

THE TRIBE FORMICOXENINI (HYMENOPTERA, FORMICIDAE) IN POLAND – A TAXONOMIC REVIEW AND KEYS FOR IDENTIFICATION

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Abstract.— A taxonomic review of 18 species of the tribe *Formicoxenini* occurring in Poland is presented, together with information on their geographical ranges, distribution in Poland, and biology. The following species are discussed: *Formicoxenus nitidulus* (Nyl.), *Harpagoxenus sublaevis* Mayr, *Epimyrma ravouxi* (E. André), *Doronomyrmex kutteri* (Buschinger), *Leptothorax (Leptothorax) acervorum* (F.), *L. (L.) muscorum* (Nyl.), *L. (L.) gredleri* Mayr, *L. (Myrafant) albipennis* (Curtis), *L. (M.) affinis* Mayr, *L. (M.) clypeatus* (Mayr), *L. (M.) corticalis* (Schenck), *L. (M.) interruptus* (Schenck), *L. (M.) nadigi* Kutter, *L. (M.) nigriceps* Mayr, *L. (M.) nylanderii* (Foerst.), *L. (M.) parvulus* (Schenck), *L. (M.) tuberum* (F.), and *L. (M.) unifasciatus* (Latr.). Keys for identifying the genera and the species are included.



Key words.— Ants, *Formicoxenini*, *Formicoxenus*, *Harpagoxenus*, *Epimyrma*, *Doronomyrmex*, *Leptothorax*, taxonomy, zoogeography, biology, fauna, Poland, catalogue, key.

INTRODUCTION

The tribe Formicoxenini (=Leptothoracini sensu Emery, 1914 et auct.) includes 22 genera and about 500 species, and has a worldwide distribution. From among six Palaearctic genera that belong to this tribe, five are represented in the Polish myrmecofauna. They are: *Formicoxenus* Mayr, *Harpagoxenus* Forel, *Epimyrma* Emery, *Doronomyrmex* Kutter, and *Leptothorax* Mayr. Members of the first four genera are social parasites (xenobionts, slave-makers andinquilines), whereas majority of *Leptothorax* species (including all Polish ones) are free-living. The taxonomic status of *Doronomyrmex* is uncertain. It was described by Kutter in 1945 as a “satellite” genus of *Leptothorax*, but recently, Heinze (1995) proposed to synonymize it under *Leptothorax* (s.str.).

This paper follows the format of two previous ones devoted to the genera *Myrmica* Latr. and *Tetramorium* Mayr (Radchenko *et al.* 1997 and 1998 respectively), in that it comprises two sections. The first provides a catalogue with a taxonomic review of the Polish species of the tribe, together with information on their geographical ranges and distribution in Poland, supplemented with notes on their biology. The second section consists of keys for the identification of species.

MATERIAL AND METHODS

The catalogue was prepared by compiling literature data on the occurrence of the species in Poland (within the present borders), supplemented by reviewing and verifying the determinations in the ant collections in the Museum and Institute of Zoology of the Polish Academy of Sciences in Warsaw. As in the previous papers, the country is divided into geographical regions (Fig. 1) following “Katalog Fauny Polski” (see Pisarski 1975), with some simplifications. Complete synonymy is given only for the less well known species. Otherwise, the synonyms cited are those which are used in the literature concerning the occurrence of a given taxon in Poland; for the remainder see Pisarski (1975), Bolton 1995a, Radchenko 1994, 1995a,b,c. Information on the biology of any particular species is compiled on the basis of the literature data, mainly using Pisarski 1975, Collingwood 1979, Saaristo 1995, Seifert 1996, Czechowska *et al.* 1998, and a number of papers by Buschinger and his associates (e.g. Buschinger 1966, 1968, 1974, 1990, Buschinger and Winter 1976, 1978, Buschinger and Klump 1988), besides the authors’ own observations.

Eighteen formicoxenine ant species are reported from Poland:

1. *Formicoxenus nitidulus* (Nylander, 1846)
2. *Harpagoxenus sublaevis* (Nylander, 1849)
3. *Epimyрма ravouxi* (E. André, 1896)
4. *Doronomyrmex kutteri* (Buschinger, 1965)
5. *Leptothorax (Leptothorax) acervorum* (Fabricius, 1793)
6. *Leptothorax (Leptothorax) muscorum* (Nylander, 1846)



Figure 1. Polish geographical regions: 1 – Baltic Coast (Pobrzeże Bałtyku), 2 – Pomeranian Lake District (Pojezierze Pomorskie), 3 – Masurian Lake District (Pojezierze Mazurskie), 4 – Wielkopolsko-Kujawska Lowland (Nizina Wielkopolsko-Kujawska), 5 – Mazovian Lowland (Nizina Mazowiecka), 6 – Podlasie, 6a – Białowieża Forest (Puszcza Białowieża), 7 – Lower Silesia (Śląsk Dolny), 8 – Upper Silesia (Śląsk Górny), 9 – Krakowsko-Wieluńska Upland (Wyżyna Krakowsko-Wieluńska), 10 – Małopolska Upland (Wyżyna Małopolska), 10a – Świętokrzyskie Mts (Góry Świętokrzyskie), 11 – Lubelska Upland (Wyżyna Lubelska), 12 – Roztocze, 13 – Sandomierska Lowland (Nizina Sandomierska), 14 – Western Sudeten Mts (Sudety Zachodnie), 15 – Eastern Sudeten Mts (Sudety Wschodnie), 16 – Western Beskidy Mts (Beskidy Zachodnie), 17 – Eastern Beskidy Mts (Beskidy Wschodnie), 18 – Bieszczady Mts (Bieszczady), 19 – Pieniny Mts (Pieniny), 20 – Tatra Mts (Tatry).

7. *Leptothorax (Leptothorax) gredleri* Mayr, 1855
8. *Leptothorax (Myrafant) albipennis* (Curtis, 1854)
9. *Leptothorax (Myrafant) affinis* Mayr, 1855
10. *Leptothorax (Myrafant) clypeatus* (Mayr, 1853)
11. *Leptothorax (Myrafant) corticalis* (Schenck, 1852)
12. *Leptothorax (Myrafant) interruptus* (Schenck, 1852)
13. *Leptothorax (Myrafant) nadigi* Kutter, 1925
14. *Leptothorax (Myrafant) nigriceps* Mayr, 1855
15. *Leptothorax (Myrafant) nylanderii* (Foerster, 1850)
16. *Leptothorax (Myrafant) parvulus* (Schenck, 1852)
17. *Leptothorax (Myrafant) tuberum* (Fabricius, 1775)
18. *Leptothorax (Myrafant) unifasciatus* (Latreille, 1798).

SURVEY OF SPECIES

Genus *Formicoxenus* Mayr, 1855

Formicoxenus Mayr, 1855: 413. Type species: *Myrmica nitidula* Nylander, 1846: 1058, by monotypy.

Symmyrmica Wheeler, 1904: 3. Synonymy by Francoeur *et al.* 1985: 347.

Formicotenus: Brischke 1988 (misspelling).

The genus includes seven species; five of them occur in North America, one is transpalearctic and one is known from East Siberia. All the species are xenobionts or guest ants living in nests of a different subfamily; Nearctic species coexist with *Myrmica* ants, whereas hosts of Palearctic forms belong to the genus *Formica* (especially *Formica* s.str.) (Francoeur *et al.* 1985).

Formicoxenus nitidulus (Nylander, 1846)

Myrmica nitidula Nylander, 1846: 1058.

Formicoxenus nitidulus Mayr, 1855: 418.

General distribution (Fig. 2). Transpalearctic species.

Distribution in Poland (Fig. 3, Table 1). Baltic Coast (Urbański 1956, Wiśniewski 1987); Pomeranian Lake District (Griep 1940, Wiśniewski 1987); Masurian Lake District (Więckowski 1957, Wiśniewski 1987); Wielkopol-



Figure 2. Distribution of *Formicoxenus nitidulus* in Palearctic.



Figure 3. Distribution of *Formicoxenus nitidulus* in Poland.

ska-Kujawska Lowland (Wiśniewski 1967, 1987); Mazovian Lowland (Pisarski 1982, Czechowski and Czechowska 1999); Białowiecka Forest (Czechowski and Czechowska 1999); Lower Silesia (Wiśniewski 1987); Upper Silesia (Nowotny 1931a, 1937, Stawarski 1966; Świętokrzyskie Mts (Krzysztofiak 1984); Lubelska Upland (Minkiewicz 1935, Pisarski 1953); Roztocze (Petal 1961); Western Beskidy Mts (Wiśniewski 1987); Bieszczady Mts: (Parapura and Pisarski 1971, Wiśniewski 1987); Pieniny Mts (Koehler 1951); «Western and Eastern Prussia» (Brischke 1888).

Biology. The commonest xenobiotic ant species; it co-exists with ants of the genus *Formica* L., mainly with red wood ants, by entering into a «compound-nest» relationship with them. Sometimes several guest ant colonies inhabit one host mound. The dependency is trophic in character; guests either beg for regurgitated food from host workers or intercept their food exchange. *F. nitidulus* colonies are functionally monogynous; they comprise up to about 150 adults and generally contain a number of intermorphic females. Nuptial period in July and August; mating takes place on the surface of the host nest.

In Poland, *F. nitidulus* has been recorded from about 50 sites dispersed in different regions. The species probably occurs throughout the country but has been underreported due to its cryptic mode of life. Its host species known so far from Poland are: *Formica truncorum* F., *F. pratensis* Retz., *F. rufa* L., *F. polyctena* Foerst. (subg. *Formica* s.str.), and *F. pressilabris* Nyl. (subg. *Coptoformica* Müll.).

Genus *Harpagoxenus* Forel, 1893

Harpagoxenus Forel, 1893: 167, nom. nov. pro *Tomognathus* Mayr, 1861 (Formicidae), junior homonym of *Tomognathus* Agassiz, 1850 (Pisces). Type species: *Myrmica sublaevis* Nylander, 1849: 33, by monotypy.

The genus consists of three species: one inhabits the boreal zone of the Palaearctic, the second occurs in South Siberia and northern Mongolia and the third is known from boreal zone of North America. All are slave-makers, parasitising *Leptothorax* s.str. species.

Harpagoxenus sublaevis (Nylander, 1849)

Myrmica sublaevis Nylander, 1849: 33.

Tomognathus sublaevis: Mayr 1861: 56.

Harpagoxenus sublaevis: Forel 1893: 167.

General distribution (Fig. 4). Boreal zone of Palaearctic, mountains of Central and South Europe, Caucasus.

Distribution in Poland (Fig. 5, Table 1). Upper Silesia (Nowotny 1931a); Sandomierska Lowland (Czechowska and Czechowski 1998, Czechowski and Czechowska 1999); Western Sudeten Mts (Stawarski 1961, 1966, Banert and Pisarski 1972); Bieszczady Mts (Parapura and Pisarski 1971); Tatra Mts (Łomnicki 1931, Czechowski and Czechowska 1999).

Biology. Slave-maker co-existing with *Leptothorax acervorum*, *L. muscorum* and *L. gredleri*; it is also a temporary social parasite of these during colony founding. Mature mixed colonies, in which slaves as a rule greatly predominate (usually >80%), comprise from a few score to several hundred adults. *H. sublaevis* also enslave host females besides the workers by depriving them their wings. The species is highly polymorphic; among females there are ergatomorphs (workers and ergatoid gynes), apterogynes (wingless gynes) and gynomorphs (alate gynes). The colonies are strictly monogynous. Nests are found in rotten twigs on the ground, in stumps and under bark, but in the mountains of Central Europe they are usually under stones. Nuptial flight in July.

In Poland, *H. sublaevis* is known from few regions in the southern part of the country. It has been found in mixed colonies with *L. acervorum* and (or) *L. muscorum*.

Genus *Epimyрма* Emery, 1915

Epimyрма Emery, 1915: 262. Type species: *Epimyрма krausse* Emery, 1915, by original designation.

Myrmetaerus Soudek, 1925: 33. Synonymy by Buschinger *et al.* 1984: 336 (junior synonym of *Myrmoxenus*).

Myrmoxenus Ruzsky, 1902: 474. Synonymy by Bolton 1994: 105.



Figure 4. Distribution of *Harpagoxenus sublaevis* in Palaearctic.

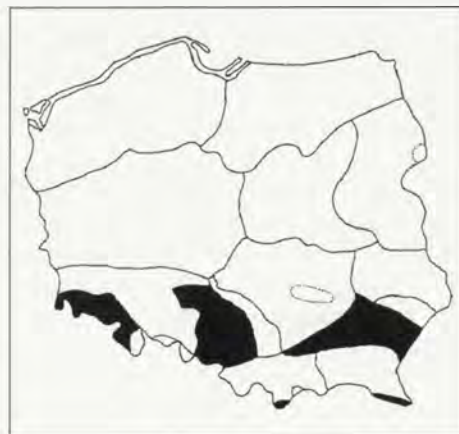
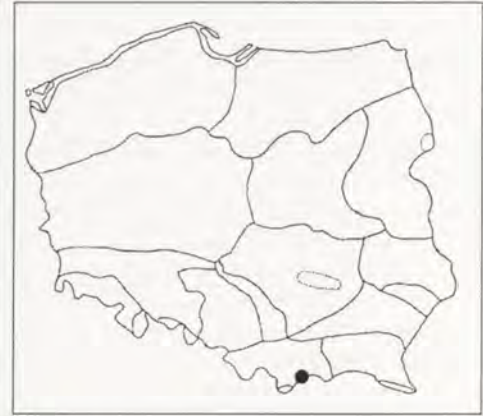


Figure 5. Distribution of *Harpagoxenus sublaevis* in Poland.

