

## Ants of the Genus *Myrmica* from Taiwan (Hymenoptera: Formicidae)

Graham W. Elmes\* Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset, BH20 5AS, United Kingdom (E-mail: gwe@ite.ac.uk)

Alexander G. Radchenko Institute of Zoology of Ukrainian National Academy of Sciences, 15, B. Khmel'nitsky str., Kiev-30, 252601, Ukraine

### ABSTRACT

Four species of the temperate ant genus *Myrmica* are found on Taiwan, all except *M. serica* are known only from the island. Three are previously described species (*M. formosae*, *M. serica* and *M. arisana*) and the fourth is an hitherto unknown species (*M. mirabile*). The status of all four species is reviewed and a key to their identification is provided. *M. mirabile* has exceptionally large workers for a *Myrmica* ant, and differs in this respect from all other known species except *M. gigantea* (Collingwood).

**Key Words:** Taiwan, Asia, taxonomy, new-species, *Myrmica mirabile*.

### Introduction

The island of Taiwan has a predominantly tropical and subtropical myrmecofauna. However, some temperate genera are found in Taiwan, usually at high altitudes in the mountains. Included among these is the genus *Myrmica* Latreille from which several species and infra specific forms have been described (Wheeler, 1929, 1930; Santschi, 1937). These are particularly interesting because they are well isolated from the nearest other Chinese populations of *Myrmica* ants and may be representative of an older relict fauna.

Four *Myrmica* species have been recorded from Taiwan. Three are possibly endemic: one of these is previously undescribed (*Myrmica mirabilis* sp. n.) and is morphologically unusual for the genus; another (*Myrmica arisana* Wheeler) be-

longs to the ruginodis-silvestrii complex of *Myrmica* species, which are abundant in the temperate forests of east Asia. The third endemic (*Myrmica formosae* Wheeler) belongs to the ritae-group of *Myrmica* species (Radchenko and Elmes, 1998) which is considered to be the most primitive of the groups of *Myrmica* (Radchenko, 1994). The fourth species (*Myrmica serica* Wheeler) also belongs to the ritae-group, and has been found in southern China besides Taiwan. Here we review the known species, describe the new and exceptional species, and provide a key for the identification of the four Taiwanese *Myrmica*.

### Materials and Methods

This paper is based on the study of material from the Museum of Comparative Zoology, Harvard University, USA

\*Correspondence / reprint request address

(MCZ), Naturhistorisches Museum, Basle (BASLE) and Keiichi Onoyama, Obihiro University of Agriculture, Inada-cho, Japan (OUJ). Other abbreviations used are - BMNH (British Museum of Natural History), ZMM (Zoological Museum of Moscow State University) and IZK (Institute of Zoology, Kiev).

In studies of *Myrmica* it has become customary to make a series of body measurements and to calculate various shape indices (Arnoldi, 1934; Sadil, 1951; Seifert, 1988) and in order to facilitate comparisons between the Taiwanese *Myrmica* and other species, we have made the following measurements and indices.

HW	maximum width of head in full-face view above eyes.
HL	length of head in full-face view, measured in a straight line from anterior point of median clypeal margin to mid-point of occipital margin.
FW	minimum width of frons between frontal lobes.
FLW	maximum width between external borders of frontal lobes.
SL	maximum straight-line length of antennal scape in profile.
PNW	maximum width of pronotum from above.
AL	diagonal length of alitrunk, measured in profile from neck shield to posterior margin of metapleural lobes.
PL	maximum length of petiole from above.
PPL	maximum length of postpetiole from above.
PW	maximum width of petiole from above.
PPW	maximum width of postpetiole from above.
PH	maximum height of petiole in profile.
PPH	maximum height of postpetiole in profile.
ESL	maximum length of propodeal spine in profile.

