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MONOGRAPHIC REVISION OF THE ANTS (HYMENOPTERA: FORMICIDAE) OF NORTH KOREA

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Abstract.— The monographic revision of North Korean ants is provided fist time in the World literature. This work was based on the investigation of very rich material collected by Polish and Hungarian entomologists in North Korea in 1959–1990. The collections are kept in the Museum and Institute of Zoology of the Polish Academy of Sciences, Warsaw, in the Institute of Environmental Sciences of the Jagiellonian University, Cracow, and in the Hungarian Natural History Museum, Budapest. In total, these unique collections include more than 70 thousand specimens collected in almost all regions of North Korea. Altogether, 99 ant species from 35 genera and 7 subfamilies, including 6 newly described species and 35 new to North Korea have been found; 17 species have been excluded from the list of the North Korean fauna. The monograph includes review of species, taxonomic and zoogeographical analysis of the Korean myrmecofauna, and the comparison of this fauna with that of the adjacent regions of Eastern Asia. A key for determination of all taxa of North Korean ants is also provided.

Key words.— Ants, Formicidae, taxonomy, key, zoogeography, North Korea, East Palaearctic.

Contents

INTRODUCTION

Ants belong to the family Formicidae of the order Hymenoptera. To date, more than 11,000 extant ant species have been described from all continents, excluding Antarctica, which belong to about 300 genera from 21 subfamilies (Bolton 1995 a, b, 2003). About 1500 species from more than 80 genera are known in the Palaearctic Region. Nevertheless, many tropical and mountain regions have not been adequately studied; additionally, many genera need revisions and there are hundreds or even thousands of undescribed species in the world collections. For example, several hundred new species of dacetine ants were described recently (Bolton 2000), and more than 30 new species were recently described even in the well-studied ant genus *Myrmica* (Radchenko and Elmes 1998, 1999, 2001 a, b, 2003, 2004, Elmes and Radchenko 1998, Radchenko et al. 2001, Elmes et al. 2001, 2002). Hence, one can suppose that the total number of ant species reaches 15,000 or even 20,000.

Ants are morphologically very diverse. The body length of workers of the smallest species is less than one millimetre, but the biggest species, such as *Camponotus gigas* from South-East Asia, or *Dinoponera grandis* from South America, are about four centimetres long.

All ants are so-called eusocial, or "true" social, insects. They live in colonies that consist of several tens to 15–20 million workers, and their females belong to different castes: queens, workers, and sometimes soldiers.

Ants belong to animals dominating, in respect of abundance and biomass, in almost all terrestrial habitats in the world, and have strong and multiple biotic impacts on ecosystems. They occupy habitats from the forest-tundra zone to equatorial forests, from bogs to deserts, from deep soil levels to forest canopy. In the mountains they have been recorded at altitudes up to 3600 m in the Pamir and 4500–4800 m in the Himalayas and Tibet.

Most ant species are non-specialised predators feeding on a very varied diet: they ingest animal and plant proteins as well as carbohydrate food, and are able to modify their diet according to the resources available in a habitat. On the other hand, ants generally tend to utilise food sources, which are the most abundant and most easily accessible at a given moment, which accounts for their essential role in maintaining homeostasis in biocoenoses.

Of significance is the influence of ants on the processes of soil formation. The building of ants' nests and their constant improvement involves the movement of large volumes of soil and plant matter, thus enriching the soil and influencing the composition of its microflora. Owing to their social habit, ants can survive virtually independently of weather changes and they are generally protected from any unfavourable impact of other habitat factors, which guarantees a considerable stability of ant communities over time.

All this makes ants a useful bioindicator of the state of the environment for ecological monitoring purposes and a model group for evaluating local biodiversity. However, this is possible only on condition that taxonomic and faunistic myrmecological knowledge is detailed enough and reliable.

Even though several hundred species and infraspecific forms of ants have been described from the East Palaearctic over the last 100 years or more, the first modern revisions and keys have only been published during the last 10–15 years. Ants of the Russian Far East have been investigated by Kupyanskaya (1990, 1995), who published a monographic revision and a key. The latest monograph on Chinese ants was prepared by Wu and Wang (1995), but this book is quite incomplete. A modern monograph of Japanese ants was published very recently (Imai et al. 2003), while there have not been any monographic revisions of Korean ants.

The earliest report on Korean ants was by Wheeler (1906), and since that time several tens papers dealing with Korean myrmecofauna have been published (see Terayama et al. 1992, Kim B.-J. 1996, 2003). At the same time, the ant fauna of the Democratic People's Republic of Korea (the name **North Korea** is used throughout the rest of the present monograph) has been investigated to a much smaller extent than that of South Korea.

Early publications (Karawajew 1912, Wheeler 1928b, 1929, Teranishi 1940, Wilson 1955, Pisarski 1966) noted several species of North Korean ants, but the most complete picture of North Korean ants was presented in two short papers by Collingwood (1976, 1981). His data were based on material collected in 1970, 1971 and 1975 by expeditions of the Hungarian Natural History Museum to North Korea. Collingwood found 63 ant species in the material. Subsequent checklists of Korean Formicidae (Paik 1984, Terayama et al. 1992, Kim B.-J. 1996, 2003) did not add any more information about North Korean ants.

The present revision was supported by the Polish Scientific Research Committee's Grant KBN No. 6 P04C 060 21 and based on the investigation of very abundant material collected by Polish and Hungarian entomologists in North Korea between 1959 and 1990 (Mahunka and Steinmann 1971, Mroczkowski 1972, Papp and Horvatovich1972, Papp and Vojnits 1976, Dely and Dely-Draskovits 1977, Vojnits and Zombori 1979, Steinmann and Vásárhelyi 1980, Forró and Topál 1981, Forró and Ronkay 1983, Vojnits and Zombori 1987, Bańkowska and Sterzyńska 1997, Pawłowski et al. 2000). The collections are preserved in the Museum and Institute of Zoology of the Polish Academy of Sciences, Warsaw, in the Institute of Environmental Sciences of the Jagiellonian University, Krakow), and in the Hungarian Natural History Museum, Budapest. Totally, these unique collections include more than 70 thousand specimens collected in almost all regions of the country (Fig. 1).

In the material I have found 99 ant species belonging to 35 genera and 6 subfamilies, including 6 species new to science, and 35 species and 6 genera new to North

Korea; 17 species are excluded from the list of the North Korean fauna.

North Korea is situated in the East Asia between 37°45'–43°00' N latitudes and 124°19'–130°40' E longitudes, in the northern part of Korean Peninsula and the mainland of Asia. Its area is 120,540 square kilometres.

Generally, North Korea is a mountainous country with deep, narrow valleys. High mountains with altitudes over 2000 m a.s.l. (the highest is Mt. Pektusan near the Chinese border, at 2750 m) are in the northern and partly in the central parts of the country. A complex system of ranges and spurs generally runs in a north-east to south-west direction. Lowland plains cover only about one-fifth of the total area and are mostly confined to the country's east coast and to the several broad river valleys of the west, but even here, there are quite a lot of relatively low (less than 1000 m) local mountains.

North Korea has a continental climate, with hot summers and quite cold winters. The average July temperature at Pyongyang is 24°C. The average winter temperature at Wonsan is -4°C, but is considerably lower in the north of the country. Annual precipitation in most parts of the country is about 1000 millimetres and is concentrated in the summer months.

The population of North Korea is about 25 million people, or approximately 200 persons per square kilometre. Such a high population density and influence of the industry and agriculture have devastated many natural areas, which has led to decreased biodiversity.

The following abbreviations of the Museums and Institutions are used: Museum and Institute of Zoology of the Polish Academy of Sciences, Warsaw (MIZ), Institute of Environmental Sciences of the Jagiellonian University, Krakow (JUK), Hungarian Natural History Museum, Budapest (HNHM), Institute of Zoology of the Ukrainian National Academy of Sciences, Kiev (IZK), Zoological Museums of Moscow State University (ZMMU), Soil and Biological Institute of Russian Academy of Sciences, Vladivostok, (BPI), The Natural History Museum, London (BMNH), Finnish Museum of Natural History, Helsinki (FMNH), Museum of Comparative Zoology of Harvard University, USA (MCZ), Museum d'Histoire Naturelle, Genève (MHNG), Museo Civico di Storia Narurale di Milano (MSNM) and collections of G. W. Elmes, UK (ELMES) and B.-J. Kim, South Korea (KIM).

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Survey of species

Taxa reported first for North Korea are marked by asterisk; workers are abbreviated as w, queens – as q, and males – as m.

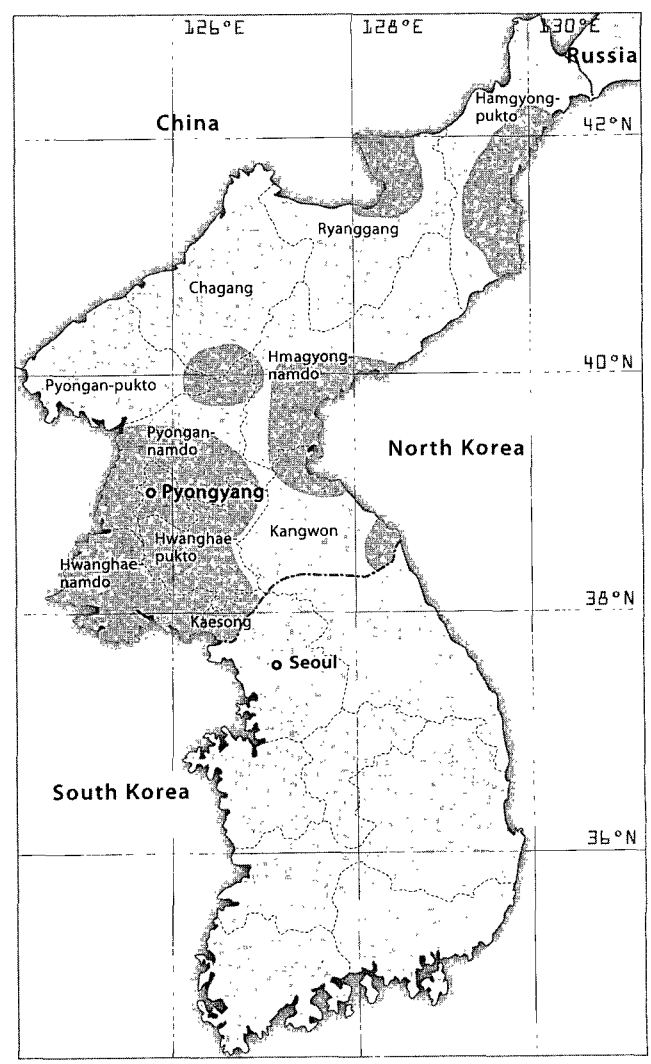

Figure 1. Areas of North Korea, where ants have been collected.

Ponerinae Lepeletier

All preceding authors placed ants with a one-segmented waist and a constriction between the first and second gastral tergites in the subfamily Ponerinae. Ponerinae s. l. was one of the biggest ant subfamilies and comprised more than 1300 species and about 50 genera distributed all over the world, predominately in the tropics and subtropics, with 11 genera and about 40 species known from the Palaearctic Region (mainly from its southern part).

Ponerinae s. l. is a heterogenic subfamily that includes very diverse, morphologically different ant genera, and the idea to divide it into several subfamilies has been suggested by many ant taxonomists, but only Bolton (2003) has done this. He divided Ponerinae into 6 subfamilies: Amblyoponinae, Ponerinae s. str., Ectatomminae, Heteroponerinae, Paraponerinae, and Proceratiinae.

*Cryptopone** Emery, 1893

Cryptopone Emery 1893 a: cclxxv. Type species: *Cryptopone testacea* Emery, 1893 a: cclxxv, by monotypy.

This not specious genus consists of 16 species distributed mainly in the tropics (worldwide, except of Madagascar). Only 2 species are known from the Palaearctic Region – *C. sauteri* and *C. ochracea* Mayr.

*Cryptopone sauteri** (Wheeler, 1906)

Pachycondyla (*Pseudoponera*) *sauteri* Wheeler 1906: 304, w, q, Japan.
Euponera (*Trachymesopus*) *sauteri*: Emery 1911: 86.
Cryptopone sauteri: Brown 1963: 6, Ogata 1987: 118, m, Bolton 1995 b: 167, Kim B.-J. 1996: 171, 2003: 2, Imai et al. 2003: 216.
Trachymesopus pilosior: Collingwood 1976: 300 (misidentification), not Wheeler 1928 b: 98.

Material examined. 11 w from North Korea and Japan.

General distribution. Japan (excluding Hokkaido), Korean Peninsula; China (?).

Distribution in North Korea (Fig. 2). Prov. Kangwon, Kumgang-san, Man-mul san; Prov. Hwanghae-namdo, 20 km SE of Kaesong, San-chon tong, Bagyon san.

Ecology. In North Korea workers were found in a leaf litter in the mountain oak forest and in the sweet chestnut forest. Generally, this cryptic species nests in a rotting wood and in a leaf litter in forests. It is a predator of dipterous and coleopterans larvae (Imai et al. 2003).

*Hypoponera** Santschi, 1938

Hypoponera Santschi 1938: 79 (as subgenus of *Ponera*). Type species: *Ponera abeillei* André 1881: 61, by original designation, Taylor 1967: 9 (raised to genus).

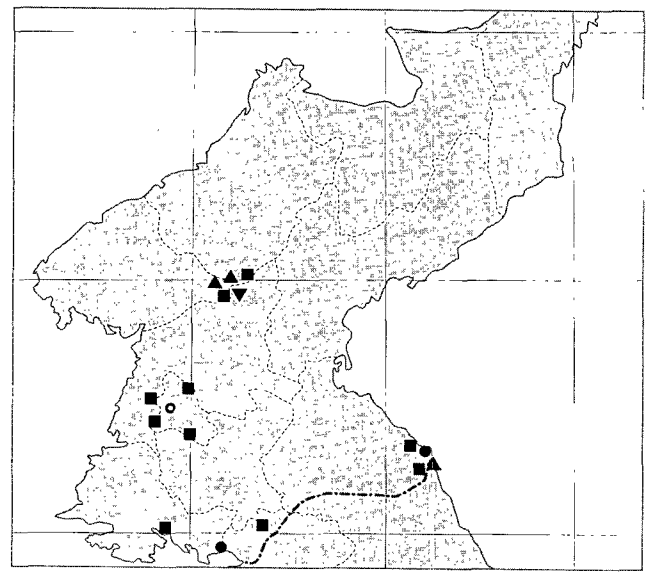

Figure 2. Distribution of *Cryptopone sauteri* (●), *Hypoponera sauteri* (▼), *Pachycondyla chinensis* (▲) and *P. astuta* (■) in North Korea.

This cosmopolitan genus comprises about 150 species distributed mainly in the tropics; about 10 species are found in the southern parts of the Palaearctic. One species is known from North Korea. They are small, predominately hypogeic predatory forms.

*Hypoponera sauteri** (Forel, 1912)

Hypoponera gleadowi subsp. *decipiens* var. *sauteri* Forel 1912 a: 48, w, Taiwan (unavailable name), Onoyama 1989 b: 7, q (raised to species, first available use of name), Wu and Wang 1995: 40, Bolton 1995 b: 216, Kim B.-J. 1996: 171, 2003: 2, Imai et al. 2003: 214.

Material examined. 5 w from North Korea and Japan.

General distribution. Taiwan, China, Japan (excluding Hokkaido), Korean Peninsula.

Distribution in North Korea (Fig. 2). Prov. Pyongan-namdo, Myohyang-san Mts.

Ecology. Similar to the species of *Ponera* (see below).

Pachycondyla F. Smith, 1858

Pachycondyla F. Smith 1858: 105. Type species: *Formica crassinoda* Latreille, 1802: 198, by subsequent designation of Emery 1901 a: 42.
Brachyponera Emery, 1900: 315 (as subgenus of *Euponera*), synonymy by Snelling 1981: 389, Bolton 1995 b: 22.
Ectomomyrmex Mayr, 1867: 83, synonymy by Brown 1973: 180, Bolton 1995 b: 28.
Trachymesopus Emery, 1911: 84, synonymy by Brown 1973: 185, Bolton 1995 b: 48.

One of the most specious genera of the subfamily Ponerinae, consisting of more than 200 species distributed mainly in the World tropics and partly in the subtropics; 5–6 species are known from the Palaearctic Region.

Pachycondyla astuta F. Smith, 1858

Pachycondyla astuta F. Smith 1858: 107, w, Australia, Collingwood 1976: 300, Wu and Wang 1995: 46, Bolton 1995 b: 303, Kim B.-J. 1996: 170, 2003: 2, not Collingwood 1981: 26 (misidentification).
Ectomomyrmex astutus: Bingham 1903: 86.

Material examined. Several tens w and 8 m from North Korea, China, Japan, Vietnam and India.

General distribution. Australia, South and South-East Asia, China, Korean Peninsula.

Distribution in North Korea (Fig. 2). Pyongyang and surrounding area (Pyongyang; Ryongak Mt., Daebong near Pyongyang; Djonjong-san Mts; Taesong-san, SE of Pyongyang); Prov. Hwanghae-namdo: vicinity of Haeju, Sujang-san Mts; 20–30 km NE Kaesong, Pakyon Mts; Prov. Pyongan-namdo and Chagang, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts.

Ecology. In North Korea it is found at low altitudes (up to 450 m a.s.l.) in pine and mixed (mainly pine-oak) forests, dry grasslands, rich meadows, glades and stony slopes with sparse vegetation, including artificial biotopes. It builds nests in the soil, often under stones. *P. astuta* is the biggest Ponerinae species in North Korea (body length up to 7–8 mm). Workers forage individually on the ground and can easily be found. They have strong stings and inflict very painful stings.

Notes. Collingwood (1981) determined several males from the Kumgang-san Mts as *P. astuta*, but in fact they are *P. chinensis* (material examined). Males of the latter species are yellowish and much smaller than the big black males of *P. astuta* (HW < 0.8, AL < 2.0 *vs.* HW > 1.2, AL > 2.5 mm).

Collingwood (1976) regarded *P. javana* (Mayr 1867) as a junior synonym of *P. astuta*. Japanese myrmecologists (Imai et al. 2003) determined Japanese samples as *P. javana*, but noted that the nomenclature for this species is still uncertain. B.-J. Kim (1996) referred for Korean Peninsula both *P. astuta* and *P. javana*. I cannot now make definitive statements about the synonymy of *P. javana* and *P. astuta*, but I think that *P. astuta* can be found in Japan. Hence, I propose to exclude *P. javana* from the list of ant fauna of the Korean Peninsula.

Pachycondyla chinensis (Emery, 1895)

Ponera nigrita subsp. *chinensis* Emery 1895: 460, w, China.
Brachyponera chinensis: Brown 1958 b: 22, Collingwood 1976: 300 (misspelled as *chinensi*).
Pachycondyla chinensis: Bolton 1995 b: 304, Kim B.-J. 1996: 170, 2003: 2, Imai et al. 2003: 211.
Pachycondyla astuta: Collingwood 1981: 26 (misidentification), not F. Smith 1858: 107.

Material examined. 5 w and 6 m from North Korea and China.

General distribution. China, Taiwan, Korean Peninsula.

Distribution in North Korea (Fig. 2). Prov. Chagang and Pyongan-pukto, Myohyang-san Mts; Prov. Kangwon, Distr. On-dzong, Kumgang-san Mts.

Ecology. Found in North Korea at low altitudes (250–300 m a.s.l.) in coniferous and mixed forests. In Japan this species is quite common in southern Honshu and the more southern Japanese islands, where it was found at the margins of woodlands (Imai et al. 2003).

Ponera Latreille, 1804

Ponera Latreille 1804: 179. Type species: *Formica coarctata* Latreille, 1802: 65, by subsequent designation of Westwood 1840 a: 83.

This genus comprises about 40 species distributed in the Oriental and Australasian Regions, in the southern part of the Palaearctic (5–6 species), in the Nearctic, and on the Pacific islands. Two species occur in North Korea. They are small hypogeic predatory forms.

Ponera japonica Wheeler, 1906

Ponera japonica Wheeler 1906: 306, w, q, Japan, Teranishi 1940: 10, Taylor 1967: 76, Collingwood 1976: 300, Kupyanskaya 1990: 86, m, Bolton 1995 b: 361, Kim B.-J. 1996: 171, 2003: 2, Imai et al. 2003: 216.
Ponera japonica var. *crocea* Santschi, 1941: 273, w, Japan, synonymy by Taylor 1967: 76.

Material examined. About 30 w and 3 q from North Korea, Japan and Russian Far East.

General distribution. Japan, Kunashir Island, south of Primorsky Region of Russia, Korean Peninsula.

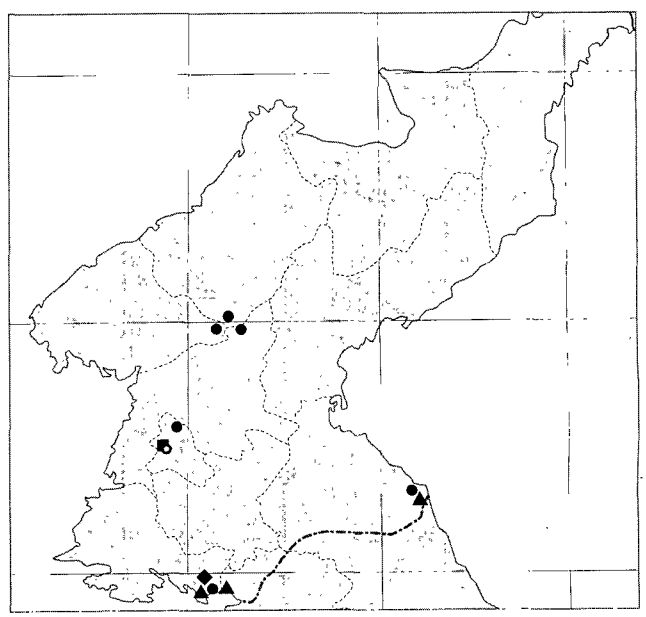

Figure 3. Distribution of *Ponera japonica* (●), *P. scabra* (▲), *Proceratium watasei* (◆) and *Tetraponera modesta* (■) in North Korea.

Taylor (1967) has recorded this species from Indonesia and Malaysia, and expected that it widely distributed in the Oriental Region; this suggestion needs confirmation.

Distribution in North Korea (Fig. 3). 10 km NE of Pyongyang, Taesong-san; Prov. Pyongan-namdo, Pyongan-pukto and Chagang, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts; Prov. Hwanghae-namdo, 30 km SW of Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon san.

Ecology. A cryptic species that inhabits mainly deciduous and mixed forest. Nests are built in soil, often under stones and in leaf litter, where the ants also forage. Colonies are small, include at most several tens workers. In North Korea all specimens were found in deciduous and mixed forests in soil or leaf litter at low altitudes (between 200 and 250 m a.s.l.).

Notes. *P. japonica* differs from the related *P. scabra* by the distinctly narrower and less massive petiolar node, by the more fine body sculpture, etc. (see also Key).

Ponera scabra Wheeler, 1928

Ponera scabra Wheeler 1928 b: 99, w, q, Japan, Taylor 1967: 49, Collingwood 1976: 300, Ogata 1987: 121, m, Bolton 1995 b: 362, Kim B.-J. 1996: 171, 2003: 2, Imai et al. 2003: 216.

Material examined. 8 w and 1 q from North Korea.

General distribution. Japan, Korean Peninsula.

Distribution in North Korea (Fig. 3). Prov. Kangwon, Kumgang-san Mts, Kuryong chon; Prov. Hwanghae-namdo: 30 km from Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon san; 20 km SE of Kaesong, San-chon tong, Bagyon san.

Ecology. Similar to that of other species of the genus. In North Korea it was found in moss and leaf litter in shrubs and pine forests.

Proceratiinae Emery

This subfamily comprises 3 genera and about 70 species, distributed mainly in the tropics; only a few species penetrate into the Palaearctic Region. The most characteristic feature of the representatives of this subfamily is the peculiar shape of the gaster: the tergite of the second gastral segment is much bigger than its sternite, strongly arched and vaulted so that the gaster curves downwards and its apex is directed anteroventrally.

Proceratium Roger, 1863

Proceratium Roger 1863: 171. Type species: *Proceratium silaceum* Roger, 1863: 172, by monotypy.

This pantropical genus comprises of about 30 species, 6 of them are known from the Palaearctic Region.

Proceratium watasei (Wheeler, 1906)

Sysphincta watasei Wheeler 1906: 303, w, q, Japan.
Proceratium watasei: Brown 1958 a: 248, Collingwood 1976: 300, Kim B.-J. 1996: 172, 2003: 2, Imai et al. 2003: 217.

Material examined. 3 w from North Korea and Japan.

General distribution. Japan (excluding Hokkaido), Korean Peninsula.

Distribution in North Korea (Fig. 3). Prov. Hwanghae-namdo, 20 km SE Kaesong, San-chon tong, Bagyon san.

Ecology. In North Korea workers were found in leaf litter in the sweet chestnut forest. A cryptic species nesting in leaf litter and in soil.

Pseudomyrmecinae M. R. Smith

This subfamily comprises 3 genera and more than 250 species, distributed mainly in the world tropics, with only a few species reaching the subtropics of the Holarctic. One genus and two species are known from the Palaearctic Region.

*Tetraponera** F. Smith, 1852

Tetraponera F. Smith 1852: 44. Type species: *Tetraponera atrata* F. Smith, 1852: 44 (junior synonym of *T. nigra* Jerdon, 1851), by subsequent designation of Wheeler 1911: 173.

This genus comprises 115 species distributed in the Old World tropics; 2 species are known from the Palaearctic Region.

*Tetraponera modesta** (F. Smith, 1860)

Pseudomyrma modesta F. Smith 1860 a: 106, w, Indonesia.
Sima modesta: Dalla Torre 1893: 54.
Sima (Tetraponera) modesta: Emery 1921: 26.
Tetraponera modesta: Donisthorpe 1932: 462, Bolton 1995 b: 418, Ward 2001: 616.
Tetraponera pisarskii Radchenko, 1997 d: 449, w, North Korea, synonymy by Ward 201: 616.

Material examined. Holotype, of *T. pisarskii*, w, North Korea, Pyongyang, 21.vii.1959.

General distribution. South-East Asia, India, New Guinea, Philippines, Taiwan, North Korea.

Distribution in North Korea (Fig. 3). Is known only from one worker from the type locality (see above).

Ecology. In North Korea is unknown. Generally, it is an arboreal species, nesting in thin twigs of trees or in bamboo (se also Ward 2001).

Notes. This species was described as *T. pisarskii* (Radchenko 1997), but later Ward (2001) synonymised it with *T. modesta*. The finding of a member of this

tropical genus in North Korea was quite unexpected. This species can be a Tertiary relict in the North Korean fauna, or it may have been introduced from the tropics.

Myrmicinae Lepeletier

The biggest ant subfamily, comprising about 4500 species and about 150 genera distributed worldwide. About 700 species from nearly 40 genera are known from the Palaearctic Region.

Aphaenogaster Mayr, 1853

Aphaenogaster Mayr 1853 a: 107. Type species: *Aphaenogaster sardoa* Mayr, 1853 a: 107, by subsequent designation of Bingham 1903: 270.

This genus comprises about 150 species, distributed worldwide apart from Afrotropical Region; in the Palaearctic there are about 100 species.

Aphaenogaster famelica (F. Smith, 1874)

Ischnomyrmex famelica F. Smith 1874: 405, w, Japan.
Aphaenogaster famelica: Mayr 1879: 669, Collingwood 1981: 26, Wu and Wang 1995: 115, Bolton 1995 b: 69, Kim B.-J. 1996: 174, 2003: 2, Imai et al. 2003: 180.

Material examined. About 30 w from North Korea and Japan.

General distribution. China, Korean Peninsula, Japan. Kupyanskaya (1990) referred to the Russian Far East only one species, *A. sinensis*, but based on her notes, specimens from the Ussurijsky Natural Reserve and Isl. Kunashir may belong to *A. famelica*.

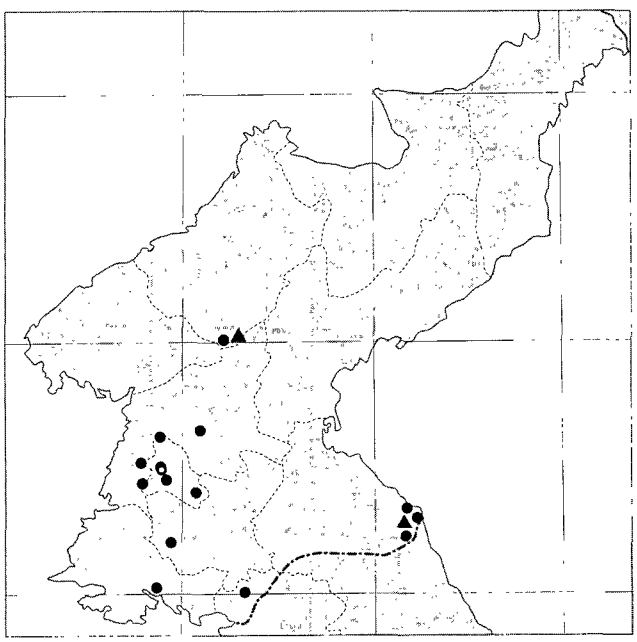

Figure 4. Distribution of *Aphaenogaster japonica* (●) and *A. famelica* (▲) in North Korea

Distribution in North Korea (Fig. 4). Prov. Kangwon, Kumgang-san Mts, distr. On-Dzong, along riv. Orku-dong; Prov. Chagang, Myohyang-san Mts (valley of riv. Hyangsan and near Myohyang-san Hotel).

Ecology. In North Korea it is a much rarer species than the next one. In the Kumgang-san Mts one worker was collected by sweeping shrubs along a pathway, one worker was found near Myohyang-san Hotel, and only one nest was found in the Myohyang Mts at 200 m a.s.l. in the bottom of a valley near a river in a rotten stump.

In contrast, *A. famelica* is the most common *Aphaenogaster* species in Japan. It is found in lowland areas of eastern Japan, and in the west its range is from lowlands to mountainous areas. Nests are found in open soil or under stones in woodlands and their margins (Imai et al. 2003).

*Aphaenogaster japonica** Forel, 1911

Aphaenogaster schmitzi japonica Forel 1911: 267, w, Japan.
Aphaenogaster (Attomyrma) syriaca japonica: Emery 1921: 60.
Aphaenogaster (Attomyrma) smythiesii japonica: Wheeler 1928 b: 101, Bolton 1995 b: 70, Kim B.-J. 1996: 175 (misspelled as *smithiesii* and missing of the subspecific name).
Aphaenogaster japonica: Wu and Wang 1995: 114, Kim B.-J. 2003: 2, Imai et al. 2003: 179.
Aphaenogaster smythiesii sinensis Wheeler, 1928 a: 9, Arnoldi 1976: 1022 (raised to species), Kupyanskaya 1990: 119, synonymy by Wu and Wang 1995: 114.
Aphaenogaster ruida: Collingwood 1976: 302 (misidentification), not Wheeler 1928 b: 104.

Material examined. Syntype, w, "Hokkaido, Japon (Sauter)", "*Aphaenogaster Schmidti* Forel subsp. *japonica* Forel type" (MHNG); non-type material: several tens w, 3 q and 5 m from North Korea, China and Japan.

General distribution. China, Korean Peninsula, Japan, Russian Far East.

Distribution in North Korea (Fig. 4). Pyongyang and surrounding area (Djonjong-san Mts; Ryongak-san Mts; Taesong-san Mts; De-sang san; Bong-ha ri, on river Te-dong; Lake Taesong-ho); Prov. Hwanghae-namdo, Sujang-san Mts, near Haeju; Prov. Kaesong City, vicinity of Kaesong; Prov. Hwanghae-pukto, Sohung-ho, 20 km SSE of Sariwon; Prov. Chagang, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts.

Ecology. In North Korea it is quite common and inhabits diverse sites at altitudes between 180 and 920 m a.s.l. It lives mainly in different types of forests, but prefers deciduous and mixed ones; it was also found in city parks, rarely on meadows. It builds nests in soil, often under stones, but also in rotten wood.

In Japan this species was found on the plains of eastern Japan, and at higher altitudes in the west, nesting in

soil or under stones in woodlands or their margins (Imai et al. 2003). In the Russian Far East it also lives in mixed forests, where it prefers warmer and sunnier habitats, building its nests in soil.

Crematogaster Lund, 1831

Crematogaster Lund 1831: 132. Type species: *Formica scutellaris* Olivier, 1792: 497, by subsequent designation of Bingham 1903.

This genus comprises about 450 worldwide-distributed species. About 30 of them are known from the Palaearctic Region. *Crematogaster* is one of the most specious ant genera, and its taxonomy is very poorly studied.

Crematogaster matsumurai Forel, 1901

Crematogaster laboriosa var. *matsumurai* Forel 1901 a: 372, w, Japan.
Crematogaster matsumurai: Wheeler 1928 b: 110, Collingwood 1976: 303, 1981: 27, Wu and Wang 1995: 65, Bolton 1995 b: 157, Kim B.-J. 1996: 174, 2003: 2, Imai et al. 2003: 109.

Material examined: several hundred w, about 20 q and m from North Korea and Japan.

General distribution. China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 5). Pyongyang and surrounding area (Sokam-Juvondzi, distr. Sunan; Taesong Mts., distr. Kangso; Nampo; distr. Kyongsong, Maram; 20 km NE Pyongyang; Ryongak-san Mts, Daebong; Djonjong-san Mts; 4 km NE Pyongyang, Lake Sokan; 10 km NE Pyongyang, Taesong-san Mts.; 15 km W of Pyongyang, Ryongak-san; 60 km NE Pyongyang, Za-mo san; 12 km NE Pyongyang, De-sang san); Prov. Kangwon, Kumgang-san Mts.; Prov. Kaesong City: Kaesong and its vicinity; Prov. Hwanghae-namdo, Sujang-san Mts, Near Haeju; Prov. Chagang, Myohyang-san Mts; Prov. Hamgyong-namdo, 15 km W Hamhung.

Ecology. In North Korea this species inhabits mainly light, relatively dry mixed forests (pine, oak, beech, elm, ash, sweet chestnut), shrubs, edges of forests at altitudes up to 780 m a.s.l., but prefers lower altitudes, between 150 and 350 m a.s.l.; it is also quite common in artificial habitats, including city parks. Nests are usually built in rotten wood, rarely in soil or under stones.

Crematogaster osakensis Forel, 1900

Crematogaster sordidula osakensis Forel 1900: 269, w, Japan.
Crematogaster osakensis: Collingwood 1976: 303, Wu and Wang 1995: 63, Bolton 1995 b: 159, Kim B.-J. 1996: 174, 2003: 2, Imai et al. 2003: 108.

Material examined. More than one hundred w, about 20 q and m from North Korea and Japan.

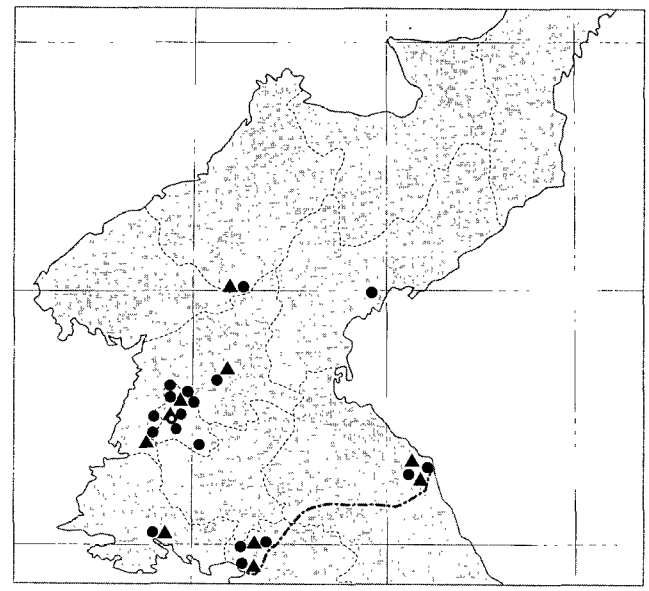

Figure 5. Distribution of *Crematogaster matsumurai* (●) and *C. osakensis* (▲) in North Korea.

General distribution. China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 5). Pyongyang and surrounding area (10 km NE Pyongyang, De Sang-san, 35 km SW Pyongyang, Taesong; 60 km NE Pyongyang, Za-mo san); Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts; Prov. Kangwon: Kumgang-san Mts., Onjong-ri; Samil-po; Prov. Kaesong City, Kaesong; 20 km SE Kaesong, San-chon tong, Bagyon san; Prov. Chagang, Myohyang-san Mts.

Ecology. *C. osakensis* is more thermophilous than *C. matsumurai*. In North Korea it lives in different habitats, including disturbed areas: dry grasslands and sparse forests (pine, oak, maple, pseudoacacia, and sweet chestnut) at lower altitudes (up to 250–300 m a.s.l.).

It nests in soil, often under stones.

Leptothorax Mayr, 1855

Leptothorax Mayr 1855: 431. Type species: *Formica acervorum* Fabricius, 1793: 358, by subsequent designation of Bingham 1903: 214.
Mychothorax Ruzsky, 1904: 288, synonymy by M. R. Smith 1950: 29, Bolton 1995 b: 36, 2003: 247.
Doronomyrmex Kutter, 1945: 485, synonymy by Heinze 1998: 195, Bolton 2003: 247.

The genus *Leptothorax* was described by Mayr in 1855, who also described the closely related genus *Temnothorax* (Mayr 1861) a few years later. For many years different authors regarded the latter either to be a good genus or perhaps, a subgenus of *Leptothorax*, but during last decade it was considered to be junior synonym of *Leptothorax* (Bolton 1995 b).

Bingham (1903) designated *Formica acervorum* as the type species for the genus *Leptothorax*. At about the same

time Ruzsky (1904) described the genus *Mychothorax*, for which *F. acervorum* was also given as the type species (by original designation); later *Mychothorax* was considered as a subgenus of *Leptothorax* inasmuch that Emery (1912, 1921) designated *Myrmica clypeata* Mayr as the type species for *Leptothorax*. All subsequent authors have placed species with 11-jointed antennae in the subgenus *Mychothorax* and species with 12-jointed antennae in the subgenus *Leptothorax* s. str. Eventually, M. R. Smith (1950) synonymised *Mychothorax* with *Leptothorax* as taxa having the same type species (hence the synonymy is absolute) and described *Myrafant* as a new subgenus of *Leptothorax*, with the type-species *L. curvispinosus* Mayr. Species from the former subgenus *Leptothorax* s. str. (e.g. *sensu* Emery) were then transferred to the subgenus *Myrafant*, and those that were in *Mychothorax* were considered to be *Leptothorax* s. str. (*sensu* Bingham).

Basically, quite high level of differences between the species belonging to *Leptothorax* s. str. and the subgenus *Myrafant* has resulted in a proposal to separate this taxon into two genera, discussed by many myrmecologists (i.e. Buschinger, Heinze, pers. comm.), and finally very recently Bolton (2003) has formally separated these genera, revived several genera from synonymy, and provided new synonyms.

The main differences between *Leptothorax* and *Temnothorax* are (after Bolton 2003):

Leptothorax	*Temnothorax*
Workers: ▪ antennae 11-segmented ▪ median clypeal carina absent ▪ transverse crest present on stipes of maxilla	**Workers:** ▪ antennae 12-, rarely 11-segmented ▪ median clypeal carina present ▪ transverse crest absent on stipes of maxilla
Males: ▪ mandibles reduced, with short masticatory margin, blunt, edentate ▪ antennae 12-segmented ▪ scape very short ▪ antennal funiculus filiform	**Males:** ▪ mandibles with distinct masticatory margin and with 3–5 teeth ▪ antennae 13-, rarely 12-segmented ▪ scape relatively long ▪ antennal funiculus with 3- or 4-segmented club

Leptothorax (s. l.) was the most specious Palaearctic ant genus, and even *Temnothorax* contains 187 species occurring in this region; only 11 *Temnothorax* species are known from the Afrotropical and Oriental Regions and more than 120 species are found in the New World. In contrast to this, genus *Leptothorax* (s. str.) includes only 16 free living and socially parasitic Holarctic, mainly boreal, species.

The species of *Leptothorax* and *Temnothorax* are small ants (1.7–4.5 mm); they frequently have an arboreal habit but often nest in soil, rock crevices, in leaf litter, under stones, etc. The species of these genera inhabit very diverse sites – from cold forests in the forest-tundra zone to the dry steppe or even semi-desert habitats.

Leptothorax acervorum (Fabricius, 1793)

Formica acervorum Fabricius 1793: 358, w, Denmark.
Leptothorax acervorum: Mayr 1855: 436, Collingwood 1981: 27, Kupyanskaya 1986 b: 96, 1990: 137, Radchenko 1994 d: 146, 1995 a: 23, Bolton 1995 b: 235, Kim B.-J. 1996: 176, 2003: 2, Terayama and Onoyama 1999: 75, Imai et al. 2003: 157, Lyu and Cho 2003 b: 270, Radchenko 2004: 130.
Leptothorax acervorum var. *nigrescens* Ruzsky, 1905: 613, w, Northern Russia, synonymy by Radchenko 1994 d: 146.
Leptothorax acervorum subsp. *kamtschaticum* Ruzsky, 1920: 77, w, Kamchatka, synonymy by Kupyanskaya 1986 b: 96.
Leptothorax acervorum subsp. *orientalis* Kuznetsov-Ugamsky, 1928: 31, w, Russian Far East, Sikhote-Alin', synonymy by Kupyanskaya 1990: 137.

Material examined. Several hundred w, several tens q and m from the Palaearctic Region, including Eastern Palaearctic.

General distribution. The boreal zone of the Holarctic, the mountains of Southern Europe, the Caucasus, Tien-Shan.

Distribution in North Korea (Fig. 6). Prov. Ryanggang: Mts Pektusan (environments of the Sam-zi-yan hotel; Samjiyon; Chan-Pay plateau, 24 km NW from Sam-zi-yan, along road to Pektusan; Mupo, NE Samjiyon, Tumanggang river, near Chinese border; 5 km N Taesong Dan; 2 km N from Chongbong); 5 km SW from Hyesan; Prov. Chagang, Myohyang-san Mts (Pobwang-Bong; Manpek-Dong; Pirobong).

Ecology. In North Korea *L. acervorum* was found only in the mountain regions in the central and northern parts of the country: Pektusan Mts and Myohyang-san Mts. At all these localities, it inhabits subalpine meadows, mountain tundra and mountain forests (usually

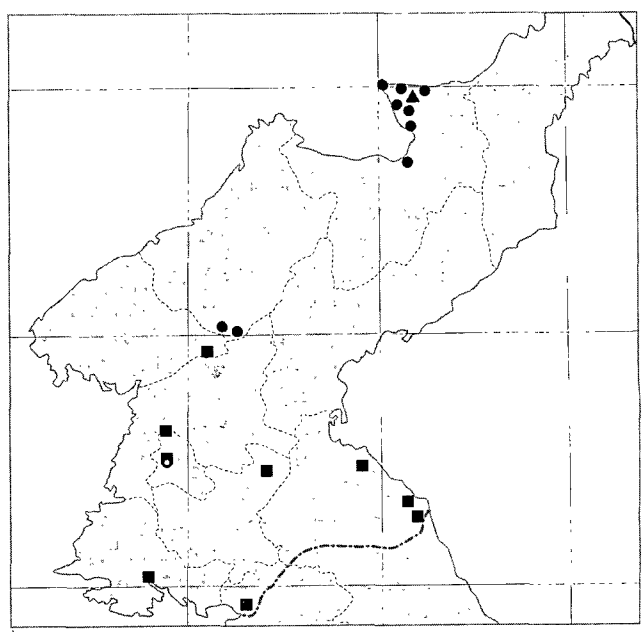

Figure 6. Distribution of *Leptothorax acervorum* (●), *L. oceanicus* (▲) and *Messor aciculatus* (■) in North Korea.

larch, birch, fir, rarely – pine, oak, elm) and shrubs at altitudes between 850 and 2000 m a.s.l., building nests in rotten wood, moss, soil, often under stones.

Generally, this species is most abundant in dry and light coniferous forests with poor undergrowth, and reaches into the north Forest-Tundra Zone. It is also seen in open habitats, ranging from moist peat bogs to xerothermal grasslands. *L. acervorum* forms mono- or polygynous colonies, usually with a few tens workers. Workers forage individually, predating on small insects or scavenging dead invertebrates; they are non-aggressive, avoiding intra- and interspecific combats with other ants.

Notes. For details of the ecology and synonymy of this species in the Eastern Palaearctic see Kupyanskaya (1986 b, 1990), Radchenko (1995 a), Bolton (1995 b), Terayama and Onoyama (1999).

*Leptothorax oceanicus** (Kuznetsov-Ugamsky, 1928)

Mychothorax muscorum subsp. *oceanicum* Kuznetsov-Ugamsky 1928: 29, w, Russia: Primorsky Region, Ussuri Distr., station Okeanskaya.
Leptothorax muscorum oceanicum: Kupyanskaya 1990: 140, w, q (ergatoid).
Leptothorax oceanicum: Heinze et al. 1993: 177 (raised to the species rank), Radchenko 1994 d: 147, 1995 a: 25.
Leptothorax oceanicus: Bolton 1995 b: 242 (emendation of spelling), Radchenko, Heinze 1997: 79 (designation of the neotype), Radchenko 2004: 131.

Material examined. Neotype, w: Russia, Primorsky Region, Suputinsky Natural Reserve, valley of the riv. Maykha, 25.v.1967, leg. A. Tichomirova (ZMMU); non-type material: 16 w, 3 q from Primorsky and Amursky Regions of Russia, north-eastern China and North Korea.

General distribution. *L. oceanicus* seems to be quite rare species and is known from several localities between 41°–53°N and 125°–135°E: Russia: Amursky Region, Zeya; Khabarovsk; Primorsky Region: Vladivostok; Anisimovka; Borisovskoe plateau; Suputinsky Natural Reserve; north-east China: Jilin Province, and in North Korea.

Distribution in North Korea (Fig. 6). Prov. Ryanggang, Samjiyon, shore of Lake Samjiyon.

Ecology. This species inhabits mainly deciduous forests, but it has also been found on a meadow near a lakeshore. It builds nests mostly in fallen logs, tree stumps, rarely in soil. In North Korea 2 workers and dealate queen were found at 1350 m a.s.l., in a sandy grassland near a lakeshore.

Notes. *L. oceanicus* the most resembles *L. muscorum* and differs from it first of all by the shape of the petiole, which is sharply triangular in profile and has a very narrowly rounded node dorsum (in *L. muscorum* the petiolar node has a distinct, often rounded dorsal plate; Figs 33 and 34) (for details see Radchenko and Heinze 1997).

Messor Forel, 1890

Aphaenogaster subgen. *Messor* Forel 1890: 68. Type species: *Formica barbara* Linnaeus, 1767: 962, by subsequent designation of Bingham 1903: 277.
Messor: Bingham 1903: 277.

This genus comprises about 100 granivorous species distributed mainly in the arid and semiarid zones of the Palaearctic (more than 80 species); several species have penetrated into the Afrotropical and Oriental Regions (Saudi Arabia, Pakistan and India).

Messor aciculatus (F. Smith, 1874)

Aphaenogaster aciculata F. Smith 1874: 405, w, q, Japan.
Stenamma (*Messor*) *aciculata:* Forel 1901 b: 60.
Aphaenogaster (*Attomyrma*) *aciculata:* Emery 1921: 57.
Messor aciculatus: Forel 1922: 93, Collingwood 1976: 303, Kupyanskaya 1990: 121, Wu and Wang 1995: 98, Bolton 1995 b: 252, Kim B.-J. 1996: 175, 2003: 2, Imai et al. 2003: 160.

Material examined. Several tens w, about 20 q and m from China, Mongolia, North Korea and Japan.

General distribution. Northern China, Mongolia, southern part of Russian Far East, Korean Peninsula, Japan (except of Hokkaido).

Distribution in North Korea (Fig. 6). Pyongyang and surrounding area (Maram); Prov. Pyongan-pukto, Tephun near Kujang; Prov. Hwanghae-namdo: Haeju; Kaesong; Prov. Hwanghae-pukto, Sympyong, Pyongwa-ri; Prov. Kangwon: Kumgang-san Mts; 50 km S from Wonsan; near Wonsan.

Ecology. Generally, this species lives in steppe and steppe-like habitats. In North Korea it seems to be not too common, but rather abundant in urban areas, where it inhabits city parks and grasslands; it was found also in seashores, on sandy soil, and in open dry grasslands. It builds nests in soil that are often quite deep (up to 3.5–4.0 m in depth). Foragers collect seeds mainly in spring and autumn.

Monomorium Mayr, 1855

Monomorium Mayr 1855: 452. Type species: *Monomorium minutum* Mayr, 1855: 453 [junior secondary homonym of *Atta minuta* Jerdon, 1851, = *Monomorium pharaonis* (Linnaeus, 1758), replacement name – *Monomorium monomorium* Bolton, 1987], by monotypy.

This worldwide genus includes about 300 species known so far, making it one of the most specious ant genera. Afrotropical forms (more than 140 species described) prevail. In the Palaearctic, there are about 50 species native to this region. There are also several cosmopolitan tramp species.

*Monomorium chinense** Santschi, 1925

Monomorium minutum var. *chinensis* Santschi 1925: 86, w, China.
Monomorium chinense: Bolton 1987: 288, Wu and Wang 1995: 88, Bolton 1995 b: 260, Kim B.-J. 1996: 177, 2003: 2, Imai et al. 2003: 134.
Monomorium minutum subsp. *minutum*: Teranishi 1940: 13 (misidentification, not Mayr 1855) (see Kim B.-J. 1996: 177).

Material examined. 11 w from North Korea and China.
General distribution. China, Korean Peninsula, Japan.
Distribution in North Korea (Fig. 7). This species was found only once: Prov. Kaesong City, Kongmin Vang Nung, near Kaesong.
Ecology. In North Korea is unknown. In Japan it has been found in woodland margins and grasslands, building nests in soil near the bases of plants (Imai et al. 2003).

Monomorium pharaonis (Linnaeus, 1758)

Formica pharaonis Linnaeus 1758: 580, w, Egypt.
Monomorium pharaonis: Mayr 1862: 752, Collingwood 1976: 303, 1981: 27, Kupyanskaya 1990: 130, Bolton 1995 b: 265, Wu and Wang 1995: 91, Kim B.-J. 1996: 178, 2003: 2, Imai et al. 2003: 133.

Material examined. More than one hundred w, q and m from different parts of Europe and Asia, including North Korea.
General distribution. Nowadays it is a cosmopolitan species. In the temperate zone, it lives only synanthropically in heated premises; widespread especially in towns.
Distribution in North Korea (Fig. 7). Pyongyang (in hotel and other buildings); Prov. Pyongan-namdo, 10 km NE from Nampo, Mts Guk-san-bong; Prov. Hwanghae-namdo, Haeju, hotel; Prov. Kangwon, Wonsan.
Ecology. In North Korea this species was found in buildings in cities and towns; but one worker was collected in a sweet chestnut forest in the Guk-san-bong Mts by sweeping. If these data are correct, it appears that *M. pharaonis* can live in North Korea as an outdoor species at least in summer.

This species has spread passively by commerce and invaded the whole world. In the tropics and subtropics it occurs in nature, but in the temperate zone it lives synanthropically in premises heated during winter, because it is very sensitive to cold and dies at 0°C. It utilises all kinds of food (dead insects, any products and left-overs in flats). These ants form very numerous colonies (often with several million workers), generally very highly polygynous (up to 2000 queens) and polydomous. They nest in all kinds of nooks, mainly in wall crevices (large-panel constructions offer particularly favourable conditions for them to live and spread).

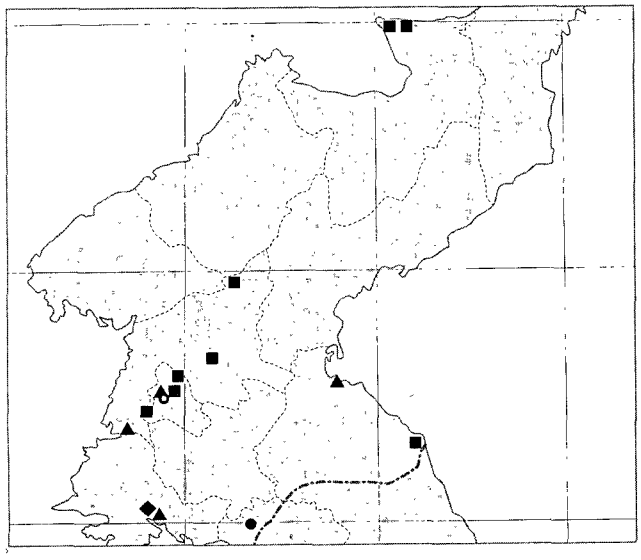

Figure 7. Distribution of *Monomorium chinense* (●), *M. pharaonis* (▲), *Myrmecina nipponica* (■) and *M. flava* (◆) in North Korea.

Myrmecina Curtis, 1829.

Myrmecina Curtis 1829: 265. Type species: *Myrmecina latreillei* Curtis, 1829: 265 (junior synonym of *Formica graminicola* Latreille, 1802: 255), by monotypy.

The genus comprises more than 30 species distributed across most zoogeographical regions (with the exception of the Afrotropical Region and Madagascar). Most species occur in south-eastern Asia; 10 species are known from the Palaearctic. All known *Myrmecina* species have hypogeic and cryptic habits, living mainly in deciduous forests and semi-dry habitats with shrubs.

*Myrmecina flava** Terayama, 1985

Myrmecina flava Terayama, 1985: 35, w, q, Japan, Bolton 1995 b: 274, Imai et al. 2003: 112, Lyu and Cho 2003 a: 190.

Material examined. 1 w and 1 q from North Korea.
General distribution. Japan, Korean Peninsula.
Distribution in North Korea (Fig. 7). Prov. Hwanghae-namdo, near Haeju, Sujang-san Mts.
Ecology. Poorly known. In North Korea 1 worker and 1 dealate queen were found in the sparse mixed forest (oak, beech, pine) at 180 m a.s.l. on a SE granite mountain slope.
Notes. This species is easily distinguished from the black *M. nipponica* by an ochreous-yellow body colour and by the conspicuous shape of the base of the scape, which forms a wide shield-like flat lamella that covers the articulation condyle (see also Key).

Myrmecina nipponica Wheeler, 1906

Myrmecina graminicola subsp. *nipponica* Wheeler 1906: 307, w, Japan, Teranishi 1940: 11, Bolton 1995 b: 274, Kim B.-J. 1996: 178.

Myrmecina nipponica: Onoyama 1997: 49, Kim B.-J. 2003: 2, Lyu and Cho 2003 a: 190, Imai et al. 2003: 111.
Myrmecina graminicola: Collingwood 1976: 303, Kupyanskaya 1990: 135 (misidentification, not Latreille 1802: 255).

Material examined. 13 w and 2 q from North Korea and Japan

General distribution. Japan, Russian Far East, Korean Peninsula, probably China.