Figure 7. Locality of *Epimyrma ravouxi* in Poland.Figure 6. Localities of *Epimyrma ravouxi* in Europe.

The genus includes 10 species distributed in South and Central Europe, North-West Africa, South-West Ukraine (Radchenko, unpubl. data), Crimea, Transcaucasus, Kazakhstan and Kirgizstan. One species is recorded from Poland. Species of this genus exhibit an evolutionary transition from active slavery to a special form of workerless permanent parasitism (so called degenerate dulosis, because unlike in typical inquiline parasitism the parasite queen kills the host queens). Their hosts are species of the genus *Leptothorax* (subgenera *Myrafant* M. R. Smith and *Temnothorax* Mayr).

Epimyrma ravouxi (E. André, 1896)

Formicoxenus ravouxi E. André, 1896: 367.

Epimyrma ravouxi: Emery 1915, Czechowski and Czechowska 1997.

Epimyrma goesswaldi Menozzi, 1931: 41. Synonymy by Buschinger 1982: 352.

Epimyrma goesswaldi: Czechowska 1976, Woyciechowski 1985.

General distribution (Fig. 6). Mediterranean species that occurs extensively in mountainous regions of South, West and Central Europe (known from Spain, Germany, Switzerland, Austria, Italy, Bulgaria, the former Yugoslavia, Greece, and Corsica).

Distribution in Poland (Fig. 7, Table 1). Pieniny Mts (Czechowska 1976, Woyciechowski 1985, Czechowska and Czechowski, in prep.).

Biology. A xerothermophilous species; typical slave-maker, which conduct well-organized raids. Its hosts (both sources of slaves and victims of dependent colony founding) are colonies of different *Leptothorax* (*Myrafant*) species.

In Poland, *E. ravouxi* occurs only in the Pieniny Mts, where it nests in xerothermic and lichenaceous grasslands inside dry empty stems of various herbaceous plants or under stones; its hosts are *Leptothorax nadigi*, *L. nigriceps* and *L. unifasciatus*.

Genus *Doronomyrmex* Kutter, 1945

Doronomyrmex Kutter, 1945: 485. Type species: *Doronomyrmex pacis* Kutter, 1945: 486, by monotypy.

Leptothorax Mayr, 1855: Buschinger 1965 (part.), Kutter 1967 (part.).

Four species of the genus are known at present; three occur in Central and North Europe, one is reported only from North America. Recently, an unidentified species of *Doronomyrmex* was found in West Siberia (Kemerovskaya Distr., Russia, leg. S. Sorokina) (Radchenko, unpubl. data). All the European species are workerless permanent social parasites of *Leptothorax acervorum*. *D. pacis* Kutter and *D. kutteri* (Buschinger) are typical inquilines; their queens coexist with the host queens. *D. goesswaldi* (Kutter) queens, however, kill host queens and, as a result, the duration of mixed colonies is limited by the longevity of host workers (3–4 years); therefore it may be termed a "murder parasite" (see Faber 1969). In North-American species, *D. pocahontas* Buschinger, a vestigial worker caste is present (Buschinger and Heinze 1993).

Doronomyrmex kutteri (Buschinger, 1965)

Leptothorax (*Mychothorax*) *kutteri* Buschinger, 1965: 327.

Doronomyrmex kutteri: Buschinger 1981, Radchenko and Czechowski 1997.

General distribution (Fig. 8). Southern Germany, Suisse, Austria, the Italian Alps, Sweden, Estonia, Finland, and the north of European part of Russia.

Distribution in Poland (Fig. 9, Table 1). Roztoezy: Rakowskie Bagno near Frampol (Radchenko and Czechowski 1997).

Biology. Workerless inquiline of *Leptothorax acervorum*.

The only record from Poland is based upon a single specimen found in the collection of Museum and Institute of Zoology, PAS in Warsaw.

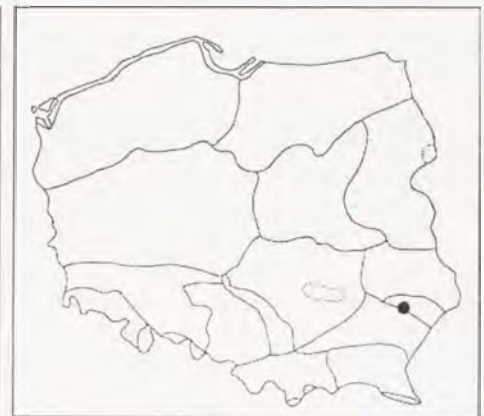


Figure 9. Locality of *Doroformix kutteri* in Poland.

Figure 8. Localities of *Doroformix kutteri* in Europe.

Genus *Leptothorax* Mayr, 1855

Leptothorax Mayr, 1855: 431. Type species: *Formica acervorum* Fabricius, 1793: 358, by subsequent designation of Bingham 1903: 214.

Macromischa Roger, 1863: 184. Synonymy by Snelling 1986: 154.
Nesomyrmex Wheeler, 1910: 259. Synonymy by Bolton 1982: 319.
Temnothorax Mayr, 1861: 68. Synonymy by Forel 1890: lxxii, Baroni Urbani 1971: 96, Bolton 1982: 319.

Cosmopolitan genus comprising more than 300 species (Bolton 1995b); 14 species are known from Poland.

Subgenus *Leptothorax* s.str.

Leptothorax s.str. (as subgenus of *Leptothorax* Mayr). Type species: *Formica acervorum* Fabricius, 1793: 358, by subsequent designation of Bingham 1903: 214.

Mychothorax Ruzsky, 1904: 288 (as subgenus of *Leptothorax* Mayr). Type species: *Formica acervorum* Fabricius, 1793: 358, by original designation. Synonymy by M. R. Smith 1950: 29.

Leptothorax acervorum (Fabricius, 1793)

Formica acervorum Fabricius, 1793: 358.

Myrmica acervorum: Zetterstedt 1840.

Leptothorax acervorum: Mayr 1855.

Leptothorax (subg. *Mychothorax*) *acervorum*: Ruzsky 1904, Kulmatycki 1920a, Begdon 1932, 1954, Jakubisiak 1948, Koehler 1951, Parapura and Pisarski 1971, Banert and Pisarski 1972, Pisarski 1975, 1981, 1982, Pisarski and Czechowski 1991, Czechowska 1976, Czechowski and Pisarski 1990b.

Leptothorax (subg. *Leptothorax* s.str.) *acervorum*: M. R. Smith 1950, Czechowski and Czechowska 1999.

Mychothorax acervorum: Kulmatycki 1920b, Jacobson 1940.

Leptothorax acervorum var. *nigrescens* Ruzsky, 1905: 613. Synonymy by Collingwood 1971: 160, Radchenko 1995a: 23.

Leptothorax acervorum var. *nigrescens*: Koehler 1951, Stawarski 1961, 1966. *Leptothorax acervorum* subsp. *nigrescens*: Pętał 1964, 1968, Banert and Pisarski 1972.

Leptothorax (subg. *Mychothorax*) *nigrescens*: Pętał 1963, Pisarski 1975, Czechowska 1976.



Figure 10. Distribution of *Leptothorax acervorum* in Palaearctic.



Figure 11. Distribution of *Leptothorax acervorum* in Poland.

General distribution (Fig. 10). Boreal zone of Palaearctic, mountains of South Europe, Caucasus, Tien-Shan.

Distribution in Poland (Fig. 11, Table 1). Baltic Coast (Kulmatycki 1922); Pomeranian Lake District (Begdon 1932, Griep 1940, Jacobson 1940, Szujecki *et al.* 1978, 1983, Mazur 1983, Czechowski *et al.* 1995); Masurian Lake District (Begdon 1958, Wengris 1962, 1963, 1977, Mazur 1983, Krzysztofiak 1985); Wielkopolsko-Kujawska Lowland (Begdon 1932, Więckowski 1957, Pawlikowski and Sobieszczyk 1980, Mazur 1983); Mazovian Lowland (Jakubisiak 1948, Więckowski 1957, Kaczmarek 1963, Dobrzański 1966, Pisarski and Czechowski 1978, Pisarski 1981, 1982, Mazur 1983, Czechowski and Pisarski 1990b, Czechowski *et al.* 1995); Podlasie (Pętał 1964, 1968, Mazur 1983); Białowieża Forest (Karpiński 1956, Czechowski *et al.* 1995, Czechowski 1998); Lower Silesia (Kotzias 1930, Stawarski 1966, Mazur 1983); Upper Silesia (Scholz 1926, Nowotny 1931a, Stawarski 1966); Krakowsko-Wieluńska Upland (Kaczmarek 1953); Małopolska Upland (Kulmatycki 1920b, Mazur 1983); Świętokrzyskie Mts (Pongrácz 1924, Mazur 1983, Krzysztofiak 1984); Lubelska Upland (Pisarski 1953, Dobrzańska 1958, Puszkarski 1978, 1982, Mazur 1983); Roztocze (Kulmatycki 1920b, Pętał 1961, 1963, 1964, Mazur 1983); Sandomierska Lowland (Mazur 1983, Czechowski and Czechowska 1999); Western Sudeten Mts (Stawarski 1961, 1966, Banert and Pisarski 1972, Pętał 1994); Western Beskidy Mts (Kulmatycki 1920a); Bieszczady Mts (Parapura and Pisarski 1971, Pisarski 1973); Pieniny Mts (Nowicki 1864, Wierzejski 1868, 1873, Koehler 1951, Czechowska 1976, Woyciechowski 1985, 1990a); Tatra Mts (Kulmatycki 1920a, Łomnicki 1931, Woyciechowski 1990a,b); «Western and Eastern Prussia» (Brischke 1888).

Biology. A eurytopic species, inhabiting very different habitats, ranging from moist peatbogs to xerothermic grasslands; most abundant in dry and light coniferous (mainly pine) forests with poor undergrowth. In mountains, it reaches the subalpine meadows and the tundra zones. Nests are built,

depending on habitat, in rotten logs or stumps, fallen branches, under bark and, more rarely, under stones or in rock crevices, also under moss; on bogs they are founded in peat. The species forms mono- or polygynous colonies, usually with a few dozen workers. The workers forage individually, preying on small insects or scavenging invertebrate corpses; they are non-aggressive, avoiding intra- and interspecific combats with other ants. Nuptial flights usually in July and August.

In Poland, this species very probably is common throughout the country (only the Eastern Sudeten Mts and the Eastern Beskidy Mts have no records).

Leptothorax muscorum (Nylander, 1846)

Myrmica muscorum Nylander, 1846: 1054.

Leptothorax muscorum: Mayr 1855.

Leptothorax (subg. *Mychothorax*) *muscorum*: Ruzsky 1905, Begdon 1932, 1954, Jakubisiak 1948, Koehler 1951, Parapura and Pisarski 1971, Banert and Pisarski 1972, Pisarski 1975, 1981, 1982, Pisarski and Czechowski 1991, Czechowska 1976, Czechowski 1990, Czechowski, Czechowska and Palmowska 1990, Czechowski, Pisarski and Czechowska 1990.

Leptothorax (subg. *Leptothorax* s.str.) *muscorum*: Czechowski *et al.* 1995, Czechowski and Czechowska 1999.

General distribution (Fig. 12). Boreal zone of Palaearctic (in general, in more southern parts than *L. acerorum*), mountains of South Europe, Caucasus.

Distribution in Poland (Fig. 13, Table 1). Pomeranian Lake District (Begdon 1932, Czechowski *et al.* 1995); Masurian Lake District (Mazur 1983, Krzysztofiak 1985, Wengris 1977); Wielkopolsko-Kujawska Lowland (Mazur 1983); Mazovian Lowland (Nasonov 1892, Jakubisiak 1948, Kaczmarek 1963, Pisarski and Czechowski 1978, Pisarski 1981, 1982, Czechowski 1990, 1991, Czechowski and Pisarski 1990a, Czechowski, Czechowska and Palmowska 1990, Czechowski, Pisarski and Czechowska 1990, Czechowski *et al.* 1995); Białowieża Forest (Czechowski *et al.* 1995); Lower Silesia (Stawarski 1966, Mazur 1983); Upper Silesia (Nowotny 1931a,b, 1937); Krakowsko-Wieluńska Upland (Kaczmarek



Figure 12. Distribution of *Leptothorax muscorum* in Palaearctic.



Figure 13. Distribution of *Leptothorax muscorum* in Poland.

1953); Małopolska Upland (Mazur 1983); Świętokrzyskie Mts (Krzysztofiak 1984); Lubelska Upland (Pisarski 1953, Puzkar 1978, 1982, Mazur 1983); Roztocze (Petal 1961, 1964, Mazur 1983); Sandomierska Lowland (Mazur 1983, Czechowski and Czechowska 1999); Western Sudeten Mts (Banert and Pisarski 1972); Western Beskidy Mts: Babia Góra ad Maków Podhalański (coll. MIZ PAS); Bieszczady Mts (Parapura and Pisarski 1971); Pieniny Mts (Koehler 1951, Czechowska 1976); Tatra Mts (Łomnicki 1931, Woyciechowski 1985, 1990b).

Biology. The ecological requirements and habits of the species are similar to those of *L. acervorum*, but with a preference for drier and warmer habitats (it does not inhabit bogs). The colonies are usually smaller than *L. acervorum*, with one or occasionally two queens. Nests are found under small stones, under bark, in rotten wood, sometimes in litter. Nuptial flights from July to September.

