

## A review of the West Palaearctic species of the ant genus *Bothriomyrmex* EMERY, 1869 (Hymenoptera: Formicidae)

Bernhard SEIFERT



### Abstract

The taxonomic status of 32 taxa of the ant genus *Bothriomyrmex* from Europe, North Africa, Asia Minor, and the Middle East was assessed and commented. Four European species were clearly distinguished by high-performance stereomicroscopy, reproducible numeric recording of 18 phenotypical characters and multivariate analyses: *B. meridionalis* ROGER, 1863, *B. atlantis* FOREL, 1894, *B. communistus* SANTSCHI, 1919 and *B. corsicus* SANTSCHI, 1923. Type investigation and evaluation of original descriptions established that there is definitely no Palaearctic taxon described before 31 March 1923 which is a senior synonym to any of these four names. Principal component (PCA) and discriminant analyses (DA) of 204 workers and 58 gynes clearly showed the following synonymies (in brackets posterior probabilities of type specimens in discriminant analyses): *B. meridionalis* var. *adriaca* SANTSCHI, 1922 ( $p = 1.000$ ) and *B. corsicus* ssp. *mohelensis* NOVÁK, 1941 ( $p = 1.000$ ) are synonyms of *B. communistus* SANTSCHI, 1919 ( $p = 1.000$ ) while *B. meridionalis* ssp. *gibbus* SOUDEK, 1924 ( $p = 0.999$ ), *B. corsicus* ssp. *gallicus* EMERY, 1925 ( $p = 1.000$ ), *B. corsicus* var. *ligurica* EMERY, 1925 ( $p = 1.000$ ), and *B. menozzii* EMERY, 1925 ( $p = 1.000$ ) are synonyms of *B. corsicus* SANTSCHI, 1923 ( $p = 1.000$ ). The performance of the DA was unexpectedly strong: After reduction to eight morphological characters, any individual of *B. communistus* and *B. corsicus* was classified with posterior probabilities of  $p > 0.960$  and the error rate in leave-one-out cross-validation was 0%. Furthermore, no specimen was allocated to a wrong cluster in PCA.

**Key words:** *Bothriomyrmex*, ant taxonomy, morphometrics, temporary social parasite.

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### Introduction

The genus *Bothriomyrmex* EMERY, 1869 contains about 33 described Palaearctic and one Neotropical species and 11 subspecies (BOLTON & al. 2007). All *Bothriomyrmex* are supposed to found their colonies in a temporary socially parasitic way in species of the genus *Tapinoma*. The nutrition is probably largely by trophobiosis with different groups of Homoptera (Aphidina, Coccina and Tettigometridae are explicitly reported; BERNARD 1967). All *Bothriomyrmex* of the West Palaearctic are thermophilous: The Central European species do not spread into the northern parts of the distributional ranges of their *Tapinoma* hosts; the northern distributional limit is at 50° N in Moravia. Gynes of *Bothriomyrmex* are much smaller than those of their host species and become extremely physogastric immediately after colony foundation. Due to the determination chaos in the past, very little reliable information is available on the special biology also of the European *Bothriomyrmex*. We do not even know in most cases which host species are used. All gynes so far investigated, both the European and North African, have a mandibular morphology more or less adapted to decapitate the host queen/s. Mandibles are likely to work in the following way: Once having seized a victim in the right position, its neck is inescapably locked between the very long apical and sub-

apical dents and anterior clypeal margin while the very sharp and fine basal dents saw off the head with quick but low-amplitude back and forth movements. Hence, it seems likely that the decapitating behaviour reliably observed in only one species (SANTSCHI 1906) is widely spread in the genus. The invasion of the *Tapinoma* colony by young *Bothriomyrmex* gynes is probably facilitated by mimicking anal gland secretions of the host (LLOYD & al. 1986).

The primary intention of this paper has been to clarify species delimitation and name priority of only the Central European *Bothriomyrmex* species but doing this demanded to consider all West Palaearctic taxa. In a preface to a key on Central European species of *Bothriomyrmex*, I quoted five years ago: "The taxonomy of the genus is in a disastrous situation. ... In the absence of a feasible revision, the very schematic statements of KUTTER (1971) are used here as emergency solution..." (SEIFERT 2007, translated from German). The provisional nature and very doubtful performance of this key has always been a thorn in my flesh – the more as basically the same key has already been published in SEIFERT (1996). The investigations presented here, based upon reproducible numeric recording of 18 phenotypical characters by high-performance stereomicroscopy allowed to credibly determine the name priority in the four

species occurring in Central Europe, France, Iberia, Italy and the Balkans, to state junior synonymies for further seven European taxa by comparing their types with those of the four earlier described species. This revision could also exclude synonymies of any of the European species with the nine taxa described by FOREL (1910) and SANTSCHE (1911, 1919) from the Middle East and North Africa. Surprisingly, these nine taxa are likely to represent separate species adding with the European ones to the astonishing number of at least 13 West Palaearctic species. I resign here to outline the historical development of Palaearctic *Bothriomyrmex* taxonomy. If comments on this issue are necessary, this will be done in the special context.

## Material

The fraction of material investigated by numeric recording of phenotypic characters is listed below. Sequence of data: country, site, date, field sample number, geographical latitude, geographical longitude, meters a.s.l. (all three geographical parameters in square brackets with coordinates in international decimal format and western longitude designated by a "-" symbol).

Identification, composition and labelling of investigated type material is described in detail in the species sections.

***Bothriomyrmex atlantis* FOREL, 1894:** Five samples with one gyne and ten workers from: **Algeria:** Franchetti, lectotype and paralectotypes of *B. atlantis*, no date [35.02°, 0.11°, 600 m]; Tlemcen, paralectotypes of *B. atlantis*, no date [34.88°, -1.33°, 800 m]. **Spain:** Andalusia (Emery, NHM Basel) no date [37°, -5°, 600 m]; Malaga: Sierra Blanca, 1.XII.1986 [36.55°, -4.89°, 500 m]; Ronda (leg. Franz), no date [36.74°, -5.17°, 650 m].

***Bothriomyrmex breviceps* SANTSCHE, 1919:** The lectotype sample with two workers and one gyne from **Tunisia:** La Quareb, 21.XII.1910 [34.740°, 10.530°, 110 m].

***Bothriomyrmex communistus* SANTSCHE, 1919:** 60 samples with 119 workers and 24 gynes from: **Austria:** Dürnstein, 15.V.1975, No 4399 [48.397°, 15.523°, 270 m]; Spitz, 5.VII.1969, No 3338 [48.365°, 15.396°, 370 m]; Spitz - 5 km NW, Setzberg, 1. - 10.VII.1990 [48.365°, 15.396°, 370 m]. **Bulgaria:** Arkutino, 1.VIII.1978 [42.328°, 27.742°, 23 m]; Malina / Tolbuchin, 9.VII.1987 [43.633°, 28.071°, 210 m]; Srebarna, 14.VII.1988 [44.09°, 27.06°, 35 m]. **Czech Republic:** Mohelno (locus typicus of *B. mohelensis*), 7.VII.2006 [49.108°, 16.547°, 270 m]; Mohelno 16.III.2007 [49.103°, 16.915°, 350 m]. **France:** Corsica: Ponte Leccia, 29.IX.1973, No 197 [42.464°, 9.207°, 300 m]; Mauroux, IV.2008 [44.450°, 1.001°, 155 m]; St. Michel observatory, 20.IV.1992 [43.911°, 5.717°, 570 m]. **Greece:** Kamarina - 1 km S, 20.V.1996, No 272 [39.126°, 20.673°, 211 m]; Kamarina - 3 road km NE, 20.V.1996, without No [39.150°, 20.679°, 550 m]; Kamarina - 3 road km NE, 20.V.1996, No 288 [39.150°, 20.679°, 550 m]; Konitsa, 24.IV.1983, No 187 [40.052°, 20.760°, 760 m]; Krini - 0.5 km S, 10.X.1996, No 60 [39.681°, 19.686°, 287 m]; Krini - 0.5 km S, 10.X.1996, No 92 [39.681°, 19.686°, 287 m]; Palaeokastriza - 1 km NW, 6.X.1996, No 238 [39.678°, 19.694°, 180 m]; Palaeokastriza - 1 km NW, 6.X.1996, No 239 [39.678°, 19.694°, 180 m]; vic. Meliana, 21.V.1996, No 296 [39.360°, 20.790°, 700 m]. **Hungary:** Budapest (leg. Szabo), 1909 [47.50°, 19.00°, 250 m]; Budapest-Farkasret, 10.V.1909 [47.483°, 18.995°, 250 m]. **Italy:** Frascineto - 1 km NW, 21.V.1994, No 1336 [39.840°, 16.250°,

500 m]; Sciacca, IV.2009 [37.501°, 13.107°, 25 m]. **Croatia:** Baska - 7 km NW, 30.V.1997, No 416 [45.017°, 14.690°, 125 m]; Biograd vic., 2.10.2004, No CRO57 [43.94°, 15.45°, 10 m]; Island Curzola, IX.1925 [42.94°, 16.91°, 100 m]; Karlobag - 1 km S, 1.X.2004, No CRO62 [44.521°, 15.085°, 65 m]; Krk: Voz, 30.V.1997, No 550 [45.236°, 14.573°, 20 m]; Krk, 18.VIII.1966, No 2999 [45.10°, 14.60°, 120 m]; Krk, 8.X.1966, No 2587 [45.10°, 14.60°, 120 m]; Krk, 26.IX.1969, No 3505 [45.10°, 14.60°, 120 m]; Krk: Baska, 21.V.1971, No 3890 [44.97°, 14.74°, 23 m]; Krk: Markini, 1.VI.1997, No 469 [45.10°, 14.60°, 125 m]; Krk: Markini, 1.VI.1997, No 470 [45.10°, 14.60°, 125 m]; Krk: Voz, 30.V.1997, No 434 [45.236°, 14.573°, 20 m]; Lissa (Emery), type series of *B. adriacus*, no date [43.04°, 16.16°, 160 m]; Medulin, 20.VIII.1979 [44.812°, 13.956°, 20 m]; Porec: Nova Vas, V.1982 [45.26°, 13.66°, 132 m], Punat - 5 km SE, 1.VI.1997, No 459 [44.991°, 14.680°, 447 m]; Rab Island: vic. Lopar, 9.IX.2006 [44.832°, 14.735°, 20 m]; Rovinj, VIII.1969, No 3548 [45.050°, 13.640°, 13 m]. **Russia:** Gelendzhik - 5 km SSE, 4.V.2006, No 257 [44.510°, 38.130°, 10 m]; Gelendzhik - 2 km SSE, 5.VI.2006, No 132 [44.530°, 38.120°, 160 m]. **Serbia-Montenegro:** Zelenika (leg. Szabo), more than one locality with this name, no date [44.52°?, 19.15°?, 100 m]; Budva, 13. - 22.IX.1977 [42.29°, 18.84°, 100 m]; Budva, 27.VIII.1984 [42.29°, 18.84°, 100 m]. **Slovakia:** Dobra Voda, 16.VIII.1986 [48.601°, 17.532°, 300 m]; Drienovec, 31.III.1986 [48.615°, 20.946°, 220 m]; Hradiste pod Vratnom, 12.VI.1988 [48.642°, 17.496°, 260 m]; Hradiste pod Vratnom, 5.VII.2006 [48.642°, 17.496°, 260 m]; Hrhov, 30.III.1986 [48.610°, 20.746°, 200 m]; Silicka Brezova / Roznava, 8.VII.1993 [48.536°, 20.488°, 480 m]; Slovensky Kras: Zadiel, 15.VII.1973, No 612 [48.618°, 20.847°, 530 m]; Slovensky Kras: Zadiel, 29.III.1986 [48.616°, 20.828°, 280 m]; Tardica, 18.IV.2006 [48.416°, 21.767°, 150 m]; vic. Hrusovo, 31.V.2005 [48.508°, 20.055°, 260 m]. **Ukraine:** Crimea (Karavajev), type series of *B. communistus*, no date [45°, 34°, ± 450 m]; Crimea: Kara Dagh / Theodosia, 1924 [44.927°, 35.229°, 450 m]; Crimea: Zalizsya, 13.VIII.1995, No 825 [44.881°, 34.100°, 450 m].

