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Redescription of *Tetramorium forte* Forel, 1904 (Insecta: Hymenoptera: Formicidae), a western Mediterranean ant species

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Abstract

The western Mediterranean ant species *Tetramorium forte* Forel, 1904 is redescribed and a lectotype is designated. Taxonomic controversy surrounding the application of the name and its synonymy is thereby resolved: *T. ruginode* Stitz, 1917 (with its junior synonym *T. hispanicum* Bondroit, 1918), *T. maurum tingitanum* Santschi, 1929 and *T. maroccanum* De Haro & Collingwood, 1994 are relegated to synonymy with *T. forte*. Lectotypes are designated for *T. hispanicum*, *T. maurum tingitanum*, *T. maroccanum* and *T. silvestrianum* Emery, 1924. The latter taxon, previously regarded as a junior synonym of *T. forte*, is synonymized with *Myrmica*

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specioides Bondroit, 1918. The distribution of *T. forte* is outlined, which encompasses southern France, the Iberian Peninsula and parts of the western Maghreb. Numerous new records are cited from throughout this range. Characters that distinguish *T. forte* from the similar species *T. chefketi* Forel, 1911, *T. alternans* Santschi, 1929 nov. stat. and *T. moravicum* Kratochvil, 1941, are presented. The latter species geographically overlaps with *T. forte* in southeastern France. Life history information available for *T. forte* is summarized.

Key words: Myrmicinae, Tetramoriini, taxonomy, lectotype designation, distribution, identification

Introduction

In the Palaearctic region, species level taxonomy in the ant genus *Tetramorium* Mayr, 1855 has remained a particularly challenging issue (López 1991; Seifert 1996; Radchenko *et al*. 1998; Sanetra *et al*. 1999; Sanetra & Buschinger 2000; Steiner *et al*. 2005). This is mainly due to the high morphological variability in the worker caste, the lack of diagnostic characters useful for species distinction and the large number of infraspecific entities described by early myrmecologists. While the *Tetramorium* taxa of other zoogeographical regions have been thoroughly revised (Bolton 1976, 1977, 1979, 1980), progress in the Palaearctic has been confined to partial revisions of local faunae with varying success (*e.g.* López 1991; Radchenko 1992; Cagniant 1997; Sanetra *et al*. 1999). Even the very common and widespread species *T. caespitum* (Linnaeus, 1758) and *T. impurum* (Förster, 1850) have been reliably distinguished only recently (Cammaerts *et al*. 1985; Seifert 1996) but new data suggest that they in turn are an assembly of cryptic species (Steiner *et al*. 2002; Schlick-Steiner *et al*., 2006).

It is thus not surprising that in species-rich parts of the Palaearctic, such as the Mediterranean region and particularly southeastern Europe and the Middle East, most *Tetramorium* species are neither well defined morphologically nor satisfactorily delimited in their geographic ranges. Fewer species seem to occur in the southwestern parts of Europe (*e.g.* Iberian Peninsula) than on the Apennine Peninsula (Sanetra *et al.* 1999) and the Balkans (Sanetra & Buschinger 2000; Steiner *et al.* 2005; Schlick-Steiner *et al.*, in press). We here give detailed taxonomic and distributional information on a species well represented in the western Mediterranean region (southern France, Iberian Peninsula, northwestern Africa), which has not been characterized satisfactorily, and whose correct name has been controversial for a long time. The name we stabilize here for this taxon, *Tetramorium forte* Forel, 1904, has occasionally been applied to other taxonomic species, including eastern European ones (*e.g. T. moravicum* Kratochvil, 1941), while *T. forte* as defined here has often been referred to by its junior synonyms *T. ruginode* Stitz, 1917 or *T. hispanicum* Bondroit, 1918. The prevalent confusion has been at least partly caused by the type material containing several taxonomic species. Thus, to achieve nomenclatural stability for this ant species after 100 years, a lectotype of *T. forte* is designated.

Material and methods

Types and other critical specimens from the following collections have been studied:

MHNG	Muséum d´Histoire Naturelle de Genève, Switzerland
NHMB	Naturhistorisches Museum Basel, Switzerland
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany
MCSN	Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy
DSTA	Dipartimento di Scienze e Tecnologie Agroambientali, Alma Mater Studiorum Università di Bologna, Italy (formerly Istituto di Entomologia "Guido Grandi" de l´Università)
CAS	personal collection of Andreas Schulz, Leverkusen, Germany

The samples constituting the new records of *Tetramorium forte* listed below are deposited in CAS, some specimens will be transferred to MHNG, NHMB, MCSN and the Hungarian Natural History Museum, Budapest, Hungary.

Measurements

All measurements in this study were taken using a Zeiss Stemi SR stereo microscope equipped with an ocular graticule, at a maximum magnification of 250x. The data are presented as mean±standard deviation, with minimum and maximum value in brackets.

The following measurements were taken:

HL	Maximum head length in median line. Both anterior and posterior outline of head must be in focus. Excavations of preoccipital margin and/or clypeus reduce HL.
HW	Maximum head width above the eyes.
HS	Head size—the arithmetic mean of HL and HW, used as a less variable indicator of body size.
SL	Maximum straight line scape length, excluding the neck and basal condyle. To obtain the real maximum, a frontal to dorsal viewing position is necessary.
2FL	Maximum length of second funiculus segment, only measured in males.
ED	Maximum diameter of eye in dorsal view, only measured in males.
ML	Mesosoma length. This is measured in lateral view from the frontalmost point of the anterior pronotal slope to the caudalmost portion of the propodeum ("Weber´s length").
MW	Maximum mesosoma width. This is measured in dorsal view at the widest part of the pronotum (workers) or constitutes the maximum width of scutum (gynes and males).
PSL	Propodeal spine length, measured in workers and gynes. In dorsocaudad view, the tip of the measured spine, its base, and the center of the concavity between the spines must all be in focus (Fig. 1: points 1, 2 and 3). Using a cross-shaped ocular

	graticule, point 1 is placed along the vertical scale, point 3 along the horizontal scale. The spine length is measured as the distance from point 1 to point 2. We measured always the right spine. We did not calculate the often used propodeal spine index, measured in lateral view, which is the distance from the propodeal spiracle to the spine tip divided by the distance of the spiracle to the posterior border of the propodeum. It is nearly impossible to focus exactly, and to find the midpoint of the rounded concave border. Also we believe that the spiracle is very variable in its position, which does not relate to the propodeal spine length.
PEL	Petiole length, measured in workers and gynes. The maximum length of the petiolar node is measured in dorsal view from the anterior notch close to the propodeum to the articulation with the postpetiole. Both points must be in focus.
PEW	Maximum width of petiole in dorsal view.
PEH	Petiole height, measured in workers and gynes. The maximum height of the petiolar node is measured in lateral view from the highest (median) point of the node to the ventral outline. The ventral outline has always a short concave part, which is the ventral measuring point.
PPL	Maximum length of postpetiole in dorsal view, only measured in workers.
PPW	Maximum width of postpetiole in dorsal view.

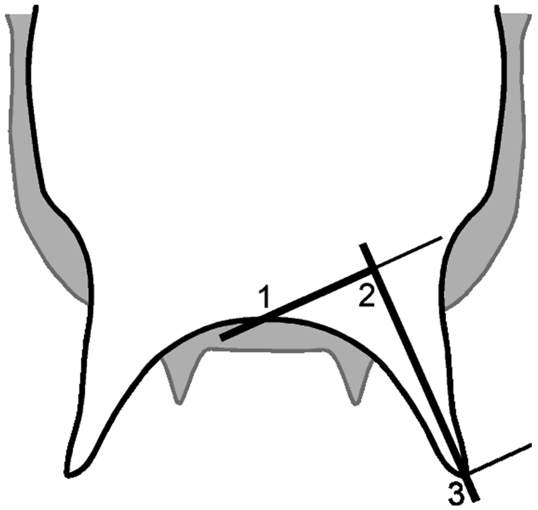


FIGURE 1. Measurement method for propodeal spine length (PSL) in ant workers using a cross-shaped ocular graticule, dorsocaudal view. Points 1, 2 and 3 must be in focus.

The indices given in addition to the measurements are the following: HW/HL, SL/HS, SL/2FL, HS/ML (in gynes only), MW/ML, PSL/ML, PEH/PEL, PEW/PEL, PEW/HS, PPL/PPW, PPW/HS, PEW/PPW. We also calculated two indices which give a dimension of waist width in relation to body size: WI-A = PEW+PPW/2xML; WI-B = PEW+PPW/2xHS, this latter being useful only in workers.

Photography

The photographic images presented here (Figs 2–20) were taken using a digital camera (JVC KY-70B) attached to a Leica Z6 APO stereo microscope. The microscope was equipped with a Z-stepper (Syncroscopy, Synoptics Ltd.) to enable the generation of usually 100 images in different focus layers from which subsequently a montage image was computed using the software AutoMontage Pro 5.02.0096 (Synoptics Ltd.). Montage images were enhanced (Photoshop 7.0, Adobe Systems Inc.) by removing inessential structures out of focus as well as artefacts caused by the montage process.

Tetramorium forte **Forel, 1904**

(Figs 2–6, 11, 16)

Tetramorium caespitum var. *forte* Forel, 1904[a]
Tetramorium caespitum ssp. *caespitum* var. *hispanicum* Emery, 1909 (name unavailable: ICZN § 45.5.)
Tetramorium caespitum var. *ruginode* Stitz, 1917: **syn. nov.**
Tetramorium caespitum var. *hispanicum* Bondroit, 1918 (synonymy with *T. ruginode* Stitz: Collingwood 1978, priority incorrectly given)
Tetramorium hispanicum Emery[sic]: Bondroit 1920
Tetramorium caespitum var. *grandis* Forel: Santschi 1921a (*lapsus calami*)
Tetramorium caespitum st. *maura* var. *tingitana* Santschi, 1921[b] (name unavailable: ICZN § 45.5.)
Tetramorium caespitum st. *ferox* var. *marocana* Santschi, 1921[c] (name unavailable: ICZN § 45.5.)
Tetramorium maurum st. *tingitanum* Santschi, 1929: **syn. nov.**
Tetramorium ferox var. *marocanum* Cagniant, 1964 (name unavailable: ICZN § 45.6.3.)
Tetramorium maroccanum De Haro & Collingwood, 1994: **syn. nov.**
Tetramorium ruginode Stitz: Bolton 1995