In Poland, the species probably occurs throughout the country, but so far has not been recorded from the Baltic Coast, Podlasie (except the Białowieża Forest), the Eastern Sudeten Mts and the Eastern Beskidy Mts. However, it is generally much less common than *L. acervorum*.

Leptothorax gredleri Mayr, 1855

Leptothorax gredleri Mayr, 1855: 438.

Leptothorax muscorum var. *gredleri*: Stitz 1939.

Leptothorax (subg. *Mychothorax*) *gredleri*: Begdon 1932, Pisarski 1975, Pisarski and Czechowski 1991.

Note. *L. gredleri* is closely related to *L. muscorum* and is hardly distinguishable from this species. For many years after its description, *L. gredleri* had been considered to be a subspecies or a variety of *L. muscorum* until Buschinger (1966) confirmed its species status. Many authors (e.g. Kutter 1977 and Agosti and Collingwood 1987) used as the most important future for the separation of these two species

the shape of petiole. However, this feature is very variable and Seifert (1996) proposed to use others characters, particularly the sculpture of head. We agree with Seifert's opinion.

General distribution (Fig. 14). Recorded from Poland, Germany, Czechia, Switzerland, Northern Italy, the former Yugoslavia, and Greece.

Distribution in Poland (Fig. 15, Table 1). Wielkopolsko-Kujawska Lowland: Toruń (Begdon 1932, Stitz 1939); Mazovian Lowland: Puszcza Kampinowska (Czechowski et al. 1998).

Biology. A relatively poorly known species, found mainly in shady and moist deciduous or mixed forests. It nests in soil, in rotten fallen branches and low under bark of living trees. Functionally monogynous.

In Poland, it is reported from only two localities, where nests were at the foot or under the bark of alder trees.

Subgenus *Myrafant* M. R. Smith, 1950

Myrafant M. R. Smith, 1950: 30 (as subgenus of *Leptothorax*). Type species: *Leptothorax curvispinosus* Mayr, 1866: 508, by original designation.

Leptothorax s.str.: Pisarski 1975 et auct., nec Bingham 1903, M. R. Smith 1950 et auct.

Leptothorax albipennis (Curtis, 1854)

Stenammina albipennis Curtis, 1854: 218.

Leptothorax tuberointerruptus Bondroit, 1918: 126 (first available use of *Leptothorax tuberum* var. *tuberointerruptus* Forel, 1874, nomen nudum). Synonymy by Orlege 1998: 31.

Note. *L. albipennis* was forgotten name, since middle of XIX century it was considered to be a synonym of a different species. However, Orlege (1998), based on investigation of a rich material, including type specimens of *L. albipennis*, showed that it is the senior synonym of *L. tuberointerruptus* Bondr. This species is closely related to *L. tuberum* and *L. uni-*



Figure 15. Localities of *Leptothorax gredleri* in Poland.

Figure 14. Localities of *Leptothorax gredleri* in Europe.

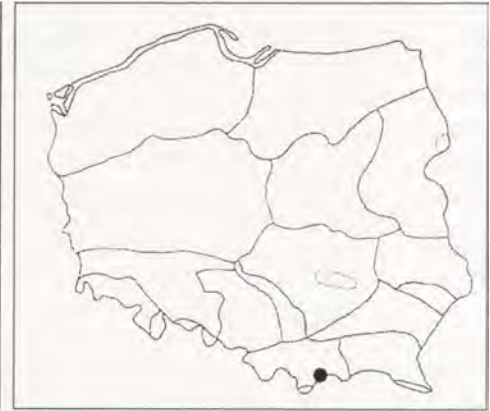


Figure 17. Locality of *Leptothorax albipennis* in Poland.

Figure 16. Localities of *Leptothorax albipennis* in Europe.

fasciatus, and is sometimes hardly distinguishable from them. Moreover, in the *L. tuborum*-group cross-breeding occurs and certain hybrid forms can not be separated either from one another, or from *L. tuborum* (Douwes and Stille 1991). Despite this, some authors tried to distinguish *L. albipennis* (= *L. tuberointerruptus*) from *L. tuborum* and *L. unifasciatus* by the sculpture of the head and alitrunk dorsum and colour of the head and funiculus, etc. (Douwes and Stille 1991, Seifert 1996). However, our study of eastern populations of *L. tuborum* and *L. unifasciatus* have not confirmed their opinions. Sculpture and colour of the two latter species are highly variable and these features overlapped with those used for separation of western-population of *L. albipennis* from *L. tuborum*.

General distribution (Fig. 16). Reported from Southern England and Wales, The Netherlands, Germany, Czechia, French and Spanish Pyrenees, Italy, and Poland; everywhere rare.

Distribution in Poland (Fig. 17, Table 1). Pieniny Mts (Czechowska and Czechowski 1999).

Biology. A xerothermophilous species, inhabiting grasslands and light scrub, especially on lime subsoil. It nests in rock crevices and rubble or in tree stumps and dry fallen branches. The colonies are monogynous, numbering about 200 workers and may form temporarily polydomous systems.

In Poland, *L. albipennis* occurs only in the Pieniny Mts, where it inhabits mainly xerothermic grasslands and, more rarely, lichenaceous grasslands, nesting in the upper layer of rocky soil, under moss and, sometimes, inside dry empty stems of herbaceous plants. Sexual forms were seen in June.

Leptothorax affinis Mayr, 1855

Leptothorax affinis Mayr, 1855: 170.

Leptothorax tuborum affinis: Kulmatycki 1920a

Leptothorax (subg. *Leptothorax* s.str.) *affinis*: Pisarski 1975, Pisarski and Czechowski 1991, Czechowska 1976.

General distribution (Fig. 18). South, Central and East Europe (northern limit of the species range is southern border of mixed forests zone), Crimea and Caucasus.

Distribution in Poland (Fig. 19, Table 1). Krakowsko-Wieluńska Upland: Ujazd near Kraków (Kulmatycki 1920a); Pieniny Mts: Zawiesy, Trzy Korony (Koehler 1951).

Biology. A xerothermophilous arboreal species inhabiting mainly dry light oak forests and nesting in dead tree branches or, more rarely, in fallen dry wood. Monogynous.

The species is very rare in Poland, found in xerothermic sites with lime subsoil only.

Leptothorax clypeatus (Mayr, 1853)

Myrmica clypeata Mayr, 1853: 282.

Leptothorax clypeatus: Mayr 1855.

Leptothorax (subg. *Leptothorax* s.str.) *clypeatus*: Pisarski 1975.

General distribution (Fig. 20). South and Central Europe, in East Europe found in Crimea and southern-east Ukraine; everywhere rare.

Distribution in Poland (Fig. 21, Table 1). Upper Silesia: Zimna Wódka near Strzelce Opolskie, Murcki near Tychy (Nowotny 1937); Lubelska Upland: Kazimierz Dolny near Puławy (Minkiewicz 1935, 1939a,b).

Biology. A xerothermophilous species which inhabits mainly dry light oak forests, nesting in dry tree branches, mainly in oaks. The colonies consist of several dozen individuals.

The occurrence of this species in Poland needs confirmation. It is possible that all reports are based on misidentification. Specimens collected in Lubelska Upland by Pisarski and identified by him as *L. clypeatus* (Pisarski 1953) are in fact, *L. unifasciatus*. Proof materials for the remaining reports do not exist.

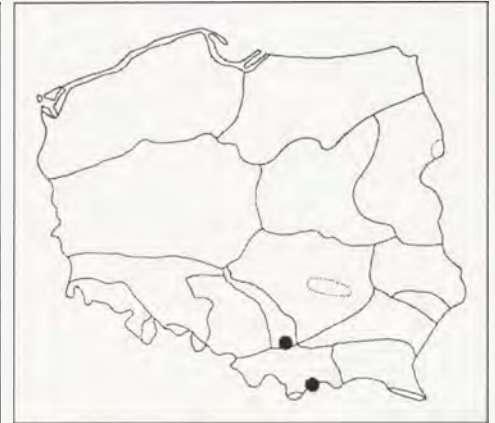


Figure 19. Localities of *Leptothorax affinis* in Poland.

Figure 18. Localities of *Leptothorax affinis* in Europe.

Leptothorax corticalis (Schenck, 1852)

Myrmica corticalis Schenck, 1852: 100.

Leptothorax corticalis: Mayr 1855.

Leptothorax corticalis var. *nylandero-corticalis* Forel: Kulmatycki 1920a, Koehler 1951, Czechowska 1976.

Leptothorax (subg. *Leptothorax* s.str.) *corticalis*: Kulmatycki 1920a, Pisarski 1975, Czechowska 1976.

General distribution (Fig. 22). South and Central Europe, central part of East Europe, southern Sweden, Crimea, Caucasus and Algeria; everywhere rare.

Distribution in Poland (Fig. 23, Table 1). Białowieża Forest (Czechowski and Dyachenko 1999, Czechowski *et al.* 1998); Upper Silesia (Nowotny 1931a, 1937); Małopolska Upland (Czechowski *et al.* 1998); Świętokrzyskie Mts

(Krzysztofiak 1984); Roztocze (Kulmatycki 1920b, Pętał 1961); Sandomierska Lowland (Czechowska and Czechowski 1998); Western Beskidy (Kulmatycki 1920a); Pieniny Mts (Koehler 1951, Woyciechowski 1985). NB! At least some of specimens from Pieniny Mts, collected and determined by Koehler (1951) as *L. corticalis*, are in fact, *L. nadigi*.

Biology. A little known and rare arboreal species; it inhabits mainly dry light forests, nesting in dead tree branches (mainly on oaks), in bark crevices and in dry fallen wood. Polymorphic queens (macro- and microgynes).

The species is very rare in Poland, found only in xerothermic sites.

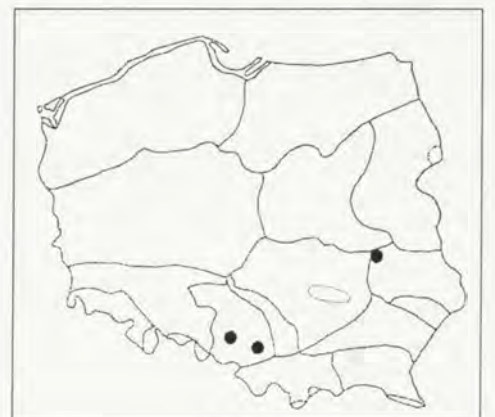


Figure 21. Localities (uncertain) of *Leptothorax clypeatus* in Poland.

Figure 20. Localities of *Leptothorax clypeatus* in Europe.

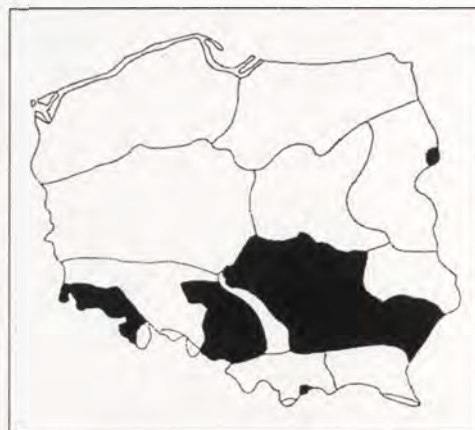


Figure 23. Distribution of *Leptothorax corticalis* in Poland.

Figure 22. Localities of *Leptothorax corticalis* in Europe.

Leptothorax interruptus (Schenck, 1852)

Myrmica interrupta Schenck, 1852: 106.

Leptothorax interruptus: Mayr 1855.

Leptothorax tuborum interruptus: Nowotny 1931a.

Leptothorax (subg. *Leptothorax* s.str.) *interruptus*: Pisarski 1975, Czechowska 1976.

General distribution (Fig. 24). South and Central Europe, southern parts of British Isles, Sweden and Finland.

Distribution in Poland (Fig. 25, Table 1). Upper Silesia: Ligota Dolna near Strzelce Opolskie (Nowotny 1931a).

Biology. A xerothermophilous species, inhabiting dry grasslands and lichenaceous surfaces. It nests in soil, dry moss, under stones and in rock crevices. The colonies are monogynous (with one macrogyne) or polygynous (with several microgynes), numbering to a few hundred workers.

Occurrence of this species in Poland needs confirmation; specimens collected in the Pieniny Mts by Koehler and determined by him as *L. interruptus* (Koehler 1951) are in fact, *L. unifasciatus*. Proof material for the Nowotny's report do not exist.

Leptothorax nadigi Kutter, 1925

Leptothorax nadigi Kutter, 1925: 409.

Leptothorax caucasicus Arnoldi, 1977: 198. Synonymy by Schulz (in prep.).

Leptothorax caucasicus Arnoldi: Arakelian 1994, Radchenko 1994, 1995c.

Leptothorax corticalis (Schenck): Koehler 1951 (part., examined) (misidentification).

Leptothorax bulgaricus Forel: Czechowska 1976 (misidentification), Woyciechowski 1985 (misidentification), Pisarski *et al.* 1992 (misidentification).

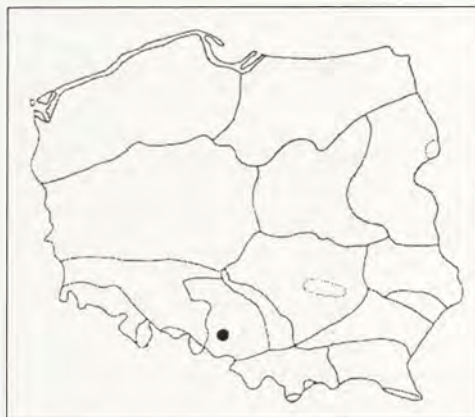


Figure 25. Locality (uncertain) of *Leptothorax interruptus* in Poland.