***Bothriomyrmex corsicus* SANTSCHE, 1923:** 50 samples with 85 workers and 34 gynes from: **Austria:** Hundsheimer Berge, 11.VIII.2002, No 11069 [48.125°, 16.933°, 338 m]; Kreuzmaiß, 23.VI.2007 [48.842°, 15.851°, 390 m]; Spitz, 17.VIII.1969, No 3445 [48.365°, 15.396°, 370 m]; Spitz, 20.VIII.1969, No 3450 [48.365°, 15.396°, 370 m]; Spitz, 1.VII.1970 [48.365°, 15.396°, 370 m]. **Bulgaria:** Arkutino, 1.VIII.1978 [42.328°, 27.742°, 23 m]; Melnik, 1.IX.1982 [41.530°, 23.392°, 400 m]; Obsor, 1.VIII.1981 [42.820°, 27.880°, 30 m]; Pamporovo, 1.VIII.1976 [41.607°, 24.674°, 1350 m]; Rozen - 4 km N, 26.VIII.1982 [41.567°, 23.440°, 1000 m]; Slatny Pjasacy, 19.VII.1970 [43.28°, 28.04°, 50 m]; Sozopol, 15.VII.1977 [42.410°, 27.690°, 25 m]. **Czech Republic:** Mikulov, 10.IX.1983 [48.806°, 16.646°, 320 m]; Suchy zleb, type series of *B. gibbus*, 15.IV.1923 [49.366°, 16.735°, 471 m]. **France:** Auberasses Vacheres, 1.VIII.1974 [43.918°, 5.623°, 760 m]; Caussol, IV.2004 [43.733°, 6.907°, 1120 m]; Dijon, paratype series of *B. gallica*, no date [47.32°, 5.02°, 250 m]; Dijon, 9.IX.1866 (Rouget) [47.32°, 5.02°, 250 m]; "Fr.merid. (coll.Piaget)", no date [44°, 5°, 500 m ?]; Marseille (Abeille), paralectotype series of *B. gallica*, no date [43.296°, 5.370°, 50 m]; Poggiolo, holotype of *B. corsicus*, 20.VIII.1922 [42.177°, 8.909°, 590 m]; Sa-

lève (Forel), lectotype series of *B. gallica*, no date [46.161°, 6.213°, 700 m]; Salève (Forel), no date [46.161°, 6.213°, 700 m]; Salève (Forel) paralectotype series of *B. gallica*, no date [46.161°, 6.213°, 700 m]; Tende - 3 km SW, 18.VII.1994, No 180 [44.060°, 7.570°, 1200 m]. **Italy:** Cuneo: vic. Valdieri, 16.IV.1988 [44.280°, 7.395°, 920 m]; Liguria: Vittoria, type series of *B. ligurica*, VI.1922 [44.20°, 8.90°, 70 m]; Emilia: Marano (Modena), holotype of *B. menozzii*, no date [44.457°, 10.972°, 142 m]. **Kosovo:** Brezovica, 20. - 23.V.1971 [42.23°, 21.00°, 1050 m]. **Romania:** Vargyas, 27.VII.2004, No AA248 [46.219°, 25.549°, 782 m]. **Slovakia:** Devínska Kobyla, 19.VII.1991 [48.195°, 16.981°, 270 m]; Domaniki u Krupiny, 31.VII.1989 [48.265°, 18.989°, 250 m]; Gemerska Horka: Koniar, 27.IX.2008 [48.541°, 20.376°, 320 m]; Jablonov nad Turnou, 30.III.1986 [48.604°, 20.694°, 320 m]; Kecovske Skrapy, 6.VIII.2010 [48.493°, 20.493°, 381 m]; Medovarce, 21.VIII.1988 [48.235°, 18.999°, 240 m]; Mikusovce, 24.IV.1983 [49.055°, 18.202°, 400 m]; Oslany, 16.IX.1988 [48.645°, 18.452°, 240 m]; Plastovce, 2.V.1987 [48.163°, 19.003°, 200 m]; Plastovce, 29.VII.1989 [48.169°, 19.008°, 200 m]; Pohranice, 12.VI.1988 [48.338°, 18.177°, 240 m]; Rykynice, 20.VIII.1988 [48.191°, 18.975°, 200 m]; Visnove, 22.V.1988 [48.725°, 17.761°, 280 m]. **Slovenia:** Podcetrtek, no exact date ("09.06") [46.16°, 15.60°, 250 m]. **Switzerland:** Castello San Pietro, 8.VIII.1928 [45.865°, 9.016°, 520 m]; Lugano: Parco Tassino, 2009 [46.001°, 8.946°, 340 m]; Lugano: Ruvigliana, 4.V.1935 [46.00°, 8.98°, 550 m]; Lugano: Ruvigliana, VIII.1936 [46.00°, 8.98°, 550 m]; Lugano: Ruvigliana, IV.1940 [46.00°, 8.98°, 550 m]; Monte Caslano, VI. / VII.1996 [45.960°, 8.880°, 320 m]; Roveredo, 2.VI.1951 [46.239°, 9.129°, 320 m].

***Bothriomyrmex cuculus* SANTSCHI, 1919:** Two samples with four workers and one gyne from: **Morocco:** Bou Iblane, VII.2010 [33.633°, -4.150°, 2080 m]. **Tunisia:** Dir El Kef, lectotype series of *B. cuculus*, V.1913 [36.195°, 8.739°, 900 m].

***Bothriomyrmex emarginatus* SANTSCHI, 1919:** The holotype gyne from **Tunisia:** Ain Draham, 1909 - 1910 [36.78°, 8.69°, 720 m].

***Bothriomyrmex meridionalis* (ROGER, 1863):** Five samples with ten workers and two gynes from: **France:** Cannel en Roussillon, V.2011 [42.700°, 3.017°, 2 m]; Fontfroide, 6.V.2005 [43.117°, 2.883°, 230 m]; Montpellier, 1862, type series of *B. meridionalis* [43.61°, 3.88°, 30 m]. **Spain:** Pozuelo de Calatrava, no date, type series of *B. m. hispanica* [38.91°, -3.84°, 630 m]; Pozuelo de Calatrava (La Fuente), no date [38.91°, -3.84°, 630 m].

***Bothriomyrmex pubens* SANTSCHI, 1919:** The lectotype sample with three workers and two gynes from **Tunisia:** Le Kef, no date [36.182°, 8.715°, 750 m].

***Bothriomyrmex regicidus* SANTSCHI, 1919:** The lectotype sample with two gynes from **Tunisia:** Kairouan, I. 1906 [35.67°, 10.10°, 65 m].

***Bothriomyrmex syrius* FOREL, 1910:** Two samples with four workers from: **Israel:** "Israel" (locality not specified, no date, coll. museum Klagenfurt) [32°, 35°, 200 m]. **Syria:** Doumar (leg. Kerville), no date [33.53°, 36.23°, 800 m].

## Evaluation methods

**Recording of morphological data:** Eighteen morphometric and three pigmentation characters in workers and seventeen morphometric characters in gynes were investigated.

In bilaterally recorded characters, arithmetic means of both body sides were calculated. All measurements were made on mounted and dried specimens using a pin-holding stage, permitting full rotations around X, Y, and Z axes. A Leica M165C high-performance stereomicroscope equipped with a 2.0 planapochromatic objective (resolution 1050 lines / mm) was used at magnifications of 120 - 384×. The mean relative measuring error over all magnifications was 0.3%. A Schott KL 1500 cold-light source equipped with two flexible, focally mounted light-cables, providing 30° inclined light from variable directions, allowed sufficient illumination over the full magnification range and a clear visualization of silhouette lines. A Schott KL 2500 LCD cold-light source in combination with a Leica coaxial polarized-light illuminator provided optimum resolution of tiny structures and microsculpture at highest magnifications. Simultaneous or alternative use of the cold-light sources depending upon the required illumination regime was quickly provided by regulating voltage up and down. A Leica cross-scaled ocular micrometer with 120 graduation marks ranging over 52% of the visual field was used. To avoid the parallax error, its measuring line was constantly kept vertical within the visual field. Measurements of body parts always refer to real cuticular surface and not to the diffuse pubescence surface. Care in selecting of the best illumination condition is needed when pubescence is profuse. A removal of allometric variance to visualise which shape characters differ independently from body size was not necessary because mean worker body size of all species considered here was very similar. Seta counts (nOcc, nT1f) include only setae protruding more than 10 µm from cuticular surface. Setae are defined to have significantly larger thickness than pubescence.

Shrinking of whole body and the collapse of the very delicate exoskeleton after drying will lead to significant morphometric differences to living or freshly prepared specimens. Consequently, all morphometrics was performed in fully dried specimens (exposure: > 2 days at 20°C and < 70% air humidity). The degree to which certain structures are deformed is different: SL, for instance, is almost unchanged while PrL and CW are stronger affected than dAN or ClyW.

Pigmentation scores (PigCap, PigMes, PigT1) indicate the brightness of pigmentation and not its colour components. They were determined by subjective comparison with a standard scale projected into the visual field. The scale showed 12 brightness steps with score 5 meaning light yellowish brown, score 8 meaning medium yellowish-reddish brown and 12 blackish brown – the full pigmentation range known from *Bothriomyrmex*. Brightness scaling was performed at 100× magnification and 2700 K colour temperature provided by both cold-light sources. The scores are difficult to reproduce using another (and even the same!) equipment and must be understood as a relative scaling to describe brightness differences.

CL Maximum cephalic length in median line. Vary positions until the maximum is achieved.

ClyW Maximum clypeal width in full face view. In case of more profuse pubescence, take special care to detect the correct endpoints of the measurement at the most lateral junction of clypeus and head capsule (Fig. 1).

CS Cephalic size; arithmetic mean of CL and CW.

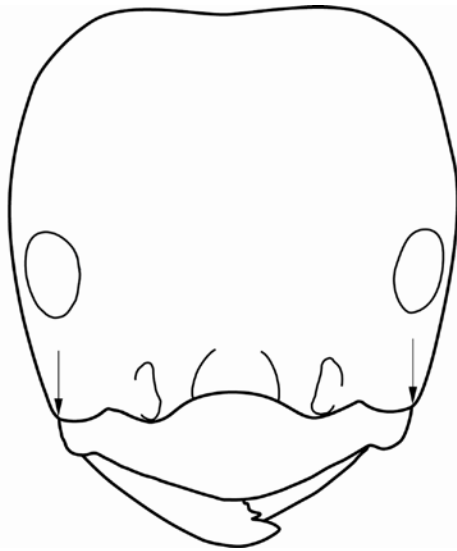


Fig. 1: Head shape of a *Bothriomyrmex corsicus* worker in dorsal aspect. Arrows indicate the points between which ClyW is measured.

