06.22, 10, FI, 23 ww, morpha Umbrata and morpha Compacta; 28.06.22, 36, FI, 16 ww, morpha Umbrata and morpha Compacta.

Polyergus rufescens (Latreille, 1798)

Data: 23.07.19, 29, FI, 20 ww; 24.07.22, 56, FI, 3 ww, 8 gg, 5 mm, including 2 ergatogynes; 05.09.22, 36, FI, 5 ww; 06.09.22, 56, FI, 7 ww; 30.06.23, 8, FI, 20 ww.

Plagiolepis cf. *taurica* Santschi, 1920

Data: 25.06.18, 61, FI, 2 ww; 02.07.18, 61, FI, 5 ww; 30.03.19, 14, FI, 10 ww; 30.03.19, 14, FI, 10 ww; 30.03.19, 14, FI, 10 ww;18.04.19, 61, FI, 5 ww; 21.04.19, 16, FI, 10 ww; 18.03.20, 16, FI, 10 ww, 1 g; 15.07.20, 19, FI, 5 ww, 3 gg; 18.08.20, 18, FI, 5 ww, 1 g; 28.06.21, 18, FI, 10 ww, 1 g, 1 m; 13.08.21, 15, FI, 10 ww.

Species *Plagiolepis pyrenaica* Emery, 1921 (KIRSCHNER et al. 2023) was not excluded during determinations. Specimens from the investigated area probably did not belong to that species based on the zoogeography. Also, it has not been reported from the Slovak Republic yet.

Plagiolepis pygmaea (Latreille, 1798)

Data: 11.03.18, 36, FI, 10 ww; 22.05.18, 61, FI, 3 ww, 1 g; 26.06.18, 38, FI, 10 ww; 02.07.18, 61, FI, 3 ww, 1 g, 2 mm; 07.08.18, 27, FI, 2 ww; 11.08.18, 68, FI, 5 ww; 19.08.18, 22, FI, 3 ww; 30.08.18, 32, FI, 10 ww, 2 gg; 06.03.19, 55, 5 ww; 13.04.19, 52, FI, 10 ww; 14.04.19, 45, FI, 10 ww, 3 gg; 01.06.19, 5, FI, 2 ww, 1 g; 16.07.19, 4, FI, 7 ww, unknown whether from a single colony; 06.08.19, 20, FI, 1 w; 30.06.20, 56, FI, 5 ww; 15.07.20, 20, FI, 2 ww, 5 mm; 29.04.21, 50, FI, 10 ww; 13.08.21, 15, FI, 10 ww, 5 mm; 14.06.21–22.08.21, 45, PT, 15 ww; 02.10.21, 6, FI, 5 ww; 29.05.22, 10, FI, 3 ww, 5 gg; 05.07.23, 21, FI, 4 ww.

The finding of this tiny xerothermophilous species at the site n. 5 is its new northernmost known distributional point in the Slovak Republic (CHYZER 1902, ZÁLESKÝ 1939, SADIL 1953, BELÁKOVÁ 1961, LABUDA 1970, DRDULOVÁ 1979, 1991, DRDULOVÁ & ZLATOŠOVÁ 1980, AMBROS et al. 1998, DEVÁN 2005, 2006b, 2007, 2008a, c, d, WIEZIK 2007, 2008a, b, c, 2010, WIEZIK & WIEZIKOVÁ 2007, 2012, KLESNIAKOVÁ & HOLECOVÁ 2015, SUVÁK 2021, PURKART 2023a, JANCÍK & PURKART 2024, MARKO et al. 2024, JANCÍK, PURKART, unpub. data).

Myrmicinae

Aphaenogaster subterranea (Latreille, 1798)

Data: 15.07.17, 52, FI, 4 ww, 1 g; 14.04.18, 52, FI, 1 w; 22.04.18, 36, FI, 5 ww; 31.03.19, 36, FI, 1; 31.08.19, 36, FI, 1 g, after dispersal and nested (without workers); 09.05.20, 56, FI, 10 ww; 30.06.20, 56, FI, 2; 05.09.20, 36, FI, 3 ww; 29.04.21, 52, FI, 60 ww; 04.05.21, 38, FI, 1 w; 09.0521, 36, FI, 10 ww; 06.08.21, 36, FI, 20 ww, 4 gg, 2 mm; 19.08.22, 26, 10 ww; 25.05.24, 38, FI, 50 ww.

