ENTOMOLOGISCHE ABHANDLUNGEN
Staatliches Museum für Tierkunde Dresden

Band 51 Ausgegeben: 20. Juli 1988 Nr. 8

A Revision of the European Species of the Ant Subgenus *Chthonolasius*

(Insecta, Hymenoptera, Formicidae)

With 5 Tables and 60 Figures

BERNHARD SEIFERT
Görlitz

Abstract. Keys and descriptions are given for the nine European species of the ant subgenus *Chthonolasius* RUZSKY. The new species *Lasius balcanicus* and the new subspecies *L. jensi longiceps* are described. The distribution of each species is outlined and brief informations on biology, as far as known, are given.

Introduction

The material examined here is not from the whole geographic area of Europe where *Chthonolasius* species are distributed; i. e. the Iberian Peninsula is not represented, except very few specimens from Spain. On the other hand, the study was extended with material from adjacent regions of Asia as the Caucasus, Armenia, and N Kazakhstan. The types of the problematic taxa *Lasius meridionalis, rabaudi, belgarum, sabularum,* and *jensi* were examined as well as reliably type-compared material (probably syntypes) of *distinguendus*. Types of the species *mixtus, umbratus, bicornis,* and *affinis* were not requested because their identity is clear from sufficient descriptions and geographic origin.

In this revision, the distribution is mostly given in terms of traditional geographic names instead of official political names to have a less complicated writing; e. g. S Russia is written instead of southern, European part of the Russian Socialist Federal Soviet Republic and the designation Germany comprises the territories of the present German states FRG and GDR.

The terminus "species" is used here in the sense of a morphospecies; i. e. the designation "species" is applied if we have distinct morphological differences for conditions of sympatric occurrence. Of course this pragmatism does not take into account that one and the same gene pool could provide two or more phenotypically and ecologically distinct morphs which feign the existence of different biospecies. This paper aims to show the clear morphological differences which are often proved by different ecology or distribution. Compared to the puzzling taxonomic situation we encounter in other ant groups, e. g. European wood ants, the taxonomy of the European *Chthonolasius* species seems to be relatively clear, if queen morphology is used as basis for taxonomic decisions. Thus, convincing differences can be shown between the hitherto doubtful species and the low percentage of series which could possibly represent transitional forms can not endanger the species concept presented here. However, workers are often difficult to separate which necessitates the time-consuming examination of many workers per nest in a lot of characters. Even more difficult is the determination of males which show, as result of their hemizygous origin, much higher variability coefficients as female castes and unfortunately exactly those species which are difficult in their separation by "somatic" morphology are hardly separable by genitalia too (WERNER, 1984).

The lack of characteristic structures in general body shape, cuticular surfaces, and pigmentation generated the urgent need of very careful examination and exact measuring of

sufficiently large samples. To reproduce the results, it is necessary to give an exact standardization how a character is investigated. Deviations from these standards may produce very misleading errors.

Although I reintroduced the forgotten *L. sabularum* and described a new species and subspecies, this revision is no contradiction to the recent species concept of COLLINGWOOD (1979). I hope this morphological study will describe taxonomic units exactly enough that their identity as real biospecies can be tested using other tools of research.

Acknowledgements

At first, I wish to thank Cedric COLLINGWOOD/Skipton who gave me valuable guidance in many problems of this revision and lent a lot of material. With many thanks I acknowledge also the very generous help of Petr WERNER/Prague who supplied me with many excellent and highly needed nest series from his own collection. Special mention should be made of those individuals who helped considerably with loans or gifts: Volker ASSING (University of Hannover), Paul DESSART (R. I. Sc. N. B. = Royal Institute of Natural Sciences of Belgium, Brussels), Gennady DLUSSKY (ZMMU = Zoologcal Museum of the Moscow Lomonossov University), Rüdiger KRAUSE (Staatliches Museum für Tierkunde Dresden), Klaus LIPPOLD (Leipzig), Jan MACEK (National Museum Prague, Entomological Department), Frank KOCH (ZMUB = Zoological Museum of the Humboldt University Berlin), Joachim OEHLKE (DITE = Department of Insect Taxonomy of the Academy of Agricultural Sciences Eberswalde), Karin VOIGTLÄNDER (SMNG = Staatliches Museum für Naturkunde Görlitz), and Wolfgang ZIMMERMANN (Museum der Natur Gotha).