ESD	distance between tips of propodeal spine from above.
HTL	length of hind tibia.
Cephalic index	CI=HL / HW
Frontal index	FI=FW / HW
Frontal-lobe index	FLI=FLW / FW
Scape index (1)	SI1=SL / HL
Scape index (2)	SI2=SL / HW
Petiole index (1)	PI1=PL / PH
Petiole index (2)	PI2=PL / HW
Post-petiole index (1)	PPI1=PPL / PPH
Post-petiole index (2)	PPI2=PPH / PPW
Post-petiole index (3)	PPI3=PPW / PW
Spine-length index	ESLI=ESL / HW
Spine-width index	ESDI=ESD / ESL
Hind-tibia index	HTI=HTL / HW

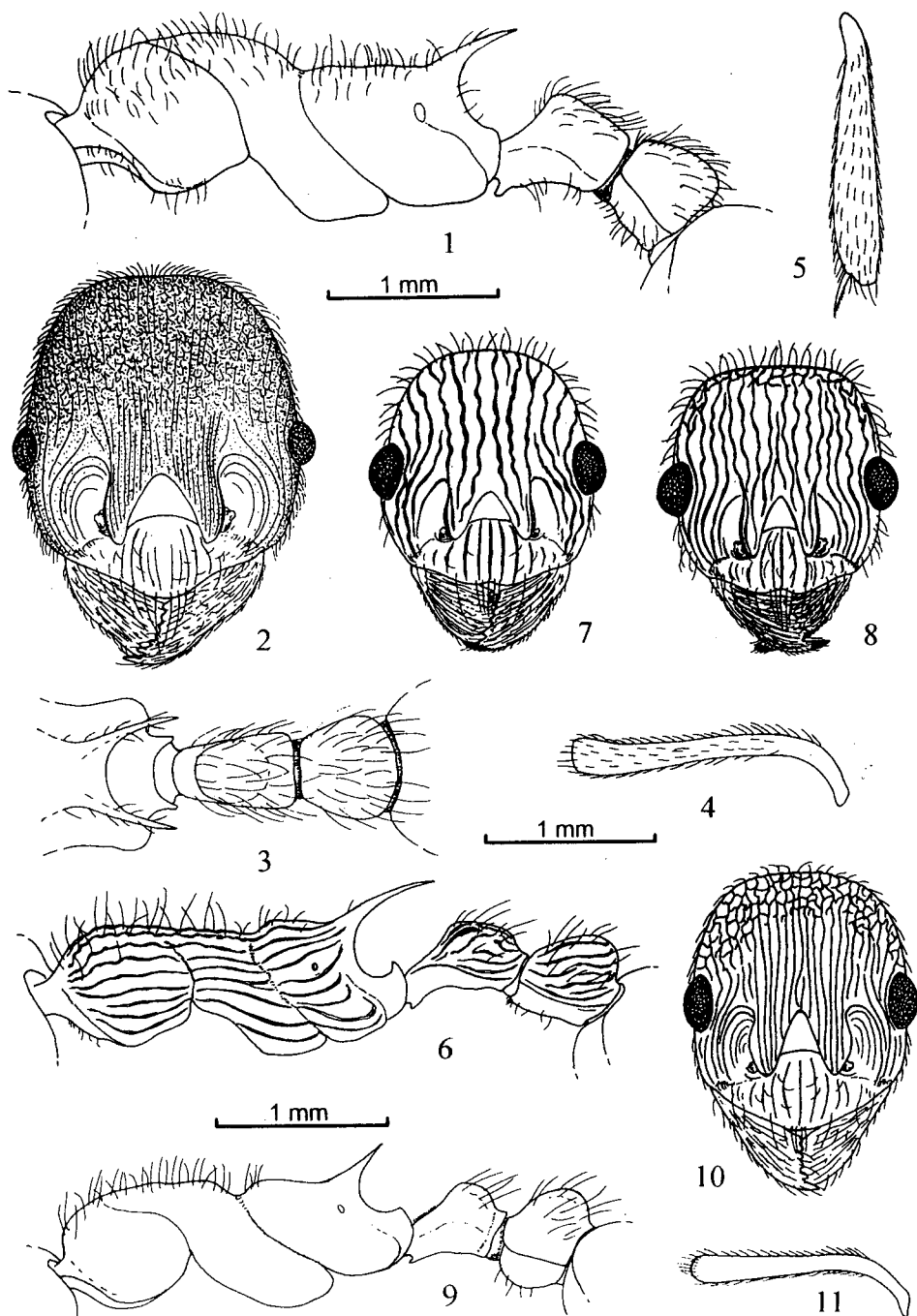
#### Key to the *Myrmica* species of Taiwan