Distribution in North Korea (Fig. 7). Pyongyang and surrounding area (15 km W of Pyongyang, Lyongak-san; 12 km NE Pyongyang, De-sang-san; 60 km NE Pyongyang, Za-mo-san); Prov. Pyongan-namdo, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts; Prov. Ryanggang: Pektusan Mts; 10 km NNE from Bochonbo, river Karim.

Ecology. This species seems to be not too common in North Korea, but, on the other hand, it has cryptic habit and may be not rare in suitable habitats. *M. nipponica* was found mainly in deciduous (maple, sweet chestnut, oak), mixed and pine forests, as well in city parks and shrubby areas. In the Pektusan Mts, it lives at altitudes up to 2300–2600 m a.s.l. in mountain meadows with rich vegetation. Like the other species of the genus, it builds nests in soil, leaf litter, moss, under stones, in rotten wood, etc. The colonies are small, consisting of several tens workers, usually monogynous, occasionally with a few fertile queens. The ants forage on the ground and in litter, scavenging and preying on small invertebrates.

Myrmica Latreille, 1804

Myrmica Latreille, 1804: 179. Type species: *Formica rubra* Linnaeus, 1758, by subsequent designation of Latreille 1810: 437.

The genus comprises about 150 described species, more than 110 of them occur in the Palaearctic Region. More than 20 species live the Nearctic, and only a few are known from the Oriental and Neotropical Regions.

Myrmica species are mostly found in the temperate zone, where they mainly inhabit humid habitats, both forest and open ones, including mountain environments. In addition, there are a few semixerophilous steppe forms. Certain species have ranges extending far north – to the Forest-Tundra natural Zone; some occur in the tundra mountain strata, where they are found at 3600 m above sea level (in the Pamir) or even at 4500–4800 m a.s.l. (in the Himalayas and in Tibet).

Myrmica ants are predatory forms foraging mainly on the ground surface, in litter or on herbs; some species tend aphids. They nest in soil, frequently under stones and pieces of old wood, in rotting tree stumps, in logs and branches lying on the ground, under moss, in tufts of grass, and in litter. Their colonies generally include from several hundred to more than one thousand (occasionally up to tens thousand) workers. They are either monogynous or polygynous (the latter may contain several tens or even more than 100 queens). Some species are social parasites (inquilines) living in colonies of other species of the same genus.

*Myrmica ademonia** Bolton, 1995

Myrmica ademonia Bolton 1995 b: 277, replacement name for *Myrmica aspersa* Kupyanskaya, 1990: 105, junior primary homonym of *Myrmica aspersa* F. Smith, 1865: 72.
Myrmica aspersa Kupyanskaya, 1990: 105, w, q, m, Russian Far East; Radchenko 1994 b: 43, 1994 c: 139, 1994 f: 89.
Myrmica sulcinodis: Collingwood 1976: 301 (part.) (misidentification), not Nylander 1846 a: 934.

Material examined. Holotype, w, Russia, Primorsky Region, Ussurijsky Natural reserve, Mt. Emelianova, 9.vii.1969, leg. A. Kupyanskaya (ZMMU); paratypes: more than 20 w, 3 q, 7 m (ZMMU, BPI); non-type material: about one hundred w, several tens q and m from Russian Far East, North Korea and Japan.

General distribution. Southern part of Russian Far East, North Korea.

Distribution in North Korea (Fig. 8). Vicinity of Pyongyang: 70 km from Pyongyang on the road to Koksan, 15 km S from Sunan; Susan Mt. near Sangwon; Gimi-san Mt.; Prov. Hamgyong-pukto: Musu-ri, distr. Puryong; Myohyang-ri, distr. Kyongsong, Mts Kvanmobong; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Ryanggang, Pektusan Mts, environments of Samjiyon hotel.

Ecology. In the Russian Far East this species inhabits mixed and deciduous forests, nesting mainly in decayed wood, rarely in soil.

In North Korea it lives mainly in mountain regions at altitudes between 600 and 1500 m a.s.l. in mixed and deciduous forests (oak, maple, elm, pine, fir), but it was also found at lower altitude (200 m), where it inhabits relatively wet places. It builds nests in decayed wood, very rarely in soil under stones.

Notes. Between two specimens in HNHM, determined by Collingwood (1976) as *M. sulcinodis* one worker is *M. ademonia*, but second one belongs to *M. ruginodis*.

Myrmica angulinodis Ruzsky, 1905.

Myrmica scabrinodis subsp. *angulinodis* Ruzsky 1905: 689, w, q, Russia (East Siberia).
Myrmica angulinodis: Pisarski 1969 a: 227, Collingwood 1962: 217, Radchenko 1994 b: 43, 1994 c: 139, 1994 f: 84, m, Bolton 1995 b: 277, Wu and Wang 1995: 94, Wei et al. 2001: 560, Kim B.-J. 1996: 179, 2003: 2, not Collingwood 1976: 302 (misidentification).
Myrmica kasczenkoi: Kupyanskaya 1986 b: 95, 1990: 113 (misidentification, material examined), not Ruzsky 1905: 702, Collingwood 1976: 302, Kim B.-J. 1996: 179.
Myrmica incurvata Collingwood, 1976: 301, w, North Korea, **syn. nov.**

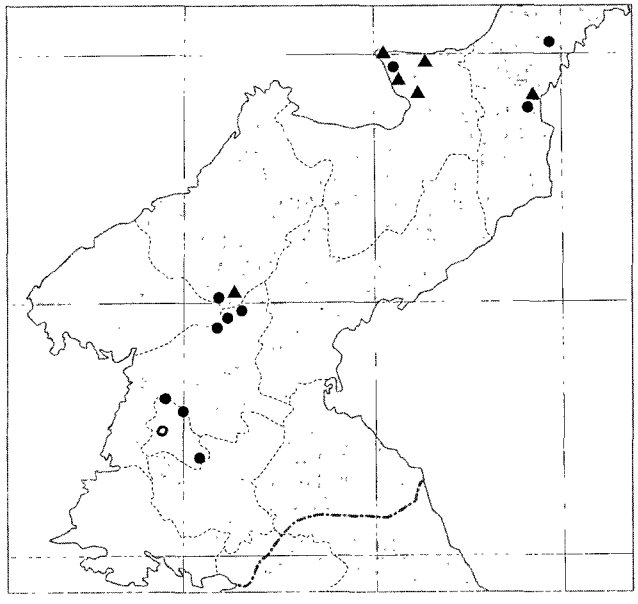

Figure 8. Distribution of *Myrmica ademonia* (●) and *M. angulinodis* (▲) in North Korea.

Material examined. *M. angulinodis*: neotype, w, Russia, Irkutsk Region, Kachuk distr., Artsykan, No. 285, 28.viii.1986, leg. Pleshanov (ZMMU); no-type material: more than one hundred w, several tens q and m from Siberia, Mongolia, Russian Far East and North Korea; *M. incurvata*: holotype and 9 paratypes, w, North Korea, Prov. Ryanggang, Chang-Pay plateau, Sam-zi-yan, 1700 m, No. 202, leg. J. Papp and S. Horvatovich (HNHM).

General distribution. Siberia from Kuznetsky Alatau until Pacific Ocean, Mongolia, China, North Korea.

Distribution in North Korea (Fig. 8). Prov. Hamgyong-pukto, Myohyang-ri, distr. Kyongsong, Mts. Kvanmobong; Prov. Chagang, Myohyang-san Mts; Prov. Ryanggang: Mupo, NE Samjiyon, near Tumang-gang river (near Chinese border); 5 km N Taesong Dan; Rijong-su waterfalls; Pektusan Mt.; Omumultong on Amnok-gang river (on China border); near Samjiyon; plateau at the foot of Pektusan Mt.

North Korea seems to be the southmost limit of the distribution of this species.

Ecology. *M. angulinodis* is a typical boreal species associated predominantly with different kinds of taiga forest. In North Korea it was found only in the mountain regions in the north of the country. There it lives in different habitats at altitudes between 1100 and 2500 m a.s.l. and most probably reaches the highest altitude of all North Korean ants. It was found in boreal forests (birch, spruce, fir, and larch), subalpine meadows, mountain tundra and peat bogs. It builds nests in rotten wood and in soil, often under stones; on peat bogs it nests in moss mounds.

Notes. This species belongs to the *lobicornis*-group and is characterised by a scape angulated at the base and without a vertical lobe or dent, and by a sharply angulated, subtriangular petiolar node (seen in profile), and often by propodeal spines curving inside (similar to those of *M. forcipata* Karawajew). Kupyanskaya (1990) determined *M. angulinodis* as *M. kasczenkoi*, the South Siberian–Mongolian steppe species, because the taxonomy of the East Palaearctic *Myrmica* was obscure at that time, i.e. before Radchenko's (1994 c, g) revision.

Collingwood (1976) described a new species, *M. incurvata*, from North Korea and compared it with *M. forcipata*, which differs considerably from the former by the absence of a vertical dent at the scape bend. On the other hand, *M. incurvata* is very similar to *M. angulinodis*, with which it shares all the main features (see above), including morphometrics. There is only one character, which separates *M. incurvata* from *M. angulinodis*: the scape is less angulated at the base. However, even in the paratype series of *M. incurvata*, some specimens have a less angulated scape, while in others the scape is identical to that seen in *M. angulinodis*. Among the very abundant material from the whole range of the latter species that I studied, I saw many specimens with less angulated scape than in "typical" *M. angulinodis* individuals, even among specimens from the same nest, and such individuals can be regarded as *M. incurvata*. Therefore, I believe that *M. incurvata* is in the range of variability of *M. angulinodis* and is its junior synonym.

Three workers from the Chang-Pay plateau determined by Collingwood (1976) as *M. angulinodis* (repeated by Kim B.-J. 1976) are in fact *M. kamtschatica*. The latter species differs from *M. angulinodis* first of all in having a non-angulated, subtriangular in profile petiolar node with a rounded dorsum (see Key).

*Myrmica eidmanni** Menozzi, 1930, **stat. rev.**

Myrmica eidmanni Menozzi 1930: 331, w, Russia (Buryatia).

Myrmica scabrinodis subsp. *eidmanni*: Weber 1950: 204, Bolton 1995 b: 278.

Myrmica jessensis: Kupyanskaya 1979: 128, 1986: 85, 1990: 110, Radchenko 1994 b: 43, 1994 c: 142, 1994 f: 88 (misprinted as *iessensis*), Bolton 1995 b: 279 (part., material from continental Asia), Wu and Wang 1995: 94, Kim B.-J. 1996: 180 (part.?), Wei et al. 2001: 561, Elmes et al. 2001: 110 (misidentification), not Forel 1901 a: 371, Imai et al. 2003: 183.

Myrmica lobicornis subsp. *littoralis* Weber, 1948: 287 (first available use of *Myrmica scabrinodis* subsp. *lobicornis* var. *littoralis* Kuznetsov-Ugamsky, 1928: 33, unavailable name), synonymy by Kupyanskaya 1986 a: 85 (as synonym of *M. jessensis*), **syn. nov.**

Material examined. Lectotype of *M. eidmanni*, w, designated here, "Verhneudinsk, Sibirien" (now – Ulan-Ude, Buryatia, Russia), "*Myrmica eidmanni* Menozzi, typus" (MSNM); non-type material: more than one hundred w, several tens q and m from South Siberia, Mongolia, Russian Far East and North Korea.

General distribution. South Siberia (from Buryatia), Mongolia, Russian Far East, Korean Peninsula and China.

Distribution in North Korea (Fig. 9). SE of Pyongyang, Susan Mt., near Sangwon; Prov. Pyongan-namdo and Chagang, Myohyang-san Mts; Prov. Hamgyong-pukto: distr. Puryong, Musu-ri; Onpho-ri near Chongjin; Chongjin city, Daeso-ri; Prov. Ryanggang: 1 km from Samjiyon; Samjiyon, shore of Lake Samjiyon; NE from Samjiyon, near Mupo, Taesong Dan; 5 km N Taesong Dan; 15 km N Hyesan, road to Pochon; 5 km NE from Hyesan; 20 km NE from Hyesan; 2 km N from Chongbong; Pektusan Mts.

Ecology. Although this species is found in similar localities to *M. angulinodis*, it lives mainly in other sites. *M. eidmanni* was found at somewhat lower altitudes (between 700 and 2100 m a.s.l.) and inhabits mainly open places: grasslands, peat bogs, sandy lake shores and riverbanks, sparse forests (pine, larch) and their edges and glades. It builds nests in soil, often under stones, in peat bogs; also lives in moss mounds.

Notes. *M. eidmanni*, the species described from Buryatia, was an enigmatic taxon forgotten by myrmecologists for many years. After its original description, only Weber (1950) and Bolton (1995) spoke of it as a subspecies of *M. scabrinodis*, and Radchenko (1994 f) supposed that, based on Menozzi's original description, it could be a junior synonym of *M. angulinodis*. During an intensive investigation of the genus *Myrmica*, we (the present author and G. W. Elmes) had an opportunity to investigate the type specimens of *M. eidmanni*. We concluded that *M. eidmanni* is the species distributed from Buryatia to the Pacific Ocean and determined by all authors (see above) as *M. jessensis*. At the same time, the continental *M. "jessensis"* is a different species than the Japanese *M. jessensis* (see also notes for the latter species).

Kuznetsov-Ugamsky (1928) described a new variety – *Myrmica scabrinodis* subsp. *lobicornis* var. *littoralis* from workers, queens and males from the southern part of the Russian Far East (Okeanskaya; station Ussuri; cape Basargin; Tigrovaya). The types of this form are lost, but based on the original description by Kuznetsov-Ugamsky of all three castes, it is clear that this name is a synonym of the "continental *jessensis*". As the proposed name is unavailable (quadrinomen), the first available use of it is *Myrmica lobicornis* subsp. *littoralis* Weber (1948), hence the name *M. eidmanni* has priority.

*Myrmica excelsa** Kupyanskaya, 1990

Myrmica excelsa Kupyanskaya 1990: 115, w, q, m, Russia (Primorsky Region), Radchenko 1994 b: 43, 1994 c: 144, 1994 f: 90, Bolton 1995 b: 279.

Myrmica cadusa Kim B.-J. et al. 1997: 425, w, South Korea, **syn. nov.**

Myrmica sp. 6: Imai et al. 2003: 181.

Myrmica kasczenkoi: Collingwood 1976: 302 (misidentification), not Ruzsky 1905: 702.

Material examined. *M. excelsa*: holotype, w, Russia, Primorsky region, Barabash-Levada, 9.v.1972, leg. A. Kupyanskaya (ZMMU); paratypes: 15 w, 3 q and 5 m from Russian Far East (ZMMU, BPI); non-type material: several tens w, about 20 q and m from Russian Far East, Korean Peninsula and Japan; *M. cadusa*: 2 paratype w and about 10 non-type w from South Korea.

General distribution. Southern part of Russian Far East, Korean Peninsula and Japan.

Distribution in North Korea (Fig. 9). Vicinity of Pyongyang (Maram; Taesong Mts near Michon Lake; above Lake Taesong; Ryongak-san Mts, Daebong; 15 km W Pyongyang, Lyongak-san; 60 km NE Pyongyang, Zamo san); Prov. Hwanghae-pukto, 70 km SE Pyongyang, near Sunan, on the road to Koksan; Prov. Kaesong City, Kongmin Vang Nung, near Kaesong; Prov. Hwanghae-namdo, near Haeju, Sujang-san Mts; Prov. Kangwon, Kumgang-san Mts; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Hamgyong-pukto: Djuyr and Onpho-ri near Chongjin; Chongjin Komalsan Park; Orang distr., Lake Changyon; Prov. Ryanggang, Samjiyon.

Ecology. *M. excelsa* is a rather thermophilous species. It was found at low and middle altitudes (100–650 m a.s.l.), where it mainly inhabits deciduous and mixed forests (oak, beech, sweet chestnut, pine), but also shrubby areas; it usually avoids open grasslands. Nests are built in soil, often under stones, also in decayed wood.

Notes. *M. excelsa* is a peculiar species, forming, together with *M. taediosa*, a distinct complex within the *lobicornis* species-group. The most characteristic feature of both species is that the lateral portion of clypeus is raised into a sharp ridge in front of the antennal insertions, so that antennal sockets are distinctly separated from the clypeal surface (as in *Tetramorium*).

I have investigated paratypes of *M. cadusa* and non-type material of this species from South Korea, kindly provided by Prof. B.-J. Kim. Without doubt it is a synonym of

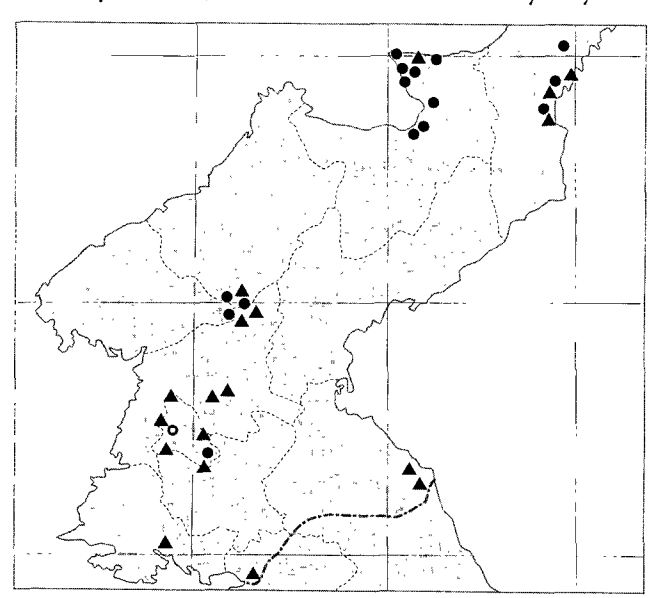

Figure 9. Distribution of *Myrmica eidmanni* (●) and *M. excelsa* (▲) in North Korea.

M. excelsa. I have also investigated specimens of this species from Japan, kindly sent to me by Prof. K. Onoyama. They are the same as the species determined as *Myrmica* sp. 6. by Japanese myrmecologists (see Imai et al. 2003). Specimens from Za-mo san determined by Collingwood (1976) as *M. kasczenkoi* are also *M. excelsa* (material is in HNHM, examined); this error was repeated by B.-J. Kim (1996).

Myrmica jessensis Forel, 1901

Myrmica jessensis Forel 1901 a: 371, w, Japan, Imai et al. 2003: 183, not Collingwood 1976: 302 (misspelled as *yessensis*) (misidentification).

Myrmica hyungokae Elmes et al. 2001: 109, w, South Korea, **syn. nov.**

See also synonymy and notes for *M. eidmanni*.

Material examined. *M. jessensis*: lectotype and paralectotype, w, designated here, Japan, Sapporo, Matsumura (MHNG); non-type material: several tens w, more than 10 q and m from Japan and North Korea; *M. hyungokae*: holotype, w, South Korea, Prov. Jeonnan, Mt. Jiri, near Gure, Nogodan area – high mountain, c 1972, in pitfall trap, leg. B.-J. Kim (BMNH). Paratypes: 3 w, the same series as holotype; 4 w, South Korea, Mt. Jiri, near Gure, 7.viii.1972, in pitfall trap, leg. B.-J. Kim; 4 w, South Korea, Mt. Jiri, near Gure, 19.viii.1972, in pitfall trap, leg. B.-J. Kim; 3 w, South Korea, near Tokyusan, 1200 m a.s.l., 21.viii.1994, leg. B.-J. Kim (ELMES, BMNH, IZK, KIM).

General distribution. Japan, Korean Peninsula.

Distribution in North Korea (Fig. 10). Prov. Ryanggang, Pektusan Mts, near Samjiyon hotel.

Ecology. In Japan this species inhabits mainly grasslands or other open areas at altitudes up to 1700 m a.s.l.; sometimes it is quite abundant on riverbanks. It builds nests in soil, often under stones (Imai et al. 2003). In North Korea only 2 specimens of this species have been found to date in a grassland and lake shore in the Pektusan Mts, which quite corresponds with the ecological preferences of this species in Japan.

Notes. Recently we described (Elmes et al. 2001) a new species, *M. hyungokae* from South Korea and compared it with *M. "jessensis"* from continental Asia (= *M. eidmanni*, see above). Unfortunately, at that time we had not enough comparative material of proper *M. jessensis* from Japan, which led us to make a mistake. *M. hyungokae* is with any doubt a synonym of *M. jessensis*, which differs from *M. eidmanni* first of all in having a narrower frons (mean FI 0.32 *v* 0.36), a shallower metanotal groove, etc. (for details see Elmes et al. 2001).

The specimens from Za-mo san, determined by Collingwood (1976) as *M. jessensis* (misspelled as *yessensis*) in fact belong to *M. koreana* (material is in HNHM, examined).

B.-J. Kim (1996) recorded *M. jessensis* from South Korea. This material probably includes both *M. jessensis* and *M. eidmanni*.

*Myrmica kamtschatica** Kupyanskaya, 1986

Myrmica kamtschatica Kupyanskaya 1986 a: 88, w, q, m, Russia (northern part of Far East), 1990: 111, Radchenko 1994 b: 43, 1994 c: 139, 1994 f: 86, Bolton 1995 b: 280.

Myrmica angulinodis: Collingwood 1976: 302, Kim B.-J. 1996: 179 (misidentification), not Ruzsky 1905: 689.

Material examined. Holotype, w, Russia, Kamchatka, Elizovo, 18.vii.1976, leg. A. Kupyanskaya (ZMMU); paratypes: about 30 w, more than 10 q and m from Russian Far East (ZMMU, BPI); non-type material: more than one hundred w, about 20 q and m from South and East Siberia, Mongolia, Russian Far East and North Korea.

General distribution. South and East Siberia, Mongolia, Russian Far East, North Korea.

Distribution in North Korea (Fig. 10). Prov. Ryanggang: 5 km N Taesong Dan; Samjiyon, shore of Lake Samjiyon; Pektusan Mts; Chang-Pay plateau, Sam-zi-yan.

Ecology. This species, rare in North Korea, was found only in the northern part of the country, in the mountain region at altitudes between 1350 and 1800 m a.s.l. It inhabits peat bogs, mountain meadows and larch-fir forests, nesting in moss mounds, often in stony places. These data quite correspond with the ecology of this species in the Russian Far East: it lives there in different kinds of forests, peat bogs, prefers humid places and builds nests in moss mound and rotten wood.

Myrmica koreana Elmes, Radchenko et Kim B.-J., 2001

Myrmica koreana Elmes, Radchenko et Kim B.-J. 2001: 108, w, South Korea.

Material examined. Holotype, w, South Korea, unknown location, in pitfall traps, leg. B.-J. Kim (BMNH). Paratypes: 13 w, the same series as holotype; 1 w, South Korea, Gechon-ri, near Pyongyang, Pyong chang-gun, in pitfall traps, c. 1970, leg. B.-J. Kim; 4 w (1 without gaster), South Korea, mountains, locality not known, leg. B.-J. Kim; 1 w, South Korea, mountains, locality not known, leg. B.-J. Kim; 7 w, South Korea, Sunchon City, 300 m a.s.l., in soil, 2.vii.1982, leg. B.-J. Kim; 4 w (1 without gaster) North Korea, Pyongyang, 21.vii.1959, leg. B. Pisarski and J. Prószyński, (ELMES, BMNH, IZK, KIM, MIZ); non-type material: several tens w, 2 q from South Siberia, Mongolia, Russian Far East and North Korea.

General distribution. South and south-east part of West Siberia, north-east Kazakhstan (Dzhungaria), Mongolia, Russian Far East and North Korea.

Distribution in North Korea (Fig. 10). Pyongyang; Prov. Kangwon, Kumgang-san Mts: Orku valley; env. of hotel Gosong; Prov. Ryanggang, Chang-Pay plateau, Sam-zi-yan.

Ecology. Poorly known. Found in mountain deciduous and mixed forests at altitudes up to 1700 m a.s.l., nests in soil.

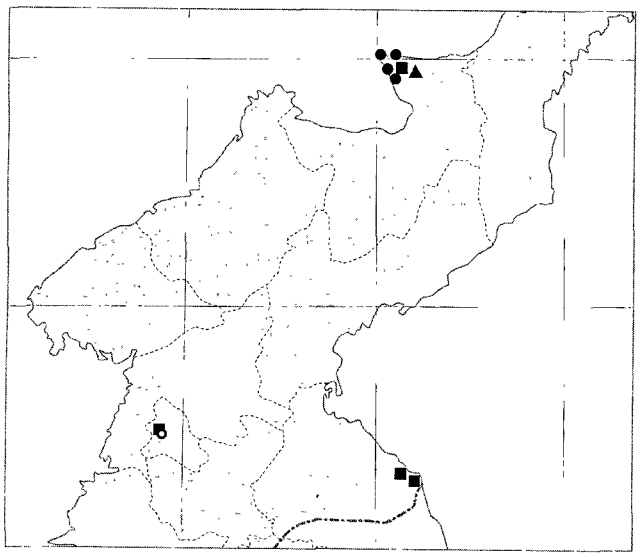

Figure 10. Distribution of *Myrmica jessensis* (▲), *M. kamtschatica* (●) and *M. koreana* (■) in North Korea.

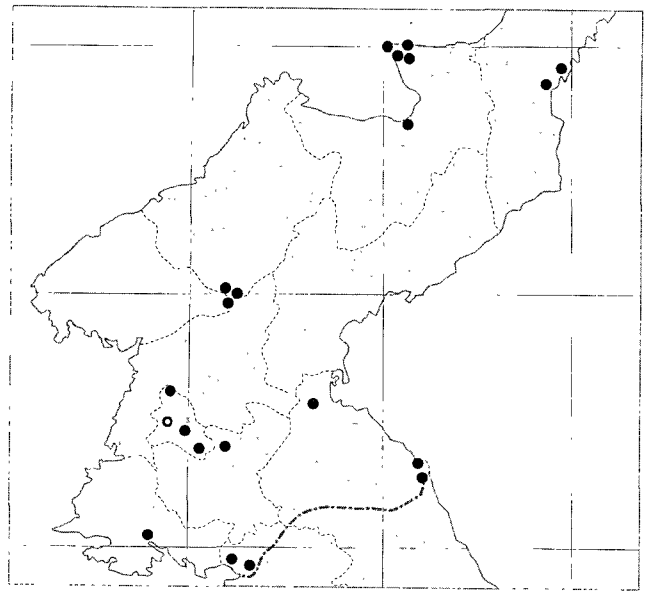

Figure 11. Distribution of *Myrmica kotokui* (●) in North Korea

*Myrmica kotokui** Forel, 1911

Myrmica rubra subsp. *kotokui* Forel 1911: 267, w, q, m, Japan.
Myrmica ruginodis subsp. *kotokui*: Terayama et al. 1992: 25.
Myrmica kotokui raised to species rank by Collingwood 1976: 300, but this was based on misidentification (see notes below).
Myrmica ruginodis subsp. *orientalis* Karawajew 1926: 65, w, Russia (Primorsky Region), **syn. nov.** [Radchenko (1994 e) considered subsp. *orientalis* as junior synonym of *M. ruginodis*].
Myrmica orientalis (part.): Kupyanskaya 1990: 101.
Myrmica rubra: Onoyama 1989 a: 131, Imai et al. 2003: 182 (misidentification), not Linnaeus, 1758: 580.

Material examined. *M. kotokui*: lectotype, w, designated here, "Nöral (? Nösal), Japan, D. Haberer", "*M. rubra* L. r. *kotokui* Forel, typ."; paralectotype, w, "Iturup, Kurilen, D. Haberer", "*M. rubra* L. r. *kotokui* Forel, typ." (NHMB); non-type material: more than one hundred w, several tens q and m from Russian Far East, North Korea and Japan; *M. ruginodis* subsp. *orientalis*: holotype, w, 30 km N of Vladivostok, No. 3044, leg. Fedynsky (in original Karawajew's label written "*Myrmica rubra* subsp. *orientalis*") (IZK).

General distribution. Russian Far East, North Korea and Japan.

Distribution in North Korea (Fig. 11). Pyongyang and surrounding area (20 km NE of Pyongyang, Maram; Su-san Mt. near Sangwon; SE of Pyongyang, Taesong-san Mts; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts; Prov. Kaesong City: SSE from Kaesong; 10 km SW from Kaesong, Lake Jonpong-ho; Prov. Hwanghae-pukto, 70 km SE of Pyongyang, near Sunan, on the road to Koksan; Prov. Kangwon: Kumgang-san Mts; 50 km W Wonsan; Prov. Hamgyong-pukto: Onphori near Chongjin; 20 km NE Chongjin; Prov. Ryanggang: Samjiyon, shore of Lake Samjiyon; Near Samjiyon hotel; Mupo, NE Samjiyon, near Tumang-gang river, near Chinese border; 5 km SW from Hyesan.

Ecology. This common in North Korea species is found throughout the country in quite varied habitats, but in mountains it does not go above 1400 m a.s.l. It prefers forests (pine, oak, maple, birch, lime, spruce, fir, larch), occurs also in shrubs and mountain meadows, but avoids dry places. It builds nests predominantly in soil, very often under stones. It rarely constructs soil mounds or nests in decayed wood.

In contrast to the closely related *M. ruginodis*, colonies of *M. kotokui* are rather highly polygynous, with population of the nests reaching several thousand workers (Kikuchi et al. 1999).

Notes. *M. kotokui* is very difficult to distinguish from *M. ruginodis*. It differs from the latter species mainly in having a slightly more rounded petiolar node dorsum, which is without a distinct dorsal plate, and in smoothly sculptured sides of the petiolar node (in *M. ruginodis* it has a coarse longitudinal rugosity). In males of *M. kotokui*, the clypeus is distinctly longitudinally striated, while in males of *M. ruginodis* it is smooth.

Collingwood (1976) raised this form to the species rank. However, specimens from Sam-zi-yan, determined by him as *M. kotokui*, are in fact *M. kurokii* (material is in HNHM, examined).

A reinvestigation of the holotype worker of *Myrmica ruginodis* subsp. *orientalis* Karawajew (1926) showed that this form is synonym of *M. kotokui* (lectotype and paralectotype of the latter species were also examined), but not of *M. ruginodis* (Radchenko 1994 e).

The specimens from Japan determined by Onoyama (1989 a) as *M. rubra* (L.), also belong to *M. kotokui*

(material kindly sent my by K. Onoyama, examined). *M. rubra* is a Euro-Siberian species, whose eastern limit of distribution is Lake Baikal. In the modern monograph on Japanese ants (Imai et al. 2003) *M. kotokui* is considered under the name *M. rubra*, but *M. ruginodis* (which is absent in that book) named as *M. kotokui*.

Myrmica kurokii Forel, 1907

Myrmica rubra subsp. *kurokii* Forel 1907: 18, w, Japan.
Myrmica kurokii: Emery 1908: 166, Collingwood 1976: 301, 1981: 26, Kupyanskaya 1990: 102, q, m, Radchenko 1994 b: 42, 1994 c: 137, 1994 e: 74, Bolton 1995 b: 280, Kim B.-J. 1996: 179, 2003: 2, Imai et al. 2003: 183.
Myrmica kotokui: Collingwood 1976: 300, Kim B.-J. 1996: 179 (misidentification), not Forel 1907: 18.
Myrmica silvestrii: Collingwood 1981: 26, Kim B.-J. 1996: 180 (misidentification, material examined), not Wheeler 1928 b: 100.

Material examined. Lectotype, w, designated here, "Japan, Ex. Coll. Frughstorfer", "*M. rubra* L. r. *kurokii* Forel, type"(NHMB); non-type material: several tens w, more than 20 q and m from Russian Far East, China, North Korea and Japan.

General distribution. Russian Far East, China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 12). Prov. Hamgyong-pukto, Myohyang-ri, distr. Kyongsong, Kvanmo-bong Mts; Prov. Ryanggang: 20 km E from Samjiyon; near Samjiyon hotel; shore of Lake Samjiyon; road from Samjiyon to Pektusan-san Mt.; Pektusan-san Mt.; Rijong-su waterfalls; Chang-Pay plateau, 24 km NW from Sam-zi-yan, along road to Pektusan; Prov. Chagang, Myohyang-san Mts.

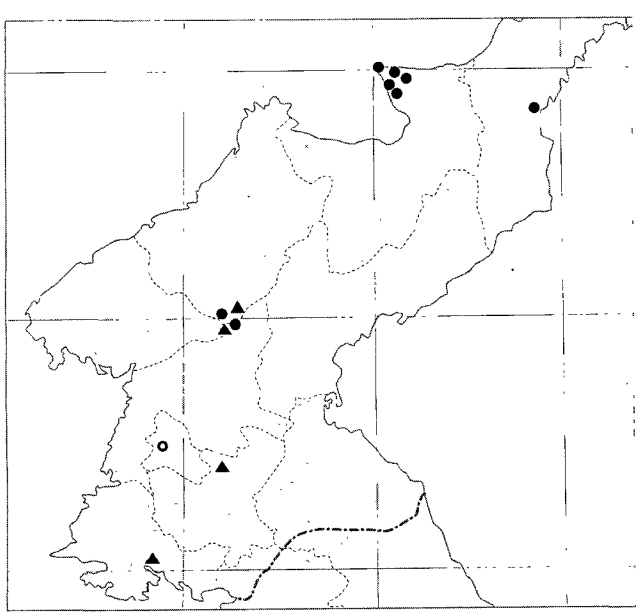

Figure 12. Distribution of *Myrmica kurokii* (●) and *M. luteola* (▲) in North Korea.

Ecology. This typical mountain species was found only in the northern part of the country in the mountains at altitudes between 1000 and 2600 m a.s.l., mostly around 1600–2000 m. Similar altitudinal preferences were established for Japan (Imai et al. 2003) and for the Russian Far East (Kupyanskaya 1990). It inhabits mainly forests (fir, spruce, larch, birch), bushes (mainly juniper), but also peat bogs, subalpine meadows and mountain tundra. In forests it builds nests almost exclusively in rotten wood, but in open habitats the ants construct moss mounds and nests in soil under stones.

Notes. This big and robust species can be confused with *M. ruginodis* and *M. kotokui*, differing from them, however, in having a denser and finer rugosity on the head and alitrunk, and in the shape of the frontal carinae, which do not curve outwards posteriorly to merge with the rugae which surround antennal sockets (see also Key).

The specimens determined by Collingwood (1976) as *M. kotokui* and by Collingwood (1981) as *Myrmica silvestrii* are in fact *M. kurokii* (material is in HNHM, examined).

*Myrmica luteola** Kupyanskaya, 1990

Myrmica luteola Kupyanskaya 1990: 103, w, q, Russia (Primorsky Region and Isl. Kunashir), Radchenko 1994 b: 44, 1994 c: 136, 1994 e: 75, m, Bolton 1995 b: 281, Masuko and Terayama 2002: 224, Imai et al. 2003: 182.

Material examined. Holotype, w, Russia, Kurily Islands, Isl. Kunashir, Lake Goriachee, 24.viii.1975, leg. Kupyanskaya (ZMMU); paratypes: 8 w from the nest of holotype; 11 w, 1 q, Primorsky province, Kedrovaya Pad', 18.ix.1973, leg. Kupyanskaya (ZMMU, BPI); non-type material: about 50 w, 9 q, 6 m from Primorsky province, Isl. Kunashir, Korea and Japan.

General distribution. Russian Far East, North Korea, Japan; reported by Imai et al. (2003) for Taiwan.

Distribution in North Korea (Fig. 12). Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Hwanghae-pukto, 70 km from Pyongyang, 15 km S from Sunan, on the road to Koksan; Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts.

Ecology. This rare species is known in North Korea only from four localities. In the Sujang-san Mts it was found at 55 m a.s.l. in a small pine-oak wood, where it nested in soil under a stone; at the same time in the Myohyang Mts alate males were collected at the top of a mountain at 1820 m a.s.l.

In the Russian Far East it is also very rare and lives in relatively warm mixed forests, building nests in rotten wood (Kupyanskaya 1990). In Japan this species inhabits sparse woodlands, and nests under stones and around the roots of trees (Imai et al. 2003). Masuko and Terayama (2002) noted that *M. luteola* is the temporary social parasite of *Manica yessensis* Azuma, but this

information is not so obvious and needs confirmation. On the other hand, a temporary socially-parasitic lifestyle for this species was supposed by us (Radchenko and Elmes 2003).

Notes. *M. luteola* is a quite peculiar species and possesses a lot of the features of the socially-parasitic syndrome, i.e. strongly reduced, not pectinate spurs on the middle and hind tibiae, a somewhat developed ventral process on the petiole and postpetiole, a hairy body, and – especially – the very small size of the queens, which are even smaller than the workers.

M. luteola can be confused with *M. kurokii*, but differs from it in having a much more hairy body, a sharp and deep metanotal groove, dense reticulate sculpture on the head and alitrunk, a distinctly lighter, reddish colour of the body, etc.

Myrmica ruginodis Nylander, 1846

Myrmica ruginodis Nylander 1846 a: 929, w, q, m, Finland, Collingwood 1976: 300, 1981: 26, Radchenko 1994 b: 44, 1994 c: 136, 1994 e: 75, m, Wu and Wang 1995: 92, Bolton 1995 b: 282, Kim B.-J. 1996: 179, Wei et al. 2001: 651, Kim B.-J. 2003: 2.

Myrmica orientalis: Kupyanskaya 1990: 101 (part.) (misidentification), not Karawajew 1926: 65.

Myrmica kotokui: Imai et al. 2003: 182 (misidentification), not Forel 1911: 267.

See also notes for *M. kotokui*.

Material examined. Lectotype, w (upper specimen on the pin with 2 w), designated here, "Kuusamo", "W. Nyland.", "Mus. Zool. H: fors Spec. typ. No. 5045 *Myrmica ruginodis* Nyl." (FMNH); paralectotypes: w (bottom) on the pin with the lectotype; m, with the same labels as lectotype, but type No. 5046; q, m and w on one pin, with the same labels as lectotype, but type No. 5046 and one additional label: "Mus. Hels. N:o 3211"; q, with the same labels as lectotype, but type No. 5046 and one additional label: "Mus. Hels. N:o 3212" (FMNH); non-type material: several hundred w, q and m from the whole range of the species.

General distribution. Transpalaearctic species (is absent in the mountains of Central Asia), distributed from Atlantic Ocean to the Pacific Ocean, including Japan.

Distribution in North Korea (Fig. 13). Vicinity of Pyongyang (20 km NE Pyongyang; Daebong near Pyongyang, Ryongak-san Mts); Prov. Pyongan-namdo, distr. Sunchon, Dzamo-ri; Prov. Hwanghae-namdo, near Haeju, Sujang-san Mts; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts; Prov. Ryanggang: small lake near Samjiyon hotel; shore of Lake Samjiyon; Pektusan Mts; Chang-Pay plateau, Sam-zi-yan; Prov. Hamgyong-pukto: Onpho-ri near Chongjin; distr. Puryong, Musu-ri; Daeso-ri; Kyowon-ri; Chongjin Komalsan Park; distr. Kyongsong, Sangonpo-ri; distr. Orang, Changyon Lake.

Ecology. This species, quite common in North Korea, was found in various habitats at altitudes between 300 and 1700 m a.s.l. (mostly between 600 and 1100 m). It prefers different kinds of forests, from open and sunny to quite shady and wet (oak, lime, birch, fir, larch), rarely inhabits meadows and other types of grasslands, peat bogs, but avoids dry places. It builds nests in soil, often under stones, in decayed wood, in moss and soil mounds.

Myrmica sulcinodis Nylander, 1846

Myrmica sulcinodis Nylander 1846 a: 934, w, q, Finland, Kupyanskaya 1986 b: 94, Radchenko 1994 b: 43, 1994 c: 139, 1994 f: 81, Wu and Wang 1995: 94, Bolton 1995 b: 284, Wei et al. 2001: 651, not Collingwood 1976: 301, Kim B.-J. 1996: 179, 2003: 2 (misidentification).

Myrmica sulcinodis eximia Kupyanskaya, 1990: 104, w, q, m, Russia (South Siberia and Far East), synonymy by Radchenko 1994 f: 81.

Material examined. *M. sulcinodis*: lectotype, w (bottom specimen on the pin with 3 w), designated here, "H: fors", "W. Nyland.", "Coll. Nyland.", "Mus. Zool. H: fors Spec. typ. No. 5054 *Myrmica sulcinodis* Nyl." (FMNH); paralectotypes: 2 w on the pin with lectotype; 3 w on one pin with the same labels as lectotype, but type No. 5055 (FMNH); non-type material: more than one hundred w, several tens q and m from the whole range of the species; *Myrmica sulcinodis eximia*: holotype, w, Russia, Khabarovsk Region, Sovetskaya Gavan', 10 km from vil. Tulucha, 24.viii.1972, leg. A. Kupyanskaya (ZMMU); paratypes: several tens w, q and m from Khabarovsk and Amur Regions and Buryatia (ZMMU, BPI).

General distribution. Boreal species, distributes from Atlantic Ocean till the Pacific Ocean; to the north reaches

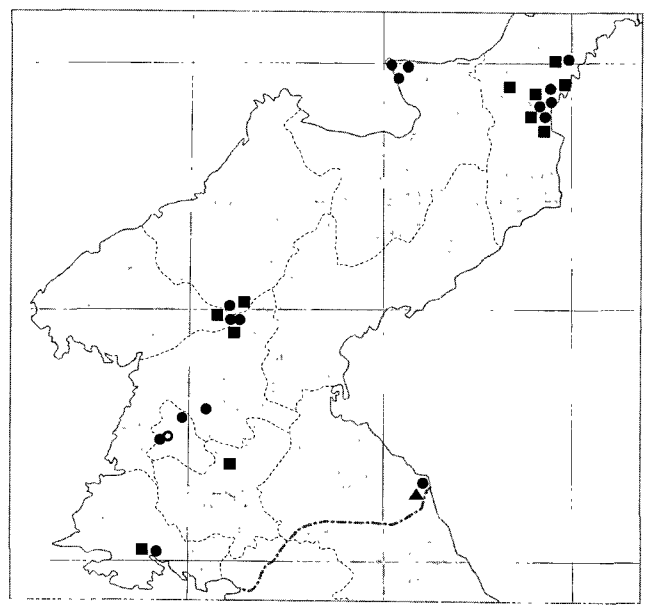

Figure 13. Distribution of *Myrmica ruginodis* (●), *M. sulcinodis* (▲) and *M. taediosa* (■) in North Korea.

forest-tundra zone, to the south on plains goes to the southern limit of the taiga zone, in the more southern regions lives only in mountains; is absent in Japan.

Distribution in North Korea (Fig. 13). Prov. Kangwon, Kumgang-san Mts, Manmul-san.

Ecology. *M. sulcinodis* was found in North Korea only once in the Kumgang-san Mts at 860 m a.s.l. in a rocky oak-lime wood, where it nested in soil. This seems to be its southernmost locality in the Eastern Palaearctic.

Notes. Kupyanskaya (1990) described a new subspecies, *Myrmica sulcinodis eximia,* from the eastern part of the area of *M. sulcinodis*. This form differs from the "typical" *M. sulcinodis* in having thicker and inwards-curved propodeal spines in workers. However, this feature is quite variable and in Siberia, even in the same nest, some of the workers have straight spines, and others have curved spines. In my opinion, in view of this fact, there is no reason for dividing this species into subspecies.

Of two specimens from Sam-zi-yan determined by Collingwood (1976) as *M. sulcinodis*, one is *M. ruginodis* and the other is *M. ademonia* (see above; material is in HNHM, examined).

*Myrmica taediosa** Bolton, 1995

Myrmica taediosa Bolton 1995 b: 284, replacement name for *Myrmica carinata* Kupyanskaya, 1990: 114, junior primary homonym of *Myrmica carinata* F. Smith, 1859: 148.
Myrmica carinata Kupyanskaya, 1990: 114, w, q, m, Russia (South Siberia and Far East), Radchenko 1994 b: 43, 1994 c: 144, 1994 f: 90.

Material examined. Holotype, w, Russia, Primorsky Region, Rudnaya Pristan', 26.vi.1972, leg. A. Kupyanskaya (ZMMU); paratypes: several tens w, q and m from Russian Far East (ZMMU, BPI); non-type material: about one hundred w, several tens q and m from South Siberia, Russian Far East and North Korea.

General distribution. South Siberia, Russian Far East, North Korea.

Distribution in North Korea (Fig. 13). Prov. Hwanghae-pukto, 70 km from Pyongyang, 15 km S from Sunan, on the road to Koksan; Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts; Prov. Chagang and Pyongan-pukto, Myohyang-san Mts; Prov. Hamgyong-pukto: Onpho-ri near Chongjin; distr. Puryong, Musu-ri; 60 km W Chongjin; 20 km SE Chongjin; distr. Hongwon, Jonpong-ri; distr. Orang, Changyon Lake.

Ecology. It was found at a wide range of altitudes, between 55 and 1820 m a.s.l. It inhabits mainly light, sparse, warm forests (oak, pine, fir) and shrubs, where it usually nests in soil, often under stones.

Addendum

Collingwood (1981) recorded *M. yoshiokai* Weber in North Korea (Kumgang-san Mts), based on one worker. This poorly known taxon is more probably synonymous with *M. kotokui* or *M. ruginodis*. I did not find the specimen mentioned above in the collection of HNHM, and have no definitive opinion on this situation, but more probably this record was based on misidentification.

Pheidole Westwood, 1839

Pheidole Westwood 1839: 219. Type species: *Atta providens* Sykes, 1835: 103, by monotypy.

This one of the most specious worldwide ant genus, comprising more than 600 species, although only about 10 of them are known from the Palaearctic Region. One of the most characteristic features of the *Pheidole* species is their high dimorphism: there are the castes of workers and soldiers, which have a very big head. Many of the species are granivorous, but polyphagous species, which feed both on seeds and on various invertebrates, are also very common. Several tropical species have spread widely by commerce to all continents.

Pheidole fervida F. Smith, 1874

Pheidole fervida F. Smith 1874: 406, s, q, Japan, Collingwood 1976: 302, Kupyanskaya 1990: 124, Wu and Wang 1995: 102, Bolton 1995 b: 321, Kim B.-J. 1996: 175, 2003: 2, Imai et al. 2003: 159.
Pheidole pieli: Collingwood 1976: 302, 1981: 26 (misidentification), not Santschi 1925: 83.

Material examined. Several tens w, about ten of q and m from Russian Far East, Japan and North Korea.

General distribution. Southern part of Russian Far East, China, Korean Peninsula, Japan.

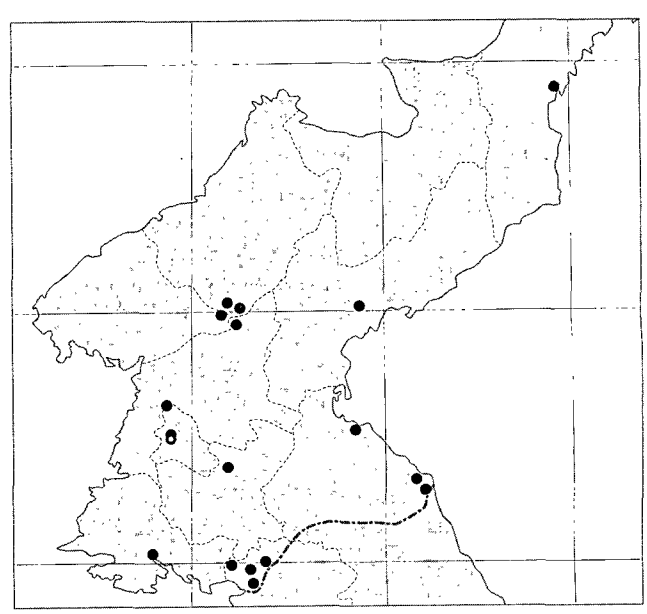

Figure 14. Distribution of *Pheidole fervida* (●) in North Korea.

Distribution in North Korea (Fig. 14). Pyongyang and surrounding area (30 km N Pyongyang, Sa-gam po); Prov. Hamgyong-pukto: 20 km NE Chongjin; Prov. Hamgyong-namdo, Hyangsan; Prov. Chagang, Pyongan-pukto and Pyongan-namdo, Myohyang-san Mts; Prov. Hwanghae-pukto, 70 km from Pyongyang, 15 km S from Sunan, on the road to Koksan; Prov. Kaesong City: Kaesong; Kongmin near Kaesong; 20 km SE Kaesong, San-chon tong, Bagyon san; 20 km NE Kaesong, Pakyon Mts; 27 km NE from Kaesong, Pakyon Mts, Pakyon popo; Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts; Prov. Kangwon; Kumgang-san Mts; Wonsan.

Ecology. This thermophilous species was found in the central and southern parts of North Korea at low altitudes, from near sea level to 750 m. It lives mainly in sparse dry forests (oak, sweet chestnut, pine), in shrubby areas, but also in grasslands; is common in artificial habitats, including city parks. It builds nests mainly in soil, but also in decayed, usually quite dry wood.

Notes. Collingwood (1976, 1981) determined a couple of the specimens from North Korea as *P. pieli*, but in fact all of them belong to *P. fervida*. These species are similar with one another, but workers of *P. fervida* differ from those of *P. pieli* by the presence of a transversal impression on the mesonotal dorsum. K. Eguchi (pers. comm.) also confirmed a very low probability of finding of *P. pieli* in North Korea.

Pristomyrmex Mayr, 1866

Pristomyrmex Mayr 1866 b: 903. Type species: *Pristomyrmex pungens* Mayr, 1866 b: 904, by monotypy.

This genus comprises 53 species, distributed mainly in the Oriental Region; 7 species are known from Australia, 5 from the Afrotropical Region, and 3 from islands in the Indian Ocean (Mauritius and Reunion). Only one species widespread in South-East Asia penetrates into the Palaearctic. Most *Pristomyrmex* species inhabit rainforests and are predators and scavengers; they build nests in soil or in decayed wood. A modern taxonomic revision of the genus was prepared by M. Wang (2003).

Pristomyrmex punctatus (F. Smith, 1860)

Myrmica punctata F. Smith 1860 a: 108, w, Indonesia.
Pristomyrmex punctatus: Mayr 1886: 361, Wang 2003: 410.
Pristomyrmex pungens Mayr, 1866 b: 904, Collingwood 1976: 303, 1981: 27, Bolton 1995 b: 365, Wu and Wang 1995: 85, Kim B.-J. 1996: 179, 2003: 2, Imai et al. 2003: 111, synonymy by Wang 2003: 410.
Pristomyrmex japonicus Forel, 1900: 268, Japan, synonymy by Viehmeier 1922: 207 (as synonym of *P. pungens*), confirmed by Wang 2003: 410.

Material examined. Several tens w from North Korea and Vietnam.

General distribution. Widely distributes in South-East Asia, New Guinea, Japan, China, and Korean Peninsula; introduced to U.S.A.

Distribution in North Korea (Fig. 15). Pyongyang and its vicinity (Maram; Techon-ri, distr. Samsok; Mt. Ryongak-san, 16 km SW Pyongyang; 25 km W Pyongyang, Lyongak-san; Daebong; 45 km N Pyongyang, Sa-gam; 4 km NE Pyongyang, Lake Sokan; 10 km NE Pyongyang, Taesong-san Mts ; 60 km NE Pyongyang, Za-mo san; Prov. Pyongan-namdo, Dzamo-ri, distr. Sunchon; Prov. Kaesong City: Kaesong; 20 km SE Kaesong, San-chon tong, Bagyon san; 20 km NE Kaesong, Pakyon Mts; Prov. Hwanghae-namdo: 8 km W Haeju, Sujang-san Mts; 4 km SE island in golf; Prov. Hwanghae-pukto, 15 km S from Sunan town; Prov. Hamgyong-pukto, Myohyang-ri and Sangonpo-ri, distr. Kyongsong, Mts Kvanmo-bong; Prov. Kangwon, Kumgang-san Mts; Prov. Pyongan-pukto, Tephun near Kujang-dong; Prov. Chagang, Myohyang-san Mts; Prov. Ryanggang, Chang-Pay plateau, Sam-zi-yan.

Ecology. In contrast to most species of the genus, *P. punctatus* generally prefers open habitats and seems to be quite tolerant with respect to humidity, temperature, type of vegetation, soil, etc. In North Korea it occurs at very diverse sites, from relatively wet and shady sandy riverbanks and lakeshores to very dry open mountain rocky slopes with sparse grass; it is quite common in disturbed and artificial habitats, such as city parks, gardens, agricultural fields, pastures, etc. In addition, it lives in pine, deciduous and mixed forests (oak, beech, sweet chestnut, ash, elm) and shrubs at altitudes from sea level up to 250–300 m; at the same time these ants

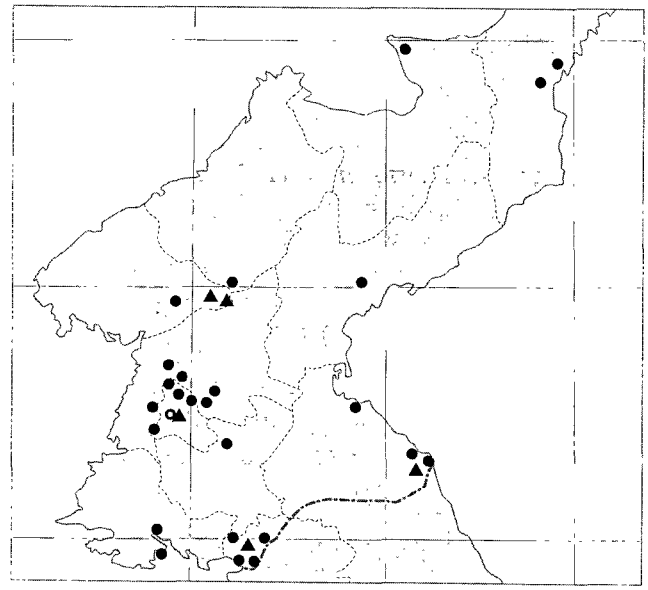

Figure 15. Distribution of *Pristomyrmex punctatus* (●) and *Solenopsis japonica* (▲) in North Korea.

were found at 1600–1700 m a.s.l. in a larch-birch forest. It builds nests in soil, often under stones, but also in decayed wood and in dry branches of living trees.

One of the most peculiar features of the biology of this species is the absence of "normal" queens, morphologically differentiated from workers; at most there may be ergatoid queens. Many colonies are entirely queenless and eggs are laid by unmated workers. A unique feature of this species is that both workers and males emerge from these eggs (while only males emerge from haploid eggs laid by workers in other ants).

Solenopsis Westwood, 1840

Solenopsis Westwood 1840 b: 86. Type species: *Solenopsis mandibularis* Westwood, 1840 b: 87 (junior synonym of *Solenopsis geminata* Fabricius, 1804: 423), by monotypy.
Diplorhoptrum Mayr, 1855: 449, synonymy by Mayr 1862: 751, revived from synonymy by Baroni Urbani 1968: 68, again synonymised by Kempf 1972: 232, synonymy confirmed by Bolton 1987: 285.

This worldwide genus comprises about 200 species distributed mainly across the Neotropical (about 90 species) and Palaearctic (about 45 species) Regions. There are several pest species among them (e.g. fire ants in America). The Old World species are very small, usually of yellowish colour, and are mostly cleptobionts in the nests of members of many ant genera.