- CW Maximum cephalic width.
- dAN Minimum distance of inner margins of toruli (the ring sclerites surmounting and enclosing antennal sockets).
- EYE Eye size: arithmetic mean of large and small diameter of compound eye across all structurally defined ommatidia; bilateral mean.
- Full face view Adjustment of head when both maximum head length in median line and maximum head width are positioned in visual plane.
- F2 Median length of 2<sup>nd</sup> funiculus segment in dorsal view (i.e., with swivelling plane of 1<sup>st</sup> funiculus segment positioned in visual plane); take care to measure median length because of unequal length of the segments' sides. Use the highest optical resolution available.
- F3 Median length of 3<sup>rd</sup> funiculus segment in dorsal view under the same conditions defined for F2.
- IF2 F2 divided by the maximum width of second funiculus segment (excluding pubescence) in dorsal view.
- MGr Depth of metanotal groove / depression in lateral view; the upper reference line extends between the highest points of mesonotum and propodeum perpendicular to which depth measuring is performed. Use of transmitted light ensures most accurate measuring.
- ML Measured in gynes: mesosoma length from caudal-most point of lateral metapleuron to anteriormost point of anterior mesosomal face.
- MW Maximum pronotal width (in workers) or maximum mesosomal width before tegulae (in gynes).
- nOcc Unilateral number of setae on hind margin of head in full face view. Counted are setae surpassing the head silhouette from hind margin of eye to median vertex. Average both sides.
- nT1f Unilateral number of setae on frontal face of 1<sup>st</sup> gaster tergite. Average both sides.
- PigCap Pigmentation score on dorsum of head.
- PigCont Brightness contrast of head and gaster relative to mesosoma – i.e., the ratio  $0.5 \text{ (PigCap + PigT1) / PigMes}$ .

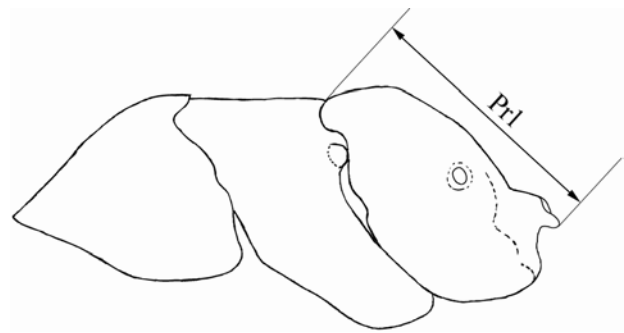


Fig. 2: Mode of measuring propodeal length PrL in workers of *Bothriomyrmex*.

- PigMes Pigmentation score of mesosoma.
- PigT1 Pigmentation score of dorsum of 1<sup>st</sup> gaster tergite.
- PLG Mean length of pubescence hairs on dorsum of 1<sup>st</sup> gaster tergite. A very discriminative character but challenging in measurement! Use the highest available optical resolution. If high pubescence density prevents visualisation of full hair length from base to tip, look for surface spots with partially torn-off pubescence or execute a spotwise ablation of pubescence using a micro tool. A more lateral view may expose more measurable hairs. Mean of at least seven measurements.
- PoOc Postocular distance: distance from transversal level of posterior eye margin to hind margin of head measured in median line; bilateral asymmetries are averaged.
- PrL Propodeal length: distance from most caudal point of posterior propodeum (a dentiform paramedian structure on both sides of petiolar junction) to hind margin of metanotal groove (Fig. 2).
- SL Maximum scape length excluding articular condyle.
- sqPDF Mean transverse pubescence distance on vertex frontal of mid ocellus. Hairs crossing or just touching a transverse line of 50 - 100  $\mu\text{m}$  length are counted. Crossing / touching hairs are counted as  $1 / 0.5$ . PDF is then line length / hair number. Average the data of three lines. Use the highest optical resolution available, take care to visualize the full length of pubescence hairs and avoid damaged or oily surface spots. Square root of PDF (sqPDF) is applied to normalise positively skewed distributions.
- sqPDG Mean transverse pubescence distance on dorsum of 1<sup>st</sup> gaster tergite. Recording conditions as in sqPDF. The counting lines can be up to 200  $\mu\text{m}$  long.

### Data analysis

All analyses were performed with the SPSS 15.0 statistical package on the basis of individuals and nest samples. The selected characters were computed in a principal component analysis (PCA) and a canonical discriminant analysis (DA). All characters passed the tolerance test in a DA to the level of 0.01 as implemented by SPSS. A parallel run of an ordinary DA and of a "Leave-One-Out Cross-Validation" DA (LOOCV-DA, LACHENBRUCH & MICKEY 1968, LESAFFRE & al. 1989) was performed to realistically estimate the error rate. The data presented by SEIFERT & SCHULTZ (2009) show that the means of the pessimistic error indication by the LOOCV-DA and of the optimistic er-

ror indication by the ordinary DA are close to the true error rate.

### Taxonomical treatment of the European species

The treatment of species in this section is arranged according to the dates of first description. In the synonymic list heading each species' section, the basis on which a synonymy has been stated is given in square brackets after the taxon's name. Numeric data in the verbal description of workers are nest sample means if not otherwise stated. Note that Dmitri Dubovikoff (St. Petersburg) performed a lot of lectotype labellings in the collections of European museums some years ago but according to a personal communication (e-mail in 2010) he stopped his revisionary work at least in the West Palearctic *Bothriomyrmex* and is not intending to publish in this field during the next years. I found his lectotype and paralectotype selections reasonably done, retained his labels and publish Dubovikoff's lectotype fixations herewith.

### *Bothriomyrmex meridionalis* (ROGER, 1863)

*Tapinoma meridionale* ROGER, 1863 [type investigation]

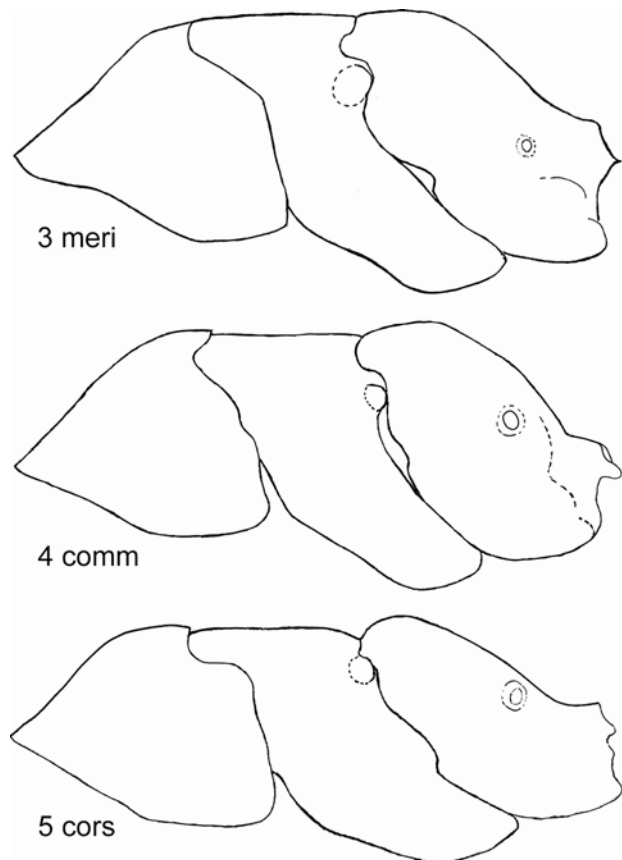
*Bothriomyrmex meridionalis* var. *hispanica* SANTSCHI, 1922 [type investigation]

### Type material of *Tapinoma meridionale* ROGER, 1863:

A lectotype and paralectotypes were fixed by present designation in the collection of Naturhistorisches Museum Wien: two workers on a pin, labelled "Mtpl Sichel fin 62", "Bothr. meridionalis det Mayr", "Lectotype (top specimen), Paralectotype (bottom) *Bothriomyrmex meridionalis* (Roger, 1863) des B.Seifert 2011" and two workers on another pin labelled "Mtpl fin 62 Sichel", "Bothr. meridionalis det Mayr", "Paralectotype *Bothriomyrmex meridionalis* (Roger, 1863) des B.Seifert 2011". One male "Mtpl fin 62 \ Sichel \ *B. meridion. det. G. Mayr*", another male "Montpellier coll. G. Mayr \ *B. meridion. det. G. Mayr*" and two further workers "Montpellier coll. G. Mayr \ *B. meridion. det. G. Mayr*" most probably also have a paralectotype status but I resigned to label them because Roger did not describe males and / or because original labels of Sichel / Roger are missing.

Comment: There are no type specimens of *B. meridionalis* present in the collections of Paris and Berlin which keep some material of Roger. I agree with EMERY (1925) that several specimens from the collection of G. Mayr (NHM Wien), collected by Sichel near Montpellier in 1862, belong to the same material upon which Roger based his original description. The arguments are the following: (a) According to a survey in NHM Wien, Julius Roger donated material of several newly described species to Gustav Mayr, (b) Roger described several ant species in material collected by Sichel, (c) the type locality is coincident, (c) the year of collection would fit and (d) the morphology of this sample is in full agreement with Rogers rather detailed description. The series donated by Roger contains material on seven pins with originally the same mode of preparation.

**Type material of *Bothriomyrmex meridionalis* var. *hispanica* SANTSCHI, 1922:** Lectotype gyne labelled "ESPAGNE C. Real Pozuela (Cabrera leg.)" [label of Santschi], "*Bothriomyrmex meridionalis* r. *hispanica* Sants ♀ SANTSCHI det. 1920" [label of Santschi], "*B. meridionalis* Pozuelo de Calatrava Espagne (Cabrera)" [handwriting of Forel], "Lectotype *Bothriomyrmex hispanica* Santschi, 1922 Dubovikoff des."; paralectotype worker labelled "C. Real Pozuelo", "*Bothriomyrmex meridionalis hispanica* Sat SANTSCHI det. 1920" [label of Santschi], "Paralectotype *Bothriomyrmex hispanicus* Santschi, 1922 Dubovikoff, des"; Naturhistorisches Museum Basel.



Figs. 3 - 5: Lateral aspect of worker mesosoma of *Bothriomyrmex meridionalis* (3 meri), *B. communistus* (4 comm), and *B. corsicus* (5 cors).

nicus Santschi, 1922 Dubovikoff des."; paralectotype worker labelled "C. Real Pozuelo", "*Bothriomyrmex meridionalis hispanica* Sat SANTSCHI det. 1920" [label of Santschi], "Paralectotype *Bothriomyrmex hispanicus* Santschi, 1922 Dubovikoff, des"; Naturhistorisches Museum Basel.

Comment: Type labels of Santschi are missing on the selected specimens. Santschi wrote in the original description a somewhat confusing sentence "Je considere comme types les exemplaires du Midi de la France, Montpellier, Marseille, parce que ROGER les cite en premier et, ceux d'Espagne, comme varietés" [I consider the specimens from the French Mediterranean, Montpellier, Marseille, which Roger cited firstly, as types and those from Spain as varieties]. There are a lot of examples where Santschi and Emery used the terminus "type" also for specimens or populations they considered to have a morphology typical for a certain taxon while evidently not meaning true type specimens. Santschi's sentence must be understood that he considered the morphologically typical *B. meridionalis* to be distributed in the French Mediterranean and *Bothriomyrmex meridionalis* var. *hispanica* to be restricted to Spain.

**Description and differential diagnosis of worker** (Fig. 3, Tab. 1): Medium-sized, CS 607 - 626 µm. Posterior margin of head almost straight or weakly excavated in the median fourth. Head and scape much elongated; CL / CW 1.136 - 1.176 (significantly longer than in *B. corsicus*, *B. communistus* and *B. atlantis*), SL / CS 0.911 - 0.941 (slightly longer than in *B. corsicus* and *B. communistus* and much longer than in *B. atlantis*). Head sides before the

Tab. 1: Worker nest sample means of morphological data of nine *Bothriomyrmex* species from Europe, Middle East and North Africa; n = number of nest samples, i = number of individuals; arrangement of data: arithmetic mean  $\pm$  standard deviation [lower extreme, upper extreme]. Data of F3, sqPDG, nOcc, nT1f, PigCap, PigMes, PigT1 are not shown as they were of little discriminative power.