1. Head and alitrunk very coarsely rugose; petiole and propodeal spines very long (Figs. 6-8).....2
- Head and alitrunk much more finely rugulose or reticulate; petiole and propodeal spines distinctly shorter (Figs. 1, 2, 9, 10).....3
2. Frons between frontal carinae level with the eyes (central frons) with 4 extremely coarse rugae (Fig. 7).....*M. formosae*
- Central frons with at least 6 finer rugae (Fig. 8).....*M. serica*
3. Very large ants (HW>1.65 mm, AL>2.50 mm); antennal scape strongly curved at base but without an angle; whole body with very abundant pilosity (Figs. 1-5).....*M. mirabile*
- Size much smaller (HW<1.20 mm, AL<2.10 mm); antennal scape weakly curved at base; pilosity on body much less abundant (Figs. 9-11).....*M. arisana*

#### The species

##### 1. *Myrmica mirabile* sp. n. (Figs. 1-5)

**Materials examined:** Holotype worker, ALISHAN (=Arisan), 21-X-1977, K. Yamauchi (BMNH). Paratypes: 10 workers from the same nest (BMNH, IZK, OUJ).



Figs. 1-11 *Myrmica mirabile* sp. n. holotype worker (1-5), *Myrmica formosae* lectotype worker (6,7); *Myrmica serica* holotype worker (8); *Myrmica arisana* lectotype worker (9-11): 1, 6, 9 alitrunk, petiole and postpetiole in profile; 2, 7, 8, 10 head, frontal view; 3 propodeal spine, petiole and postpetiole from above; 4, 11 antennal scape; 5 hind tibia.

**Workers:** Head slightly longer than wide (CI 1.07-1.12) with somewhat convex sides; occipital margin straight or very slightly concave, rounded occipital corners. Anterior clypeal margin slightly convex with no medial notch; frontal carinae slightly curved, curving outwards and merging with rugae surrounding antennal sockets. Frons relatively wide (FI 0.34-0.39); eyes convex, oval, located slightly anteriorly to mid point of sides of head. Antennal scapes distinctly shorter than the head (SII 0.82-0.88), strongly curved at base but not angled, no trace of a lobe; funicular joints relatively short (<1.5 longer than wide) with 4-jointed apical club. Promesonotum convex and propodeal dorsum more or less flat; promesonotal suture distinct and mesopropodeal furrow distinct but shallow; metapleural lobes rounded. Propodeal spines moderately long (ESLI 0.29-0.37), wide at base, projecting posteriorly upwards with slight downwards curve, and appearing slightly divergent from above (ESDI 1.03-1.22). Petiole with short anterior peduncle and relatively high (PII 1.24-1.50). In profile petiole anterior surface slightly concave, posterior surface flat or somewhat convex, node appearing subtriangular and narrowly rounded on top. Postpetiole subcubical, with feebly arched dorsum (PPII 0.84-0.93). Both petiole and postpetiole without ventral lobes.

Middle and hind tibiae have well developed pectinate spurs. Head dorsum densely but not coarsely, longitudinally rugulose, with reticulate sculpture on posterior and lateral parts; surfaces between rugae finely punctured but appear more or less shiny. Clypeus has numerous longitudinal fine rugae; frontal area very finely superficially sculptured, but appears shiny; mandibles finely but densely longitudinally rugulose. Alitrunk sinuously rugulose with only lower parts of meso- and metapleurae being longitudinally rugose, surface between sculpture smooth

and shiny. Propodeal declivity between propodeal spines smooth and shiny. Both petiole and postpetiole with short sinuous rugosity, fine punctures between rugae, appearing submatt. Gaster has short striae at base of first tergite but otherwise, has only very fine superficial reticulation appearing smooth and shiny. Head, alitrunk, waist and gaster with very abundant curved fine hairs; legs and antennal scape have suberect hairs. Overall colour yellowish-red but appendages slightly lighter.