Solenopsis japonica Wheeler, 1928

Solenopsis fugax var. *japonica* Wheeler 1928 b: 113, w, Japan.
Solenopsis japonica: Collingwood 1976: 302, Wu and Wang 1995: 76, Kim B.-J. 1996: 178, Imai et al. 2003: 132.
Diplorhoptrum japonica: Kupyanskaya 1990: 133.

Material examined. 13 w and 2 q from North Korea and Japan.

General distribution. Japan, Isl. Kunashir, Korean Peninsula.

Distribution in North Korea (Fig. 15). Pyongyang; Prov. Pyongan-pukto: Myohyang-san Mts, Tephun near Kujang; Myohyang-san Mts., distr. Hjangam-ri distr., Hyangsan; Prov. Kaesong City, 20 km SE Kaesong, San-chon tong, Bagyon-san; Prov. Kangwon, Kumgang-san Mts.

Ecology. This species is probably quite rare in North Korea. It was found in deciduous forests (oak, sweet chestnut, maple), also in city parks in Pyongyang. Like many other Old World species, it nests in the ground and under stones, frequently in lestobiosis with other ant species.

Stenamma Westwood, 1839

Stenamma Westwood, 1839: 219. Type species: *Stenamma westwoodi* Westwood, 1839: 219, by monotypy.

This genus comprises more than 40 species distributed in the Holarctic (mainly), Neotropical and Oriental Regions. About 20 species live in the Palaearctic. The ants of this genus usually inhabit deciduous forests, where they nest in the ground or in leaf litter. Colonies are small, consisting of several tens individuals.

Stenamma owstoni Wheeler, 1906

Stenamma owstoni Wheeler 1906: 314, w, Japan, Collingwood 1976: 302, 1981: 26, Wu and Wang 1995: 81, Bolton 1995 b: 393, Kim B.-J. 1996: 176, 2003: 2, Imai et al. 2003: 180.

Material examined. 3 w from North Korea and Japan.

General distribution. China, North Korea, Japan.

Distribution in North Korea (Fig. 16). Pyongyang; Prov. Hamgyong-namdo, vicinity of Hamhung; 20 km SE Kaesong, San-chon tong, Bagyon san; Prov. Kangwon, Kumgang-san Mts, near Manmul-san.

Ecology. This species occurs rather rarely throughout its range. In Japan it lives in forests and nesting in soil (Imai et al. 2003). The ecology of *S. owstoni* in North Korea is very poorly known, available material consisting only of several workers found in an oak forest and in a park in Pyongyang.

*Stenamma ussuriense** Arnoldi, 1975

Stenamma ussuriense Arnoldi 1975: 1825, w, q, m, Russia (Primorsky Region), Kupyanskaya 1990: 117, Bolton 1995 b: 394.

Material examined. Holotype, w and paratypes, w, q and m, Russia, Primorsky Region, Kedrovaya pad', vii–ix.1964, leg. G. Dlussky (ZMMU); non-type material: 1 w from North Korea.

General distribution. Southern part of Russian Far East, North Korea.

Distribution in North Korea (Fig. 16). Prov. Pyongan-namdo, Myohyang-san Mts.

Ecology. In the Primorsky Region of Russia it lives in well-preserved, shady, rich coniferous forests of the southern type. The colonies are very small, and nests are built in thin fallen tree branches and pieces of wood. Only one worker was found in North Korea, in the Myohyang Mts.

Strongylognathus Mayr, 1853

Strongylognathus Mayr 1853 b: 389. Type species: *Eciton testaceum* Schenck, 1852: 117, by monotypy, replacement name for *Myrmus* Schenck, 1853: 188, junior homonym of *Myrmus* Hahn, 1832: 81 (Hemiptera).

This Palaearctic genus includes about 30 socially parasitic species, which are true slave-makers or degenerate slave-makers dependent on *Tetramorium* colonies.

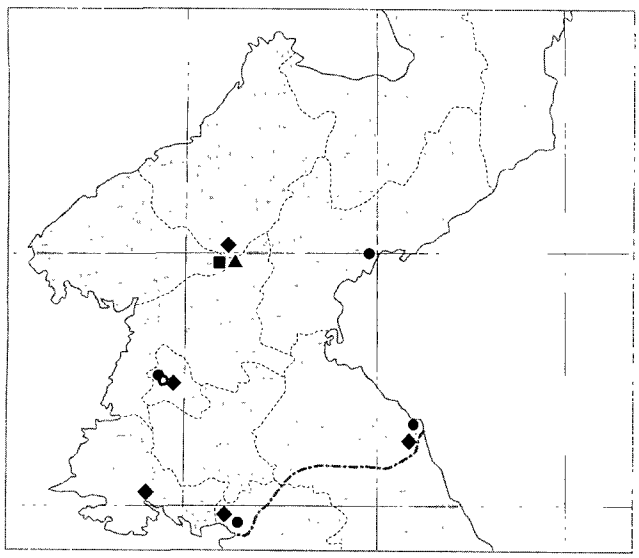

Figure 16. Distribution of *Stenamma owstoni* (●), *S. ussuriense* (▲), *Strongylognathus koreanus* (■) and *Strumigenys lewisi* (◆) in North Korea.

Strongylognathus koreanus Pisarski, 1966

Strongylognathus koreanus Pisarski 1966: 519, w, North Korea, Collingwood 1976: 304, Wu and Wang 1995: 96, Bolton 1995 b: 395, Kim B.-J. 1996: 181, 2003: 2, Imai et al. 2003: 134.

Material examined. Holotype and paratypes, w, North Korea, Prov. Pyongan-namdo, Myohyang-san Mts, 9.viii.1958, No. 2313, leg. B. Pisarski, J. Prószyński (MIZ).

General distribution. North Korea, China, Japan.

Distribution in North Korea (Fig. 16). This species is still known only from the type locality in Myohyang-san Mts.

Ecology. Poorly known. Like other species of the genus, *S. koreanus* is a social parasite of *Tetramorium* species. It was found in a nest of *T. tsushimae* on a dry and stony SW slope of a low mountain, with poor vegetation and singular sparse small pine trees; the nest was in soil under a stone.

Strumigenys F. Smith, 1860

Strumigenys F. Smith 1860 b: 72. Type species: *Strumigenys mandibularis* F. Smith, 1860 b: 72, by monotypy.

This peculiar morphologically and biologically pantropical genus belongs to the tribe Dacetini. All members of this tribe are small, cryptic predator species, living usually in leaf litter and rotten wood. The most recent revisions of the tribe, and particularly of the genus *Strumigenys* (Bolton 1999, 2000), have greatly enlarged the number of known species: the genus now comprises more than 460 species, distributed mainly in tropics; only 5–6 species are known from the Palaearctic Region.

Strumigenys lewisi Cameron, 1886

Strumigenys lewisi Cameron 1886: 229, w, q, Japan, Collingwood 1976: 313, Bolton 1995 b: 397, Kim B.-J. 1996: 180, Bolton 2000: 794, Lyu et al. 2001: 232, Kim B.-J. 2003: 2, Imai et al. 2003: 87.

Material examined. Several tens w, 4 q and 2 m from North Korea.

General distribution. Japan, Korean Peninsula, China, Taiwan, Burma, Hawaii, India, Sri Lanka.

Distribution in North Korea (Fig. 16). Pyongyang; Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts; Prov. Kaesong City, 30 km from Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon san; Prov. Chagang, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts. Manmul-san.

Ecology. In North Korea it was found at lower altitudes (up to 350 m a.s.l.) in various habitats: oak and pine forests, shrubs, open grassland, city parks. It builds nests in decayed wood, in soil and in leaf litter. Colonies are small, usually consisting of several tens workers, and often polygynous. This species is a predator hunting for various small invertebrates, usually Collembola. It is one of the most common soil-dwelling ants in Japan (Imai et al. 2003).

Temnothorax Mayr, 1861

Temnothorax Mayr 1861: 68. Type species: *Myrmica recedens* Nylander, 1856: 94, by monotypy.

Temnothorax as junior synonym of *Leptothorax*: Bolton 1982: 319, 1995: 48.

Temnothorax revived from synonymy: Bolton 2003: 252.

Myrafant M. R. Smith, 1950: 30 (as subgenus of *Leptothorax*), synonymy by Bolton 2003: 253.

For details of characters and distribution see notes to the genus *Leptothorax*.

Temnothorax congruus (F. Smith, 1874)

Leptothorax congruus F. Smith 1874: 406, w, Japan, Hyogo, Wheeler 1906: 316, q, m, Chapman, Capco 1951: 110, Onoyama 1980: 197, Terayama et al. 1992: 27, Radchenko 1994 d: 150, Bolton 1995 b: 237, Radchenko 1996 b: 16, Kim, 1996: 176, 2003: 2, Terayama and Onoyama 1999: 83, Imai et al. 2003: 157, Lyu and Cho 2003 b: 271, not Collingwood 1976: 303 (misidentification).

Temnothorax congruus: Bolton 2003: 271, Radchenko 2004: 121.

Material examined. Several tens w from Japan, Korea and Russian Far East.

General distribution. Japan, south of the Primorsky Region of Russia, Isl. Kunashir, north-east China, Korean Peninsula.

Distribution in North Korea (Fig. 17). Prov. Kangwon, Kumgang-san Mts, above Kuryong waterfall.

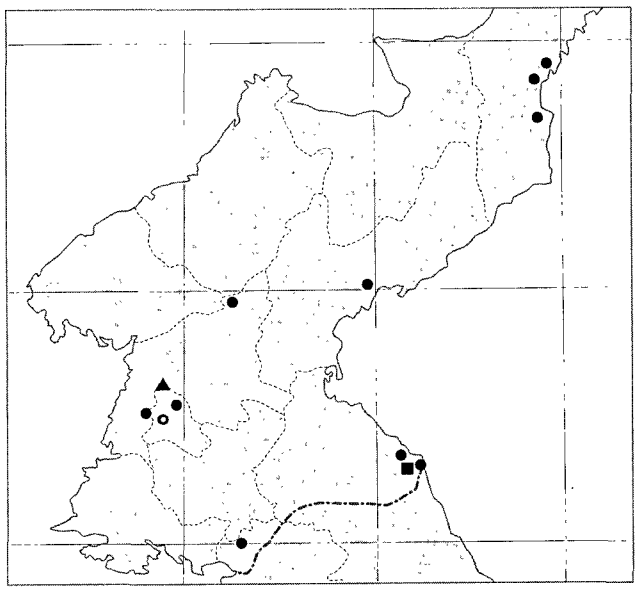

Figure 17. Distribution of *Temnothorax congruus* (■), *T. cuneinodis* (▲) and *T. eburneipes* (●) in North Korea.

Ecology. Inhabits different kinds of forests and meadows, nests build mainly in rotten wood, but sometimes in a soil, often under stones. In North Korea several foragers were found at altitude 710 m a.s.l. in deciduous forest.

Notes. The specimens from North Korea, determined by Collingwood (1976) as *T. congruus*, are in fact *Vollenhovia emeryi* Wheeler (material is in HNHM, examined).

Temnothorax cuneinodis Radchenko, 2004

Temnothorax cuneinodis Radchenko 2004: 112, w, North Korea.

Material examined. Holotype, w, North Korea, Maram ad Pyongyang, 10.viii.1959, leg. B. Pisarski and J. Prószyński.

General distribution. This species is known only from the single holotype worker (Fig. 17).

Ecology. Very poorly known. One forager was collected in the dry open slope of the hill near the valley of the stream, in the sparse young mixed forest.

Notes. *T. cuneinodis* is the quite conspicuous species and well differs from all known *Temnothorax* species with 12-segmented antennae from the Eastern Palaearctic by the combination of several features: distinctly marked and slightly angulated anterolateral corners of the pronotum (Fig. 3) (except of *T. alinae* Radchenko, 1994 a), the high and short, cuneiform petiole, reduced sculpture on the head dorsum, etc. *T. alinae* well differs from it by the densely sculptured, rugulose and reticulated head dorsum; by the much lower and massive petiole, which is distinctly longer than its height and with broadly rounded petiolar node dorsum; by the longer, straight, not widened at the base, finger-like, bluntly rounded on the tip propodeal spines; by the straight, blunt, thick and short standing hairs on the alitrunk, which length not bigger than minimal diameter of the eye, etc. (see also Key).

*Temnothorax eburneipes** (Wheeler, 1927)

Leptothorax congruus var. *eburneipes* Wheeler 1927 b: 1, w, China, Kuliang near Kiu-Kiang (Gee).
Leptothorax eburneipes: Wheeler 1929: 8, Radchenko 1996 b: 17, Bolton 1995 b: 238.
Temnothorax eburneipes: Bolton 2003: 271, Radchenko 2004: 123.

Material examined. 3 w, syntypes, "Kuliang near Kiu-Kiang, China, N. Gist Gee", "M.C.Z. Type 1–9 22618", "Syntypes *Leptothorax congruus* var. *eburneipes* Wheeler" (MCZ); more than one hundred w and 9 q from North Korea.

General distribution. China, North Korea.

Distribution in North Korea (Fig. 17). Pyongyang city and its vicinity (Ryongak-san Mts, Daebong; 4 km NE Pyongyang, Lake Sokan); vicinity of Kaesong; Prov. Pyongan-namdo, Myohyang-san Mts; Prov. Hamgyong-pukto: Onpho-ri and Djuyr near Chongjin; Orang County, near Changyon Lake; Prov. Hamgyong-namdo, Jonpong-ri, distr. Hongwon; Prov. Kangwon, Kumgang-san Mts.

Ecology. Semixerophilous species. In North Korea lives mostly in a lower altitude, up to 500 m, where inhabits mainly open, relatively dry grasslands (from sandy to stony soil), shrubs, rarely found in young, not dense forests (pine, oak, maple). In Myohyang-san Mts inhabits also mountain meadows up to the altitude 900 m a.s.l.

Notes. *T. eburneipes* resembles *T. nassonovi* but well differs from it by entirely brown body.

*Temnothorax kaszabi** (Pisarski, 1969)

Leptothorax kaszabi Pisarski, 1969 b: 301, w, q, Mongolia, Radchenko 1994 d: 157, 1995 b: 19, m, Bolton 1995 b: 240.
Leptothorax tuberum sachalinensis Kupyanskaya, 1990: 142, w, q, Isl. Sakhalin, synonymy by Radchenko 1995 b: 19.
Leptothorax rabaudi Bondroit: Collingwood 1976: 304, Terayama et al. 1992: 28, Kim, 1996: 177, 2003: 2 (misidentification), not Bondroit, 1918: 129.
Temnothorax kaszabi: Bolton 2003: 271, Radchenko 2004: 124.

Material examined. Paratypes of *L. kaszabi*: 11 w, Mongolia, Central Aimak, SE from Somon Bajanzogt, 1600 m a.s.l., 27.vii.1966, No 749, leg Z. Kaszab (nest of holotype); the same locality, 11.vi.1966, No 519, leg. Z. Kaszab (MIZ, ZMMU); holotype and paratypes of *L. tuberum sachalinensis*: 10 w and 1 q, Isl. Sakhalin, Starodubskoe, 1.viii.1978, leg. A. Kupyanskaya (BPI); non-type material: several tens w, 5 q, 4 m from Mongolia, Tuva, Chita Region and North Korea.

General distribution. Mongolia, south-eastern Altai, Tuva, southern Yakutia, Russian Far East, North Korea.

Distribution in North Korea (Fig. 18). Pyongyang and its vicinity (12 km NE Pyongyang, De-sang san); Prov. Hamgyong-pukto: Djuyr near Chongjin; distr. Orang, near Changyon Lake; Prov. Ryanggang: near Hungnam; Pektusan Mts, vicinity of Mupo; Prov. Pyongan-pukto, Myohyang-san Mts, Chosan.

Ecology. Inhabits mainly steppes, dry meadows, rarely lives in light, open forests, nests build in soil, often under stones. In North Korea it found in open grasslands, in shrubby areas, and mixed and deciduous forests (larch, birch, oak) up to the altitude 960 m a.s.l.

Notes. *T. kaszabi* is similar to the Euro-Siberian *T. tuberum* (Fabricius) and differs from it by another colour of the first gastral tergite (see Radchenko 1994 b). It also resembles *T. michali* (see below).

Collingwood (1976) recorded for North Korea the South European species, *L. rabaudi*, but the specimens from De-sang-san, 12 km NE of Pyongyang, Nr. 38 belong to *T. kaszabi* (material is in HNHM, examined); this Collingwood's mistake was repeated by Terayama et al. (1992) and by B.-J. Kim (1996, 2003).

Temnothorax koreanus (Teranishi, 1940)

Leptothorax (*Nesomyrmex*) *koreanus* Teranishi 1940: 16, w, Korea, Suigen.

Leptothorax koreanus: Terayama et al. 1992: 27, Bolton 1995 b: 240, Kim, 1996: 176, Terayama and Onoyama 1999: 88, Kim, 2003: 2, Imai et al. 2003: 156, Lyu and Cho 2003 b: 272.

Temnothorax koreanus: Bolton 2003: 271, Radchenko 2004: 125.

I have never seen this species and all discussions below are based on the literature data.

General distribution. Korea, Japan (from Hokkaido until Okinava). Not found yet in North Korea.

Notes. *T. koreanus* is the quite conspicuous species with 11-segmented antennae. By this feature it could placed to the genus *Leptothorax* [for example, Collingwood (1976) placed it to the *L. acervorum*-group], but on the other hand, it well differs from all known species from this genus by the distinctly marked and slightly angulated anterolateral corners of the pronotum (seen from above), and by the very long propodeal spines, which are similar to those of *T. nassonovi* and related species. I assume the taxonomic position of *T. koreanus* is still uncertain.

Temnothorax michali Radchenko, 2004

Temnothorax michali Radchenko 2004: 117, w, q, North Korea.

Material examined. Holotype, w, North Korea, Prov. Chagang, Mts Myohyang-san, 630 m a.s.l., valley Jonnasma, mixed forest (maple, larch, pine), No. 151-85, nest in the soil, under stone, 22.vi.1985, leg. M. Woyciechowski (MIZ); paratypes: 57 w from the nest of the holotype; 5 w, North Korea: Mts Myohyang-san, valley Manpek Dong, 860 m a.s.l., mixed forest (maple, larch, pine), No. 130-85, 21.vi.85, foragers collected on the ground, leg. M. Woyciechowski; 1 w, Mts Myohyang-san, valley Hyangsan, 185 m a.s.l., mixed forest (pine, maple), No. 174-85, 22.vi.85, leg. M. Woyciechowski; 43 w, Mts Myohyang-san, near Myohyang Hotel, 200 m a.s.l., deciduous forest, No. 245-85, 25.vi.1985, nest in fallen piece of wood, leg. M. Woyciechowski; 15 w, the same locality as the previous, No. 249-85, nest in rotten log, leg. M. Woyciechowski; 1 q, Chongjin city, Daeso-ri, 15.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 39 w, 1 q, Chongjin city, Kyowon-ri, 16.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 1 w, Prov. Hamgyong-pukto, distr. Kyongsong, Sangonpo-ri, 17.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 11 w, Prov. Kangwon, Kumgang-san Mts, near Kuryong Falls, 22.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 2 w, Kumgang-san Mts, Puryong-ri, 23.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 3 w, 2 q, Kumgang-san Mts, Nr. 714, 19.ix.1980, leg. L. Forró and Gy. Topal; 2 w, Kumgang-san Mts, Nr. 488, 12.x.1978, leg. A. Vojnits and L. Zombori; 1w, Prov. Pyongan-pukto, Mts Myohyang-san, about 100 m, Nr. 930, 21.v.1985, leg. A. Vojnits and L. Zombori; 13 w, ibid., Nr. 934, 22.v.1985, leg. A. Vojnits and L. Zombori; 2 w, ibid., Nr. 940, 23.v.1985, leg. A. Vojnits and L. Zombori; 3 w, Prov. Kangwon, Mts Kumgang-san, Nr. 949, 27.v.1985, leg. A. Vojnits and L. Zombori; 23 w, ibid., Nr. 951, 27.v.1985, leg. A. Vojnits and L. Zombori; 1w, Prow. Kangwon, Manmul-san, Nr. 1340, 21.vi.1988, leg. O. Merkl and Gy. Szél (MIZ, HNHM, JUK, IZK).

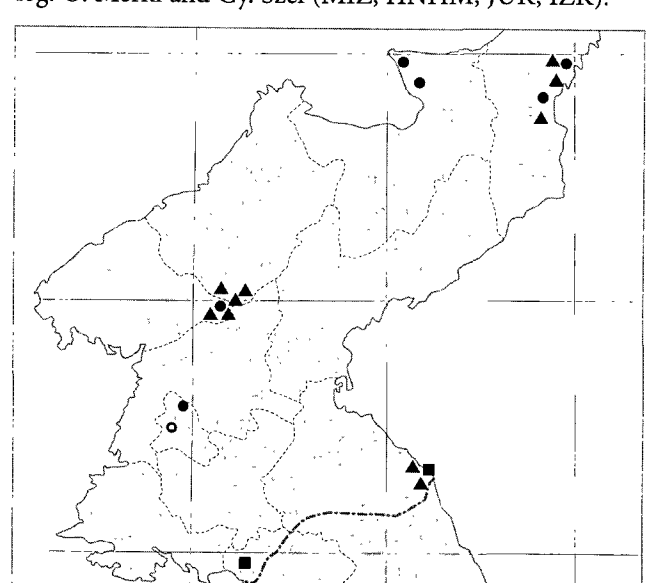

Figure 18. Distribution of *Temnothorax kaszabi* (●), *T. michali* (▲) and *T. mongolicus* (■) in North Korea.

General distribution. The species is known from the type localities (North Korea, see above) (Fig. 18).

Ecology. In Myohyang Mts this species inhabits deciduous and mixed forests (oak, maple, pine and larch) at the lower and middle altitude (between 185 and 860 m a.s.l.). Nests build in soil, under stones and in rotten wood.

Notes. *T. michali* the most resembles *T. kaszabi* and differs from it by the distinctly longer scape, by distinctly lighter colour of the gaster, which is concoloured with the alitrunk or only slightly darker, and without the light spot at the base of the first tergite (in *L. kaszabi* gaster is brown, distinctly darker than alitrunk and with the distinct yellowish spot at the base of the tergite).

Kupyanskaya (1990) has recorded in the Russian Far East *T. volgensis* (Ruzsky), the steppe species distributes from the Southern Ukraine until Western Kazakhstan. Based on her description, this material seems to be belonging to the newly described *T. michali*; for the definitive opinion one has to examine the proper material of Kupyanskaya.

*Temnothorax mongolicus** (Pisarski, 1969)

Leptothorax serviculus mongolicus Pisarski 1969 b: 301, w, Mongolia, Dlussky, Pisarski 1970: 86.
Leptothorax mongolicus: Radchenko 1994 d: 156, 1995 b: 18, q, m, Bolton 1995 b: 241.
Temnothorax mongolicus: Bolton 2003: 271, Radchenko 2004: 125.
Leptothorax serviculus Ruzsky: Kupyanskaya 1990: 140, Terayama et al. 1992: 28, Kim B.-J. 1996: 177, 2003: 2, Lyu and Cho 2003 b: 273, (misidentification), not Ruzsky 1902 a: 476.

Material examined. 3 w (holotype and paratypes), Mongolia, Songino, 24 km SW from Ulan-Bator, 22.v.1962, No 3299, leg. R. Bielawski and B. Pisarski; paratypes: 4 w, Mongolia, Uburchangaj Aimak, Changai Distr., 18 km S from Somon Chužirt, 1830 m a.s.l., 29.vi.1964, No 223, leg. Z. Kaszab (MIZ, HNHM); non-type material: several tens w, 4 q, 4 m from Mongolia, South Siberia and North Korea.

General distribution. Mongolia, Chita and Amur Regions of Russia, North Korea.

Distribution in North Korea (Fig. 18). Prov. Kangwon, Kumgang-san Mts.; Prov. Kaesong City, 30 km from Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon san.

Ecology. Inhabits steppes, dry meadows and dry light sparse forests, nests build in soil. In North Korea found in shrubs, riverside grassland and artificial habitats along roads and fields.

Notes. *T. mongolicus* the most resembles *T. pisarskii* (see Notes to the latter species). Collingwood (1976) determined couple of the specimens from North Korea as *L. serviculus*, but really they belong to *T. mongolicus* (material is in HNHM, examined). This error was repeated by Terayama et al. (1992) and by B.-J. Kim (1996, 2003).

Temnothorax nassonovi (Ruzsky, 1895)

Leptothorax nassonovi Ruzsky 1895: 26, w, Russia: vicinity of Simbirsk and Orenburg Regions), 1905: 579, Collingwood 1976: 303, Kupyanskaya 1990: 143, w, q, m, Radchenko 1994 d: 155, 1995 c: 9, Bolton 1995 b: 240, Kim B.-J. 1996: 176, Lyu and Cho 2003 b: 272.
Leptothorax nassonovi var. *subnudus* Ruzsky, 1905: 581, w, China, Manchuria, synonymy by Radchenko 1995 c: 9 (provisional).
Leptothorax nassonovi firssovi Kuznetsov-Ugamsky, 1928: 28, w, Russia: Primorsky Region, Okeanskaya, Pisarski 1969 a: 225, 1969 b: 302 (misspelled as *frissovi*), synonymy by Kupyanskaya 1990: 143.
Temnothorax nassonovi: Bolton 2003: 271, Radchenko 2004: 126.
Leptothorax galeatus Wheeler, 1927 b: 1, w, China, Tsinghua, 1929: 8, Chapman, Capco 1951: 254, Radchenko 1994 d: 156, Bolton 1995 b: 239, Wu and Wang 1995: 108, Radchenko 1996 b: 18, synonymy by Radchenko 2004: 126.

Material examined. Syntypes of *L. nassonovi*: 2 w, vicinity of Simbirsk, vi.1894 (ZMMU); non-type material: several hundred w, several tens q and m from Ukraine, Southern European Russia, South Siberia, Mongolia, north-east China, Russian Far East and North Korea; lectotype and paralectotype of *L. nassonovi firssovi*: 2 w, "Okeanskaya, vi.[19]26, Kuznetsov-Ugamsky" (designated by Radchenko 1995c) (ZMMU); holotype of *L. galeatus*: w, "Tsinghua, nr. Peking, China, N. Gist Gee", "M.C.Z. Type 21025", "Syntypes *Leptothorax galeatus* Wheeler" (see also Notes below) (MCZ).

General distribution. Steppe and forest-steppe Zones from the eastern Ukraine till the Pacific Ocean, Tien-Shan; it is absent in Japan.

Distribution in North Korea (Fig. 19). Pyongyang and surrounding area (distr. Kyongsong, Maram; 20 km W Pyongyang, Ryongak-san Mts, Daebong; Djonjong-San Mts; above Lake Taesong; 10 km NE Pyongyang, near Sang-san; 35 km SW Pyongyang, Taesong; 30–40 km N Pyongyang, Sa-gam; 15 km W Pyongyang, Lyongak-san; Taesong-san Mts ; 45 km E Pyongyang, Bong-ha ri, on river Te-dong; 12 km NE Pyongyang, De-sang san; 45 km N Pyongyang, Sa-gam; 50 km N Pyongyang, Chang-lyong san, 15 km E Sa-gam); Prov. Chagang and Pyongan-namdo, Myohyang Mts; Prov. Pyongan-namdo: 10 km NE from Nampo, Mts Guk-san-bong; Prov. Hamgyong-pukto, distr. Orang, near Changyon Lake; Prov. Kaesong City; 10 km SW of Kaesong, Lake Jonpong-ho; 30 km from Kaesong, vicinity of Bagyon popo, De-hung-sol, Bagyon san; Kongmin Vang Nung, near Kaesong; Prov. Hwanghae-namdo: 8 km W Haeju, Sujang-san Mts; Prov. Kangwon: Kumgang-san Mts; Wonsan; Prov. Hamgyong-namdo, dist. Jonpong-ri, Hongwon; Prov. Hamgyong-pukto: dist. Puryong, Musu-ri; Onpho-ri near Chongjin; Chongjin Komalsan Park; Prov. Ryanggang, 15 km N from Hyesan, road to Pochon.

Ecology. Generally inhabits steppe and dry meadows, nests are built in soil. In North Korea seems to be quite common species and inhabits different types of habitats: dry grasslands, including ruderal and artificial

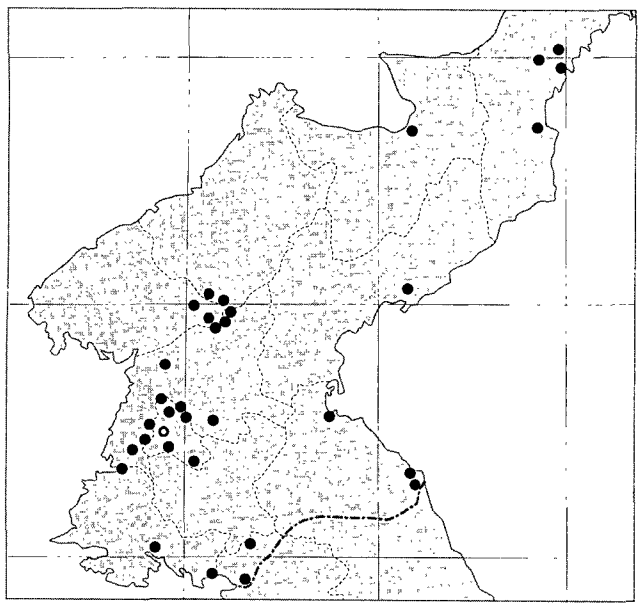

Figure 19. Distribution of *Temnothorax nassonovi* (●) in North Korea.

biotopes (also found in cities and towns), sea shores, shrubs, light and sparse forests (oak, pine, sweet chestnut, maples, pseudoacacia) at an altitude usually up to 200–250 m a.s.l., but in Myohyang Mts occurs also at the altitude 840 m in the steppe mountain slope. Nests built in soil, often under stones.

Notes. Investigation of the types of *L. nassonovi* and subsp. *firssovi* is confirmed the synonymy established by Kupyanskaya (1990) (see also Radchenko 1995 c).

The types of var. *subnudus* seem to be lost. Ruzsky (1905) noted that this variety differs from the "typical" *T. nassonovi* by the very sparse standing hairs on the body (sometimes hairs are completely absent), by somewhat another colour of the head dorsum, and by presence of the yellow spot at the base of first gastral tergite. The two latter features are quite variable, but absence of the standing hairs is a quite significant character. Conspecificity (or dissimilarity) of these two forms can be definitely resolved only after obtaining of an additional material from the type locality (Manchuria) of var. *subnudus*.

I have investigated 2 workers of *L. galeatus*, preserved in the collection of MCZ. One worker with the labels "Peking, China, P. H. Lefivre", "M.C.Z. Type 7 21025" was designated by A. Schulz in 1997 as the lectotype, and second specimen from Tsinghua (for details see above) is labelled as the paralectotype. Nevertheless, Wheeler (1927 b) has described *L. galeatus* based only on "A single specimen from Tsinghua (Gee)" (*loc. cit.*, p. 2), which is the holotype according to the International Code of Zoological Nomenclature. The second specimen from Peking, designated as the lectotype, does not belong to the type series.

This species with any doubt is junior synonym of *T. nassonovi*.

Temnothorax pisarskii Radchenko, 2004

Temnothorax pisarskii Radchenko 2004: 115, w, q, m, North Korea.

Material examined. Holotype, w, North Korea, Myohyang-san Mts, 6.viii.1959, No. 2291, leg. B. Pisarski and J. Prószyński (MIZ); paratypes: 9 w from the nest of the holotype; 1 w, the same locality and collectors, but 5.viii.1959, No. 2282; 4 w, Pyongyang city, near Tomb of King Tongmen, 27.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 2 w, Ryongak-san Mts, Daebong near Pyongyang, 7.vi.1990, leg. E. Chudzicka, E. Kierych and R. Pisarska; 1 w, Prov. Pyongan-namdo, De-sang san, 12 km NE of Pyongyang, 27.v.1970, leg. S. Mahunka, H. Steinmann; 17 w, 1 q, 6 m, Prov. Pyongyang City, Taesong-san Mts (SE of Pyongyang), 28.vii.1989, No. 1-89, leg. M. Woyciechowski (MIZ, HNHM, JUK, IZK).

General distribution: the species is known from the type localities (see above) (Fig. 20).

Ecology. Poorly known. In Myohyang Mts this species was found in two sites: in the young forest and shrubs on the dry mountain slope, in the shady place with the rich herb layer, nesting under the stone, in the dry forest on the rocky slope. In Taesong, these ants inhabit mixed (pine, oak) forest, with the height of trees 5–7 m, with juniper shrubs, at the altitude 150 m a.s.l., nesting in the soil under stone.

Notes. *T. pisarskii* the most resembles *T. mongolicus* by the shape of petiole, and at the same time well differs by this feature from all other East Palaearctic bicoloured *Temnothorax* species with the short propodeal spines. It differs from *T. mongolicus* by the longer scape, longer propodeal spines, and by somewhat another colour. In *T. pisarskii* alitrunk and waist are from ochreous-yellow to brownish-yellow, concoloured with the head dorsum, gaster is brown but the basal ¼ of the first tergite is yellow; in *T. mongolicus* the head dorsum is brownish, distinctly darker than the ochreous-yellow or brownish-yellow alitrunk, and gaster is totally brown, without yellow spot at the base of the first tergite.

Temnothorax xanthos Radchenko, 2004

Temnothorax xanthos Radchenko 2004: 114, w, North Korea.

Material examined. Holotype, w, North Korea, Kongmin Vang Nung, near Kaesong, 14.viii.87, leg. E. Kierych (MIZ).

General distribution. The species is known from the type locality (above) (Fig. 20).

Ecology. Unknown.

Notes. This peculiar species well differs from all known *Temnothorax* species from the Eastern Palaearctic by its entirely yellowish colour and characteristic shape of the head, which broadly rounded above the eyes,

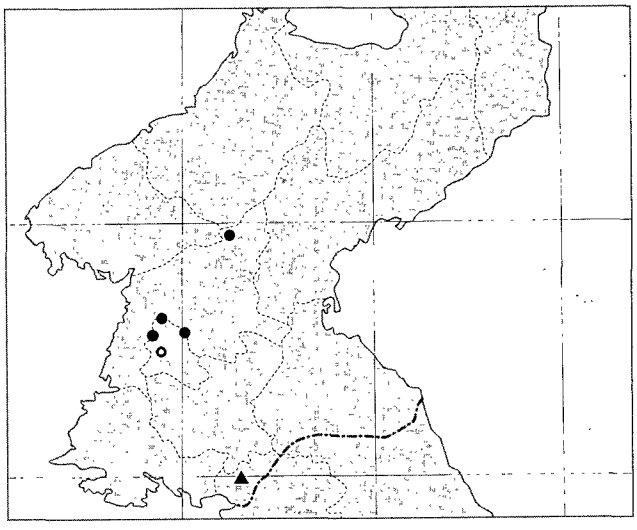

Figure 20. Distribution of *Temnothorax pisarskii* (●) and *T. xanthos* (▲) in North Korea.

without marked occipital corners, and with the distinctly convex sides.

Tetramorium Mayr, 1855

Tetramorium Mayr 1855: 423. Type species: *Formica caespitum* Linnaeus, 1758: 581, by subsequent designation of Girard 1879: 1016.

Tetramorium belongs to the most specious ant genera: it includes more than 400 species, distributed mainly in the tropics and subtropics (205 species are known from the Afrotropical region). About 60 species occur in the Palaearctic, mostly in the southern parts of the region.

While numerous tropical *Tetramorium* species are strongly differentiated in respect of their biology, habitat requirements, food preferences, nest types, etc. (see Bolton 1977, 1980), the bionomics of the Palaearctic species is uniform. They build mainly ground nests, often with quite large soil mounds; they also nest under stones or, very rarely, in rotten wood. Most species are predators or scavengers; their diet also contains grass seeds, especially in warm and dry regions. Their colonies are large, sometimes including several thousand workers.

Tetramorium tsushimae Emery, 1925

Tetramorium tsushimae Emery 1925 b: 187, w, q, Japan, Bolton 1995 b: 415, Imai et al. 2003: 136.

Tetramorium caespitum subsp. *jacoti* Wheeler, 1927 a: 7 (first available use of name *Tetramorium caespitum semilaeve* var. *jacoti* Wheeler, 1923: 3, w, China).

Tetramorium jacoti: Radchenko 1992 a: 45, 1992 b: 51.

Tetramorium caespitum: Collingwood 1976: 304, 1981: 27, Kupyanskaya 1990: 151, Wu and Wang 1995: 82, Kim B.-J. 1996: 181, 2003: 2 (misidentification), not Linnaeus 1758: 581.

Material examined. Syntypes, w, China, Tartar, Peking (MIZ); non-type material: more than one hundred w, several tens q and m from South Siberia, Russian Far East, North Korea, China and Japan.

General distribution. Eastern Palaearctic from Transbaikalia until Japan.

Distribution in North Korea (Fig. 21). Pyongyang and surrounding area (Ryongak Mts, Daebong; Djonjong-san Mts; 4 km NE Pyongyang, Lake Sokan; near Pyongyang, Tomb Kogurio; 15 km from Pyongyang, road to Haeju; above Lake Taesong; Susan Mt.; SE Pyongyang, Taesong-san Mts; 30 km N Pyongyang, Sa-gam po; 12 km NE Pyongyang, De-sang san; 10 km NE Pyongyang, near Sang-san; 35 km SW Pyongyang, Taesong; Ryongak-san Mts; Michon Lake); Prov. Pyongan-pukto, Tephun near Kujang-dong; Prov. Pyongan-namdo, Sokam-Juvonji, distr. Sunan; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Hamgyong-namdo, Hangman; Prov. Hamgyong-pukto: Onpho near Chongjin; Juur near Chongjin; distr. Orang, on Changyon Lake; Chongjin, Daeso-ri; Chongjin Komalsan Park; 20 km NE Chongjin; 20 km NW Kyongsong, Poro-chon; Prov. Kaesong City: Kaesong, canyon near Pakyon Falls; Kaesong, near Koryo Museum; Kongmin near Kaesong; 20 km SE Kaesong, San-chon tong, Bagyon san; 20 km NE Kaesong, Pakyon Mts; Prov. Hwanghae-namdo: Haeju; 4 km SE Haeju, island in golf; 8 km W Haeju, Sujang-san Mts; Prov. Kangwon: Kumgang-san Mts; Wonsan; 50 km S from Wonsan; Prov. Ryanggang: 3 km SE from Hyesan; 15 km N Hyesan, road to Pochon; Jugo near The, above riv. Sogundansu.

Ecology. *T. tsushimae* is one of the most common North Korean ants. This xerothermophilous species was found in very diverse habitats at altitudes up to 1050

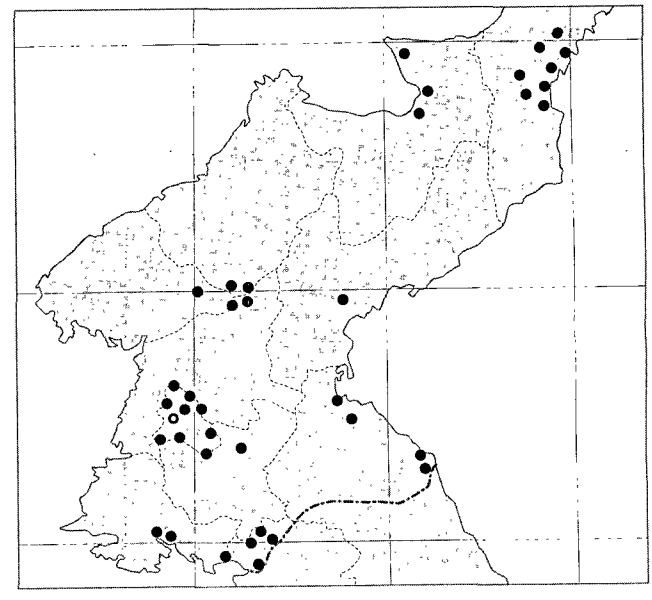

Figure 21. Distribution of *Tetramorium tsushimae* (●) in North Korea.

m a.s.l., although it mainly lives at lower altitudes. The preferred biotopes are dry grassland, sea and lakeshores, sandy riverbanks, edges of forests, shrubs, dry, open, sunny forests (oak, pine, sweet chestnut, etc.). It exhibits a synanthropic inclination and is very common in artificial habitats: cities, towns, villages, pastures, fields, etc. It builds nests in soil, often under stones or in soil mounds, rarely in decayed wood and in soil under it. The colonies, seemingly monogynous, number from several thousand to several tens thousand workers. The species is highly polyphagous. Its diet includes dead insects and other invertebrates, and even bodies of small dead vertebrates (birds, mice, frogs, etc.), but this fairly aggressive species can also prey on living soil arthropods. At the same time herb seeds and honeydew of root aphids are an essential supplement for its diet.

Notes. Taxonomy of *Tetramorium* is very difficult and for the correct determination of many species one needs to investigate workers as well as queens and males. Most probably there are more than one *Tetramorium* species in North Korea, but sexuals of all these dubious forms are absent from the material collected and investigated. That is why I have no definitive opinion about their taxonomic status and regard them now as *T. tsushimae*.

T. tsushimae is very similar morphologically and biologically to the common Palaearctic species *T. caespitum*, and many authors still determine this Oriental species as *T. caespitum*.

Wheeler (1927 a) regarded *T. tsushimae* as the junior synonym of *T. jacoti*, but the former name has priority (see synonymy above).

Vollenhovia Mayr, 1855

Vollenhovia Mayr 1855: 21. Type species: *Vollenhovia punctatostriata* Mayr, 1865: 21, by monotypy.

This genus comprises about 50 species, distributed in the Oriental and Australasian Regions, and in Madagascar; only 3–4 of them occurs in the eastern part of the Palaearctic Region.

Vollenhovia emeryi Wheeler, 1906

Vollenhovia emeryi Wheeler 1906: 312, w, q, Japan, Wu and Wang 1995: 107, Bolton 1995 b: 422, Kim B.-J. 2003: 2, Imai et al. 2003: 129.

Vollenhovia emeryi subsp. *chosenica* Wheeler, 1928 b: 113, w, Korea, Kim B.-J. 1996: 182 (misspelled as *emeri*), **syn. nov.**.

Leptothorax congruus: Collingwood 1976: 303 (misidentification), not F. Smith 1874: 406.

Material examined. Several tens w from North Korea and Japan.

General distribution. China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 22). Pyongyang; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Hwanghae-namdo, 20 km SE Kaesong, Sanchon tong, Bagyon san; Prov. Hamgyong-pukto, Onphori near Chongjin.

Ecology. This thermophilous species was found at a low altitude (up to 280 m a.s.l.) and inhabits mainly dry open forests (oak, sweet chestnut, pine). It is rather abundant locally (i.e. in the Myohyang Mts). It builds nests in decayed wood, very rarely in soil under stones or under moss.

Notes. Wheeler (1928 b) described *V. emeryi* subsp. *chosenica* from Korea. I compared material from North Korea with the Japanese *V. emeryi* and could not find any significant differences. Most probably, it is not necessary to divide this species into different subspecies.

Collingwood (1976) determined a couple of specimens from the vicinity of Kaesong as *Leptothorax congruus*, but they are in fact *V. emeryi* (material is in HNHM, examined).

Dolichoderinae Forel

This subfamily comprises about 900 species and 22 genera, distributed all over the world, predominantly in the tropics and subtropics. 7 genera and about 70 species are known from the Palaearctic Region (mainly from its southern part).

Dolichoderus Lund, 1831

Dolichoderus Lund 1831: 130. Type species: *Formica attelaboides* Fabricius, 1775: 394, by monotypy.

Hypoclinea Mayr, 1855: 377, synonymy by Forel 1878: 386, Shattuck 1992: 66.

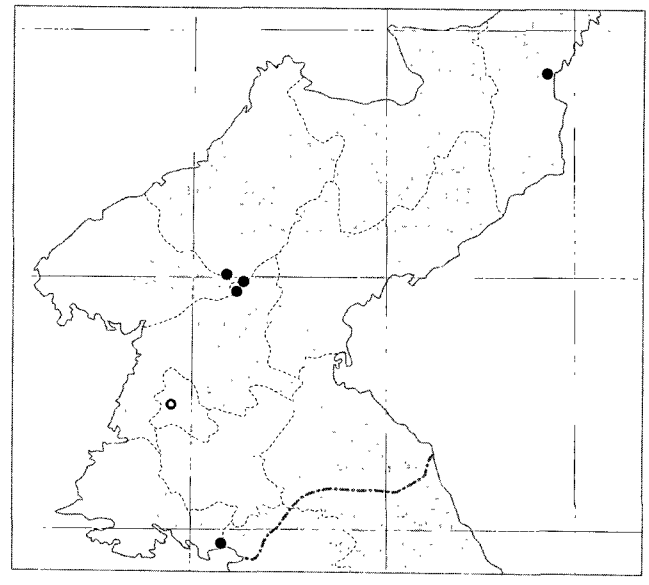

Figure 22. Distribution of *Vollenhovia emeryi* (●) in North Korea.

This genus comprises about 140 species, distributed mainly in the World tropics (except the Afrotropical Region and Madagascar). Two species occur in the Palaearctic. They are ants of moderate size, mainly of arboreal habit.

Dolichoderus sibiricus Emery, 1889

Dolichoderus quadripunctatus subsp. *sibiricus* Emery 1889: 442, w, Russia (Siberia).
Dolichoderus (*Hypoclinea*) *sibiricus*: Kupyanskaya 1990: 155, q, m.
Dolichoderus sibiricus: Yasumatsu 1962: 96, Collingwood 1976: 299, 1981: 26, Bolton 1995 b: 176, Kim B.-J. 1996: 172, 2003:2, Imai et al. 2003: 85.
Hypoclinea sibirica: Wu et Wang 1995: 121.
Dolichoderus (*Hypoclinea*) *quadripunctatus* subsp. *yoshiokae* Wheeler, 1933: 67, synonymy by Yasumatsu 1941: 182.
Dolichoderus (*Hypoclinea*) *abietis* Kono and Sugihara, 1939: 12, synonymy by Yasumatsu 1941: 182.
Dolichoderus (*Hypoclinea*) *quadripunctatus* subsp. *japonicus* Yoshioka, 1939: 70, synonymy by Yasumatsu 1941: 182.

Material examined. About one hundred w, several tens q and m from Siberia, Russian Far East, Mongolia, North Korea and Japan.

General distribution. Siberia, Mongolia, Russian Far East, Japan, China.

Distribution in North Korea (Fig. 23). Prov. Pyongan-namdo: 60 km NE Pyongyang, Za-mo san; Sokam-Juvondzi, Distr. Sunan; vicinity of Pyongyang; Prov. Kangwon, Kumgang-san Mts., Onjong-ri and Bek-sung-li near Kumgang-san Hotel; Prov. Hamgyong-pukto, near Lake Chongjin-ho; Kaesong; Prov. Chagang, Myohyang-san Mts.

Ecology. This arboreal species was found in North Korea in mixed and deciduous forests (including sweet chestnut), in parks, at low altitudes (up to 400–450 m a.s.l.). It builds nests in dry branches on living trees, rarely in logs under bark.

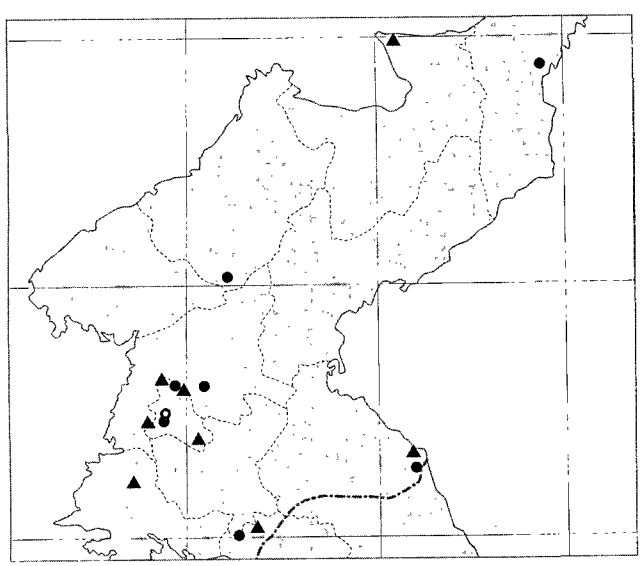

Figure 23. Distribution of *Dolichoderus sibiricus* (●) and *Tapinoma sinense* (▲) in North Korea.

*Linepithema** Mayr, 1866

Linepithema Mayr 1866 a: 496. Type species: *Linepithema fuscum* Mayr, 1866 a: 497, by monotypy.

This small Neotropical genus comprises about 20 species, one of them, *L. humile* (Mayr) occasionally introduced to all continents.

*Linepithema humile** (Mayr, 1868) [Argentine ant]

Hypoclinea humilis Mayr 1868: 164, w, Argentina.
Hypoclinea (Iridomyrmex) humilis: Mayr 1870: 959.
Iridomyrmex humilis: Emery 1888: 386.
Linepithema humile: Shattuck 1992: 16, Imai et al. 2003: 83.

Material examined. One m from North Korea, and several w, q and m from Europe and Vietnam.

General distribution. Tramp species of the Neotropical origin, introduced all over the world tropics and subtropics.

Distribution in North Korea (Fig. 24). Prov. Kangwon, vicinity of Wonsan.

Ecology. Only 1 male was found in North Korea, probably this species still does not permanently lives in this country (*L. humile* is unknown in South Korea and in the temperate zone of China).

L. humile is the pest, so called Argentine ant, formerly known as *Iridomyrmex humilis*. Its colonies are often very large and highly polygynous, and can comprise hundreds of queens and several tens thousand workers. If it infests houses, it contaminates and spoils stored food; in orchards and gardens this species actively tends homopterous pest insects, and severely damages and depletes populations of native ant species in infested areas.

*Liometopum** Mayr, 1861

Liometopum Mayr 1861: 38. Type species: *Formica microcephala* Panzer, 1798: no page, by monotypy.

This small relict genus consists only 9 species, distribute in Holarctic and Oriental Regions; 3 of them live in the Palaearctic.

*Liometopum orientale** Karawajew, 1927

Liometopum microcephalum var. *orientalis* Karawajew 1927: 339, w, Russian Far East.
Liometopum orientalis: Kupyanskaya 1988: 29, q, m, 1990: 157.
Liometopum orientale: Bolton 1995 b: 247 (emendation of spelling).

Material examined. Syntypes, 24 w, "Suchansky rudnik, No. 3082, leg. Kochubey and Vereschagin" (IZK); non-type material: several tens w, 2 q and 2 m from Russian Far East and North Korea.

General distribution. Russian Far East, North Korea.

Distribution in North Korea (Fig. 24). Prov. Chagang, Myohyang San Mts, valley Manpek-Dong.

Ecology. In North Korea it was found in a pine-oak forest at 780 m a.s.l. Like the other species of this genus, *L. orientalis* is characterised by a high level of sociality. They build carton nests in hollows of tree trunks, their colonies are very big, sometimes consisting of several tens thousand workers. The foraging strategy of this species is similar to that of the red wood ants. Detailed studies of the ecology and biology of *L. orientale* can be found in Kupyanskaya (1988, 1990).

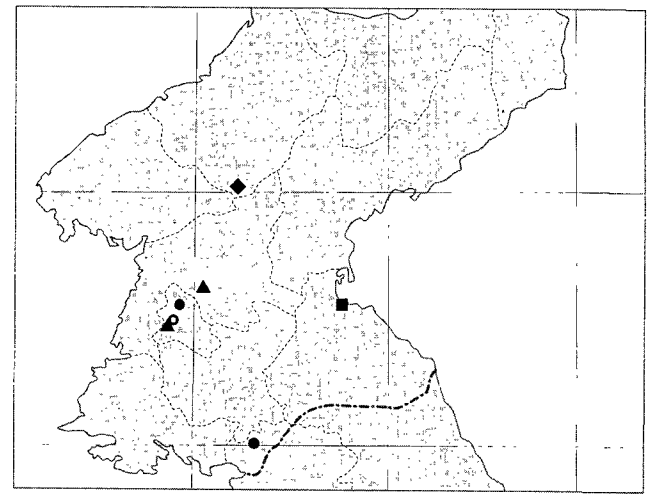

Figure 24. Distribution of *Technomyrmex albipes* (●), *T. gibbosus* (▲), *Linepithema humile* (■) and *Liometopum orientale* (◆) in North Korea.

Tapinoma Förster, 1850

Tapinoma Förster 1850: 43. Type species: *Tapinoma collina* Förster, 1850: 43, by monotypy.

This cosmopolitan genus comprises about 100 species, more than 20 of them are known from the Palaearctic.

Tapinoma sinense Emery, 1925

Tapinoma sinense Emery 1925 c: 61, w, China, Collingwood 1976: 299, 1981: 26, Bolton 1995 b: 401, Kim B.-J. 1996: 173, 2003: 2.
Tapinoma sessile: Kupyanskaya 1990: 156 (misidentification), not Say 1836: 287.

Material examined. Several tens w, 11 q, 19 m from North Korea and China.

General distribution. Siberia, Mongolia, Russian Far East, China.

Distribution in North Korea (Fig. 23). Pyongyang and surrounding area (near Tomb of King Tongmen; 35 km SW of Pyongyang, Taesong; 30–40 km N of Pyongyang, Sa Gam; Nung-ra do, island in riv. Te-dong; Te-dong gang; Nampo); Prov. Hwanghae-namdo, Sunchon; Prov. Kaesong City, 27 km NE from Kaesong, Pakyon Mts, Pakyon popo; Prov. Kangwon, Distr. Ondzong, Kumgang-san Mts, along riv. Orku-dong; Prov. Ryanggang, Mt. Pektusan, env. Sam-zi-yan hotel.

Ecology. In North Korea this species was found at low altitudes (up 350–400 m a.s.l.). It inhabits mainly dry, often stony grasslands, artificial habitats, lakeshores and riverbanks, shrubs, sparse pine and mixed forests. Nests are usually built in soil, frequently under stones, rarely in decayed wood.

Notes. *T. sinense* belongs to the *sessile* species-group. The species of this group are small and are characterised by a very shallow notch on the anterior clypeal margin in workers and queens, and by a peculiar structure of the male genitalia. Besides American *T. sessile,* this group also includes several species locally distributed in the Palaearctic from Spain to the Pacific Ocean, and all of them seem to be Pleistocene relicts (Radchenko 1983).

Technomyrmex Mayr, 1872.

Technomyrmex Mayr 1872: 147. Type species: *Technomyrmex strenuus* Mayr, 1872: 147, by monotypy.

This pantropical genus comprises more than 90 species, about 10 of them distributed in the southern part of the Palaearctic Region. Two species were found in North Korea.

Technomyrmex albipes (F. Smith, 1861)

Technomyrmex albipes F. Smith 1861: 38, w, Sulavesi, Collingwood 1976: 300, Wu and Wang 1995: 118, Bolton 1995 b: 402, Kim B.-J. 1996: 173, 2003: 2, Imai et al. 2003: 84.

Material examined. Several tens w, 5 m from North Korea, Vietnam and Singapore.