Material examined

New records: **France**—☿☿, Dept. Gard, banks of Rhône river 7km n Avignon, 03.V.1992, leg. A. Schulz; ☿☿, ♀♀, Dept. Vaucluse, banks of Rhône river near Avignon, 100m, 05–11.V.1992, leg. A. Schulz; ☿☿, Dept. Hérault, Bois Noir n of Vailhauquès, ca. 15km nw Montpellier, 21.III.1995, leg. Windschnurer; ☿☿, Dept. Bouches-du-Rhône, St.-Martin-de-Crau, ca. 12km e Arles, 23.III.1995, leg. Windschnurer; ☿☿, Dept. Loire, above Malleval, VI.2002 and 02.V.2003, leg. R. Güsten. **Spain**—☿☿, Prov. Badajoz, Presa, near Embalse de Orellana, 22.I.1989, leg. D. Wrase; ☿☿, S side of Sierra Nevada, 2200m, 06–18.V.1991, leg. A. Schulz; ☿☿, Prov. Cádiz, Sierra Ubrique, between Benaocaz and Grazalema, 28.VIII.1991, leg. A. Buschinger & P. Douwes; ☿☿, ♀♀, Prov. Granada, Sierra Nevada, rd GR 420, ca. 3rkm nw Sierra Nevada, ca. 1900m, 22.V.1995, leg. T. Aßmuth & M. Sanetra; ☿☿, ♀♀, Prov. Jaén, se Desfiladero de Despeñaperros, Puerto de los Jardines, 870m, 26.V.1995, leg. T. Aßmuth & M. Sanetra; ☿☿, ♀♀, ♂♂, Prov. Cuenca, ca. 2rkm e Villalba de la Sierra, ca. 20km n Cuenca, ca. 1200m, 26.V.1995, leg. T. Aßmuth & M. Sanetra; ☿☿, Prov. Cuenca, 2rkm n rd Beamud-Buenache, dir. Embalse de la Toba ne Cuenca, ca. 1400m, 27.V.1995, leg. T. Aßmuth & M. Sanetra; ☿☿, ♀♀, Prov. Teruel, Guadalaviar river, 5rkm ne Albarracin, ca. 1200m, 29.V.1995, leg. T. Aßmuth & M. Sanetra; ☿☿, Prov. Cordoba, Sierra de Hornachuelos, Cortijo de Spinola, 23.II.1999, leg. D. Wrase; ☿☿, Com. de Madrid, Boadilla del Monte, ca. 10km w Madrid, 25.II.1999, leg. D. Wrase; ☿☿, Prov. Toledo, Quero, 08.III.1999, leg. D. Wrase. **Portugal**—☿☿, Distr. Viseu, Caldas da Felgueira, 600m, 22.VI.2000, leg. A. Schulz & K. Vock; ☿☿, ♀♀, ♂♂, Distr. Guarda, Serra da Estrela, n slope of Torre, 1500m, 23.VI.2000, leg. A. Schulz & K. Vock; ☿☿, ♀♀, Distr. Castelo Branco, nr. Monsanto, 400m, 25.VI.2000, leg. A. Schulz & K. Vock; ☿☿, Distr. Viseu, Serra de Montemuro, 1100–1300m, 26.VI.2000, leg. A. Schulz & K. Vock; ☿☿, Distr. Bragança, nr. Macedo de Cavaleiros, 600m, 27.VI.2000, leg. A. Schulz & K. Vock; ☿☿, ♀♀, ♂♂, Distr. Bragança, Parque natural de Montesinho, 700–900m, 29.VI.2000, leg. A. Schulz & K. Vock; ☿☿, ♀♀, ♂♂, Distr. Bragança, Parque natural de Montesinho, 700–800m, 30.VI.2000, leg. A. Schulz & K. Vock; ☿☿, Distr. Bragança, Parque natural de Montesinho, 1000–1300m, 01.VII.2000, leg. A. Schulz & K. Vock. **Morocco**—☿☿, ♀♀, Reg. Ifrane, Moyen Atlas, rd 3325, 6rkm n rd S 309, 6rkm se Ifrane, ca. 1800m, 25.IV.1995, leg. R. Güsten, M. Sanetra & R. Schumann; ☿☿, Reg. Meknès, Moyen Atlas, rd S 303, ca. 24rkm s Aïn Leuh, ca. 1300m, 12.V.1995, leg. T. Aßmuth, R. Güsten, M. Sanetra, A. Schulz & R. Schumann; ☿☿, Reg. Meknès, Moyen Atlas, rd 3211, 14 rkm n rd 3485, ca. 40rkm s Aïn Leuh, ca. 1100m, 12.V.1995, leg. T. Aßmuth, R. Güsten, M. Sanetra, A. Schulz & R. Schumann; ☿☿, Reg. Kénitra, Forêt de la Mamora, 2 rkm n Aïn-Johra, 100m, 19–20.V.1995, leg. T. Aßmuth, M. Sanetra & A. Schulz; ☿☿, Moyen Atlas, Reg. Meknès, Aguelmame Azigza, 1500m, 19.II.1999, leg. D. Wrase.

Other examined specimens: 1 ☿, **lectotype of *T. caespitum forte* Forel (hereby designated, Fig. 2)**: „*T. caespitum* L. ☿ v. *forte* Forel, type, Albaron Camargum / Lectotype Poldi 74 / Lectotypus *Tetramorium caespitum forte* Forel des. R. Güsten, A. Schulz & M. Sanetra 2005“ (MHNG, together with 2 paralectotype ☿☿ on same pin, lectotype marked by red cardboard square); 34 paralectotype ☿☿, Albaron (Camargue) (MHNG, 2 of these on same pin as lectotype); 2 paralectotype ☿☿, same data as previous (MCSN); 3 paralectotype ☿☿, same data as previous (NHMB); 2 paralectotype ☿☿, same data as previous (DSTA); 11 ☿☿, FRA, Camargue (MHNG); 3 ☿☿, same data as previous (NHMB); 1 ☿, same data as previous (DSTA); 5 ☿☿, FRA, Albaron, 23.I.1925, leg. A. Chobaut (DSTA); 5 ☿☿, FRA, Banyuls, leg. Saulcy (MCSN); 1 ♀, FRA, Var, Cavalaire-sur-Mer, VI.1922, leg. L. Berland (NHMB); 6 ☿☿, **syntypes of *T. caespitum ruginode* Forel**: „Spanien, Cordova, Lehmann / *Tetramorium caespitum* L. v. *ruginode* Stz.[this label only with one of the syntypes] / Type / Zool. Mus. Berlin” (ZMHB); 5 ☿☿, POR, Viana Castells (DSTA); 1 ☿, ESP, Barcelona, Certellas, VIII.1921, leg. Xaxars (DSTA); 24 ☿☿, 1 ♀, ESP, Pozuelo de Calatrava, leg. La Fuente (DSTA); 5 ☿☿, same data as previous (MCSN); 1 ☿, same data as previous (NHMB); 1 ☿, ESP, Venta de Cardeñas, 27.VII.1879, leg. L. Bleuse (MCSN); 1 ☿, ESP, Chamartín, 15.IV.1900 (MCSN); 4 ☿☿, ESP, Puig, 13.I.1923 (MCSN); 4 ☿☿, ESP, Montsiak, 15.I.1923 (MCSN); 1 ☿, ESP, Cuenca, Belinchón, 08.VII.1925, leg. J.M. Dusmet (NHMB); 3 ☿☿, 1 ♀, ESP, Villalba near Madrid, 28.III.1926, leg. H. & H. Lindberg (NHMB); 2 ☿☿, ESP, Sta Morena Sta Helena, 04–08.IV.1926, leg. H. & H. Lindberg (NHMB); 1 ☿ [not ♀ as stated by Emery 1909], **lectotype of *T. caespitum hispanicum* Bondroit (hereby designated)**: „Espagne Per[?] / Lectotypus *Tetramorium caespitum hispanicum* Bondroit des. R. Güsten, A. Schulz & M. Sanetra 2005" (MCSN); 1 paralectotype ☿ (of *T. c. hispanicum*), same data as previous (MCSN); 2 paralectotype ☿☿ (of *T. c. hispanicum*), leg. Cabrera (MCSN, together with 1 paralectotype ☿ of *T. c. hispanicum* on same pin which is not *T. forte*); 1 paralectotype ☿ (of *T. c. hispanicum*), ESP (MHNG); 2 paralectotype ☿☿ (of *T. c. hispanicum*), ESP, Carmona (DSTA); 1 ♀, **lectotype of *T. maurum tingitanum* Santschi (hereby designated)**: „Maroc, Rabat, Thery / *T. caespitum* st *maura* v. *tingitana*, Santschi det. 1920 / Naturhist. Museum Basel / Sammlung Dr. F. Santschi, Kairouan / Lectotypus *Tetramorium maurum tingitanum* Santschi des. R. Güsten, A. Schulz & M. Sanetra 2005" (NHMB, together with paralectotype ♀ on same pin, lectotype marked by red cardboard square); 1 paralectotype ♀ (of *T. m. tingitanum*), MAR, Rabat, leg. A. Théry (NHMB, on same pin as lectotype); 1 ☿, **lectotype of *T. maroccanum* De Haro & Collingwood (hereby designated)**: „Aïn Leuh 103 / 17 / 41[?] / *Tetramorium caespitum* v. *marocane* Sants., Santschi det. 19 / Sammlung Dr. F. Santschi, Kairouan / Naturhist. Museum Basel / Lectotypus *Tetramorium maroccanum* De Haro & Collingwood des. R. Güsten, A. Schulz & M. Sanetra 2005" (NHMB); 1 paralectotype ☿ (of *T. maroccanum*), MAR, Aïn Leuh (NHMB); 1 ☿, MAR, Aïn Leuh, leg. A. Théry (NHMB); 2 ☿☿, MAR, Rabat, leg. A. Théry (NHMB); 1 ☿, MAR, Tanger, 1901, leg. G. Buchet (NHMB); 2 ☿☿, MAR, Larache, III.1907 (NHMB); 1 ☿, MAR, Ben-Slimane (formerly Boulhaut), leg. A. Théry (NHMB); 2 ☿☿, MAR, Khénifra near Azrou, leg. A. Théry (NHMB); 11 ☿☿, MAR, Forêt de Zaer (DSTA).

Description of worker

Measurements and indices (n=34): HL 0.824±0.057(0.725–0.936)mm, HW 0.783±0.059(0.680–0.906)mm, HS 0.804±0.056(0.702–0.921)mm, SL 0.631±0.038(0.563–0.728)mm, ML 0.986±0.111(0.831–1.194)mm, MW 0.529±0.046(0.456–0.637)mm, PSL 0.104±0.016(0.076–0.143)mm, PEL 0.328±0.033(0.247–0.385)mm, PEW 0.290±0.030(0.219–0.342)mm, PEH 0.271±0.026(0.238–0.323)mm, PPL 0.208±0.017(0.171–0.238)mm, PPW 0.335±0.037(0.257–0.404)mm, HW/HL 0.951±0.022(0.912–1.020), SL/HS 0.786±0.026(0.727–0.840), MW/ML 0.560±0.032(0.509–0.675), PSL/ML 0.110±0.012(0.085–0.130), PEH/PEL 0.826±0.048(0.750–1.019), PEW/PEL 0.868±0.078(0.742–1.192), PEW/HS 0.360±0.019(0.311–0.402), PPL/PPW 0.622±0.044(0.553–0.688), PPW/HS 0.419±0.021(0.365–0.466), PEW/PPW 0.860±0.044(0.813–1.033), WI-A 0.322±0.019(0.269–0.359), WI-B 0.390±0.018(0.338–0.430).

Measurements and indices of the lectotype (Fig. 2): HL 0.906mm, HW 0.891mm, HS 0.898mm, SL 0.675mm, ML 1.102mm, MW 0.618mm, PSL 0.143mm, PEL 0.385mm, PEW 0.328mm, PEH 0.323 mm, PPL 0.238 mm, PPW 0.394mm.