Investigation Methods and Terminology

All measurements have been taken under use of the Carl Zeiss Jena stereomicroscopes SM XX and TECHNIVAL 2 at magnifications between 80x and 250x. A measuring accuracy of $\pm$ 1 μm is achieved for small structures as funiculus segments or hairs, but not for the largest measures (e. g. queen head width) where the error may be $\pm$ 5 μm. To have a uniform recording and because the accuracy is better than 0.01 mm, all data are given in μm even for measurements where such a precision is not possible.

The characters investigated are:

ADM – number of small denticles at the masticatory border of male mandible which may occur additionally to the always existing apical and subapical dents.

AW – maximum alitrunk width before the tegulae.

GHL – length of longest hair on dorsal face of first tergite (see Fig. 1).

HL – maximum head length measured from midpoint of occipital border to midpoint of anterior clypeal border; the head has to be tilted till maximum length comes to lie in measuring plane.

HTL – length of hind tibia from distal end of extensor profile to the narrow at proximal end of flexor profile.

HTMAX – maximum diameter of hind tibia at midpoint; to measure the real cuticular surface transmitted-light was used.

HTMIN – minimum diameter of hind tibia at midpoint; transmitted-light was used, but even then errors are to be expected because in species with thick pubescence the real cuticular surface is not exactly visible.

HW – maximum measurable head width; that may be the outer distance of eyes (in males and queens) or the maximum width of head capsule (in workers normally across or slightly behind the eyes). In latter case it was tried to measure the real surface using transmitted-light.

I2FS – ratio of length to width of second funiculus segment measured in transmitted-light with dorsal surface of scape situated in the visual plane. In case of unequal sides the length is taken along the median line.

m-cu – presence of cross vein m-cu in male forewing; presence is counted as 1.0, absence as 0, and imperfect cross veins as 0.5. The data of both forewings are averaged.

nHHT – number of standing hairs protruding more than 11 μm from cuticular surface of extensor profile of hind tibia, except the hairs on distal apex which are always present. Data of both hind tibiae are averaged.

PDF – average pubescence distance in front of midocellus; the number of pubescence hairs crossing a straight, transversal measuring line of 250–500 μm is counted and the average distance between two hairs is calculated. Horizontal light directed perpendicular to the axis of the pubescence hairs is used to improve their visibility or a darkfield reflected-light microscope EPIGNOST was used.

PDG – average pubescence distance on dorsal area of first gaster tergite obtained in same way as in PDF.
PLG – average length of pubescence hairs on dorsal surface of first gaster tergite; the average of at least five measurements taken under same illumination as in PDF.
SCW – maximum width of the petiole scale above the stigmata.
SL – maximum straight line length of scape excluding articular bulb.
SMAX – maximum diameter of scape at midpoint; to measure the real cuticular surface transmitted-light was used.
SMIN – minimum diameter of scape at midpoint measured as in SMAX.

The characters SMAX, SMIN, HTMAX, HTMIN, I2FS, GHL, PDF, PDG, PLG were taken at magnifications of 200x to 250x.

The terminology of the hairs (= seta = pilosity) and of pubescence (= microchaeta) is very similar to the system used by WILSON (1955). Depending on the angle at which a hair projects from cuticular surface are distinguished here appressed (0°), decumbent (15°), subdecumbent (30°), suberect (35–45°), and erect (> 45°) hairs/pubescence hairs. In seta counts, only hairs projecting more than 11 μm from cuticular surface are incorporated. Fig. 2 illustrates the terminology of hairs.

I have used here simple ratios (e. g. SL/HL) to characterize body proportions in order to avoid a more complicated presentation. A description of these ratios in terms of their allometric functions would produce a slightly better discriminative power of many characters, but would result in reduced lucidity of my writing. That is why I rarely give allometric functions.

I have used here absolute data as measure for hair length in workers because the application of simple size-related indices as GHL/HL is problematic; e. g. the smallest *L. umbratus* workers will have the same GHL/HL ratios as the largest *L. affinis* workers while absolute data clearly differ. For that reason, the use of absolute GHL data with slight size-related corrections is more appropriate. The increase of GHL with growing HL is very weak and in only four of the nine species significant for $p < 0.05$. As approximate rule of thumb may be accepted for the workers of the species dealt with here a GHL increase of 3.5 μm with a HL increase of 200 μm.