General distribution. This tropical tramp species was introduced all over the world tropics and subtropics. In the temperate zone it is typical indoor species and lives mainly in greenhouses and hothouses. In the Eastern Palaearctic this species is known from China, North Korea and southern Japan; in South Korea is not found.

Distribution in North Korea (Fig. 24). It is known only from 2 males collected in the pine forest near Desang san, 12 km NE of Pyongyang, and near Kaesong.

Ecology. In tropics, *T. albipes* is very common in artificial and disturbed habitats. Generally it prefers open, relatively dry sites: grasslands, edges of forests, etc., where it nests mainly in rotting wood. Colonies of

this species may be very big, up to millions of workers; in such cases it forms highly polycalic nests system.

*Technomyrmex gibbosus** Wheeler, 1906

Technomyrmex gibbosus Wheeler 1906: 319, w, Japan, Bolton 1995 b: 402, Kim B.-J. 1996: 173, 2003: 2, Imai et al. 2003: 84.
Tapinoma wroughtoni: Collingwood 1976: 299 (misidentification), not Forel 1904 b: 26.

Material examined. 4 w and 1 q from North Korea and Japan.

General distribution. Japan, Korean Peninsula.

Distribution in North Korea (Fig. 24). It is known from 2 workers and 1 queen collected in two localities: Pyongyang and Za-mo san, 60 km NE Pyongyang.

Ecology. In North Korea one worker was collected in a hotel garden in Pyongyang, and other worker and queen were found in a sweet chestnut forest. In Japan this species nests in dead twigs and dead bamboo stems.

Notes. Collingwood (1976) erroneously determined this species as *Tapinoma wroughtoni*, the Indian species. *T. gibbosus* differs from *T. albipes* by the absence of erect hair on the first to third gastral tergites, different body coloration, etc. (see also Key).

Formicinae Latreille

This is the second (after Myrmicinae) biggest ant subfamily. It comprises about 2500 species and 50 genera, distributed on all continents. About 350 species from 17 genera are known from the Palaearctic Region, and many of them are keystone species in both the temperate and arid zones of this region.

Camponotus Mayr, 1861

Camponotus Mayr 1861: 35. Type species: *Formica ligniperda* Latreille, 1802: 88, by subsequent designation of Bingham 1903: 347.

It is the most specious ant genus worldwide, a typical example of the "*crux myrmecologorum*". The genus comprises 46 subgenera and no fewer than 1000 species, which reach their greatest abundance in the tropics. Eight subgenera and more than 100 species are known from the Palaearctic. Some species mine in wood (in trunks or branches of living trees, in rotten stumps or in wooden constructions), while others nest in the ground. The ants are both carnivorous and aphidicolous, and some species are nocturnal forms. Many species are highly polymorphic, of medium to large size (4–15 mm); *C. gigas* Latreille (lives in the Oriental Region) is the biggest known ant in the world, the body length of its workers reaching almost 30 mm.

Camponotus (*Camponotus*) *atrox* Emery, 1925

Camponotus japonicus var. *atrox* Emery 1925 a: 73, replacement name for *Camponotus japonicus* var. *cruentata* Emery, 1925 a: 73 (first available use of name *C. herculeanus* subsp. *japonicus* var. *cruentata* Karawajew, 1912: 595), junior secondary homonym of *Formica cruentata* Latreille, 1802: 116 (transferred to *Camponotus*).
Camponotus atrox: Yasumatsu and Brown 1957: 49 (revived from synonymy as junior synonym of *C. japonicus*: Yasumatsu and Brown 1951: 37), Collingwood 1976: 307, 1981: 29, Bolton 1995 b: 87, Kim B.-J. 1996: 182, Radchenko 1996 c: 1202, 1997 a: 555, Kim B.-J. 2003: 2.
C. herculeanus subsp. *japonicus* var. *cruentata* Karawajew, 1912: 595, w, q, North Korea, unavailable name (quadrimonen).
Camponotus herculeanus subsp. *jeholensis* Teranishi, 1936: 4, w, Korea, synonymy by Radchenko 1997 a: 555.
Camponotus herculeanus subsp. *koreanus* Teranishi, 1940: 71, w, Korea, synonymy by Radchenko 1997 a: 555.

Material examined. Syntypes: 1 w, 1 q (without gaster), Tshin-jasi-san, 28.vii.[19]00, No. 3580, leg. P. Shmidt (label written in Russian), "*Camponotus herculeanus pennsylvanicus* var. *atrox* Emery, nom. nov." (IZK); non-type material: several tens w from North Korea.

General distribution. Korean Peninsula, China. B. J. Kim (1996) erroneously recorded this species from Japan and Europe.

Distribution in North Korea (Fig. 25). Vicinity of Pyongyang (10 km NE Pyongyang, Taesong-san Mts, near Michon Lake; Su-san Mt.); Prov. Kaesong City: Kaesong, canyon at Pakyon falls; 27–30 km from Kaesong, Pakyon popo, De-hung-sol, Pakyon-san Mts; 20 km SE Kaesong, San-chon tong; Prov. Hwanghaènamdo, Haeju; near Haeju, Sujang-san Mts; Prov. Kangwon: Kumgang-san Mts.

Ecology. This species seems to be quite widespread, although generally not abundant. In North Korea it was

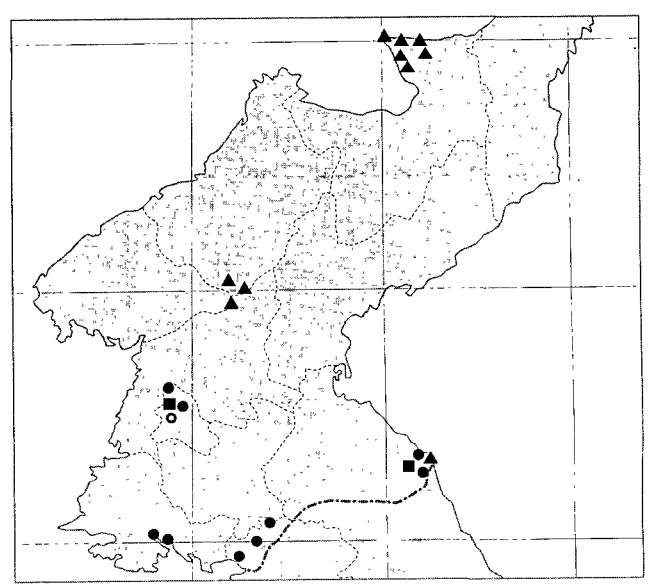

Figure 25. Distribution of *Camponotus atrox* (●), *C. herculeanus sachalinensis* (▲) and *C. itoi* (■) in North Korea.

found at altitudes up to 860 m a.s.l., mainly in mountain regions. It inhabits different kinds of forests (oak, pine), but also lives in city parks. Nests are built in rotten wood or in soil, often under stones.

Notes. For many years after being raised to the species rank, *C. atrox* was a poorly recognised taxon. Arnoldi (1967) regarded it as most closely related to *C. saxatilis* and to *C. japonicus* var. *sanguinea* Karawajew (see Radchenko 1997 a). However, investigation of the types of this species showed that it is considerably different from the related Oriental species, first of all in having a bicoloured body, with a black head and gaster and a reddish alitrunk, and to be superficially similar to the European *C. herculeanus* s. str. and to the oriental *C. obscuripes*. From the latter species it differs in having an entirely black first gastral tergite, and much longer pubescence on the gastral tergites (depressed hairs 4–6 times longer than the distance between them *vs.* 1.5 times longer in *C. obscuripes*).

Yasumatsu and Brown (1951) stressed that the subsp. *jeholensis* and *koreanus* are very similar to *C. atrox* and regarded all these forms as junior synonyms of *C. japonicus*. I have never seen the types of *jeholensis* and *koreanus*, which are probably lost, but tentatively propose to regard them as synonyms of *C. atrox* based on Yasumatsu and Brown's (*loc. cit.*) opinion.

Camponotus (*Camponotus*) *herculeanus* subsp. *sachalinensis* Forel, 1904

Camponotus herculeanus var. *sachalinensis* Forel 1904 a: 380, q, Russia (Isl. Sakhalin).

Camponotus herculeanus subsp. *sachalinensis*: Collingwood 1976: 306, Kupyanskaya 1990: 166, Terayama et al. 1992: 38, Radchenko 1996 c: 1203, 1997 a: 555.

Camponotus sachalinensis: Collingwood 1981: 29, Bolton 1995 b: 121, Terayama, 1999 a: 29, Kim B. J., 2003: 2, Imai et al. 2003: 39.

For details of synonymy see Radchenko (1997 a).

Material examined. Syntypes, 2 q, Sakhalin (ZIN); non-type material: more than one hundred w, several tens q and m from East Siberia, Russian Far East, Mongolia, North Korea and Japan.

General distribution. East Siberia, Mongolia, Russian Far East, north-east China, North Korea (is not found yet in South Korea), Japan.

Distribution in North Korea (Fig. 25). Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Ryanggang: Samjiyon, shore of Lake Samjiyon; 20 km E Samjiyon; Pektusan San Mt.; plateau at the foot of Pektusan Mt.; 5 km N from Taesong Dan; Rijong-su waterfalls; 2 km N from Chongbong; near Hungnam; Jugo near The, above riv. Sogundansu; Chang-Pay plateau, Sam-zi-yan; Pektusan Mt., 16 km E from Samjiyon hotel; vicinity of Mupo, Tumang-gang; Konchang; Prov. Kangwon, Kumgang-san Mts, Manmul-san.

Ecology. This boreal species was found in North Korea only in the mountain regions. It lives at altitudes between 780 and 2000 m a.s.l. (mostly above 1300 m). It inhabits different kinds of forests (usually fir, larch, birch, rarely oak and pine), mountain meadows, shrubs (mainly juniper), and peat bogs. In contrast with *C. herculeanus*, which nests almost exclusively in wood, including living trees, subs. *sachalinensis* builds nests both in decayed wood and in soil, usually under stones. The locality in the Kumgang-san Mts is the southernmost one for this subspecies.

Notes. Forel (1904) described this form as a variety of *C. herculeanus*, and subsequently various authors have regarded it either as a subspecies of the latter species or as a good species. It differs from the Euro-West Siberian *C. herculeanus* s. str. in having a unicoloured blackish body (in *C. herculeanus* the alitrunk is reddish), but the queens and males of both forms are indistinguishable. In the Altai and Tuva there are intermediate-colour populations, and even in the Far East I found specimens of subsp. *sachalinensis* with a somewhat reddish alitrunk. In my opinion, *sachalinensis* may be more reasonably treated as a subspecies of the widespread Transpalaearctic *C. herculeanus*.

It can be confused with two other black oriental *Camponotus* species: *C. japonicus* and *C. saxatilis*, but differs markedly from them in having much shorter pubescence on the gastral tergites (depressed hairs at most 2.5 times longer than the distance between them *vs.* 4–6 times longer in both other species).

Wu and Wang (1995) recorded for China *C. herculeanus*, but in China distributed subsp. *sachalinensis*.

For an unknown reason, this species, recorded in Korea by many previous authors (Karawajew 1912, Arnoldi 1967, Kupyanskaya 1990, Radchenko 1997 a, b), is omitted in the Lists of Korean Ants by B.-J. Kim (1996).

Camponotus (*Myrmamblys*) *itoi* Forel, 1912

Camponotus itoi Forel 1912 b: 340, w, Japan, Collingwood 1981: 29, Wu and Wang 1995: 177, Bolton 1995 b: 106, Kim B.-J. 1996: 182, Radchenko 1997 c: 812, Terayama 1999 a: 30, Kim B.-J. 2003: 2, Imai et al. 2003: 36.

Material examined. 4 w form North Korea and Japan.

General distribution. China, Japan, Korean Peninsula.

Distribution in North Korea (Fig. 25). 12 km NE Pyongyang, De-sang san; Prov. Kangwon, Kumgang-san Mts.

Ecology. This species, very rare in North Korea, is known only from two localities. In the Kumgang-san Mts it was found in shrubs at coniferous forest level.

Camponotus (*Camponotus*) *japonicus* Mayr, 1866

Camponotus japonicus Mayr 1866 b: 885, w, Japan, Collingwood 1976: 307, 1981: 29, Kupyanskaya 1990: 169, Wu and Wang 1995:

181, Bolton 1995 b: 106, B.J. Kim, 1996: 182, Radchenko 1996 c: 1202, 1997 a: 556, Terayama 1999 a: 30, Kim B.-J. 2003: 3, Imai et al. 2003: 39.

For details of synonymy see Bolton (1995), Radchenko (1997 a).

Material examined. More than one hundred w, several tens q and m from South Siberia, Mongolia, Russian Far East, North Korea and Japan.

General distribution. Mongolia, South Siberia, Russian Far East, China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 26). Pyongyang and surrounding area (10 km NE Pyongyang, Taesong-san Mts; Techon-ri, distr. Samsok; 35 km from SW Pyongyang, Taesong Mts, near Michon Lake; Taesong Park; Lake Taesong; Ryongak-san Mts, Daebong; 10 km NE Pyongyang, near Sang-san, 30–40 km N Pyongyang, Sa-Gam; 14 km W from Pyongyang, Lyongak-san; Ryanggang-san Mts; 12 km NE Pyongyang, De-sang san; 50 km N Pyongyang, Chang-lyong san; 45 km E Pyongyang, Bong-wa ri on Te-dong riv.; 60 km NE Pyongyang, Za-mo-san; 4 km NE from Pyongyang, Lake Sokan); Prov. Pyongan-namdo: Sokam-Juvondzi, distr. Sunan; Taesong, distr. Kangso; Djamo-ri, distr. Sunchon; Nampo; 10 km SW from Kaechon, Jonpong-ho; 10 km NE from Nampo, Mts Guk-san-bong; Prov. Chagang, Pyongan-namdo and Pyongan-pukto, Myohyang-san Mts; Prov. Hwanghae-pukto: 20 km SSE Sariwon, Sohung-ho; Sympyong, Pyongwa-ri; 70 km from Pyongyang, 15 km S from Sunan, on the road to Koksan; Prov. Kaesong City: Sunchon; Kaesong; Kongmin Vang Nung, near Kaesong; Suyong-san; 27 km NE from Kaesong, Pakyon popo; Kongmin near Kaesong; Prov. Hwanghae-namdo: 8 km W from Haeju, Suyangsan Mts; Prov. Kangwon, Kumgang-san Mts; Wonsan; Prov. Hamgyong-namdo, Hamhung; Jonpong-ri, distr. Hongwon; Hyangsan; Hangman; Hyngpong-ri, distr. Haeju, ca 15 km W Hamhung; Prov. Hamgyong-pukto: Chongjin, Daeso-ri; 20 km NE Condign; Onpho-ri near Chongjin, distr. Kyongsong; Chongjin Komalsan Park; valley riv. Poro-chon, 20 km NW Kyongsong; Sangonpo-ri, distr. Kyongsong; Juur near Chongjin; distr. Puryong, Musu-ri; Musan-ryong pass, 60 km N Condign; Changyon Lake, distr. Orang; Prov. Ryanggang, Samjiyon, shore of Lake Samjiyon; 5 km SW from Hyesan; 15 km N from Hyesan, road to Pochon; 3 km SE from Hyesan.

Ecology. *C. japonicus* is one of the commonest North Korean ant species. It was found practically in all regions studied. It inhabits relatively dry sites at altitudes up to 1350 m a.s.l. (usually between 200 and 700 m). It lives both in open areas and in various kinds of forests (oak, sweet chestnut, pseudoacacia, maple, elm, pine, ash, very rarely larch and beech, but does not reach upper mountain birch, fir and spruce woods) and in shrubs. It is also quite common in anthropogenic landscapes, including pastures, fields, city parks and streets, margins of roads, etc. Nests are built mainly in soils, often under stones, but the ants also construct soil mounds and are rarely found in rotten wood.

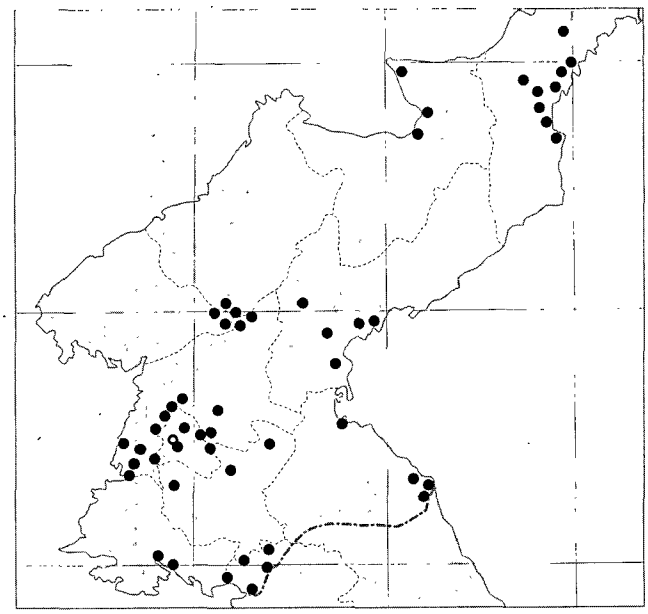

Figure 26. Distribution of *Camponotus japonicus* (●) in North Korea.

Notes. *C. japonicus* resembles *C. saxatilis* and can be confused with the latter, but differs from it in the sculpture of mandibles, which are very finely sculptured, with only small foveae and spots, and no striation (in *C. saxatilis* the mandibles are densely sculptured, with small foveae, spots and striation).

*Camponotus (Myrmamblys) nipponensis** Santschi, 1937

Camponotus nipponensis Santschi 1937: 381, w, q, m, Japan, Bolton 1995 b: 113, Kim B.-J. 1996: 183, Terayama 1999 a: 29, Kim B.-J. 2003, 2, Imai et al. 2003: 35.

Camponotus quadrinotatus: Collingwood 1976: 307, 1981: 29 (misidentification), not Forel 1886: 142.

Material examined. Several tens w from North Korea and Japan.

General distribution. Japan, Korean Peninsula.

Distribution in North Korea (Fig. 27). Pyongyang and surrounding area (Ryongak-san Mts; 60 km NE of Pyongyang, Za-mo san); Prov. Pyongan-namdo: Myohyang-san Mts; Sokam-Juvondzi, distr. Sunan; Prov. Hamgyong-namdo, Hung pong-ri, distr. Haeju, 15 km W Hamhung; Prov. Hwanghae-namdo, 8 km W of Haeju, Sujang-san Mts; Prov. Kaesong City: 30 km from Kaesong, env. of Pakyon popo, De-hung-sol, Pakyon-san; Prov. Kangwon, Kumgang-san Mts.

Ecology. A semixerophilous species, which was found at altitudes up to 950 m a.s.l. (mainly between 200 and 400 m). It inhabits usually relatively dry sparse forests (oak, pine, sweet chestnut) and shrubs. It builds nests in decayed wood, rarely in soil under stones.

Camponotus (*Camponotus*) *obscuripes* Mayr, 1879

Camponotus ligniperdus var. *obscuripes* Mayr 1879: 645, w, Japan.
Camponotus obscuripes: Collingwood 1976: 307, Kupyanskaya 1990: 171, Bolton 1995 b: 114, Kim B.-J. 1996: 183, Radchenko 1996 c: 1202, 1997 a: 557, Terayama 1999 a: 29, Kim B.-J. 2003, 2, Imai et al. 2003: 39.

Material examined. About 20 w from Russian Far East, North Korea and Japan.

General distribution. Russian Far East, Japan, Korean Peninsula.

Distribution in North Korea (Fig. 27). Prov. Ryanggang, Pektusan Mt., valley Chomilpo. It was recorded for North Korea by Kupyanskaya (1990) but without any concrete locality.

Ecology. Only one queen was found in North Korea in a dead tree stump at 1700 m a.s.l. in a spruce-birch forest in the Pektusan Mts. Generally this forest species builds nests in decayed wood and in the stumps of living trees.

Camponotus (*Myrmentoma*) *quadrinotatus* Forel, 1886

Camponotus marginatus var. *quadrinotatus* Forel 1886: 142, w, q, Japan.
Camponotus quadrinotatus: Kupyanskaya 1990: 173, Wu and Wang 1995: 176, Bolton 1995 b: 119, Kim B.-J. 1996: 183, Radchenko 1996 c: 1199, 1997 b: 704, Terayama 1999 a: 30, Kim B.-J. 2003, 2, Imai et al. 2003: 36, not Collingwood 1976: 307, 1981: 29 (misidentification).

Material examined. About 20 w from Russian far East, North Korea and Japan.

General distribution. Russian Far East, Japan, China, Korean Peninsula.

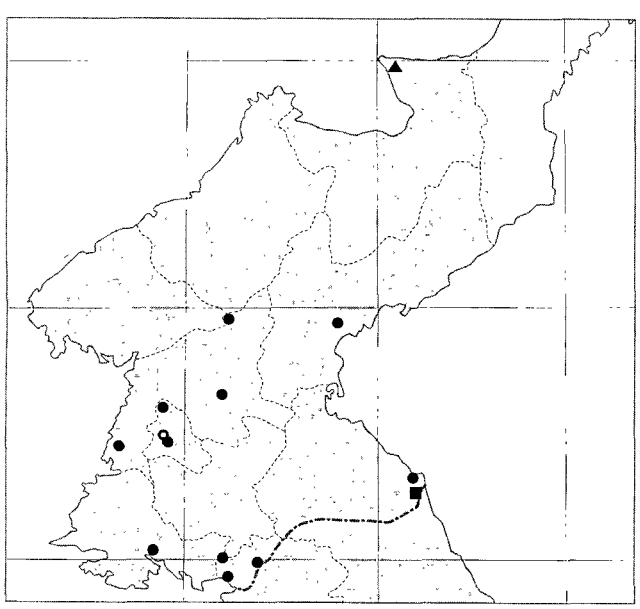

Figure 27. Distribution of *Camponotus nipponensis* (●), *C. obscuripes* (▲) and *C. quadrinotatus* (■) in North Korea.

Distribution in North Korea (Fig. 27). Prov. Kangwon, Kumgang-san Mts.

Ecology. Only one worker was found in North Korea in the Kumgang-san Mts, near the Kuryong Falls, at an altitude of 710 m a.s.l. in a deciduous forest. *C. quadrinotatus* lives in deciduous and mixed forests, but it is quite rare. It builds nests in the stumps of living trees, rarely in decayed wood.

Notes. The specimens from North Korea determined by Collingwood (1976, 1981) as *C. quadrinotatus*, in fact belong to *C. nipponensis* (material is in HNMB, examined).

Camponotus (*Camponotus*) *saxatilis** Ruzsky, 1895

Camponotus herculeanus subsp. *saxatilis* Ruzsky 1895: 7, w, q, m, Russia.
Camponotus saxatilis: Kupyanskaya 1990: 167, Bolton 1995 b: 122, Radchenko 1996 c: 1203, 1997 a: 557.

Material examined. Syntypes, 2 w, "Permskaya guberniya" (ZMMU); non-type material: more than one hundred w, several tens q and m from Russia, Mongolia and North Korea.

General distribution. Russia (from Volga and Kama rivers to the Far East), Mongolia, North Korea; more probably presents also in China; is absent in Kurily Islands and in Japan.

Distribution in North Korea (Fig. 28). Environments of Pyongyang (Djonjong-san Mts; 4 km NE of Pyongyang, Lake Sokan; Taesong-san Mts, SE of Pyongyang); Prov. Chagang, Myohyang-san Mts.; Prov. Hwanghae-namdo, 8 km W Haeju, Sujang-san Mts; Prov. Kangwon, Kumgang-san Mts; Prov. Ryanggang: Samjiyon, shore of Lake Samjiyon; NE of Samjiyon, Mupo, near riv. Tumang-gang (near Chinese border); 5 km N of Taesong Dan; 15 km N of Hyesan, road to Pochon; Rijong-su waterfalls; 2 km N of Chongbong; near Hungnam; Jugo near The, above riv. Sogundansu; Pektusan Mt., 16 km from Sam-zi-yang hotel; between Sam-zi-yang and Mupo.

Ecology. Generally, this species inhabits mostly open areas: steppe, dry meadows, mountain slopes with grass and shrubs, etc., but also lives in sparse, light forests.

In North Korea *C. saxatilis* was found at altitudes between 200 and 1850 m a.s.l. The preferred habitats are grasslands, shrubs and relatively dry mixed forests (oak, maple, sweet chestnut, pine); at higher altitudes it also lives in larch, fir and birch forests, where it prefers clearings, glades and forest edges. Nests are built mainly in soil, often under stones, very rarely in decayed wood in direct contact with soil.

Formica Linnaeus, 1758

Formica Linnaeus 1758: 579. Type species: *Formica rufa* Linnaeus, 1761: 426, by subsequent designation of Curtis 1829: 752.

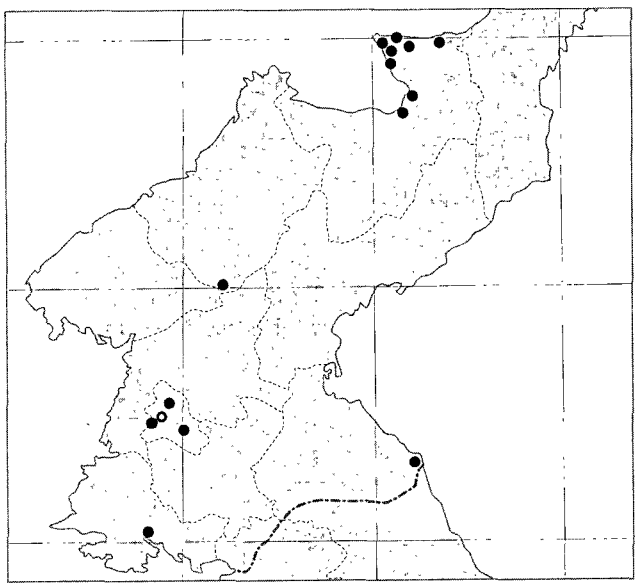

Figure 28. Distribution of *Camponotus saxatilis* (●) in North Korea.

This genus comprises about 160 species, which are distributed mainly in the Holarctic; only a few species are known from the mountains of Mexico and Burma; one species, *F. fusca*, was introduced into some tropical regions (Indonesia, Cuba). More than 50 species occur in the Palaearctic. Quite like the genera *Lasius* and *Myrmica*, it is a "keystone" ant genus in the myrmecofauna of the temperate zone of the Holarctic.

Formica (*Formica*) *aquilonia** Yarrow, 1955

Formica aquilonia Yarrow 1955: 31, w, q, m, Great Britain, Dlussky 1967: 90, Kupyanskaya 1990: 197, Wu and Wang 1995: 143, Bolton 1995 b: 191.

Material examined. Several tens w, about 30 q and m from North Europe, Russia, Mongolia, China and North Korea.

General distribution. A boreal Transpalaearctic species, distributed mainly in the zone of coniferous forests, in Central and Southern Europe lives only in mountains, where is quite rare.

Distribution in North Korea (Fig. 29). Prov. Ryanggang: Samjiyon; Konchang.

Ecology. This species, very rare in North Korea, was found in the north of the country at altitude 800–1000 m in a coniferous forest. This locality is southernmost for the species.

F. aquilonia is a species from the *F. rufa*-group and is typical for the boreal coniferous forest. Like other species from this group it builds big mounds from needles and small pieces of branches. The colonies are generally highly polygynous and can form polycalic systems, with the population of one colony reaching several hundred thousands or even millions of workers.

Formica (*Serviformica*) *candida** F. Smith, 1878

Formica candida F. Smith 1878: 11, q, Tadzhikistan (Pamir Mts.), Bolton 1995 b: 192 (part.), Kim B.-J. 1996: 184, 2003: 2, Imai et al. 2003: 57, Seifert 2004: 34.

Material examined. More than one hundred w, several tens q and m from Russia, Mongolia, China and North Korea.

General distribution. A boreal species, distributed from Altai Mts. to Japan; it is also found in the Central Asian mountains, the Himalayas, and Tibet.

Distribution in North Korea (Fig. 29). Prov. Chagang, Myohyang-san Mts; Prov. Ryanggang: Pektusan Mt., Mupo, riv. Dehondang; between Sam-zi-yang and Mupo; 5 km N of Taesong Dan; 15 km N of Hyesan, road to Pochon; 20km NE of Hyesan, riv. Amnok-gang; 20 km of Samjiyon, road to Hyesan, Pote-Nongja; 2 km N of Chongbong; near Hungnam; Prov. Hamgyong-pukto: Onpho-ri near Chongjin; Kyowon-ri.

Ecology. In North Korea *F. candida* was found only in mountain regions at altitudes above 770 m a.s.l. (up to 1900 m). It inhabits there subalpine meadows, bogs and shrubs, while in sparse fir forests it is only found in open areas. It builds nests in soil, often under stones; in boggy wet places the ants construct moss mounds.

In lowlands of South Siberia and Mongolia it is one of the commonest *Formica* species, inhabiting steppes and forest-steppes.

Notes. The taxonomic situation of this species was complicated and it has been resolved nowadays by Seifert (2004), who separated *F. candida* from Euro-West-Siberian *F. picea* Nylander.

This species of black to brownish-black ants differs from the other black *Formica* species in having a smooth and shiny body, and very sparse decumbent pubescence on the gastral tergites (see also Key).

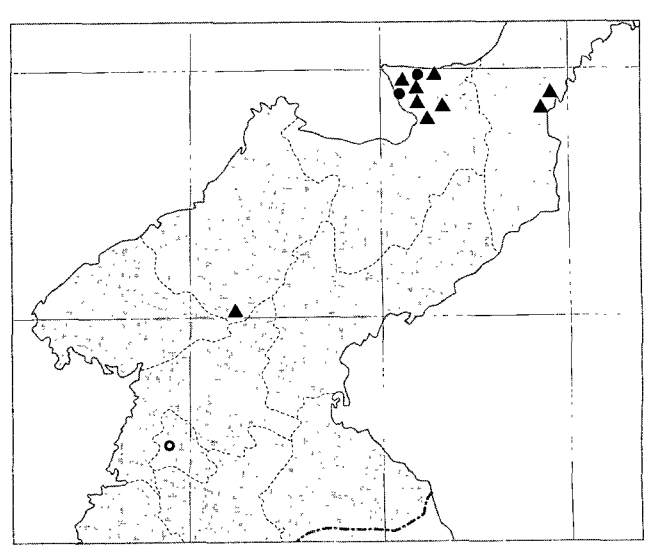

Figure 29. Distribution of *Formica aquilonia* (●) and *F. candida* (▲) in North Korea.

Formica (*Serviformica*) *japonica* Motschoulsky, 1866

Formica japonica Motschoulsky 1866: 183, w, Japan, Dlussky 1967: 78, Collingwood 1976: 305, 1981: 27, Kupyanskaya 1990: 185, Wu and Wang 1995: 143, Bolton 1995 b: 197, Kim B.-J. 1996: 184, 2003: 2, Imai et al. 2003: 57.

Material examined. Several tens w, about 20 q and m from Russian Far East, Mongolia, China and North Korea.

General distribution. Mongolia, south of East Siberia, Russian Far East, China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 30). Pyongyang and surrounding area (Maram; Taesong-san Mts, near Michon Lake; Ryongak-san Mts, Daebong; 4 km NE of Pyongyang, Lake Sokan; 10 km NE of Pyongyang, De Sang-san; 35 km SW of Pyongyang, Taesong; 30 km N of Pyongyang, Sa-gam; 10 km W of Pyongyang, Lyongak-san; 60 km E of Pyongyang, Za-mo san; Djonjong-san Mts; 15 km from Pyongyang to Haeju); Prov. Pyongan-namdo: distr. Sunchon, Djamo-ri; 10 km NE of Nampo, Guk-san-dong Mts; Prov. Chagang, Pyongan-namdo and Pyongan-pukto, Myohyang-san Mts; Prov. Kaesong City: Kaesong; Kongmin near Kaesong; Prov. Hwanghae-namdo: Haeju; 8 km W of Haeju, Sujang-san Mts; Prov. Hwanghae-pukto, 70 lm SE Pyongyang, near Sunan, road to Koksan; Prov. Kangwon, Kumgang-san Mts; Prov. Hamgyong-pukto: Onpho-ri near Chongjin; 60 km N of Chongjin; Chongjin, Daeso-ri; Chongjin, Kyowon-ri; distr. Kyongsong, Sangonpo-ri; distr. Orang, Changyon Lake; Chongjin Komalsan Park; Sympyong, Pyongwa-ri; Prov. Ryanggang: Pektusan Mt.; Pektusan Mt., 2–6 km N of Sam-zi-yan hotel; plateau at the foot of Pektusan Mt.; Mupo, NE of Samjiyon, riv. Tumang-gang (near Chinese border); Omultong near riv. Amnok-gang, on Chinese border; 20 km E of Samjiyon; Samjiyon, shore of Lake Samjiyon; 2 km N of Chongbong; near Hungnam; Jugo near The, above riv. Sogundansu; Hyesan; 5 km SW of Hyesan; 15 km N of Hyesan, road to Pochon, valley E from riv. Amnok-gang; 3 km SE of Hyesan.

Ecology. *F. japonica* seems to be one of the commonest and ecologically very flexible North Korean ant species. It was found all over the country in very diverse habitats, from rather dry grasslands at sea level to mountain tundra and bogs in the mountains (up to 2100 m a.s.l.). It is common in anthropogenic biotopes (pastures, edges of the roads, city parks, streets, etc.). In natural and seminatural areas it inhabits different kinds of grasslands (from dry to rather wet), shrubs, forests (but avoids dense and coldest mountain woods, like fir or spruce), peat bogs, subalpine meadows. It builds nests in soil (often with soil mounds or under stones), but also in decayed wood.

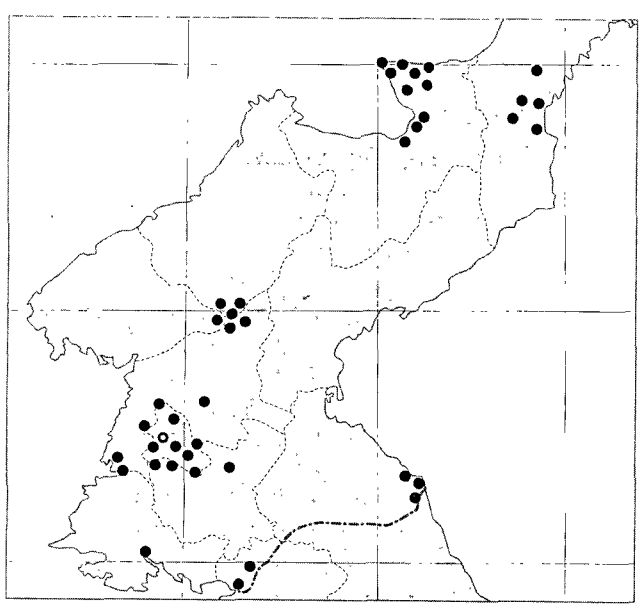

Figure 30. Distribution of *Formica japonica* (●) in North Korea.

Formica (*Formica*) *kupyanskayae** Bolton, 1995

Formica kupyanskayae Bolton 1995 b: 197, replacement name for *Formica opacus* Kupyanskaya, 1980: 106, junior primary homonym of *Formica opaca* Nylander, 1856: 55.

Formica opacus Kupyanskaya, 1980: 106, q, Russia (Primorsky Region), 1990: 199, w, q, m (*Formica opaca*, emendation of spelling).

Material examined. Holotype, q, Russia, Primorsky Region, Anisimovka, 12.vii.1975, leg. A. Kupyanskaya (ZMMU); several tens w, 5 q and 1 m from Russian Far East and North Korea.

General distribution. Russian Far East, North Korea.

Distribution in North Korea (Fig. 31). Prov. Ryanggang: Samjiyon; 20 km E of Samjiyon; Hyesan; 15 km N of Hyesan, road to Pochon; Pektusan Mt.; plateau at the foot of Pektusan Mt.; Rijong-su waterfalls.

Ecology. This quite rare species was found only in the northern part of the country, in mountain regions at altitudes between 800 and 2000 m a.s.l. Although *F. kupyanskayae* lives in the forest zone of the mountains,

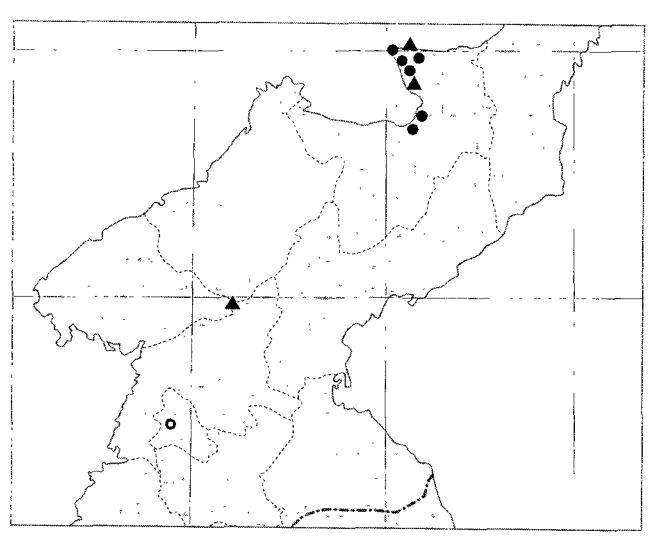

Figure 31. Distribution of *Formica kupyanskayae* (●) and *F. lemani* (▲) in North Korea.

it prefers more open sites, such as edges of larch and birch forests, glades, shrubs (mainly juniper), or sparse, light and sunny forests. This species belongs to the *F. rufa*-group and builds nests (anthills) typical of the red wood ants. The nests are usually not too big (80–100 cm in diameter and 60–80 cm high) and their population is smaller than in the related *F. aquilonia*. Its biology is similar to the other species from the *F. rufa*-group.

Notes. *F. kupyanskayae* is most similar to *F. aquilonia*. Its workers differ from those of the latter species in having a more hairy alitrunk and head (see also Key), queens being the most characteristic of this species. They differ considerably from any other species of the *F. rufa*-group in having very dense pubescence on the gastral tergites, which appear matt.

Formica (*Serviformica*) *lemani* Bondroit, 1917

Formica lemani Bondroit 1917: 186, w, q, France, Dlussky 1967: 60, Collingwood 1976: 305, 1981: 27, Kupyanskaya 1990: 184, Wu and Wang 1995: 143, Bolton 1995 b: 197, Kim B.-J. 1996: 184, 2003: 2, Imai et al. 2003: 57.

Material examined. Several tens w, about 20 q and m from Europe, Russia and North Korea.

General distribution. A boreo-montane species. The northern limit of the forest-tundra zone is the northern limit of its range. In Europe, southern England, Fennoscandia and the northern part of Russia form the southern limit of its range; to the east this line reaches the south of Siberia and North Korea. Locally, the species also occurs in the subalpine zones of the more southern mountains.

Distribution in North Korea (Fig. 31). Prov. Pyongan-namdo, Myohyang-san Mts; Prov. Ryanggang: Chan-Pay plateau, 24 km NW of Sam-zi-yan, along road to Pektusan; 10 km NNE of Bochonbo, riv. Karim.

Ecology. This species was found only in mountain regions, at altitudes between 1000 and 2000 m a.s.l. It lives in mixed (larch, birch) forests, where it inhabits mainly glades and clearings, their edges, in shrubby areas and subalpine meadows. It builds nests almost exclusively in soil, often under stones, very rarely in rotten wood.

Notes. Among North Korean species, *F. lemani* may be confused with *F. japonica*. The latter species differs from *F. lemani* in having denser microsculpture of the body, which appears matt, denser decumbent pilosity on the gastral tergites, and a lack of standing hairs on the middle and hind femora (see also Key).

Formica (*Formica*) *lugubris* Zetterstedt, 1838

Formica lugubris Zetterstedt 1838: 449, m, Norway, Dlussky 1967: 91, Collingwood 1976: 304, Kupyanskaya 1990: 198, Bolton 1995 b: 198, Kim B.-J. 1996: 185, 2003: 2.

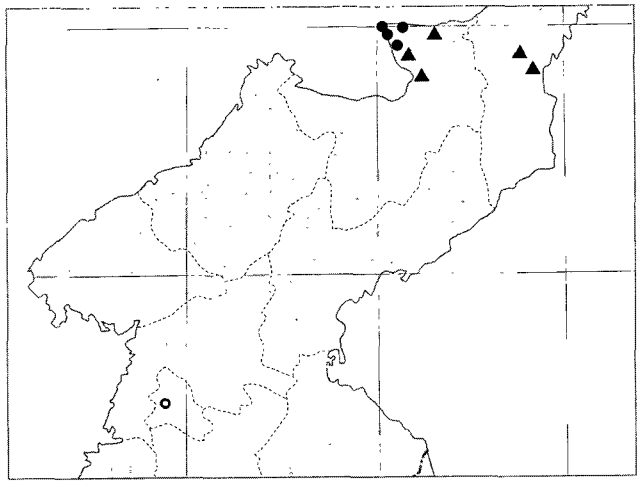

Figure 32. Distribution of *Formica lugubris* (●) and *F. truncorum* (▲) in North Korea.

Material examined. Several tens w, about 20 q and m from Europe, Russia and North Korea.

General distribution. A boreo-montane species, distributed mainly in the zone of coniferous forests of Europe and Asia, locally also occurs in the coniferous forest zone of the more southern mountains. Is absent in Japan.

Distribution in North Korea (Fig. 32). Prov. Ryanggang: 2 km N of Chongbong; Omumultong, near riv. Amnok-gang, on Chinese border; Pektusan Mt.; Rijong-su waterfalls; plateau Chan-Pay, Sam-zi-yan.

Ecology. The species was found in the north of the country in the mountain area at altitudes between 1100 and 2100 m a.s.l. It lives in mixed (larch and birch) forests and at their edges just below the mountain tundra zone.

F. lugubris belongs to the *F. rufa* species-group and has a similar biology to the other species of this group. The colonies are mainly monogynous, but polygynous ones are also recorded, and these can form vast polydomous systems. New colonies are founded through temporal parasitism of queens (mainly in nests of *F. lemani*) or through colony fission.

Notes. *F. lugubris* differs considerably from the other species of the *rufa*-group in having a hairy occipital margin of the head and alitrunk dorsum, and a not completely red head (see also Key).

Formica (*Raptiformica*) *sanguinea* Latreille, 1798

Formica sanguinea Latreille 1798: 37, w, France, Dlussky 1967: 97, Collingwood 1976: 305, 1981: 27, Kupyanskaya 1990: 191, Wu and Wang 1995: 140, Bolton 1995 b: 203, Kim B.-J. 1996: 185, 2003: 2, Imai et al. 2003: 59.

Material examined. More than one hundred w, several tens q and m from Europe, Russia, Mongolia and North Korea.

General distribution. A Transpalaearctic species, distribute mainly in the temperate zone of the Region.

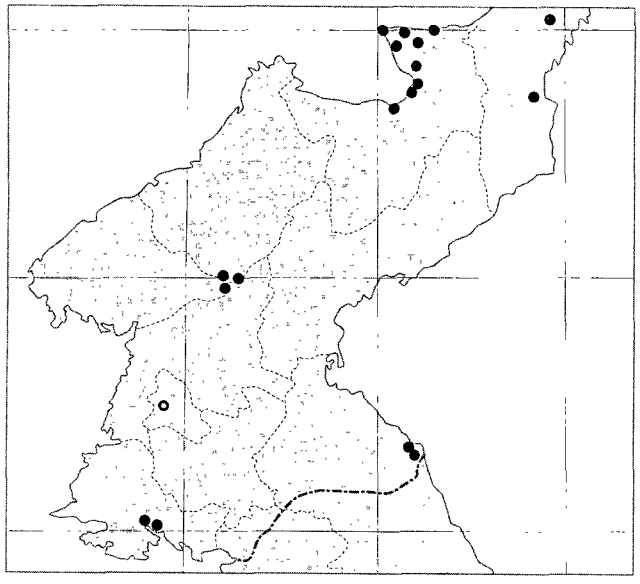

Figure 33. Distribution of *Formica sanguinea* (●) in North Korea.

Distribution in North Korea (Fig. 33). Pyongyang; Prov. Chagang and Pyongan-namdo, Myohyang-san Mts; Prov. Hwanghae-namdo: Haeju; near Haeju, Sujang-san Mts; Prov. Kangwon: Kumgang-san Mts; Prov. Ryanggang: Pektusan Mt.; near Samjiyon hotel; 20 km E of Samjiyon; Mupo, NE of Samjiyon, near riv. Tumang-gang (near Chinese border); Omumultong near riv. Amnok-gang on China border; 20 km NE of Hyesan, valley of riv. Amnok-gang; 5 km SW of Hyesan; 5 km NE of Hyesan; 15 km N of Hyesan, road to Pochon; 2 km N of Chongbong; near Hungnam; Jugo near The, above riv. Sogundansu; plateau at the foot of Pektusan-san Mt.; Chan-Pay plateau, Sam-zi-yan; Prov. Hamgyong-pukto: distr. Puryong, Musu-ri; distr. Orang, Changyon Lake; Chongjin Komalsan Park.

Ecology. *F. sanguinea* is quite tolerant to a range of ecological conditions. In North Korea it was found in very diverse habitats, from relatively dry grasslands at lower altitude (200-300 m a.s.l.) to subalpine meadows and coniferous and mixed (larch, birch) forests in the mountains at altitudes up to 2000 m a.s.l., but in forests it inhabits mainly open places (glades, clearings). It builds nests in soil, under stones, in rotten wood or constructs soil mounds.

F. sanguinea is a facultative slave-maker. Its victims in North Korea are *F. japonica* and *F. candida*. The proportion of slaves in a mixed colony seldom exceeds a few percent. These are very aggressive and predaceous ants.

Formica (*Formica*) *truncorum* Fabricius, 1804

Formica truncorum Fabricius 1804: 403, q, Czechia, Dlussky 1967: 81, Kupyanskaya 1990: 192, Bolton 1995 b: 205, Kim B.-J. 1996: 185, 2003: 2, Imai et al. 2003: 58.

Material examined. Several tens w, more than 20 q and m from Europe, Russia, Mongolia and North Korea.

General distribution. A Transpalaearctic species, distributed mainly in the forest zone of Eurasia from Belgium to Japan, and in the mountains of Southern Europe, Central Asia, Asia Minor, and in the Caucasus.

Distribution in North Korea (Fig. 32). Prov. Hamgyong-pukto: Mehyang-ri, Kvanmo-bong Mts; Lake Chongjin-ho; Prov. Ryanggang: Samjiyon; Mupo, NE of Samjiyon, near riv. Tumang-gang (near Chinese border); Rijong-su waterfalls; 15 km N of Hyesan, road to Pochon.

Ecology. This species was found in the northern part of the country, in mountain regions at altitudes between 840 and 1360 m a.s.l. It inhabits forest edges and clearings (larch, fir, birch) and shrubby areas. Its biology is similar to that of other red wood ants. It usually nests in rotting tree stumps covered with loose dry plant material. Colonies usually number from over a tens to several score thousand adults and mostly are polygynous.

Notes. *F. truncorum* the most resembles *F. yessensis*, but generally it is more hairy. It differs from the latter species in having standing hairs on the external margin of tibiae.

Formica (*Serviformica*) *uralensis** Ruzsky, 1895

Formica uralensis Ruzsky 1895: 13, w, q, m, Russia, Dlussky 1967: 79, Kupyanskaya 1990: 189, Wu and Wang 1995: 143, Bolton 1995 b: 205.

Material examined. Several tens w, about 10 q and m from Europe, Russia, Mongolia and North Korea.

General distribution. A boreo-montane species. To the east of the Ural Mts it inhabits biotopes of varying types, mainly grasslands, but in Europe, where it is very scarce and relict, it lives mainly in swamps and, more rarely, in mountain meadows.

Distribution in North Korea (Fig. 34). Prov. Ryanggang, Pektusan Mt., env. of Mupo.

Ecology. In North Korea only one worker was collected in a subalpine meadow in the Pektusan Mts. at an altitude of more than 1000 m a.s.l.

Formica (*Formica*) *yessensis* Wheeler, 1913

Formica trunicola var. *yessensis* Wheeler 1913: 391, w, Japan (first available use of name *Formica rufa* r. *trunicola* var. *yessensis* Forel, 1901 b: 66).

Formica yessensis: Collingwood 1976: 304, 1981: 27, Kupyanskaya 1990: 194, Wu and Wang 1995: 143, Bolton 1995 b: 206, Kim B.-J. 1996: 185, 2003: 2, Imai et al. 2003: 58.

Material examined. Several tens w, about 10 q and m from Russian Far East, North Korea and Japan.

General distribution. Southern part of Russian Far East, China, Korean Peninsula, Japan.

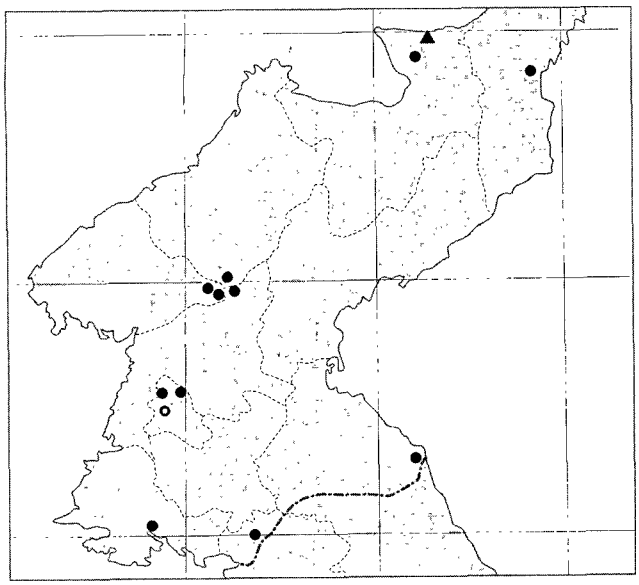

Figure 34. Distribution of *Formica uralensis* (▲) and *F. yessensis* (●) in North Korea.

Distribution in North Korea (Fig. 34). Vicinity of Pyongyang (Taesong-san Mts; 10 km NE of Nampo, Guk-san-bong Mts); Prov. Pyongan-namdo, Pyongan-pukto and Chagang, Myohyang-san Mts; Prov. Hwanghae-namdo, 8 km W of Haeju, Sujang-san Mts; Prov. Kaesong City, 27 km NE of Kaesong, Pakyon Mts, Pakyon popo; Prov. Kangwon, Kumgang-san Mts, Onjong-ri; Prov. Ryanggang, 20 km E of Samjiyon; Prov. Hamgyong-pukto: Onpho-ri near Chongjin.

Ecology. This quite rare species is sporadically found in many regions of North Korea at altitudes from 100 to 1260 m a.s.l. It inhabits rich grasslands, including mountain meadows, light deciduous and mixed forests (oak, sweet chestnut, pine) and shrubs. Morphologically and biologically it is similar to the closely related *F. truncorum* (see above).

Lasius Fabricius, 1804

Lasius Fabricius 1804: 415. Type species: *Formica nigra* Linnaeus, 1758: 580, by subsequent designation of Bingham 1903: 338.

This genus comprises about 80 Holarctic species, more than 50 of which are known from the Palaearctic. Many *Lasius* species are very common in the temperate zone of the Holarctic, and together with representatives of the genera *Myrmica* and *Formica* they form an essential part of the Palaearctic myrmecofauna. Recent revisions of the Palaearctic species of the subgenera *Lasius* s. str. and *Chthonolasius* Ruzsky were provided by Seifert (1988, 1990, 1992), and a revision of the subgenus *Dendrolasius* is being prepared by Radchenko (2005).

The name *Lasius* Fabricius, 1804 (Formicidae) was formally a junior homonym of *Lasius* Jurine, 1801 (Apidae). Morice and Durrant (1915) resurrected the latter name and proposed a replacement name – *Donisthorpera* for *Lasius* Fabricius. A year later, Emery (1916) and Forel (1916) proposed other replacement names for *Lasius* Fabricius - *Formicina* Shuckard and *Acanthomyops* Mayr, respectively. However, the former is a junior synonym of *Formica* and, moreover, *Acanthomyops* and *Lasius* Fabricius are in fact two different ant genera of the tribe *Lasiini*. Later, the name *Lasius* Jurine was suppressed by the act of the Commission of Zoological Nomenclature, and Wheeler (1916) revived the name *Lasius* Fabricius from synonymy.

Lasius (*Chthonolasius*) *citrinus** Emery, 1922

Lasius bicornis var. *citrina* Emery 1922: 12, w, Italy.
Lasius citrinus: Seifert 1990: 8, Bolton 1995 b: 222, Czechowski et al. 2002: 115.
Formica affinis Schenck, 1852: 62, w, q, m, Germany.
Lasius affinis: Kupyanskaya 1990: 225, Seifert 1988: 163, synonymy by Wilson 1955: 151 (considered it as senior synonym of *L. citrinus*), Seifert 1990: 8 (for details see Notes below).

Material examined. Several tens w, about 10 q and m from Europe, Russia and North Korea.

General distribution. A Transpalaearctic species distributed from West Europe until Russian Far East and North Korea.

Distribution in North Korea (Fig. 35). 4 km NE of Pyongyang, Lake Sokan; Prov. Chagang, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts, Manmul-san.

Ecology. This species, rare in North Korea, was found at the low and middle altitudes between 200 and 700 m a.s.l. It is a quite thermophilous species, mainly inhabiting deciduous and mixed forests (oak, ash, pine), but was found also on a pasture. It builds nests in soil, often under stones.

Notes. Wilson (1955) synonymised *L. affinis* (Schenck, 1852) with *L. citrinus* Emery, 1922, and regarded the latter name as a junior synonym. Since then all subsequent authors have used the name *affinis* for this species. However, the name *Formica affinis* Schenck, 1852 is preoccupied (the primary junior homonym of *Formica affinis* Leach, 1825), and the first available replacement name is *L. citrinus* Emery.

Lasius (*Chthonolasius*) *distinguendus** (Emery, 1916)

Formicina umbrata subsp. *distinguenda* Emery 1916: 64, w, q, Italy.
Lasius distinguendus: Seifert 1988: 149, Bolton 1995 b: 222, Czechowski et al. 2002: 111.
Lasius rabaudi: Collingwood 1976: 306, Kim B.-J. , 1996: 187 (misidentification), not Bondroit 1917: 177.

Material examined. Several tens w, about 10 q and m from Europe, Russia and North Korea.

General distribution. A Transpalaearctic species distributed from West Europe until Russian Far East and North Korea.

Distribution in North Korea (Fig. 35). Prov. Pyongan-namdo, 60 km NE of Pyongyang, Za-mo san.

Ecology. Only one specimen of this species was found in North Korea, in a sweet chestnut forest. Collingwood (1976) erroneously determined this specimen as *L. rabaudi*, an error has repeated by B.-J. Kim (1996).

Lasius (*Cautolasius*) *flavus* (Fabricius, 1782)

Formica flava Fabricius 1782: 491, w, Europe.

Lasius flavus: Collingwood 1981: 28, Kupyanskaya 1990: 222, Wu and Wang 1995: 156, Bolton 1995 b: 223, Kim B.-J. 1996: 186, 2003: 2, Imai et al. 2003: 61.