	<i>corsicus</i> (n = 45, i = 85)	<i>communistus</i> (n = 60, i = 119)	<i>meridionalis</i> (n = 5, i = 10)	<i>atlantis</i> (n = 5, i = 10)	<i>syrius</i> (n = 2, i = 4)	<i>breviceps</i> (n = 1, i = 3)	<i>cuculus</i> (n = 2, i = 3)	<i>pubens</i> (n = 1, i = 3)	<i>regicidus</i> (n = 1)
CS [ $\mu$ m]	614 $\pm$ 19 [563, 655]	616 $\pm$ 23 [565, 672]	617 $\pm$ 7 [607, 626]	589 $\pm$ 30 [548, 628]	622 $\pm$ 21 [607, 637]	631	605 $\pm$ 12 [596, 613]	600	620
CL / CW	1.106 $\pm$ 0.016 [1.074, 1.140]	1.121 $\pm$ 0.022 [1.063, 1.164]	1.158 $\pm$ 0.015 [1.136, 1.176]	1.110 $\pm$ 0.028 [1.069, 1.147]	1.093 $\pm$ 0.027 [1.073, 1.112]	1.072	1.168 $\pm$ 0.017 [1.156, 1.181]	1.106	1.102
PoOc / CL	0.444 $\pm$ 0.007 [0.428, 0.461]	0.445 $\pm$ 0.009 [0.421, 0.465]	0.470 $\pm$ 0.002 [0.467, 0.472]	0.479 $\pm$ 0.005 [0.472, 0.485]	0.456 $\pm$ 0.002 [0.455, 0.458]	0.461	0.466 $\pm$ 0.014 [0.456, 0.476]	0.464	0.478
ClyW / CS	0.758 $\pm$ 0.009 [0.736, 0.771]	0.800 $\pm$ 0.010 [0.773, 0.820]	0.816 $\pm$ 0.011 [0.803, 0.826]	0.814 $\pm$ 0.008 [0.806, 0.826]	0.810 $\pm$ 0.005 [0.806, 0.813]	0.849	0.801 $\pm$ 0.004 [0.798, 0.804]	0.817	0.786
dAn / CS	0.329 $\pm$ 0.007 [0.314, 0.342]	0.345 $\pm$ 0.008 [0.332, 0.366]	0.329 $\pm$ 0.010 [0.321, 0.345]	0.343 $\pm$ 0.003 [0.340, 0.348]	0.339 $\pm$ 0.005 [0.336, 0.343]	0.340	0.335 $\pm$ 0.001 [0.334, 0.336]	0.333	0.335
EYE / CS	0.172 $\pm$ 0.006 [0.162, 0.186]	0.158 $\pm$ 0.008 [0.144, 0.179]	0.138 $\pm$ 0.005 [0.134, 0.146]	0.118 $\pm$ 0.007 [0.109, 0.128]	0.137 $\pm$ 0.000 [0.137, 0.137]	0.131	0.144 $\pm$ 0.003 [0.142, 0.146]	0.136	0.148
SL / CS	0.895 $\pm$ 0.012 [0.878, 0.929]	0.901 $\pm$ 0.016 [0.872, 0.950]	0.931 $\pm$ 0.013 [0.911, 0.941]	0.852 $\pm$ 0.017 [0.824, 0.867]	0.900 $\pm$ 0.014 [0.890, 0.910]	0.870	0.891 $\pm$ 0.003 [0.889, 0.894]	0.871	0.896
F2 / CS	0.155 $\pm$ 0.005 [0.143, 0.165]	0.167 $\pm$ 0.005 [0.156, 0.176]	0.178 $\pm$ 0.007 [0.167, 0.184]	0.154 $\pm$ 0.006 [0.147, 0.160]	0.151 $\pm$ 0.008 [0.145, 0.157]	0.154	0.170 $\pm$ 0.004 [0.167, 0.173]	0.159	0.156
IF2	1.499 $\pm$ 0.070 [1.346, 1.703]	1.586 $\pm$ 0.076 [1.394, 1.767]	1.666 $\pm$ 0.067 [1.576, 1.730]	1.383 $\pm$ 0.062 [1.296, 1.461]	1.475 $\pm$ 0.096 [1.407, 1.542]	1.438	1.576 $\pm$ 0.080 [1.519, 1.633]	1.452	1.493
MW / CS	0.657 $\pm$ 0.013 [0.622, 0.678]	0.656 $\pm$ 0.018 [0.617, 0.703]	0.668 $\pm$ 0.014 [0.645, 0.678]	0.670 $\pm$ 0.016 [0.656, 0.698]	0.666 $\pm$ 0.012 [0.658, 0.675]	0.682	0.658 $\pm$ 0.004 [0.655, 0.661]	0.676	0.664
PtL / CS	0.555 $\pm$ 0.019 [0.498, 0.589]	0.568 $\pm$ 0.017 [0.513, 0.599]	0.611 $\pm$ 0.014 [0.592, 0.625]	0.581 $\pm$ 0.010 [0.568, 0.595]	0.550 $\pm$ 0.011 [0.542, 0.557]	0.616	0.568 $\pm$ 0.014 [0.558, 0.578]	0.593	0.593
MPGr / CS [%]	3.10 $\pm$ 0.48 [2.1, 4.1]	1.83 $\pm$ 0.53 [0.36, 3.28]	0.63 $\pm$ 0.427 [0.00, 1.14]	0.89 $\pm$ 0.16 [0.6, 1.0]	1.23 $\pm$ 0.24 [1.06, 1.39]	0.0	0.25 $\pm$ 0.26 [0.1, 0.4]	0.16	0.18
PLG / CS [%]	5.14 $\pm$ 0.25 [4.64, 5.68]	6.35 $\pm$ 0.41 [5.62, 7.58]	6.10 $\pm$ 0.23 [5.85, 6.46]	6.99 $\pm$ 0.20 [6.15, 7.50]	4.97 $\pm$ 0.00 [4.96, 4.97]	6.30	6.92 $\pm$ 0.79 [6.36, 7.48]	6.33	6.29
sqPDF	2.34 $\pm$ 0.16 [1.98, 2.67]	2.48 $\pm$ 0.14 [2.10, 2.71]	2.34 $\pm$ 0.18 [2.11, 2.60]	2.49 $\pm$ 0.16 [2.32, 2.76]	2.49 $\pm$ 0.12 [2.41, 2.58]	2.67	2.68 $\pm$ 0.05 [2.65, 2.72]	2.70	2.75

eyes only very weakly converging, ClyW / CS 0.803 - 0.826 (much larger than in *B. corsicus*). 2<sup>nd</sup> funiculus segment more elongated than in the other species, F2 / CS 0.167 - 0.184. Postocular distance large, PoOc / CL 0.467 - 0.472 (significantly larger than in *B. communistus* and *B. corsicus*). Hind margin of head and frontal face of 1<sup>st</sup> gaster tergite without erect setae. Eye small, EYE / CS 0.134 - 0.146 (significantly smaller than in *B. communistus* and *B. corsicus* but larger than in *B. atlantis*). Dorsal profile of mesonotum and propodeum continuous, almost linear to slightly convex. Metanotal groove missing, or very small, reduced to a suture, MGr / CS 0.0 - 1.14% (always smaller than in *B. corsicus* and frequently weaker than in *B. communistus*). Differences between *B. meridionalis*, *B. corsicus* and *B. communistus* in curvature of mesosomal sclerites and relative position of metanotal and propodeal spiracles suggested by Figs. 3 - 5 have not been checked by numeric data; propodeal spiracle in *B. meridionalis* apparently positioned more caudoventrally. Pubescence on whole body, scape and tibiae semierect and profuse. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite rather large, PLG / CS 5.85 - 6.46%. Head, mesosoma, gaster and appendages more or less pale yellowish or pale yellowish brown.

**Description and differential diagnosis of gyne** (Tab. 2): medium-sized, CS 726 - 730  $\mu$ m (much larger than *B.*

*communistus*). Head in full face view with a weakly concave to straight posterior margin and much elongated; CL / CW 1.179 - 1.204 (much longer than in *B. communistus* and *B. corsicus*), scape very long, SL / CS 1.016 - 1.061 (much longer than in *B. communistus* and *B. corsicus*). Head sides before the eyes weakly converging, ClyW / CS 0.718 - 0.734. 2<sup>nd</sup> funiculus segment much elongated, F2 / CS 0.205 - 0.213 (much longer than in *B. communistus* and *B. corsicus*). Postocular distance long, PoOc / CL 0.468 - 0.474 (significantly longer than in *B. communistus* and *B. corsicus*). Hind margin of head unilaterally with 4 - 55 erect setae, frontal face of 1<sup>st</sup> gaster tergite unilaterally with 17 - 22 erect setae which is more than in *B. communistus* and *B. corsicus*. Eye relatively small, EYE / CS 0.236 - 0.237 (significantly smaller than in *B. communistus*). Relative mesosoma length larger than in *B. communistus* and *B. corsicus*, ML / CS 1.541 - 1.557. Scape and tibiae without fine semierect setae. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite large, PLG / CS 4.45 - 4.59%. Head, mesosoma and gaster dark brown.

**Results of taxonomical evaluation:** The species is not likely to be confused with the three other European species, representing a combination of much elongated head, scape, 2<sup>nd</sup> funiculus segment, and mesosoma in both female castes (Tabs. 1, 2). *Bothriomyrmex meridionalis* var. *hispa-*

Tab. 2: Morphological data of gyne individuals of eight *Bothriomyrmex* species from Europe, Middle East and North Africa; i = number of individuals; arrangement of data: arithmetic mean  $\pm$  standard deviation [lower extreme, upper extreme].