Based on the reported data (ZÁLESKÝ 1939, LABUDA 1970, DRDULOVÁ 1991, AMBROS et al. 1998, HOLECOVÁ et al. 2003, DEVÁN 2006a, 2008a, 2009a, WIEZIK 2007, 2008a, b, c, WIEZIK & WIEZIKOVÁ 2007, 2012, WIEZIK et al. 2010, PURKART & HOLECOVÁ 2017, PURKART 2018, 2023a), the site n. 36 is currently the northernmost known distributional point in the Slovak Republic. About 5 colonies were discovered there; all were nesting near the bases of living *Pinus*

sylvestris trees in the soil, or simply in the soil. Nests were mostly under stones throughout all the sites except that one (stones were available to a small extent over there). Northwards distribution in the direction of the Púchov valley (Fig. 1 – lies near inhabited areas Dohňany, Záričie, and Lysá pod Makytou) seems to be cut off at the northernmost site n. 36 – near the town Púchov and the Váh river. A suitable habitat for this species appeared to be at site n. 5 (Fig. 2A). Unfortunately, it was not found there; maybe it could have been present there in lower abundances, and due to quick terrain inspections during the only two visits, it was undetected.

Formicoxenus nitidulus (Nylander, 1846)

Data: 16.04.19., 31, FI, 5 ww, 1 g, in nest of *Formica polyctena*; 18.05.20, 36, FI, 5 ww, in nest of *Formica pratensis*.

Leptothorax acervorum (Fabricius, 1793)

Data: 01.09.19, 1, FI, 2 ww, unknown whether from a single colony; 06.04.20, 57, FI, 20 ww; 20.07.20, 64, FI, 10 ww, 10 gg, a colony with at least hundreds of workers, and at least tens of wingless gynes, under bark of single *Pinus sylvestris* tree, and few centimeters above the ground; 22.10.20, 34, FI, 10 ww; 05.7.23, 21, FI, 1 w.

Leptothorax gredleri (Mayr, 1855)

Data: 19.07.20, 3, FI, 5 ww, 2 gg; 19.07.20, 3, FI, 10 ww, 1 g; 17.08.20., 26, FI, 5 ww, 1 g; 21.08.20, 47, FI, 5 ww, 5 gg, 5 mm; 03.09.20, 54, FI, 1 w, 5 gg; 06.07.21, 64, FI, 10 ww, 2 gg; 15.07.21, 33, FI, 2 ww, 2 gg.

Additional findings: 28.03.20, 49.0951°,18.3215°, Považské Podolie Val., FI, 30 ww, 1g, *Salix* tree on a cemetery; 14.11.21, 49.1909°,18.2304°, Javorníky Mts, FI, 10 ww, 1 g, *Tilia* tree on a cemetery; 05.07.23, 49.1176°,18.2942°, Biele Karpaty Mts, FI, 5 ww, 1 g, *Ulmus* tree near a small stream.

This species is considered as endangered in the Red (Ecosozological) List of Hymenoptera of Slovakia (LUKÁŠ 2001). PURKART (2016) stated that there is very poor knowledge on its distribution within the Slovak Republic what was and still is true since the only available records are by KOŽÍŠEK (1985b) and DEVÁN (2007). Therefore, the multiple newly confirmed sites listed herein substantially extend the knowledge. This species was observed to nest exclusively under bark on the trunks of living trees rather close to the ground – in accordance with SEIFERT (2018). The trees were always older ones with much of the old bark providing enough micro-spaces for nesting and hunting the prey. During the surveys, there were no troubles in extracting the majority of colony members, including the queen(s), directly from their nests as a palette knife was used to peel off the old layer of bark.

Leptothorax muscorum (Nylander, 1846)

Data: 01.09.19, 1, FI, 1 w.

Manica rubida (Latreille, 1802)

Data: 24.06.15, 25, FI, 3 ww; 15.10.17, 67, FI, 2 ww.

Myrmecina graminicola (Latreille, 1802)

Data: 12.07.17, 38, FI, 5 ww, 1 g; 14.06.21–22.08.21, 45, PT, 15 ww; 02.09.23, 38, LS, 4 ww.

Myrmica lobicornis Nylander, 1846

Data: 20.07.20, 64, FI, 1 w.

Myrmica rubra (Linnaeus, 1758)

Data: 13.04.20, 60, FI, 10 ww; 30.04.20, 57, FI, 10 ww, 5 gg, macrogynes and microgynes; 29.04.21, 40, FI, 20 ww; 30.04.21, 57, FI, 50 ww; 16.08.21, 23, FI, 10 ww, 5 gg, macrogynes and microgynes; 04.04.22, 58, FI, 10 ww.

Keeping the data about the microgynes is useful if *Myrmica microrubra* Seifert, 1993 will be renewed from the current synonymy of *M*. *rubra* in the future.

Myrmica ruginodis Nylander, 1846

Data: 08.09.19, 38, FI, 5 ww.

Myrmica rugulosa Nylander, 1849

Data: 21.06.21, 51, FI, 10 ww; 06.05.22, 42, FI, 5 gg, unknown whether from a single colony, after dispersal; 08.05.22, 42, FI, 12 ww; 06.07.22, 11, FI, 10 ww.