Material examined. More than one hundred w, several tens q and m from Europe, Russia and North Korea.

General distribution. A Transpalaearctic species distributed from Atlantic Ocean to the Pacific Ocean.

Distribution in North Korea (Fig. 35). Pyongyang and surrounding area (Djonjong-san Mts; 4 km NE of Pyongyang, Lake Sokan); Prov. Pyongan-namdo, Pyongan-pukto and Chagang, Myohyang-san Mts; Prov. Hwanghae-namdo: near Haeju, Sujang-san Mts; Prov. Hwanghae-pukto: Sariwon; 70 km SE of Pyongyang, road to Koksan, near Sunan; Prov. Kaesong City: Pakyon waterfalls; Kaesong, hotel Janamsan; Prov. Kangwon: Kumgang-san Mts; Wonsan; Prov. Ryanggang: Hyesan; 3 km SE from Hyesan; 5 km SW of Hyesan; 15 km N of Hyesan, road to Pochon; near Samjiyon hotel; 20 km of Samjiyon, road to Hyesan, Pote-Nongja; Rijong-su waterfalls; 2 km N of Chongbong; Prov. Hamgyong-pukto: Onpho-ri near Chongjin; 60 km N of Chongjin, Musan-ryong pass; distr. Orang, Changyon Lake.

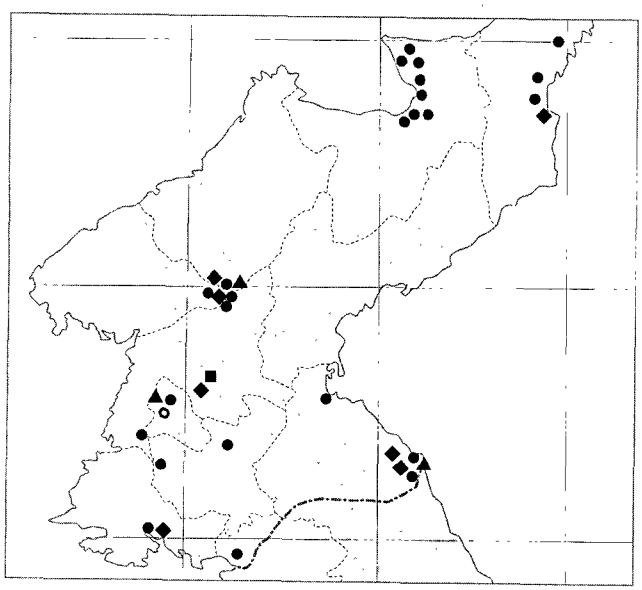

Figure 35. Distribution of *Lasius citrinus* (▲), *L. distinguendus* (■), *L. flavus* (●) and *L. fuji* (◆) in North Korea.

Ecology. *L. flavus* is quite common and ubiquitous (eurytopic) species that, however, prefers open and sunny habitats, but usually with wet subsoil. In North Korea it was found in very diverse habitats: deciduous, mixed and coniferous forests (oak, maple, birch, pine, spruce, fir, larch), where it prefers glades, cleanings, edges of forests, shrubs and different kinds of meadows; it also inhabits devastated areas. Its altitudinal preference is also very diverse, from 150 to about 1400 m a.s.l.

It builds nests in soil, under stones, but very often constructs big, dense soil mounds, which are overgrown with moss, thyme, grasses. The colonies are monogynous and started independently by young queens; primary pleometrosis is frequent. *L. flavus* are entirely subterranean ants feeding mainly on the honeydew of specially raised root aphids.

Lasius (*Dendrolasius*) *fuji* Radchenko, 2005

Lasius fuji Radchenko 2005: 91, w, q, m, North Korea, Russian Far East, Japan.

Lasius fuliginosus: eastern populations only, distributed from Amursky Region of Russia till Japan; revisions and reviews: Wilson 1955: 138, Yamauchi and Hayashida 1968: 398, Yamauchi 1978: 171, Collingwood 1981: 28 (part.), Kupyanskaya 1989: 783, 1990: 227, Wu and Wang 1995: 156, Bolton 1995 b: 223, Kim B.-J. 1996: 186, 2003: 2, not Latreille 1798: 36, not Collingwood 1976: 306 (misidentification).

Lasius nipponensis: as junior synonym of *L. fuliginosus*: Wilson 1955: 138, Yamauchi 1978: 171, Kupyanskaya 1989: 783, 1990: 227, Wu et Wang 1995: 156, Bolton 1995: 224, revived from synonymy and raised to species as first available replacement name for "oriental *fuliginosus*": Espadaler et al. 2001: 340, Imai et al. 2003: 60, not Forel 1912: 339.

Material examined. Holotype, w, North Korea, Prov. Chagang, Myohyang-san Mts., way to Pirobong, No. 275-85, 25.VI.1985, leg. M. Woyciechowski (IZK); paratypes: 15 w, 6 q from the nest of the holotype; more than 50 w: North Korea, Prov. Hwanghae-pukto, 8 km W Haeju, Sujang-san Mts, 55 m a.s.l., pine-oak forest, No. 44-85, 15.VI.1985; bid., 600 m a.s.l., young oak forest, No. 81-85, 17.VI.1985; Prov. Chagang, Myohyang-san Mts, below Chonju Rock, No. 169-85, 22.VI.1985, 230 m a.s.l., deciduous forest; Prov. Chagang, Myohyang-san Mts, near monastery Pliodae, No. 217-85, 24.VI.1985, 540 m, a.s.l., pine-chestnut forest; Prov. Samjiyon, shore of Lake Samjiyon, No. 596-85, 10.VII.1985, 1360m, larch forest; Prov. Kangwon, Kumgang-san Mts, above Kuryong waterfall, No. 708-85, 18.VII.1985, 710 m, deciduous forest (all leg. M. Woyciechowski); 27 w, North Korea, Onpho near Chongjin, No. 2355, 12.VIII.1959, leg. B. Pisarski and J. Prószyński; 5 w, Prov. Hamgyong-pukto, distr. Orang, Changyon Lake, 17.VI.1990, leg. R. Pisarska; 5 w, Russia, vicinity of Vladivostok, 5.V.1989, oak forest, leg. A. Radchenko; ibid., 2 w, 1 q, 1 m, 2.VI.1983, leg. A.

Kupyanskaya; 4 w, Russia, Isl. Sakhalin, Chehova Mt., val. of the riv. Bureya, 29.VII.1986, leg. M. Nesterov; 4 w, Russia, Primorsky Region, Ussurijsky Natural Reserve, 10.VIII.1986, leg. A. Kotenko; 3 w, Japan, Pref. Kanagawa, Doryosan, 10.VII.1982, leg. M. Kubota; 5 w, "Japonia, Sauter" (IZK, MIZ, JUK, BPI).

General distribution. Russian Far East, north-eastern China, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 35). Prov. Pyongan-namdo, 60 km NE of Pyongyang, distr. Bek-sung-li, Za-mo san; Prov. Hwanghae-namdo, 8 km W of Haeju, Sujang-san Mts; Prov. Chagang, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts; Prov. Ryanggang, Samjiyon Lake; Prov. Hamgyong-pukto, distr. Orang, Changyon Lake.

Ecology. In North Korea it inhabits deciduous and mixed forests (sweet chestnut, oak, maple, ash, pine, rarely – larch) at altitudes between 200 and 1360 m a.s.l. Like the other species from the subgenus *Dendrolasius* Ruzsky, it is a dendrophilous species. It nests in cavities under tree trunks and roots or in holes at the base of usually living trees. The empty spaces are filled with carton nests of chewed wood impregnated with honeydew. The colonies are very populous, often polygynous and polycalic. Foraging workers form long and narrow trails leading to aphids on bushes and trees; large parts of these trails often run in underground tunnels. These ants feed not only on honeydew but also on tiny soft insects (a high proportion of their food frequently consists of other ants' brood). A temporary social parasite; young queens start new colonies in nests of species of the subgenus *Chthonolasius*.

Notes. Espadaler et al. (2001) have provided both morphological and molecular evidence that the "oriental *fuliginosus*" is a species, separate from the "typical" *L. fuliginosus* (Latreille), distributed in the western part of the Palaearctic Region (e. g. to the east as far as the Altai Mts.), and have proposed for it the replacement name *L. nipponensis* Forel (as the oldest former junior synonym of this species). Nevertheless, neither *L. nipponensis*, nor *L. orientalis* or any other published names of the species or infraspecific forms of *Dendrolasius* can be used as replacement names for the "oriental *fuliginosus*" since all of them are assigned to other species. In view of this, I have described a new species (Radchenko 2005).

The specimens from the Kaesong City Province (No. 104) and the Kumgang-san Mts (No. 324) determined by Collingwood (1976, 1981) as *L. fuliginosus* are in fact *L. morisitai* (material is in HNHM, examined).

Lasius (*Lasius*) *hayashi* Yamauchi et Hayashida, 1970

Lasius hayashi Yamauchi et Hayashida 1970: 510, w, q, m, Japan, Collingwood 1976: 305 (part.), 1981: 28, Kupyanskaya 1990: 220, Seifert 1992: 45, Bolton 1995 b: 223, Kim B.-J. 1996: 186, 2003: 2, Imai et al. 2003: 63.

Material examined. Several hundred w, several tens q and m from Russian Far East and North Korea.

General distribution. Russian Far East (southern Kurily Islands), Korean Peninsula, Japan.

Distribution in North Korea (Fig. 36). Pyongyang and surrounding area (Ryongak-san Mts, Daebong; Taesong-san Mts, near Michon Lake; Lake Taesong; 10 km W of Pyongyang, Lyongak-san; 12 km NE of Pyongyang, De-sang san; 45 km N of Pyongyang, Sa-gam; 60 km E of Pyongyang, Za-mo san; Nampo; Djonjong-san Mts; near Pyongyang, Djonjong-san Mts; 15 km from Pyongyang, road to Haeju; 4 km NE of Pyongyang, Lake Sokan); Prov. Pyongan-namdo, 10 km NE of Nampo, Guk-san-gong Mts; Prov. Pyongan-namdo, Pyongan-pukto and Chagang, Myohyang-san Mts; Prov. Hwanghae-namdo, 8 km W of Haeju, Sujang-san Mts; 4 km SE of Haeju, island in golf; Prov. Kaesong City: Kaesong; between Kaesong and Pakyon popo; Kongmin near Kaesong; Prov. Kangwon: Kumgang-san Mts; Wonsan; Prov. Ryanggang: Mupo, NE of Samjiyon, near riv. Tumang-gang (near Chinese border); Hyesan; 15 km N of Hyesan, road to Pochon; Chan Pay plateau, Sam-zi-yang; 20 km E of Samjiyon; near Samjiyon hotel; shore of Lake Samjiyon; 5 km N of Taesong Dan; Rijong-su waterfalls; 2 km N of Chongbong; near Hungnam; Jugo near The, above riv. Sogundansu; Pektusan-san Mt.; Omumultong near riv. Amnok-gang (near Chinese border); Prov. Hamgyong-pukto: Chongjin Komalsan Park; Daeso-ri; Kyowon-ri; distr. Kyongsong, Sangonpo-ri; distr. Orang, near Changyon Lake; Chongjin.

Ecology. An eurytopic species very common in North Korea. It was found all over the country at altitudes ranging from sea level to 1600 m. It inhabits very diverse sites: city parks, gardens, streets, fields, pastures, different kinds of grasslands (from dry stony low-grass

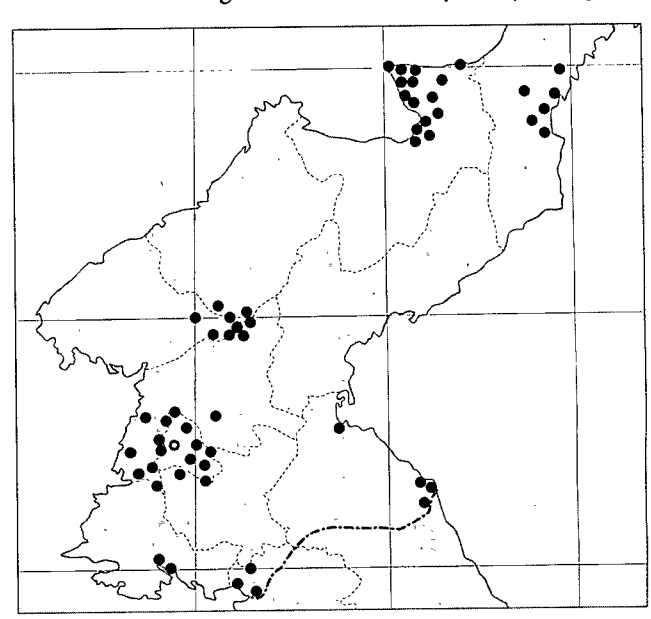

Figure 36. Distribution of *Lasius hayashi* (●) in North Korea.

habitats to mountain meadows and peat bogs), shrubs and forests (oak, sweet chestnut, maple, ash, elm, lime, beech, birch, pine, larch), although it avoids the most shady and cold fir and spruce woods. It builds nests mostly in soil, often under stones, and rarely constructs soil mounds, but also can live in rotten wood.

Notes. *Lasius* is a taxonomically difficult genus and determination of the species in many cases, especially after Seifert's (1990, 1992) revisions and description of many species, often poses problems. That is why the individuals determined by Collingwood (1976) as *L. hayashi* actually belong to 3 species: *L. hayashi*, *L. koreanus* and *L. japonicus*.

L. hayashi resembles *L. japonicus* the most and differs from the latter mainly in having less abundant standing hairs on the dorsal surface of the scape, which do not stand out much from the relatively long pubescence, and also in having a more or less bicoloured body with the alitrunk lighter than the gaster (see also Seifert 1992).

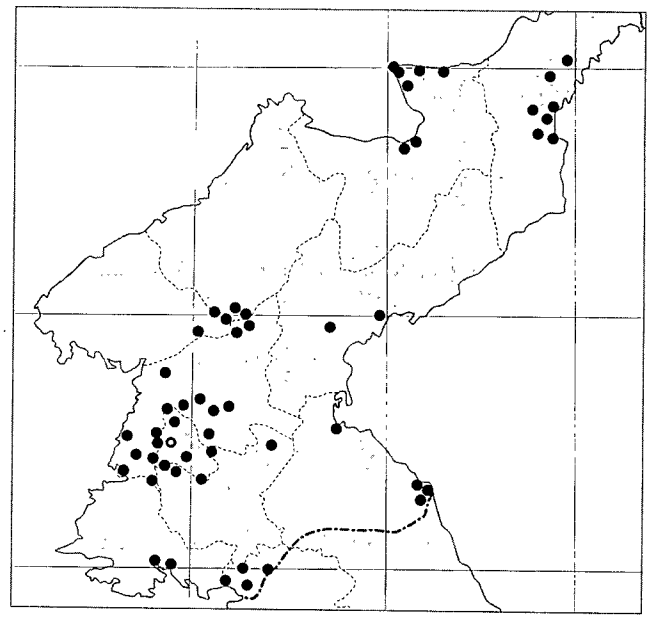

Figure 37. Distribution of *Lasius japonicus* (●) in North Korea.

Lasius (*Lasius*) *japonicus** Santschi, 1941

Lasius emarginatus var. *japonicus* Santschi 1941: 277, w, q, Japan, junior synonym of *Lasius niger* (L.): Wilson 1955: 60.

Lasius japonicus: Seifert 1992: 30 (revived from synonymy and raised to species rank), Bolton 1995 b: 223, Kim B.-J. 1996: 186, 2003: 2, Imai et al. 2003: 62.

Lasius niger: Collingwood 1976: 305, 1981: 27 (misidentification), not Linnaeus 1758: 580.

L. hayashi: Collingwood 1976: 305 (part.) (misidentification), not Yamauchi and Hayashida 1970: 510.

Material examined. Several hundred w, several tens q and m from North Korea and Japan.

General distribution. Korean Peninsula, Japan. Most probably, it distributes also in Russian Far East and China.

Distribution in North Korea (Fig. 37). Pyongyang and surrounding area (distr. Samsok, Techon-ri; 70 km NE of Pyongyang, distr. Kyongsong, Maram; Taesong Mts, near Michon Lake; Ryongak-san Mts, Daebong; 10 km NE of Pyongyang, near De-sang san; 10 km NE of Pyongyang, Taesong-san Mts; 35 km SW of Pyongyang Taesong Mts; 30–40 km N of Pyongyang, Sa-gam; 30 km N of Pyongyang, Kumgang Reserve; 10 km W of Pyongyang, Lyongak-san; 45 km E of Pyongyang, Bong-ha; 50 km N of Pyongyang, Chang-lyon san; 60 km NE of Pyongyang, Za-mo san; 4 km NE of Pyongyang, Lake Sokan); Prov. Pyongan-namdo: distr. Sunan, Sokam-Chosuji; distr. Sunchon, Djamo-ri; Prov. Pyongan-namdo, Pyongan-pukto and Chagang, Myohyang-san Mts; Prov. Kangwon: Kumgang-san Mts; Wonsan; Prov. Hwanghae-pukto, Sympyong, Pyongwa-ri; Prov. Hwanghae-namdo: 8 km W of Haeju, Sujang-san Mts; Prov. Kaesong City: Kaesong; Kongmin Vang Nung, near Kaesong; 22 km SE of Kaesong, Pakyon near Sunchon-ri; Prov. Hamgyong-namdo, Hungnam; Hyangsan; Prov. Ryanggang: Pektusan Mt., 2–6 km N of Samjiyon hotel; shore of Lake Samjiyon; Pektusan Mt., Mupo, Dehondang; Hyesan; 5 km SW of Hyesan; Chan Pay plateau, Sam zi-yang; 5 km N of Taesong Dan; 2 km N of Chongbong; Prov. Hamgyong-pukto: distr. Kyongsong, Onpho-ri, near Chongjin; distr. Kyongsong, Sangonpo-ri; Juur near Chongjin; 20 km NE of Chongjin; Lake Chongjin-ho; Chongjin Komalsan Park; distr. Orang, Lake Changyon; distr. Puryong, Musu-ri; distr. Hongwon, Jonpong-ri; Daeso-ri; Kyowon-ri; Daeso-ri; Kyowon-ri.

Ecology. Similar to that of *L. hayashi* (see above), but *L. japonicus* generally prefers less hot and dry habitats; in the mountains it was found at altitudes up to 2000 m a.s.l. One of the commonest ant species in North Korea.

Lasius (*Chthonolasius*) *jensi** Seifert, 1982

Lasius jensi Seifert 1982: 85, w, q, m, Germany, 1988: 155, Bolton 1995 b: 223, Czechowski et al. 2002: 114.

Material examined. Several tens w, 5 q and 3 m from Europe and North Korea.

General distribution. Central Europe, Balkans, southern part of Eastern Europe, northern Kazakhstan, North Korea, probably Russian Far East.

Distribution in North Korea (Fig. 39). Prov. Hwanghae-namdo, near Haeju, Sujang-san Mts; Prov. Ryanggang, 15 km N of Hyesan, road to Pochon.

Ecology. It is a thermophilous species. In Europe and Kazakhstan it mainly inhabits grasslands on a limestone substratum, less frequently on a sandy substratum. Its nests have carton-lined chambers and it occasionally

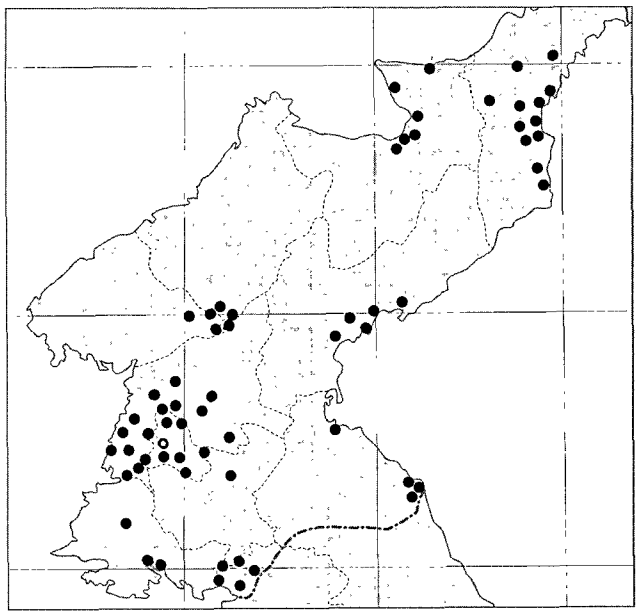

Figure 38. Distribution of *Lasius koreanus* (●) in North Korea.

builds soil mounds. In North Korea it was found in open areas with sparse grass at altitudes of 330 and 770 m a.s.l.

Notes. Kupyanskaya (1990) recorded *L. meridionalis* in the Russian Far East. However, based on the descriptive characters provided by her, it was more probably *L. jensi*: the queens have a flattened scape and tibiae, and the petiolar scale of the workers tapers towards the apex and has no notch on the dorsal surface (*loc. cit.*, p 226-227) (see also Seifert 1982, 1988).

Lasius (*Lasius*) *koreanus* Seifert, 1992

Lasius koreanus Seifert 1992: 47, w, q, North Korea, Bolton 1995 b: 223.
Lasius alienus: Collingwood 1976: 305, 1981: 27, Kim B.-J. 1996: 185 (misidentification), not Förster 1850: 36.
Lasius hayashi: Collingwood 1976: 305 (part.) (misidentification), not Yamauchi and Hayashida 1970: 510.

Material examined. Paratypes: 3 w, Prov. Kangwon, Kumgang-san Mts, distr. On-dzong, along brook Orku-dong, No 317, 5.viii.1975, leg. leg. J. Papp and A. Vojnits; non-type material: several hundred w, several tens q and m from North Korea.

General distribution. It is known from the North Korea only, but more probably widely distributes in the Eastern Palaearctic.

Distribution in North Korea (Fig. 38). Pyongyang and surrounding area (Maram; distr. Samsok, Techon-ri; 70 km NE of Pyongyang, distr. Kyongsong; Ryongak-san Mts, Daebong; 35 km SW of Pyongyang, Taesong Mts; above Lake Taesong; 30–40 km N Pyongyang, Sa-gam; 10 km NE of Pyongyang, Taesong-san Mts ; 25 km W of Pyongyang, Lyongak-san; 25 km W of Pyongyang, Mang-young-dae; 45 km E of Pyongyang, Bong-ha on riv. Te-dong; 50 km N of Pyongyang, Chang-lyon san; 60 km E of Pyongyang, Za-mo san; Nampo; Djonjong-san Mts., near Pyongyang; 4 km NE of Pyongyang, Lake Sokan); Prov. Pyongan-namdo: distr. Sunan, Sokam-Juvonji; distr. Sunchon, Djamo-ri; distr. Kangwon, Taesong; San-ri near Nampo; Prov. Pyongan-namdo, Pyongan-pukto and Chagang, Myohyang-san Mts; Prov. Hwanghae-namdo: Sunchon; Haeju; 8 km W of Haeju, Sujang-san Mts; Prov. Hamgyong-namdo: Hamhung; 15 km W of Hamhung, distr. Haeju, Hyngpong-ri; Hungnam; distr. Hongwon, Jonpong-ri; Hungsang; Prov. Kangwon: Kumgang-san Mts; Wonsan; Prov. Kaesong City: Kaesong; 27 km SW of Kaesong, Pakyon-san, Pakyon popo; 10 km SW of Kaesong, Jonpong-ho; Prov. Ryanggang: Pektusan Mt., Mupo; Hyesan; 3 km SE of Hyesan; 5 km SW of Hyesan; 15 km N of Hyesan, road to Pochon; Chan Pay plateau, Sam zi-yang; Prov. Hamgyong-pukto: Juur near Chongjin; Taesong-ho; Onpho-ri, distr. Kyongsong; 20 km NW Kyongsong, riv. Poro-chon; 60 km N of Chongjin, Musan-ryong pass; Chongjin Komalsan Park; distr. Kyongsong, Kvanmo-bong Mt., Mehyang-ri; distr. Puryong, Musu-ri; Daeso-ri; Kyowon-ri; distr. Kyongsong, Sangonpo-ri; distr. Orang, Changyon Lake.

Ecology. One of the commonest North Korean ant species. Its ecology is similar to that of *L. japonicus*, but it seems to be somewhat more thermophilous. It was found at altitudes up to 1700 m a.s.l., but mainly inhabits rather dry areas between 200 and 700 m. It usually builds nests in soil under stones, rarely in rotten wood.

Notes. This species differs from the related *L. japonicus* and *L. hayashi* in the absence of standing hairs on the scape and tibiae. All previous authors (e.g. Collingwood, Kupyanskaya and others) determined it as *L. alienus*. As noted above, among North Korea individuals determined by Collingwood (1976) as *L. hayashi*, a couple of samples belong to *L. koreanus*.

Lasius (*Chthonolasius*) *meridionalis* (Bondroit, 1920)

Formicina meridionalis Bondroit 1920: 143, q, France.
Lasius meridionalis: Collingwood 1981: 29 (part.), Seifert 1988: 154, Bolton 1995 b: 224, Kim B.-J. 1996: 186, Czechowski et al. 2002: 112, Kim B.-J. 2003: 2, Imai et al. 2003: 61.

Material examined. Several tens w, about 20 q and m from Europe and North Korea.

General distribution. A Transpalaearctic species, distributed from Europe to Japan.

Distribution in North Korea (Fig. 39). Prov. Kangwon, Kumgang-san Mts, Manmul-san; Prov. Ryanggang, Hyesan (?).

Ecology. In Europe *L. meridionalis* is an oligotope of dry grasslands. The nests are sometimes constructed with low soil mounds and with characteristic carton-lined chambers. It is a temporary social parasite of spe-

cies of the subgenus *Lasius* s. str. Only one queen was found in North Korea in a grassland at altitudes between 660 and 810 m a.s.l.

Notes. Collingwood (1976) recorded *L. rabaudi* in North Korea, although later he (Collingwood 1981) re-determined his specimens from Za-mo san (No 231) as *L. meridionalis*. However, the specimen from Za-mo san is in fact *L. distinguendus* (is in HNHM, examined). On the other hand, Collingwood (1981) determined 3 males from Hyesan as *L. meridionalis*. I investigated these males but have no definitive opinion about their conspecificity with *L. meridionalis*, because males of many related species (*L. umbratus*, *L. distinguendus*, etc.) are in reality indistinguishable.

Lasius (*Chthonolasius*) *mixtus** (Nylander, 1846)

Formica mixta Nylander 1846 b: 1059, w, q, n, Finland.
Lasius mixtus: Seifert 1988: 145, Bolton 1995 b: 224, Czechowski et al. 2002: 115.

Material examined. Syntype, q (dealate), "*Formica mixta* Nylander Upsala", "Mus. Zool. H: fors Spec. typ. No. 5066", "Mus. Hels. N:o 2372" (FMNH); non-type material: several tens w, about 10 q and m from Europe and North Korea.

General distribution. Transpalaearctic species, distributed from Europe until Pacific Ocean, is absent in Japan.

Distribution in North Korea (Fig. 39). Prov. Kangwon, Kumgang-san Mts, near hotel.

Ecology. In Europe *L. mixtus* prefers open habitats (meadows, pastures), where it nests in soil, sometimes constructing small soil mounds. In North Korea several flying gynes were found in the Kumgang-san Mts (19. vii.1985).

Lasius (*Dendrolasius*) *morisitai** Yamauchi, 1978

Lasius morisitai Yamauchi 1978: 176, w, q, m, Japan, Kupyanskaya 1989: 787, 1990: 232, Bolton 1995 b: 224, Imai et al. 2003: 60, Radchenko 2005: 90.
Lasius fuliginosus: Collingwood 1976: 306, 1981: 28 (part.) (misidentification), not Latreille 1798: 36.

Material examined. Several tens w, about 10 q and m from Russian Far East and North Korea.

General distribution. Russian Far East, North Korea, Japan.

Distribution in North Korea (Fig. 39). Prov. Pyongan-pukto, Myohyang-san Mts; Prov. Kangwon: Kumgang-san Mts, near Kuryong falls; Kumgang-san Mts, distr. On-dzong, along Orku-dong; Prov. Hwanghae-namdo, 30 km of Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon-san.

Ecology. This species, quite rare in North Korea, was found in mixed and coniferous forests (oak, pine) at low altitudes (up to 300 m a.s.l.). Like the other species of the subgenus *Dendrolasius*, it has arboreal habit, nesting in a wood of living and dead trees.

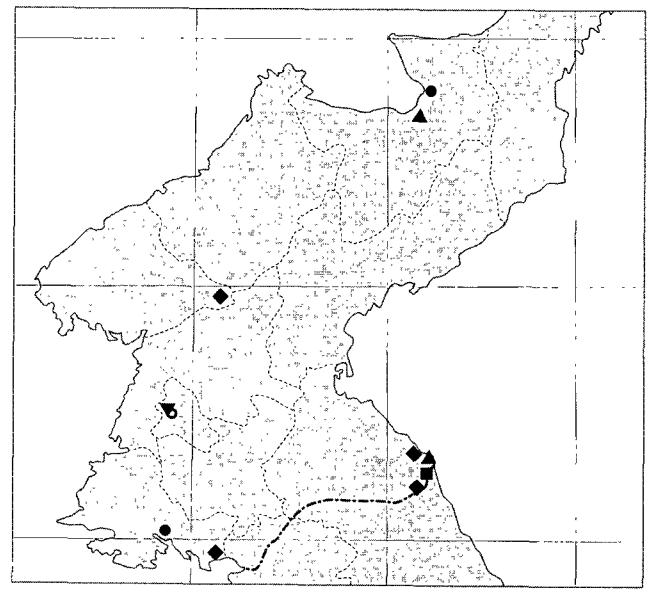

Figure 39. Distribution of *Lasius jensi* (●), *L. meridionalis* (▲), *L. mixtus* (■), *L. morisitai* (◆) and *L. myops* (▼) in North Korea.

Notes. Collingwood (1976, 1981) determined a couple of specimens (No. 321 and 324) as *L. fuliginosus*, but they are in fact *L. morisitai* (material is in HNHM, examined).

Lasius (*Cautolasius*) *myops** Forel, 1894

Lasius flavus r. *myops* Forel 1894: 12, w, Algeria.
Lasius myops: Seifert 1983: 13, Bolton 1995 b: 224.

Material examined. About 20 w from Europe and North Korea.

General distribution. More probably Transpalaearctic species

Distribution in North Korea (Fig. 39). Pyongyang.

Ecology. In Europe it lives mainly in mountain meadows. Its biology is similar to that of *L. flavus*. In North Korea several workers were found in Pyongyang in a meadow near a small lake.

Notes. Different authors have regarded *L. myops* as a good species, or as a subspecies/variety of *L. flavus*. Seifert (1983) raised it to the species rank. For the details of synonymy see Bolton (1995).

Lasius (*Dendrolasius*) *nipponensis* Forel, 1912

Lasius fuliginosus var. *nipponensis* Forel 1912: 339, w, not q, Japan.
Lasius nipponensis: Santschi 1941: 278 (raised to species), Radchenko 2005: 84.

L. fuliginosus var. *nipponensis*: as junior synonym of *L. fuliginosus* (Latreille): Wilson 1955: 138, Yamauchi 1978: 171, Bolton 1995 b: 224, not Espadaler et al. 2001: 340 (revived from synonymy and raised to species as the first available replacement name for "oriental *fuliginosus*"), not Imai et al. 2003: 60 (repeating of the Espadaler's et al. synonymy).

Lasius crispus Wilson, 1955: 144, w, q, m, Japan (unresolved primary homonym of *Lasius crispus* Théobald, 1935: 68, France, Mio-Pliocene), Yamauchi and Hayashida 1968: 401, 402, Yamauchi 1978: 174, synonymy by Radchenko 2005: 84.

Material examined. Paralectotypes of *L. nipponensis*: 3 w on one pin with the labels: "*L. fuliginosus* Latr., w, Tokyo (Yano)", "v. *nipponensis* Forel, w, Type, Tokyo" (both written by Forel's own hand), "Coll. Forel", "Typus" (red printed label) (MHNG); non-type material: several tens w, about 10 q and m from Russian Far East and North Korea.

General distribution. Southern part of Russian Far East, Korean Peninsula, Japan, Taiwan [B.-J. Kim (1996) has erroneously given Korea and Europe as the range of this species].

Distribution in North Korea (Fig. 40). Prov. Pyongan-namdo, 60 km NE of Pyongyang, Za-mo san; Prov. Chagang, Myohyang-san Mts, val. of riv. Hwajangam; Prov. Hamgyong-pukto, Onpho-ri near Chongjin.

Ecology. This species, rare in North Korea, was found in three localities at altitudes between 100 and 790 m a.s.l. in deciduous and mixed forests (sweet chestnut, oak, maple, pine). Its biology is similar to that of *L. fuji* (see above).

Notes. Espadaler et al. (2001) have provided both morphological and molecular evidence that the "oriental *fuliginosus*" is not conspecific with the "typical" *L. fuliginosus* (Latreille), distributed in the western part of the Palaearctic Region (e.g. to the east as far as the Altai Mts.), and proposed for this species the replacement name *L. nipponensis* Forel (as the oldest former synonym of the "Oriental *fuliginosus*"). However, *L. nipponensis* is not conspecific with the "oriental *fuliginosus*", whose workers have a much thicker petiolar scale not narrowed at the top (seen in profile), a head not narrowed anteriorly with a distinctly emarginated occipital margin, etc. (see Radchenko 2005).

Lasius (*Dendrolasius*) *orientalis* Karawajew, 1912

Lasius fuliginosus var. *orientalis* Karawajew 1912: 586, w, Korea, Wheeler 1928 b: 123, as junior synonym of *L. fuliginosus* (Latreille): Wilson 1955: 138, Yamauchi 1978: 171, Kupyanskaya 1989: 783, 1990: 228, Bolton 1995: 225, as junior synonym of *L. nipponensis* Forel: Espadaler et. al., 2001: 341, Imai et al. 2003: 60.

Revived from synonymy and raised to species by Radchenko 2005: 87.

Lasius (*Chthonolasius*) *teranishii* Wheeler, 1928 b: 120, q, Japan, *nom. nov. pro Lasius umbratus*: Teranishi 1927: 92, not Nylander, 1846: 1048 *et auct.*, Wilson 1955: 146 (transferred to subgenus *Dendrolasius*), Yamauchi and Hayashida 1968: 399, w, m, Collingwood 1976: 306, Yamauchi 1978: 174, Kupyanskaya 1989: 786, 1990: 230, Bolton 1995 b: 226, Kim B.-J. 1996: 187, 2003: 2, Imai et al. 2003: 59, synonymy by Radchenko 2005: 87.

Lasius (*Chthonolasius*) *ouchii* Teranishi, 1940: 76, q, Japan (as junior synonym of *L. teranishii*: Wilson 1955: 146), synonymy by Radchenko 2005: 87.

Material examined. Neotype, w (designated by Radchenko 2005), "Buhta Gaidamak, No. 3196, 21.v.[18]80, leg. P. Shmidt"; non-type material: several tens w from Russian Far East and North Korea.

General distribution. Russian Far East, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 40). 4 km NE of Pyongyang, Lake Sokan; Prov. Hwanghae-namdo, 30 km from Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon san; Prov. Ryanggang, 3 km SE of Hyesan; 5 km NE of Hyesan; Prov. Hamgyong-pukto, Onpho-ri near Chongjin; Chongjin Komalsan Park; Daeso-ri; Kyowon-ri; distr. Orang, Changyon Lake.

Ecology. In North Korea it was found in mixed and deciduous forests (oak, maple, ash, pine, larch) at altitudes between 250 and 1100 m a.s.l. Its biology is similar to that of other species from the subgenus *Dendrolasius*.

Notes. Karawajew's (1912) description of *L. fuliginosus* var. *orientalis* is very short and insufficient, and the most important diagnostic features of this form are not given there. The name *orientalis* was used by Kuznetsov-Ugamsky (1928, 1929). However, the specimens from the Russian Far East collected and investigated by him belong to *L. capitatus* Kuznetsov-Ugamsky (Radchenko 2005).

Wilson (1955) synonymised var. *orientalis* with *L. fuliginosus*, though he never saw the types of this

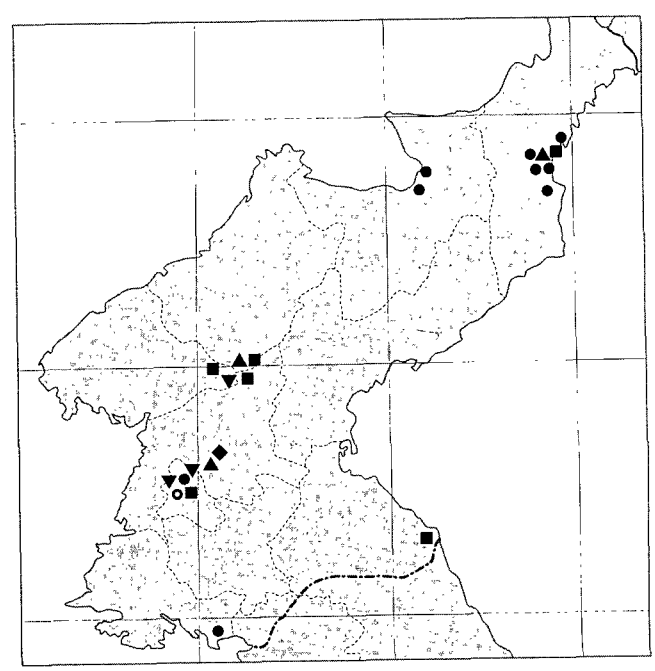

Figure 40. Distribution of *Lasius nipponensis* (▲), *L. orientalis* (●), *L. spathepus* (■), *L. talpa* (◆) and *L. umbratus* (▼) in North Korea.

form. Wilson's synonymy has been repeated by Yamauchi (1978) and Kupyanskaya (1989, 1990), while Espadaler et al. (2001) have considered var. *orientalis* to be the junior synonym of *L. nipponensis*.

Though the types of var. *orientalis* seem to be lost, I designated the neotype of var. *orientalis* (Radchenko 2005). The workers of *L. orientalis* have a distinctly flattened scape and a very thick, low petiolar scale (seen in profile), which gradually widens towards the apex when seen in front or from behind. These diagnostic features completely correspond with those of *L. teranishii* Wheeler (see Yamauchi and Hayashida 1968, Yamauchi 1978, Kupyanskaya 1989, 1990).

Lasius (*Dendrolasius*) *spathepus* Wheeler, 1910

Lasius spathepus Wheeler 1910: 130, w, Japan, 1928 b: 121, w, m, Wilson 1955: 147, Yamauchi and Hayashida 1968: 401, Yamauchi 1978: 172, Kupyanskaya 1989: 787, 1990: 231, Bolton 1995 b: 225, Kim B.-J. 1996: 187, 2003, 2, Imai et al. 2003: 59, Radchenko 2005: 89.

Material examined. Holotype, q, "Japan, Kuwana coll., 1910", "Type", "Holotype Lasius spathepus Wheeler", "M.C.Z. type 71691"; several tens w, 2 q from the Russian Far East, North Korea and Japan.

General distribution. Japan, Korean Peninsula.

Distribution in North Korea (Fig. 40). Pyongyang; Prov. Chagang, Pyongan-namdo and Pyongan-pukto, Myohyang-san Mts; Prov. Kangwon, Kumgang-san Mts, Manmul-san; Prov. Hamgyong-pukto, Onpho-ri near Chongjin. Kupyanskaya (1990) referred this species for North Korea, but without concrete locality.

Ecology. In North Korea it was found in deciduous and mixed forests (lime, oak, ash, pine) at altitudes between 250 and 860 m a.s.l. Its biology is similar to that of the other species from the subgenus *Dendrolasius*.

Lasius (*Cautolasius*) *talpa* Wilson, 1955

Lasius talpa Wilson 1955: 136, w, q, m, Japan, North Korea, Yamauchi 1978: 160, Bolton 1995 b: 226, Kim B.-J. 1996: 187, 2003: 2, Imai et al. 2003: 61.

Material examined. Paratype, w, Hiroka, Shikoku, Japan, 8.iii.1936, leg. Okamoto (MIZ); non-type material: 2 w from Japan.

General distribution. Japan, Korean Peninsula.

Distribution in North Korea (Fig. 40). I did not find this species among all investigated material from North Korea. It was recorded from Pyongan-namdo Province, Kejo by Wilson (1955).

Ecology. Biology of this species is similar to those of the closely related *L. flavus*, but *L. talpa* lives mainly in forests (Yamauchi, 1979).

Lasius (*Chthonolasius*) *umbratus* (Nylander, 1846)

Formica umbrata Nylander 1846 b: 1048, q, m, Finland.
Lasius umbratus: Yamauchi 1978: 168, Kupyanskaya 1990: 224, Bolton 1995 b: 226, Kim B.-J. 1996: 187, Czechowski et al. 2002: 110, Kim B.-J. 2003: 2, Imai et al. 2003: 60.

Material examined. Syntypes: q (dealate), "H: fors", "W. Nyland.", "Coll. Nyland.", "16/viii", "Mus. Zool. H: fors Spec. typ. No. 5062", "Mus. Hels. No. 2371", "Holotype Stärcke, 36" (this specimen can not be considered as holotype); q (alate), "H: fors", "W. Nyland.", "*umbrata* q H: fors", Coll. Nyland.", "16/viii", "Mus. Zool. H: fors Spec. typ. No. 5061"; q (alate), "H: fors", "W. Nyland.", "Coll. Nyland.", "Mus. Zool. H: fors Spec. typ. No. 5064", "Mus. Hels. No. 2371"; q (alate), "Vichtis", "4/x", "Coll. Nyland.", "Mus. Zool. H: fors Spec. typ. No. 5065"; m, "Vichtis", "4/x", "Coll. Nyland.", "Mus. Zool. H: fors Spec. typ. No. 5063" (FMNH); non-type material: several tens w, more than 20 q and m from Europe, Russia, North Korea.

General distribution. Transpalaearctic species, distribute from Europe to Japan.

Distribution in North Korea (Fig. 40). Pyongyang and surrounding area (Taesong-san Mts); Prov. Pyongan-namdo, Myohyang-san Mts.

Ecology. In North Korea it was found in deciduous forests and parks. In Europe *L. umbratus* is a polytope of wet areas that lives in various habitats, from forests, gardens and brushwood to moderately wet grasslands. Nests are usually built deep in the ground among the roots of trees and bushes; on the outskirts of towns it also nests in the foundations of buildings. Like all the other species of the subgenus *Chthonolasius*, these subterranean ants open their nests only at the time their sexuals fly off.

Paratrechina Motschoulsky, 1863

Paratrechina Motschoulsky 1863: 13. Type species: *Paratrechina currens* Motschoulsky, 1863: 14 (junior synonym of *Paratrechina longicornis* Latreille, 1802: 113), by subsequent designation of Wheeler 1911: 170.

This cosmopolitan, predominantly tropical genus comprises more than 100 species, 10 of which are known from the Palaearctic Region. Several tramp species have been introduced by commerce to the temperate zone of all continents, where they live mainly in hothouses.

Paratrechina flavipes (F. Smith, 1874)

Tapinoma flavipes F. Smith 1874: 404, w, q, Japan.
Paratrechina flavipes: Collingwood 1976: 306, 1981: 29, Kupyanskaya 1990: 233, Wu and Wang 1995: 152, Bolton 1995 b: 313, Kim B.-J. 1996: 188, Terayama 1999 b: 51, Kim B.-J. 2003: 2, Imai et al. 2003: 81.
Paratrechina sakurae: Collingwood 1976: 306, 1981: 29 (misidentification), not Ito 1914: 43.

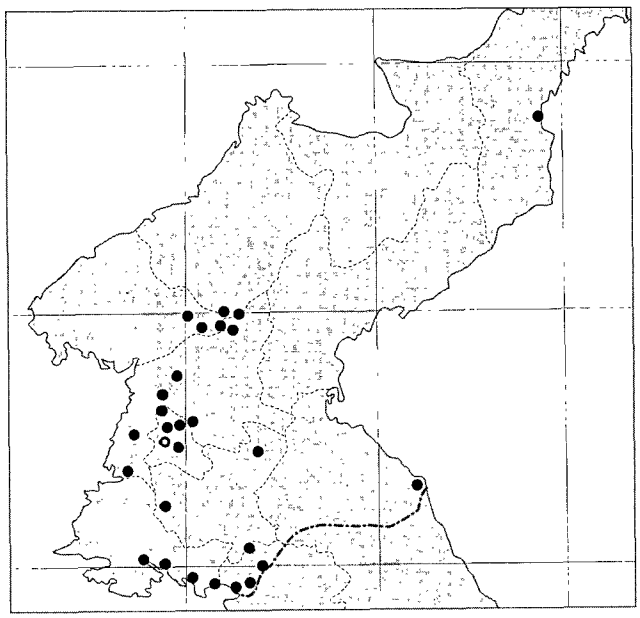

Figure 41. Distribution of *Paratrechina flavipes* (●) in North Korea.

Material examined. More than one hundred w, more than 20 q and m from North Korea and Japan.

General distribution. China, Kunashir Isl., Korean Peninsula, Japan; occasionally introduced to many tropical and subtropical regions of the World.

Distribution in North Korea (Fig. 41). Pyongyang and surrounding area (Maram; Nampo; Ryongak-san Mts, Taebong; Taesong Mts, near Michon Lake; 30–40 km N of Pyongyang, Sa-gam; 4 km NE Pyongyang, Lake Sokan; 25 km W of Pyongyang, Lyongak san; 50 km N of Pyongyang, Chang-lyong san, 15 km E of Sa-gam; 12 km NE of Pyongyang, De-sang san; 60 km NE of Pyongyang, Za-mo san, Bek-sung-li); Prov. Pyongan-pukto, Pyongan-namdo and Chagang, Myohyang-san Mts; Prov. Hwanghae-pukto, 20 km SSE of Sariwon, Sohung-ho; Sympyong, Pyongwa-ri; Prov. Hwanghae-namdo, Haeju, Sujang-san Mts; 8 km W of Haeju, Sujang-san Mts; 30 km from Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon-san; 20 km SE of Kaesong, San-chon tong, Bagyon-san; 20 km NE of Kaesong, Pakyon Mts; Prov. Kaesong City: Kaesong; Kongmin Vang Nung, near Kaesong; Pakyon Falls; Prov. Kangwon: Kumgang-san Mts; Samil-po; Prov. Hamgyong-pukto, Kyowon-ri.

Ecology. A xerophilous species, inhabiting mostly woodlands. In North Korea it was found at low altitudes (between 50 and 600 m a.s.l.), mainly in dry, light deciduous and mixed forests (oak, pseudoacacia, sweet chestnut, maple, elm, ash, pine), but it also lives in shrubs and anthropogenic habitats (city parks, gardens, streets), and very rarely inhabits dry grasslands. It builds nests in soil, often under stones.

Notes. In the taxonomy of the Korean *Paratrechina* species, I follow the ideas of Japanese myrmecologists (Terayama 1999 b, Imai et al. 2003), whose treatment of *P. sakurae* Ito, 1914, differs from that of Collingwood (1976, 1981). *P. sakurae* are small, brownish ants, superficially similar to the *Plagiolepis* species and considerably different from *P. flavipes* in body colour, shape of the alitrunk, etc. Collingwood's "*sakurae*" is actually *P. flavipes*.

Paratrechina sauteri Forel, 1913

Paratrechina (*Nylanderia*) *minutula* var. *sauteri* Forel 1913: 198, w, Taiwan.

Paratrechina sauteri: Collingwood 1976: 306, 1981: 29, Bolton 1995 b: 315, Kim B.-J. 1996: 188, 2003: 2.

Material examined. Syntypes, 4 w, "Taihorn unter Rinde No H3b", "*Prenolepis minutula* For. R. *sauteri* For. Typus" (MHNG); non-type material: several tens w North Korea.

General distribution. Korean Peninsula, Japan.

Distribution in North Korea (Fig. 42). Pyongyang and surrounding area (Ryongak-san Mts, Daebong; Taesong-san Mts; above Lake Taesong; 30 km N of Pyongyang, Sa-gam; 60 km NE of Pyongyang, Za-mo san; 12 km NE of Pyongyang, De-sang san); Prov. Pyongan-pukto, Tephun near Kujang-dong; Prov. Pyongan-pukto, Pyongan-namdo and Chagang, Myohyang-san Mts; Prov. Hwanghae-namdo: 30 km from Kaesong, env. of Bagyon popo, De-hung-sol, Bagyon san; 20 km SE of Kaesong, San-chon tong, Bagyon san; Kaesong; Prov. Kangwon, Kumgang-san Mts; Prov. Hamgyong-pukto: Onpho-ri near Chongjin; Daeso-ri; distr. Kyongsong, Sangonpo-ri.

Ecology. Similar to that of *P. flavipes*, but *P. sauteri* seems to be even more xerophilous than the former. In North Korea it lives both in dry grasslands and in

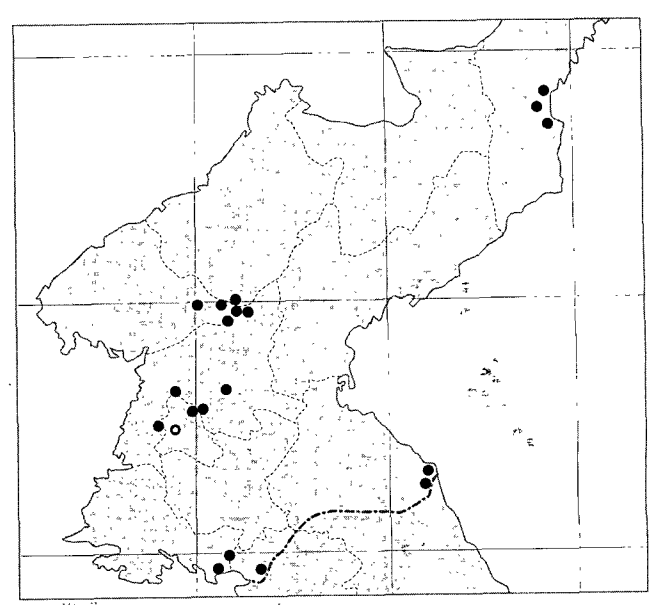

Figure 42. Distribution of *Paratrechina sauteri* (●) in North Korea.

sparse light forests (pseudoacacia, chestnut, oak, elm, ash, pine) at altitudes up to 1300 m a.s.l. It builds nests in soil, rarely in dry decayed wood.

Notes. I have investigated the syntypes (4 w) of *P. sauteri* preserved in the MHNG. These small brownish ants are really indistinguishable from Japanese *P. sakurae sensu* Terayama (1999 b) and Imai et al. (2003). I cannot exclude the possibility that *P. sakurae* Ito, 1914 is a junior synonym of *P. sauteri* Forel, 1913.

Plagiolepis Mayr, 1861

Plagiolepis Mayr 1861: 42. Type species: *Formica pygmaea* Latreille, 1798: 45, by monotypy.

This Old World genus comprises more than 50 species, with about 20 distributed in the Palaearctic Region. The members of the genus are minute ants (1.8–2.3 mm) that live in xerophilous habitats, where they nest almost exclusively in soil, often under stones.

Plagiolepis flavescens Collingwood, 1976

Plagiolepis flavescens Collingwood 1976: 307, w, North Korea, 1981: 29, Bolton 1995 b: 335, Kim B.-J. 1996: 188, 2003: 2, Imai et al. 2003: 82.

Material examined. Holotype and 9 paratypes, w, Prov. Kaesong City, 20 km SE of Kaesong, Sunchon, Pakyon-san, 8.vi.1970, No. 118, 119, leg. S. Mahunka and H. Steinmann; Prov. Kangwon, Kumgang-san Mts, Samilpo, 1.vi.1970, No 86, leg. S. Mahunka and H. Steinmann; non-type material: about 20 w from North Korea.

General distribution. Korean Peninsula, Japan.

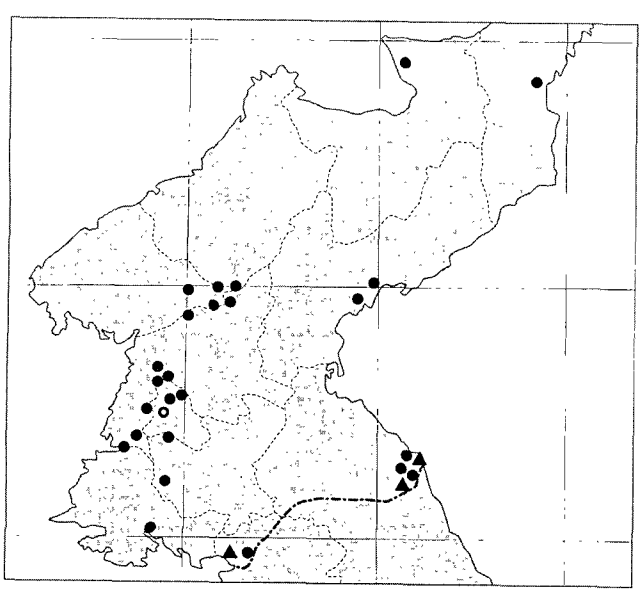

Figure 43. Distribution of *Plagiolepis flavescens* (▲) and *P. manczshurica* (●) in North Korea.

Distribution in North Korea (Fig. 43). Except of the type localities (see above) it was found in the Kumgang-san Mts (distr. On-dzong, near hotel Go-song, plus one more unknown locality).

Ecology. A rather xerophilous species, it was found in a dry sweet chestnut forest, a pine wood, and a grassland near a lakeshore. It builds nests in soil.

Notes. This species differs considerably from *P. manczshurica* in having a yellow-coloured body and a short, subsquare third funicular joint, which is distinctly shorter than the fourth one.

Plagiolepis manczshurica Ruzsky, 1905

Plagiolepis pygmaea var. *manczshurica* Ruzsky 1905: 467, w, China.
Plagiolepis manczshurica: Collingwood 1976: 307, 1981: 29 (misspelled as *mandzurica*), Wu and Wang 1995: 132, Bolton 1995 b: 335, Radchenko 1996 a: 185 (as junior synonym of *P. tauricus* Santschi, misspelled as *manchurica*), Kim B.-J. 1996: 188, 2003: 2.

Material examined. More than one hundred w, about 10 q and m from South Siberia, Mongolia, China and North Korea.

General distribution. South Siberia, Mongolia, China, Korean Peninsula.

Distribution in North Korea (Fig. 43). Pyongyang and surrounding area (Ryongak-san Mts, Daebong; 35 km SW of Pyongyang, Taesong; 30–45 km N of Pyongyang, Sa-gam; 10 km NE of Pyongyang, Taesong-san Mts; 30 km N of Pyongyang, Kumgang Reserve; 10–25 km W of Pyongyang, Lyongak-san; 12 km NE of Pyongyang, De-sang san; Djonjong-san Mts; 4 km NE of Pyongyang, Lake Sokan); Prov. Pyongan-namdo: 10 km SW of Kaechon, Jonpong-ho; Nampo; Prov. Pyongan-pukto, Pyongan-namdo and Chagang, Myohyang-san Mts; Prov. Hwanghae-pukto, 20 km SSE of Sariwon, Sohung-ho; Prov. Hwanghae-namdo, Haeju; Kaesong; Prov. Kangwon, Kumgang-san Mts; Prov. Hamgyong-namdo, distr. Hongwon, Jonpong-ri; Hamhung; Prov. Ryanggang, Pektusan Mt., Sam-zi-yan hotel; Prov. Hamgyong-pukto, Juur near Chongjin.