	<i>corsicus</i> (i = 34)	<i>communistus</i> (i = 24)	<i>meridionalis</i> (i = 2)	<i>atlantis</i> lectotype	<i>emarginatus</i> holotype	<i>breviceps</i> lectotype	<i>cuculus</i> lectotype	<i>pubens</i> types (i = 2)	<i>regicidus</i> types (i = 2)
CS	730 $\pm$ 20 [693, 762]	640 $\pm$ 14 [615, 660]	728 $\pm$ 2 [726, 730]	771	679	637	696	798 $\pm$ 52 [761, 835]	680 $\pm$ 0 [680, 681]
CL / CW	1.101 $\pm$ 0.025 [1.038, 1.141]	1.081 $\pm$ 0.021 [1.052, 1.151]	1.192 $\pm$ 0.018 [1.179, 1.204]	0.998	1.195	1.100	1.226	1.076 $\pm$ 0.049 [1.041, 1.110]	1.194 $\pm$ 0.000 [1.194, 1.194]
SL / CS	0.905 $\pm$ 0.014 [0.876, 0.949]	0.911 $\pm$ 0.013 [0.881, 0.948]	1.038 $\pm$ 0.032 [1.016, 1.061]	0.815	0.983	0.905	0.946	0.868 $\pm$ 0.025 [0.851, 0.886]	0.956 $\pm$ 0.006 [0.951, 0.960]
F2 / CS	0.166 $\pm$ 0.006 [0.151, 0.178]	0.179 $\pm$ 0.007 [0.166, 0.191]	0.209 $\pm$ 0.006 [0.205, 0.213]	0.161	0.194	0.157	0.182	0.170 $\pm$ 0.005 [0.167, 0.174]	0.181 $\pm$ 0.006 [0.177, 0.185]
F3 / CS	0.117 $\pm$ 0.006 [0.106, 0.129]	0.122 $\pm$ 0.006 [0.110, 0.135]	0.136 $\pm$ 0.000 [0.136, 0.137]	0.113	0.141	0.102	0.129	0.114 $\pm$ 0.004 [0.111, 0.116]	0.128 $\pm$ 0.001 [0.127, 0.129]
IF2	1.705 $\pm$ 0.082 [1.531, 1.869]	1.799 $\pm$ 0.098 [1.645, 1.974]	2.053 $\pm$ 0.000 [1.974, 2.132]	1.558	1.911	1.489	1.768	1.740 $\pm$ 0.046 [1.708, 1.773]	1.828 $\pm$ 0.013 [1.818, 1.837]
PoOc / CL	0.449 $\pm$ 0.006 [0.440, 0.464]	0.438 $\pm$ 0.011 [0.419, 0.456]	0.471 $\pm$ 0.004 [0.468, 0.474]	0.485	0.438	0.455	0.464	0.461 $\pm$ 0.007 [0.456, 0.466]	0.461 $\pm$ 0.008 [0.455, 0.467]
ClyW / CS	0.660 $\pm$ 0.012 [0.636, 0.683]	0.718 $\pm$ 0.013 [0.697, 0.742]	0.726 $\pm$ 0.011 [0.718, 0.734]	0.728	0.725	0.798	0.699	0.736 $\pm$ 0.022 [0.720, 0.751]	0.684 $\pm$ 0.025 [0.666, 0.701]
dAn / CS	0.319 $\pm$ 0.006 [0.308, 0.334]	0.328 $\pm$ 0.007 [0.311, 0.339]	0.324 $\pm$ 0.002 [0.322, 0.325]	0.328	0.337	0.347	0.315	0.335 $\pm$ 0.007 [0.330, 0.340]	0.326 $\pm$ 0.005 [0.322, 0.329]
nOcc	0.0 $\pm$ 0.0 [0.0, 0.0]	0.3 $\pm$ 1.5 [0.0, 7.5]	29.0 $\pm$ 36.8 [4.0, 55.0]	67	4.0	5.0	0.0	3.0 $\pm$ 0.0 [3.0, 3.0]	0.0 $\pm$ 0.0 [0.0, 0.0]
nT1f	2.5 $\pm$ 2.6 [0.0, 10.0]	6.3 $\pm$ 2.8 [0.5, 10.5]	19.5 $\pm$ 3.5 [17.0, 22.0]	15	15.0	9.0	10.0	17.0 $\pm$ 0.0 [17.0, 17.0]	10.5 $\pm$ 2.1 [9.0, 12.0]
EYE / CS	0.242 $\pm$ 0.006 [0.229, 0.258]	0.261 $\pm$ 0.009 [0.246, 0.276]	0.236 $\pm$ 0.001 [0.236, 0.237]	0.198	0.241	0.184	0.237	0.219 $\pm$ 0.006 [0.215, 0.223]	0.245 $\pm$ 0.006 [0.241, 0.249]
MW / CS	0.831 $\pm$ 0.036 [0.777, 0.923]	0.769 $\pm$ 0.025 [0.731, 0.840]	0.804 $\pm$ 0.037 [0.777, 0.830]	0.830	0.802	0.745	0.747	0.892 $\pm$ 0.018 [0.879, 0.904]	0.840 $\pm$ 0.009 [0.833, 0.846]
ML / CS	1.461 $\pm$ 0.048 [1.362, 1.543]	1.412 $\pm$ 0.045 [1.316, 1.487]	1.549 $\pm$ 0.048 [1.541, 1.557]	1.318	1.533	1.315	1.502	1.448 $\pm$ 0.067 [1.400, 1.495]	1.465 $\pm$ 0.003 [1.463, 1.467]
sqPDF	2.20 $\pm$ 0.12 [1.98, 2.43]	2.22 $\pm$ 0.18 [1.88, 2.65]	1.99 $\pm$ 0.17 [1.87, 2.11]	2.46	2.18	2.55	1.85	2.52 $\pm$ 0.02 [2.51, 2.54]	2.50 $\pm$ 0.16 [2.39, 2.62]
sqPDG	2.35 $\pm$ 0.17 [2.13, 2.88]	2.09 $\pm$ 0.16 [1.82, 2.50]	2.00 $\pm$ 0.05 [1.97, 2.04]	1.92	2.29	2.30	2.16	2.48 $\pm$ 0.12 [2.39, 2.56]	2.40 $\pm$ 0.04 [2.37, 2.42]
PLG / CS [%]	2.35 $\pm$ 0.26 [1.74, 2.97]	4.19 $\pm$ 0.37 [3.50, 4.81]	4.52 $\pm$ 0.10 [4.45, 4.59]	5.35	3.41	6.84	4.741	3.66 $\pm$ 0.27 [3.47, 3.85]	3.35 $\pm$ 0.10 [3.28, 3.42]

*nica* is in any character close to *B. meridionalis* except the larger nOcc in the gyne. Hence, it is most probably only a more hairy Spanish variant.

**Biology and distribution:** *Bothriomyrmex meridionalis* certainly does not extend its range to Central Europe. It is apparently a West Mediterranean species occurring in Iberia and southernmost France. Due to frequent confusion with other species, its biology is completely unknown. The mandibular morphology of the gyne is very well adapted to potentially decapitating a host queen.

#### *Bothriomyrmex atlantis* FOREL, 1894

*Bothriomyrmex meridionalis atlantis* FOREL, 1894 [type investigation]

**Type material of *Bothriomyrmex meridionalis r. atlantis* FOREL, 1894:** Lectotype gyne labelled "Typus", "B. meridionalis [sic] Rog. ♀ For. Franchetti Algerie" [Forel's handwriting], "Lectotype *Bothriomyrmex atlantis* Forel 1894 Dubovikoff des.", "ANTWEB CASENT 0103282"; eight worker paralectotypes on three pins labelled "B. meridionalis

*atlantis* Roger v. *atlantis* Forel Franchetti (Forel)" [Forel's handwriting], Muséum d'Histoire Naturelle Genève. Eight worker syntypes on three pins labelled "B. meridionalis ♀ Roger v. *atlantis* Forel Tlemcen (Forel)" [Forel's handwriting], Muséum d'Histoire Naturelle Genève; one worker with the same label of Forel Hungarian Museum of Natural History Budapest.

**Description and differential diagnosis of worker** (Tab. 1): Rather small, CS 545 - 639  $\mu$ m. Head rather short; CL / CW 1.069 - 1.154, Scape shorter than in any other European species, SL / CS 0.815 - 0.867. Head sides before the eyes not notably converging, ClyW / CS 0.803 - 0.838 (much larger than in *Bothriomyrmex corsicus*). 2<sup>nd</sup> funiculus segment short, F2 / CS 0.144 - 0.163. Postocular distance very large, PoOc / CL 0.472 - 0.489 (much larger than in *B. communistus* and *B. corsicus*). Hind margin of head and frontal face of 1<sup>st</sup> gaster tergite without erect setae. Eye smaller than in any other European species, EYE / CS 0.109 - 0.130. Overall shape of mesosoma in lateral view similar to *B. meridionalis* (compare with Fig. 3);

metanotal groove very weak, MGr / CS 0.5 - 1.7% (much shallower than in *B. corsicus*). Pubescence on whole body profuse and subdecumbent to suberect. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite large, PLG / CS 6.15 - 8.15% (much longer than in *B. corsicus*). Head, mesosoma and gaster usually light yellowish brown, almost no brightness difference between mesosoma and head plus gaster.

**Description and differential diagnosis of gyne:** Larger than the other European species, CS 771 µm. Head very short, CL / CW 0.998, in dorsal view with almost straight posterior margin. Scape much shorter than in any other European species, SL / CS 0.815. Head sides before the eyes weakly converging, ClyW / CS 0.728. 2<sup>nd</sup> funiculus segment short, F2 / CS 0.161. Postocular distance larger than in all other European species, PoOc / CL 0.485. Whole surface of head with very profuse semierect to erect setae, surpassing cuticular surface of occiput in dorsal view by 70 - 80 µm. Numerous semierect setae also present on scape, mesosoma and gaster. Eye smaller than in all other European species, EYE / CS 0.198. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite very large, PLG / CS 5.35%. Head, mesosoma and gaster medium brown, appendages lighter yellowish brown.

**Results of taxonomical evaluation:** *Bothriomyrmex atlantis* is unlikely to be confused with any European species. It is characterized both in the worker and gyne by an unmistakable combination of short head, short scape, small eye, large postocular distance and long pubescence on 1<sup>st</sup> gaster tergite. (Tabs. 1, 2). The studied syntype workers from Franchetti have shorter scapes and funiculus segments, a more erected pubescence and a smaller size than those from Tlemcen. I consider these differences to represent intraspecific variability but a possible taxonomic validity should be checked if enough comparison material is once available.

**Biology and distribution:** So far, *B. atlantis* has been confirmed to occur only in southern Spain and Algeria. Its biology is unknown but morphology strongly suggests a subterranean foraging.

#### ***Bothriomyrmex communistus* SANTSCHI, 1919**

*Bothriomyrmex meridionalis* var. *communista* SANTSCHI, 1919 [type investigation]

*Bothriomyrmex meridionalis* var. *adriaca* SANTSCHI, 1922; syn.n. [type investigation]

*Bothriomyrmex corsicus* ssp. *mohelensis* NOVÁK, 1941; syn.n. [description and topotypical material]

**Type material of *Bothriomyrmex meridionalis* var. *communista* SANTSCHI, 1919:** Lectotype worker labelled "♀ Crimee Karawaiew", *Bothriomyrmex meridionalis* v. *communista* type ♀ Sants", "Sammlung Dr. F. Santschi Kairouan" and "Lectotype *Bothriomyrmex communistus* Santschi, 1919 Dubovikoff des."; one paralectotype worker labelled "♀ Crimee Karawaiew" and "Paralectotype *Bothriomyrmex communistus* Santschi, 1919 Dubovikoff des."; two workers "Karadagh près Theodosia Crimee Karaw.", "*Bothriomyrmex meridionalis* var. *communista* Sant. Dr. Karavaiev, 1924."; Naturhistorisches Museum Basel.

**Type material of *Bothriomyrmex meridionalis* var. *adriaca* SANTSCHI, 1922:** Lectotype worker with laterally damaged head "Lissa Adriatique Emery leg." [Santschi's

handwriting], "*Bothriomyrmex meridionalis* v. *adriaca* XXX XXX SANTSCHI det. 1920" [Santschi's label, illegible text marked 'XXX'], "NATURHISTORISCHES MUSEUM BASEL", "Lectotype *Bothriomyrmex adriacus* Santschi, 1922 Dubovikoff des."; one paralectotype worker with caudocentrally crushed head "Liss Adriatique Emery leg." [Santschi's handwriting], "Paralectotype *Bothriomyrmex adriacus* Santschi, 1922 Dubovikoff des.", both Naturhistorisches Museum Basel.

Data of paralectotype and lectotype (µm): CL 624.6, 647.6; PoOc (279.8), 291.5; CW 539.9, (583.8); SL 532.4, 545.2; ClyW 467.2, 507.3; DAN 189.0, 217.0; sqPDF 2.03, 2.24; sqPDG 2.16, 2.23; PLG 31.1, 37.9; MW 362.3, 414.9; MGr --, 13.0; PrL 324.7, 353.0; EYE 85.2, 97.5; F2 89.9, --; F3 68.4, --; IF2 1.500, --; PigCap 8.5, 8.0; PigMes 6, 5; PigT1 7, 6. Measurements in brackets were affected by damage and were reconstructed or estimated by relational calculations referring to undamaged body parts. To allow an analysis on individual level, a single, average individual was mathematically constructed from both damaged specimens.