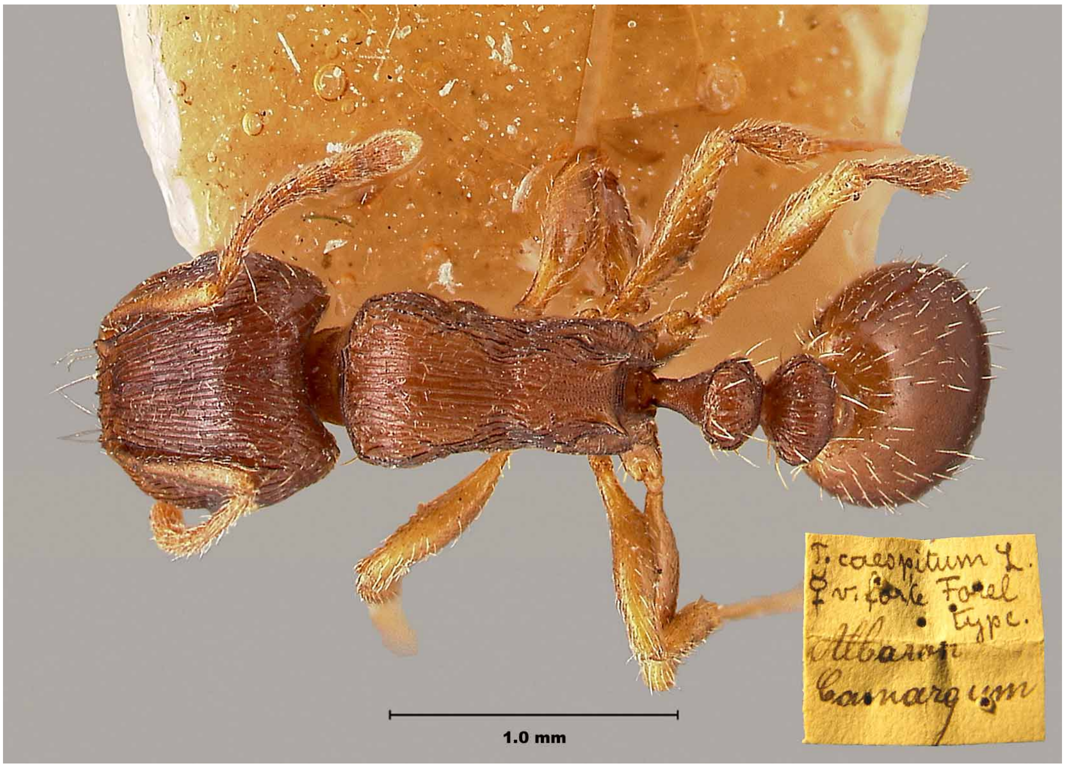


FIGURE 2. Lectotype worker of *Tetramorium forte* Forel, 1904 from Albaron (France, Camargue) in dorsal view, with original determination and locality label in A. Forel´s handwriting.

Larger Palaearctic *Tetramorium* worker with subquadrate head. Preoccipital margin nearly straight to concave, genae more or less straight, outlines convergent (Fig. 11). Head widest behind the eyes. Mesosoma robust, broad, with pronounced pronotal angles (Fig. 2). Mesopropodeal suture shallowly depressed. Propodeal spines moderately long and straight. Petiole robust, node in lateral view rather rounded, outline anterior of node concave. Petiole and postpetiole broad in relation to mesosoma, postpetiole with laterally prominently protruding angles (Figs 2, 16). Dark brown to blackish, appendages lighter, orange-brown. Head, dorsal parts of mesosoma, petiole and postpetiole entirely carinate or rugose. Frontal area of head with 14–16 even rugae which diverge slightly towards the preoccipital margin, converging into a conspicuously arcuate pattern in lateral view (see Schulz 1996, p. 407). Genae and surface of occipital corners rugose (Fig. 11). Dorsal surface of head with reticulate microsculpture, but with few more conspicuous anastomoses between principal rugae. Ventral head surface longitudinally striate without any microsculpture. Scapes usually smooth and shinning, sometimes with diffuse microsculpture, and with an inconspicuous anterio-dorsal carina at the base which may grade into the trace of a transverse extension but not into a conspicuous dorsally projecting flange. Dorsal surface of mesosoma rugose with variably developed reticulate microsculpture, on the propodeum evenly and roughly reticulate, especially between the spines. Dorsal part of petiole and postpetiole longitudinally to concentrically, often rather irregularly rugose with reticulate microsculpture, no weakening of sculpture on dorsalmost surfaces (Fig. 16). Ventral parts of petiolar nodes heavily reticulate. Polygonal microsculpture on the first gaster tergite never absent, rarely covers the whole surface of the tergite (in some Moroccan specimens). On the anteriormost part of the tergite, this microsculpture can appear striated in some specimens. Frequency of the latter feature within the same nest series increases towards the south of the species´ range.

Description of gyne

Measurements and indices (n=23): HL 1.064±0.073(0.842–1.293)mm,
HW 1.127± 0.096(0.891–1.391)mm, HS 1.096±0.080(0.866–1.330)mm,
SL 0.791±0.044(0.634–0.861)mm, ML 1.762±0.101(1.391–1.879)mm,
MW 1.082±0.074(0.830–1.196)mm, PSL 0.147±0.022(0.105–0.181)mm,
PEL 0.467±0.029(0.380–0.504)mm, PEW 0.559±0.047(0.418–0.618)mm,
PEH 0.460±0.034(0.371–0.518)mm, PPW 0.711±0.054(0.556–0.817)mm,
HW/HL 1.060±0.060(1.000–1.326), SL/HS 0.723±0.034(0.602–0.763),
HS/ML 0.622±0.028(0.581–0.727), MW/ML 0.614±0.019(0.568–0.653),
PSL/ML 0.083±0.011(0.062–0.102), PEH/PEL 0.984±0.059(0.902–1.111),
PEW/PEL 1.194±0.097(1.000–1.383), PEW/HS 0.511±0.037(0.421–0.569),
PPW/HS 0.650±0.045(0.525–0.712), PEW/PPW 0.787±0.042(0.630–0.855),
WI-A 0.360±0.017(0.324–0.392).

Medium-sized Palaearctic *Tetramorium* gyne, generally with rather robust appearance. Head with rather rounded preoccipital corners and straight to slightly convex, somewhat convergent genal outlines (Fig. 3). Scape relatively short and broad. Mesosoma short and robust, with flat (not bulging) dorsal outline. In dorsal view the pronotal angles are fully visible (Fig. 5). Propodeal spines broadly attached, triangular with pointed tips, orientation subcaudate. Petiole and postpetiole very wide, lobe-like, the petiole medially emarginated. First gaster tergite with at least a few erect hairs. Colour as in workers. Frons rugose, the rugae divergent and curving towards the occipital corners with little or no anastomosing (Fig. 3). Genae rugose, ventral head surface longitudinally striate. On the genae and near the occipital corners, a fine reticulate microsculpture occurs between the main rugae. Sides of mesosoma and petiolar segments mainly longitudinally carinate, restricted parts only rugose. In dorsal view, pronotum with rugose sculpture, mesonotum longitudinally rugose but more weakly so laterally, with a very small smooth and shining spot anterio-medially, scutellum rugose except for narrow smooth median part (Fig. 5). Sculpturing between the spines variable, principally longitudinally rugose. Sculpture of dorsal surface of waist segments also variable, diffusely rugose to rugulose, to concentrically striate. Individuals with more pronounced sculpturing have the rugose portion more strongly developed. Polygonal microsculpture covers small spots on the first gaster tergite, appearing longitudinally striate on the anterior part (0.150–0.250mm) of the tergite.

Descriptions of *T. forte* gynes have been published by Bondroit (1920, as *T. hispanicum*), Santschi (1921b, as "*T. caespitum* st. *maura* var. *tingitana*"), Santschi (1932, as "*T. caespitum* st. *hispanicum* var. *ruginodis*") and Cagniant (1997, as *T. ruginode marocana*), the latter providing a drawing of the petiolar segments. The gynes from Spain studied by Santschi (1932) are present in NHMB.

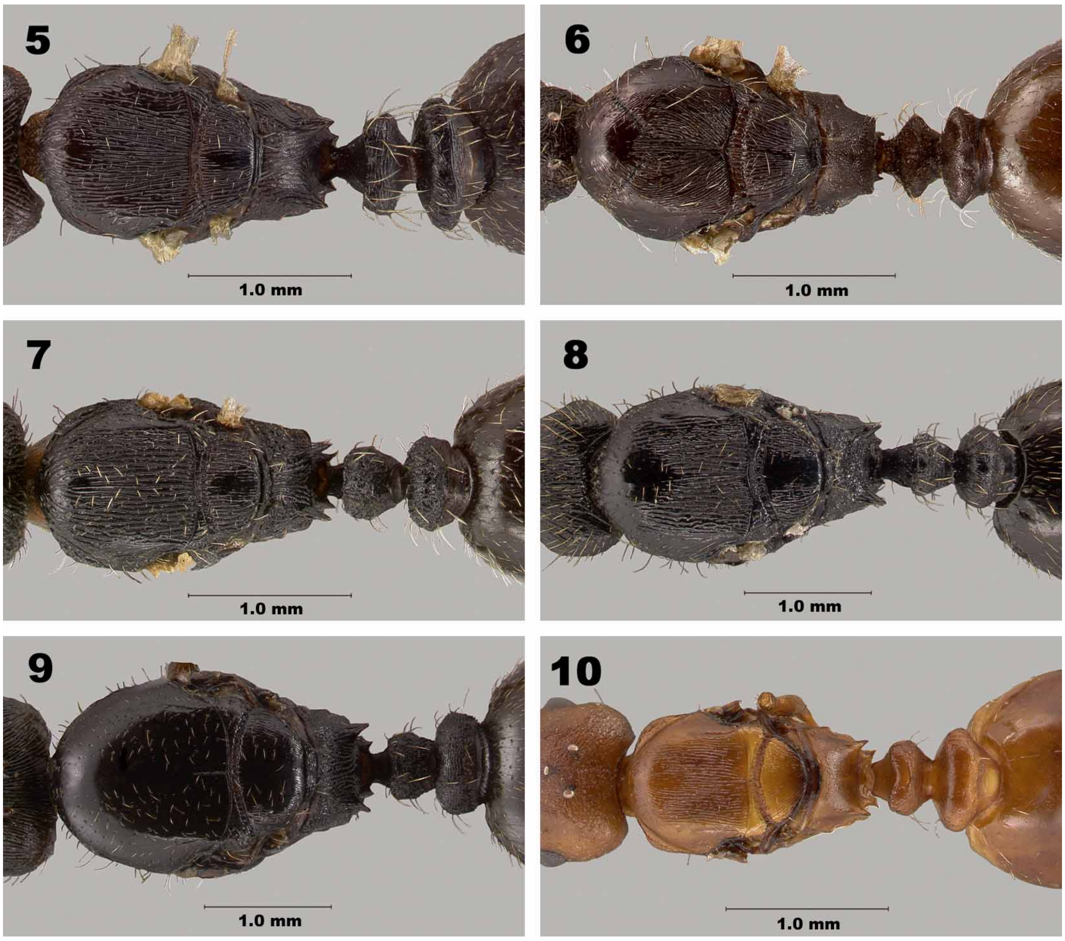
FIGURES 3–4. *Tetramorium forte*, full-face view of heads. 3, gyne; 4, male. See Appendix B for provenance of specimens depicted.

Description of male

Measurements and indices (n=22): HL 0.738±0.019(0.702–0.770)mm, HW 0.752±0.043(0.687–0.891)mm, HS 0.745±0.025(0.695–0.800)mm, SL 0.344±0.011(0.323–0.361)mm, 2FL 0.406±0.018(0.361–0.428)mm, ED 0.278±0.012(0.257–0.304)mm, ML 2.028±0.064(1.891–2.135)mm, MW 1.210±0.064(1.098–1.318)mm, PEW 0.482±0.048(0.390–0.589)mm, PPW 0.637±0.046(0.570–0.722)mm, HW/HL 1.020±0.059(0.959–1.255), SL/HS 0.462±0.022(0.421–0.501), SL/2FL 0.847±0.041(0.778–0.925), MW/ML 0.597±0.037(0.538–0.663), PEW/HS 0.647±0.057(0.529–0.772), PPW/HS 0.854±0.051(0.778–0.934), PEW/PPW 0.758±0.056(0.661–0.848), WI-A 0.276±0.017(0.236–0.311).