Ecology. A xerophilous species living in dry grasslands, shrubs, sparse, light, often young, forests (pine, pseudoacacia, oak, elm, maple, ash), usually at low altitudes (100–300 m a.s.l.). Quite common in anthropogenic habitats: city parks, gardens, streets, pastures, field edges, etc. It builds nests in soil, often under stones.

Polyergus Latreille, 1804

Polyergus Latreille 1804: 179. Type species: *Formica rufescens* Latreille, 1798: 44, by monotypy.

This amazing genus includes five species distributed in the Holarctic; three of them occur in the Palaearctic

All species are obligatory slave-makers; their hosts are ants of the subgenus *Serviformica*.

Polyergus samurai Yano, 1911

Polyergus rufescens subsp. *samurai* Yano 1911: 110, w, q, Japan.
Polyergus samurai: Collingwood 1976: 305, Kupyanskaya 1990: 209, Wu and Wang 1995: 134, Bolton 1995 b: 342, Kim. B.-J., 1996: 188, 2003, 2, Imai et al. 2003: 39.

Material examined. 7 w and 1 m from Russian Far East and North Korea.

General distribution. China, Russian Far East, Korean Peninsula, Japan.

Distribution in North Korea (Fig. 44). Vicinity of Pyongyang, Susan Mts, near Sangwon; Prov. Kangwon, Kumgang-san Mts, Onjong-ri, near Kumgang-san Hotel. Kupyanskaya (1990) recorded this species for North Korea, but with any concrete locality.

Ecology. In the Russian Far East and Japan it inhabits mainly open areas (grasslands, shrubs). In the Susan Mts one male was found and no ecological data were provided for the workers from the Kumgang-san Mts.

Like all other *Polyergus* species, *P. samurai* is an obligatory social parasite (slave-maker) wholly dependent on its host-ants of the subgenus *Serviformica* (*F. japonica* is known as its host species). Its nests are like those of the kept slave species.

Polyrhachis F. Smith, 1857

Polyrhachis F. Smith 1857: 58. Type species: *Formica bihamata* Drury, 1773: 73, by original designation.

One of the most specious ant genera comprising more than 500 species. It is distributed in the Old World tropics, and only a few species have penetrated into the southern part the Palaearctic Region. *Polyrhachis* species are big (up to more than 10 mm), peculiar and very nice ants. The alitrunk and petiole of many of them are armed with differently shaped spines or hooks, which are doubtless adaptive characters, protecting the ants against predators.

Polyrhachis lamellidens F. Smith, 1874

Polyrhachis lamellidens F. Smith 1874: 403, w, Japan, Collingwood 1976: 307, Wu and Wang 161, Bolton 1995 b: 351, Kim B.-J. 1996: 184 (misspelled as *Polyrachis*), 2003: 2, Imai et al. 2003: 33.

Material examined. Several tens w from North Korea.

General distribution. China, Korean Peninsula, Taiwan, Japan.

Distribution in North Korea (Fig. 44). Vicinity of Pyongyang: Maram; 4 km NE of Pyongyang, Lake Sokan; 15 km W of Pyongyang, Lyongak-san; Prov. Pyongan-pukto and Pyongan-namdo, Myohyang-san Mts (Chosan; Tephun near Kujang-dong).

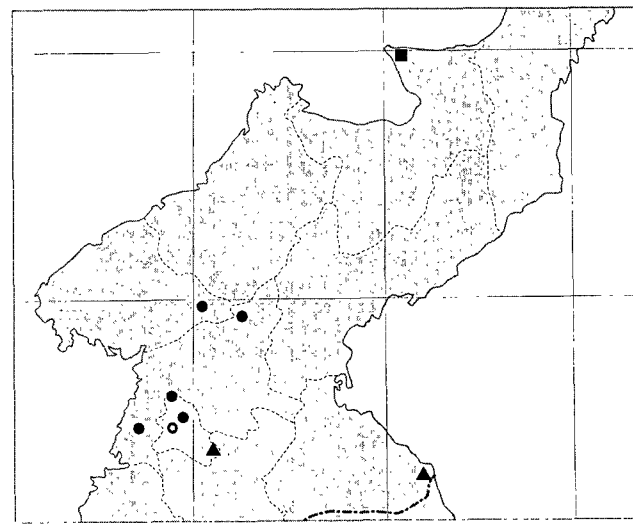

Figure 44. Distribution of *Polyergus samurai* (▲), *Polyrhachis lamellidens* (●) and *Proformica mongolica* (■) in North Korea.

Ecology. A thermophilous species living in hot dry habitats: open grasslands (including pastures, edges of roads, etc.), sparse pine and oak forests at low altitudes (up to 500 m a.s.l.). It builds nests in hollow tree trunks.

*Proformica** Ruzsky, 1902

Proformica Ruzsky 1902 b: 13 (as subgenus of *Formica*). Type species: *Formica nasuta* Nylander, 1856: 66, by monotypy.

This small Palaearctic genus comprises about 25 species, distributed mainly in semiarid regions. *Proformica* ants are polymorphic and some workers in colonies are able to store liquid food in the crop, like the American honey-ants of the genus *Myrmecocystus* Wesmael.

*Proformica mongolica** (Emery, 1901)

Formica nasuta subsp. *mongolica* Emery 1901 b: 159, w, Mongolia.
Proformica mongolica: Dlussky 1969: 225, Wu and Wang 148, Bolton 1995 b: 368.
Prenolepis melanogaster: Collingwood 1981: 29, Kim B.-J. 1996: 187 (misidentification), not Emery 1893 b: 223.

Material examined. Several tens w from Mongolia, South Siberia and North Korea.

General distribution. Mongolia, South Siberia, North Korea.

Distribution in North Korea (Fig. 44). Prov. Ryanggang, 10 km NNE of Bochonbo, riv. Karim.

Ecology. Generally, this species inhabits steppes, where builds nests in soil. It North Korea only one, somewhat

damaged worker (with a crumpled gaster) was found in an open dry mountain slope with low grass and shrubs at 1100 m a.s.l. Collingwood (1981) erroneously determined this specimen as *Prenolepis melanogaster*, a species distributed in India and South-East Asia.

TAXA EXCLUDED FROM THE NORTH KOREAN MYRMECOFAUNA (except of previously established synonyms)

Tapinoma wroughtoni Forel, 1904 – recorded for North Korea by Collingwood (1976). In fact, two collected specimens belong to *Technomyrmex gibbosus*.

Trachymesopus pilosior Wheeler, 1928 b – this species was recorded for North Korea by Collingwood (1976). In fact, collected specimens belong to *Cryptopone sauteri*.

Aphaenogaster ruida Wheeler, 1928 b – this species was recorded for North Korea by Collingwood (1976). In fact, material, determined as *A. ruida*, belongs to *A. japonica*. More probably *A. ruida* is junior synonym of *A. japonica*.

Myrmica incurvata Collingwood, 1976 synonymised here with *M. angulinodis* Ruzsky, **syn. nov.**

Myrmica kasczenkoi Ruzsky, 1905 – this species was recorded for North Korea by Collingwood (1976). In fact, collected specimens belong to *M. excelsa*.

Myrmica silvestrii Wheeler, 1928 b – his species was recorded for North Korea by Collingwood (1976, 1981). In fact, collected specimens belong to *M. kurokii*.

Myrmica yoshiokai Weber, 1947 – This poorly known taxon more probably is synonym of *M. kotokui* or *M. ruginodis*. I did not find the specimen (1 worker), determined by Collingwood (1981) as *M. yoshiokai* in the collection of HNHM, and have no definitive opinion on this situation, but more probably, this record was based on the misidentification.

Leptothorax rabaudi Bondroit, 1918 – this species was recorded for North Korea by Collingwood (1976). In fact, collected specimens belong to *Temnothorax kaszabi*.

Leptothorax serviculus Ruzsky, 1902 – this species was recorded for North Korea by Collingwood (1976). In fact, collected specimens belong to *Temnothorax mongolicus*.

Pheidole pieli Santschi, 1925 – this species was recorded for North Korea by Collingwood (1976, 1981). In fact, collected specimens belong to *Ph. fervida*.

Pristomyrmex pungens Mayr, 1866 was very recently synonymised with *P. punctatus* (F. Smith 1860) (Wu, 2003).

Tetramorium caespitum (Linnaeus, 1758) – this species was recorded for North Korea by Collingwood (1976, 1981). In fact, collected specimens belong to *T. tsushimae*.

Lasius alienus (Förster, 1850) – all previous records of this species for North Korea belong to *L. koreanus*.

Lasius niger (Linnaeus, 1758) – all previous records of this species for North Korea belong to *L. japonicus* or *L. hayashi*.

Lasius rabaudi Bondroit, 1917 – this species was recorded for North Korea by Collingwood (1976). In fact, collected specimens belong to *L. distinguendus*.

Paratrechina sakurae Ito, 1914 – this species was recorded for North Korea by Collingwood (1976, 1981). In fact, collected specimens belong to *P. flavipes*.

Prenolepis melanogaster Emery, 1893 – this species was recorded for North Korea by Collingwood (1981). In fact, collected specimens belong to *Proformica mongolica*.

ZOOGEOGRAPHICAL IMPLICATION

In terms of zoogeography, North Korea belongs to the East-Asian Subregion of the Palaearctic Region, and it lies within the two Superprovinces – northern and southern. Various names have been proposed for this chorons [the term "choron", from Greece "choros" – place, means *sensu* Kryzhanovski (1987, 2002) zoogeographical region of any rank; for example, the term "taxon" means in taxonomy unit of any rank, from subspecies to phylum].

Thus, Semenov-Tien-Shan'sky (1936) called the East-Palaearctic Subregion "Palaeachaearctic", which emphasises the availability there of numerous ancient Tertiarian faunistic elements; Emelianov (1974) used for it name "Chinese-Himalayan". Kryzhanovski (2002) has supposed that the boundary between the northern and southern Superprovinces (according to his terminology – Subregions) lies somewhere in the Korean Peninsula. I use the name "Manchurian" for the northern Superprovince and "Chinese-Himalayan" for the southern one.

The most distinctive feature of North Korean myrmecofauna (as well as the whole East-Asian Subregion) is the mixing of both autochthonous species and Oriental (tropical) and boreal taxa. It is known that the proportion of tropical species is gradually increasing southward, while at the same time the proportion of boreal elements is decreasing. This is due to both the present naturally-climatic peculiarity of East Asia and the history of origin of the fauna of this area.

First of all, it should be mentioned that the dwellers of the broad-leaved and mixed forests form the core of the fauna of the East-Asian Subregion, while in the northern adjacent regions the dominant forms are boreal taxa, associated mostly with coniferous (taiga) forests. At the same time, the sufficiently clear faunogenetic relations of this Subregion with the European broad-leaved forests are being retraced, though the modern ant

fauna of these historically related areas are considerably different.

It is significant that there are so-called amphipalaearctic taxa in the Palaearctic Region, which are found, on the one hand, in Euro-Caucasian deciduous forests, and on the other hand, in the floristically and ecologically similar forests of the southern part of the East Palaearctic. There are pairs of related species among ants, such as *Myrmecina graminicola* (Latr.) – *M. nipponica*, *Lasius fuliginosus* (Latr.) – *L. fuji*, *Solenopsis fugax* (Latr.) – *S. japonica*, *Liometopum microcephalum* (Panzer) – *L. orientale*, the species of the genera *Aphaenogaster*, *Stenamma*, *Strongylognathus*, etc.

On the other hand, the endemics Palaearctic ant genera are absent from the East-Asian Subregion (except the relict South Korean genus *Dacatria* Rigato, which certainly is of tropical origin). In contrast, there are many endemics at generic level in the Euro-Caucasian region: *Bajkaridris* Agosti, *Chalepoxenus* Menozzi, *Myrmoxenus* Ruzsky, *Phacota* Roger, *Teleutomyrmex* Kutter, *Aulacopone* Arnoldi, *Oxyopomyrmex* André, and others.

Such differences are caused by the antiquity of the fauna in the southern part of the Palaearctic deciduous and mixed forest zone, as well as by the separation of its western and eastern regions during nearly all the history of this zone.

In the Cretaceous and Palaeogene period forests occupied almost the whole area of Eurasia, except for its arid central regions. However, towards the end of the Cretaceous the forest flora began to split into the two major types – evergreen broad-leaved subtropical and tropical (Poltavian), and temperate mixed deciduous with an addition of coniferous species (Turgayan, after Kryshtofovich 1946). The spatial distribution of these floras did not change principally in the Paleocene and Eocene epochs, and the boundary line between them extended approximately from the northern Baltic Region to the Sea of Okhotsk. As the climate became considerably colder, this line has run to the south in the Oligocene epoch. Before the beginning of the Neogene period, the Poltavian flora survived only on the territory of Southern and partly Central Europe, and floristically rich deciduous forests grew on the vast territory of Northern Europe, Siberia and Kazakhstan.

The subsequent cooling and aridisation of the climate in the Neogene led to gradual extinction of the evergreen broad-leaved forests, but the southern border of the forest zone did not change essentially up to the end of the Miocene epoch. At the same time the Turgayan flora was differentiated into the northern (with a predominance of small-leaved and coniferous trees) and southern (predominantly broad-leaved species) variants. In the late Miocene – early Pliocene this led to the formation of the taiga type of forests in North-East Asia, and by the end of Pliocene these forests had spread widely towards the west up to the north of Europe.

Since the cooling and aridisation of the climate were still continuing, some gaps were appearing in the continuous area of the deciduous and mixed southern forests as early as the end of the Pliocene epoch, and in the early Pleistocene it had completely separated between the Altai Mts and the west Baikal region. It is significant that the forest zone was not cleaved by the glaciers, but by the wedge of the steppe and desert vegetation, which moved from the heart of the Central Asia. As a result, two clearly different provinces of the deciduous forest, the European and the East Asian, were created (Matiushkin 1976, 1982).

In the Neogene and Pleistocene, much more dynamic geological processes and changes of the climate, landscapes and of the biota as a whole were very important factors underlying substantial differentiation of the ant fauna in the south-western part of the Palaearctic. The most important of these processes were active orogenesis, the drying up of the Mediterranean Sea, mountain glaciations, etc. At the same time, the geological regime in East Asia was relatively stable, and this region was a huge refuge for the conservation of biota where the ancient fauna and flora were able to survive. Furthermore, all mountain ranges in East Asia are longitudinal and do not form any barriers to the swapping of both boreal and tropical faunistic elements. Hence, the zoogeographical boundaries there are slipshod and the most difficult thing is to define the Palaearctic border in South-East China (Radchenko 2003).

As stated above, 99 ant species were found in North Korea and I have placed them into 9 zoogeographical complexes: boreal, Transpalaearctic, northern east-Palaearctic, southern east-Palaearctic, east steppic, south Siberian, Oriental (tropical), North Korean endemics and introduced species (Table 1).

Boreal elements are distributed in the northern regions of Eurasia and ecologically associated with the taiga forests, including mountain taiga, with some reaching into the forest-tundra zone and mountain tundra. In North Korea they are found only in the mountains (at altitudes 800–2000 m a.s.l.).

Transpalaearctic elements have a wide range of distribution, often extending from the Atlantic Ocean to Japan; they are associated mainly with coniferous and mixed forests, but often inhabit open grasslands in the forest-steppe zone. In North Korea, these species are usually distributed throughout the country and, as a rule, are quite tolerant to environmental conditions.

Northern eastpalaearctic elements are widely distributed in the East-Asian Subregion, including the Russian Far East. They do not normally reach farther south than 30°N. In North Korea lots of them are found throughout the country.

Southern eastpalaearctic elements have a similar range of distribution to species from the preceding group, but, with some exceptions, they are absent from

the Russian Far East. Towards the north they reach the island of Hokkaido and the South Kurily Islands (Shikotan, Kunashir) and in the south many of them penetrate into the Oriental Region. There are quite a lot of Oriental (tropical) genera among them. In North Korea species from this group are found almost exclusively in the southern part of the country.

East-steppic elements are mostly distributed in the steppes of Asia (in the west from the Altai Mts through South Siberia and Mongolia), a few of them reaching westward as far as the Volga River or Eastern Ukraine. In North Korea many of these species can be found all over the country.

South-Siberian elements are distributed in South Siberia and Mongolia and usually associated with coniferous forests of the southern type. In North Korea they are not numerous and are found throughout the country.

Oriental (tropical) elements are derivatives of the tropical fauna that have penetrated into the Palaearctic Region. In North Korea all of them are found exclusively in the southern part of the country (with only one exception).

The **endemic** group includes species known only in the North Korea. This group is conditional, because many of the newly described species can be found in adjacent regions.

Finally, there are several widespread tropical tramp-species, occasionally introduced by humans to many regions, including North Korea. Some of them are outdoor species, while others live only in houses.

Table 1. Zoogeographical characteristic of North Korean ants.

Zoogeographical elements: **bor** – boreal; **trans** – Transpalaearctic; **nep** – northern eastpalaearctic; **sep** – southern eastpalaearctic; **est** – east-steppic; **ssib** – south-siberian; **ori** – oriental (tropical); **end** – endemics of North Korea; **intr** - introduced to many regions tropical species.
** - newly described species;
* - species, new for North Korea.

No	Taxa	Zoogeographical elements	Distribution in North Korea			Shared with:		
			everywhere	north	south	South Korea	Rus. Far East	Japan
	subfamily Ponerinae							
1	*Cryptopone sauteri**	sep			+	+		+
2	*Hypoponera sauteri**	sep	+			+		+
3	*Pachycondyla astuta*	ori			+	+		+
4	*Pachycondyla chinensis*	sep			+	+		+
5	*Ponera japonica*	nep	+			+	+	+
6	*P. scabra*	sep			+	+		+
	subfamily Proceratiinae							
7	*Proceratium watasei*	sep			+	+		+
	subfamily Pseudomyrmecinae							
8	*Tetraponera modesta**	ori			+			
	subfamily Myrmicinae							
9	*Aphaenogaster japonica**	nep			+	+	+	+
10	*A. famelica*	nep			+	+		+
11	*Crematogaster matsumurai*	sep			+	+		+
12	*C. osakensis*	sep			+	+		+
13	*Leptothorax acervorum*	bor		+		+	+	+
14	*L. oceanicus**	nep		+			+	
15	*Messor aciculatus*	est			+	+	+	+
16	*Monomorium chinense**	sep			+			+
17	*M. pharaonis*	intr	+			+	+	+
18	*Myrmecina flava**	sep			+	+		+
19	*M. nipponica*	nep	+			+	+	+
20	*Myrmica ademonia**	nep	+			+	+	
21	*M. angulinodis*	ssib		+		+	+	
22	*M. eidmanni**	ssib	+				+	
23	*M. excelsa**	nep	+			+	+	+

No	Taxa	Zoogeographical elements	Distribution in North Korea			Shared with:		
			everywhere	north	south	South Korea	Rus. Far East	Japan
24	*M. jessensis*	nep		+		+	?	+
25	*M. kamtschatica**	nep		+			+	
26	*M. koreana***	est	+			+	+	
27	*M. kotokui*	nep	+			+	+	+
28	*M. kurokii*	nep		+		+	+	+
29	*M. luteola**	sep			+	+	+	+
30	*M. ruginodis*	trans	+			+	+	
31	*M. sulcinodis**	bor	?				+	
32	*M. taediosa**	ssib	+			+	+	
33	*Pheidole fervida*	nep	+			+	+	+
34	*Pristomyrmex punctatus*	ori	+			+		+
35	*Solenopsis japonica*	sep			+	+		+
36	*Stenamma owstoni*	sep			+	+		+
37	*S. ussuriense**	nep		+		+	+	
38	*Strongylognathus koreanus*	sep			+			+
39	*Strumigenys lewisi*	ori			+	+		+
40	*Temnothorax congruus**	nep			+	+	+	+
41	*T. cuneinodis***	end			+			
42	*T. eburneipes**	sep			+	+		
43	*T. kaszabi**	est	+				+	
44	*T. koreanus*	sep			?	+		+
45	*T. michali***	end	+					
46	*T. mongolicus**	est			+			
47	*T. nassonovi*	est	+			+	+	
48	*T. pisarskii***	end			+			
49	*T. xanthos***	end			+			
50	*Tetramorium tsushimae**	nep	+			+	+	+
51	*Vollenhovia emeryi*	sep	+			+		+
	subfamily Dolichoderinae							
52	*Dolichoderus sibiricus*	nep	+			+	+	+
53	*Liometopum orientale**	nep		+			+	
54	*Linepithema humile**	intr			+			+
55	*Tapinoma sinense*	nep	+			+	+	
56	*Technomyrmex albipes*	intr			+	+		+
57	*T. gibbosus**	sep			+	+		+
	subfamily Formicinae							
58	*Camponotus atrox*	sep			+	+		
59	*C. herculeanus sachalinensis*	nep	+			+	+	+
60	*C. itoi*	sep			+	+		+
61	*C. japonicus*	nep	+			+	+	+
62	*C. nipponensis*	sep			+	+		+
63	*C. obscuripes*	nep		+		+	+	+
64	*C. quadrinotatus*	nep			+	+	+	+
65	*C. saxatilis**	est	+				+	
66	*Formica aquilonia**	bor		+			+	
67	*F. candida**	bor		+		+	+	+

No	Taxa	Zoogeographical elements	Distribution in North Korea			Shared with:		
			everywhere	north	south	South Korea	Rus. Far East	Japan
68	*F. japonica*	nep	+			+	+	+
69	*F. kupyanskayae**	nep		+			+	
70	*F. lemani*	bor		+		+	+	+
71	*F. lugubris*	bor		+		+	+	
71	*F. sanguinea*	trans	+			+	+	+
73	*F. truncorum**	trans		+		+	+	+
74	*F. uralensis**	trans		+			+	
75	*F. yessensis*	nep	+			+	+	+
76	*L. citrinus**	trans	+				+	
77	*L. distinguendus**	trans			+			
78	*L. flavus*	trans	+			+	+	+
79	*L. fuji***	nep	+			+	+	+
80	*L. hayashi*	nep	+			+	?	+
81	*L. japonicus*	nep	+			+	?	+
82	*L. jensi**	trans	+					
83	*L. koreanus*	nep	+			+	?	
84	*L. meridionalis*	trans	+			+	+	+
85	*L. mixtus**	trans			+			
86	*L. morisitai**	sep			+	+	+	+
87	*L. myops*	trans			+			
88	*Lasius nipponensis*	nep	+			+	+	+
89	*L. orientalis*	nep	+			+	+	+
90	*L. spathepus*	nep	+			+	+	+
91	*L. talpa*	sep			+	+		+
92	*L. umbratus*	trans			+	+	+	+
93	*Paratrechina flavipes*	sep	+			+		+
94	*P. sauteri*	sep	+			+		+
95	*Plagiolepis flavescens*	sep			+	+		+
96	*P. manczshurica*	est	+			+		
97	*Polyergus samurai*	nep			+	+	+	+
98	*Polyrhachis lamellidens*	ori			+	+		+
99	*Proformica mongolica**	est		+				
	Total:					**74**	**57**	**64**

The relations between the different zoogeographical elements in the North Korean myrmecofauna are shown in Fig. 45.

As mentioned above, Kryzhanovski (2002) supposed that the boundary between the Manchurian and Chinese-Himalayan Superprovinces lies somewhere in the Korean Peninsula. The data based on the analysis of the distribution of North Korean ants allow me to define this border approximately at the 40°N latitude. Hence, North Korea is quite distinctly divided faunistically into two different parts – northern and southern, which respectively belong to the Manchurian and Chinese-Himalayan Superprovinces.

Thus, only 41 out of 99 North Korean ant species are common to these two regions. The fauna of the southern part of the country is much richer than in the northern part (82 species *versus* 58). In addition, these two faunas are quite different in terms of zoogeographical composition (compare Figs 46 and 47). First of all, the portion of southern eastpalaearctic and Oriental elements is essentially decreasing in the northern part, whereas boreal elements are practically absent from the south.

The considerable differences in the ant fauna between the south and north of North Korea are also illustrated by quite low values of Jaccard's coefficient of faunal similarity (JC), which is only 0.414, being distinctly

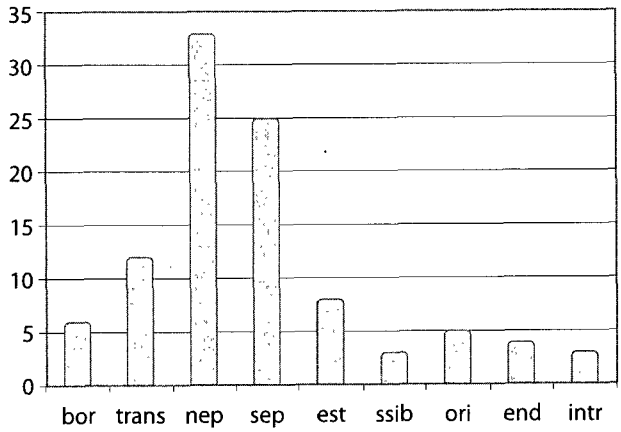

Figure 45. Correlation of zoogeographical elements in the North Korean myrmecofauna.

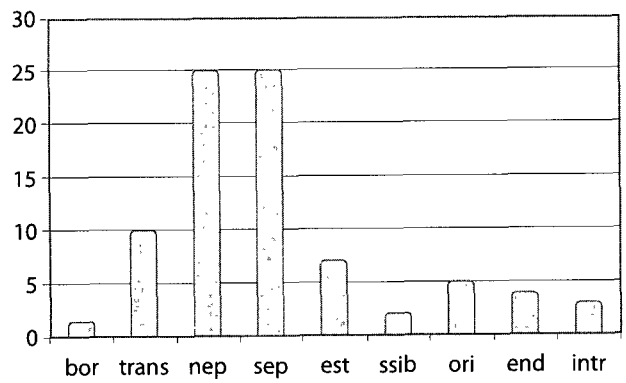

Figure 46. Correlation of the zoogeographical elements in the southern part of the North Korean myrmecofauna.

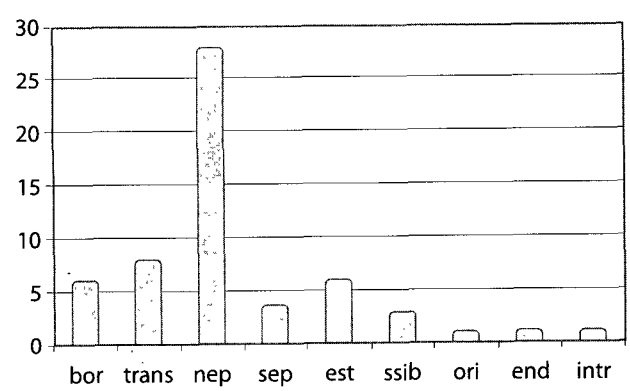

Figure 47. Correlation of the zoogeographical elements in the northern part of the North Korean myrmecofauna.

lower than the similarity coefficients between the North Korean, South Korean and Russian Far East ant faunas (see below).

Jaccard's coefficient is defined by the following equation: $JC=c/(a+b-c)$ $(0 \leq JC \geq 1)$, where: a, b – number of species in the two regions being compared; c – number of species common to these two regions.

To understand better the peculiarity of the North Korean myrmecofauna, it is necessary to compare it with the faunas of the adjacent regions, particularly with South Korea, the Russian Far East and Japan. Unfortunately, the data for a detailed comparison of the North Korean ant fauna with those of northern and north-eastern China are still insufficient.

The ant fauna of all three regions mentioned above has been investigated well enough. Data on the taxonomy, ecology and distribution of the ants of the Russian Far East are taken from the monographs of Kupyanskaya (1990, 1995) (with additions and alterations), and the results of long-term investigations of the Japanese myrmecofauna are summarised by Imai et al. (2003).

While there are no monographic revisions on the ants of South Korea yet, there are plenty of articles devoted to the taxonomy, faunistic and ecology of the ants in this country, and several modern catalogues of the species (Paik 1984, Terayama et al. 1992, Kim B.-J. 1996, 2003; see also references in these papers).

The latest ant list of the Korean Peninsula (Kim B.-J. 2003) includes 136 species and the author expected that more than 200 species could be found here. Having finished my present revision and having excluded some doubtful and erroneous ant records (see above), I counted 104 species in South Korea, and now 117 ant species are known in the Korean Peninsula. There is no doubt that some more ant species will be found in North and South Korea and the faunistic list will be longer, but as for me, the anticipated number of 200 potential ant species is too high. The occurrence of about 150 ant species may be supposed in the Korean Peninsula. First of all, the conclusion in question is based on the premise that finding of many tropical species in Korea, which, for example, are quite common in Southern China, Taiwan or Southern Japan, is questionable (see also the discussion below), and on the typically Palaearctic character of the myrmecofauna of the adjacent regions.

The species, which are distributed only in the southern part of the Russian Far East (e.g. in the East-Asian Subregion), are chosen for a comparative analysis of the ant faunas of North Korea and the Russian Far East. At the same time species found only in the South Kurily Islands (Shikotan, Kunashir) are excluded from this analysis and grouped together with the Japanese fauna, being genetically connected with the latter.

A comparison of the North Korean myrmecofauna with the Japanese fauna has been carried out twice, because the latter fauna is considerably heterogenic. According to the latest data, 275 ant species are known in Japan (Imai et al. 2003, with additions), and 128 of them were found only in the subtropical and tropical parts of the country, which I have placed in the Oriental Region (see below). The first analysis includes all Japanese species, but the second one excludes these 128 "tropical" species. In my opinion, this approach more adequately characterises the similarities and differences between the two Palaearctic temperate faunas. The results of the analysis are presented in Table 2.

Table 2. Jaccard's value (vertical) and number of common species (horizontal) of ants in the compared regions.

Regions	North Korea	South Korea	Russian Far East	Japan (whole country's fauna)	Japan (without "tropical" species)
North Korea	—	74	57	64	64
South Korea	0.566	—			
Russian Far East	0.483		—		
Japan (whole country's fauna)	0.206			—	
Japan (without "tropical" species)	0.351				—

It is obvious from Table 2 that the myrmecofauna of North Korea is the most similar to that of South Korea and the Russian Far East, and the least related to the Japanese fauna. There are some reasons for this anticipated result, and I think that climatic and historical factors are the most important among them.

Historically, the territories of the Russian Far East and the Korean Peninsula formed the same region at least from the early Tertiary period. Furthermore, in the Pleistocene epoch it was not catastrophically affected by glaciations, as there were only local glaciers in the mountains. Consequently, throughout the history of the formation of the modern myrmecofauna, there were no insuperable barriers for the swapping of some faunistic elements between the Russian Far East and the Korean Peninsula.

The history of the origin of the Japanese myrmecofauna, which has a noticeable island character, was quite different. The separation of the Japanese Islands from the continental mainland began at the boundary of the Oligocene and Miocene (ca 25 Ma) in the north-east, though a land connection in the south-east (in the area of the modern Korean Peninsula) existed till the Middle Miocene (ca 16 Ma) (Hayashida et al. 1988). Later there were some periodic junctions between different islands as well as between the islands and the continent. The last connection was recorded in the Middle Pleistocene in the north via the island of Sakhalin and further through the four main Japanese Islands until the south of the Korean Peninsula, turning the Sea of Japan into a lake. Later, from the Late Pleistocene until the Holocene, the continental connection in the south was interrupted and existed only via Sakhalin Bridge (Monin and Shyshkov 1979, Zubakov 1986, Momohara 1994, Millien-Parra and Jaeger 1999).

At the same time, the climate in the Late Pleistocene in Sakhalin and in the north of Hokkaido was much colder than nowadays and there were tundra-like landscapes and vegetation there, which prevented the spread of ants from the continent. Simultaneously, in the more southern regions (modern southern part of the island Honshu, islands Shikoku and Kyushu) cold periods alternated with warm ones, although temperate mixed deciduous forests and even evergreen broad-leaved forests were preserved, where heat-loving pre-Pleistocenic fauna could survive (Iwauchi 1994, Millien-Parra and Jaeger, 1999).

At present southern Japan is separated from the continent by the Korean Strait and by the Tsushima Strait. They are considerable barriers to the exchange of species between the mainland and the islands, as has been confirmed by comparative analyses of the South Korean and Japanese myrmecofaunas (Choi et al. 1993, Terayama et al. 1998, see also Millien-Parra and Jaeger 1999). For example, the similarity between the ant faunas of the extreme southern part of the Korean Peninsula and north-western part of Kyushu Isl. is quite low, despite the close proximity of these areas. Jaccard's value (JC) for these two regions is only 0.423 (Choi et al. 1993), whereas the similarity between the ant fauna in South Korean and on the island of Honshu one is significantly higher (JC = 0.512) (Terayama et al. 1998). To all appearances, there is more to this essential difference of the modern fauna of the Korean Peninsula and south of Japan than only historical factors.

Most importantly, the limit of distribution of the Oriental (tropical) fauna runs across the south of Japan. It approximately coincides with several important climatic separating lines, which are astonishingly akin to one another. First, this is the average January isotherm of +5°C. Then, the -3.5°C isotherm of mean minimum year temperature (Imai 1971). Finally, there is the 120°C isotherm of so-called Kira's warm index [WI = Σ (t-5), where t – the average temperature of a month] (Choi et al. 1993). Such a coincidence of several climatic indices is without doubt not casual and reflects global and regional climatic processes.

This line crosses Japan on the extreme south of the island of Honshu, so that the islands of Sikoku and Kyushu are situated southward of it. Further, it runs to the south-west through the Tsushima Strait, encircles the Korean Peninsula from the south, and in China it goes approximately from the downstream part of the Hwang Ho up to the south-east slope of Tibet.

As mentioned above, this is the dividing line, with Oriental faunistic elements, dominating southward of it, and Palaearctic ones dominating northward, what is wholly confirmed by the analysis of the myrmecofauna. Certainly, this limit is not sharp and absolute, and defines a zone of intergradations between the large zoogeographical Regions – Palaearctic and Oriental.

The above information helps to understand the essential differences between the myrmecofaunas of the closely

located south of the Korean Peninsula and Kyushu Island, whereas the regions which are situated approximately at the same latitude and have similar climatic conditions (South Korea and Hokkaido Island, North Korea and "non-tropical" Japan), have quite similar faunas.

The last question is why latitude 40°N is also the line of the faunistic division, although it is less important than the separating lines mentioned above.

Some interesting data confirming my conclusion about the differences of the ant fauna northward and southward of latitude 40°N have been published by Qian et al. (2003). In that paper, the authors compared the phytogeographical patterns in East Asia, from the Arctic Ocean until southern China. They proved that the most drastic changes in flora are at latitude 40°N! The numbers of the subtropical/tropical plant genera abruptly decreases northward of this latitude and to the south of it the rate of temperate genera is suddenly decreased. In East Asia this latitude corresponds more or less with another important climatic line: the +10°C isotherm of mean annual temperature. It is also interesting to note that the annual mean isotherm of +10°C is the limit of the distribution in both the North and South Hemispheres of termites (Isoptera), which are mainly tropical and are of tropical origin.

I cannot definitely say what physiological or other biological processes have led to the divisions of the myrmecofauna mentioned above, but the correlation of the zoogeographical boundaries with climatic ones is quite obvious.

KEYS FOR IDENTIFICATION OF THE ANTS OF NORTH KOREA

For the general ant morphology and measurements see Figures 48–49.

Morphometrics of a sample of specimens were measured (accurate to 0.01mm) and these were used to calculate various indices:

HL length of head in dorsal view, measured in a straight line from the anterior point of median clypeal margin to mid-point of the occipital margin.
HW maximum width of head in dorsal view behind the eyes.
FW minimum width of frons between the frontal lobes.
FLW maximum width between external borders of the frontal lobes.
SL maximum straight-line length of scape seen in profile.
AL diagonal length of the alitrunk seen in profile, from the neck shield to the posterior margin of propodeal lobes (workers) and from the anterio-dorsal point of alitrunk to posterior margin of propodeal lobes (queens and males).
PL maximum length of petiole from above.
PH maximum height of petiole in profile.
PW maximum width of petiole from above.
PnL length of petiolar node from above.
ESL maximum length of propodeal spine in profile, measured from the mid-point of imaginary line between spine's base to the tip of spine.
OI maximum diameter of eye

Indices:

CI=HL/HW
FI=FW/HW
FLI=FLW/FW
SI_1=SL/HL
SI_2=SL/HW
PI=PL/PH
PnI=PW/PnL
ESLI=ESL/HW
OI=OL/HW

Key to subfamilies

Workers and queens

1. Body with one isolated segment (petiole) between alitrunk and gaster (Figs 50, A–B, J–M; 51, H, J; 55, A–D, I; 56, C–D; 57, B, E–F, J, L, N; 58, A–D, O–Q; 59, A, C, G, L, O; 60, A, H; 61, I, M) 2
–. Body with two isolated segments (petiole and postpetiole) between alitrunk and gaster (Figs 52, A, F, I, N–O, R–S; 63, C–F; 64, B, F, I–J; 65, B, E, G–H, J; 66, B–D, F, H–K) 5

2(1). 1st gastral segment separated from the second one by distinct constriction (Figs 50, A–B). Sting present, always visible without dissection 3
–. 1st gastral segment not separated from the 2nd one by constriction (Figs 55, A–C; 58, C–D; 60, H). Sting absent or rudimental, not visible without dissection 4

3(2). Tergite of 2nd gastral segment much bigger than its sternite, strongly arched and vaulted so that gaster curved downwards and its apex directed antero-ventrally (Fig. 50, A) ..... **Proceratiinae**
In North Korea one genus – ***Proceratium*** Roger, with one species – ***P. watasei*** (Wheeler)
–. Tergite of second gastral segment subequal to its sternite, not arched, gaster does not curved downwards and its apex directed backwards (Fig. 50, B) ..... **Ponerinae**

4(2). Apex of gaster with circular nozzle-like acidopore, fringed with setae (coronula) (Figs 51, A; 58, C–D; 60, H); if acidopore and coronula are absent, antennae join distinctly behind the posterior clypeal margin (Figs 56, A–B)..... **Formicinae**
–. Apex of gaster lacking acidopore and coronula (Fig. 51, B); antennae always join close to the posterior clypeal margin..... **Dolichoderinae**

5(1). Pretarsal claws with additional tooth on the inner margin (Fig. 51, C). Eyes very big, OI > 0.40 (Fig. 51, D) ..... **Pseudomyrmecinae**
In North Korea one genus – ***Tetraponera*** F. Smith, with one species – ***T. modesta*** F. Smith
–. Pretarsal claws simple, without additional tooth on the inner margin. Eyes much smaller or even absent, OI < 0.30 (Figs 52, B–C, E, G–H, J, M, R–S; 63, A–B, I; 64, A, G; 65, A, D; 66, A, E, G, L–M) ..... **Myrmicinae**

Males

1. Body with one isolated segment (petiole) between alitrunk and gaster (Figs 55, R; 58, M–N) **2**
–. Body with two isolated segments (petiole and postpetiole) between alitrunk and gaster (Figs 51, E–F; 53, E, N–O; 54, A–B, L–M) **5**
2(1). 1st gastral segment separated from the second one by distinct constriction **3**
–. 1st gastral segment not separated from the second one by constriction **4**
3(2). Forewing with one cubital cell. 2nd gastral tergite strongly arched dorsally, gastral apex directed downwards ..... **Proceratiinae**
–. Forewing with two cubital cells. 2nd gastral tergite not arched, gastral apex directed backwards ..... **Ponerinae**
4(2). Mandibles triangular, masticatory margin long, multidentate or even serrate, with more than 10 small teeth (Figs 55, E–F). Middle tibia with pectinate spur ..... **Dolichoderinae**
–. Mandibles elongate, masticatory margin short, never serrate, with not more than 6 teeth, or even edentate (Fig. 55, O). Middle tibia with simple spur ..... **Formicinae**
5(1). Postpetiole widely attached to the 1st gastral segment, which is anteriorly nearly as wide as postpetiole (seen from above); petiole with very long peduncle and without node (seen in profile) (Figs 51, E–F) ..... **Pseudomyrmecinae**
–. Postpetiole narrowly attached to 1st gastral segment, which is much wider than postpetiole (seen from above); petiole with much shorter peduncle or even without it, node always developed (seen in profile) (Figs 53, E, N–O; 54, A–B, L–N) ..... **Myrmicinae**

Keys to genera

Subfamily Ponerinae

Workers and queens

1. Middle tibia with row of coarse bristles on dorsal (outer) surface, attended by fine hairs (Fig. 50, C). Mandibles with big elongate fovea at their base (Fig. 50, D) ..... ***Cryptopone*** Emery
In North Korea one species – ***C. sauteri*** (Wheeler)
–. Middle tibia without bristles on dorsal (outer) surface, only with fine hairs (Fig. 50, E). Mandibles without or with fovea at their base (Figs 51, G, I) **2**
2(1). Hind tibia with two spurs: big pectinate one and much smaller simple one (Fig. 50, F). Eyes well developed (Fig. 50, G) .... ***Pachycondyla*** F. Smith
–. Hind tibia with one pectinate spur (Fig. 50, H). Eyes minute, often from several ommatidia (Fig. 50, I) **3**
3(2). Subpetiolar process with foramen, sharply angulate or with tooth behind (Figs 50. B, J, L) ..... ***Ponera*** Latreille
–. Subpetiolar process without foramen, rounded and without tooth behind (Fig. 50, N) ..... ***Hypoponera*** Santschi
In North Korea one species – ***H. sauteri*** (Forel)

Males

1. Hind tibia with two spurs: big pectinate one and much smaller simple one **2**
–. Hind tibia with one pectinate spur **3**
2(1). Notauli on the scutum present ..... ***Pachycondyla*** F. Smith
–. Notauli on the scutum absent... ***Cryptopone*** Emery
3(1). Pygidium with spine, which curved downwards. Subpetiolar process sharply angulate or with tooth behind ..... ***Ponera*** Latreille
–. Pygidium without spine. Subpetiolar process rounded and without tooth behind ..... ***Hypoponera*** Santschi

Subfamily Myrmicinae

Workers and queens

1. Postpetiole articulated on dorsal surface of 1st gastral segment; petiole flattened dorsoventrally, without node (Fig. 52, A) ... ***Crematogaster*** Lund
–. Postpetiole articulated on anterior surface of 1st gastral segment; petiole not flattened dorsoventrally, with node of different shape (Figs 52, F, I, N–O, R–S; 63, E–F; 64, B, F, I–J; 65, B, E, G–H, J; 66, B, F, H–K) **2**
2(1). Antennae with conspicuous 1–2-segmented club (Fig. 52, B) **3**
–. Antennae with 3–5-segmented club or without club (Figs 52, P–Q) **4**
3(2). Antennae with 10 segments (in queens – with 11 segments). Mandibles not elongate, subtriangular (Fig. 52, B) ..... ***Solenopsis*** Westwood
In North Korea one species – ***S. japonica*** Wheeler
–. Antennae with 6 segments. Mandibles long and linear (Fig. 52, C) ..... ***Strumigenys*** F. Smith
In North Korea one species – ***S. lewisi*** Cameron
4(2). Mandibles narrow and falcate, without masticatory margin and teeth (Fig. 52, D) ..... ***Strongylognathus*** Mayr
In North Korea one species – ***S. koreanus*** Pisarski

–. Mandible wide, triangular, with distinct masticatory margin, which is usually with teeth (Figs 52, E, G, M; 63, A–B, I; 64, A, G; 65, A, D; 66, A, E, G, L–M) **5**

5(4). Antennae with 11 segments **6**

–. Antennae with 12 segments **8**

6(5). Frontal lobes absent, so that antennal sockets completely exposed (Fig. 52, E). Propodeum with long spines (Fig. 52, F) .... ***Pristomyrmex*** Mayr
In North Korea one species – ***P. punctatus*** (F. Smith)

–. Frontal lobes present and at least partly cover antennal sockets (Fig. 52, G). Propodeum with much shorter spines or with denticles (Figs 63, E–F)... **7**

7(6). Anterolateral corners of pronotum widely rounded (seen from above) (like in Fig. 66, D)..... ..... ***Leptothorax*** Mayr

–. Anterolateral corners of pronotum distinctly marked, slightly angulate (seen from above) (like in Fig. 66, C)..... ***Temnothorax*** Mayr (part.)

8(5). Ventrolateral margin of head delineated by sharp longitudinal carina on each side (Fig. 52, H). Petiole low, without peduncle, gable-like in profile (Fig. 52, I)..... ***Myrmecina*** Curtis

–. Ventrolateral margin of head not delineated by longitudinal carina (Fig. 52, J). Petiole of another shape (Figs 52, N–O, R–S; 64, B, F, I–J; 65, B, E, G–H, J; 66, B, F, H–K) **9**

9(8). Palp formula 6, 4. Middle and hind tibiae usually with single large pectinate spur, which distinctly longer than width of tibia at the apex (Fig. 52, K), only in some species spurs may be reduced (Figs 64, D–E). Propodeum with spine (Figs 64, B, I–J; 65, B, E, G–H, J) (only in queens of *Myrmica lutеola* propodeum with blunt tubercles, Fig. 64, F). Body length of workers more than 5.5 mm ....***Myrmica*** Latreille

–. Palp formula less than 6, 4. Middle and hind tibiae usually with single simple spur (Fig. 52, L); if spur pectinate, it is shorter than width of tibia at the apex. Propodeum rounded, angulate or with short denticles (Figs 52, N–O, R–S; 66, B–D, J–K); if propodeum with long spines (Figs 66, F, H, I) workers smaller, body length less than 4 mm **10**

10(9). Lateral portion of clypeus raised into sharp ridge in front of antennal insertions (Fig. 52, M)..... ..... ***Tetramorium*** Mayr
In North Korea one species – ***T. tsushimae*** Emery

–. Lateral portion of clypeus not raised into sharp ridge in front of antennal insertions (Figs 63, A–B; 66, A, E, G, L–M)..... **11**

11(10). Propodeum rounded or angulate, without denticles, at most with blunt tubercles (Figs 52, N–O) **12**

–. Propodeum with sharp denticles or spines (Figs 52, R–S; 66, B–D, F, H–K) **14**

12(11). Petiole sessile, without anterior peduncle, ventrally with wide plate-like process (Fig. 52, N) ..... ***Vollenhovia*** Mayr
In North Korea one species – ***V. emeryi*** Wheeler

–. Petiole with distinct, quite long anterior peduncle and without ventral process (Fig. 52, O)..... **13**

13(12). Small monomorphic species, body length of workers less than 3.5 mm, that of queens less than 6 mm..... ***Monomorium*** Mayr

–. Much bigger polymorphic species, body length even of small worker more than 4.5 mm, that of queens more than 8 mm ..... ***Messor*** Mayr
In North Korea one species – ***M. aciculatus*** (F. Smith)

14(11). Antenna with 3-segmented club (Fig. 52, P).. **15**

–. Antennae with 4–5-segmented club, or without it (Fig. 52, Q)..... **16**

15(14). Dimorphic species. Head of **soldiers** bigger than alitrunk, with very short scape, which far not reaches occipital margin (Fig. 52, R). Alitrunk of **workers** with deep metanotal groove, promesonotum strongly convex and distinctly raised over level of propodeal dorsum (Fig. 52, S); scape long, surpassing occipital margin not less than on ¼ of its length, $SI_1 > 1.05$. **Queens** bigger, body length more than 6.5 mm, head transversal, CI < 1.00 ..... ***Pheidole*** Westwood
In North Korea one species – ***Ph. fervida*** (F. Smith)

–. Monomorphic species. Alitrunk dorsum with shallow metanotal groove or without it, at most slightly convex or flat, promesonotum not raised over level of propodeal dorsum (Figs 66, B, F, H–K); scape shorter, at most slightly surpassing occipital margin, $SI_1 < 1.00$. **Queens** smaller, body length less than 5.5 mm, head elongate, CI > 1.00..... ***Temnothorax*** Mayr (part)

16(14). Scape long, much exceeding occipital margin of head, $SI_2 > 0.90$, usually >1.00. Eyes distinctly bigger, OI > 0.20 ..... ***Aphaenogaster*** Mayr

–. Scape shorter, at most slightly exceeding occipital margin of head, $SI_2 < 0.80$. Eyes very small, OI < 0.15 ..... ***Stenamma*** Westwood

Males

1. Antennae with 10 segments, second funicular segment very long, distinctly longer than three following segments together (Fig. 53, A)..... **2**

–. Antennae with 11–13 segments, second funicular segment not very long, distinctly shorter than three following segments together (Figs 53, H–J, L; 54, G, I–K)..... **3**

2(1). Mandibles triangular, with teeth on masticatory margin (Fig. 53, B) ..... ***Tetramorium*** Mayr

–. Mandibles narrow, falcate, without teeth (Fig. 53, C) ..... ***Strongylognathus*** Mayr

3(1). Wing venation reduced (Fig. 53, D). Petiole and postpetiole ventrally with spongiform tissue

(Fig. 53, E). Very small species, body length less than 2 mm ..... ***Strumigenys*** F. Smith
–. Wing venation well developed (Figs 53, K, M; 54, C–E). Petiole and postpetiole ventrally without spongiform tissue (Figs 53, N–O; 54, B, L–M). Bigger species, body length more than 2 mm... **4**
4(3). Scutum without notauli (Fig. 53, F)..... **5**
–. Scutum with notauli (Fig. 53, G)..... **10**
5(4). Eyes with very abundant hairs.... ***Vollenhovia*** Mayr
–. Eyes without hairs or with sparse ones **6**
6(5). Antennae with 12 segments..... **7**
–. Antennae with 13 segments..... **8**
7(6). Postpetiole articulated on dorsal surface of 1st gastral segment. 3rd to 5th funicular segments nearly as long as wide (Fig. 53, H) .... ***Crematogaster*** Lund
–. Postpetiole articulated on anterior surface of 1st gastral segment. 3rd to 5th funicular segments distinctly longer than their width (Fig. 53, I) .... ***Solenopsis*** Westwood
8(6). 1st funicular segment (pedicel) globular (Fig. 53, J). Forewing with one closed cubital cell (Fig. 53, K). Smaller species, body length not more than 4 mm ..... ***Monomorium*** Mayr
–. 1st funicular segment (pedicel) not globular (Fig. 53, L). Forewing with two closed cubital cells (Fig. 53, M). Bigger species, body length more than 5 mm **9**
9(8). Alitrunk high, strongly convex, body with sparse short straight standing hairs (Fig. 53, N)..... ..... ***Aphaenogaster*** Mayr
–. Alitrunk relatively low, slightly convex, with long abundant curved standing hairs (Fig. 53, O) .... ***Messor*** Mayr
10(4). Antennae with 12 segments..... **11**
–. Antennae with 13 segments..... **12**
11(10). Alitrunk distinctly longer than high (Fig. 54, A) . ..... ***Leptothorax*** Mayr
–. Alitrunk nearly as long as high (Fig. 54, B)..... ..... ***Pristomyrmex*** Mayr
12(10). Forewing with one cubital cell, which is partly separated by short vein (Fig. 54, C). Middle and hind tibiae with pectinate spur ..... ***Myrmica*** Latreille
–. Forewing with one or with two completely separated cubital cells (Figs 54, D–E). Middle and hind tibiae with simple spur **13**
13(12). Mandibles reduced, small, narrow, with short edentate masticatory margin (Fig. 54, F). Forewing darkened, with coarse veins and always without discoidal cell (Fig. 54, D). Scape shorter than 2nd and 3rd funicular segments together (Fig. 54, G) ..... ***Myrmecina*** Curtis
–. Mandibles well developed, subtriangular, with distinct masticatory margin, which is at least with 3 teeth (Fig. 54, H). Forewing transparent, not darkened, with fine veins and with discoidal cell (in *Temnothorax* it is occasionally absent) (Fig. 54, E); scape of different length (Figs 54, I–K) **14**
14(13). 1st funicular segment (pedicel) globular, scape very short, subequal to 2nd and 3rd funicular segments together (Fig. 54, I) ..... ***Pheidole*** Westwood
–. 1st funicular segment (pedicel) not globular, scape distinctly longer than 2nd and 3rd funicular segments together (Figs 54, J–K) **15**
15(14). Antennae without distinct apical club (Fig. 54, J); petiole with long cylindrical anterior peduncle (Fig. 54, L) ..... ***Stenamma*** Westwood
–. Antennae with distinct 4-segmented apical club (Fig. 54, K); petiole with shorter peduncle (Fig. 54, M)..... ***Temnothorax*** Mayr

Subfamily Dolichoderinae

Workers

1. Petiole lacking scale, overlapped by gaster (Fig. 55, A)... **2**
–. Petiole with scale, does not overlapped by gaster (Figs 55, B–D) **3**
2(1). In dorsal view only four gastral tergites visible; anal office opening ventrally..... ***Tapinoma*** Förster
In North Korea one species – ***T. sinense*** Emery
–. In dorsal view five gastral tergites visible; anal office opening apically..... ***Technomyrmex*** Mayr
3(1). Integument thick, solid, alitrunk with quite coarse sculpture (foveolate, punctate or granulate); gaster black and with four light spots on 1st and 2nd tergites; propodeal declivity in profile deeply concave (Fig. 55, B)..... ***Dolichoderus*** Lund
In North Korea one species – ***D. sibiricus*** Emery
–. Integument thin, relatively soft, body more or less smooth or with fine micropunctures; gaster black or dark brown, without light spots; propodeal declivity in profile straight or convex (Figs 55, C–D)..... **4**
4(3). Alitrunk (seen in profile) regularly arched, without metanotal groove, only with distinct metanotal suture (Fig. 55, C). Alitrunk reddish, gaster dark brown to black..... ***Liometopum*** Mayr
In North Korea one species – ***L. orientale*** Karawajew
–. Alitrunk (seen in profile) not regularly arched, with distinct metanotal groove (Fig. 55, D). Whole body dark brown to black ..... ***Linepithema*** Mayr
In North Korea one species – ***L. humile*** (Mayr)

Males

1. Scape long, surpassing occipital margin of the head, $SI_2 > 0.90$ (Fig. 55, E) ..... ***Tapinoma*** Förster
–. Sape short, far not reaching to the occipital margin of the head, $SI_2 < 0.45$ (Fig. 55, F) **2**
2(1). Forewing with two cubital cells (Fig. 55, G)..... **3**
–. Forewing with one cubital cell (Fig. 55, H) **4**
3(2). Smaller species, HW < 0.8, AL < 1.7 mm. Alitrunk and margins of head without standing hairs or at most with sparse and short ones. Scape shorter, $SI_2 < 0.35$ ..... ***Dolichoderus*** Lund

–. Bigger species, HW > 1.2, AL > 3.0 mm. Alitrunk and margins of head with abundant, long standing hairs (Fig. 55, F). Scape longer, $SI_2 > 0.40$ ..... ***Liometopum*** Mayr

4(2). Masticatory margin of mandibles longer, serrate ..... ***Technomyrmex*** Mayr

–. Masticatory margin of mandibles shorter, multidentate but not serrate ..... ***Linepithema*** Mayr