**Description and differential diagnosis of worker** (Fig. 4, Tab. 1): Medium-sized, CS 565 - 672 µm. Head and scape moderately elongated; CL / CW 1.063 - 1.164, SL / CS 0.872 - 0.950. Head sides before the eyes not notably converging, ClyW / CS 0.773 - 0.820 (significantly larger than in *B. corsicus*). 2<sup>nd</sup> funiculus segment moderately elongated, F2 / CS 0.156 - 0.176. Postocular distance short, PoOc / CL 0.421 - 0.465 (significantly shorter than in *B. meridionalis* and *B. atlantis*). Hind margin of head and frontal face of 1<sup>st</sup> gaster tergite without erect setae. Eye moderately large, EYE / CS 0.144 - 0.179 (much larger than in *B. meridionalis* and *B. atlantis*). Metanotal groove rather shallow, MGr / CS 0.36 - 3.28% (shallower than in *B. corsicus* but deeper than in *B. meridionalis* and *B. atlantis*). Differences between *B. meridionalis*, *B. corsicus* and *B. communistus* in curvature of mesosomal sclerites and relative position of metanotal and propodeal spiracles suggested by Figs. 3 - 5 have not been checked by numeric data; dorsal surface of propodeum in *B. communistus* longer and much less curved than in *B. corsicus*. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite rather large, PLG / CS 5.62 - 7.58% (significantly longer than in *B. corsicus*). Head and gaster usually medium to dark yellowish brown, mesosoma a little lighter yellowish brown. Brightness contrast between mesosoma and head plus gaster often weaker than in *B. corsicus*.

**Description and differential diagnosis of gyne** (Tab. 2): Small-sized, CS 615 - 660 µm (much smaller than in *B. corsicus* and *B. meridionalis*). Head in full face view with straight posterior margin and short, CL / CW 1.052 - 1.151 (much shorter than in *B. meridionalis*); scape rather short, SL / CS 0.881 - 0.948 (much shorter than in *B. meridionalis*). Head sides before the eyes not notably converging, ClyW / CS 0.697 - 0.742 (much larger than in *B. corsicus*). 2<sup>nd</sup> funiculus segment moderately elongated, F2 / CS 0.166 - 0.191 (slightly longer than in *B. corsicus*, but significantly shorter than in *B. meridionalis*). Postocular distance short, PoOc / CL 0.419 - 0.456 (significantly shorter than in *B. meridionalis*). Hind margin of head without or only few erect setae, frontal face of 1<sup>st</sup> gaster tergite with few erect setae. Eye large, EYE / CS 0.246 - 0.276 (larger than in *B. meridionalis* and *B. corsicus*). Relative mesosoma



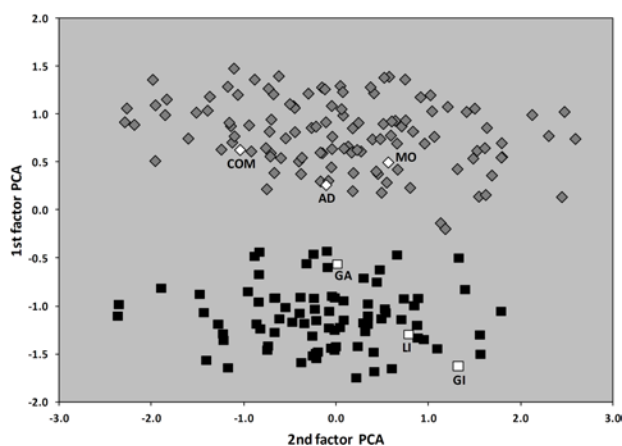


Fig. 6: Principal component analysis of worker individuals of *Bothriomyrmex communistus* (rhombs) and *B. corsicus* (squares). White rhombs and squares belong to type specimens: COM = Lectotype *B. communistus*, AD = lectotype *B. adriacus*, MO = worker from the type locality of *B. ssp. mohelensis*, GA = lectotype *B. ssp. gallicus*, LI = syntype *B. var. ligurica*, GI = lectotype *B. ssp. gibbus*.

length small, ML / CS 1.316 - 1.487 (much smaller than in *B. meridionalis*). Scape and tibiae with semierect pubescence and very fine semierect setae. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite large, PLG / CS 3.50 - 4.81% (much longer than in *B. corsicus*). Head, mesosoma and gaster dark brown.

**Results of taxonomical evaluation:** A surprisingly clear separation of individual workers of *B. communistus* from those of the next abundant species *B. corsicus* was given both in hypothesis-driven and explorative data analyses and all synonymies could be determined unambiguously. A canonical discriminant function (DA) using the eight characters ClyW / CS, PLG / CS, F2 / CS, MpGr / CS, DAN / CS, EYE / CS, sqPDF, CS (arranged in order of decreasing canonical correlation) separated each of the 119 *B. communistus* and 85 *B. corsicus* workers with posterior probabilities of  $p > 0.960$  and an error rate of 0% in the LOOCV test. The posterior probabilities of the allocation of type specimens to the *B. corsicus* cluster were 1.000 in the lectotype and two paralectotypes of *gibbus*, 0.998, 1.000 and 1.000 in the lectotype and two paralectotypes of *gallicus* from Salève and both 1.000 in the two syntypes of *ligurica*. The posterior probabilities of the allocation to the *B. communistus* cluster were both 1.000 in the lectotype and paralectotype of *B. communistus*, 1.000 in the lectotype of *adriaca* and each 1.000 in three workers from the type locality of *mohelensis*. The first two factors of a principal component analysis (PCA) using the same character set and describing 49.9% and 13.8% of variance confirmed this very clear separation (Fig. 6).

A full separation of the 24 and 34 gyne individuals of *B. communistus* and *B. corsicus* was given in both a DA and PCA using the characters PLG / CS, CS, ClyW / CS, EYE / CS, F2 / CS, MW / CS, DAN / CS, and ML / CS (Fig. 7). All individuals were allocated in the DA to either cluster with  $p = 1.000$  and an error rate of 0% in the LOOCV test. The holotype of *B. menozzii* and the paralectotype of *gallicus* clustered closely together with the holotype of *B. corsicus*.

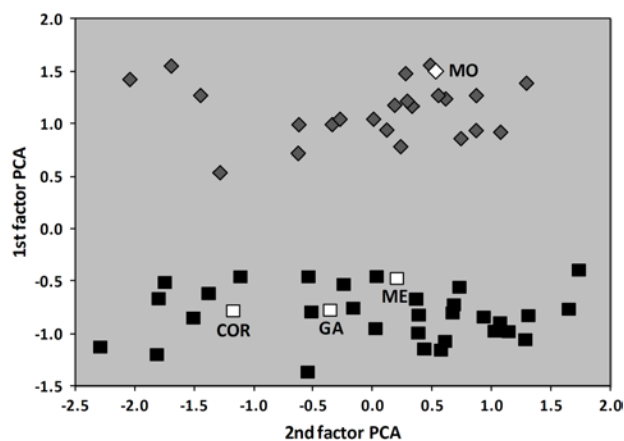


Fig. 7: Principal component analysis of gyne individuals of *Bothriomyrmex communistus* (rhombs) and *B. corsicus* (squares). White rhombs and squares belong to type specimens: COR = holotype *B. corsicus*, GA = paralectotype *B. ssp. gallicus*, ME = holotype *B. menozzii*, MO = gyne from the type locality of *B. ssp. mohelensis*.

A comment is necessary to *B. corsicus* ssp. *mohelensis* NOVÁK, 1941, described from Hadcova Step, situated about 0.5 km S of Mohelno village / South Moravia. As *B. communistus* and *B. corsicus* are the only species of the genus which have reached southern Central Europe, *mohelensis* belongs with a high probability to one of these species. Types of *mohelensis* are apparently lost – at least they are not present in the museums of Praha, Brno and Jihlava – and for assessment we must use the descriptions of NOVÁK (NOVÁK & SADIL 1941, KRATOCHVÍL, NOVÁK & SNOFLÁK 1944). The verbal statements and figures of NOVÁK do not allow a clear allocation to *B. corsicus* and *B. communistus* and Novák's head and scape measurements are not reproducibly defined and difficult to interpret. However, he stated as total length of the gynes before development of ovaries 2.3 - 2.8 mm. I found in fully dried (shrinked) gynes from Czech Republic, Slovakia and Austria a total length of  $2.426 \pm 0.104$  [2.29, 2.62] in 19 *B. communistus* gynes and one of  $2.854 \pm 0.098$  [2.75, 3.15] in 17 *B. corsicus* gynes. Since *B. corsicus* gynes being smaller than 2.75 mm are not known, the size argument indicates a junior synonymy of *mohelensis* with *B. communistus*. This is strongly supported by the fact that two samples collected by Bezděčka at the type locality clearly clustered with *B. communistus* (see above, Figs. 6, 7).

**Biology and distribution:** *Bothriomyrmex communistus* is confirmed for South France, Italy, Austria, Moravia, Slovakia, Hungary, Croatia, Serbia, Bulgaria, Greece, Ukraine, South Caucasus. Southern and northern range limits are at 37.5 and 49.1° N. The mean air temperature from May to August of 49 European sites is  $19.72 \pm 2.20$  [15.6, 24.0]°C which is significantly higher than in *B. corsicus*. Main habitat is open xerothermous grassland, often in karst regions. In southern parts of its range it may occur in light forest. It is the most abundant species of the genus in Europe. Considering the whole European range, alates occur in two periods: 22 May - 15 July ( $n = 7$ ) and 18 August to 1 October ( $n = 6$ ), the first period is observed in both Central European and Mediterranean populations, the second period only in the Mediterranean populations.

### ***Bothriomyrmex corsicus* SANTSCHI, 1923**

*Bothriomyrmex meridionalis* var. *corsica* SANTSCHI, 1923 [type investigation]

*Bothriomyrmex meridionalis* ssp. *gibbus* SOUDEK, 1924; syn.n. [type investigation]

*Bothriomyrmex corsicus* ssp. *gallicus* EMERY, 1925 [type investigation]

*Bothriomyrmex corsicus* var. *ligurica* EMERY, 1925 [type investigation]

*Bothriomyrmex menozzii* EMERY, 1925; syn.n. [type investigation]

**Type material of *Bothriomyrmex meridionalis* var. *corsica* SANTSCHI, 1923:** Holotype gyne labelled "Corse Poggiolo Santschi 30 VIII 22 1922", "Bothriomyrmex meridionalis v corsica Sant" and "Holotype Bothriomyrmex corsicus Santschi, 1923 Dubovikoff det.", Naturhistorisches Museum Basel.

**Type material of *Bothriomyrmex meridionalis gibbus* ssp. SOUDEK, 1924:** Lectotype worker labelled "Transcriptio Moravia centr. Moravsky Kras Suchý zleb 15.IV 1923 St.Soudek leg.", "Transcriptio Bothriomyrmex  $\checkmark$  meridionalis gibbus ssp.n. St.Soudek det.", "Collectio J.Slaviček Moravské museum, Brno", "Invent. č. 1190 / Ent. Mor.museum, Brno", "Typus", "Syntypus" and "Lectotype Bothriomyrmex gibbus Soudek 1924 Dubovikoff des."; one paralectotype worker labelled "Transcriptio Moravia centr. Moravsky Kras Suchý zleb 15.IV 1923 St.Soudek leg.", "Transcriptio Bothriomyrmex  $\checkmark$  meridionalis gibbus ssp.n. St.Soudek det.", "Macocho 1923 Dr.Soudek", "Bothr.merid.gibbus". "Collectio J.Slaviček moravské museum, Brno", "Invent. č. 1187 / Ent. Mor. museum, Brno", "Syntypus" and "Paralectotype Bothriomyrmex gibbus Soudek 1923 Dubovikoff des."; one paralectotype worker labelled "Transcriptio Moravia centr. Moravsky Kras Suchý zleb 1923 St.Soudek leg.", "Transcriptio Bothriomyrmex  $\checkmark$  meridionalis gibbus ssp.n. St.Soudek det.", "Collectio J.Slaviček Moravské museum, Brno", "Invent. č. 1191 / Ent. Mor.museum, Brno", "Syntypus" and "Paralectotype Bothriomyrmex gibbus Soudek Dubovikoff des."; all material Moravian Museum Brno. Lectotype fixation already published by DUBOVIKOFF (2002).