Small Palaearctic *Tetramorium* male, with broad head and relatively large eyes (Fig. 4). Mesonotum and scutellum bulging. Propodeal spines well visible, but short and more or less triangular, tooth-like. Petiole and postpetiole very broad (Fig. 6), petiole on each side with two laterally oriented processes and a distinctly emarginate median part. Isolated erect hairs on first gaster tergite. Colour dark brown, appendages yellowish orange. Sculpture on head, mesosoma and waist dense. Head largely rugoreticulate (Fig. 4), pronotum and lateral parts of mesosoma chiefly longitudinally striate with reticulate microsculpture, mesonotum longitudinally to concentrically striate but with extensive parts laterally and anterio-medially smooth and shining (Fig. 6). Scutellum completely striate, propodeum diffusely striate to reticulate, waist segments reticulate, gaster without sculpture.

The male of *T. forte* had hitherto only been described by Cagniant (1997, under the name *T. ruginode marocana*), based on one specimen. This work included detailed drawings of genitalic characters.



FIGURES 5–10. *Tetramorium* gynes and male, dorsal views showing mesosoma and waist. 5, gyne of *T. forte*; 6, male of *T. forte*; 7, gyne of *T. chefketi*; 8, gyne of *T. moravicum*; 9, gyne of *T. caespitum* s.l.; 10, gyne of *T. meridionale*. See Appendix B for provenance of specimens depicted.

Selection of the lectotype

The incorporation of a western Mediterranean and an eastern European taxonomic species under the nominal taxon *Tetramorium forte* dates back to the original description and has persisted until the present. The type series on which Forel (1904a) based his new taxon was both varied and ambiguously delimited by him. He included workers from several localities in southern France and one series of workers from the Crimean Peninsula. Gynes and males from Crimea and Transcaucasia were described; the latter were only doubtfully assigned to the new taxon. The author made conflicting statements in different sections in the description whether the sexuals from Crimea were definitely or conditionally included. Also, after describing those males and gynes, only two gynes from Crimea and one from Transcaucasia were actually listed among the specimens, but no males. Because of the reservations in assigning the sexuals to the new taxon, these are not to be considered syntypes (ICZN § 72.4.1.). According to Radchenko (1992), the sexuals in question, preserved at the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZISP), are referable to *T. caespitum* (Linnaeus, 1758). The syntype series to be appraised thus consists of at least 55 workers from 4 localities in southern France (mainly at MHNG, but some also at MCSN, DSTA and ZMHB, more may be detected in other collections) along with 15 workers from Alušta, Crimea, Ukraine, of which 11 are currently deposited at ZISP (Csősz *et al*., unpubl.).

As a consequence of the description of the taxon from widely scattered localities preserved at different institutions, researchers in western and eastern Europe have tended to use *T. forte* for species from their respective areas of investigation, without addressing the inconsistency of the type series. For example, Casevitz-Weulersse (1990a) and López (1991) referred to subsets of Forel´s original specimens from southern France as types, even mentioning a putative “lectotype”, while Radchenko (1992) cited as syntypes only the specimens from Crimea and Transcaucasia, disregarding the French part of the type series. No lectotype of *T. forte* has ever been formally designated.

To terminate this ambiguous and instable nomenclatural situation, we decided to have the western European taxonomic species bear the name *T. forte* which is represented in the type series by numerous syntypes from Albaron (Camargue, France). As will be detailed below, this choice is the one most furthering stability and universality in nomenclature, following the predominant usage in the ant literature of the past 100 years including recent important phylogenetic studies. And it is also the interpretation most consistent with the original author´s intentions, because his statement of the postpetiole being about twice as wide as long only applies, in approximation, to the chosen taxonomic species among those represented in the type series (Fig. 2, compare with Figs 16–18 and 20). This indicates that Forel (1904a) had that species in mind (which is also clearly the predominant one among syntypes) when he drafted the description. As the lectotype of *T. forte* (Fig. 2), we herewith choose one of three syntypes on a pin labeled „lectotype“ by B. Poldi in 1974 (without indicating the specimen), but not published. We have marked the lectotype by a red square with the indication "LT" attached to the cardboard triangle bearing the specimen. Presence of the lectotype in MHNG has also practical advantages for subsequent investigators, as the great majority of primary types of taxa described by A. Forel are preserved in that institution.

Numerous publications have used the name *T. forte* in the sense coinciding with our concept (*e.g.* Forel 1905; Bondroit 1918; Santschi 1921a, 1921c, 1937; Bernard 1967; Collingwood & Yarrow 1969; Collingwood 1978; López 1991; Sanetra *et al*. 1994; Sanetra & Buschinger 2000; Steiner *et al*. 2005; Schlick-Steiner *et al*. 2005). This includes all works of the past twelve years which for the first time elucidate phylogenetic relationships in the genus *Tetramorium* in western and central Europe. A lesser number of publications has applied the name *T. forte* to eastern European and Middle Eastern species (*e.g.* Wheeler & Mann 1916; Agosti & Collingwood 1987a, 1987b; Radchenko 1992; Atanassov & Dlussky 1992, Arakelian 1994). However, the Tetramoriini of these parts of the Palaearctic are both very diverse and particularly little known, so that it is difficult to determine which concepts really form the basis for the mentioned usages of the name *T. forte*. It is likely that few, if any, refer exclusively to the taxonomic species to which the workers from Alušta (Crimea) in the syntype series of *T. forte* actually belong. According to current revisionary work (Csősz *et al*., unpubl.), *T. chefketi* Forel, 1911 and *T. caespitum sarkissiani* Forel, 1911, two names of equal priority, are available for that species, the former of which having also been used in recent taxonomic, faunistic and phylogenetic studies (Schulz 1996; Sanetra & Buschinger 2000; Schulz & Sanetra 2002; Schlick-Steiner *et al*. 2005; see also Appendix A). Thus it would have been a substantial disservice to nomenclatural stability to choose the lectotype of *T. forte* from the Alušta specimens.

It needs to be noted that a few publications, both old and recent, have used *T. ruginode* Stitz, 1917 as the name of the western Mediterranean species treated here (*e.g.* Menozzi 1926; Santschi 1932; Cagniant 1997; De Haro & Collingwood 1997; Espadaler 1997a; Salgueiro 2002a), which would have become its valid name, had *T. forte* been formally stabilized for the eastern European species involved in the type series. However, the name most frequently in use for the western Mediterranean species in recent publications has been *T. hispanicum* Bondroit, 1918 (*e.g.* Acosta Salmerón *et al*. 1983; Ortiz & Tinaut 1988; De Haro & Collingwood 1988, 1991, 1992; Paiva *et al*. 1990; Tinaut 1991; Espadaler & Suñer 1995; Cammell *et al*. 1996; Way *et al*. 1997; Molero-Baltanás *et al*. 1998; Reyes López & García 2001), and that is definitely a junior synonym of *T. ruginode* (see in the following section). Many of the afore-mentioned authors wrongly credited the description of *T. hispanicum* to Emery (1909).

The use of *T. ruginode* and *T. hispanicum* for the species probably originated in deviant concepts for *T. forte* which were based at least in part on type studies disregarding the Albaron specimens (Casevitz-Weulersse 1974, 1990a, 1990b; López Gómez 1988; López 1991). Our investigations revealed that at least two other taxonomic species are represented among the French syntypes. Three workers each from Nice and Palavas (near

Montpellier) are relatively robust and strongly sculptured specimens of *T. caespitum sensu lato* (see Appendix A). They probably belong to an as yet weakly defined species separate from *T. caespitum* (Linnaeus, 1758) which commonly occurs along Mediterranean coasts (Schlick-Steiner *et al*., 2006). Study of these syntypes was probably partly responsible for the recording of *T. forte* from Corsica (Casevitz-Weulersse 1990a, 1990b) and for its treatment as merely a variety (Casevitz-Weulersse 1974) or subspecies (Cagniant 1997) of *T. caespitum*. While the postpetiole is on average slightly wider in these specimens than in true *T. caespitum,* it is by far not twice as wide as long as mentioned in the original description of *T. forte*, and rugosity and microsculpture are much less developed than in the lectotype from Albaron. Six workers from Dieulefit (Dept. Drôme) do show that pronounced sculpturing but the postpetiole is in no way shorter or wider than *e.g.* in *T. caespitum*. These workers belong to *T. moravicum* Kratochvil, 1941, a chiefly eastern European species described from the Czech Republic (Novak & Sadil 1941) which only recently has been found to occur in southeastern and eastern France (Schlick-Steiner *et al*., in press; Güsten, unpubl.; see Fig. 22). The addition of these specimens to the syntype series by Forel (1904a) can be ascribed to the incomplete understanding of variability and critical characters in the genus at the time.

Synonymy

Upon stabilization of the name *T. forte* for a western Mediterranean ant species, three species-group names in the genus *Tetramorium* can be firmly established as its junior synonyms: *T. ruginode* Stitz, 1917 (with its junior synonym *T. hispanicum* Bondroit, 1918), *T. maurum tingitanum* Santschi, 1929 and *T. maroccanum* De Haro & Collingwood, 1994. In contrast, three other names are recognized to have incorrectly been proposed earlier as junior synonyms of *T. forte*: *T. caespitum pyrenaeicum* Röszler, 1936, *T. moravicum* Kratochvil in Novak & Sadil, 1941 and *T. taurocaucasicum* Arnol´di, 1968. An oddity is *T. silvestrianum* Emery, 1924, which was claimed to be a synonym of *T. forte* by Collingwood and Yarrow (1969), Collingwood (1978) and López (1991) although it belongs in fact to the genus *Myrmica* Latreille (see Appendix C). Santschi (1921a) cited a "var. *grandis* For.", with "Camargue" as the type locality, a *lapsus calami* for "*fortis*" probably caused by the similar meaning of the two words in Latin. Further on in the same paper, the correct name is used. The same error occurs on labels of several North African specimens of *T. forte* in F. Santschi´s collection in NHMB.

Newly established synonyms

T. ruginode Stitz, 1917 (with *T. hispanicum* Bondroit, 1918):

The synonymy of *T. ruginode* and *T. hispanicum* with *T. forte* as defined above is straightforward. Types of both taxa originate from Spain, its main area of distribution, and López (1991), Sanetra and Buschinger (2000) and this study have convincingly shown that not more than one species with similar morphological features occurs there. Some misunderstanding was caused by Emery (1909) who allegedly described only the gyne morph of "*T. caespitum caespitum* var. *hispanica*", as accepted by Bondroit (1918) and other subsequent authors. However, the inclusion of "*hispanica*" in the worker key in Emery (1909) as well as the study of syntypes in several collections made it clear that a misprint of the worker icon as a female icon had occurred, and in fact only workers had been available. Thus, the character Emery (1909) gave to differentiate his new variety from var. *forte*, namely the presence of fine striation on the gaster base, referred to workers. Nevertheless, as detailed below, this character does not have taxonomic value. Stitz (1917) also separated his new variety from *T. forte* only on uninformative characters such as worker size and roughness of rugosity on head and mesosoma.