**Notes:** Measurements and indices are given in Tables 1 & 2. *M. mirabile* is unusually large (HW 1.62-1.83 mm) and currently is the *Myrmica* species having the largest workers known for the genus worldwide, exceeding by about 5% the previous largest - *Myrmica gigantea* (Collingwood) (ritae-group, HW 1.62 mm). Morphologically it appears to be closely related to *Myrmica luteola* Kupyanskaya 1990, but otherwise it is clearly different from all other *Myrmica* ants. Apart from its size, *M. mirabile* mainly differs from *M. luteola* by the absence of the pre-socially-parasitic characters associated with the latter. For example, *M. luteola* has lobe-like processes on ventral surfaces of the petiole and postpetiole, reduced, simple, non-pectinate spurs on the middle and hind tibiae, which are small, and sometimes hardly distinguishing from apical setae. The females and males of *M. luteola* are very small, sometimes smaller than the workers, and females have very short, dentiform propodeal spine or even tubercles. Unfortunately males and females of *M. mirabile* are unknown, but we suggest that they will be found to be "normal" for *Myrmica*. It is possible that *M. luteola* is a "microgyne" derivation of *M. mirabile* which is in the process of evolving towards a socially-parasitic lifestyle. Little is known about the ecology of *M. mirabile* other than its nest was found in decaying wood on a forest margin. A comparative ecological study

Table 1. The measurements made on the type specimens and the minimum and maximum values (mm) of the measurements made on samples of specimens (number in parenthesis) from the Taiwanese *Myrmica* (The measurements codes are as indicated in the text)

	<i>M. mirabile</i> (11)		<i>M. arisana</i> (5)		<i>M. formosae</i> (8)		<i>M. serica</i> (9)	
	Holotype	Min-Max	Lectotype	Min-Max	Lectotype	Min-Max	Holotype	Min-Max
HW	1.68	1.62-1.83	1.18	1.10-1.18	1.22	1.11-1.26	1.28	1.10-1.36
HL	1.85	1.82-2.00	1.48	1.36-1.48	1.36	1.32-1.42	1.40	1.26-1.54
FW	0.64	0.60-0.70	0.56	0.50-0.56	0.47	0.43-0.49	0.47	0.44-0.53
FLW	0.71	0.69-0.78	0.60	0.57-0.60	0.50	0.47-0.53	0.49	0.46-0.54
SL	1.61	1.52-1.68	1.30	1.12-1.30	1.63	1.51-1.71	1.63	1.30-1.64
PNW	1.12	1.07-1.23	0.88	0.82-0.88	0.89	0.89-0.95	0.91	0.80-1.00
PW	0.41	0.40-0.45	0.36	0.34-0.37	0.34	0.31-0.36	0.30	0.28-0.34
PPW	0.57	0.52-0.63	0.54	0.50-0.54	0.53	0.49-0.55	0.46	0.40-0.53
PH	0.56	0.52-0.63	0.42	0.42-0.48	0.38	0.35-0.40	0.37	0.34-0.40
PPH	0.57	0.56-0.64	0.55	0.52-0.58	0.51	0.48-0.53	0.50	0.45-0.60
PL	0.74	0.74-0.88	0.60	0.48-0.60	0.82	0.74-0.83	0.71	0.62-0.71
PPL	0.53	0.50-0.60	0.40	0.35-0.42	0.56	0.55-0.61	0.58	0.41-0.58
ESL	0.56	0.50-0.64	0.41	0.36-0.41	0.72	0.61-0.82	0.67	0.56-0.86
ESD	0.62	0.56-0.70	0.51	0.47-0.57	0.61	0.52-0.68	0.54	0.46-0.63
AL	2.56	2.56-2.92	2.02	1.86-2.02	2.18	1.97-2.32	2.06	1.88-2.32
HTL	1.61	1.52-1.70	1.14	1.02-1.14	1.44	1.34-1.51	1.38	1.06-1.42