General Characterization of the Subgenus *Chthonolasius* RUZSKY

Maxillary palp segments 5 and 6 shorter than segment 4; segment 6 shorter 10 % HW. The opening of the metapleural gland is, measured perpendicularly to its longer diameter, less wide than the maximum diameter of the outer margin of the propodeal spiracle. Queens brown to blackish brown, with HW at least as large as AW and eye length shorter 18 % HW. Workers bright yellow to amber and with eye length shorter than 20 % HW.
All species are, as far as we know, temporary social parasites securing colony foundation in nests of the subgenus *Lasius* s. str. The above-ground foraging activity is very low or absent.

Lasius mixtus (NYLANDER, 1846) (Figs. 7, 17, 26, 35, 54)

Formica mixta NYLANDER, 1846; queen, worker, male; Sweden.
Lasius umbratus (NYLANDER), sensu WILSON, 1955, partim.

Material studied

60 queens, appr. 100 workers, and 13 males from Germany, Czechoslovakia, Bulgaria, France, Switzerland, and Kazakhstan which originate from at least 40 different nests.

Description

— Queen: Pubescence on head, alitrunk, and gaster very thick, regular, and mostly subdecumbent, on head suberect. Pubescence on the appendages suberect and very dense, projecting on average 20 μm from cuticular surface. In contrast, the standing hairs on all body parts are much shorter than in all other species. Scape (Fig. 17) and hind tibia on the average with few standing hairs which project at the most 20 μm from the pubescence surface and are finer than in other species. Genae with few standing hairs, the longest measure 35–45 μm. Scape short and subcylindrical. Second funiculus segment nearly as wide as long. Tibiae less flattened and head length index much larger than in other species. Petiole in frontal view with convex sides, tapering dorsad; dorsal crest normally with shallow emargination or straight (Fig. 7).

HW 1495.1 ± 39.3 (n = 46, largest 1591), HL 1365.0 ± 28.0 (n = 46), HL/HW 0.913 ± 0.0129 (n = 46), SL/HW 0.763 ± 0.0122 (n = 45), SL/HL 0.836 ± 0.0113 (n = 45), SMAX/SMIN 1.193 ± 0.0589 (n = 31), HTMAX/HTMIN 1.429 ± 0.122 (n = 27), I2FS 1.316 ± 0.0635 (n = 41), GHL 48.2 ± 4.31 (n = 45, longest 58), nHHT 6.67 ± 4.63 (n = 29, longest pubescence hairs included!), PDG 4.8 ± 0.25 (n = 10), SMAX 139.7 ± 6.8 (n = 30), SMIN 117.4 ± 7.94 (n = 30), HTMAX 234.0 ± 9.36 (n = 27), SL 1141.4 ± 18.6 (n = 45).

— Worker: Head, alitrunk, and gaster with many erect hairs which are shorter than in other species. Genae with many erect hairs. Pubescence on all body parts very dense, regular and subdecumbent to suberect. Dorsal plane of scape with thick subdecumbent pubescence, projecting 15–20 μm from cuticular surface; few subdecumbent hairs projecting 25–30 μm from surface are normally present, but these appear to be in most cases only elongated pubescence hairs and no real seta. A similar situation exists on extensor profile of hind tibia but, there, few erect seta may be additionally present. Scape and tibiae clearly less flattened than in other species. Dorsal crest of scale in frontal view with shallow emargination or entire, sides of scale convex and tapering dorsad; whole scale relatively lower than in other species. Colour of head and alitrunk on average notably darker than in other species, beeing a dull brownish yellow.
HL 1056.3 ± 54.9 (n = 30, largest 1177), HW 990.1 ± 56.14 (n = 30), SL/HL 0.839 ± 0.0133 (n = 30), SL/HW 0.895 ± 0.0175 (n = 30), HL/HW 1.067 ± 0.0128 (n = 30), SMAX/SMIN 1.227 ± 0.0796 (n = 30), GHL 45.8 ± 4.42 (n = 30), nHHT 7.26 ± 6.44 (n = 25; largest 27, long pubescence hairs included), PDG 5.76 ± 0.89 (n = 26), PDF 8.61 ± 1.30 (n = 24), PLG 35.1 ± 5.66 (n = 20), I2FS 1.174 ± 0.048 (n = 24), SMAX 97.9 ± 7.71 (n = 30), SMIN 80.1 ± 8.10 (n = 30).
Allometry: $HW = 0.6189\ HL^{1.0596}$ (r = 0.9792, n = 30).