Subfamily Formicinae

Workers and queens

1. Alitrunk with spines; petiolar scale with long hook-like spines (Fig. 55, I)..... ***Polyrhachis*** F. Smith
In North Korea one species – ***P. lamellidens*** F. Smith

–. Alitrunk and petiolar scale without spines (Figs 56, C–D; 57, B, E–F, J, L, N; 58, A–B, O–Q; 59, A, C, G, L, O; 60, A, H; 61, I, M) **2**

2(1). Mandible narrow and falcate, without masticatory margin and teeth (Fig. 55, J).... ***Polyergus*** Latreille
In North Korea one species – ***P. samurai*** Yano

–. Mandible broad, subtriangular, with distinct masticatory margin and teeth (Figs 55, K–M; 56, A–B, G–H; 57, I, K, M, O; 59, K, N; 60, B, G; 61, A, F, L; 62, D–E) **3**

3(2). Antennae with 11 segments. Body of workers small, less than 3 mm ..... ***Plagiolepis*** Mayr

–. Antennae with 12 segments. Body of workers larger, more than 3.5 mm..... **4**

4(3). Antennae jointed distinctly behind posterior clypeal margin (Figs 56, A–B) ..... ***Camponotus*** Mayr

–. Antennae jointed close to posterior clypeal margin (Figs 55, K; 57, I, K, M, O; 59, K, N; 60, B, G; 61, A, F, L) **5**

5(4). Eyes situate at or in front of the midlength of sides of head (Fig. 55, K)... ***Paratrechina*** Motschoulsky

–. Eyes situate distinctly behind of the midlength of sides of head (Figs 57, K, M, O; 59, K, N; 60, B, G; 61, A, F, L; 62, D–E) **6**

6(5). Dorsal surface of propodeum in workers distinctly shorter than its declivity (Figs 58, Q; 59, A, C, G, L, O). In all castes hind coxae widely separated in ventral view, their inner margins far apart when the coxae directed outwards..... ***Lasius*** Fabricius

–. Dorsal surface of propodeum in **workers** subequal to its declivity (Figs 57, B, E–F, J, L). In all castes hind coxae close together in ventral view, their inner margins touching or almost touching when the coxae directed outwards..... **7**

7(6). Apical tooth of mandible distinctly longer than preapical one (Fig. 55, L). Whole body dark brown to black ..... ***Proformica*** Ruzsky
In North Korea one species – ***P. mongolica*** (Emery)

–. Apical tooth of mandible only slightly longer than preapical one (Fig. 55, M). Body dark brown to black or bicoloured, with reddish alitrunk and blackish gaster ..... ***Formica*** Linnaeus

Males

1. Mandibles narrow, elongate, without masticatory margin, stick-like (Fig. 55, N).... ***Polyergus*** Latreille

–. Mandibles widened, with at least narrow but distinct masticatory margin (Fig. 55, O)..... **2**

2(1). Antennae with 12 segments.... ***Plagiolepis*** Mayr

–. Antennae with 13 segments..... **3**

3(2). Antennae jointed distinctly behind posterior clypeal margin **4**

–. Antennae jointed close to posterior clypeal margin **5**

4(3). Dorsal surface of 1st gastral tergite without setae, at most with decumbent pubescence ..... ***Polyrhachis*** F. Smith

–. Dorsal surface of 1st gastral tergite with at least a few setae ..... ***Camponotus*** Mayr

5(3). Body small, not more than 2.5 mm. Mesopleura smooth and shiny (seen under magnification more than 50 ×). Forewing without discoidal cell (Fig. 55, P)..... ***Paratrechina*** Motschoulsky

–. Body larger, not less than 3.5 mm.. Mesopleura with at least microsculpture, appears dull (seen under magnification more than 50×). Forewing with discoidal cell (Fig. 55, Q) (in *Lasius* it is occasionally absent)..... **6**

6(5). Hind coxae widely separated in ventral view, their inner margins far apart when the coxae directed outwards. Gaster, seen from above, subtriangular, genitalia small (Fig. 55, R). Propodeal spiracle circular or semicircular. Body smaller, less than 5 mm ..... ***Lasius*** Fabricius

–. Hind coxae close together in ventral view, their inner margins touching or almost touching when the coxae directed outwards. Gaster, seen from above, subcylindrical, genitalia big (Figs 58, M–N). Propodeal spiracle distinctly elongate. Body larger, more than 5.5 mm..... **7**

7(6). Subgenital plate distally curved upwards and forwards, forming loop (seen in profile, Fig. 55, S)... ***Proformica*** Ruzsky

–. Subgenital plate distally straight, not curved upwards (seen in profile, Fig. 55, T)..... ***Formica*** Linnaeus

Keys to species

Subfamily Ponerinae

Ponera

Workers

1. Petiolar node narrower and not massive, its posterior margin (seen from above) very slightly concave, PnI < 1.7; petiole and dorsum of alitrunk finely and sparsely punctate (Figs 50, J–K). Smaller species, HW < 0.50, AL < 0.85 mm ..... ***P. japonica*** Wheeler

–. Petiolar node wide and massive, its posterior margin (seen from above) distinctly concave, PnI > 2; petiole and dorsum of alitrunk coarsely and densely punctate (Figs 50, L–M). Bigger species, HW > 0.60, AL > 1.00 mm ..... ***P. scabra*** Wheeler

Pachycondyla

Workers and males

1. Metanotal groove not developed, propodeal dorsum lays on the same level as promesonotal dorsum (Fig. 51, H). Mandibles without fovea at their base (Fig. 51, G). Bigger species, body length 8–10 mm. **Males**: body black; bigger species, HW > 1.2, AL > 2.5 mm..... ***P. astuta*** (F. Smith)

–. Metanotal groove deep, so that propodeal dorsum lays lower than promesonotal dorsum (Fig. 51, J). Mandibles with elongate fovea at their base (Fig. 51, I). Smaller species, body length 5–6 mm. **Males**: body yellowish; smaller species, HW < 0.8, AL < 2.0 mm..... ***P. chinensis*** (Emery)

Subfamily Dolichoderinae

Technomyrmex

Workers

1. Whole body black, antennal funiculi and tarsi of legs yellowish-white. 1st to 3rd gastral tergites with erect hairs. Eyes situate at about midlength of sides of head..... ***T. albipes*** (F. Smith)

–. Head and alitrunk reddish brown to brown, distinctly lighter than dark brown to black gaster, antennal funiculi and tarsi of legs yellowish-brown. 1st to 3rd gastral tergites without erect hairs. Eyes situate distinctly in front of midlength of sides of head..... ***T. gibbosus*** Wheeler

Subfamily Formicinae

Camponotus

Workers

1. Anterior clypeal margin distinctly notched medially (Fig. 56, A)..... **2**

–. Anterior clypeal margin not notched medially (Fig. 56, B) **3**

2(1). Alitrunk dorsum with sparse (usually less than 15) standing hairs (Fig. 56, C). 1st and 2nd gastral tergites with a pair of light spots..... ***C. quadrinotatus*** Forel

–. Alitrunk dorsum with numerous (usually more than 20) standing hairs (Fig. 56, D). 1st and 2nd gastral tergites without light spots..... ***C. nipponensis*** Santschi

3(1). Head dark brown to black, alitrunk red, gaster entirely black or with red spot at the base of 1st tergite..... **4**

–. Whole body blackish-brown to black, only mandibles, and occasionally ventral surface of head, reddish... **5**

4(3). 1st gastral tergite with red spot at its base. Gastral tergites with sparse pubescence, distance between appressed hairs 1.2–1.5 times shorter than hairs' length (similar to Fig. 56, E)... ***C. obscuripes*** Mayr

–. Gaster entirely black. Gastral tergites with dense pubescence, distance between appressed hairs 4–6 times shorter than hairs' length (like in Fig. 56, F) ..... ***C. atrox*** Emery

5(3). Smaller species, body length of the largest workers not more than 7 mm. Surface of body with very fine superficial microsculpture, appears shiny ..... ***C. itoi*** Forel

–. Bigger species, body length of the smallest workers not less than 7–8 mm. Surface of body with distinct microsculpture, appears dull..... **6**

6(5). Gastral tergites with sparse and short pubescence, distance between appressed hairs 2–2.5 times shorter than hairs' length (Fig. 56, E). Mandibles densely sculptured, with small foveae, spots and striation (Fig. 56, G)..... ***C. herculeanus sachalinensis*** Forel

–. Gastral tergites with denser and longer pubescence, distance between appressed hairs 4–6 times shorter than hairs' length (Fig. 56, F). Mandibles differently sculptured **7**

7(6). Mandibles finely sculptured, with only small foveae and spots, without striation (Fig. 56, H)..... ***C. japonicus*** Mayr

–. Mandibles densely sculptured, with small foveae, spots and striation (like in Fig. 56, G) ..... ***C. saxatilis*** Ruzsky

Formica

Workers

1. Whole body dark brown to black..... **2**

–. Body bicoloured, alitrunk reddish, often with darker patches, contrasting with brownish-black gaster... **4**

2(1). Body smooth and shiny. 1st gastral tergite with very sparse pubescence, distance between appressed hairs longer than hairs' length (Fig. 57, A). Promesonotal dorsum with long standing hairs, curving forwards (Fig. 57, B)..... ***F. candida*** F. Smith

–. Body with dense microsculpture, not shiny. 1st gastral tergite with dense pubescence, distance between appressed hairs much shorter than hairs' length (Figs 57, C–D). Promesonotal dorsum without or, at most, with short straight standing hairs (Figs 57, E–F)..... **3**

3(2). Whole body with very dense microsculpture, appears matt. Gastral tergites with extremely dense pubescence, distance between appressed hairs nearly twice as long as their average thickness (Fig. 57, C). Forefemora at most with 2–3 standing hairs on inner margin, middle femora usually without standing hairs, rarely with 1–2 hairs near

the base of femora (Fig. 57, G). Promesonotal dorsum usually without standing hairs, rarely with 1–5 hairs on pronotum (Fig. 57, E)..... ..... ***F. japonica*** Motschoulsky

–. Body with finer microsculpture, gastral tergites somewhat shiny, lateral and posterior surfaces of head at least slightly shiny. Gastral tergites with sparser pubescence, distance between appressed hairs 3–4 times shorter than hair's length (Fig. 57, D). Forefemora with 3–12 standing hairs on inner margin, middle femora with 3–7 hairs (Fig. 57, H). Promesonotal dorsum with more than 6 standing hairs (Fig. 57, F)..... ***F. lemani*** Bondroit

4(1). Anterior clypeal margin distinctly notched medially (Fig. 57, I) ..... ***F. sanguinea*** Latreille

–. Anterior clypeal margin not notched medially (Figs 57, K, M, O) 5

5(4). Head dorsum entirely black. Frontal triangle dull ..... ***F. uralensis*** Ruzsky

–. Frons, vertex and occiput blackish, remainder parts of head dorsum reddish, or head dorsum entirely reddish. Frontal triangle shiny, contrasting with dull surface of other parts of head..... 6

6(5). Frons, vertex and occiput blackish, remainder parts of head dorsum reddish. Scape shorter than head length..... 7

–. In major workers head dorsum entirely reddish. Scape longer than head length..... 9

7(8). Alitrunk with sparse standing hairs (Fig. 57, J). Occipital margin of head with a few short standing hairs, situated usually only on occipital corners (Fig. 57, K) ..... ***F. aquilonia*** Yarrow

–. Alitrunk with much more abundant standing hairs (Figs 57, L, N). Occipital margin of head with numerous standing hairs (Figs 57, M, O) 8

8(7). Occipital margin of head with numerous standing hairs, which are the same length as hairs on alitrunk; hairs on lateral margins of head run to the level of anterior (lower) margin of eyes (Fig. 57, M). Alitrunk with abundant, regular standing hairs (Fig. 57, L)..... ***F. lugubris*** Zetterstedt

–. Occipital margin of head with not numerous standing hairs, which are shorter than hairs on alitrunk; hairs on lateral margins of head run to the level of posterior (upper) margin of eyes (Fig. 57, O). Alitrunk with not abundant, irregular standing hairs (Fig. 57, N) ..... ***F. kupyanskayae*** Bolton

9(6). External margin of tibiae with standing hairs (Fig. 57, P)..... ***F. truncorum*** Fabricius

–. External margin of tibiae without standing hairs (Fig. 57, Q) ..... ***F. yessensis*** Forel

Queens

1. Whole body dark brown to black. Eyes without microscopic hairs (seen under magnification more than 40×)..... 2

–. Body bicoloured, alitrunk at least partly reddish, head from entirely red to entirely black, gaster black. Eyes with microscopic hairs (seen under magnification more than 40×)..... 4

2(1). Ventral surface of head with 2–5 standing hairs (seen in profile). Whole body shiny..... ..... ***F. candida*** F. Smith

–. Ventral surface of head without standing hairs (seen in profile). At least head and alitrunk with microsculpture, not shiny..... 3

3(2). Whole body with very dense microsculpture, appears matt. Gastral tergites with very dense pubescence, distances between appressed hairs much shorter than hair's length..... ..... ***F. japonica*** Motschoulsky

–. Head and alitrunk dull, gaster with very fine microsculpture, appears shiny. Gastral tergites with much sparser pubescence, distances between appressed hairs subequal to hair's length....***F. lemani*** Bondroit

4(1). Anterior clypeal margin distinctly notched medially ..... ***F. sanguinea*** Latreille

–. Anterior clypeal margin not notched medially.. 5

5(4). Head dorsum entirely black. Frontal triangle dull ..... ***F. uralensis*** Ruzsky

–. Frons, vertex and occiput blackish, remainder parts of head dorsum reddish, or head dorsum entirely reddish. Frontal triangle shiny, contrasting with dull surface of other parts of head..... 6

6(5). Alitrunk with sparse straight standing hairs (Fig. 58, A). Both scutum and scutellum black. Frons, vertex and occiput blackish, remainder parts of head dorsum reddish 7

–. Alitrunk with abundant, usually curved standing hairs (Fig. 58, B). Scutum never black, at least partly reddish, contrasting with black scutellum. Head dorsum usually reddish, at most slightly darkened on its upper third..... 9

7(6). Gaster with dense microsculpture, appears dull. Gastral tergites with short, fine, very abundant silk-like, pubescence, distance between appressed hairs several times shorter than hairs' length .... ***F. kupyanskayae*** Bolton

–. Gaster with fine microsculpture, appears shiny. Gastral tergites with short, fine, less abundant pubescence, distance between appressed hairs 1.5–2 times shorter than hairs' length 8

8(7). Occipital margin of head and temples with numerous short straight standing hairs. Declivity of first gastral tergite with relatively long curved standing hairs (Fig. 58, C) ..... ***F. lugubris*** Zetterstedt

–. Occipital margin of head usually without hairs, rarely with a few short hairs on occipital corners. Declivity of first gastral tergite with short straight standing hairs (Fig. 58, D) ...***F. aquilonia*** Yarrow

9(6). External margin of tibiae with standing hairs..... ..... ***F. truncorum*** Fabricius

–. External margin of tibiae without standing hairs ..... ***F. yessensis*** Forel

Males

1. Anterior clypeal margin notched medially ..... ***F. sanguinea*** Latreille
–. Anterior clypeal margin not notched medially... 2
2(1). Eyes without hairs 3
–. Eyes with conspicuous hairs..... 6
3(2). Occipital margin and ventral surface of head with standing hairs. Petiolar scale very thick, broadly rounded at the apex (seen in profile, Fig. 58, E), with feebly concave or more or less straight dorsal margin (seen in front or from behind, Fig. 58, F) ..... ***F. candida*** F. Smith
–. Occipital margin of head without standing hairs. Petiolar scale of different shape (Figs 58, G–L) 4
4(3). Petiolar scale narrowed to the apex, with flattened dorsal crest (seen in profile, Fig. 58, G), and with strongly concave dorsal margin (seen in front or from behind, Fig. 58, H)..... ***F. japonica*** Motschoulsky
–. Petiolar scale not narrowed to the apex, quite thick, with rounded dorsal crest (seen in profile, Figs 58, I, K), and with feebly concave or straight dorsal margin (seen in front or from behind, Figs 58, J, L)..... 5
5(4). Dorso-lateral corners of petiolar scale with both short and long hairs (seen in front or from behind, Fig. 58, J). Body robust, densely punctate, appears dull. Ventral surface of head with a few standing hairs..... ***F. uralensis*** Ruzsky
–. Dorso-lateral corners of petiolar scale only with long hairs (seen in front or from behind, Fig. 58, L). Body slender, finely punctate, appears at least slightly shiny. Ventral surface of head without standing hairs..... ***F. lemani*** Bondroit
6(2). Head margins, including genae, with numerous long standing hairs 7
–. Genae without or at most with a few standing hairs..... 9
7(6). Gastral tergites with very abundant, short suberect hairs, forming uninterrupted fringe from base to apex of gaster (Fig. 58, N)..... 8
–. Gastral tergites with less abundant, scattered longer hairs, not forming uninterrupted fringe from base to apex of gaster (Fig. 58, M) ..... ***F. lugubris*** Zetterstedt
8(7). External margin of tibiae with standing hairs..... ***F. truncorum*** Fabricius
–. External margin of tibiae without standing hairs ..... ***F. yessensis*** Forel
9(6). Genae completely lacking standing hairs..... ***F. aquilonia*** Yarrow
–. Genae with a few standing hairs..... ***F. kupyanskayae*** Bolton

Lasius

Workers and queens

1. **Workers**: Body shiny black, head usually with strongly concave (in some species with slightly concave) occipital margin (Figs 59, K, N). Maxillary palpes short, not reaching to midlength of ventral surface of head. **Queens**: metapleural gland offices do not covered by curved hairs ... 2
–. **Workers**: Body never shiny black. Occipital margin of head straight, convex or very slightly concave. Maxillary palpes of different length. **Queens**: metapleural gland offices covered by curved hairs 6
2(1). Scape strongly flattened dorso-ventrally, ratio of its min/max diameters ≤ 0.5 (Figs 59, E–F; 60, C–D). Legs of **queens**, including first tarsal joint, remarkably flattened, ratio of min/max diameters of hind tibia ≤ 0.4 (Figs 60, E–F, H) 3
–. Scape not flattened dorso-ventrally, elliptical in cross-section, ratio of its min/max diameters ≥0.7 (Figs 59, I–J; 61, B–C, G–H). Legs of **queens** not or much less flattened, ratio of min/max diameters of hind tibia ≥ 0.5 (Figs 61, D–E, J–K) 4
3(2). **Workers**: petiolar scale (seen in profile) thin, quite high, asymmetrical, narrowing to the top, with flattened dorsal crest; seen in front or from behind, it is the widest at the level of spiracles, gradually narrowing to the dorsal crest (Figs 59, A–B). **Queens**: body (except of appendages) with very short and sparse decumbent pubescence, alitrunk dorsum without standing hairs (Fig. 60, A); head cordiform, distinctly wider than its length (Fig. 60, B)..... ***L. spathepus*** Wheeler
–. **Workers**: petiolar scale (seen in profile) thick, low, not narrowing to the top, with widely rounded dorsal crest, symmetrical; seen in front or from behind, it is the widest at the dorsal crest (Figs 59, C–D). **Queens**: body and appendages with very dense decumbent pubescence, alitrunk dorsum with not abundant, short standing hairs (Fig. 60, H); head with distinctly emarginated occipital margin, but not cordiform, at most slightly wider than its length (Fig. 60, G) ..... ***L. orientalis*** Karawajew
4(2). **Workers**: petiolar scale, seen in front or from behind, distinctly tapering to the top, with very narrowly rounded dorsal crest; seen in profile, it is thin, with flattened dorsal crest (Figs 59, G–H). Occipital margin of head shallowly emarginated (Fig. 59, K). **Queens**: head distinctly narrowed anteriorly, its lateral margins below the eyes not convex, almost straight; head margins with very abundant, long, often curved standing hairs (Fig. 61, A). Hind tibia and scape with dense decumbent pubescence and numerous subdecumbent hairs (Figs 61, B–E)..... ***L. nipponensis*** Forel

–. **Workers**: petiolar scale, seen in front or from behind, only slightly narrowing to the top, with widely rounded, flattened or slightly emarginated dorsal crest; seen in profile, it is relatively thick, its dorsal crest never flattened (Figs 59, L–M, O). Occipital margin distinctly emarginated (Fig. 59, N). **Queens**: head not narrowed anteriorly, with regularly convex lateral margins; head margins without or with much less abundant, relatively short straight standing hairs (Figs 61, F, L). Hind tibia and scape only with dense decumbent pubescence (Figs 61, G–H, J–K)..... 5

5(4). **Workers**: petiolar scale (seen in profile) thicker, very slightly narrowed to the top, roughly inversely U-shaped (Fig. 59, L). **Queens**: body with numerous standing hairs and with rather dense decumbent pubescence (Figs 61, F, I)... ***L. fuji*** Radchenko

–. **Workers**: petiolar scale somewhat thinner, distinctly narrowed to the top, roughly inversely V-shaped (seen in profile) (Fig. 59, O). **Queens**: body with very sparse short standing hairs and with extremely short and sparse decumbent pubescence, appears shiny (Figs 61, L–M) ..... ***L. morisitai*** Yamauchi

6(1). Body of **workers** light yellow to ochreous-yellow. Maxillary palpes in both castes short, not reaching to midlength of ventral surface of head (Fig. 62, A) 7

–. Body of **workers** brownish to black or bicoloured, with alitrunk lighter than gaster, but never yellow. Maxillary palpes in both castes relatively long, distinctly reaching beyond midlength of ventral surface of head (Fig. 62, B) 15

7(6). **Workers** polymorphic. Petiolar scale (seen in front or from behind) widest near its upper margin (Fig. 62, C). Head of **queens** distinctly narrower than maximum width of alitrunk (Fig. 62, D)..... 8

–. **Workers** monomorphic. Petiolar scale (seen in front or from behind) widest distinctly below of its upper margin, or with subparallel sides (Figs 62, M, R). Head of **queens** not narrower than maximum width of alitrunk (Fig. 62, E) 10

8(7). Scape and tibiae with standing hairs ..... ***L. talpa*** Wilson

–. Scape and tibiae without standing hairs..... 9

9(8). **Workers**: eyes very small, their maximal diameter at least 7.5 times less than head length ..... ***L. myops*** Forel

–. **Workers**: eyes bigger, their maximal diameter 6–7.2 times less than head length..... ***L flavus*** (Fabricius)

10(7). **Workers**: alitrunk and gaster with very short standing hairs (Fig. 62, F); length of longest hairs on anterodorsal face of first gastral tergite of **queens** less than 0.06 mm ..... ***L. mixtus*** (Nylander)

–. **Workers**: alitrunk and gaster with much longer, "normal" standing hairs (Fig. 62, G); length of longest hairs on anterodorsal face of first gastral tergite of **queens** more than 0.07 mm 11

11(10). Dorsal surface of scape and external margin of hind tibia without standing hairs, at most with 1–2 hairs at the base of tibia (Figs 62, H–I) ..... ***L. citrinus*** Emery

–. Dorsal surface of scape and external margin of hind tibia with a few to many standing hairs (Figs 62, J–L) 12

12(11). External margin of hind tibia with a few (usually less than 10) standing hairs (Fig. 62, K)..... ***L. distinguendus*** (Emery)

–. External margin of hind tibia with numerous (usually more than 15) standing hairs (Fig. 62, L) (if in **queens** less than 10 hairs, their scape and tibiae distinctly flattened) 13

13(12). **Workers**: petiolar scale (seen in front or from behind) distinctly tapering to a bluntly pointed or narrowly rounded dorsal crest, very rarely crest slightly notched, but never distinctly emarginated (Fig. 62, M). Scape distinctly flattened (ratio of min/max scape diameters 0.49–0.67); scape and tibiae of **queens** strongly flattened (corresponding ratios 0.43–0.56 and 0.33–0.48) (Figs 62, N–Q)..... ***L. jensi*** Seifert

–. **Workers**: petiolar scale (seen in front or from behind) not tapering to the apex, dorsal crest, usually emarginated, very rarely broadly rounded (Fig. 62, R); scape and tibiae of **workers** and **queens** flattened or oval in cross-section (ratio of min-max diameter of scape of **workers** 0.63–0.80, that of **queens** 0.48–0.87, ratio of min/max diameter of hind tibia of **queens** 0.42–0.74) (Figs 62, S–Z) ...14

14(13). Scape and tibiae of **workers** and **queens** not flattened, oval in cross-section (Figs 62, S–V)..... ***L. umbratus*** (Nylander)

–. Scape and tibiae of **workers,** and especially those of **queens,** flattened (Figs 62, W–Z)..... ***L. meridionalis*** (Bondroit)

15(6). Scape and tibiae without standing hairs (Fig. 62, X') ..... ***L. koreanus*** Seifert

–. Scape and tibiae with standing hairs (Figs 62, Y'–Z') 16

16(15). Dorsal surface of scape with more abundant standing hairs, which are distinctly contrast with short pubescence (Fig. 62, Y')..... ***L. japonicus*** Santschi

–. Dorsal surface of scape with less abundant standing hairs, which are less contrast with relatively long pubescence (Fig. 62, Z')..... ***L. hayashi*** Yamauchi et Hayashida

Paratrechina

Workers

1. Alitrunk dorsum with wide and deep metanotal groove, propodeal dorsum relatively long, approxi-

mately 2 times shorter than propodeal declivity, strongly arched (Fig. 58, O). Alitrunk and gaster without decumbent pubescence. Alitrunk yellow to ochreous, head from ochreous to brownish-yellow, gaster from ochreous to brown ..... ***P. flavipes*** (F. Smith)

–. Alitrunk dorsum with narrow and shallow metanotal groove, propodeal dorsum very short, approximately 4 times shorter than propodeal declivity, flattened (Fig. 58, P). Alitrunk and gaster with dense silk-like decumbent pubescence. Whole body light brown to dark brown..... ***P. sauteri*** Forel

Plagiolepis
Workers

1. Body yellow, apex of gaster occasionally brownish. 3rd funicular segment subsquare, distinctly shorter than the 4th one ..... ***P. flavescens*** Collingwood
–. Body brown. 3rd funicular segment elongate, subequal to the 4th one ..... ***P. manczshurica*** Ruzsky

Subfamily Myrmicinae

Aphaenogaster
Workers

1. Head narrower (CI 1.22–1.31), gradually rounded behind eyes, with barely marked occipital corners (Fig. 63, A). Scape longer, SI_2 1.37–1.46..... ***A. famelica*** (F. Smith)
–. Head wider (CI 1.16–1.22), with more distinct occipital corners (Fig. 63, B). Scape shorter, SI_2 1.25–1.36..... ***A. japonica*** Forel

Crematogaster
Workers

1. Petiole (seen from above) distinctly widened anteriorly (Fig. 63, C). Head and alitrunk reddish to reddish-brown, gaster dark brown to black..... ***C. matsumurai*** Forel
–. Petiole (seen from above) with subparallel sides, its width anteriorly is the same as posteriorly (Fig. 63, D). Head and alitrunk yellow, gaster brownish-yellow ..... ***C. osakensis*** Forel

Leptothorax
Workers

1. Tibiae and scape with numerous standing hairs. Anterior and dorsal faces of petiolar node meet at rounded blunt angle, so that node with distinct, often rounded dorsal plate (seen in profile, Fig. 63, E) .... ***L. acervorum*** (Fabricius)
–. Tibiae and scape without standing hairs, only with decumbent pilosity. Anterior and posterior faces of petiolar node meet at acute angle, so that node sharply triangular (seen in profile, Fig. 63, F)..... ..... ***L. oceanicus*** Kuznetsov-Ugamsky

Monomorium
Workers

1. Whole body dark brown to blackish-brown, smooth, appears shiny ..... ***M. chinense*** Santschi
–. Head and alitrunk ochreous-yellow to reddish-yellow, gaster brownish; head and alitrunk densely punctate, appears dull ... ***M. pharaonis*** (Linnaeus)

Myrmecina
Workers

1. Body yellow to brownish-yellow. Base of scape enlarged to a shield-like hemispherical plate, which covers antennal socket (Fig. 63, G) .... ***M. flava*** Terayama
–. Body blackish brown to black. Base of scape simple, not enlarged, antennal socket exposed (Fig. 63, H) ..... ***M. nipponica*** Wheeler

Myrmica
Workers

1(2). Lateral portion of clypeus raised into sharp ridge in front of antennal insertions, so that antennal sockets distinctly separated from clypeal surface (similar to that of *Tetramorium*) (Fig. 63, I) **2**
–. Lateral portion of clypeus not raised into sharp ridge in front of antennal insertions, so that antennal sockets lay on the same level with clypeal surface (Figs 64, A, G; 65, A, D)..... **3**
2(1). Scape at the bend as the same width as on its midlength (seen in profile, Fig. 63, J); its vertical (shorter) part with longitudinal groove and lateral ridges (seen in front, Fig. 63, K). **Males**: petiole and postpetiole with fine superficial microsculpture, appear dull ..... ***M. excelsa*** Kupyanskaya
–. Scape at the bend distinctly narrower that on its midlength (seen in profile, Fig. 63, L); its vertical (shorter) part without longitudinal groove and lateral ridges (seen in front, Fig. 63, M). **Males**: petiole and postpetiole smooth, appear shiny..... ..... ***M. taediosa*** Bolton
3(2). Frontal carinae curved outwards posteriorly to merge with the rugae, which surround antennal sockets (Figs 64, A, G). Scape only curved at the base, without angle or lobe (Figs 64, C, H) **4**
–. Frontal carinae not curved outwards posteriorly, merge with the longitudinal rugae running towards occipital margin of head; antennal sockets surround by concentric rugae, which join frontal carinae (Figs 65, A, D). Scape of different shape (Figs 65, C, F, I, K–L) **6**
4(3). Scape strongly curved at the base (Fig. 64, C). Much more hairy species, petiolar node with about 10 long standing hairs and with numerous shorter hairs (Fig. 64, B). First gastral tergite finely but distinctly longitudinally striated at the base (Fig. 64, B). Spurs on tibiae of middle and hind

legs reduced, simple (Figs 64, D–E). Frons with numerous, fine longitudinal rugae, their number between frontal carinae level with the eyes not less than 20 (Fig. 64, A). **Queens** smaller than workers, their propodeum without spines, at most with bunt tubercles (Fig. 64, F). **Males**: scape short (SI_2 < 0.50) ..... ***M. luteola*** Kupyanskaya

–. Scape gently curved at the base (Fig. 64, H). Less hairy species, petiolar node with 6–8 long standing hairs only (Figs 64, I–J). First gastral tergite completely smooth. Spurs on tibiae of middle and hind legs well developed and pectinate. Frons with not numerous, relatively coarse longitudinal rugae, their number between frontal carinae level with the eyes note more than 15 (Fig. 64, G). **Queens** distinctly bigger than workers, their propodeum with spines. **Males**: scape long (SI_2 > 0.70) **5**

5(4). Petiolar node with distinct, sharp, flattened dorsal plate, laterally with quite coarse short sinuous longitudinal rugae (Fig. 64, I). **Males**: clypeus usually smooth, at most with very fine superficial punctures ..... ***M. ruginodis*** Nylander

–. Petiolar node dorsum slightly convex, without sharp dorsal plate, laterally with fine short longitudinal rugulae (Fig. 64, J). **Males**: clypeus with fine longitudinal striation ..... ***M. kotokui*** Forel

6(3). Scape only curved at the base, without angle or lobe, always without ridge on inner margin of its vertical (short) part (Figs 65, C, F) **7**

–. Scape distinctly angulate at the base, without or with vertical lobe or dent, but always with ridge on inner margin of its vertical (short) part (Figs 65, I, K–L) **9**

7(6). Scape gently curved at the base (Fig. 65, C). Frons with numerous fine longitudinal rugae, their number between frontal carinae level with the eyes not less than 20, surface of head between rugae densely and quite coarsely punctate, appears dull (Fig. 65, A). Sides of alitrunk with not coarse longitudinal sinuous rugosity, its dorsum with irregular, short, not coarse rugae (Fig. 65, B) ..... ***M. kurokii*** Forel

–. Scape strongly curved at the base (Fig. 65, F). Frons with not numerous coarse longitudinal rugae, their number between frontal carinae level with the eyes not more than 15, surface of head between rugae smooth or at most with very fine superficial punctures, appears shiny (Fig. 65, D). Whole alitrunk with coarse longitudinal rugae (Figs 65, E, G) **8**

8(7). Sides of petiolar node with the alike coarse rugae as on alitrunk; anterior face of petiole very steep, meets with dorsal surface at an almost right angle; propodeal spines shorter than length of propodeal dorsum (mean ESLI 0.40) (Fig. 65, E) ..... ***M. sulcinodis*** Nylander

–. Sides of petiolar node with coarse punctures and short rugae, which are much less coarse than on alitrunk; anterior face of petiole not steep, meets with dorsal surface at a blunt angle; propodeal spines very long, equal or longer than length of propodeal dorsum (mean ESLI 0.44) (Fig. 65, G) ..... ***M. ademonia*** Bolton

9(6). Scape at the base only strongly angulate, without vertical lobe or dent (Figs 65, I, K) **10**

–. Scape at the base strongly angulate and with vertical lobe or dent (Fig. 65, L) **11**

10(9). Petiolar node sharply angulate (seen in profile), its anterior face meets with dorsal face under acute angle; propodeal spines directed backwards and upwards, usually curved inwards (Fig. 65, H) ..... ***M. angulinodis*** Ruzsky

–. Petiolar node not angulate (seen in profile), its anterior face meets with dorsal face under rounded blunt angle; propodeal spines directed mainly backwards, do not curved inwards (Fig. 65, J) ..... ***M. kamtschatica*** Kupyanskaya

11(9). Frontal carinae strongly curved, frons narrow (FI 0.27–0.31, mean 0.29) and frontal lobes widely extended (FLI ≥1.50). **Males**: scape short (SI_2 < 0.50) ..... ***M. koreana*** Elmes, Radchenko et Kim

–. Frontal carinae less curved, frons wider (FI 0.31–0.39, means 0.32..0.36) and frontal lobes less extended (FLI < 1.45). **Males**: scape relatively long (SI_2 > 0.60) **12**

12(11). Frontal carinae more curved, frons narrower (FI 0.31–0.34, mean 0.32, FLI 1.29–1.42, mean 1.35). Alitrunk with shallow metanotal groove ..... ***M. jessensis*** Forel

–. Frontal carinae less curved, frons wider (FI 0.32–0.39, mean 0.36, FLI 1.18–1.40, mean 1.29). Alitrunk with deeper metanotal groove ..... ***M. eidmanni*** Menozzi

Stenamma

Workers

1. Eyes smaller, OI ≤ 0.10 ..... ***S. ussuriense*** Arnoldi
–. Eyes bigger, OI ≥ 0.12 ..... ***S. owstoni*** Wheeler

Temnothorax

Workers

1. Antennae with 11 segments ..... ***T. koreanus*** Teranishi
–. Antennae with 12 segments **2**

2(1). Anterolateral corners of pronotum (seen from above) distinctly marked, slightly angulate (Fig. 66, C). Head dorsum with reduced sculpture, only finely rugulose and striated, surface between them smooth and shiny (Fig. 66, A). Petiole without anterior peduncle, about as long as high (PI 1.05), its node with narrowly rounded dorsum, cunei-

form (seen in profile, Fig. 66, B). Head, alitrunk and waist dark reddish, gaster brown. Relatively big species, HW 0.66, AL 0.98 mm..... ..... ***T. cuneinodis*** Radchenko

–. Anterolateral corners of pronotum (seen from above) widely rounded (Fig. 66, D). Head dorsum with striation and/or punctures, surface never appears smooth and shiny (Figs 66, E, G, L–M). Petiole usually with distinct anterior peduncle (Figs 66, F, H–I, K), if without it, petiolar node subtriangular in profile (Fig. 66, J). Head, alitrunk and waist of another colour. Smaller species, HW < 0.60, AL < 0.95 mm..... **3**

3(2). Propodeum with long, sharp spines, ESLI > 0.33 (Figs 66, F, H–I)..... **4**

–. Propodeum with short spines or only with sharp denticles, ESLI < 0.28 (Figs 66, D, J–K)..... **7**

4(3). Whole body ochreous-yellow. Head with very broadly rounded, barely marked occipital corners (Fig. 66, E)..... ***T. xanthos*** Radchenko

–. Body reddish-brown to dark brown or bicoloured, with alitrunk distinctly lighter than head and gaster. Head with narrowly rounded, well-marked occipital corners (Fig. 66, G)..... **5**

5(4). Alitrunk yellow to brownish-yellow, head dorsum and gaster brown..... ***T. nassonovi*** Ruzsky

–. Whole body reddish brown to dark brown..... **6**

6(5). Propodeal spines longer (ESLI > 0.48); petiole comparatively higher and shorter (PI < 1.40), petiolar node less massive, with narrowly rounded dorsum (Fig. 66, H). Scape somewhat longer (SI_1 > 0.75, SI_2 > 0.90)..... ***T. eburneipes*** Wheeler

–. Propodeal spines shorter (ESLI < 0.44); petiole comparatively lower and longer (PI > 1.50), petiolar node massive, with broadly rounded dorsum (Fig. 66, I). Scape somewhat shorter (SI_1 < 0.75, SI_2 < 0.90)..... ***T. spinosior*** Forel

7(3). Whole body reddish-brown to black..... ..... ***T. congruus*** F. Smith

–. Alitrunk yellow to brownish-yellow, contrasting with darker head and gaster, or whole body ochreous-yellow..... **8**

8(7). Petiole without anterior peduncle, PI < 1.25; petiolar node in profile subtriangular, with very slightly concave or almost straight anterior face and very narrowly rounded dorsum (Fig. 66, J)..... **9**

–. Petiole with distinct anterior peduncle, PI > 1.28; petiolar node in profile with distinctly concave anterior face and broadly rounded, convex dorsum (Fig. 66, K)..... **10**

9(8). Alitrunk and waist ochreous-yellow to brownish-yellow, head dorsum of the same colour as alitrunk, gaster brown, but basal ¼ of 1st tergite yellow. Scape longer (SI_1 0.73–0.78, mean 0.75). Propodeum with short spines, ESLI 0.18–0.25, mean 0.22..... ***T. pisarskii*** Radchenko

–. Alitrunk and waist ochreous-yellow to brownish-yellow, head dorsum brownish, distinctly darker than alitrunk, gaster brown, without light spot at the base of 1st tergite. Scape shorter (SI_1 0.71–0.75, mean 0.72). Propodeum usually with short sharp denticles, ESLI 0.09–0.22, mean 0.15 ..... ***T. mongolicus*** Pisarski

10(8). Sape relatively long, almost reaching or even slightly surpassing occipital margin of head, SI_1 > 0.75. Head dorsum with distinct rugulosity and punctures (Fig. 66, L). Gaster concolour with ochreous-yellow alitrunk or slightly darker than alitrunk, 1st tergite without pale spot at the base ..... ***T. michali*** Radchenko

–. Scape short, distinctly not reaching occipital margin of head, SI_1 < 0.71. Head dorsum densely punctate and at most with fine longitudinal striations (Fig. 66, M). Gaster brown, distinctly darker than alitrunk, 1st tergite with pale spot at the base ..... ***T. kaszabi*** Pisarski

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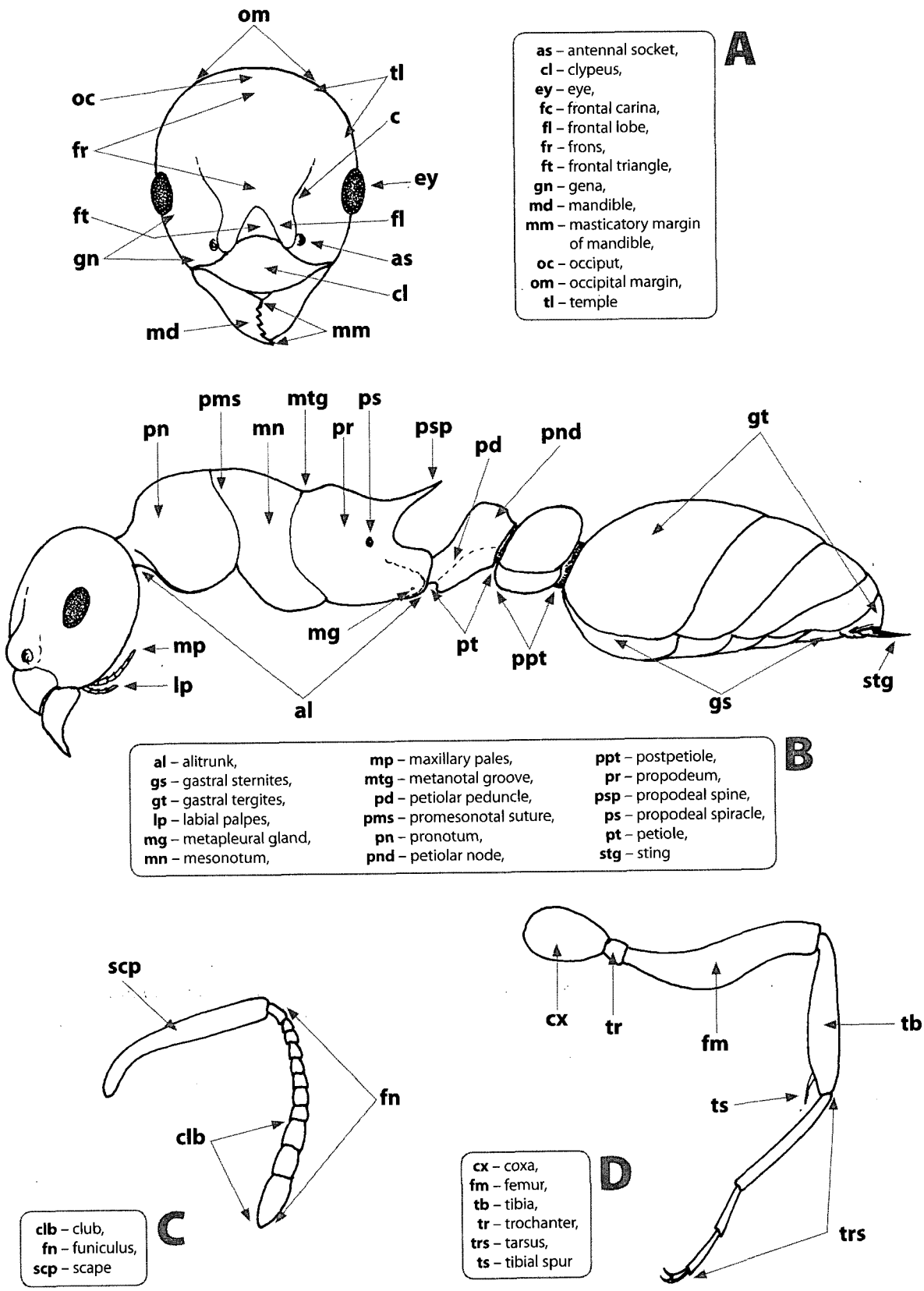
Pages with taxonomic characteristics of the species are marked by **bold**; pages, where taxa are in the Key, are marked by *italic*.



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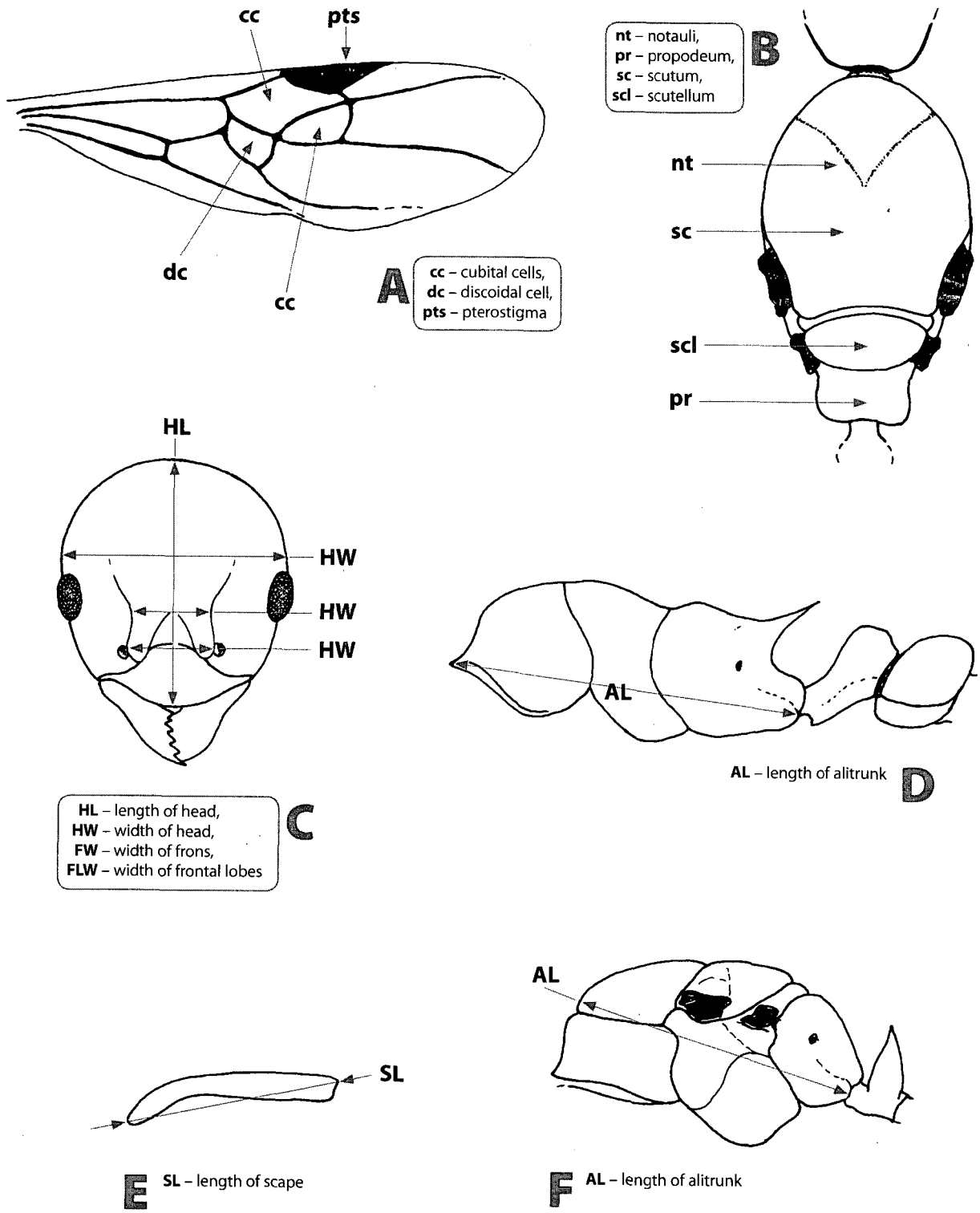

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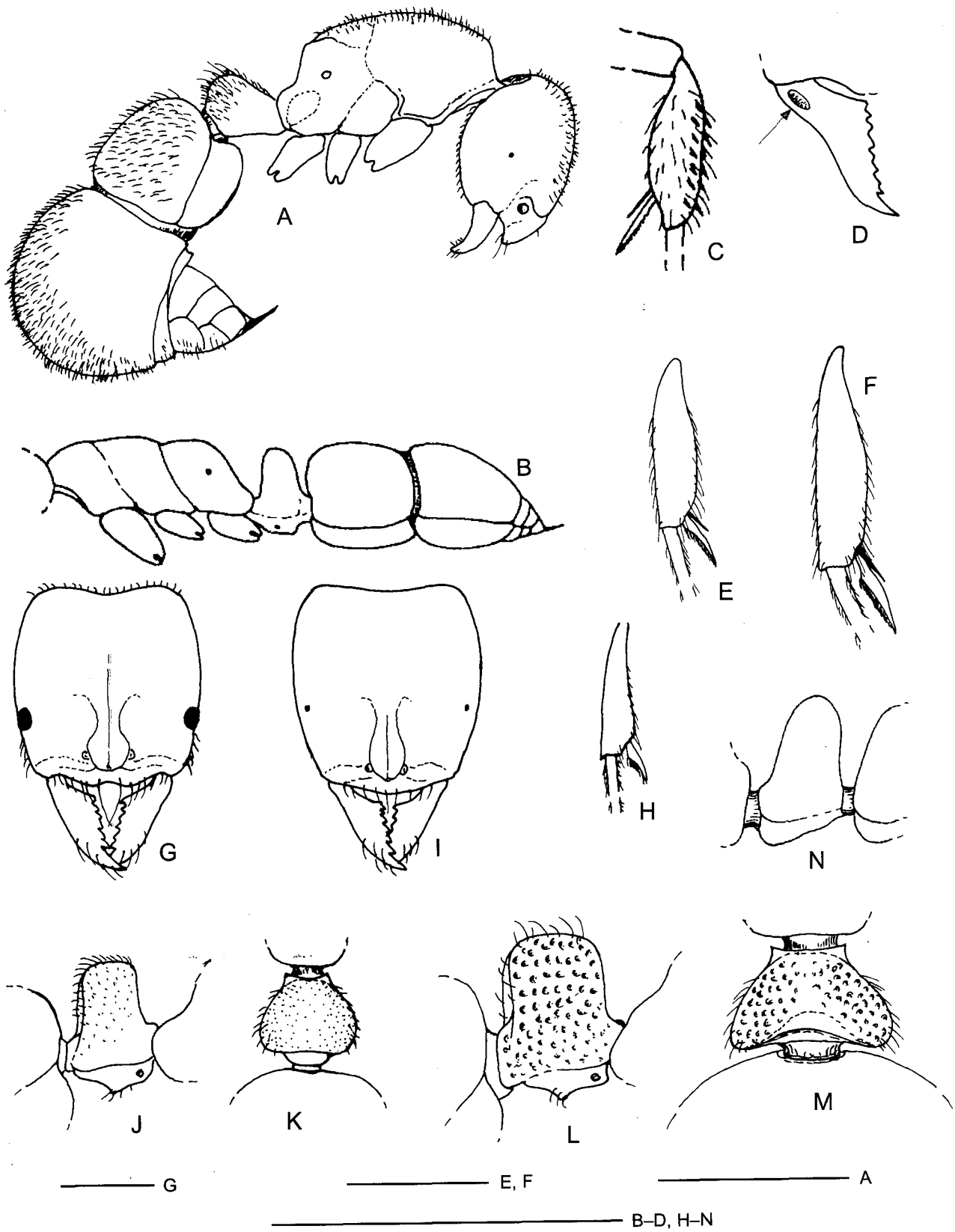

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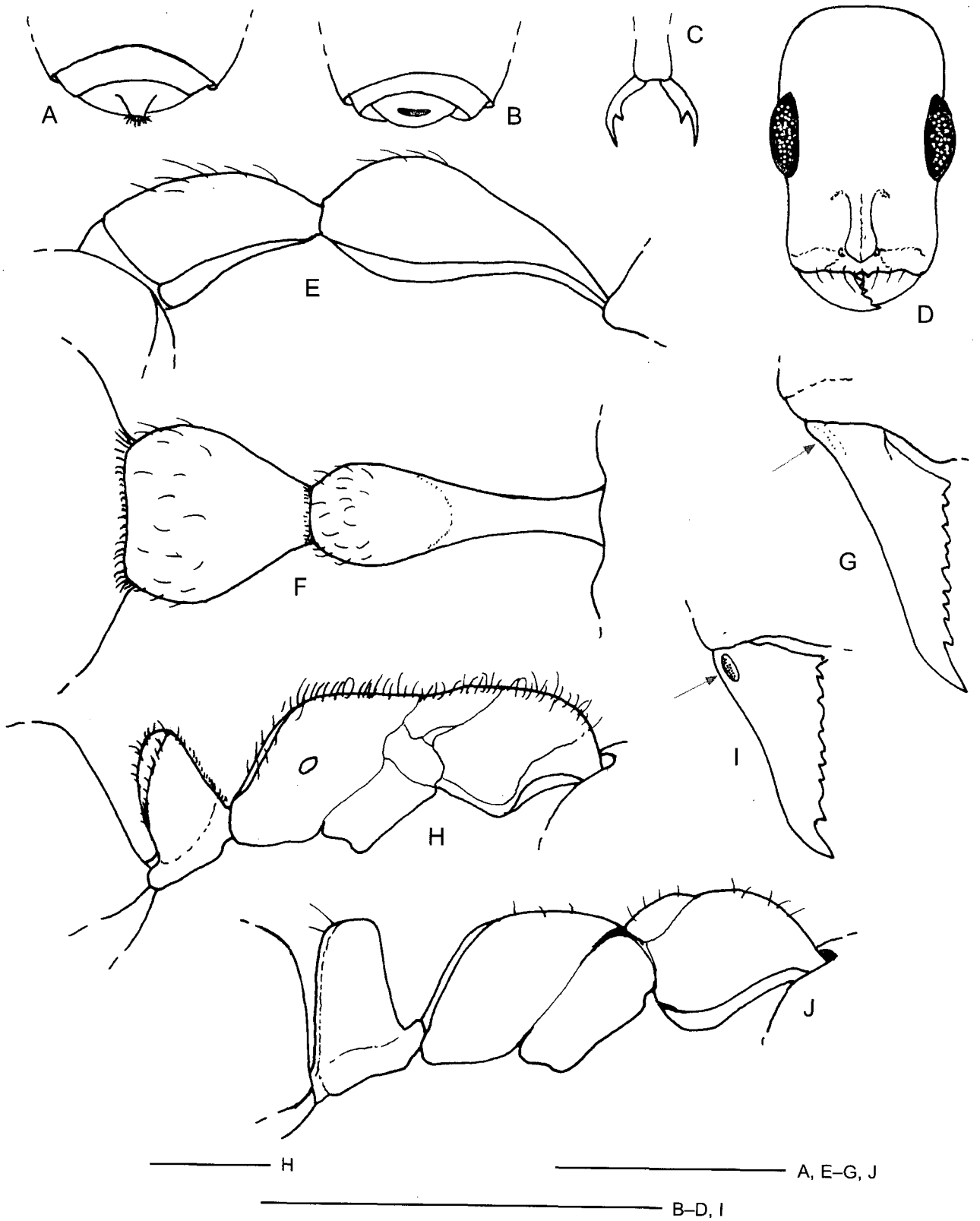