Table 2. The index values for the type specimens and the range made from measuring a sample of other specimens (number in parenthesis) from the Taiwanese *Myrmica* (The index codes are as indicated in the text)

Index	<i>M. mirabile</i> (11)		<i>M. arisana</i> (5)		<i>M. formosae</i> (8)		<i>M. serica</i> (9)	
	Holotype	Min-Max	Lectotype	Min-Max	Lectotype	Min-Max	Holotype	Min-Max
CI	1.10	1.07-1.12	1.25	1.21-1.26	1.11	1.07-1.21	1.09	1.10-1.16
FI	0.38	0.34-0.39	0.47	0.45-0.47	0.38	0.38-0.40	0.36	0.37-0.40
FLI	1.11	1.11-1.23	1.07	1.07-1.14	1.06	1.04-1.01	1.04	1.04-1.09
SI1	0.87	0.82-0.88	0.88	1.81-0.88	1.20	1.14-1.20	1.16	1.00-1.16
SI2	0.96	0.88-0.96	1.10	1.02-1.10	1.34	1.27-1.41	1.27	1.12-1.28
PI1	1.32	1.24-1.50	1.43	1.07-1.43	2.15	1.97-2.19	1.92	1.73-1.94
PI2	0.44	0.44-0.49	0.51	0.43-0.52	0.67	0.63-0.68	0.55	0.55-0.58
PPI1	0.93	0.84-0.94	0.73	0.60-0.75	1.09	1.08-1.18	1.16	0.98-1.16
PPI2	1.00	1.00-1.11	1.02	1.02-1.08	0.96	1.00-1.08	1.09	0.88-0.96
PPI3	1.39	1.29-1.40	1.50	1.41-1.50	1.56	1.49-1.63	1.53	1.43-1.61
ESLI	0.33	0.29-0.37	0.35	0.32-0.35	0.59	0.55-0.72	0.52	0.48-0.56
ESDI	1.11	1.03-1.22	1.24	1.21-1.58	0.86	0.73-0.88	0.81	0.80-1.05
HTI	0.96	0.91-0.96	0.97	0.91-0.97	1.18	1.09-1.30	1.08	0.93-1.08

of these two species would be rewarding.

## 2. *Myrmica arisana* Wheeler 1930, stat. n.

*Myrmica rugosa* var. *arisana* Wheeler, 1930: Proc. New Eng. Zoo. Club 95.

*Myrmica rugosa* subsp. *arisana*: Weber, 1947: Ann. Entomol. Soc. Amer. 462; Chapman and Capco, 1951: Check List Ants of Asia 128; Bolton, 1995: Cat. Ants of World 277.

*Myrmica kurokii* st. *tipuna* Santschi, 1937: Bull. Ann. Soc. Entomol. Belg. 367.

*Myrmica kurokii* subsp. *tipuna*: Weber, 1947: Ann. Entomol. Soc. Amer. 470; Chapman and Capco, 1951: Check List Ants of Asia 127; Bolton, 1995: Cat. Ants of World 284, syn. n.

**Materials examined:** Lectotype worker of *M. arisana* Wheeler (our designation-bottom specimen on the pin): ALISHAN (=Arisan), Taiwan (=Formosa), 24-IV-1928, No 48, R. Takahashi ("MCZ cotypus No 20557"). Paralectotypes: worker upper specimen on pin with lectotype and 5 workers, ALISHAN (=Arisan), 20-X-1977, leg. K. Yamauchi. Lectotype of *M. kurokii* st. *tipuna* Santschi (our designation-top specimen on the pin): TAIWAN (=Formosa), K. Sato, No 727 (BASLE). Paralectotypes: 4 workers on the same pin.