**Type material of *Bothriomyrmex corsicus* ssp. *gallicus* EMERY, 1925:** Lectotype worker labelled "COTYPE", "B. corsicus var. gallicus Em. a Salève (Forel)" (Forel's handwriting), "Salève (Forel)" (Santschi's handwriting) and "Lectotype Bothriomyrmex gallicus Emery, 1925 Dubovikoff des."; NHM Basel. Two paralectotype workers labelled "P./ F Salève Forel  $\checkmark$ " [Forel's handwriting], "SYNTYPUS Bothriomyrmex corsicus ssp. gallicus Emery, 1925"; MCSN Genova. One paralectotype worker labelled "Dijon", "SYNTYPUS Bothriomyrmex corsicus ssp. gallicus Emery, 1925"; MCSN Genova. One paralectotype gyne labelled "Marseille Abeille", "SYNTYPUS Bothriomyrmex corsicus ssp. gallicus Emery, 1925"; Museo Civico di Storia Naturale Genova.

**Type material of *Bothriomyrmex corsicus* var. *ligurica* EMERY, 1925:** Four syntype workers labelled "LIGURIA VITTORIA VI. 1922 G.Mantero", "B. corsicus var. ligurica Emer" [Emery's handwriting], "SYNTYPUS Bothriomyrmex corsicus var. ligurica Emery 1925"; Museo Civico di Storia Naturale Genova.

**Type material of *Bothriomyrmex menozzii* EMERY, 1925:** Holotype gyne labelled "Emilia Marano Menozzi", "B.menozzii Eme", "TYPUS", "SYNTYPUS Bothriomyr-

mex menozzii Emery, 1925", Museo Civico di Storia Naturale Genova.

**Description and differential diagnosis of worker** (Figs. 1, 4; Tab. 1): Medium-sized, CS 563 - 655  $\mu$ m. Head and scape moderately elongated; CL / CW 1.074 - 1.140, SL / CS 0.878 - 0.929. Head sides before the eyes notably converging, ClyW / CS 0.736 - 0.771 (best diagnostic character, clearly smaller than in any other European species). 2<sup>nd</sup> funiculus segment rather short, F2 / CS 0.143 - 0.165. Postocular distance short, PoOc / CL 0.428 - 0.461 (significantly shorter than in *B. meridionalis* and *B. atlantis*). Hind margin of head and frontal face of 1<sup>st</sup> gaster tergite without erect setae. Eye large, EYE / CS 0.162 - 0.186 (much larger than in *B. meridionalis* and *B. atlantis*). Metanotal groove usually well-developed, MGr / CS 2.1 - 4.1% (frequently deeper than in *B. communistus*, always deeper than in *B. meridionalis* and *B. atlantis*). Differences between *B. meridionalis*, *B. corsicus* and *B. communistus* in curvature of mesosomal sclerites and relative position of metanotal and propodeal spiracles suggested by Figs. 3 - 5 have not been checked by numeric data; dorsal surface of propodeum in *B. corsicus* shorter and much more curved than in *B. communistus* and *B. meridionalis*. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite rather small, PLG / CS 4.64 - 5.68% (most diagnostic character, significantly shorter than in all other European species). Head and gaster often a little darker than in *B. communistus*, giving a stronger contrast to mesosoma.

**Description and differential diagnosis of gyne** (Tab. 2): medium-sized, CS 693 - 762  $\mu$ m (much larger than *B. communistus*). Head in full face view with a weakly concave to straight posterior margin and short; CL / CW 1.038 - 1.141 (much shorter than in *B. meridionalis*), scape rather short, SL / CS 0.876 - 0.949 (much shorter than in *B. meridionalis*). Head sides before the eyes strongly converging, ClyW / CS 0.636 - 0.683 (best diagnostic character, much smaller than in any other European species). 2<sup>nd</sup> funiculus segment short, F2 / CS 0.151 - 0.178 (slightly shorter than in *B. communistus*, but much shorter than in *B. meridionalis*). Postocular distance moderately long, PoOc / CL 0.440 - 0.464 (significantly shorter than in *B. meridionalis*). Hind margin of head without erect setae, frontal face of 1<sup>st</sup> gaster tergite without or with only few erect setae. Eye relatively small, EYE / CS 0.229 - 0.258 (significantly smaller than in *B. corsicus*). Relative mesosoma length moderate, ML / CS 1.362 - 1.543 (significantly smaller than in *B. meridionalis*). Scape and tibiae without fine semierect setae. Pubescence on scape, tibiae, head, mesosoma and gaster appressed and very short. Mean length of pubescence hairs on 1<sup>st</sup> gaster tergite very small, PLG / CS 1.74 - 2.97% (best diagnostic character, much shorter than in any other European species). Head, mesosoma and gaster medium to dark brown.

**Results of taxonomical evaluation:** The convincing results of discriminant and principal component analysis and the clear allocation of the type specimens of seven taxa to either the *B. communistus* and *B. corsicus* cluster are given in the *B. communistus* section. There is no indication that the single type gyne of *B. corsicus* from Corsica deviates from the continental populations. Considering the full phenotypic character set in a PCA, there was no combination of principal components 1 to 5 according to which this gyne was outside the continental cluster.

**Biology and distribution:** *Bothriomyrmex corsicus* is second most abundant species of the genus in Europe and was confirmed for South France, Corsica, Italy, Slovenia, Switzerland, Austria, Moravia, Slovakia, Kosovo, Romania, and Bulgaria. The southern and northern range limits were at 41.5 and 49.4° N. The mean air temperature from May to August of 44 European sites was  $17.50 \pm 2.18$  [12.8, 22.7]°C which is 2.3°C colder than in *B. communistus*. It goes up to 1300 m at 42° N – i.e., about 500 m higher than *B. communistus*. The preferred habitat is open xerothermous grassland, often in karst regions. It builds up very populous nests. Alates occur in a monophasic period within the period 20 August  $\pm$  19 days [19 July - 27 September] (n = 17, data from whole European range). One flying gyne was caught at about eight hours a.m.

**There is no Palaearctic taxon of *Bothriomyrmex* described before 31 March 1923 which is a senior synonym of a European taxon.**

In the sections above I proved the existence of four species in Europe: *Bothriomyrmex meridionalis* ROGER, 1863, *B. atlantis* FOREL, 1894, *B. communistus* SANTSCHI, 1919 and *B. corsicus* SANTSCHI, 1923. In order to confirm name priority in these cases, it is important to check which further taxa have been described from other regions of the Palaearctic before 31 March 1923, the date of description of *B. corsicus*. This condition is matched by nine taxa described by FOREL (1910) and SANTSCHI (1911, 1919) from the Middle East and North Africa. These taxa were definitely no senior synonyms of *B. communistus* and *B. corsicus* and, surprisingly, most of these taxa have good chances to be confirmed as separate species once enough data will be available. The cases are commented in the following.

***Bothriomyrmex syrius* FOREL, 1910**

This taxon was described as *Bothriomyrmex meridionalis* var. *syria* in workers from Lebanon: Doummar, Anti Liban (leg. M. Gaddeau de Kerville) and is likely to represent a good species (Tab. 1). Examined were three syntype workers labelled "TYPUS", "*Bothriomyrmex meridionalis* Roger v. *syria* Forel ♂ type Doummar Antiliban Syrie (Kerville)"; three syntype workers labelled "TYPUS", "*Bothriomyrmex meridionalis* Rog. v. *syria* ♂ type Forel", "Doumar / Syrie) (Kerville / c)" [poorly legible], all deposited Muséum d'Histoire Naturelle Genève.

The morphology of the type series and of the single worker from Israel is fully outside the range of variation of *B. corsicus* in the characters ClyW / CS, EYE / CS, dAN / CS and MGr / CS and it is fully outside the range of variation of *B. communistus* in the characters EYE / CS and PLG / CS. Furthermore, 98.3% of the *B. communistus* samples have a CL / CW value larger than in the studied *B. syrius* workers.

***Bothriomyrmex decapitans* SANTSCHI, 1911**

This species has been described from Tunisia: Kairouan in worker, gyne and male. Types were not ordered because the synonymy with *B. communistus* and *B. corsicus* is perfectly excluded alone by the much larger absolute size of the gyne and other characters Santschi reported in figures and verbal descriptions.

***Bothriomyrmex crosi* SANTSCHI, 1919**

It has been described as species from Algeria: Mascara (leg. Dr. Cros) in the gyne, male and worker. Types were not ordered because a synonymy with *B. communistus* and *B. corsicus* can be clearly excluded alone by the extremely long head and scape pilosity and much too large size of the gyne reported in Santschi's description.

***Bothriomyrmex inquilinus* SANTSCHI, 1919**

This species has been described from Tunisia: Le Kef in the worker and gyne. Types were not ordered from Basel because a synonymy with *B. communistus* and *B. corsicus* can be clearly excluded according to description. The gyne of *B. inquilinus* is much larger than those of *B. communistus* and *B. corsicus*: The total length of head plus mesosoma is 2.4 mm (in *B. corsicus*  $\pm$  1.8 mm and *B. communistus*  $\pm$  1.6 mm). According to fig. II-14, the entire contour of head capsule is fringed by short erect setae – a character not found in *B. communistus* and *B. corsicus*.

***Bothriomyrmex regicidus* SANTSCHI, 1919**

It has been described as species from Tunisia: Kairouan in workers and gynes. Examined were the lectotype, a dealate gyne, labelled "Kairouan IV 06", "*Bothriomyrmex regicidus* Sant Type ♀ Kairouan Janvier 1906 (Santschi)" [Santschi's handwriting], "Lectotype *Bothriomyrmex regicidus* Santschi, 1919 Dubovikoff des."; a dealate paralectotype gyne labelled "*Bothriomyrmex regicidus* Sant Type" [Santschi's handwriting], "K. VII. 06 vol nup. Sant" [Santschi's handwriting]; two males and eight workers on two pins both labelled "Kairouan 1906 (Sants)", "*Bothriomyrmex regicidus* Sant Type Kairouan I. 1906"; all in Naturhistorisches Museum Basel.

A senior synonymy with the European taxa can be clearly excluded by the following facts. The *B. regicidus* type gynes are outside the range of variation of *B. corsicus* and *B. communistus* in the characters CL / CW, SL / CS, CS, and PLG / CS – additional differences can be derived from Table 2. The *B. regicidus* type workers are fully outside the range of variation of *B. corsicus* in the characters PoOc / CL, ClyW / CS, EYE / CS, PrL / CS, MGr / CS, and PLG / CS and they are fully outside the range of variation of *B. communistus* in PoOc / CL (Tab. 1). Furthermore, 98.3% of the *B. communistus* samples have a F2 / CS value larger and 93.3% a PrL / CS value smaller than in the *B. regicidus* type sample.

***Bothriomyrmex breviceps* SANTSCHI, 1919**

It has been described as species from Tunisia: La Quareb in the worker and gyne. Examined were the lectotype gyne labelled "Tunisie La Quareb Santschi", "*Bothriomyrmex breviceps* Sant- ♀ ♂ ♂ type.", "Lectotype *Bothriomyrmex breviceps* Santschi, 1919 Dubovikoff des."; seven paralectotype workers plus one male on the same pin "La Quareb 24 XII - 10", "Paralectotype *Bothriomyrmex breviceps* Santschi, 1919 Dubovikoff des."; all material Naturhistorisches Museum Basel.