Myrmica sabuleti Meinert, 1861

Data: 22.05.18, 61, FI, 5 ww; 07.08.18, 27, FI, 2 ww; 26.09.18, 36, FI, 10 ww; 12.10.18, 36, FI, 20 ww; 20.10.18, 14, FI, 20 ww; 30.03.19, 14, FI, 5 ww; 31.03.19, 36, FI, 10 ww; 21.04.19, 16, FI, 10 ww; 07.08.20, 7, FI, 30 ww; 18.08.20, 18, FI, 4 ww; 13.08.21, 15, FI, 20 ww; 06.07.22, 11, FI, 10 ww.

Myrmica scabrinodis Nylander, 1846

Data: 05.05.21, 31, FI, 80 ww, 12 gg, 6 mm.

Myrmica schencki Viereck, 1903

Data: 11.05.18, 36, FI, 2 ww; 08.07.18, 52, FI, 1 w; 11.08.18, 68, FI, 6 ww, 1 m; 30.08.18, 32, FI, 1 w; 22.09.18, 36, FI, 1 w; 08.07.20, 70, FI, 1 w; 24.04.21, 36, FI, 4 ww; 10.08.21, 31, FI, 1 w.

Myrmica specioides Bondroit, 1918

Data: 15.07.18, 46, FI, 5 ww; 06.09.18, 36, FI, 10 ww; 15.08.20, 68, FI, 1 ww; 21.05.21, 36, FI, 8 ww.

Solenopsis cf. *fugax* (Latreille, 1798)

Data: 11.03.18, 36, FI, 8 ww; 24.04.21, 26, FI, 20 ww; 14.06.21–22.08.21, 45, PT, 15 ww; 25.08.22, 38, FI, 6 ww; 26.08.22, 52, FI, 10 ww; 28.08.22, 50, FI, 2 ww; 02.09.22, 20, FI, 4 ww.

Specimens were not investigated using the complex morphological analysis (Csősz et al. 2023), therefore, species *S. juliae* Csősz et al. (2023) was not excluded from determinations. The probability of the latter species to occurring within the investigated area was rather low due to zoogeography. Also, this species has not been detected in the Slovak Republic yet.

Stenamma debile (Förster, 1850)

Data: 22.09.17, 52, FI, 1 w; 29.04.18, 38, LS, 1 w, 1 g; 01.05.18, 52, LS, 3 ww; 14.09.18, 45, FI, 1 g, after dispersal; 14.10.18, 14, FI, 1 g, after dispersal; 17.09.19, 52, FI, 1 w; 14.06.21–26.07.21, 45, PT, 3 ww, 1 g.

Strumigenys argiola (Emery, 1869)

Data: 30.07.18–30.08.18, 45, PT, 1 m; 14.06.21–22.08.21, 45, PT, 2 gg, 5 mm; 26.08.22–03.09.22, 45, PT, 1 m.

Findings in the years 2018 and 2021 have already been published (PURKART et al. 2021); new finding is from the year 2022. Another attempt to record this species using the pitfall traps was conducted in the year 2023, but this one was unsuccessful. FI and LS methods were deployed to find a nest or workers (Fig. 10) at the site, but it did not bring success.

Fig. 10. Worker of *Strumigenys argiola* in laboratory keeping, showing its elongated mandibles. Specimen originated from S Slovakia. Photo: February 2024.

Temnothorax affinis (Mayr, 1855)

Data: 14.03.18, 44, Fl, 20 ww, 1 g; 17.03.18, 52, Fl, 20 ww, 1 g; 16.04.18, 52, Fl, 3 ww; 29.06.18, 36, Fl, 10 ww; 14.08.18, 65, Fl, 5 ww; 04.09.18, 52, Fl, 20 ww, 1 g; 06.03.19, 55, Fl, 5 ww, 1 g; 17.03.19, 36, Fl, 10 ww, 1 g; 23.03.19, 36, Fl, 20 ww, 1 g; 23.07.21, 30, Fl, 3 ww; 26.06.22, 12, Fl, 5 ww.

Temnothorax albipennis (Curtis, 1854)

Data: 08.07.20, 70, Fl, 40 ww, 1 g, nest under moss and on stone; 05.11.21, 73, Fl, 54 ww, 1 g, nest in rock crevices, rev. Seifert; 17.06.22, 46, Fl, 24 ww, 11 gg, nest under stone and on rocky soil; 07.07.22, 53, Fl, 25 ww, 3 gg, 2 mm, nest in grass tuft and rocky soil; 29.06.23, 24, Fl, 4 ww, nest in rock crevices; 05.07.23, 21, Fl, 10 ww, 1 g, nest in rock crevice and in soil; 24.07.23, 56, Fl, 1 w; 29.07.23, 56, Fl, 75 ww, 1 g, nest in rocky soil.