**Notes:** Measurements and indices are given in Tables 1 & 2. Females and males are unknown. *M. arisana* is clearly related to the ruginodis-silvestrii complex of *Myrmica* species and does not belong to the rugosa-group. It differs from *Myrmica rugosa* Mayr principally by having a head dorsum which is not punctinate, by the shape of its frontal carinae which curve outwards and merge into the rugae which surround the antennal sockets, and by other more minor characteristics. The types of st. *tipuna* slightly differ from those of *M. arisana* by their smaller size, slightly more truncated petiolar dorsum and more feeble sculpture of the alitrunk, petiole and postpetiole. But in our opinion, these differences are not sufficient for a separation as species, an opinion which was confirmed by study of additional material from Taiwan (see above). This species may be endemic to Taiwan where little is known of its ecology other than one nest was found by K. Yamauchi living under stone on "herbaceous ground" in southern Taiwan (material studied).

### 3. *Myrmica formosae* Wheeler, 1929

*Myrmica margaritae* var. *formosae* Wheeler, 1929: Bull. Lab. Zool. Portici 37; (*Myrmica margaritae* var. *formosae* Wheeler, 1928: Bull. Lab. Zool. Portici 9, nomen nudum); Chapman and Capco, 1951: Check List Ants of Asia 127.

*Myrmica ritae* subsp. *formosae* Weber, 1950: Ann. Entomol. Soc. Amer., 220.

*Myrmica formosae* Radchenko, 1994: Entomol. Rev. 44; Bolton, 1995: Cat. Ants of World, 279; Radchenko and Elmes, 1998: Vestnik Zool. 32.

*Myrmica margaritae* var. *pulchella* Santschi, 1937: Bull. Ann. Soc. Entomol. Belg. 368; Weber, 1947: Ann. Entomol. Soc. Amer. 219; Chapman and Capco, 1951: Check List Ants of Asia 127; Radchenko, 1994: Entomol. Rev. 44.

*Myrmica margaritae* subsp. *pulchella* Bolton, 1995: Cat. Ants of World 282; Radchenko and Elmes, 1998: Vestnik Zool. 32.

**Materials examined:** Lectotype worker: FENCHIFU (=Funiko), Taiwan (=Formosa), Silvestri (MCZ). Paralectotypes: 9 workers, with same label (MCZ, ZMM). Lectotype worker of *M. margaritae* var. *pulchella* Santschi: WUSHE (=Musha), Taiwan (=Formosa), K. Sato (BASLE). Paralectotypes: 2 workers on the same pin.

**Notes:** Females and males are unknown. This species is recorded only from Taiwan where its ecology is unknown. The status and morphology of *M. formosae* was discussed in a taxonomic revision of the ritae-group (Radchenko and Elmes, 1998), summary measurements and indices are given here for comparison with the other species (Tables 1 & 2).

### 4. *Myrmica serica* Wheeler, 1928

*Myrmica margaritae* var. *serica* Wheeler, 1928: Bull. Lab. Zool. Portici, 8;

- Chapman and Capco, 1951: Check List Ants of Asia 127.
- Myrmica ritae* subsp. *serica* Weber, 1950: Ann. Entomol. Soc. Amer. 222.
- Myrmica serica* Radchenko, 1994: Entomol. Rev. 74; Bolton, 1995: Cat. Ants of World 283; Radchenko and Elmes, 1998: Vestnik Zool. 32.

**Materials examined:** Holotype worker: [ China ], YUNNANFU, Silvestri (MCZ). 5 workers: Southern Taiwan, ALISHAN (=Arisan), 20-X-1977, K. Yamauchi. 4 workers and 2♂ (Central Taiwan, MT. HOU-HOA-SHAN, 22-VIII-1995, K. Onoyama.

**Notes:** A female of this species was described by Weber (1950) and males by Radchenko and Elmes (1998). The males had relatively short scapes which is considered a primitive character in *Myrmica* ants. Summary measurements and indices are given here for workers to enable comparison with the other species (Tables 1 & 2). This species is more widespread, having been recorded in southern China and Taiwan. Nothing is known about its ecology except a nest in Taiwan was collected from under a stone on grassland.