— Male: Masticatory border of mandibles with 0–2 small denticles in addition to the larger apical and subapical dent (Fig. 35). Sectional view of scape at midpoint subcylindrical. Dorsal surface of scape with thick suberect to subdecumbent pubescence which projects 15–20 μm from cuticular surface; few longer suberect hairs may project up to 30 μm (Fig. 35). Extensor profile of hind tibia with profuse subdecumbent pubescence, projecting 12–18 μm, few slightly longer hairs may be present. Petiolar scale shape in frontal view varying from very rounded to slightly emarginated dorsal crest. Cross vein m-cu in 88 % of wings present.
HW 1029.2 ± 28.8 (n = 13, largest 1071), SL 649.8 ± 23.9 (n = 13), SMAX 85.1 ± 3.71 (n = 13), SMIN 69.5 ± 3.18 (n = 13), SMAX/SMIN 1.224 ± 0.045 (n = 13), AW 1002.8 ± 33.7 (n = 13), I2FS 2.001 ± 0.119 (n = 13), GHL 66.4 ± 7.24 (n = 13), SCW 310.3 ± 20.3 (n = 13), nHHT 2.25 ± 2.60 (n = 12), PDG 11.45 ± 1.96 (n = 11), ADM 0.69 ± 0.63 (n = 13), m-cu 0.88 ± 0.22 (n = 13), SL/HW 0.632 ± 0.0216 (n = 13), SCW/HW 0.302 ± 0.0209 (n = 13), SL/SMIN 9.367 ± 0.447 (n = 13).

Comments

Except *Lasius sabularum* (see this species), *L. mixtus* is hardly to be confused with other European *Chthonolasius* species. In the queen, a slightly similar species is *L. distinguendus*, but there is no overlap in data of HW (largest *mixtus* 1591, smallest *distinguendus* 1601), GHL (longest in *mixtus* 58, shortest in *distinguendus* 63), and I2FS (largest in *mixtus* 1.45, smallest in *distinguendus* 1.47) and additional characters are clearly different (see Table 1 and Table 4). A simple product index $I = GHL \times SL \times HW / HL^2$ gives a perfect separation (see Fig. 54) with I_{mixt} 43.39 ± 4.60 (largest 54.5, n = 30) and I_{dist} 78.58 ± 8.95 (smallest 62.3, n = 32). There is no clinal trend detectable from Central Europe to S Bulgaria or to Kazakhstan respectively which coincides with the opinion of COLLINGWOOD (1963) who quoted that it seemed morpholigically consistent throughout its range from Spain to E Siberia. The worker is well characterized by its very low GHL (having no overlap with any other species), low SL/HL, I2FS, PDG, and SMAX/SMIN. The best characters of the male are the low ADM, the scape pubescence, short GHL, low SL/SMIN, and genitalia (see WERNER, 1984).

Biology

This species has a similar habitat selection as *umbratus*, possibly produced by similar temperature and moisture requirements, but seems to prefer more open habitats, particularly meadows and pastures. It is less eurytropic than *umbratus* and is not observed in xerothermous grasslands and dry heath. The major or exclusive host species is probably *L. niger*, concluded from the species composition in the recorded *mixtus* habitats. There seems to be a profound difference in dispersal behaviour of fertilised queens after nuptial flight compared to other species. Beginning from September, many dealate queens may be found resting under stones and in other hidden places, but they are frequently observed to move above ground beginning from warm November and winter days (!) till spring. One queen was recorded to wander at air temperatures of 5 °C. That could mean that *mixtus* queens will hide after nuptial flight for a certain time and will begin to search a host colony after the end and before the onset of the main activity period of their most important predators which are ants. Very likely such an adaption could enlarge the colony foundation success. Flight period: recorded from 12. vii to 28. ix.

Distribution

The northern border of its distribution in Fennoscandia is approximately the 62nd degree northern latitude and it goes south to 41°30′ N in the Balkan where it is a subalpine species. The distributional range of *mixtus* is thus very similar to the *umbratus* range. COLLINGWOOD (1963) reports *mixtus* for Great Britain to be more abundant in the north, while *umbratus* predominates in the south. This could indicate that *mixtus* would better tolerate cool and wet climatic conditions.

Lasius sabularum (BONDROIT, 1918) (Figs. 56–60)

Formicina umbrata var. *sabularum* BONDROIT, 1918; queen; Malo-les-Bains near Dunkerque/N France, Oct. 1914.