Available records from the Slovak Republic were well summarised by JANCÍK & PURKART (2024). Additional data were reported by PURKART et al. (2024) and

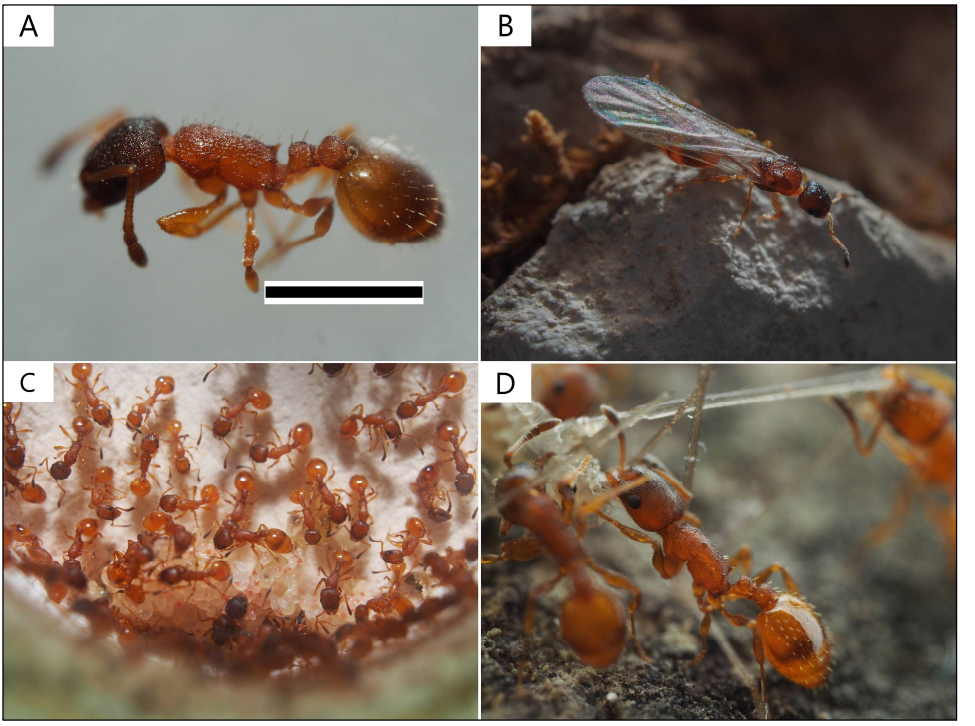

Fig. 11. *Temnothorax albipennis*. **A:** Worker with colony-average pigmentation. Scale bar: 0.9 mm. Photo: September 2021. Individuals in photos B–D were part of the single colony collected at the site n. 24. **B:** Alated gyne left mother colony and is headed to swarming, locating on a limestone rock. Photo: July 2023. **C:** Colony members including brood in laboratory keeping. Photo: December 2023. **D:** Workers processing a prey – *Pholcus phalangioides* (Füssli, 1775) individual. Photo: January 2024.

MARKO et al. (2024). Thorough searches were conducted to discover this species, which resulted in detection of 7 colonies. Findings from the Biele Karpaty Mts come from even 5 sites, what contrasts with no records from that area until now. This can be explained by the lower abundances of the species in the field, as confirmed by this survey, where only one nest was discovered at each site. Also, it can be explained by possible misidentifications with any of the sibling species (mainly with *T. tuberum* (Fabricius, 1775)) sharing similar body features in the past. One such similarity was observed during this study when some colonies had abnormally darkly pigmented average workers (Fig. 11A) – resembling *T. tuberum* pattern. Such a colony came from site, e.g., n. 73, which included a worker depicted in the Fig. 11A. This phenomenon can be confusing during determinations, what requires consideration of morphological signs, too.

Temnothorax corticalis (Schenck, 1852)

Data: 21.09.18, 36, FI, 9 ww, under the bark of living *Pinus sylvestris* tree; 20.07.20, 64, FI, 4 ww, unknown whether from a single colony, on the bark of a living coniferous tree; 20.07.20, 64, FI, 5 ww, 1 g.

Temnothorax crassispinus (Karavajev, 1926)

Data: 15.03.18, 36, FI, 10 ww, 2 gg; 21.08.20, 47, FI, 10 ww; 03.09.20, 54, FI, 10 ww; 22.10.20, 34, FI, 20 ww; 06.04.21, 37, FI, 20 ww, 1 g; 15.06.21, 45, LS, 10 ww; 15.07.21, 33, FI, 20 ww; 01.05.24, 35, FI, 15 ww.

Temnothorax interruptus (Schenck, 1852)