Because of the scattering of the syntype series over several collections and its unknown extent, it was considered useful for nomenclatural stability and for further study to designate a lectotype of *T. caespitum hispanicum* Bondroit, 1918 from the two remaining specimens in Emery´s original collection at MCSN. Bondroit (1918) made it clear that he had no additional specimens available. In the case of *T. caespitum ruginode* Stitz, 1917, there are six syntype workers at MZHB obviously originating from the same collection event so that the designation of a lectotype appeared superfluous.

T. maroccanum De Haro & Collingwood, 1994:

We have studied numerous specimens from Morocco including types of *T. maroccanum* and in our opinion there are no reasons to separate them from *T. forte*. This is suggested also by allozyme (Sanetra & Buschinger 2000) and mtDNA studies (Schlick-Steiner *et al*., 2006). Cagniant (1997) proposed to uphold *maroccanum* as a subspecies (of *T. ruginode*), based on whitish instead of yellowish pilosity, and on reticulated, relatively distinct rugosity on the anterior part of the first gastral tergite in workers (as opposed to relatively weak or absent striation in the nominate subspecies). We could not confirm differing colouration of pilosity in the specimens studied. We did find, though, substantial individual variation in the polygonal microsculpture of the first gaster tergite in workers. Csősz (pers. comm.) confirms a geographical component to that variation with those from the north of the range usually much more weakly sculptured, although intracolonial variability is high. Gynes also have that microsculpture on the first gaster tergite, but differences along a north-south gradient are not observed. In males the first gaster tergite is never sculptured. The clinal geographic variation of a single surface sculpture character in only one morph seems to us no justification for retaining subspecific differentiation in *T. forte*.

T. maroccanum was inadvertently described by De Haro and Collingwood (1994) who did not realize that the infrasubspecific entity "*T. caespitum* st. *ferox* var. *marocana*" earlier proposed by Santschi (1921c) was an unavailable name (ICZN § 45.5.). Following § 72.4.4., the type series of a species-group taxon made available by biographical reference consists of those specimens on which the unavailable name had been based, plus any additional specimens that the subsequent author had at his or her disposal when making available the name. As it is not fully clear which these latter may be in the case of *T. maroccanum* De Haro & Collingwood, a lectotype is designated from those syntypes in NHMB labeled "*Tetramorium caespitum* v. *marocanum*" by F. Santschi, to provide a reliable basis for establishing the name as a junior synonym of *T. forte*.

T. maurum tingitanum Santschi, 1929:

The syntypes of *T. maurum tingitanum* described from Rabat (Morocco) posed a problem. Gynes were not distinguishable from North African *T. forte*, while workers grossly differed in being small, yellowish and not strongly sculptured, as is typical for *T. semilaeve* André, 1883 and related species. Most likely based on these workers, Cagniant (1997) had synonymized *T. maurum tingitanum* with *T. biskrense* Forel, 1904[b], a North African species similar in some respects to *T. semilaeve*. However, we have studied the syntypes of *T. biskrense* from eastern Algeria and we do not believe that the worker syntypes of *T. maurum tingitanum* belong to this species. They may be referable to *T. maurum* Santschi, 1918 (see Appendix A), but the occurrence of that species in Morocco needs to be confirmed. Even though gynes of true *T. maurum* are indeed quite similar to those of *T. forte* (see below), and gynes and workers in the type series of *T. maurum tingitanum* bear the same locality labels and may originate from the same collection event, we still deem it highly improbable that they represent the same species. Instead of upholding a questionable synonymy based on the workers, we decided to designate one of the two gynes as the lectotype of *T. maurum tingitanum* Santschi and synonymize this taxon with *T. forte*.

Previously proposed synonyms

T. moravicum Kratochvil in Novak & Sadil, 1941:

Radchenko (1992) proposed the synonymy of *T. moravicum* with *T. forte*, an opinion also advocated by Atanassov and Dlussky (1992). This view was based on one hand on the consideration of only the Crimean specimens from the type series of *T. forte*, on the other hand on the belief that besides *T. moravicum*, which is frequent on the Crimean Peninsula, no other species with similar morphological features occurs there. It was later recognized (Radchenko *et al.* 1998; Csősz, pers. comm.) that the workers from Alušta in the *T. forte* type series are not conspecific with the similar species found in most parts of Crimea. Radchenko *et al.* (1998) consequently accepted *T. moravicum* again as a good species. Schlick-Steiner *et al*. (2005) demonstrated that *T. rhenanum* Schulz, 1996 is to be included in *T. moravicum* as a microgynous form.

T. taurocaucasicum Arnol´di, 1968:

Another taxon described from Crimea, *T. taurocaucasicum* Arnol´di, 1968, was also regarded as a junior synonym of *T. forte* by Radchenko (1992). The holotype of *T.*

taurocaucasicum is conspecific to the Alušta workers (Csősz *et al*., unpubl.), so that upon the stabilization of *T. forte* for a western Mediterranean species, *T. taurocaucasicum* must be listed as a synonym of *T. chefketi* and *T. caespitum sarkissiani* (see Appendix A).

T. pyrenaeicum Röszler, 1936:

This taxon was initially described from Andorra as a subspecies of *T. caespitum* and elevated to species rank by Röszler (1951). Some authors have later considered it synonymous with *T. forte* (Collingwood & Yarrow 1969; López 1991). The original description of *T. caespitum pyrenaeicum* was inadvertently published in a paper (Röszler 1936) projected to appear after Röszler (1937), which contains the more detailed intended original description. The latter makes it clear that *T. pyrenaeicum* cannot be identical to *T. forte*: the gynes are almost the size of *T. caespitum* s.l. gynes, and as in these, the mesonotum is completely smooth and shining. The petiolar nodes, however, are as broad as in *T. forte*, while the petiole bears a short projection medio-dorsally instead of a slight emargination. We do not know any *Tetramorium* species with these characters, neither from Andorra nor from Hungary and central Germany, whence a slight variety of *T. pyrenaeicum* was characterized by Röszler (1937). No syntypes of *T. pyrenaeicum* remain in its original depositories, the Muzeul Brukenthal, Sibiu, Romania (Pascu, *in litt.*; Markó & Csősz 2002) and the Zoologisches Museum der Universität Hamburg, Germany (see *e.g.* Rabaglia 2005), and none have as yet been detected in other European collections which contain scattered syntypes of taxa described by P. Röszler. *Tetramorium pyrenaeicum* thus remains enigmatic for the time being.

Phylogenetic relationships and similar species

Tetramorium forte belongs to the *caespitum*-group of species in the sense of Bolton (1977), which is (except for some peripheral species) the only Palaearctic one out of 40 largely provisional species-groups defined by Bolton (1976, 1977, 1979, 1980) in the genus *Tetramorium*. Few studies have addressed phylogenetic relationships in this group and in particular the position of *T. forte*. Palomeque *et al*. (1989) studied the karyotype of *T. forte*, which proved to be of little interest for phylogeny as all Palaearctic *Tetramorium* species hitherto studied have a haploid chromosome number of n=14 with few differences in chromosome morphology (Lorite *et al*. 2000; Sanetra, unpubl.). Based on allozyme electrophoresis, Sanetra and Buschinger (2000) found *T. chefketi* (see Appendix A) to be very closely related to *T. forte*, a finding corroborated by mtDNA studies (Schlick-Steiner *et al*. 2005). The position of *T. moravicum* was ambiguous, as it constituted a clade with *T. forte* and *T. chefketi* in some but not all data analyses (Sanetra & Buschinger 2000; Schlick-Steiner *et al*., 2006).

Tetramorium forte is a member of a morphologically defined assembly of species in which the workers are dark and strongly sculptured, with no unsculptured surface areas on the waist segments. While not all these species are necessarily closely related, the allopatric *T. chefketi*, found to be related to *T. forte* in phylogenetic studies, is also the most similar species. *Tetramorium moravicum* is also closely similar and sympatric with *T. forte* in southeastern France (see below). One other species sharing the lack of smooth and shining areas on the petiolar nodes, *T. alternans* Santschi, 1929 (see Appendix A), is sympatric with *T. forte* in North Africa. The other *Tetramorium* taxa sympatric with *T. forte* in Europe, which are *T. caespitum* s.l. (see Appendix A), *T. semilaeve* and *T. meridionale*, belong to other species complexes and show more divergent morphological characters. *Tetramorium maurum* (see Appendix A), which may be sympatric with *T. forte* in the Maghreb, is anomalous as the gynes are very similar, even though based on the workers the species should rather be assigned to a widely conceived *T. semilaeve* complex.

Differentiation of workers

In workers, *T. forte* is most readily distinguishable from other dark, strongly sculptured Palaearctic *Tetramorium* species by its wide petiolar nodes. While this is not as obvious as in gynes, the postpetiole shows a conspicuously angular lateral outline in dorsal view (compare Fig. 16 with Figs 17–19), and the values for WI-A and WI-B are larger while that for PPL/PPW is smaller than in the most similar species, with some overlap (Table 1).

Except for this character, workers of *T. chefketi* are very similar to *T. forte*, though the mesosoma is narrower (Table 1) and the sculpture overall more strongly rugose, particularly near the occipital corners where there is also some anastomosing of the rugae (Fig. 12). *Tetramorium moravicum* workers are also similar—they may be identified by a more prominent anterio-dorsal carina at the base of the scape than in *T. forte* and *T. chefketi*, which extends into a conspicuous dorsally projecting flange (Fig. 13). Also, in contrast to *T. forte*, the scape is reticulate or faintly longitudinally rugose in *T. moravicum*, and the occipital corners are quite prominent with the main rugae on the head running parallel throughout their length and not converging into an arcuate pattern in lateral view as in *T. forte* (see Schulz 1996, p. 407). *Tetramorium alternans* is a smaller species than *T. forte* (Table 1) with a lighter, reddish-brown colour. The scapes are shorter with a densely striate to granulate sculpture. While there are no smooth and shining spots on the waist segments, densely reticulate microsculpture predominates with only a sparse weak rugosity (Fig. 19). In this character, *T. alternans* recalls *T. brevicorne* Bondroit, 1918 from the Tyrrhenian Islands (see Sanetra *et al*. 1999) rather than *T. forte*, *T. chefketi* or *T. moravicum*.

Workers of *T. caespitum* s.l. strongly differ from those discussed before by conspicuous smooth and shining medial areas on the petiolar segments (which, however, may greatly vary in width), and the head surface has a much more weakly developed rugosity, appearing shining through the lack of microsculpture (Figs 15, 20). The waist segments are a lot narrower than in *T. forte* (Table 1). The workers of *T. semilaeve*, and many ill-defined species similar to it, are even more weakly sculptured, yellowish to light reddish-brown and much smaller than *T. forte* (nest means of ML always < 0.800mm, HS < 0.730mm). Workers of *T. meridionale* have petiole and postpetiole at least as broad as *T. forte*, but in other characters generally resemble *T. semilaeve*.

Differentiation of gynes

In gynes, *T. forte* is easily distinguished from *T. chefketi*, *T. moravicum* and *T. alternans* by the very broad waist segments (compare Fig. 5 with Figs 7–8, see also Table 2).

Tetramorium chefketi gynes are otherwise very similar, particularly in dorsal surface sculpturing (Fig. 7), but the mesosoma is somewhat more slender (only slightly narrower numerically, Table 2) and the rugosity is more pronounced. The latter is most obvious on the head with a rugoreticulum developed near the hind margin, even extending anterio-laterally beyond the eyes (see Schulz 1996, p. 407), whereas few anastomoses between the longitudinal rugae are evident in *T. forte* (Fig. 3). *Tetramorium moravicum* gynes differ in the structure of the scape base in a similar way as workers do; in most populations they are much larger than *T. forte* but microgynes are the size of large *T. forte* gynes (Table 2). The only known gyne of *T. alternans* has the mesonotum more tapering anteriorly, and narrower (Table 2) than in *T. forte* and less than half of its surface (medio-posteriorly) is longitudinally rugose to striate.