### Acknowledgements

We sincerely thank Keiichi Onoyama, Obihiro University, Japan for generously loaning the unidentified specimens upon which this study is based; also all the other museums listed above, which so readily loaned the type specimens essential for this work. The study was supported by the INTAS programme (award 94-2072) and the basic science programmes of our institutes.

### References

- Arnoldi, K. V. 1934. Studien über die Systematik der Ameisen. VIII. Vorläufige Ergebnisse einer biometrischen Untersuchung einiger, *Myrmica* - Arten aus dem Europäischen Teile der USSR. Folia Zool. et Hydrobiol. Riga 6: 151-174.
- Bolton, B. 1995. A New General Catalogue of the Ants of the World.: Harvard Univ. Press, Cambridge-London 504 pp.
- Chapman, J. W., and S. R. Capco 1951. Check list of the ants (Hymenoptera, Formicidae) of Asia. Bureau of Printing, Manila 310 pp.
- Kupyanskaya, A. N. 1990. Ants of Far East of the USSR. DVO AN SSSR, Vladivostok 258pp. (in Russian).
- Radchenko, A. G. 1994. Taxonomic structure of the genus *Myrmica* (Hymenoptera, Formicidae) of Eurasia. Zoologicheskii Zhurnal. T. 73: 39-51 (in Russ., English translation: Entomological Review 1995. 74: 91-106).
- Radchenko, A. G., and G. W. Elmes 1998. Taxonomic revision of *ritae* species-group of the genus *Myrmica* (Hymenoptera, Formicidae). Vestnik Zool. 32: 3-27.
- Sadil, J. V. 1951. A revision of the Czechoslovak forms of the genus *Myrmica* (Hymenoptera). Acta Entomol. Musei Nat. Pragae 32: 233-278.
- Santschi, F. 1937. Fourmis du Japon et de Formosa. Bull. Ann. Soc. Entomol. Belgique 77: 361-388.
- Seifert, B. 1988. A taxonomic revision of the *Myrmica* species of Europe, Asia Minor, and Caucasus (Hymenoptera, Formicidae). Abhand. Berich. Naturmus. Górlitz. 62: 1-75.
- Weber, N. A. 1947. A revision of the North American ants of the genus *Myrmica* Latreille with a synopsis of the Palearctic species. I. Ann. Entomol. Soc. Amer. 40: 437-474.
- Weber, N. A. 1950. A revision of the North American ants of the genus *Myrmica* Latreille with a synopsis of the Palearctic species. III. Ann. Entomol. Soc. Amer. 43: 189-226.
- Wheeler, W. M. 1928. Ants collected by

Professor F. Silvestri in China. Boll. Lab. Zool. gen. agraria di Portici 22: 3-38.

**Wheeler, W. M.** 1929. Ants collected by Professor F. Silvestri in Formosa, the Malay Peninsula and the Philippines. Boll. Lab. Zool. gen. agraria di Portici 24: 27-67.

**Wheeler, W. M.** 1930. Formosan ants collected by Dr. R. Takahashi. Proc. New England Zoo. Club 11: 93-106.

*Received for publication May 12, 1998*

*Revised manuscript accepted Sep. 25, 1998*

## 臺灣產家蟻屬（膜翅目：蟻科）

**Graham W. Elmes\*** Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset, BH 20 5AS, United Kingdom (E-mail: gwe@ite.ac.uk)

**Alexander G. Radchenko** Institute of Zoology of Ukrainian National Academy of Science, 15, B. Khmel'nitsky str., Kiev-30, 252601, Ukraine

### 摘 要

台灣已發現 4 種溫帶性分佈的家蟻屬 (*Mymica*)，除 *M. serica* Wheeler 外，均僅分佈於台灣島。本文審訂 3 舊記錄種 (*M. formosae* Wheeler, *M. serica* Wheeler 及 *M. arisana* Wheeler) 與描述 1 新種 (*M. mirabile* sp. n.)，並附“種”之檢索表。*M. mirabile* 的職蟻體型碩大，為家蟻屬種類所罕見，僅 *M. gigantea* (Collingwood) 有相似體型。

**關鍵詞：**台灣、亞洲、分類、新種、家蟻屬。