Data: 28.07.18, 66, FI, 20 ww, 1 g, macrogyne; 02.08.18, 61, FI, 20 ww, 1 g, macrogyne; 02.08.18, 61, FI, 10 ww, 1 g, macrogyne; 02.08.18, 61, FI, 10 ww, 1 g, macrogyne; 02.08.18, 61, FI, 10 ww, 1 g, macrogyne; 15.09.18, 61, FI, 20 ww; 07.08.19, 20, FI, 1 w; 17.08.19, 20, FI, 4 ww, unknow whether from a single colony; 17.03.20, 61, FI, 10 ww, 1 g, macrogyne; 15.07.20, 19, FI, 1 w; 11.09.20, 20, FI, 1 w; 10.10.20, 61, FI, 30 ww, 1 g, macrogyne; 02.10.21, 6, FI, 10 ww, 1 g, macrogyne; 17.06.22, 49, FI, 10 ww, 1 g, macrogyne; 17.06.22, 53, FI, 2 ww; 25.06.22, 36, FI, 1 g, macrogyne, after dispersal and in soil without workers – probably establish a new colony; 08.05.23, 56, FI, 1 w; 30.06.23, 8, FI, 38 ww, 1 g, 11 mm, macrogyne; 05.07.23, 21, FI, 1 w; 24.07.23, 36, FI, 10 ww; 29.07.23, 56, FI, 80 ww, 1 g, macrogyne; 29.07.23, 56, FI, 8 ww, 2 gg, 9 mm, macrogynes.

BEZDĚČKA (2000, 2018) summarised findings of ant colonies which built their nests entirely or partly within shells of snails or clams. My two last findings at site n. 56 in the year 2023 refer to colonies completely nesting in shells of the snail *Xerolenta obvia* (Menke, 1828). This ant species extends the Bezděčka's list for the species of snail. The shells were not damaged; they were located on the ground surface, slightly in vegetation humus, and surrounded by grass-herbal vegetation cover. The shells' opening parts were silted by the ants with soil

particles, causing only a small entrance hole with a diameter of 1–2 mm to be kept for each shell. This species also forms microgynes, but no such individual was part of the collected material.

Temnothorax nigriceps (Mayr, 1855)

Data: 30.03.18, 66, FI, 20 ww, 1 g; 28.07.18, 66, FI, 10 ww, 1 g; 07.08.18, 27, FI, 5 ww, unknown whether from a single colony; 11.08.18, 68, FI, 3 ww, 1 g; 11.08.18, 68, FI, 10 ww, 1 g; 16.08.18, 69, FI, 20 ww , 1 g; 19.08.18, 22, FI, 2 ww, unknown whether from a single colony; 30.08.18, 32, FI, 2 ww, unknown whether from a single colony; 15.04.19, 31, FI, 10 ww, 1 g; 01.09.19, 1, FI, 2 ww, unknown whether from a single colony; 08.07.20, 70, FI, 5 ww, unknown whether from a single colony; 17.06.22, 49, FI, 10 ww; 05.07.23, 21, FI, 10 ww; 26.05.24, 62, FI, 40 ww, 1 g, under moss on the concrete surface.

Temnothorax parvulus (Schenck, 1852)

Data: 22.04.18, 36, FI, 10 ww; 21.04.20, 65, FI, 1 w; 30.06.20, 53, FI, 1 w; 07.07.20, 61, FI, 1 w; 05.09.20, 45, LS, 6 ww; 05.09.20, 36, LS, 6 ww; 15.06.21, 45, LS, 10 ww; 31.10.21, 56, FI, 100 ww, 2 gg, wingless gynes; 17.09.22, 45, FI, 10 ww, 1 g.

Temnothorax saxonicus (Seifert, 1995)

Data: 07.08.18, 27, FI, 2 ww, unknown whether from a single colony; 19.08.18, 22, FI, 1 w; 30.08.18, 32, FI, 10 ww, 1 g, nest in rock crevice; 30.08.18, 32, FI, 1 w.

This species was considered as vulnerable in the Red (Ecosozological) List of Hymenoptera of Slovakia (LUKÁŠ 2001). The finding of the nest was done only at the site n. 32, all other findings contained workers collected outside their nests. The site n. 22 was the northernmost known distributional point in the Slovak Republic (KOŽÍŠEK 1986, DEVÁN 2006a, 2009b, WIEZIK & WIEZKOVÁ 2012, SUVÁK 2021, PURKART 2023a, MARKO et al. 2024).

Temnothorax tuberum (Fabricius, 1775)

Data: 21.04.19, 16, FI, 8 ww, 1 g, nest in rock crevice; 15.06.20, 14, FI, 14 ww, 1 g, nest in moss.

Temnothorax unifasciatus (Latreille, 1798)