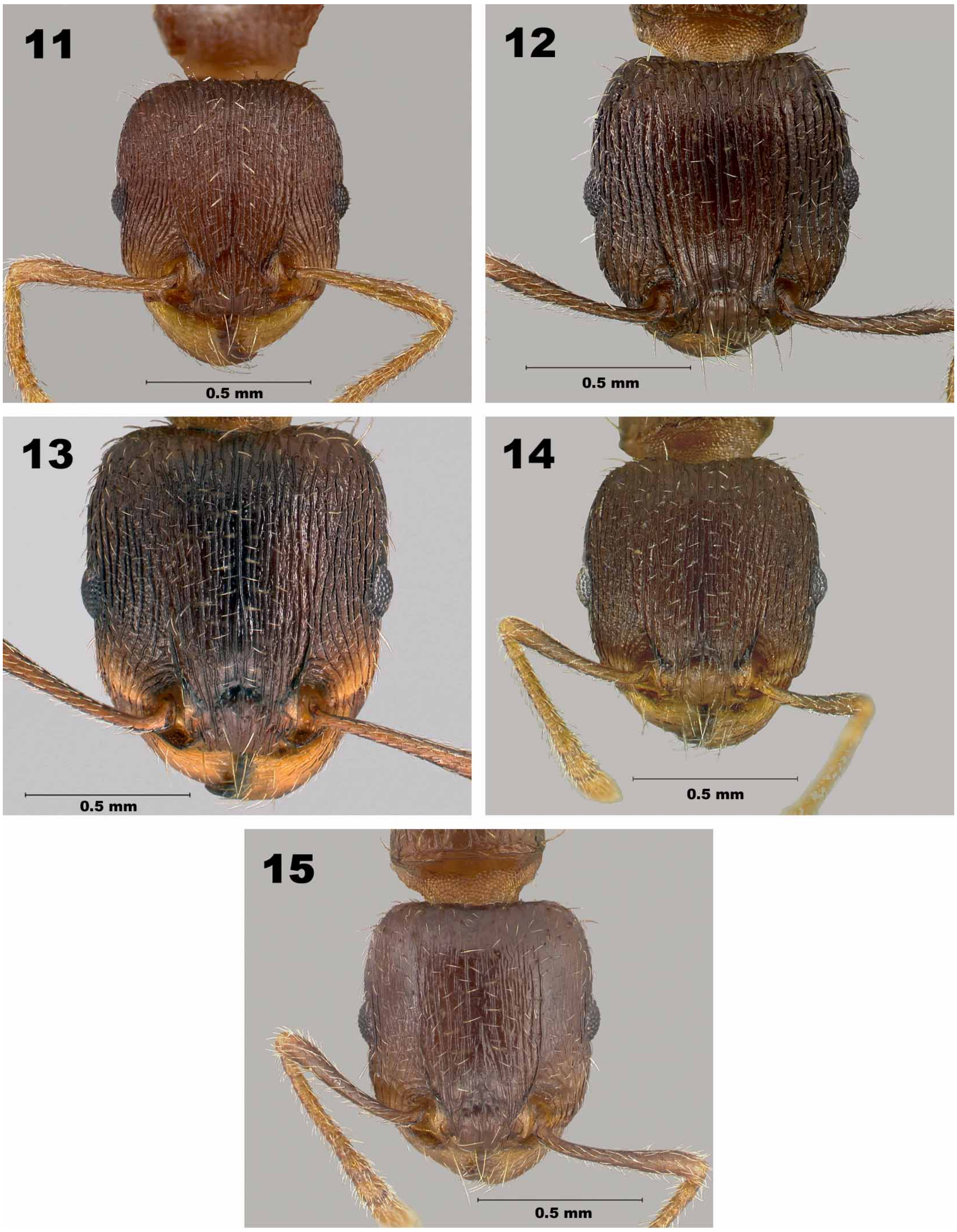
The gynes of *T. caespitum* s.l. are much larger than those of *T. forte* (Table 2), which is associated with a relatively smaller head and a bulging mesonotum completely concealing the pronotal corners in dorsal view, and the mesosoma is smooth and shining over two thirds of its surface or throughout (Fig. 9). *Tetramorium semilaeve* gynes are also weakly sculptured (usually few shallow striae on the mesonotum), and are more lightly brownish than those of *T. forte*, while they are of similar size. Those of *T. meridionale* are even more yellowish, have a conspicuous transverse striation on the occipital margin and enlarged petiolar nodes though somewhat less than *T. forte* (Fig. 10).

Even though the workers of *T. maurum* are very dissimilar to those of *T. forte* and indicate the affiliation to a different species complex, the gynes surprisingly were found to be closely similar. No morphometric characters have been detected that reliably differentiate the gynes of the two species. However, *T. maurum* gynes are lighter in colour (reddish-brown), the dorsal border of the petiole is not emarginated medially, the rugae on the head are less pronounced, and a larger medial unsculptured surface (> 50%) occurs on the scutellum, sometimes small unsculptured areas are also present on the petiolar nodes.

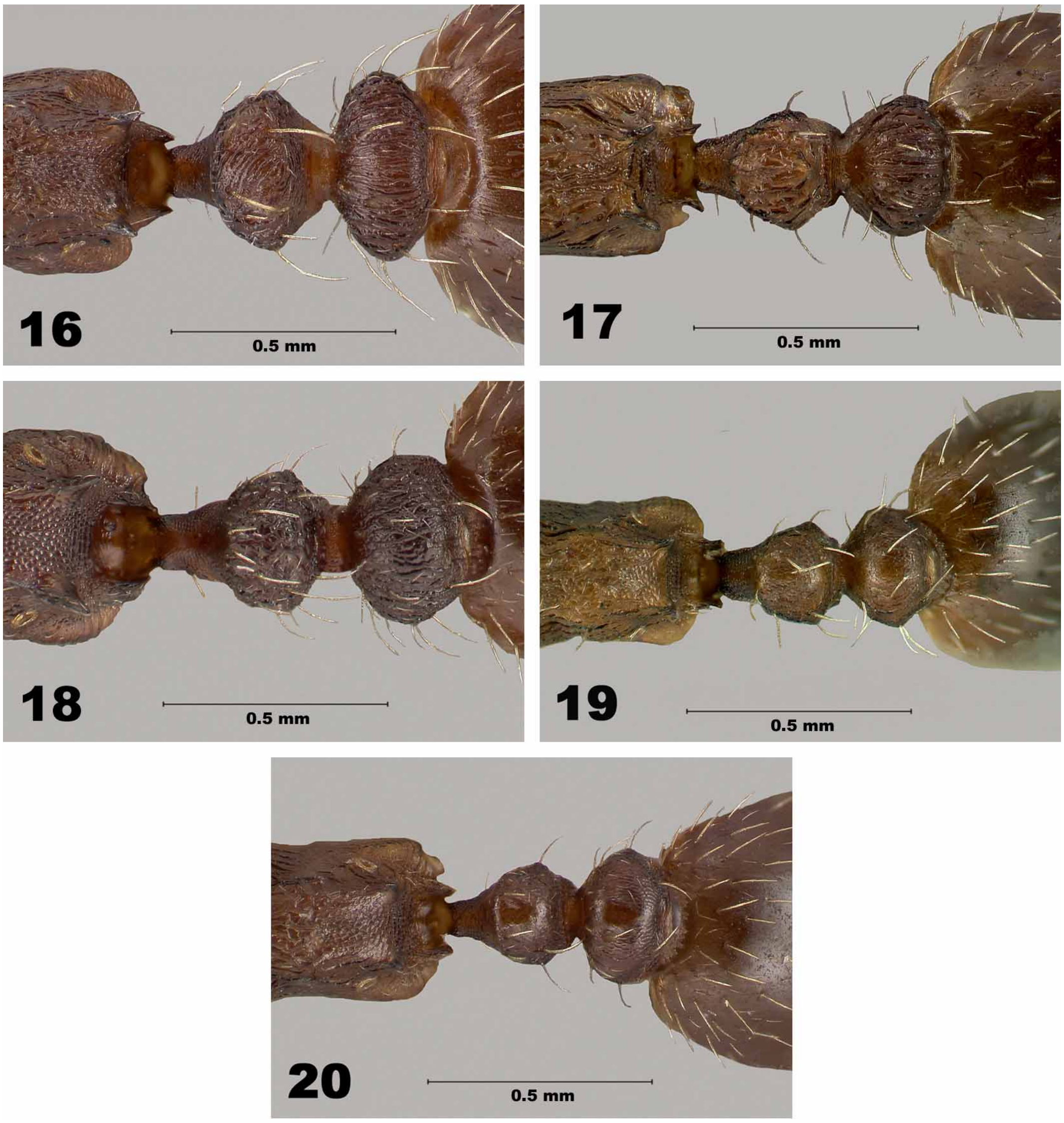
Differentiation of males

In males, much as in gynes, *T. forte* is characterized by a wider petiole and postpetiole (WI-A: 0.236–0.311) than *T. chefketi* and *T. moravicum* (nest means of WI-A always < 0.240, compare also Schulz 1996, p. 412).

In most populations, *T. moravicum* males are larger (ML > 2.200mm) but where microgynes occur, the size is about the same as for *T. forte* males. In *T. forte* the scutellum is clearly striate (Fig. 6), whereas *T. moravicum* has a more diffuse often striolo-reticulate sculpture with sometimes a shining median part. *Tetramorium alternans* males are unknown.



FIGURES 11–15. *Tetramorium* workers, full-face view of heads. 11, *T. forte*; 12, *T. chefketi*; 13, *T. moravicum*; 14, *T. alternans*; 15, *T. caespitum* s.l. See Appendix B for provenance of specimens depicted.



FIGURES 16–20. *Tetramorium* workers, dorsal views showing petiole and postpetiole. 16, *T. forte*; 17, *T. chefketi*; 18, *T. moravicum*; 19, *T. alternans*; 20, *T. caespitum* s.l. See Appendix B for provenance of specimens depicted.

Males of *T. caespitum* s.l. are much larger (nest means of ML always > 2.500mm) than those of *T. forte* with narrower waist segments (nest means of WI-A always < 0.240), the latter also applies to those of *T. semilaeve*. The male of *T. meridionale* has not been described.