Figure 24. Localities of *Leptothorax interruptus* in Europe.

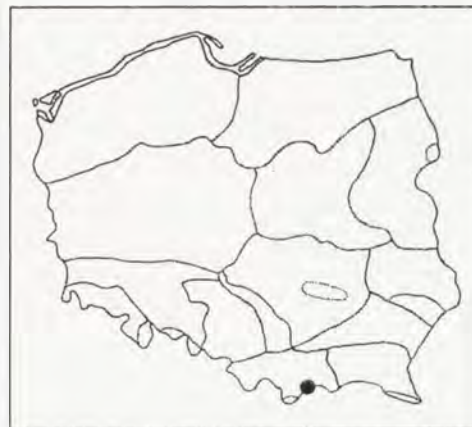


Figure 27. Locality of *Leptothorax nadigi* in Poland.

Figure 26. Localities of *Leptothorax nadigi* in Europe.

General distribution (Fig. 26). A mountain species known from separate localities in the plateau of Pyrenees (Spain), in Alps (France, Switzerland), the Western Carpathians (Pieniny Mts; Poland), the Rodopy Mts (Bulgaria), Turkey, and Transcaucasia.

Distribution in Poland (Fig. 27, Table 1). Pieniny Mts (Czechowska 1976, Woyciechowski 1985, Czechowska *et al.* 1998).

Biology. Data on ecology and biology of this species are very scant. In Switzerland, it was found in dry stalks of *Laserpitium* sp. (Umbelliferae); In Spain, the colonies were collected from under the bark of decaying pine stumps and of a living pine tree in dense pine forest. In Bulgaria, the nests were situated in the bark of pine stumps on a semidry grassland on limestone; the largest colony consisted of about 250 workers. The species seems to be either functionally monogynous or facultatively polygynous.

The Pieniny Mts in Poland are the northernmost locality for *L. nadigi*. It occurs there in xerothermic grasslands (*Origano-Brachypodietum*), which develops on warm and dry slopes with a south-facing aspect, on soil rich in calcium carbonate. The nests are inside dry empty stems of various herbaceous plants, most frequently in *Cynanchum vincetoxicum* (Asclepiadaceae). The colonies are monogynous and number from several dozen to about 100 workers. Sexuials were observed during August.

Leptothorax nigriceps Mayr, 1855

Leptothorax nigriceps Mayr, 1855: 441.

Leptothorax tuborum Mayr, 1855: 170. Synonymy by Collingwood 1971: 161, Radchenko 1995b: 14. Revived from synonymy: Seifert 1996: 125.

Leptothorax tuborum var. *nigriceps*: Kulmatycki 1920b.

Leptothorax tuborum nigriceps: Nowotny 1931a.

Leptothorax (subg. *Leptothorax* s.str.) *nigriceps*: Pisarski 1975, Pisarski and Czechowski 1991, Czechowska 1976.

General distribution (Fig. 28). South and Central Europe.

Distribution in Poland (Fig. 29, Table 1). Upper Silesia: Kielcza near Strzelce Opolskie (Nowotny 1931a); Krakowsko-Wieluńska Upland: Ojców (Czechowski *et al.* 1998); Roztocze: Krasnobród near Zamość (Kulmatycki 1920b); Pieniny (Koehler 1951, Czechowska 1976, Woyciechowski 1985); Tatra Mts (Woyciechowski, unpubl. data).

Biology. A xerothermophilous local species, inhabiting dry and insulated rocky habitats with sparse vegetation; nests in rock crevices and rubble or under stones. Monogynous.

In Poland, known from a few separate xerothermic localities in the southern part of the country. In the Pieniny Mts sexuials were observed from mid-July to mid-October.

Leptothorax nylanderi (Foerster, 1850)

Myrmica nylanderi Foerster, 1850: 53.

Leptothorax nylanderi: Mayr 1861.

Leptothorax tuborum var. *nylanderocorticalis* Forel, 1874: 86. Synonymy by Kutter 1977: 14).

Leptothorax (subg. *Leptothorax* s.str.) *nylanderi*: Begdon 1932, 1954, Parapura and Pisarski 1971, Pisarski 1975, 1981, 1982, Pisarski and Czechowski 1991, Czechowska 1976, Czechowski 1990, Czechowski and Pisarski 1990b.

General distribution (Fig. 30). South, West, Central and East Europe, southern part of British Isles and Sweden, Crimea, Caucasus.

Distribution in Poland (Fig. 31, Table 1). Pomeranian Lake District (Begdon 1932, 1954, Griep 1940, Mazur 1983); Masurian Lake District (Begdon 1954, Mazur 1983); Wielkopolsko-Kujawska Lowland (Kulmatycki 1922, Jakubisiak 1948, Mazur 1983); Mazovian Lowland (Jakubisiak 1948, Pisarski and Czechowski 1978, Pisarski

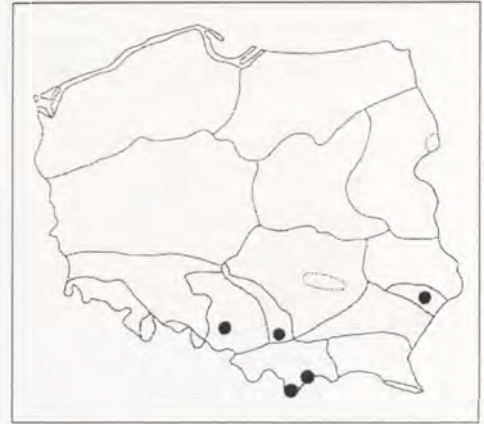


Figure 29. Localities of *Leptothorax nigriceps* in Poland.

Figure 28. Localities of *Leptothorax nigriceps* in Europe.

1981, 1982, Mazur 1983, Bańkowska *et al.* 1984, Czechowski 1990, 1991, Czechowski and Pisarski 1990a); Podlasie (Pętał 1961); Białowieża Forest (Karpiński 1956); Lower Silesia (Mazur 1983); Upper Silesia (Scholz 1926, Nowotny 1931a, 1937); Krakowsko-Wieluńska Upland (Kaczmarek 1953); Małopolska Upland (Mazur 1983); Świętokrzyskie Mts (Nasonov 1892); Lubelska Upland (Pisarski 1953, Pętał 1961, Mazur 1983); Roztocze (Pętał 1961); Sandomierska Lowland (Begdón 1954, Mazur 1983); Bieszczady Mts (Parapura and Pisarski 1971); Pieniny Mts (Koehler 1951).

Biology. A mesothermophilous species that inhabits mainly moderately dry deciduous and mixed forests. One of the most common *Leptothorax* species in temperate European woodlands. The nests are in dead tree branches and dry fallen branches, rotten logs, stumps, under bark, under moss, in litter, in empty acorns. The colonies consist of 100–200 workers; normally monogynous. A relatively aggressive species, able to attack and sting freely. Nuptial flights in July and early August.

Widely distributed in Poland, there are no records only from the Baltic Coast and some southernmost regions. It inhabits different habitats, finding optimum conditions in deciduous forests.

Leptothorax parvulus (Schenck, 1852)

Myrmica parvula Schenck, 1852: 103.

Leptothorax parvulus: Mayr 1855.

Leptothorax nylanderi var. *parvulus*: Nowotny 1931a.

Leptothorax (subg. *Leptothorax* s.str.) *parvulus*: Pisarski 1975, Pisarski and Czechowski 1991, Czechowska 1976.

General distribution (Fig. 32). South, West and Central Europe, southern part of East Europe, Crimea, Caucasus, and Kopetdag Mts.

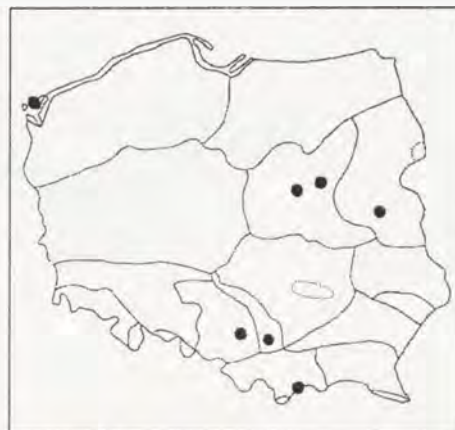
Distribution in Poland (Fig. 33, Table 1). Baltic Coast: Międzyzdroje near Kamień Pomorski (Czechowski *et al.* 1998); Mazovian Lowland: Rybienko near Wyszaków and Kampinoska Forest (Czechowski *et al.* 1998); Podlasie: Jata



Figure 30. Distribution of *Leptothorax nylanderi* in Palearctic.



Figure 31. Distribution of *Leptothorax nylanderi* in Poland.

Figure 32. Distribution of *Leptothorax parvulus* in Palearctic.Figure 33. Localities of *Leptothorax parvulus* in Poland.

near Łuków (Czechowski *et al.* 1998); Upper Silesia: Brynek near Tarnowskie Góry (Nowotny 1931a); Krakowsko-Wieluńska Upland: Ojców (Czechowski *et al.* 1998); Pieniny: Sokolica Mt. (Koehler 1951); «Western and Eastern Prussia» (Brischke 1888).

Biology. Similar to that of *L. nylanderi*, but prefers drier and lighter forests. It nests in the upper soil layer, in rotten wood, under stones, in litter, moss, empty galls, etc. Monogynous.

Very rare in Poland, found in dry habitats only. Sexu- als were caught in August and September.

Leptothorax tuberum (Fabricius, 1775)

Formica tuberum Fabricius, 1775: 393.

Myrmica tuberum Nylander, 1846: 939.

Leptothorax tuberum: Mayr 1855.

Leptothorax tuberum var. *tubero-affinis* Forel: Kulmatycki 1920a,b.

Leptothorax (subg. *Leptothorax* s.str.) *tuberum*: Pisarski 1975, Pisarski and Czechowski 1991, Czechowska 1976.

Leptothorax corticalis: Pisarski 1982 (misidentification).

Note. Very variable species, especially in respect of length of the propodeal spines, sculpture of the body and

colour. For a long time, it was usually not distinguished from the related species (*L. albipennis*, *L. nigriceps*, etc.). Orlege (1998) has shown that all records of *L. tuberum* for British Isles refer to *L. albipennis*. So, all previous data on the distribution of this species (especially in South Europe; Baroni Urbani 1971) need verification.

General distribution (Fig. 34). Almost all of Europe (except its northernmost parts and British Isles), Crimea, Caucasus, southern part of Siberia up to Baikal Lake, Tien-Shan, and Kopetdag Mts. One of the commonest *Leptothorax* species in the deciduous forest zone.

Distribution in Poland (Fig. 35, Table 1). Pomeranian Lake District (Griep 1940); Mazovian Lowland (Pisarski 1982, Czechowski and Pisarski 1990a, Czechowski 1991); Podlasie (Czechowski *et al.* 1998); Krakowsko-Wieluńska Upland (Kulmatycki 1920a, Czechowski *et al.* 1998); Świętokrzyskie Mts (Kulmatycki 1920b); Lubelska Upland (Petal 1961); Pieniny (Nowicki 1864, Wierzejski 1868, 1873, Koehler 1951, Woyciechowski 1985).

Biology. A mesothermophilous species. It occurs mainly in warm, dry and moderately dry stony places (in Central

Figure 34. Distribution of *Leptothorax tuberum* in Palearctic.Figure 35. Distribution of *Leptothorax tuberum* in Poland.



Figure 36. Distribution of *Leptothorax unifasciatus* in Palearctic.

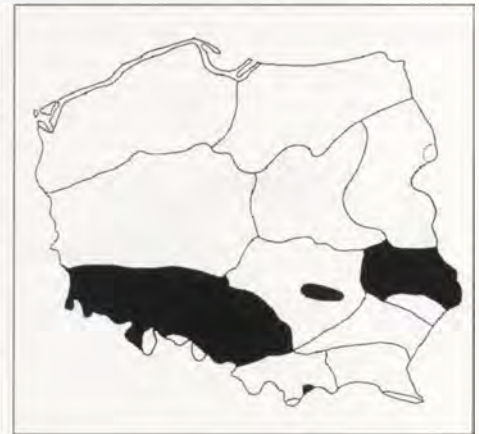


Figure 37. Distribution of *Leptothorax unifasciatus* in Poland.

Europe on xerothermic grasslands), nesting in soil, often around a plant root, under moss, under small stones or in rock crevices, sometimes in rotten wood. The colonies are mainly monogynous (facultatively polygynous), usually consist of about one hundred workers. Nuptial flights in July and August.

In Poland, found locally in dry, well insolated habitats.

***Leptothorax unifasciatus* (Latreille, 1798)**

Formica unifasciata Latreille, 1798: 47.

Myrmica unifasciata: Nylander 1848.

Leptothorax unifasciatus: Mayr 1855.

Leptothorax tuborum unifasciatus: Kulmatycki 1920a, Nowotny 1931a, 1937.

Leptothorax tuborum (F.) var. *unifasciata*: Stawarski 1966.

Leptothorax unifasciatus var. *staegeri*: Czechowska 1976 (unavailable name).

Leptothorax (subg. *Leptothorax* s.str.) *unifasciatus*: Banert and Pisarski 1972, Pisarski 1975, Pisarski and Czechowski 1991, Czechowska 1976.

Leptothorax interruptus: Koehler 1951 (part., examined) (misidentification).

Leptothorax clypeatus (Mayr): Pisarski 1953 (examined) (misidentification).