Data: 30.03.18, 66, FI, 20 ww, 1 g; 30.03.18, 66, FI, 20 ww, 1 g; 03.04.18, 52, FI, 10 ww, 1 g; 04.04.18, 66, FI, 20 ww, 1 g; 11.05.18, 36, FI, 5 ww, 1 g; 02.08.18, 61, FI, 10 ww, 1 g; 16.08.18, 69, FI, 15 ww, 1 g; 30.08.18, 32, FI, 10 ww, 1 g; 07.09.18, 31, FI, 10 ww, 1 g; 22.09.18, 36, FI, 10 ww; 14.10.18, 14, FI, 5 ww, 1 g; 14.10.18, 14, FI, 10 ww, 1 g; 04.03.19, 55, FI, 20 ww, 1 g; 06.03.19, 55, FI, 20 ww, 1 g; 07.03.19, 61, FI, 10 ww, 1 g; 21.04.19, 17, FI, 10 ww, 1 g; 22.04.19, 17, FI, 10 ww, 1 g; 14.09.19, 5, FI, 20 ww; 18.03.20, 16, FI, 10 ww, 1 g; 30.06.20, 56, FI, 10 ww, 1 g; 19.07.20, 3, FI, 1 w; 07.08.20, 7, FI, 20 ww, 1 g; 29.05.22, 10, FI, 20 ww; 17.06.22, 49, FI, 16 ww, 1 g; 05.05.23, 45, FI, 20 ww, 1 g; 05.05.23, 38, FI, 15 ww, 1 g; 05.05.23, 37, FI, 10 ww; 07.05.23, 27, FI, 1 w; 09.05.23, 28, FI, 5 ww; 13.05.23, 22, FI, 2 ww; 13.05.23, 21, FI, 1 w;

16.05.23, 6, Fl, 1 w; 16.05.23, 4, Fl, 25 ww; 16.05.23, 18, Fl, 2 ww; 16.05.23, 20, Fl, 2 ww, unknown whether from a single colony; 18.05.23, 13, Fl, 13 ww; 18.05.23, 19, Fl, 3 ww; 21.05.23, 68, Fl, 4 ww; 01.06.23, 65, Fl, 3 ww; 03.06.23, 70, Fl, 41 ww; 06.06.23, 71, Fl, 2 w; 08.06.23, 15, Fl, 2 ww; 10.06.23, 9, Fl, 12 ww, 1 g.

Tetramorium caespitum (Linnaeus, 1758)

Data: 25.06.22, 10, Fl, 10 ww, 1 g, 1 m; 08.05.23, 36, Fl, 30 ww, 7 gg, 2 mm; 08.05.23, 56, Fl, 20 ww, 2 gg, 8 mm.

Colony samples of *Tetramorium caespitum* species complex also containing males were determined to the species level based on the male specimens, and to a small extent, based on the workers too. These determinations always had clear results for *T. caespitum*, or *T. immigrans*. Colony samples that were not determined to the species level did not contain males. Nevertheless, species *T. immigrans* and *T. hungaricum* were ruled out from them based on the worker caste. Worker specimens were not investigated with complex morphological analysis.

Tetramorium immigrans (Santschi, 1927)

Data: 21.06.22, 62, Fl, 84 ww, 1 g, 1 m, sexuals were pupae; 28.06.22, 63, Fl, 80 ww, 14 gg, 13 mm, part of sexuals were pupae; 02.07.22, 63, Fl, 30 mm; 17.07.22, 63, Fl, 40 mm; 25.06.23, 28, Fl, 20 ww, 6 gg, 5 mm, sexuals were pupae.

See comment on *T. caespitum*. *T. immigrans* was reported only once from the Slovak Republic WAGNER et al. (2017). The site n. 28 represented the northernmost distributional point of this species in the Slovak Republic. This species was first discovered at the site n. 63 where it nested in spaces between older concrete where the substrate was gravel-sand and vegetation humus. A single colony was found at the site n. 28 where it nested in gravel sand near the country road and the railway embankment. If the sexuals were collected as pupae, then they were kept alive and put under laboratory conditions to develop into adult stage, and subsequently the determinations to be possible based on the male caste. This species is synanthropic in the Central Europe (SEIFERT 2018), and the ruderal habitats where it was found during this survey are well-known for it (SEIFERT 2018). Average worker is the largest one among all the species in the *T. caespitum* species complex discovered in the Slovak Republic so far. Its occurrence in the Slovak Republic is strongly under-recorded (JANCÍK, unpub. data), what is probably because its similarity to other species of the complex and due to its synanthropic occurrence, usually at grubby places, as are, e.g., roadsides or pavements – places usually not interesting for myrmecological research at the first sight.

Tetramorium moravicum Kratochvíl, 1941

Data: 23.05.18, 61, Fl, 12 ww; 27.08.18, 61, Fl, 20 ww; 18.04.19, 61, Fl, 60 ww; 10.09.21, 61, Fl, 10 ww; 19.06.22, 61, Fl, 40 ww.

The site n. 61 represented the northernmost known distributional point within the Slovak Republic (DRDULOVÁ & ZLATOŠOVÁ 1980, AMBROS et al. 1998, WIEZIK 2007, 2008a, b, c, WIEZIK & WIEZIKOVÁ 2007, 2012, WIEZIK et al. 2010, PURKART et al. 2019, PURKART 2020, SUVÁK 2021, MARKO et al. 2024, JANCÍK, PURKART, unpub. data). Only one colony was discovered on a small rocky slope (Fig. 3B).

Tetramorium sp(p). (*caespitum* species complex)

Data: 18.08.18, 68, Fl, 30 ww; 27.08.18, 61, Fl, 20 ww; 30.08.18, 32, Fl, 20 ww; 04.09.18, 52, Fl, 30 ww; 14.04.19, 45, Fl, 20 ww; 20.04.19, 67, Fl, 20 ww; 21.04.19, 16, Fl, 20 ww

See comment on *T. caespitum*.