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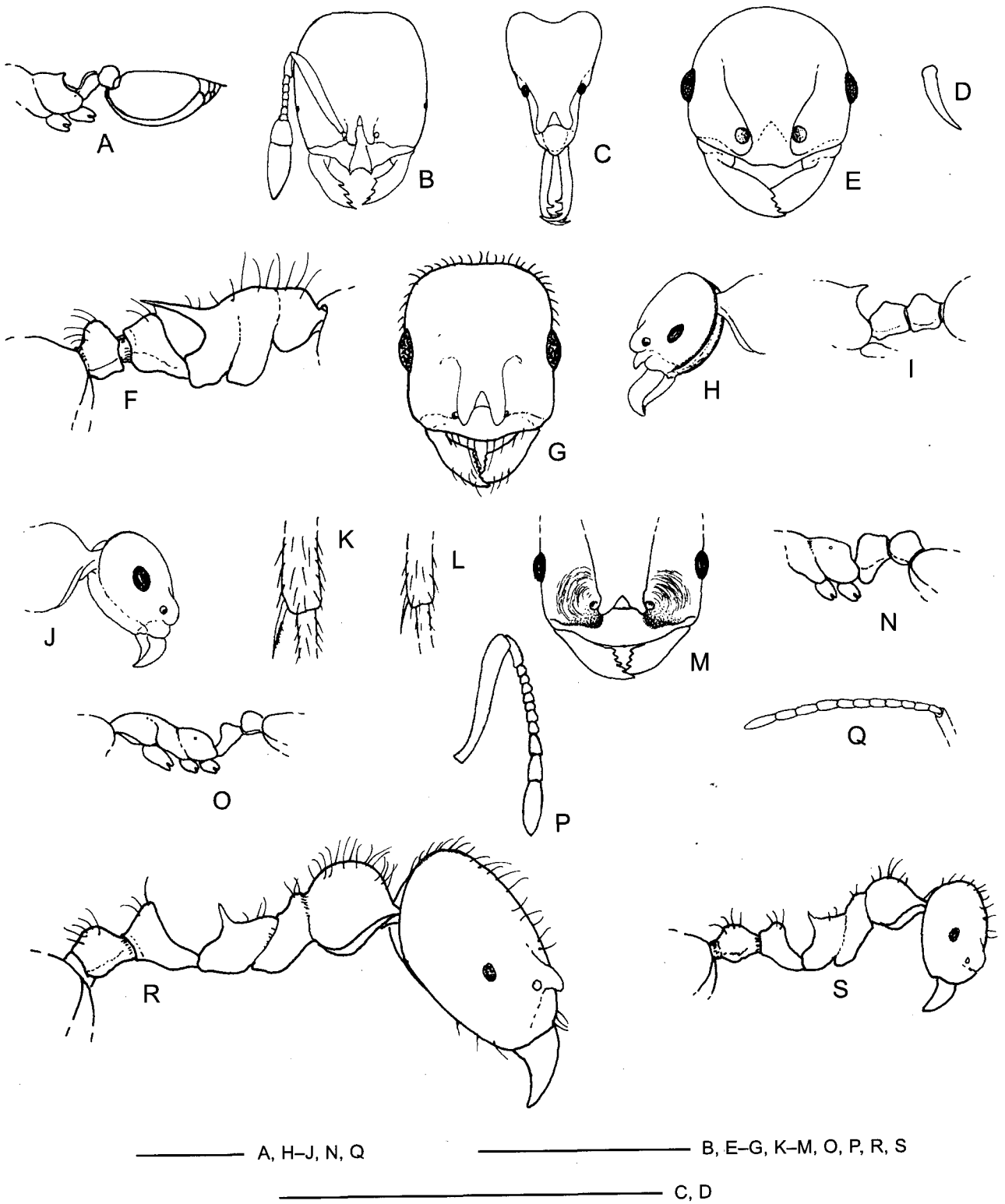

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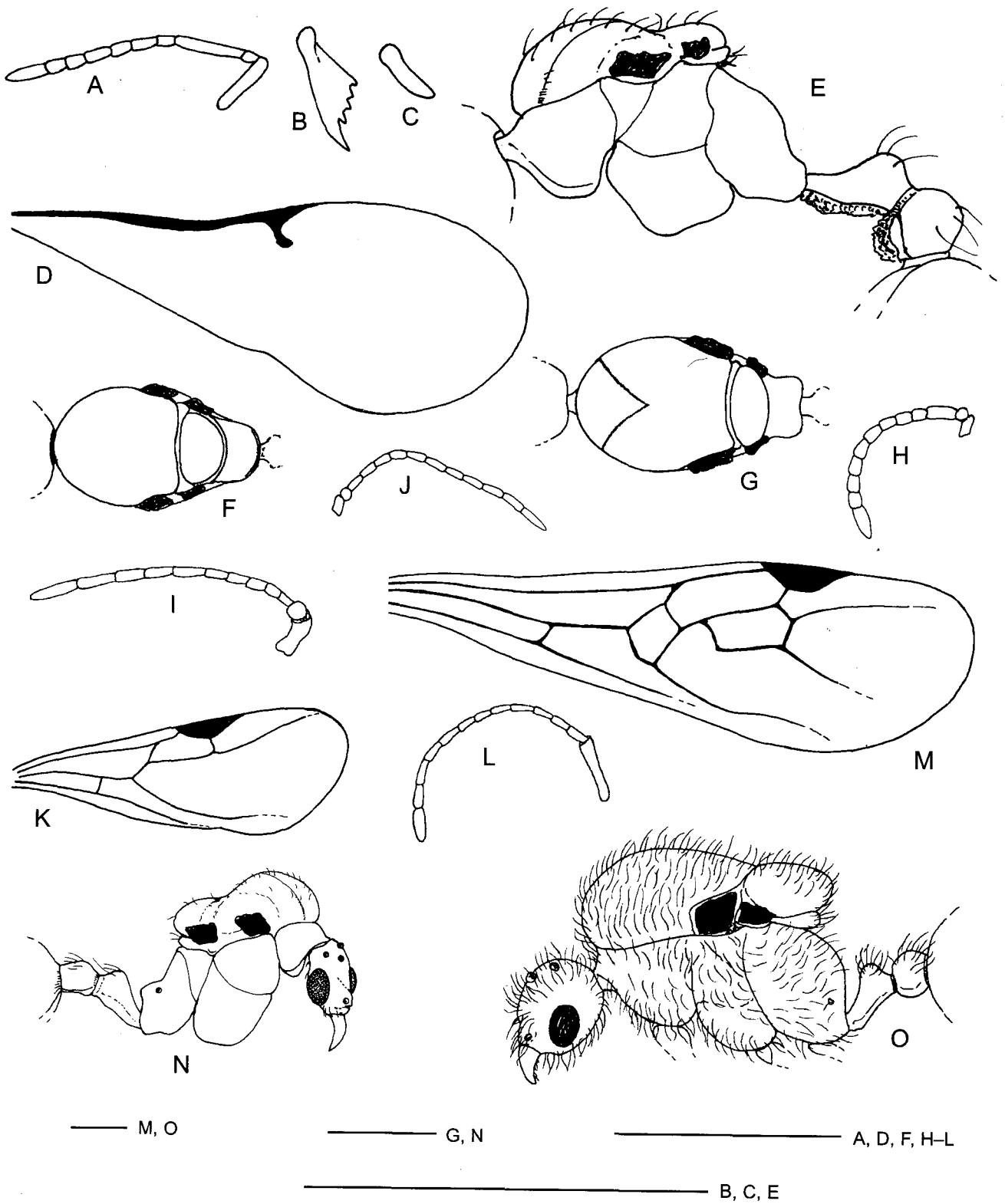

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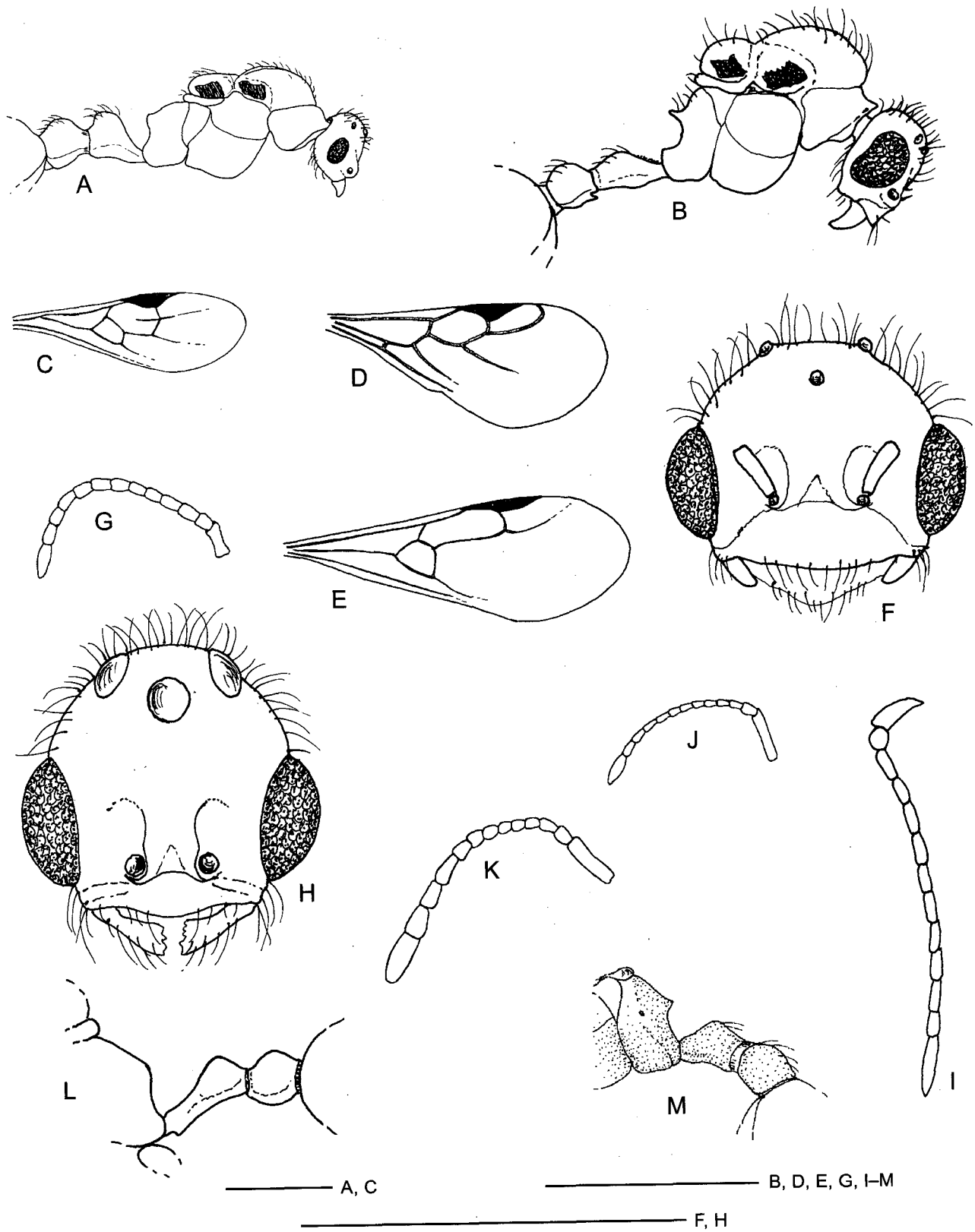

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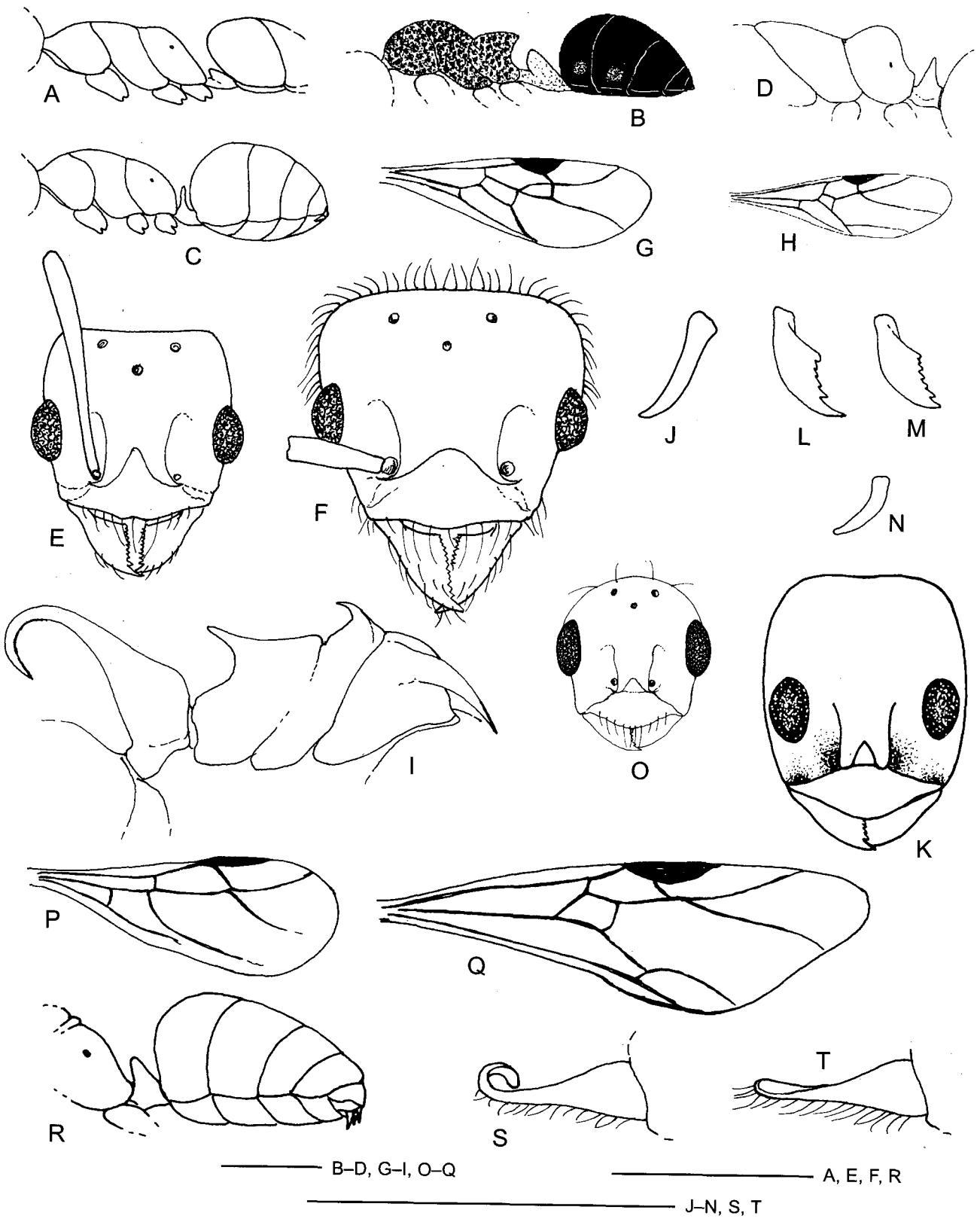

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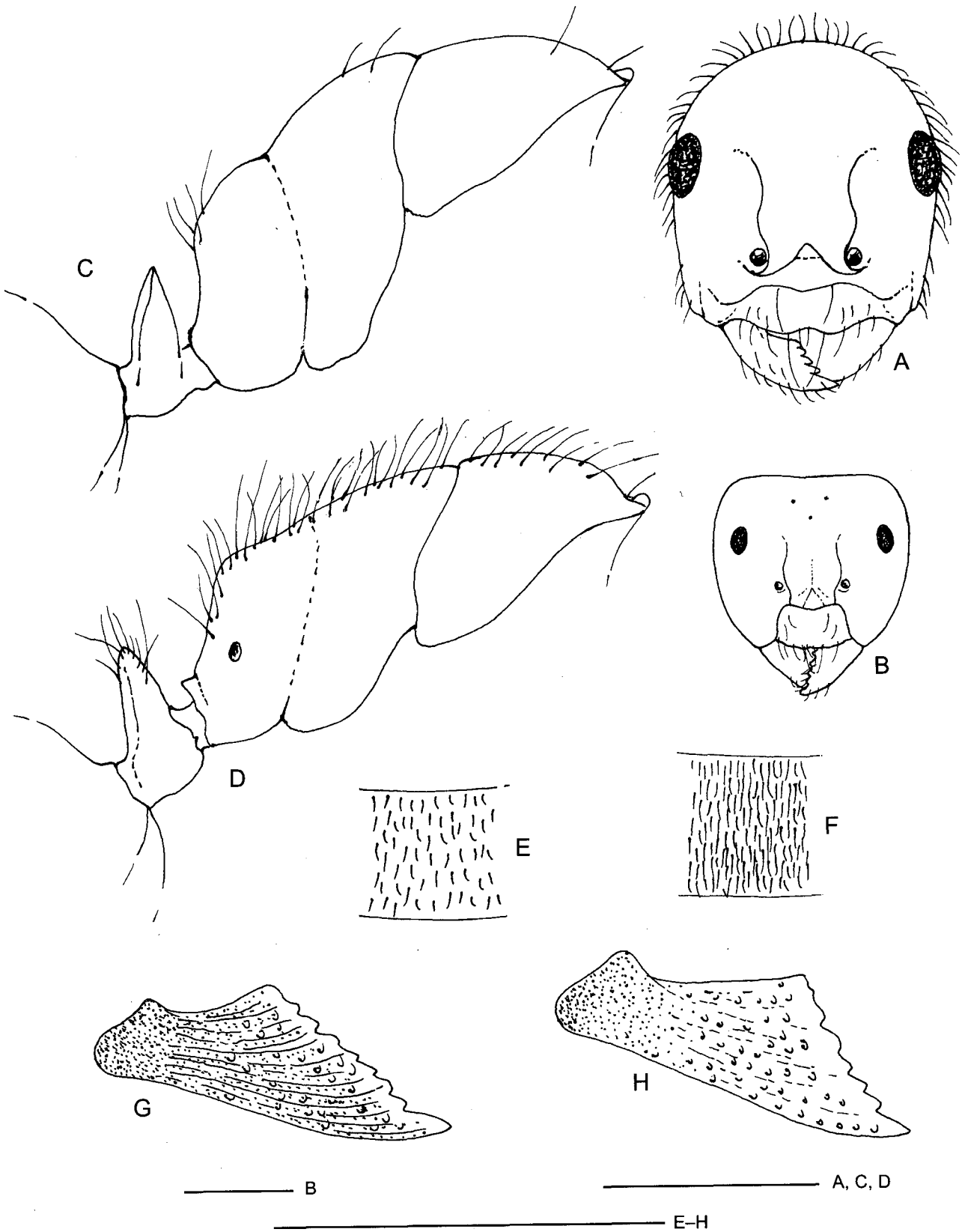

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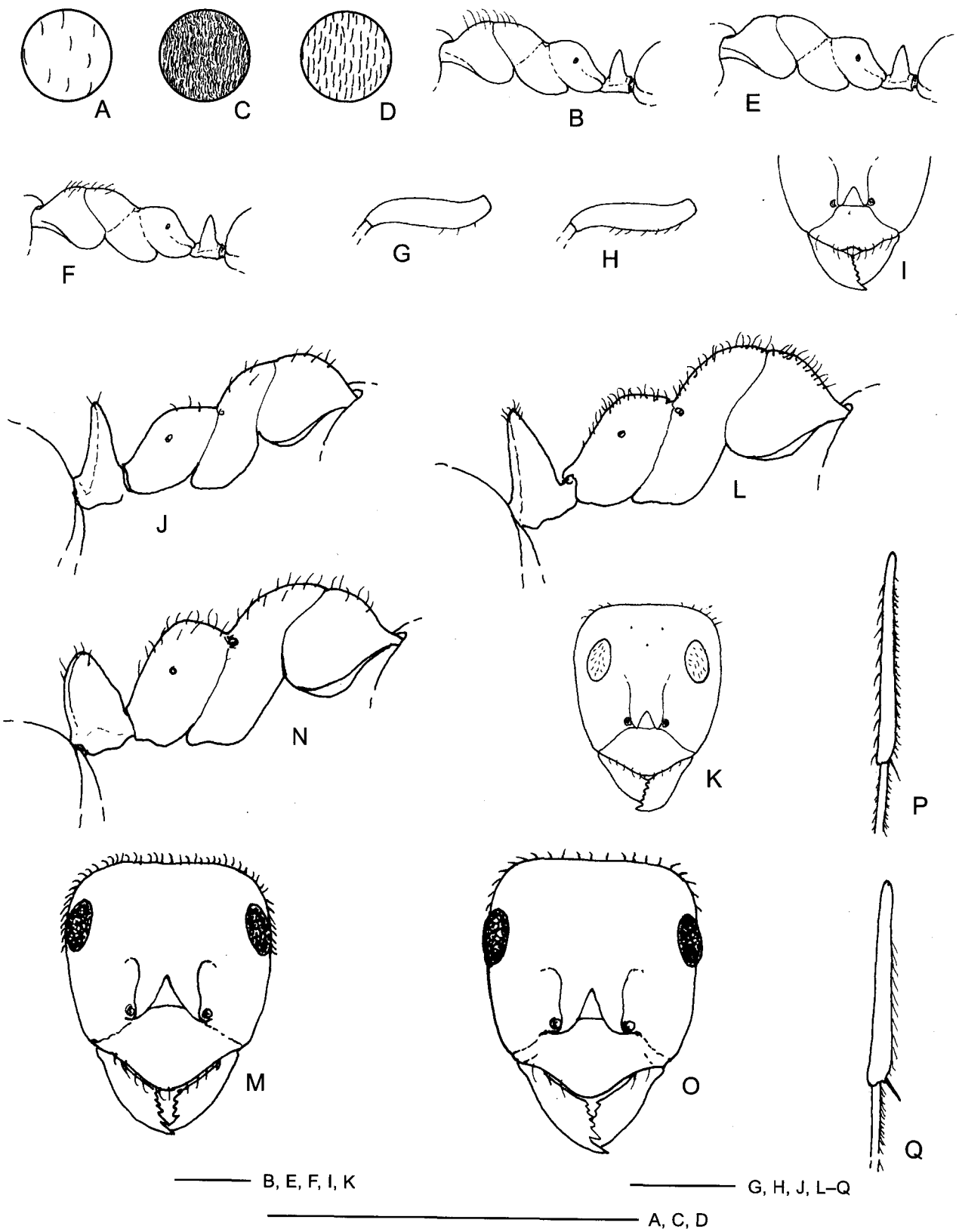

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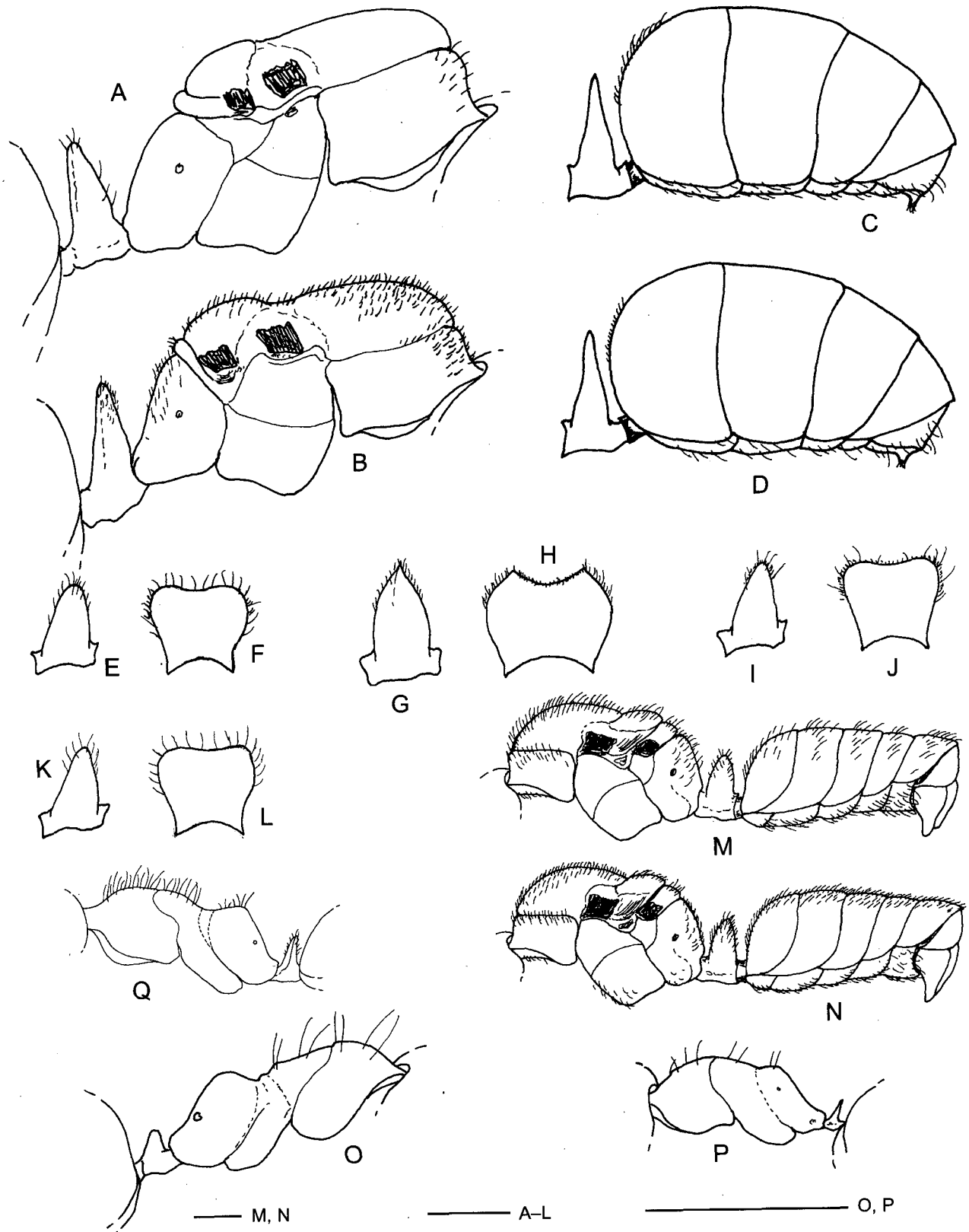

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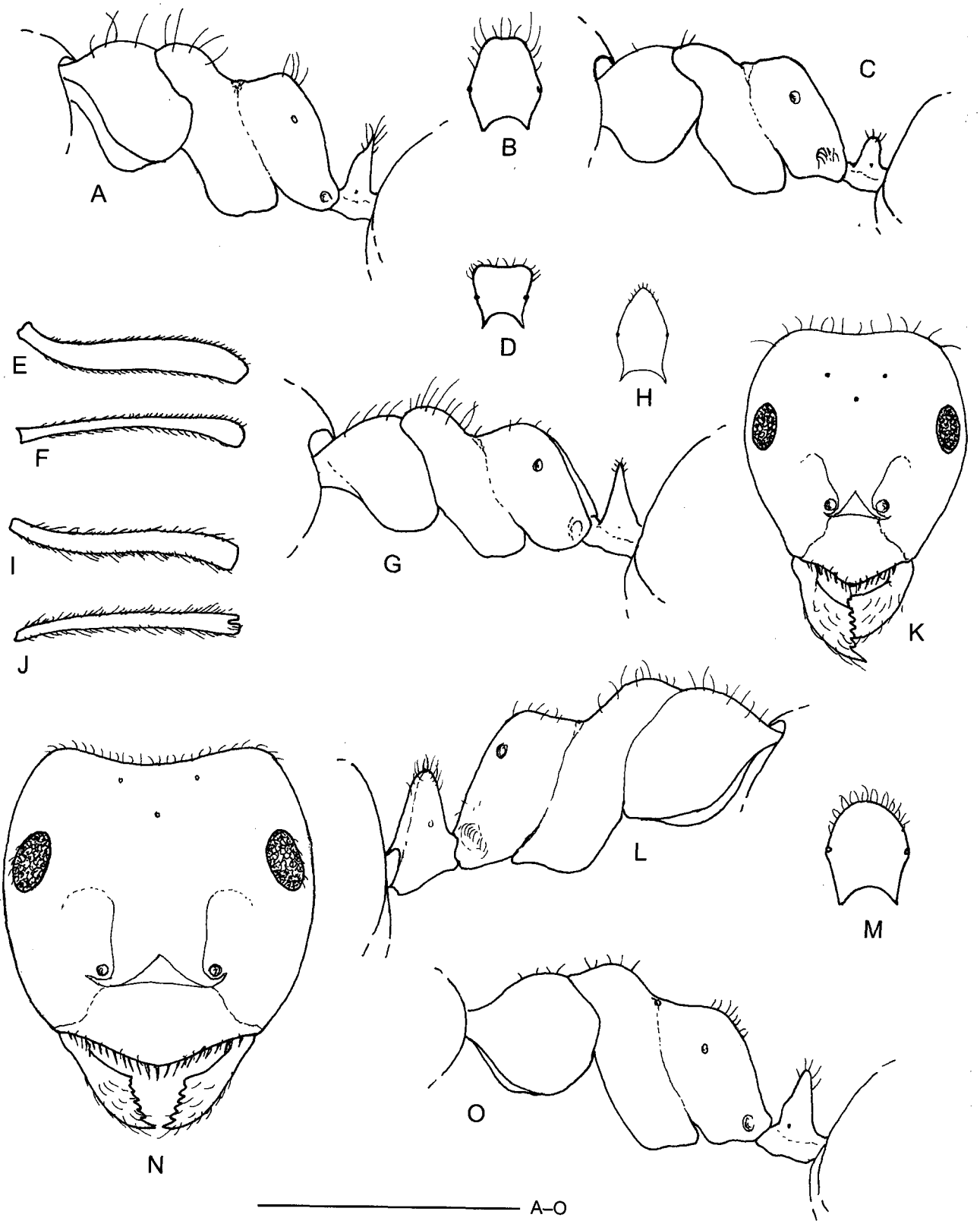

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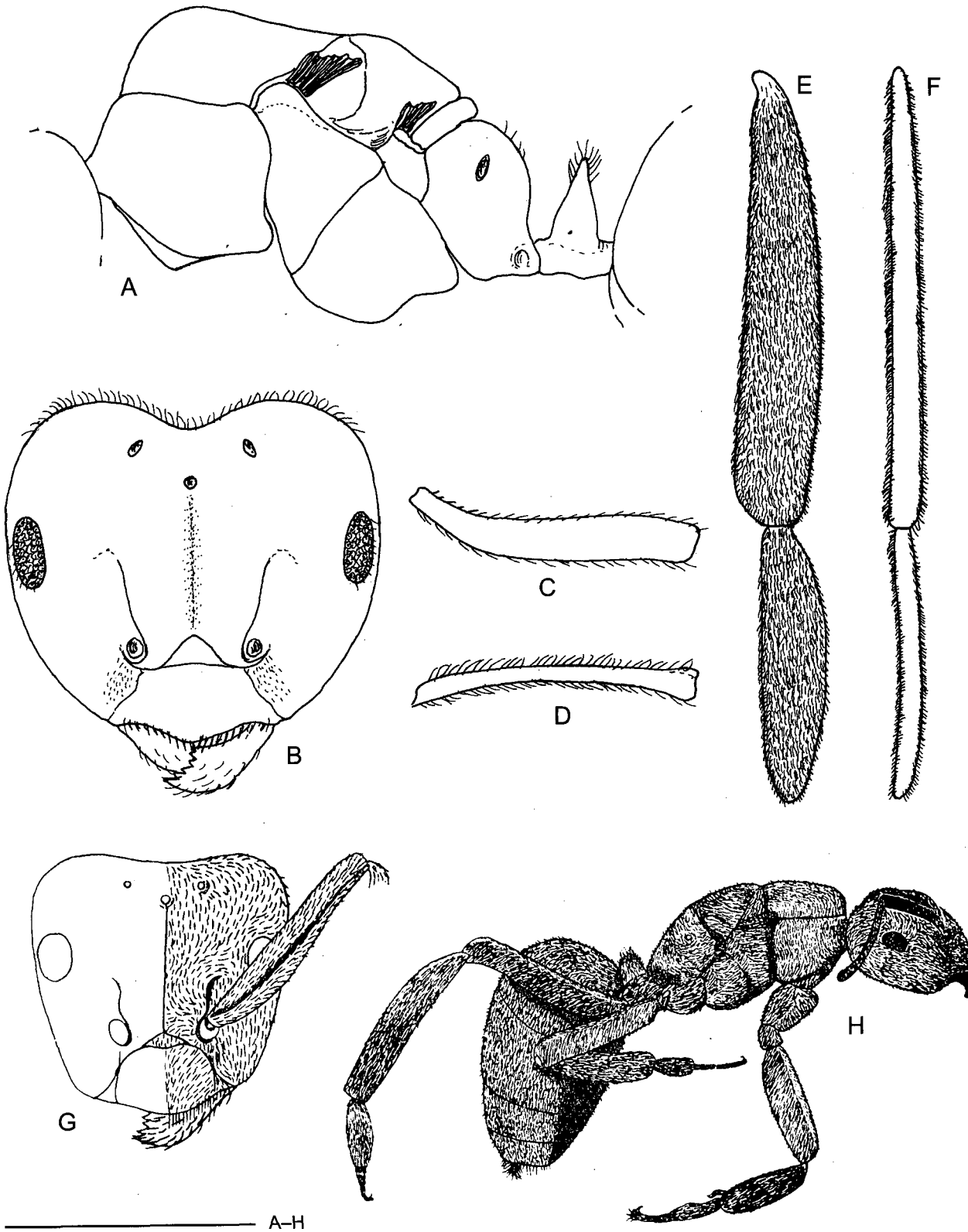

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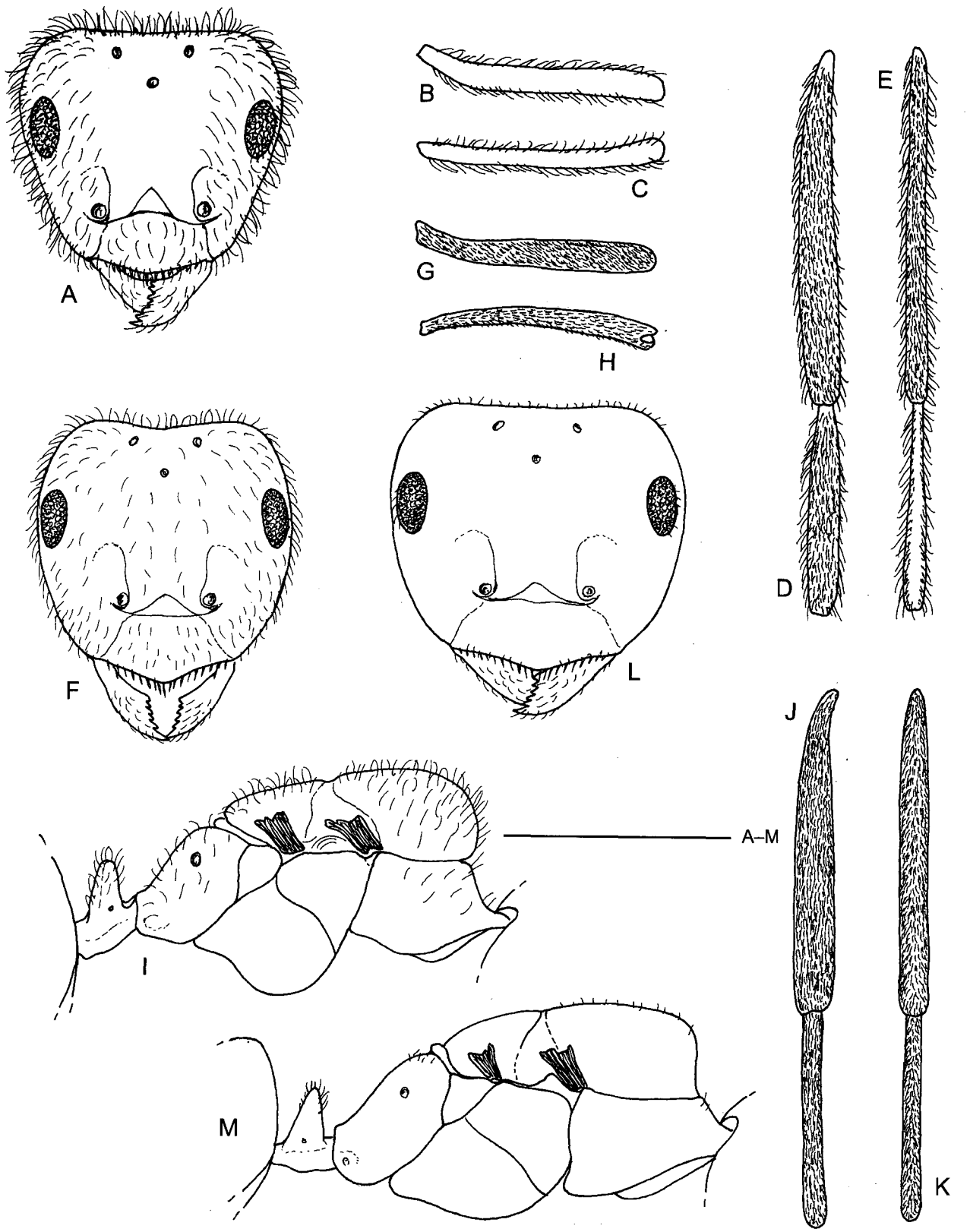

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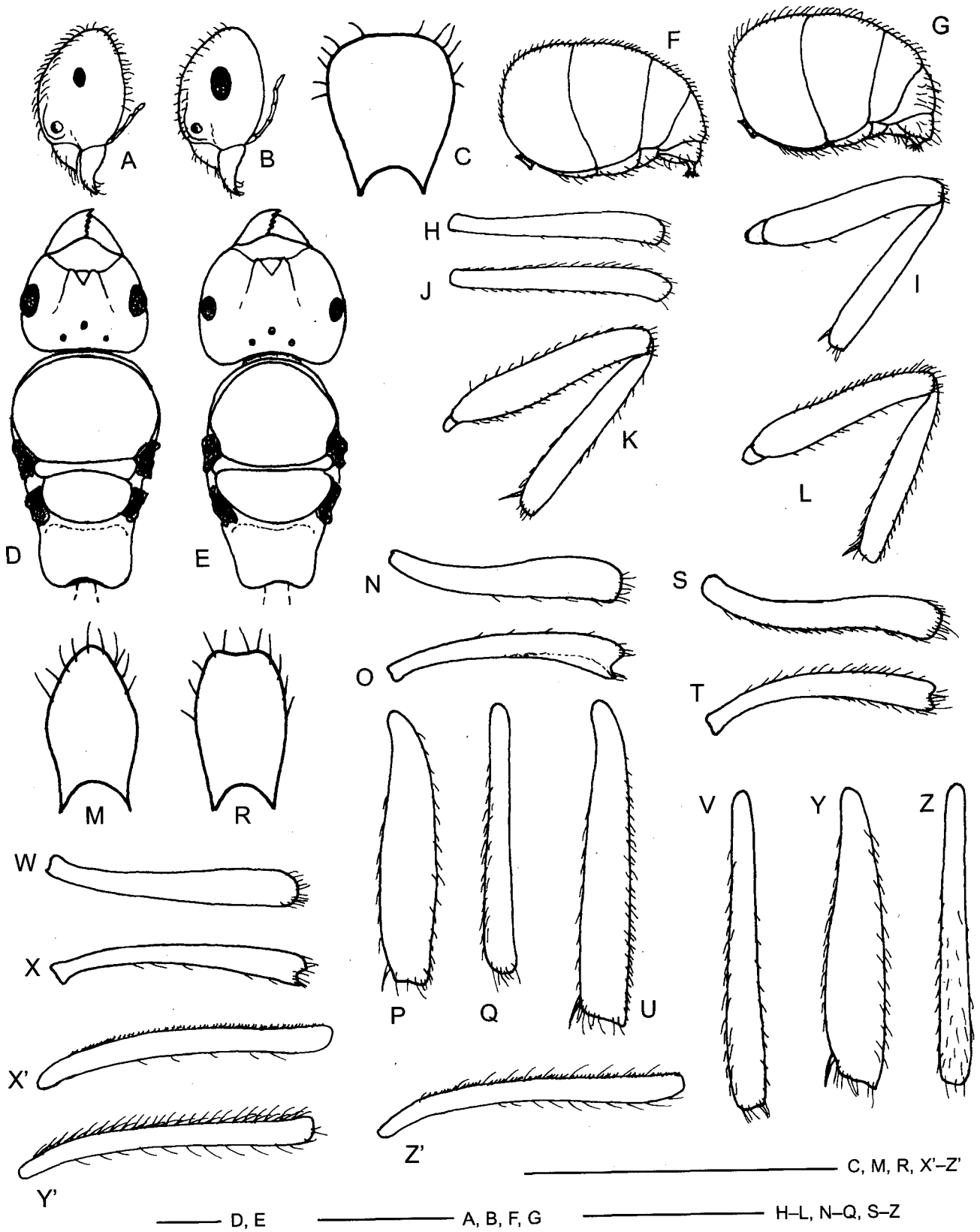

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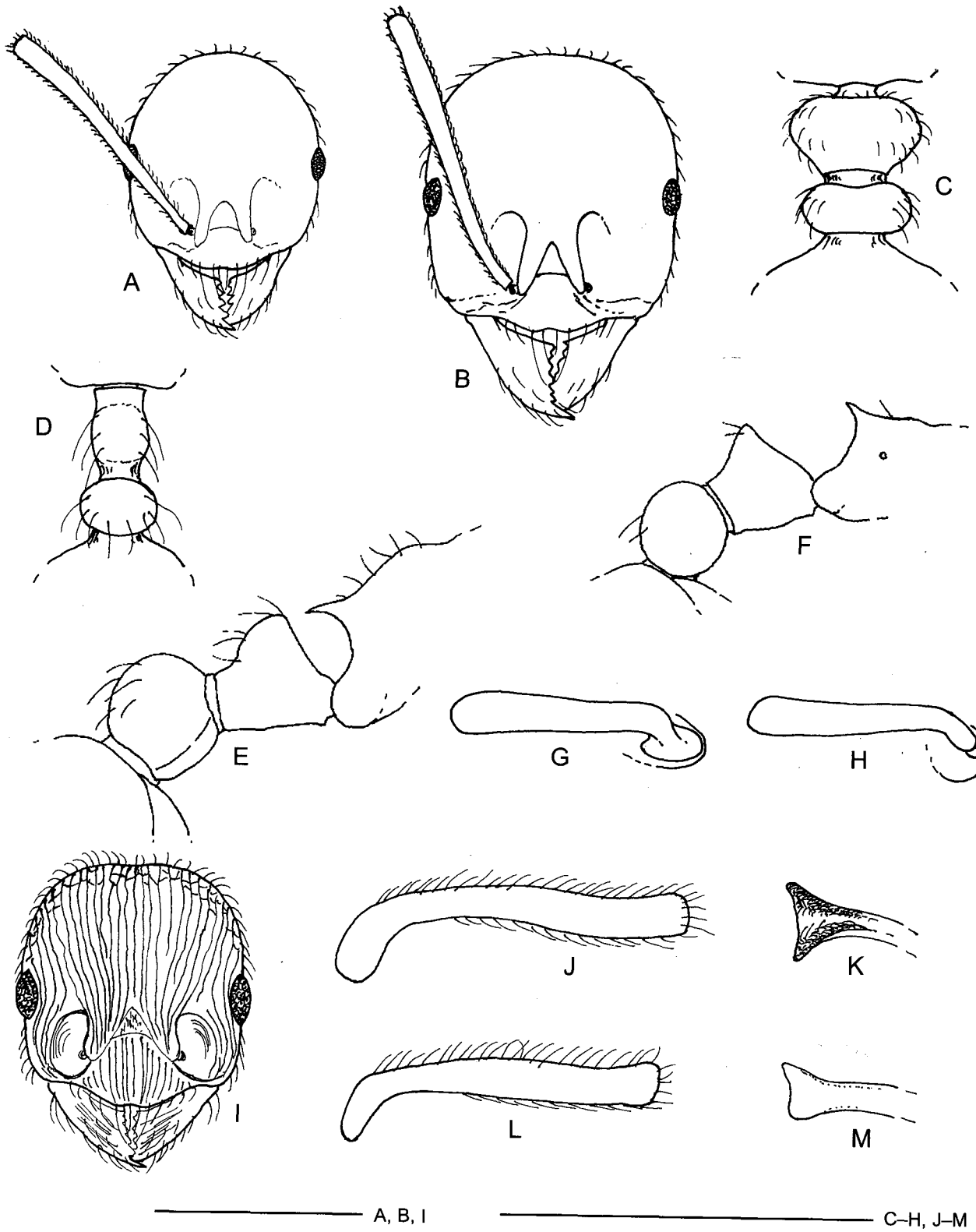

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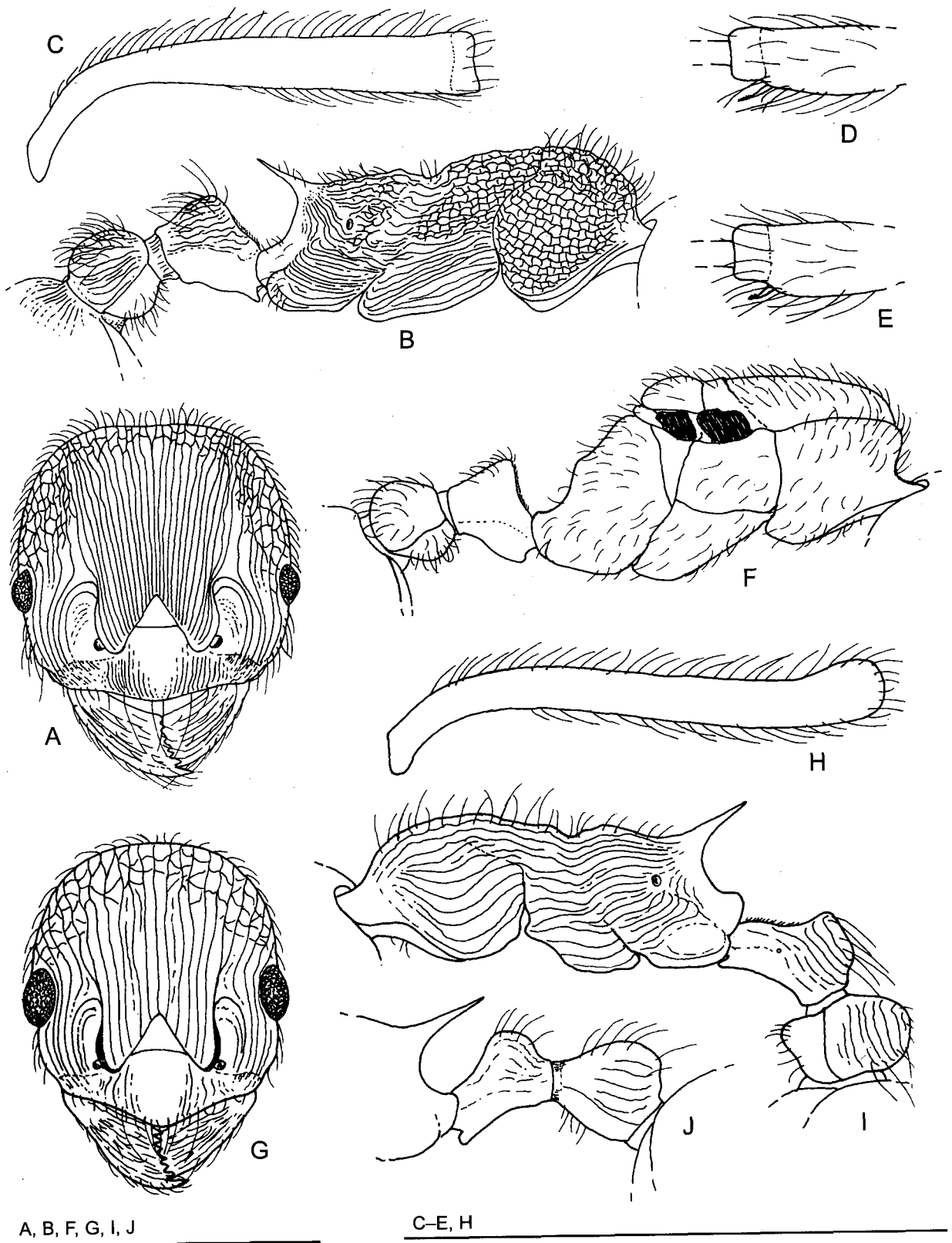

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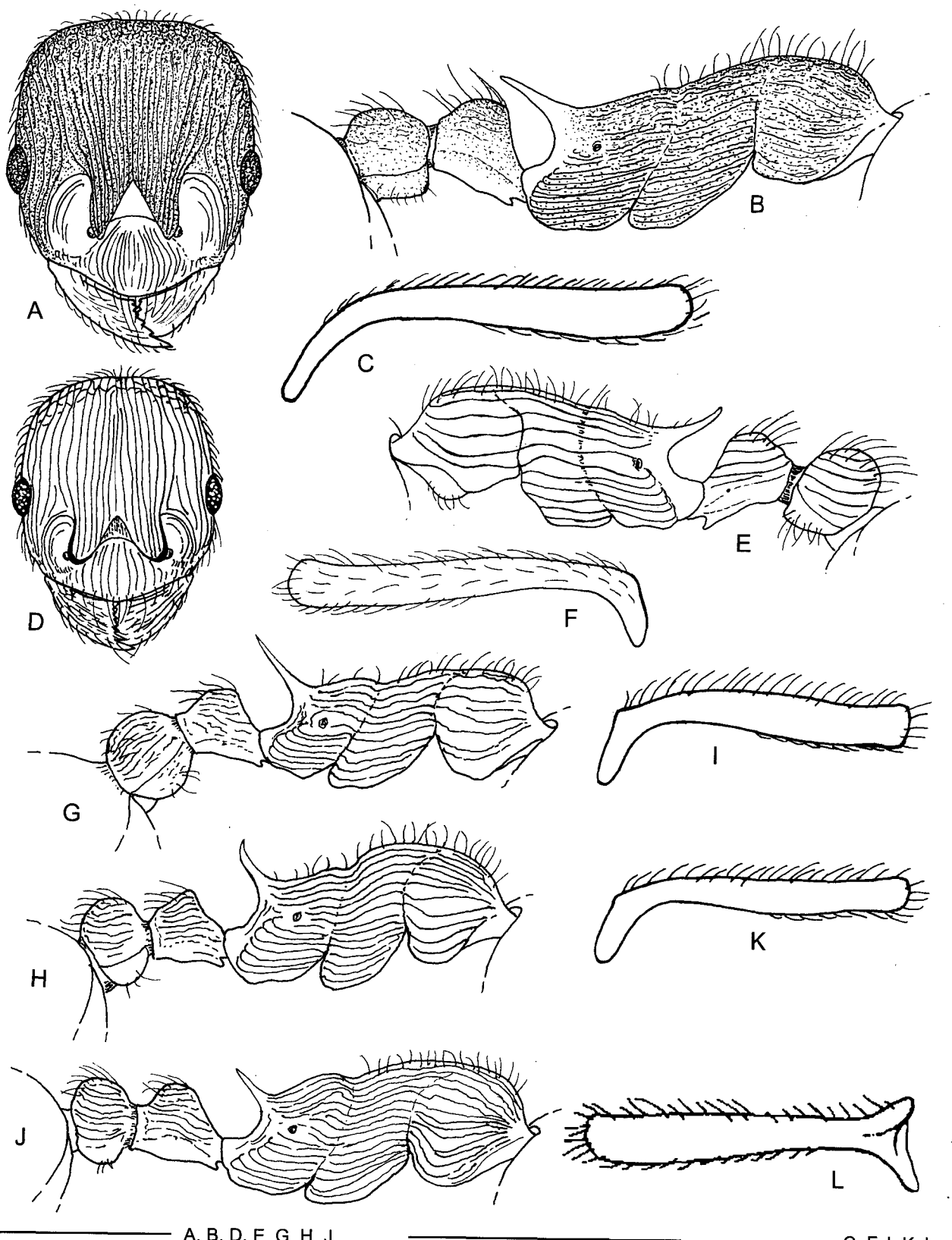

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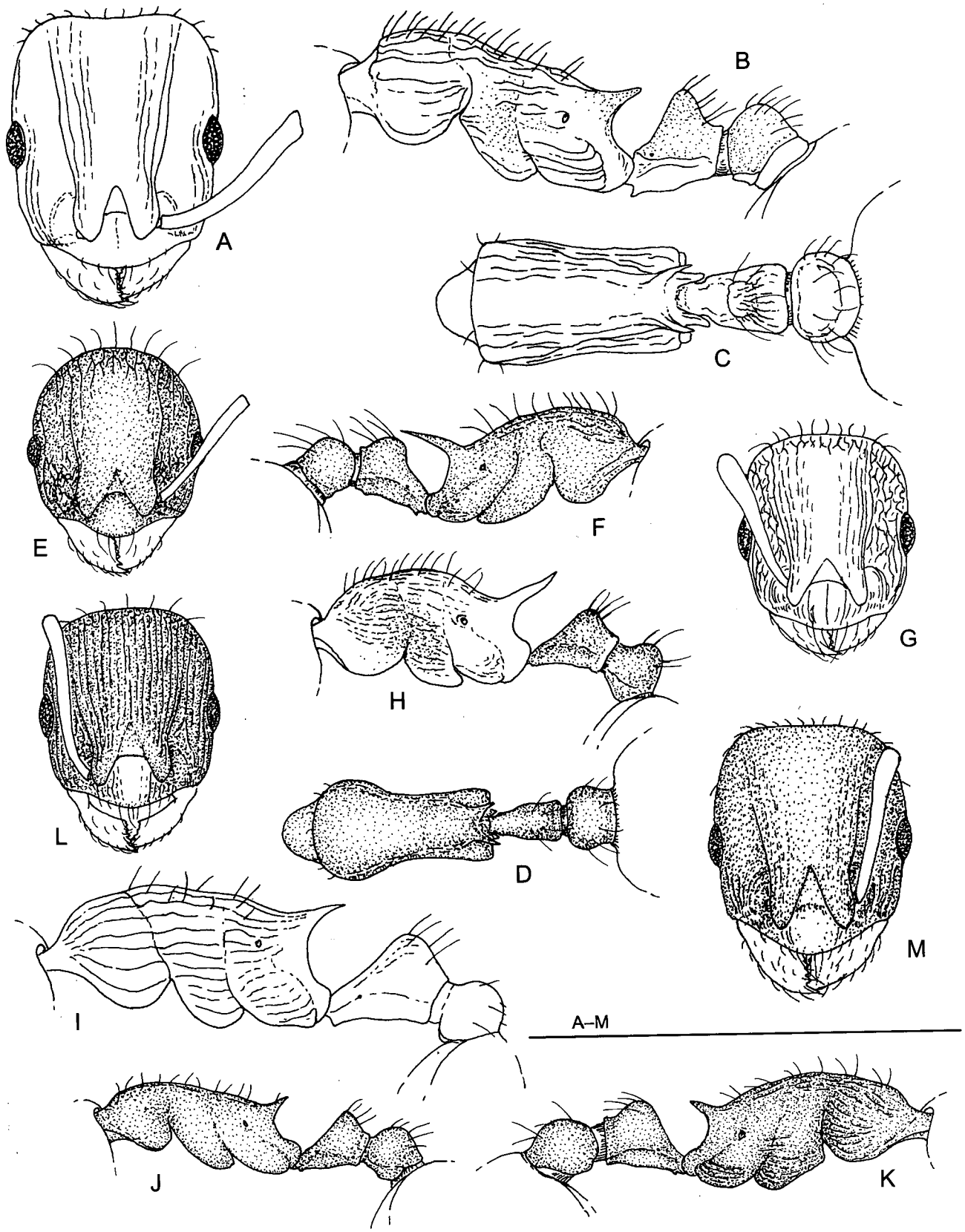

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