Table 1. Distribution of *Formicoxenini* species in particular geographical regions of Poland (see Fig. 1): 1 – Baltic Coast, 2 – Pomeranian Lake District, 3 – Masurian Lake District, 4 – Wielkopolsko-Kujawska Lowland, 5 – Mazovian Lowland, 6 – Podlasie, 6a – Białowieża Forest, 7 – Lower Silesia, 8 – Upper Silesia, 9 – Krakowsko-Wieluńska Upland, 10 – Małopolska Upland, 10a – Świętokrzyskie Mts, 11 – Lubelska Upland, 12 – Roztocze, 13 – Sandomierska Lowland, 14 – Western Sudeten Mts, 15 – Eastern Sudeten Mts, 16 – Western Beskidy Mts, 17 – Eastern Beskidy Mts, 18 – Bieszczady Mts, 19 – Pieniny Mts, 20 – Tatra Mts (● – certain data, ○ – uncertain data)

No.	Species	Region																					
		1	2	3	4	5	6	6a	7	8	9	10	10a	11	12	13	14	15	16	17	18	19	20
1	<i>Formicoxenus nitidulus</i> (Nyl.)	●	●	●	●	●		●	●	●			●	●	●				●		●	●	
2	<i>Harpagoxenus sublaevis</i> (Nyl.)									●						●	●					●	●
3	<i>Epinyrma ravouxi</i> (E. André)																						●
4	<i>Doronomyrmex kutteri</i> (Buschinger)														●								
5	<i>Leptothorax (Leptothorax) acervorum</i> (F.)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
6	<i>Leptothorax (Leptothorax) muscorum</i> (Nyl.)		●	●	●	●		●	●	●	●	●	●	●	●	●	●		●		●	●	●
7	<i>Leptothorax (Leptothorax) gredleri</i> Mayr				●	●																	
8	<i>Leptothorax (Myrafant) albipennis</i> (Curtis)																						●
9	<i>Leptothorax (Myrafant) affinis</i> Mayr									●													●
10	<i>Leptothorax (Myrafant) clypeatus</i> (Mayr)													○									
11	<i>Leptothorax (Myrafant) corticalis</i> (Schenck)							●		●		●	●		●	●			●				●
12	<i>Leptothorax (Myrafant) interruptus</i> (Schenck)										○												
13	<i>Leptothorax (Myrafant) nadigi</i> Kutter																						●
14	<i>Leptothorax (Myrafant) nigriceps</i> Mayr										●	●			●								●
15	<i>Leptothorax (Myrafant) nylanderi</i> (Foerst.)		●	●	●	●	●	●	●	●	●	●	●	●	●	●					●	●	
16	<i>Leptothorax (Myrafant) parvulus</i> (Schenck)	●				●	●				●	●											●
17	<i>Leptothorax (Myrafant) tuborum</i> (F.)		●			●	●				●		●	●									●
18	<i>Leptothorax (Myrafant) unifasciatus</i> (Latr.)									●	●	●		●	●			●					●

General distribution (Fig. 36). South, West and Central Europe, Island Gothland, Channel Islands (absent in Great Britain), steppe, forest-steppe and southern part of forest zones of East Europe (up to Ural Mts), Crimea, Caucasus, Kopetdag Mts, Morocco.

Distribution in Poland (Fig. 37, Table 1). Lower Silesia (Stawarski 1966); Upper Silesia (Nowotny 1931a, 1937); Krakowsko-Wieluńska Upland (Wierzejski 1873, Czechowski *et al.* 1998); Świętokrzyskie Mts (Krzysztofiak 1984, Czechowski *et al.* 1998); Lubelska Upland (Pisarski 1953, Czechowski *et al.* 1998); Western Sudeten Mts (Banert and Pisarski 1972, Czechowski *et al.* 1998); Pieniny (Koehler 1951, Czechowska 1976, Woyciechowski 1985); «Western and Eastern Prussia» (Brischke 1888).

Biology. A xerothermophilous species, which inhabits warm and dry habitats of different types. Nests are built mainly in rock crevices, under stones and patches of lichenaceous vegetation but also under bark, in fallen branches and empty stems of herbaceous plants. A monogynous form; the colonies are numerically relatively strong, consisting of 200 or more workers. Nuptial flights in July and August.

Rare in Poland, found only in xerothermic sites, mainly with lime subsoil; known from a few regions in the southern part of the country.

KEY FOR IDENTIFICATION OF GENERA

Workers and females

1. Antennae with 11 segments..... 2
- . Antennae with 12 segments.....
..... *Leptothorax* Mayr (subg. *Myrafant* M. R. Smith)
2. Both postpetiole and petiole ventrally with lamella, spine or tooth (Figs 38, 39 and 41)..... 3
- . Postpetiole ventrally without lamella, spine or tooth (Fig. 40). *Leptothorax* Mayr (subg. *Leptothorax* s.str.)
3. Antennal scrobs on sides of head present; masticatory margin of mandible without teeth (Fig. 43).....
..... *Harpagoxenus* For.
- . Antennal scrobs absent; masticatory margin of mandible with teeth (Fig. 44)..... 4
4. Both postpetiole and petiole with wide ventral lamella (Fig. 38)..... *Epimyрма* Emery.
- . Postpetiole with ventral spine or tooth (Fig. 39 and 41)..... 5
5. Whole body densely sculptured. Workerless social parasite of *Leptothorax* s.str. *Doronomyrmex* Kutter.
- . Whole body smooth and shiny. Workers present. Xenobiont of Formica colonies... *Formicoxenus* Mayr.

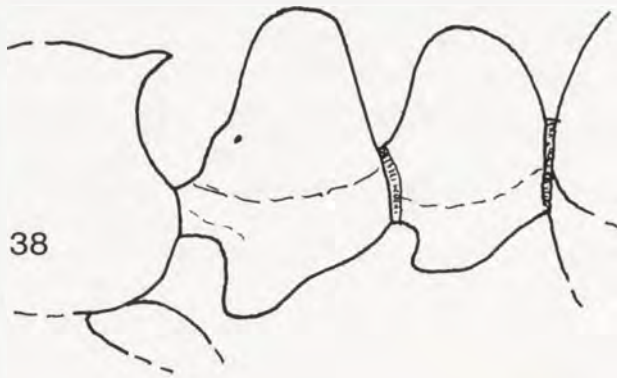
Males

1. Alate specimens 2
- . Dealate, ergatoid specimens that differ from workers by 12-segmented antennae and by presence of ocelli and genitalia (Fig. 45); whole body smooth and shiny
..... *Formicoxenus* Mayr

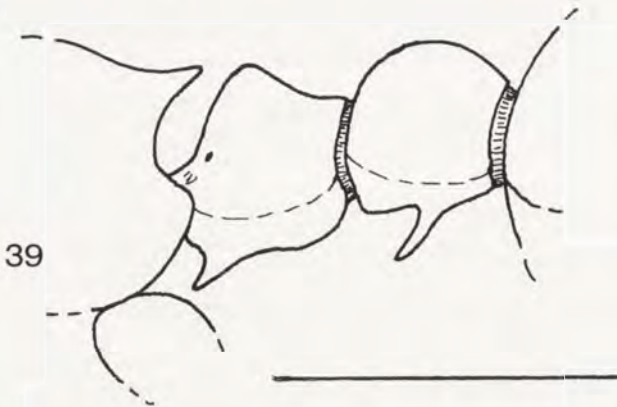
2. Antennae with 13 segments.....
..... *Leptothorax* Mayr (subg. *Myrafant* M. R. Smith)
- . Antennae with 12 segments..... 3
3. Second to sixth funicular joints short, 1.5–2 times longer than broad; antennal scape longer than sum of second to fourth funicular joints; apical antennal club distinctly 4-segmented (Fig. 46); masticatory margin of mandible with 3–5 pointed teeth (Fig. 48)
..... *Epimyрма* Emery
- . Second to sixth funicular joints long, 3–4 times longer than broad; antennal scape shorter than sum of second and third funicular joints; apical antennal club indistinct (Fig. 47); mandible bidentate or udentate (Figs 49 and 50)..... 4
4. Postpetiole ventrally with pointed tooth (Fig. 41); body smaller, less than 2.5 mm *Doronomyrmex* Kutter.
- . Postpetiole ventrally without tooth (Fig. 42); body larger, more than 2.5 mm 5
5. Mandible bidentate (Fig. 49), rarely with reduced teeth. Hardly differentiated from males of *Leptothorax* s.str.
..... *Harpagoxenus* Forel.
- . Mandible udentate (Fig. 50)
..... *Leptothorax* Mayr (subg. *Leptothorax* s.str.).

KEY FOR IDENTIFICATION OF SPECIES OF *LEPTOTHORAX* (workers)

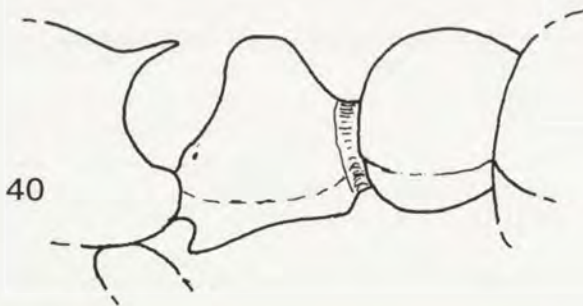
1. Antennae with 11 segments (subg. *Leptothorax* s.str.).. 2
- . Antennae with 12 segments (subg. *Myrafant*) 4
2. Antennal scapes and tibiae with numerous erect hairs (Fig. 51) *L. acervorum* (F.).
- . Antennal scapes and tibiae only with decumbent pilosity (Fig. 52) 3
3. Central part of clypeus between two longitudinal carinae entirely smooth and shiny, without any trace of striation; postero-lateral part of head dorsum punctured and with distinct short longitudinal striation (Fig. 53). Alitrunk ochraceous-yellow, head dorsum from ochraceous-yellow to yellowish brown *L. gredleri* Mayr.
- . Central part of clypeus between two longitudinal carinae shiny but at least with short striae; postero-lateral part of head dorsum only with granulate sculpture, without striation (Fig. 54). Alitrunk reddish-yellow, head dorsum from brown to dark brown..... *L. muscorum* (Nyl.).
4. Alitrunk dorsum with mesopropodeal impression (Figs 55 and 56) 5
- . Alitrunk dorsum without mesopropodeal impression (Figs 57–61)..... 6
5. Propodeal spines long, distinctly wide at the base and curved downward (Fig. 55). Females: length of propodeal spines 1.5–2 times shorter than distance between their tips from above (Fig. 62)
..... *L. nylanderi* (Foerst.).
- . Propodeal spines shorter, less wide at the base and more or less straight (Fig. 56). Females: length of propodeal spines 2.5–3 times shorter than distance between their tips from above (Fig. 63)..... *L. parvulus* (Schenck).



38

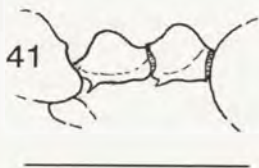


39



40

Figures 38–40. Worker petiole and postpetiole, lateral (scale: 0.5 mm). (38) *Epimyrmex ravouxi*; (39) *Formicoxenus nitidulus*; (40) *Leptothorax acervorum*.

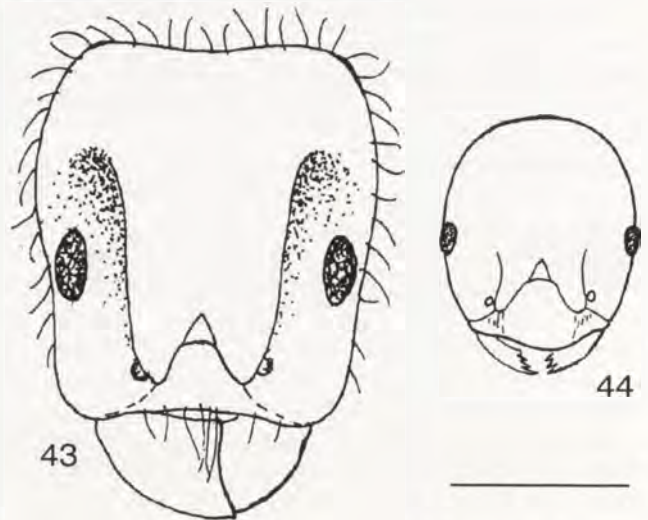


41



42

Figure 41 and 42. Male petiole and postpetiole, lateral (scale: 0.5 mm). (41) *Dronomyrmex kutteri* (42) *Harpagoxenus sublaevis*.



43

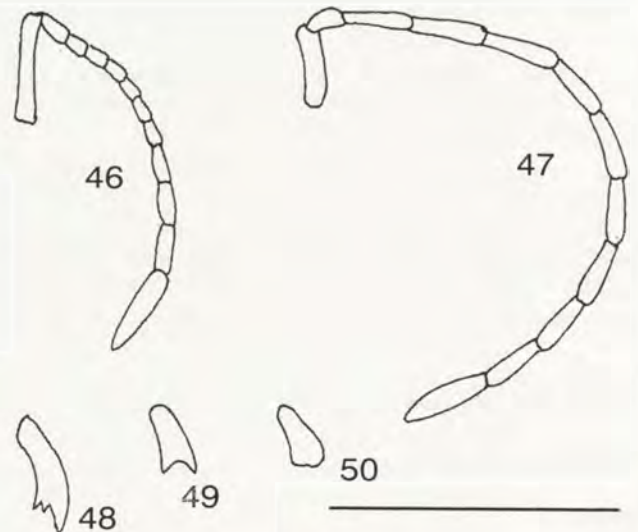
44

Figures 43 and 44. Worker head, frontal (scale: 0.5 mm). (43) *Harpagoxenus sublaevis*; (44) *Formicoxenus nitidulus*.