Ponerinae

Ponera coarctata (Latreille, 1802)

Data: 06.07.18, 36, Fl, 1 w; 21.04.19, 16, Fl, 1 w; 30.06.20, 56, Fl, 1 w; 06.07.20, 42, Fl, 1 w.

Ponera testacea Emery, 1895

Data: 22.08.17, 36, Fl, 1 w; 30.09.17, 36, Fl, 3 ww; 25.06.18, 61, Fl, 1 w; 26.06.18, 38, Fl, 2 ww; 08.07.18, 52, Fl, 1 w; 30.08.18, 32, Fl, 1 ww; 19.04.19, 45, Fl, 1 w; 22.04.19, 17, Fl, 1 w; 12.5.20, 36, Fl, 1 w; 15.09.20, 45, Fl, 2 ww; 29.04.21, 50, Fl, 2 ww, 3 gg; 25.06.21, 45, Fl, 1 w; 06.08.21, 36, 8 ww, 3 gg; 25.06.22, 36, Fl, 1 w; 28.06.22, 36, Fl, 1 w; 23.06.23, 37, Fl, 1 w; 30.06.23, 8, Fl, 1 w.

The specimens collected at sites n. 17 and n. 61 were found at semi-shaded places in light *Pinus sylvestris* forest with grassy undergrowth. Although, these sites were gradually becoming more and more shaded due to succession process and forest development during past decades, permanent occurrence of this species was confirmed here, and, therefore, these observations extend its ecological data (SEIFERT 2018).

Proceratiinae

Proceratium melinum (Roger, 1860)

Data: 26.09.17, 36, Fl, 1 g, after dispersal, fully winged, at 15:50h.

The gyne (Fig. 12) was found during wind-free weather at the site containing suitable, though degrading, habitat. It is likely that its mother colony was located at that site at that time. However, targeted attempt to find nest or workers failed, anyway, cryptic subterranean habits make this species mostly unreachable. The gyne was caught when located on the ground surface on a *Pinus sylvestris* root protruding from the country road in the ecotone. It was immediately transported into laboratory to study its behaviour, where it was placed into a small tube with diameter of seven mm with a sufficient humidity level. It was trying to put off its wings for even 4 days from the day when it was found until when all its wings were put off on the September 29, 2017. This long time could be influenced by the environment in the laboratory keeping. Wings putting off behaviour was carefully observed. The gyne was pushing its abdomen upwards, moving the wings aside, and downwards, and trying to wrest the wings by hind leg. Wings at one side were wedged between the femur located in front of the wings, and the tibia located behind them. After the wings were wedged, the gyne was trying to pull out them by moving the leg downwards. The gyne was also observed to move slightly backward from time to time, what was causing movement of its body, but wings were mostly not moving since they were moved aside and downwards, touching the surface.

Fig. 12. Dealate gyne of *Proceratium melinum*. Specimen originating from the site n. 36. Scale bar: 0.6 mm. Photo: August 2024.

This species was rarely reported from the Slovak Republic (WERNER & WIEZIK 2007, KLESNIAKOVÁ et al. 2016, PURKART & REPTA 2022). The newly presented site was the northernmost known distributional point of this species within the Slovak Republic, making it more precious as it is the only known site with natural habitat so far. Other records with known habitat come from synanthropic areas (KLESNIAKOVÁ et al. 2016, PURKART & REPTA 2022, JANCÍK, unpub. data). Species was reported from neighbouring Moravian region at more (two) sites with the natural habitats (BEZDĚČKA 1992, 1996b, 2007b, 2008a, BEZDĚČKA & BEZDĚČKOVÁ 2013).

DISCUSSION

A total of 75 ant species were detected across the study sites, and for each species its permanent presence (meaning colony occurrence) was confirmed (directly or indirectly) at least for a specific bounding geomorphological unit, if not for a certain site. It represents more than 62% of the total number of 120 free-living ant species reported from the Slovak Republic (KOŽÍŠEK 1984, 1987, SEIFERT 1988, WERNER & WIEZIK 2007, DEVÁN 2008a, WAGNER et al. 2011, SEIFERT 2012, WIEZIK & WIEZIKOVÁ 2013, BEZDĚČKA & TĚŤÁL 2013, SEIFERT & GALKOWSKI 2016, WAGNER et al. 2017, SUVÁK 2021, PURKART & REPTA 2022). Base for this species enumeration is the last specimen-based checklist by WERNER & WIEZIK (2007) which confirmed 106 species. Each one of most of the later studies (7) document one species. The other later studies of WAGNER et al. 2017 and SUVÁK 2021 bring per 2 species. KOŽÍŠEK (1987) reported the species *Formica picea* Nylander, 1846, which specimen(s) was not available for the last revision (WERNER & WIEZIK 2007). The authors of the checklist omitted and did not refer to KOŽÍŠEK (1984) and SEIFERT (1988). Reported species from these studies are *Lasius carniolicus* Mayr, 1861, and *Lasius sabularum* (Bondroit, 1918), respectively. BEZDĚČKA & TĚŤÁL (2013) reported the species *Cardiocondyla elegans* Emery, 1869, but revision of SEIFERT (2023) marked this record as *Cardiocondyla dalmatica* Soudek, 1925.