A synonymy with *B. communistus* and *B. corsicus* can be clearly excluded because the workers and gyne have ClyW / CS much above the upper extremes of these and any other species (Tabs. 1, 2). Extreme character expressions are also observed in EYE, PLG and DAN of the gyne.

### ***Bothriomyrmex cuculus* SANTSCHI, 1919**

It has been described as species from Tunisia: Dir-el-Kef. Examined were the lectotype gyne plus seven paralectotype workers on the same pin, labelled "Tunisie Dir el Kef Santschi V. 13", "Lectotype (gyne, top) Paralectotype (workers) *Bothriomyrmex cuculus* Santschi, 1919 des. B. Seifert 2011"; ten paralectotype workers on the same pin, labelled "6.", "Tunisie Le Kef Santschi V. 13"; one paralectotype worker labelled "Tunisie Le Kef Santschi V. 13", "*Bothriomyrmex regicidus* Sant v. *cuculus* Sant"; all material Naturhistorisches Museum Basel.

The *B. cuculus* lectotype gyne differs from *B. communistus* and *B. corsicus* by having a CL / CW much above the upper extremes observed in the latter species. The worker of *B. cuculus* differs by significantly larger CL / CW and PoOc / CL, and smaller EYE / CS. Other strongly deviating characters, in particular against *B. corsicus*, can be derived from Tables 1 and 2. The heterospecificity of *B. cuculus* and *B. regicidus* seems doubtful but investigating this is not the topic of this paper.

### ***Bothriomyrmex emarginatus* SANTSCHI, 1919**

It has been described as species in an alate gyne from Tunisia: Ain-Draham. Examined was the holotype, labelled "TUNISIE Ain Draham Dr. Normand 1909-1910", "*Bothriomyrmex emarginata* ♀ type Sant" [Santschi's handwriting], "Holotype *Bothriomyrmex emarginatus* Santschi", Naturhistorisches Museum Basel.

CL / CW, SL / CS, PoOc / CL, F2 / CS, and F3 / CS of the holotype of *B. emarginatus* are above the upper extremes observed in *B. communistus* and *B. corsicus* (Tab. 2; see there also for other differences). Hence, a synonymy can be clearly excluded.

### ***Bothriomyrmex pubens* SANTSCHI, 1919**

It has been described as species from Tunisia: Le Kef in workers, gynes and males. Examined were the lectotype gyne labelled "Tunisie Le Kef", "*Bothriomyrmex pubens* Sants type Le Kef (Dr. Santschi coll.)", "Lectotype *Bothriomyrmex pubens* Santschi, 1919 Dubovikoff des."; a paralectotype gyne labelled "Tunisie Le Kef", "*Bothriomyrmex pubens* Sants type Le Kef (Dr. Santschi coll.)", "Paralectotype *Bothriomyrmex pubens* Santschi, 1919 Dubovikoff des."; five paralectotype workers labelled "Tunisie Le Kef", "*Bothriomyrmex pubencens* Sants type"; all Naturhistorisches Museum Basel.

Synonymies can be clearly rejected. The two type gynes are outside the known variation in *B. communistus* and *B. corsicus* in having larger CS, smaller EYE / CS and much more numerous setae on frontal face of 1<sup>st</sup> gaster tergite (Tab. 2). The type workers are outside the known variation in *B. communistus* and *B. corsicus* in having much smaller EYE / CS. Not or very weakly overlapping with *B. communistus* are the data of SL / CS, PoOc / CL, DAN / CS, and PrL / CS (Tab. 1). The paralectotype workers are completely outside the range of *B. corsicus* in SL / CS, PoOc / CL, CLyW / CS, PrL / CS, MGr / CS, and PLG / CS.

### **Taxa to be checked if additional species will be identified from Europe**

The previous section aimed to make sure that there were no senior synonyms referring to the four species identi-

fied from the territory of Europe. In case of discovery of additional species not fitting to these four species, it will be necessary to also check the following taxa, the types of which were currently not available but should probably exist in the museums of Geneva, Genova, Basel, Bologna, Sibiu, Kiev, and St. Petersburg.

***Bothriomyrmex adriacus* ssp. *anatolicus* EMERY, 1925:** Described in the worker from Anatolia "Ismid près Smyrne (coll. Forel au Muséum de Genève)".

***Bothriomyrmex adriacus* ssp. *ionius* EMERY, 1925:** Described in the worker from Corfou (leg. Silvestri). Synonym of *Bothriomyrmex communistus*?

***Bothriomyrmex syrius* ssp. *turcomenicus* EMERY, 1925:** Described in the worker from Turkmenistan: Merv, Bagir (N. Kuznezov leg.).

***Bothriomyrmex atlantis* var. *perfidus* SANTSCHI, 1926:** Described in workers and gyne from "Tunisie: Cherichera (25-X-25), 1 ♀ et plusieurs ♂ trouvés nichant sous une pierre sur le flanc Nord d'une colline de 300 mètres."

***Bothriomyrmex jannonei* MENOZZI, 1936:** Described in the worker from the Island of Calymnos.

***Bothriomyrmex meridionalis* var. *hungarica* ROESZLER, 1942:** Collection data of types: Budapest, Nagytétény, 1 April 1935. The description is extremely sparse. ROESZLER (1942) stated workers of 1.9 - 2.9 mm total length and distinguished small and large workers with each of the latter acting as repletes. According to the species expected for the type locality, var. *hungarica* should be a junior synonym of *B. communistus* or, less likely, of *B. corsicus*. The identification of types in the Paul Roeszler collection in the museum of Sibiu (Hermannstadt) is problematic. MARKÓ & CSÖSZ (2002) revised the whole collection and reported of three existing workers from Budapest: Nagytétény, 1 May 1935, leg. Rösler, No. 126. These are labelled "*Bothriomyrmex dimorphus* RÖSZLER det. RÖSZLER, typus". The disagreement in collecting date is probably a writing error and the unavailable (unpublished) name *B. dimorphus* indicates the dimorphic condition (normal workers plus repletes) Roeszler reported for the living nest population of *B. m. hungarica*. Hence, these three workers probably represent the missing types of *B. m. hungarica*.

***Bothriomyrmex modestus* RADCHENKO, 1985:** Collection data of types: Ukraine, Proval'skaya step', near selo Provalje, 30 June 1983 (leg. Radchenko). Radchenko stated for the worker a narrower head than in the ant he called "*B. gibbus*" and the petiole to have single setae also near to crest. Types probably in Schmalhausen Institute of Zoology Kiev.

***Bothriomyrmex anastasiae* DUBOVIKOFF, 2002:** The holotype gyne plus three gyne and three worker paratypes originate from Dzhankhot, SE of Gelendzhik, Russia, leg. Arnoldi 8.VII.1956. Dubovikoff allocated this species to a "*B. adriacus* group" without giving an argumentation or defining the characters of this group. Comparing the types of *B. m. adriacus* with Dubovikoff's drawings of gyne head and worker mesosoma of *B. anastasiae*, the latter seems to be more similar to *B. corsicus*: The head sides of the gyne converge conspicuously towards the clypeus and the metanotal depression and propodeal curvature of the worker is more similar to the situation in *B. corsicus*. Types in Zoological Institute of the Russian Academy of Sciences in St. Petersburg.

***Bothriomyrmex urartus* DUBOVIKOFF, 2002:** The holotype gyne plus two male, one gyne and two worker para-

types originate from Dzhrvezh near Erevan, Armenia, leg. Radchenko, 19.VI.1988. Dubovikoff associated his new species close to *B. communistus* and stated as difference from the latter "the presence of standing pubescence on gyne body" and some putative differences in male genitalia. There was no study on intraspecific variation of these supposed diagnostic characters. Types in Zoological Institute of the Russian Academy of Sciences in St. Petersburg.

#### ***Bothriomyrmex incertae sedis***

The following taxa cannot be reliably interpreted because of insufficient descriptions in combination with loss of types or inability to identify these.

***Bothriomyrmex costae* EMERY, 1869:** According to EMERY (1869) the type material consisted in a single gyne "provvegnente ai dintorni di Napoli". 56 years later he wrote that the type had been kept in the museum of university of Naples (coll. Costa) but had been consumed by *Anthrenus* and he doubted the accuracy of his own figures on *B. costae* published in 1869 because they did not fit to any species he knew (EMERY 1925).

***Bothriomyrmex regicidus* var. *saundersi* SANTSCHI, 1922:** Santschi described this variant in the gyne and male but gave no locus typicus or terra typica. Types cannot be identified. SANTSCHI (1922) stated for the gyne: Head plus mesosoma 1.8 mm long. Dark reddish-brown. Eyes a little bit larger than their distance from anterior border of head. Scape a little surpassing occipital margin. In absence of types and figures, this taxon cannot be positively identified. Against a synonymy with *B. corsicus* speaks that the body colour of fresh *B. corsicus* gynes is dark to blackish brown without a notable reddish component. Furthermore, if Santschi should have meant with eye size the projected length of eye visible in dorsal view and with "anterior border of head" the anterior clypeal margin, the eye of *B. saundersi* would be larger than in *B. corsicus*.

***Bothriomyrmex corsicus* ssp. *laticeps* EMERY, 1925:** Described in the worker from the Pyrenees without precise locality (coll. Pandellé). Not found in Muséum National d'Histoire Naturelle Paris and Museo Civico di Storia Naturale Genova.

#### **Key to the workers of European *Bothriomyrmex* species**

Morphometric data in this key are nest sample means of two workers.

- 1a Clypeal width small, ClyW / CS 0.736 - 0.771 (Fig. 1). Pubescence of first gaster tergite short, PLG / CS 4.64 - 5.68%. Propodeal dome usually clearly surmounting mesonotum, rather short and strongly curved (Fig. 5), metanotal groove / depression always present, MGr / CS 2.1 - 4.4%. ..... ***B. corsicus***
- 1b Clypeal width larger, ClyW / CS 0.773 - 0.826. Pubescence of first gaster tergite longer, PLG / CS 5.62 - 8.15%. Dorsal plane of propodeum almost at same level with mesonotum, longer and less curved (Figs. 3, 4), metanotal groove / depression absent or weaker, MGr / CS 0.0 - 3.3. .... **2**
- 2a Postocular distance smaller, PoOc / CL 0.421 - 0.465; Eye larger, EYE / CS 0.144 - 0.179. ....  
..... ***B. communistus***

- 2b Postocular distance larger, PoOc / CL 0.467 - 0.486; Eye smaller, EYE / CS 0.109 - 0.146. .... **3**
- 3a Scape and 2<sup>nd</sup> funiculus segment much longer, SL / CS 0.911 - 0.941, F2 / CS 0.167 - 0.184.  
..... ***B. meridionalis***
- 3b Scape and 2<sup>nd</sup> funiculus segment much shorter, SL / CS 0.846 - 0.867, F2 / CS 0.144 - 0.159.  
..... ***B. atlantis***

#### **Key to the gynes of European *Bothriomyrmex* species**

- 1a Head sides in front of eyes strongly converging, clypeal width small, ClyW / CS 0.636 - 0.683. Pubescence of first gaster tergite appressed and short, PLG / CS 1.7 - 3.0%. ..... ***B. corsicus***
- 1b Head sides in front of eyes weakly converging, clypeal width higher, ClyW / CS 0.697 - 0.742. Pubescence of first gaster tergite not perfectly smooth and longer, PLG / CS 3.5 - 5.5%. ..... **2**
- 2a Scape very long, SL / CS > 0.98. .. ***B. meridionalis***
- 2b Scape not very long, SL / CS < 0.96. .... **3**
- 3a Scape longer: SL / CS 0.881 - 0.948. Small, CS < 700 µm. .... ***B. communistus***
- 3b Scape much shorter, SL / CS < 0.85. Large, CS > 700 µm. .... ***B. atlantis***

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