45

Figure 45. *Formicoxenus nitidulus*, male body, lateral (scale: 1 mm).



46

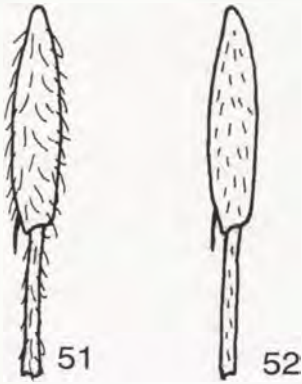
47

48

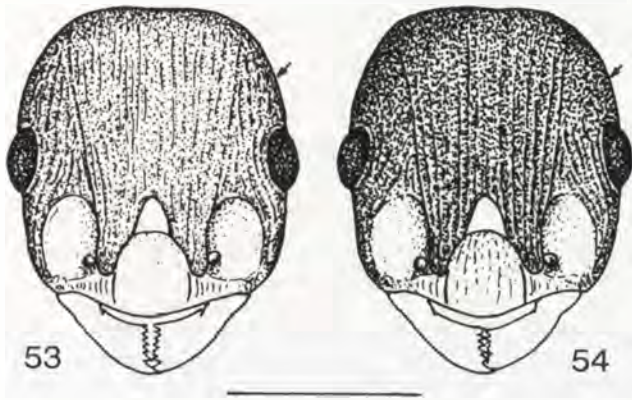
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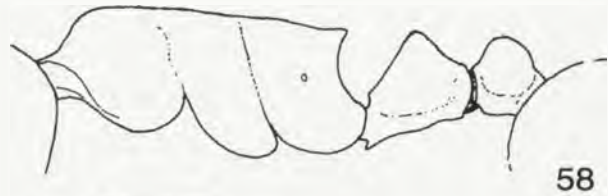
Figures 46–50. Male antenna (46 and 47). (46) *Epimyrmex ravouxi*; (47) *Harpagoxenus sublaevis*. Male mandible (48–50). (48) *Epimyrmex ravouxi*; (49) *Harpagoxenus sublaevis*; (50) *Leptothorax acervorum*. (Scale: 0.5 mm).



Figures 51 and 52. Worker tibia. (51) *Leptothorax acervorum*; (52) *L. muscorum*.



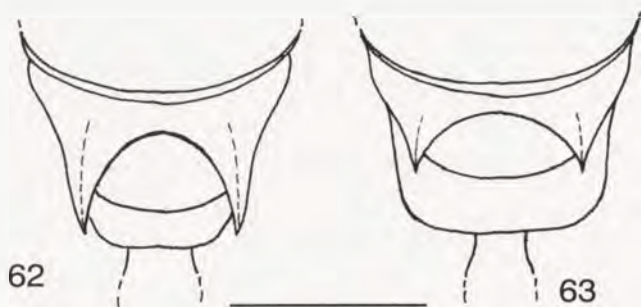
Figures 53 and 54. Worker head, frontal (scale: 0.5 mm). (53) *Leptothorax gredleri*; (54) *L. muscorum*.



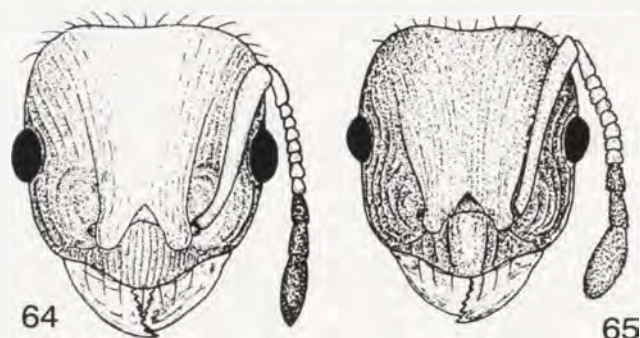
Figures 55–61. Worker alitrunk, petiole and postpetiole, lateral (scale: 0.5 mm). (55) *Leptothorax nylanderi*; (56) *L. parvulus*; (57) *L. interruptus*; (58) *L. corticalis*; (59) *L. affinis*; (60) *L. nadigi*; (61) *L. unifasciatus*.

- 6. Alitrunk dorsum with distinct promesonotal suture (see from above). Anterior clypeal margin distinctly notched medially *L. clypeatus* (Mayr).
- Alitrunk dorsum without promesonotal suture (see from above). Anterior clypeal margin without notch 7
- 7. Propodeal spines long, wide at the base and curved downward, its length only slightly less than length of propodeal dorsum; petiole with very short peduncle and with slightly concave, almost straight anterior surface (Fig. 57) *L. interruptus* (Schenck).
- Propodeum with teeth, if with spines they are thin, straight, not wide at the base and not curved downward; petiole has another shape (Figs 58–61) 8
- 8. Petiole in profile triangular, without peduncle, not truncate above; propodeum with blunt, short denticles (Fig. 58) *L. corticalis* (Schenck).
- Petiole in profile not triangular, with distinct peduncle and with distinctly truncate dorsum (Figs 59–61) 9
- 9. Propodeal spines long and thin, more or less straight and not wide at base; their length approximately equal to 3/4 of the length of propodeal dorsum (Fig. 59) *L. affinis* Mayr.

- Propodeum with blunt, short denticles or pointed teeth; their length distinctly less than 1/2 length of propodeal dorsum (Figs 60 and 61) 10

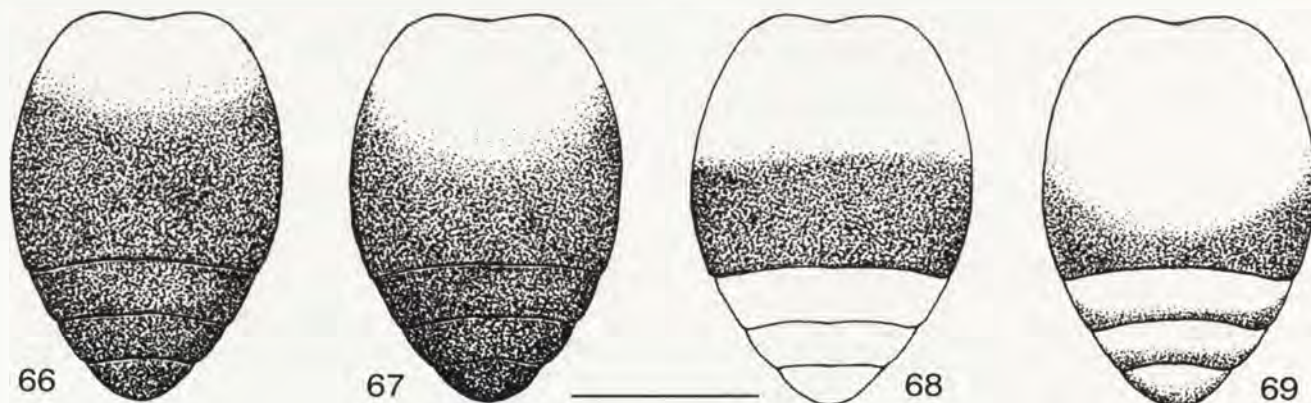


Figures 62 and 63. Female propodeal spines, dorsal (scale: 0.5 mm). (62) *Leptothorax nylanderi*; (63) *L. parvulus*.



Figures 64 and 65. Worker head, frontal (scale: 0.5 mm). (64) *Leptothorax nadigi*; (65) *L. tuberum*.

10. Sculpture of head partly reduced, at least central part of head dorsum smooth and shiny (Fig. 64). Propodeum with blunt short denticles (Fig. 60)..... *L. nadigi* Kutter.
- . Head dorsum entirely sculptured (Fig. 65). Propodeum with pointed teeth (Fig. 61).....11
11. At least central part of femora brown. Gastral tergites brown, only first tergite yellow at the base (Fig. 66). Antennal club always distinctly darker than the rest of funiculus..... *L. nigriceps* Mayr.



Figures 66–69. Worker gastral tergites, dorsal (scale: 0.5 mm). (66) *Leptothorax nigriceps*; (67) *L. tuberum*; (68) *L. unifasciatus*; (69) *L. albipennis*.

- . Femora unicoloured, yellow or ochraceous-yellow. Gastral tergites variously colored. Antennal club darker or not than the rest of funiculus..... 12
12. Gastral tergites brown, only first tergite yellow at the base (Fig. 67)..... *L. tuberum* (F.).
- . Gastral tergites yellow, only with dark wide band on the posterior half of the first tergite or with narrow bands on the posterior margins of all tergites (Figs 68 and 69).. 13
13. Gastral tergites yellow, only with dark wide band on the posterior half of the first tergite (Fig. 68). Head dorsum usually yellowish, unicolour with alitrunk, rarely slightly darkened anteriorly..... *L. unifasciatus* (Latr.).
- . Gastral tergites yellow, only with narrow bands on the posterior margins of all tergites (Fig. 69). Head dorsum darkened, distinctly darker than alitrunk..... *L. albipennis* (Curtis).

ACKNOWLEDGEMENTS

We are grateful to two reviewers, Graham W. Elmes and Michael I. Saaristo, for their hard work improving the manuscript.

REFERENCES

- Agassiz, J. L. R. 1850. In: Dixon, F. The geology and fossils of the Tertiary and Cretaceous formation of Sussex. London, 422 pp.
- Agosti, D. and C. A. Collingwood, 1987. A provisional list of the Balkan ants (Hym., Formicidae) with a key to the worker caste. 2. Key to the worker caste, including the European species without the Iberian. Mitteilungen der Schweizerischen Entomologischen Gesellschaft, 60: 261–293.
- André, E. 1896. Description d'une nouvelle fourmi de France. Bulletin de la Société Entomologique de France, 1896: 367–368.
- Arakelian, G. R. 1994. Fauna Respubliki Armeniya. Nasekomye pereponchatokrylye. Murav'i (Formicidae). Erevan, 153 pp.
- Arnoldi, K. V. 1977. Novye i maloizvestnye vidy murav'ev roda *Leptothorax* Mayr evropejskoj chasti SSSR i Kavkaza. Entomologicheskoe Obozrenie, 56: 198–204.
- Banert, P. and B. Pisarski. 1972. Mrówki (Formicidae) Sudetów. Fragmenta Faunistica, 18: 345–359.