TABLE 1. Measurements and indices suitable for differentiation of *Tetramorium forte* workers from the similar species *T. chefketi*, *T. moravicum* and *T. alternans*, as well as from *T. caespitum* s.l. See Appendix B for provenance of specimens measured.

worker	ML	SL/HS	MW/ML
T. forte (n=34)	0.986±0.111mm (0.831–1.194)	0.786±0.026 (0.727–0.840)	0.560±0.032 (0.509–0.675)
T. chefketi (n=28)			0.478±0.021 (0.418–0.527)
T. moravicum (n=74)			
T. alternans (n=6)	0.809±0.038mm (0.747–861)	0.699±0.013 (0.681–0.717)	
T. caespitum s.l. (n=18)			

continued.

worker	PEW/HS	PPL/PPW	WI-A	WI-B
T. forte (n=34)	0.360±0.019 (0.311–0.402)	0.622±0.044 (0.553–0.688)	0.322±0.019 (0.269–0.359)	0.390±0.018 (0.338–0.430)
T. chefketi (n=28)	0.316±0.021 (0.244–0.357)	0.767±0.058 (0.611–0.854)	0.257±0.016 (0.221–0.310)	
T. moravicum (n=74)		0.766±0.065 (0.632–0.927)	0.267±0.017 (0.236–0.312)	
T. alternans (n=6)		0.729±0.027 (0.682–0.750)		0.352±0.019 (0.324–0.373)
T. caespitum s.l. (n=18)			0.269±0.017 (0.239–0.295)	

Distribution and biology

López (1991) compiled the first comprehensive list of collecting localities of *T. forte* on the Iberian Peninsula (also presented as a distribution map in López Gómez 1988). From these data it is evident that *T. forte* occurs throughout Spain up to the extreme northwest, although the species might be absent from the north coast beyond the Cantabrian Mts. There is no obvious preference for areas with a stronger Mediterranean climatic influence. In the Sierra Nevada, the species occurs at least up to 2200m. Many additional Spanish records (*e.g.* Tinaut 1991; De Haro & Collingwood 1991, 1992; Espadaler & Suñer 1995; Espadaler 1997b; Espadaler & Roig 2001; Reyes López & García 2001) confirm the ecologically generalistic occurrence of the species, which also holds true for the distribution pattern in Portugal (Paiva *et al*. 1990; De Haro & Collingwood 1992; Tinaut &

Ruano 1994; Cammell *et al*. 1996; Way *et al*. 1997; Salgueiro 2002b, 2003; present study). Menozzi (1926) and Wheeler (1926) reported *T. forte* from Mallorca, but its presence on the Balearic Islands should be reconfirmed due to the commonly dubious application of the name.

TABLE 2. Measurements and indices suitable for differentiation of *Tetramorium forte* gynes from the similar species *T. chefketi*, *T. moravicum* and *T. alternans*, as well as from *T. caespitum* s.l. See Appendix B for provenance of specimens measured.

gyne	ML	MW	HS/ML
T. forte (n=23)	1.762±0.101mm (1.391–1.879)	1.082±0.074mm (0.830–1.196)	0.622±0.028 (0.581–0.727)
T. chefketi (n=22)			
T. moravicum (n=25)	1.997±0.174mm (1.830–2.440)		
T. alternans (n=1)			
T. caespitum s.l. (n=10)	2.453±0.213mm (2.090–2.800)	1.438±0.130mm (1.269–1.610)	0.489±0.026 (0.447–0.530)

continued.

gyne	MW/ML	PEW/HS	PPW/HS	WI-A
T. forte (n=23)	0.614±0.019 (0.568–0.653)	0.511±0.037 (0.421–0.569)	0.650±0.045 (0.525–0.712)	0.360±0.017 (0.324–0.392)
T. chefketi (n=22)	0.586±0.029 (0.546–0.635)	0.395±0.018 (0.365–0.433)	0.502±0.028 (0.457–0.564)	0.268±0.012 (0.250–0.291)
T. moravicum (n=25)		0.405±0.018 (0.361–0.436)		0.257±0.015 (0.213–0.291)
T. alternans (n=1)	0.564	0.418	0.526	0.292
T. caespitum s.l. (n=10)				0.258±0.020 (0.228–0.293)

Abundant samples compiled from Morocco (Cagniant 1997, collecting localities not specified) show *T. forte* to occur in diverse habitats from sea-level up to 2000m in the north of the country (especially in the Middle Atlas), much as in southern Spain (Fig. 21). In the south, however, it appears much more localized at higher elevations of the High Atlas. According to Csősz (*in litt.*), a few samples from Algeria have been traced in collections. Three workers from Ponta Delgada (São Miguel, Azores, leg. W.M. Wheeler) in NHMB had previously been determined as *T. forte*, but proved to belong to *T. caespitum* s.l. upon investigation. The ant fauna of the Azores, largely or entirely introduced, is well known (Yarrow 1967; Heinze 1986; Salgueiro 2002a) and it seems certain that no other *Tetramorium* species of the *caespitum*-group occur. On the Canary Islands, *T. forte* has likewise not been recorded.

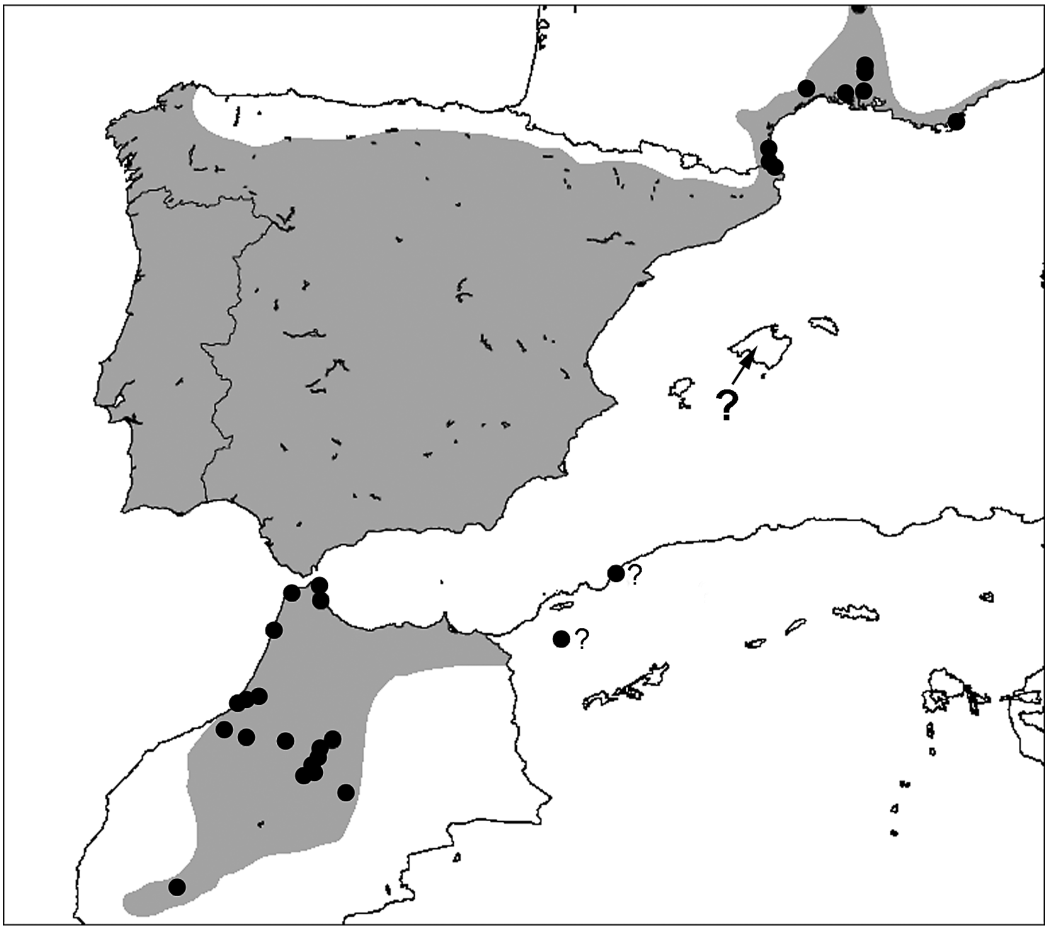


FIGURE 21. Overview of the distribution of *Tetramorium forte* Forel, 1904. Available records are indicated separately only for France and Morocco, as they are very numerous for Spain and Portugal. The occurrence on the Baleares needs corroboration. The only known Algerian record most likely refers to one of the two localities indicated.

The range of *T. forte* extends into France along the Mediterranean coast, but except for one sample in the extreme southeast (Sommer & Cagniant 1988), no reliable records other than the original description had been published prior to this study. As Bernard´s (1967) understanding of *T. forte* was evidently insufficient, his locality citings from the Îles d´Hyères and the Côte d´Azur need to be re-investigated. Consequently, a gyne from Cavalaire-sur-Mer (Var) in NHMB currently represents the easternmost confirmed record. The northernmost locality in the Dept. Loire indicates an inland extension along the Rhône river for more than 200km. Only recent investigations (Schulz 1996; Schlick-Steiner *et al.*, in press; Güsten, unpubl.) have shown that the distribution of *T. forte* in southern France is entwined with that of *T. moravicum*, which is very similar in the worker morph. Current data suggest that *T. moravicum* occurs at xerothermic localities with less overt Mediterranean influence compared with those of *T. forte* (Fig. 22). *Tetramorium moravicum* is usually found above 600m where its range approaches the coast, although it may inhabit lower elevations in the Dept. Alpes-Maritimes where the ocurrence of *T. forte* is not confirmed. The overall distribution pattern of *T. forte* (Fig. 21) renders likely the postglacial recolonization into its present range from an atlanto-mediterranean refuge. Resulting contact with the ecologically similar *T. moravicum* progressing from a ponto-mediterranean refuge (Schlick-Steiner *et al.*, in press) might have impeded further spreading of both species, but this needs additional investigation.

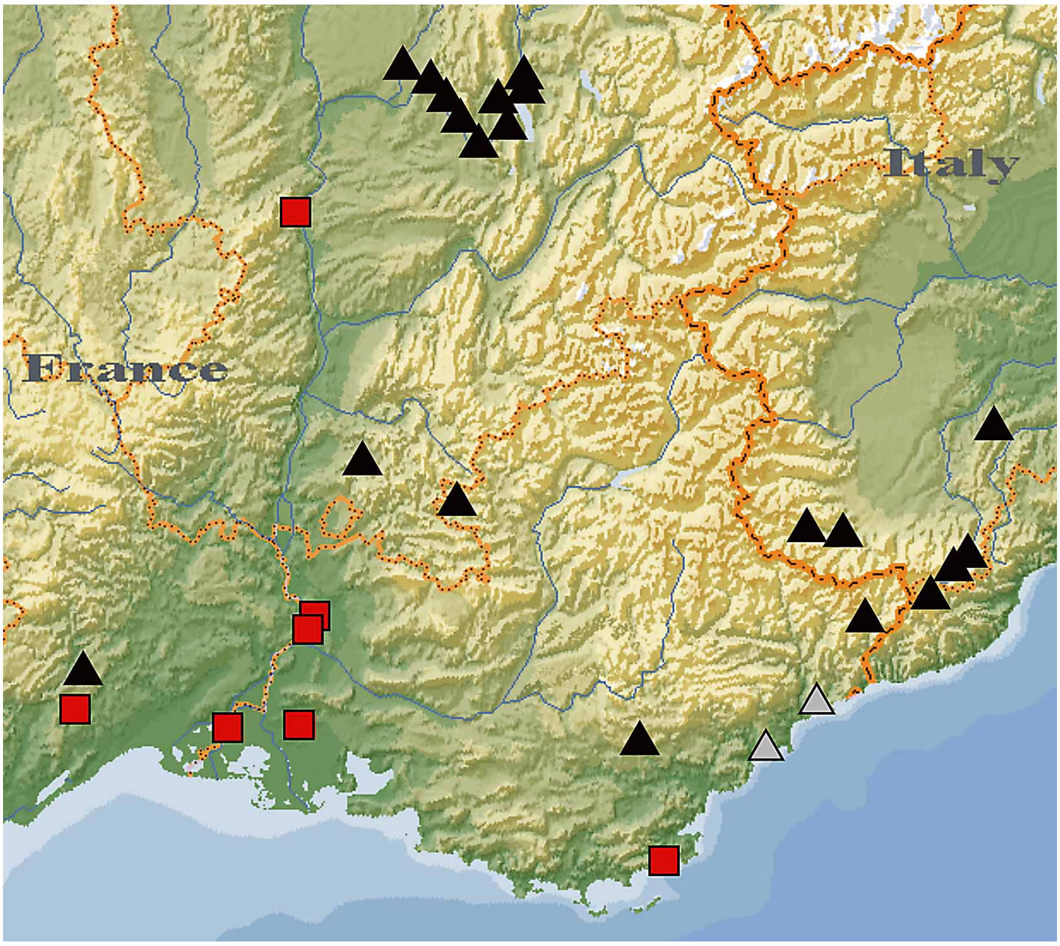


FIGURE 22. Distribution of *Tetramorium forte* Forel, 1904 (squares) and *Tetramorium moravicum* Kratochvil, 1941 (black triangles) in southeastern France and adjacent Italy. Records of *T. moravicum* are largely unpublished; the localities given on old museum specimens as “Nice” and “Cannes” may be imprecise (grey triangles).