This survey was primarily focused on the easternmost part of the Biele Karpaty Mts where the ant fauna was studied on 63% of all the sites. Permanent presence of 73 ant species was confirmed for this geomorphological unit, representing portion of more than 60% of the total Slovak myrmecofauna (as referred above).

Summarising ant species that have been reported from the Biele Karpaty Mts (see Material and Methods) so far brings territory incompatibility with an area of "Biele Karpaty" referred by BEZDĚČKA & BEZDĚČKOVÁ (2010) in their checklist. Therefore, species from the checklist cannot be included within the Biele Karpaty Mts, otherwise, some of them could potentially drop from the summary. The summarisation can be done only for an area of Biele Karpaty Mts Merged

comprising both the mentioned territories. This is because records for some species are available only in the checklist where they absent any concrete collecting data, making these records unable to assign or not to be assigned to the area of the Biele Karpaty Mts. This way, unfortunately, the area of the Biele Karpaty Mts Merged is undefined since the area of "Biele Karpaty" was undefined by BEZDĚČKA & BEZDĚČKOVÁ (2010).

The summary of ant species with confirmed colony occurrence for the Biele Karpaty Mts Merged consists of species records reported in the past, and these ones are presented herein. The old records comprise 71 ant species – DEVÁN (2006a) (1), BEZDĚČKA & BEZDĚČKOVÁ (2010) (69), and PURKART et al. (2021) (1). The checklist lacks species *Anergates atratulus*, which was reported by DEVÁN (2006a) and referred to by PURKART (2023b). The authors of the checklist operated probably only with material of specimens which was available to them. This study adds 10 species – *P. melinum*, *P. testacea*, *T. albipennis*, *T. corticalis*, *T. immigrans*, *L. paralienus*, *L. myops*, *L. sabularum*, *L. bicornis*, and *L. reginae*. Therefore, the summarised list contains 81 species representing more than 68% of the total Slovak myrmecofauna (as referred above). This large list increase was only partly predicted by the authors of the checklist – they predicted the possible occurrence of 8 species that could be additionally found in the future, but only two of them are being confirmed herein – *P. testacea*, and *L. paralienus*. The author of this study supposes that *Myrmica gallienii* Bondroit, 1920, *Myrmica karavajevi* (Arnol'di, 1930), *Tetramorium staerckei* Kratochvíl, 1944, *Myrmoxenus ravouxi* (André, 1896), *Strongylognathus testaceus* (Schenck, 1852), and *Plagiolepis xene* Stärcke, 1936 can be found within the area in the future, ordering them by the highest probability.

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SÚHRN

Práca prináša nové faunistické údaje mravcov prevažne z oblasti najvýchodnejších častí Bielych Karpát, čo je oblasť rozprestierajúca sa najmä pri meste Púchov a obci Streženice. Toto hornaté územie je zároveň v severnej časti daného geomorfologického celku a tiež má relatívne severnú pozíciu v rámci krajiny. Aj napriek tomu tu boli zistené vzácne teplomilné druhy mravcov. Nie je preto prekvapením, že niektoré z týchto druhov tu dosahujú svoje známe severné hranice rozšírenia v rámci Slovenskej Republiky; sú nimi napríklad *Aphaenogaster subterranea*, *Lasius myops*, *Lasius reginae*, či *Proceratium melinum*. Práca prináša aj nové poznatky o biológii vzácneho arborikolného druhu *Lasius bicornis*, kde sa v chovných podmienkach podarilo simulovať jav založenia kolónie v prírode. Niekoľko skúmaných lokalít sa nachádza aj v okolí Bielych Karpát – v rámci geomorfologických celkov Javorníky a Považské podolie. Dôkladný, 10 ročný prieskum spoločenstiev mravcov mal za cieľ odhaliť mnohé zriedkavo nachádzané druhy, čo sa vo veľkej miere aj podarilo. Za takéto druhy možno považovať najmä *Lasius myops*, *Lasius reginae*, *Lasius sabularum*, *Leptothorax gredleri*, *Proceratium melinum*, *Strumigenys argiola*, *Temnothorax albipennis*, či *Tetramorium immigrans*. Celkovo bolo zistených 75 druhov mravcov zo všetkých piatich čeľadí, ktorých zástupcovia sú známi zo Slovenska. U vybraných druhov mravcov sú uvedené všetky dostupné historické údaje o ich výskyte, čo okrem iného dokumentuje vzácnosť ich nálezov.