- Bañkowska, R., W. Czechowski, H. Garbarczyk and P. Trojan. 1984. Present and prognosticated fauna of the housing estate Białoleka Dworska, Warsaw. *Memorabilia Zoologica*, 40, 168 pp.
- Baroni Urbani, C. 1971. Catalogo delle specie di Formicidae d'Italia. (Studi sulla mirmecofauna d'Italia, 10). *Memorie della Società Entomologica Italiana*, 50: 5–287.
- Begdon, J. 1932. Studja nad mrówkami Pomorza. *Polskie Pismo Entomologiczne*, 11: 57–96.
- Begdon, J. 1954. Rozmieszczenie i makrotopy gatunków z rodziny Formicidae na terenach nizinnych. *Annales Universitatis Mariae Curie-Skłodowska, C*, 8: 435–506.
- Begdon, J. 1958. Nowe stanowiska kilku interesujących gatunków Formicoidea w Polsce. *Annales Universitatis Mariae Curie-Skłodowska, C*, 13: 85–93.
- Bingham, C. T. 1903. The fauna of British India, including Ceylon and Burma. Hymenoptera 2. Ants and cuckoo-wasps. London, 506 pp.
- Bolton, B. 1982. Afrotropical species of myrmicine ant genera *Cardiocondyla*, *Leptothorax*, *Melissotarsus*, *Messor* and *Cataulacus*. *Bulletin of the British Museum (Natural History) (Entomology)*, 45: 307–370.
- Bolton B., 1994. Identification guide to the ant genera of the World. Cambridge, MA, 222 pp.
- Bolton, B., 1995a. A new general catalogue of the ants of the world. Harvard University Press, Cambridge, MA, 504 pp.
- Bolton, B. 1995b. A taxonomic and zoogeographical census of the extant ant taxa (Hymenoptera: Formicidae). *Journal of Natural History*, 29: 1037–1056.
- Bondroit, J. 1918. Les fourmis de France et de Belgique. *Annales de la Société Entomologique de France*, 87: 1–174.
- Brischke, C. G. A. 1888. Hymenoptera Aculeata der Provinzen West- und Ostpreussen. *Schriften der Naturforschenden Gesellschaft in Danzig, Neue Folge*, 7: 85–107.
- Buschinger, A. 1965. *Leptothorax (Mychothorax) kutteri* n. sp., eine sozialparasitische Ameise (Hymenoptera, Formicidae). *Insectes Sociaux*, 12: 327–334.
- Buschinger, A. 1966. *Leptothorax (Mychothorax) muscorum* Nylander und *Leptothorax (M.) gredleri* Mayr, zwei gute Arten. *Insectes Sociaux*, 13: 165–172.
- Buschinger, A. 1968. Untersuchungen an *Harpagoxenus sublaevis* Nyl. (Hymenoptera, Formicidae). III. Kopula, Koloniengründung, Raubzüge. *Insectes Sociaux*, 15: 89–104.
- Buschinger, A. 1974. Experimente und Beobachtungen zur Gründung und Entwicklung neuer Sozietäten der sklavenhaltenden Ameise *Harpagoxenus sublaevis* (Nyl.). *Insectes Sociaux*, 21: 381–406.
- Buschinger, A. 1981. Biological and systematic relationships of social parasitic Leptothoracini from Europe and North America. In: P. E. Howse and J.-L. Clément (eds). *Biosystematics of Social Insects*. Systematics Association, spec. vol. 19: 211–222.
- Buschinger, A. 1982. *Epimyrma goesswaldi* Menozzi, 1931 = *Epimyrma ravouxi* (André, 1896) – morphologischer und biologischer Nachweis der Synonymie (Hym., Formicidae). *Zoologischer Anzeiger*, 208: 352–358.
- Buschinger, A. 1989. Evolution, speciation and inbreeding in the parasitic ant genus *Epimyrma*. *Journal of Evolutionary Biology*, 2: 265–283.
- Buschinger, A. 1990. Sympatric speciation and radiative evolution of socially parasitic ants – Heretic hypotheses and their factual background. *Zeitschrift für Zoologische Systematik und Evolutionsforschung*, 28: 241–260.
- Buschinger, A. and J. Heinze. 1993. *Doronomyrmex pocahontas*: not a workerless parasite but still an enigmatic taxon (Hymenoptera, Formicidae). *Insectes Sociaux*, 40: 423–432.
- Buschinger, A. and B. Klump. 1988. Novel strategy of host-colony exploitation in a permanently parasitic ant *Doronomyrmex goesswaldi*. *Naturwissenschaften*, 75: 577–578.
- Buschinger, A. and U. Winter 1976. Funktionelle Monogynie bei der Gastameise *Formicoxenus nitidulus* (Nyl.) (Hym., Form.). *Insectes Sociaux*, 23: 549–558.
- Buschinger, A. and U. Winter. 1978. Echte Arbeiterinnen, fertile arbeiterinnen und sterile Wirtweibchen in Völkern der dulotischen Ameise *Harpagoxenus sublaevis* (Nyl.) (Hym., Form.). *Insectes Sociaux*, 25: 63–78.
- Buschinger, A., U. Winter and W. Faber. 1984. The biology of *Myrmoxenus gordiagini* Ruzsky, a slave-making ant. *Psyche*, 90: 335–342.
- Collingwood, C. A. 1971. A synopsis of the Formicidae of North Europe. *The Entomologist*, 104: 150–176.
- Collingwood, C. A. 1979. The Formicidae (Hymenoptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica*, 8, 174 pp.
- Curtis, J. 1854. On the genus *Myrmica*, and other indigenous ants. *Transactions of the Linnean Society of London*, 21: 211–220.
- Czechowska, W. 1976. Myrmekofauna Pienińskiego Parku Narodowego (Hymenoptera, Formicoidea). *Fragmenta Faunistica*, 21: 115–144.
- Czechowska, W., and W. Czechowski. 1998. Gatunki mrówek (Hymenoptera, Formicidae) nowe dla Niziny Sandomierskiej. *Fragmenta Faunistica*, 41: 251–254.
- Czechowska, W. and W. Czechowski. 1999. *Leptothorax albipennis* Curtis, 1854 (Hymenoptera, Formicidae) – nowy dla Polski gatunek mrówki. *Przegląd Zoologiczny* (in press).
- Czechowska, W. and W. Czechowski. *Epimyrma ravouxi* (André, 1896) (Hymenoptera, Formicidae) in the Pieniny Mts – notes on its occurrence and biology. (In prep.).
- Czechowska, W., A. Radchenko and W. Czechowski. 1998. Ecological and taxonomic notes on *Leptothorax nadigi* Kutter, 1925 (Hymenoptera, Formicidae) – an ant species new to Poland. *Annales Zoologici*, 48: 119–123.
- Czechowski, W. 1990. Mrówki (Hymenoptera, Formicidae) trawników Warszawy (informacja wstępna). *Wiadomości Entomologiczne*, 9: 27–33.
- Czechowski, W. 1991. Comparison of the myrmecofaunas (Hymenoptera, Formicoidea) of tree stands and lawns in Warsaw parks. *Fragmenta Faunistica*, 35: 179–184.
- Czechowski, W. 1998. Sukcesja zespołów mrówek (Hymenoptera, Formicidae) w borze Świeżym Puszczy Białowieskiej. *Parki Narodowe i Rezerваты Przyrody*, 17.3 (supl.): 55–62.
- Czechowski, W. and W. Czechowska. 1997. Formicidae. In: J. Razowski (ed.). *Wykaz Zwierząt Polski*. Kraków, pp. 50–56.
- Czechowski, W. and W. Czechowska. 1999. New sites in Poland and notes on the biology of socially parasitic ants *Formicoxenus nitidulus* (Nyl.) and *Harpagoxenus sublaevis* (Nyl.) (Hymenoptera, Formicidae). *Fragmenta Faunistica*, 42: 1–6.
- Czechowski, W., W. Czechowska and A. Palmowska A. 1990. Arboreal myrmecofauna of Warsaw parks. *Fragmenta Faunistica*, 34: 37–45.
- Czechowski, W., W. Czechowska and A. Radchenko. 1998. Nowe dane o występowaniu w Polsce rzadkich gatunków mrówek z rodzaju *Leptothorax* Mayr (Hymenoptera, Formicidae). *Fragmenta Faunistica*, 41: 247–250.
- Czechowski, W. and N. G. Dyachenko. 1999. Mrówki (Formicidae). In: J. Gutowski (ed.) *Wykaz Zwierząt Puszczy Białowieskiej* (in press).
- Czechowski, W. and B. Pisarski. 1990a. Ants (Hymenoptera, Formicoidea) of the Vistula escarpment in Warsaw. *Fragmenta Faunistica*, 33: 109–128.
- Czechowski, W. and B. Pisarski. 1990b. Ants (Hymenoptera, Formicoidea) of linden-oak-hornbeam forests and thermophilous oak forests of the Mazovian Lowland. I. Nest density. *Fragmenta Faunistica*, 34: 133–141.

- Czechowski, W., B. Pisarski and W. Czechowska. 1990. Ants (Hymenoptera, Formicoidea) of moist meadows on the Mazovian Lowland. *Fragmenta Faunistica*, 34: 47–60.
- Czechowski, W., B. Pisarski and K. Yamauchi. 1995. Succession of ant communities (Hymenoptera, Formicidae) in moist pine forests. *Fragmenta Faunistica*, 38: 447–488.
- Dobrzańska, J. 1958. Partition of foraging grounds and modes of conveyings information among ants. *Acta Biologiae Experimentalis*, 18: 55–67.
- Dobrzański, J. 1966. Contribution to the ethology of *Leptothorax acervorum* (Hymenoptera: Formicidae). *Acta Biologiae Experimentalis*, 26: 71–78.
- Douwes, P. and B. Stille. 1991. Hybridization and variation in the *Leptothorax tuberum* group (Hymenoptera: Formicidae). *Zeitschrift für Zoologische Systematik und Evolutionsforschung*, 29: 165–175.
- Emery, C. 1914. Intorno alla classificazione dei Myrmicinae. *Rendiconto delle Sessioni della R. Accademia delle Scienze dell'Istituto di Bologna (N.S.)*, 18: 29–42.
- Emery, C. 1915. Contributo alla conoscenza delle formiche delle isole italiani. *Descrizioni di forme mediterranee nuove o critiche. Annali del Museo Civico di Storia Naturale di Genova* (3), 6: 244–270.
- Faber, W. 1969. Beiträge zue Kenntniss sozialparasitischer Ameisen. 2. *Aporomyrmex ampeloni* nov. gen., nov. spec. (Hym. Formicidae), ein neuer permanenter Sozialparasit bei *Plagiolepis vindobonensis* Lomnicki aus Österreich. *Pflanzenschutz Berichte*, 39: 39–100.
- Fabricius, J. Ch. 1775. *Systeama entomologiae, sistens insectorum classes, ordines, genera, species, adjectis synonymis, locis, descriptionibus, observationibus. Flensburgi et Lipsiae*, 832 pp.
- Fabricius, J. Ch. 1793. *Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species adjectis synonymis, locis, observationibus, descriptionibus. 2. Hafniae*, 519 pp.
- Foerster, A. 1850. *Hymenopterologische Studien. I. Formicariae. Aachen*. 74 pp.
- Forel, A. 1874. *Les fourmis de la Suisse. Systématique. Notices anatomiques et physiologiques. Architecture. Distribution géographique. Nouvelles expériences et observations de moeurs. Neue Denkschriften der Allgemeinen Schweizerischen Gesellschaft für die Gesamten Naturwissenschaften*, 26: 1–447.
- Forel, A. 1890. Fourmis de Tunisie et de l'Algérie orientale. *Annales de la Société Entomologique de Belgique*, 34: 61–77.
- Forel, A. 1893. Sur la classification de la famille des formicides, avec remarques synonymiques. *Annales de la Société Entomologique de Belgique*, 37: 61–167.
- Francoeur, A., R. Loiselle and A. Buschinger. 1985. Biosystématique de la tribu Leptothoracini. 1. Le genre *Formicoxenus* dans la région holarctique. *Naturaliste Canadien*, 112: 343–403.
- Griep, E. 1940. Die Ameisen von Bellinchen a. d. Oder. (Hym., Form.). *Märkische Tierwelt*, 4: 224–230.
- Heinze, J. 1995. The origin of workerless parasites in *Leptothorax* (s.str.) (Hymenoptera: Formicidae). *Psyche*, 102: 195–214.
- Jacobson, H. 1940. Mitteilungen zur Ameisenfauna Pommerns sowie über das Vorkommen einer für Deutschland neuen Art: *Myrmica rolandi* Bondr. *Zoologischer Anzeiger*, 131: 145–150.
- Jakubisiak, S. 1948. Mrówki okolic Przybyszewa (południowe Mazowsze). *Annales Universitatis Mariae Curie-Skłodowska, C*, 3: 319–353.
- Kaczmarek, W. 1953. Badania nad zespołami mrówek leśnych. *Ekologia Polska*, 1: 69–96.
- Kaczmarek, W. 1963. An analysis of interspecific competition in communities of the soil macrofauna of some habitats in the Kampinos National Park. *Ekologia Polska*, A, 11: 421–483.
- Karpiński, J. J. 1956. Mrówki w biocenozie Białowieskiego Parku Narodowego. *Roczniki Nauk Leśnych*, 14: 203–221.
- Koehler, W. 1951. Fauna mrówek Pienińskiego Parku Narodowego. *Warszawa*, 55 pp.
- Kotzias, H. 1930. *Formica picea* Nyl. in Schlesien. *Zoologischer Anzeiger*, 92: 56–58.
- Krzysztofiak, L. 1984. Mrówki (Hymenoptera, Formicoidea) Świętokrzyskiego Parku Narodowego. *Fragmenta Faunistica*, 28: 309–323.
- Krzysztofiak, L. 1985. Rozmieszczenie i zagęszczenie gniazd mrówek w Puszczy Augustowskiej (Pojezierze Mazurskie). *Fragmenta Faunistica*, 29: 137–149.
- Kulmatycki, W. 1920a. Mrówki niektórych okolic Małopolski. *Sprawozdanie Komisji Fizjograficznej*, 53/54: 157–172.
- Kulmatycki, W. 1920b. Przyczynek do fauny myrmekologicznej b. Królestwa Polskiego. *Sprawozdanie Komisji Fizjograficznej*, 53/54: 189–194.
- Kulmatycki, W. 1922. Przyczynek do fauny mrówek Wielkopolski i Pomorza. *Sprawozdanie Komisji Fizjograficznej*, 55/56: 71–86.
- Kutter, H. 1925. Eine neue Ameise der Schweiz. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, 13: 409–412.
- Kutter, H. 1945. Ein neue Ameisengattung. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, 15: 207–210.
- Kutter, H. 1967. Beschreibung neuer Sozialparasiten von *Leptothorax acervorum* F. (Formicidae). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, 10: 78–91.
- Kutter, H. 1977. *Insecta helvetica Fauna. 6. Hymenoptera, Formicidae. Zürich*, 298 pp.
- Latreille, P. A. 1798. *Essai sur l'histoire des fourmis de la France. Brive*. 50 pp.
- Lomnicki, J. 1931. Przegląd mrówek (Formicidae) Tatr polskich. *Polskie Pismo Entomologiczne*, 10: 97–101.
- Mayr, G. 1853. Beschreibung einiger neuer Ameisen. *Verhandlungen des Zoologisch-Botanischen Vereins in Wien*, 3: 277–286.
- Mayr, G. 1855. Formicina austriaca. Beschreibung der bister im osterreichischen Kaiserstaade aufgefundenen Ameisen nebst Hinzufugung jener in Deutschland, in der Schweiz und in Italien vorkommender Ameisen. *Verhandlungen des Zoologisch-Botanischen Verreins in Wien*, 5: 273–478.
- Mayr, G. 1861. *Die Europäischen Formiciden. Wien*, 80 pp.
- Mayr, G. 1866. Myrmecologische Beitrage. *Sitzungsberichte der k. Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe*, 53: 484–517.
- Mazur, S. S. 1983. Mrówki borów sosnowych Polski. *Rozprawy Naukowe i Monografie*, 25, Wydawnictwo SGGW-AR, Warszawa, 71 pp.
- Menozi, C. 1931. Revisione del genere *Epimyrma* Em. e descrizione di una specie inedita di questo genere. *Memorie della Società Entomologica Italiana*, 10: 36–53.
- Minkiewicz, R. 1935. *Myrmosa brunripes* Lepel. tudzież inne żądłowki południowe lub rzadkie, wykryte w Polsce Środkowej. *Fragmenta Faunistica Musei Zoologici Polonici*, 2: 189–227.
- Minkiewicz, R. 1939a. Niesienie się robotnic a determinizm płci u mrówek. *Polskie Pismo Entomologiczne*, 16/17: 144–161.
- Minkiewicz, R. 1939b. Les sexués du *Leptothorax clypeatus* Mayr et le problème de la sexualisation somatique chez les fourmis. *Polskie Pismo Entomologiczne*, 16/17: 215–239.
- Nasonov, N. V. 1892. K faune murav'ev Rossii. (K faune Privislyanskogo Kraya.). *Izvestiya Varshavskago Universiteta*, 5: 1–14.
- Nowicki, M. 1864. Przyczynek do owadniczej fauny Galicyi. *Kraków*, 87 pp.
- Nowotny, H. 1931a. Verzeichnis der bisher in Oberschlesien aufgefundenen Ameisen. *Mitteilungen des Beuthener Geschichts- und Museumsvereins*, 13/14: 150–157.
- Nowotny, H. 1931b. Nachtrag zum Verzeichnis oberschlesischer Ameisen. *Mitteilungen des Beuthener Geschichts- und Museumsvereins*, 13/14: 294.
- Nowotny, H. 1937. Nachtrag zur Ameisenfauna Oberschlesien. *Zeitschrift für Entomologie*, 18: 5–6.