As stated above, records of *T. forte* from Corsica (Casevitz-Weulersse 1974, 1990a, 1990b) were based on a different concept of the species. Our study of comprehensive samples from Corsica and Sardinia indicated that the true *T. forte* is not present on the Tyrrhenian Islands.

Apparent polygynous colonies have been observed in *T. forte* several times throughout its range (*e.g.* near Avignon, France; near Ifrane, Morocco), and the functional status as queens has been confirmed by dissection in one instance (five inseminated egg-laying queens: Sierra Nevada, Spain). Winged sexuals were recorded in *T. forte* colonies during late May in Spain, but during late June in the mountains of northern Portugal. The lepismatid silver-fish *Proatelurina pseudolepisma* (Grassi, 1887) is a generalistic myrmecophile commonly found inhabiting nests of *T. forte* (Molero-Baltanás *et al*. 1998). *Astenus* (*Eurysunius*) *alcarazae* Assing, 2003 and probably other species of the subgenus also occur with *T. forte*; these are myrmecophilous staphylinid beetles specialized to live in the colonies of ants of the genus *Tetramorium* in the western Palaearctic (Assing 2003). However, no records of ant social parasites collected together with *T. forte* are available, including the inquilines *Strongylognathus testaceus* (Schenck, 1852) and *Anergates atratulus* (Schenck, 1852), which are known to use a relatively broad range of hosts in the genus *Tetramorium* (*e.g.* Sanetra *et al*. 1999; Sanetra & Buschinger 2000). Polygyny in a potential host species might be seen as a critical barrier for colony-founding queens of socially parasitic ants (see also Sanetra & Güsten 2001).

Appendix A: Taxonomic notes on *Tetramorium* species discussed in this paper

Tetramorium chefketi Forel, 1911

Tetramorium caespitum var. *chefketi* Forel, 1911
Tetramorium chefketi Forel: Agosti & Collingwood 1987a, 1987b

According to Agosti and Collingwood (1987a), the species (misspelled "*chefteki*"), which was described from the European part of Turkey, occurs also in Greece and Anatolia. We compared specimens from these areas with the worker syntypes (MHNG) and support this view. Schulz (1996) presented characters differentiating *T. chefketi* from the closely similar *T. moravicum* and *T. forte*, and Sanetra and Buschinger (2000) as well as Schlick-Steiner *et al*. (2005) studied its phylogenetic position in relation to *T. forte*, *T. moravicum* and *T. semilaeve*. Csősz *et al*. (unpubl.) ascribe the paralectotypes of *T. forte* from Alušta (Crimea, Ukraine) to *T. caespitum sarkissiani* Forel, 1911 and regard that taxon as synonymous to *T. chefketi*, which has equal priority.

Tetramorium alternans **Santschi, 1929 nov. stat.**

Tetramorium caespitum v. *alternans* Santschi, 1929

Cagniant (1997), treating this taxon as a subspecies of *T. caespitum*, cites records from diverse sites throughout Morocco. We have recently procured further samples, including the first known gyne (Morocco, Middle Atlas, Reg. Meknès, in CAS), and regard it as a good species which may occur throughout the Maghreb. Some specimens from Tunisia (in NHMB) are very similar, as are workers from the northeastern mountains of Teneriffa.

Tetramorium maurum **Santschi, 1918**

Tetramorium caespitum st. *maura* Santschi, 1918
Tetramorium maurum Santschi: Santschi 1929

The taxonomy of this species is unsettled: the type series contains syntypes from all three Maghreb countries and is probably heterogeneous. However, the principal collection series among the syntypes in NHMB, comprising gynes, originate from northern Tunisia. We base the comparison with *T. forte* on these gynes. There is currently no indication that the species occurs in Morocco.

“*Tetramorium caespitum sensu lato*”

Species morphologically similar to *T. caespitum* (Linnaeus, 1758) are the dominant *Tetramorium* ants in temperate parts of Eurasia. Cammaerts *et al*. (1985) distinguished *T. impurum* (Förster, 1850) from *T. caespitum* in central Europe based on male genitalic characters. It has recently become clear that the *T. caespitum*/*impurum* species complex constitutes in fact an assembly of cryptic species, which cannot yet be delimited clearly or assigned valid names (Steiner *et al*. 2002; Schlick-Steiner *et al*., 2006). More than one species is included within the current concepts of both *T. caespitum* and *T. impurum*. Throughout this paper we use the term “*T. caespitum* s.l.” to denote species of the complex.

Appendix B: Provenance of specimens figured and measured

Specimens depicted in Figs 3–20

Tetramorium forte
  worker (Figs 11, 16), male (Figs 4, 6): Portugal, Distr. Bragança, Montesinho
  gyne (Figs 3, 5): Portugal, Distr. Viseu, Serra de Montemuro

Tetramorium chefketi

worker (Figs 12, 17): Turkey, Prov. Konya, 20 km sw Ayrancı
gyne (Fig. 7): Turkey, Prov. Artvin, ca. 30 km s Artvin

Tetramorium moravicum

worker (Figs 13, 18): France, Dept. Savoie, Serrières-en-Chautagne
gyne (Fig. 8): France, Dept. Drôme, Col du Pertuis

Tetramorium alternans

worker (Figs 14, 19): Morocco, Reg. Meknès, ca. 40 km s Aïn Leuh

Tetramorium caespitum s.l.

worker (Figs 15, 20): Spain, Prov. Huesca, Puerto de Monrepós
gyne (Fig. 9): Spain, Prov. Ávila, 5 km sw El Tiemblo

Tetramorium meridionale

gyne (Fig. 10): Italy, Sardegna, Prov. Sassari, Lago di Coghinas

Specimens measured for Tables 1 and 2

Tetramorium forte

France, Dept. Vaucluse, 7 km n Avignon; Spain, Prov. Cuenca, 2 km e Villalba de la Sierra; Spain, Prov. Jaén, Puerto de los Jardines; Spain, Prov. Granada, Sierra Nevada (2200m); Spain, Prov. Badajoz, Embalse de Orellana; Portugal, Distr. Viseu, Caldas da Felgueira; Portugal, Distr. Castelo Branco, nr. Monsanto; Morocco, Reg. Kénitra, Forêt de la Mamora; Morocco, Reg. Meknès, Aguelmame Azigza

Tetramorium chefketi

Turkey, Prov. Sinop, 5 km e Kabali; Turkey, Prov. Kastamonu, 30 km s Inebolu; Turkey, Prov. Niğde, 10 km nw Acipinar; Turkey, Prov. Konya, Ereğli swamps; Turkey, Prov. Konya, Belören; Greece, Pref. Arcadia, 5 km sw Levidion; Greece, Pref. Pieria, 4 km w Litóhoro

Tetramorium moravicum

Turkey, Prov. Kars, nr. Posof; Turkey, Prov. Van, 8 km e Budakli; Slovakia, Reg. Nitriansky Kraj, Kozarovce; Czech Republic, Reg. Vysočina, Mohelno; Austria, State Niederösterreich, St. Pölten; Germany, State Baden-Württemberg, Vogtsburg; Germany, State Rheinland-Pfalz, Lorchhausen; France, Dept. Alpes-Maritimes, Maurioun; France, Dept. Savoie, 12 km e Belley; France, Dept. Savoie, Serrières-en-Chautagne

Tetramorium alternans

Morocco, Reg. Meknès, ca. 40 km s Aïn Leuh

Tetramorium caespitum s.l.

Greece, Pref. Corinthia, Killini N-slope; Germany, State Rheinland-Pfalz, Lorchhausen; France, Dept. Gard, 15 km nnw Le Vigan; Spain, Prov. Girona, 5 km sse Camprodon; Spain, Prov. Granada, Puerto de la Ragua

Appendix C: Taxa excluded from the genus *Tetramorium*

Myrmica specioides Bondroit, 1918

Myrmica specioides Bondroit, 1918
Tetramorium silvestrianum Emery, 1924: **syn. nov.**
Myrmica rugulosoides var. *striata* Finzi, 1926 (synonymy: Collingwood 1979)
Myrmica scabrinodis var. *ahngeri* Karavaiev, 1926 (synonymy: Seifert 1988)
Myrmica puerilis Stärcke, 1942 (synonymy: Collingwood & Yarrow 1969)
Myrmica neglecta Stärcke, 1942 (*nomen nudum*)
Myrmica scabrinodis var. *atlantica* Stärcke, 1942 (*nomen nudum*)
Myrmica (*Myrmica*) *balcanica* Sadil, 1952 (synonymy: Pisarski 1975)
Myrmica (*Myrmica*) *balcanica* var. *scabrinodoides* Sadil, 1952 (synonymy: Pisarski 1975)

Material examined

1 ☿, **lectotype of *T. silvestrianum* Emery (hereby designated)**: „Manresa Silvestri / Typus / *Tetramorium silvestrianum* Emery Typus / *Myrmica* nec *Tetramorium* M^{F}[label most likely by B. Poldi] / Lectotypus *Tetramorium silvestrianum* Emery des. R. Güsten, A. Schulz & M. Sanetra 2005“ (MCSN); 1 ☿, „Solden (A.), 9.VII.20 / *Tetramorium silvestrianum* Em. var.!, Santschi det. 1926 / Sammlung Dr. F. Santschi, Kairouan (NHMB)“.

One of the two original syntypes of *T. silvestrianum* Emery remains at MCSN. It is in good condition and can easily be determined as a worker of *Myrmica specioides* Bondroit. Also, Emery´s (1924) description matches this specimen and his outline figure shows the petiole shape of *M. specioides*, so that there is no reason to believe that the other syntype represented a different species. Nevertheless, the surviving specimen is designated as lectotype in order to firmly establish the synonymy. We cannot explain Emery´s (1924) gaffe. Continuing the misconception, F. Santschi also determined a worker of *M. specioides* from “Solden (A.)” (probably Sölden, Tirol, Austria) in his collection as *T. silvestrianum*. Collingwood and Yarrow (1969), Collingwood (1978) and López (1991) regarded *T. silvestrianum* as a synonym of *T. forte* on the grounds that the descriptions where allegedly corresponding. A worker ant from Genève (Switzerland) was determined as *T. silvestrianum* by Collingwood (in López 1991).

The synonymy of *M. specioides* Bondroit is summarized above. Seifert (2002) has demonstrated that *M. specioides* is not a synonym of *M. bessarabica* Nassonov, 1889 as previously stated by Atanassov and Dlussky (1992). We have not included several junior synonyms proposed by Dlussky *et al*. (1990) and Arakelian (1994) concerning taxa described from areas east of the range of *M. specioides* as given by Seifert (1988), chiefly from the Caucasus. These synonymies need reinvestigation.

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