- Nylander, W. 1846. Adnotationes in monographium Formicarum borealium Europae. Acta Societatis Scientiarum Fennicae, 2: 875–944, 1041–1062.
- Nylander, W. 1849. Adnotationes in monographium Formicarum borealium Europae. Acta Societatis Scientiarum Fennicae, 3: 25–48.
- Orlege, G. M. 1998. The identity of *Leptothorax albipennis* (Curtis) (Hymenoptera: Formicidae) and its presence in Great Britain. Systematic Entomology, 23: 25–33.
- Parapura, E. and B. Pisarski. 1971. Mrówki (Hymenoptera, Formicidae) Bieszczadów. Fragmenta Faunistica, 17: 319–356.
- Pawlikowski, T. and W. Sobieszcyk. 1980. Zagęszczenie mrówek na obszarach kserotermicznych siedlisk wydmowych w Kotlinie Toruńskiej. Acta Universitatis Nicolai Copernici, Biologia, 23: 15–23.
- Pętał, J. 1961. Materiały do znajomości mrówek (Formicidae) Lubelszczyzny (I–IV). Fragmenta Faunistica, 9: 135–151.
- Pętał, J. 1963. Donnée pour la morphologie de *Myrmica rugulosoides* For. et *Leptothorax nigrescens* Ruzsky (Hymenoptera, Formicidae). Bulletin de l'Académie Polonaise des Sciences, Classe II, 11: 379–382.
- Pętał, J. 1964. Fauna mrówek projektowanego rezerwatu torfowiskowego Rakowskie Bagno k. Frampola (woj. lubelskie). Annales Universitatis Mariae Curie-Skłodowska, C, 18: 143–173.
- Pętał, J. 1968. Materiały do znajomości mrówek (Hymenoptera, Formicidae) Lubelszczyzny. VII. Zespoły mrówek środowisk torfowiskowych, leśnych i wydmowych okolic Libiszowa (pow. Parczew). Annales Universitatis Mariae Curie-Skłodowska, C, 22: 117–127.
- Pętał, J. 1994. Reaction of ant communities to degradation of forest habitats in the Karkonosze Mountains. Memorabilia Zoologica, 48: 171–179.
- Pisarski, B. 1953. Mrówki okolic Kazimierza. Fragmenta Faunistica Musei Zoologici Polonici, 6: 465–500.
- Pisarski, B. 1973. Struktura społeczna *Formica (C.) exsecta* Nyl. (Hymenoptera: Formicidae) i jej wpływ na morfologię, ekologię i etologię gatunku. Warszawa, 134 pp.
- Pisarski, B. 1975. Mrówki. Formicoidea. Katalog Fauny Polski (no. 23), 26, 1, 85 pp.
- Pisarski, B. 1981. Mrówki (Formicidae, Hymenoptera). In: Zoocenologiczne podstawy kształtowania środowiska przyrodniczego osiedla mieszkaniowego Białołęka Dworska w Warszawie. I. Skład gatunkowy i struktura fauny terenu projektowanego osiedla mieszkaniowego. Fragmenta Faunistica, 26 (1981): 341–354.
- Pisarski, B. 1982. Ants (Hymenoptera, Formicidae) of Warsaw and Mazovia. In: Species composition and origin of the fauna of Warsaw. 3. Memorabilia Zoologica, 36: 73–90.
- Pisarski, B. and W. Czechowski. 1978. Influence de la pression urbaine sur la myrmécofaune. Memorabilia Zoologica, 29: 109–128.
- Pisarski, B. and W. Czechowski. 1991. Ant communities (Hymenoptera, Formicoidea) of moist and wet deciduous forests of Central Europe. Fragmenta Faunistica, 35: 167–172.
- Pisarski, B., T. Huflejt, H. Garbarczyk, S. Głogowski, E. Kierych, P. Marczak, J. Sawoniewicz and E. Skibińska. 1992. Błonkówki. Hymenoptera. In: Z. Głowaciński (ed.). Czerwona Lista Zwierząt Ginących i Zagrożonych w Polsce. Kraków, pp. 43–48.
- Pongrácz, A. 1924. Beiträge zur Tiergeographie Polens. Archiv für Naturgeschichte, 89A, pp. 244–259.
- Puszkarski, T. 1978. Les fourmis (Formicidae) de la zone polluée des Établissements de l'Azote de Puławy. Memorabilia Zoologica, 29: 129–142.
- Puszkarski, T. 1982. Ants (Formicidae) in the agrocenoses affected by intensive pressure of industrial emissions. Annales Universitatis Mariae Curie-Skłodowska, C, 37: 105–116.
- Radchenko, A. G. 1994. Opredelitel'naya tablica murav'ev roda *Leptothorax* central'noj i vostochnoj palearktiki. Zoologicheskij Zhurnal, 73: 146–158.
- Radchenko, A. G. 1995a. Obzor murav'ev roda *Leptothorax* (Hymenoptera, Formicidae) Central'noj i Vostochnoj Palearktiki. Soobshchenie 1. Delenie na gruppy. Gruppy *acervorum* i *bulgaricus*. Vestnik Zoologii, 6 (1994): 22–28.
- Radchenko, A. G. 1995b. Obzor murav'ev roda *Leptothorax* (Hymenoptera, Formicidae) Central'noj i Vostochnoj Palearktiki. Soobshchenie 2. Gruppy *tubertum*, *corticalis*, *affinis*, *clypeatus* i *singularis*. Vestnik Zoologii, 2/3: 14–21.
- Radchenko, A. G. 1995c. Obzor murav'ev roda *Leptothorax* (Hymenoptera, Formicidae) Central'noj i Vostochnoj Palearktiki. Soobshchenie 3. Gruppy *nylanderi*, *korbi*, *nassonovi* i *susamyri*. Vestnik Zoologii, 4: 3–11.
- Radchenko, A. G. and W. Czechowski. 1997. *Doronomyrmex kutteri* (Buschinger, 1965) (Hymenoptera, Formicidae) – a representative of a genus new to Poland. Fragmenta Faunistica, 40: 47–51.
- Radchenko, A., W. Czechowski and W. Czechowska. 1997. The genus *Myrmica* Latr. (Hymenoptera, Formicidae) in Poland – a survey of species and a key for their identification. Annales Zoologici, 47: 481–500.
- Radchenko, A., W. Czechowski and W. Czechowska. 1998. The genus *Tetramorium* Mayr (Hymenoptera, Formicidae) in Poland – a survey of species and a key for their identification. Annales Zoologici, 48: 107–118.
- Roger J., 1863. Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses, nebst Ergänzung einiger früher gegeben Beschreibungen. Berliner Entomologische Zeitschrift, 7: 131–214.
- Ruzsky, M. 1902. Neue Ameisen aus Russland. Zoologische Jahrbücher. Abteilung für Systematic, Geographie und Biologie der Tiere, 17: 469–484.
- Ruzsky, M. 1904. O murav'yakh Arkhangel'skoj gubernii. Zapiski po Obshej Geografii Imperatorskago Russkago Geograficheskago Obshestva, 41: 287–294.
- Saaristo, M. 1995. Distribution maps of the outdoor myrmecid ants (Hymenoptera, Formicidae) of Finland, with notes on their taxonomy and ecology. Entomologica Fennica, 6: 153–162.
- Schenck, C. F. 1852. Beschreibung nassauischer Ameisenarten. Jahrbücher des Vereins für Naturkunde im Herzogtum Nassau, 8: 1–149.
- Scholz, E. J. R. 1926. Die Ameisen des Annaberges. Aus dem Chelmer Lande, Gross Strehlitz, 2 pp.
- Seifert, B. 1996. Ameisen: beobachten, bestimmen. Naturbuch Verlag, Augsburg, 352 pp.
- Smith, M. R. 1950. On the status of *Leptothorax* Mayr and some of its subgenera. Psyche, 57: 29–30.
- Snelling, R. R. 1986. New synonymy in Caribbean ants of the genus *Leptothorax*. Proceedings of the Entomological Society of Washington, 88: 154–156.
- Soudek, S. 1925. Four new European ants. Entomologist's Record and Journal of Variation, 37: 33–37.
- Stawarski, I. 1961. Nowe stanowiska rzadkich gatunków mrówek. (Hym., Formicidae). Polskie Pismo Entomologiczne, 31: 135–138.
- Stawarski, I. 1966. Typy gniazd mrówek i ich związki z siedliskiem na terenach południowej Polski. Zeszyty Przyrodnicze Opolskiego Towarzystwa Przyjaciół Nauk, 6: 93–157.
- Stitz, H. 1939. Hautflüger oder Hymenoptera. I. Ameisen oder Formicidae. Die Tierwelt Deutschlands, 37, 428 pp.
- Szujecki, A., J. Szyszko, S. Mazur and S. Perliński. 1978. A succession of the ants (Formicidae) on afforested arable land and forest soils. Memorabilia Zoologica, 29: 183–189.
- Szujecki, A., J. Szyszko, S. Mazur and S. Perliński. 1983. The process of forest soil macrofauna formation after afforestation of farmland. Warsaw Agricultural University Press, Warszawa, 196 pp.
- Urbański, J. 1956. Dziesięć lat badań zoologicznych w projektowanym Wolińskim Parku Narodowym. Zeszyty Naukowe Uniwersytetu Poznańskiego, 1: 173–200.

- Wengris, J. 1962. Mrówki (Hymenoptera, Formicidae) rezerwatu torfowiskowego Redykajny pod Olsztynem. Zeszyty Naukowe Wyższej Szkoły Rolniczej w Olsztynie, 14: 93–103.
- Wengris, J. 1963. Mrówki (Hymenoptera, Formicidae) rezerwatu torfowiskowego Mszar (woj. olsztyńskie). Zeszyty Naukowe Wyższej Szkoły Rolniczej w Olsztynie, 16: 411–423.
- Wengris, J. 1977. Stan badań nad mrówkami (Formicoidea) północno-wschodniej Polski. Biuletyn Informacyjny Polskiego Towarzystwa Entomologicznego, 20: 14–21.
- Wheeler, W. M. 1904. Three new genera of inquiline ants from Utah and Colorado. Bulletin of the American Museum of Natural History, 20: 1–17.
- Wheeler, W. M. 1910. Three new genera of myrmicine ants from tropical America. Bulletin of the American Museum of Natural History, 28: 259–265.
- Więckowski, S. 1957. Entomofauna pniaków sosnowych w zależności od wieku i rozmiaru pniaka. Ekologia Polska, 5: 13–140.
- Wierzejski, A. 1868. Przyczynek do fauny owadów błonkoskrzydłych (Hymenoptera). Sprawozdanie Komisji Fizjograficznej, [2]: (108)–(120).
- Wierzejski, A. 1873. Dodatek do fauny błonkówek (Hymenoptera). Sprawozdanie Komisji Fizjograficznej, 8: (253)–(273).
- Wiśniewski, J. 1967. Analiza reśztek pochodzenia zwierzęcego występujących w mrowiskach *Formica polyctena* Först. (Hym., Formicidae). Polskie Pismo Entomologiczne, 37: 385–390.
- Wiśniewski, J. 1987. Nowe stanowiska gładyszka mrowiskowego – *Formicoxenus nitidulus* (Nyl.) (Hymenoptera, Formicidae) w Polsce. Badania Fizjograficzne nad Polską Zachodnią, C, 35: 125–128.
- Woyciechowski, M. 1985. Mrówki (Hymenoptera, Formicidae) Małych Pienin – Karpaty. Acta Zoologica Cracoviensia, 28: 283–296.
- Woyciechowski, M. 1990a. Nuptial flights in several ant species and their aerial aggregations (Hymenoptera, Formicidae). Acta Zoologica Cracoviensia, 33: 555–564.
- Woyciechowski, M. 1990b. Mrówki (Hymenoptera, Formicidae) polan tatrzańskich. Studia Naturae, Ser. A, 34: 125–138.
- Zetterstedt, L. W. 1840. Insecta Lapponica descripta. Lipsiae, vi + 1140 pp., (Hymenoptera): pp. 315–476.

Received: February 10, 1999

Accepted: May 20, 1999

Corresponding Editor: M. Hołyńska

Issue Editor: D. Iwan

Muzeum i Instytut Zoologii
Polskiej Akademii Nauk
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