Material studied

21 queens from 7 different nests, among them the type queen from Malo-les-Bains; 34 workers from 8 different nests, and 11 males from 4 different nests. Origin of series: Romania (2), Slovakia (2), Moravia (1), southern GDR (4).

Description

— Queen: Pubescence on head, alitrunk, and gaster very dense, regular and decumbent to subdecumbent; similar to the condition in *mixtus*. Dorsal plane of scape with decumbent to subdecumbent pubescence projecting 10–18 μm from cuticular surface and short and fine subdecumbent hairs which project up to 25 μm from cuticular surface. Extensor profile of hind tibia with decumbent pubescence projecting 13–15 μm from cuticular surface and 5–18 subdecumbent to erect hairs which project at the most 45 μm. Shape of head in dorsal view similar to *mixtus*; the occipital margin is much less emarginated than in *distinguendus* which results in distinctly larger HL/HW. Petiolar scale in frontal view with convex or nearly straight sides converging towards the dorsal crest that is frequently straight or with shallow emargination. Scape subcylindrical as in *mixtus* but longer. Second funiculus segment as short as in *mixtus*.

HW 1623.2 ± 29.7 (n = 21, 1569–1678), HL/HW 0.897 ± 0.0077 (n = 21), SL/HL 0.856 ± 0.0171 (n = 21), SL/HW 0.768 ± 0.0131 (n = 21), SMAX/SMIN 1.254 ± 0.0573 (n = 20), HTMAX/HTMIN 1.489 ± 0.0801 (n = 20), I2FS 1.371 ± 0.0468 (n = 20), GHL 64.5 ± 6.55 (n = 21), nHHT 11.3 ± 3.67 (n = 21), PDG 4.8 ± 0.25 (n = 10), SMIN 111.7 ± 5.62 (n = 20), HTMAX 232.5 ± 7.05 (n = 20), SL 1246.4 ± 21.7 (n = 21).

— Worker (Figs. 58, 59, 60): Head, alitrunk, and gaster with dense decumbent pubescence and many standing hairs which are shorter than in most oft the other species. Scape appearing at lower magnifications smooth as in *mixtus*; its dorsal plane with decumbent to subdecumbent pubescence projecting 12 μm from cuticular surface and short decumbent to subdecumbent hairs projecting at the most 22 μm from cuticular surface. Extensor profile of hind tibia with decumbent pubescence projecting 12 μm; a number of hairs inter-

mediate between pubescence and pilosity may project up to 20 μm, while stronger suberect to erect seta which may project up to 45 μm are present in very low numbers. Petiolar scale lower and relatively broader than in other species, with straight to convex sides, converging towards the dorsal crest that is slightly emarginate, straight or a little rounded. Long head and comparably large body size.

HL 1117.0 ± 69.7 (n = 34), HW 1044.8 ± 70.6 (n = 34), HL/HW 1.069 ± 0.0108 (n = 34), SL/HL 0.842 ± 0.0095 (n = 34), SL/HW 0.901 ± 0.0143 (n = 34), SMAX/SMIN 1.285 ± 0.0598 (n =34), GHL 70.8 ± 7.84 (n = 32), PDF 7.41 ± 0.94 (n = 30), PDG 6.26 ± 0.82 (n = 32), nHHT 8.81 ± 4.94 (n = 33, longest pubescence hairs included!), SMAX 98.7 ± 5.30 (n = 32).

Allometry: $HW = 0.56397\ HL^{1.07205}$ (r = 0.9912, n = 34).

— Male: Masticatory border of mandibles with 2–6 small denticles in addition to the larger apical and subapical dent. Sectional view of scape at midpoint elliptic. Dorsal surface of scape with decumbent to subdecumbent pubescence projecting 13 μm from cuticular surface and few suberect to erect hairs projecting up to 33 μm. Extensor profile of hind tibia with decumbent pubescence projecting about 13 μm, single subdecumbent hairs projecting up to 20 μm are occasionally present. Data of 11 males: HW 1146.4 ± 21.8, SL/HW 0.644 ± 0.0204, SMAX/SMIN 1.297 ± 0.0250, GHL 80.27 ± 8.91, PDG 10.35 ± 2.05, m-cu 0.273 ± 0.410, ADM 4.27 ± 1.10, HW/AW 1.142 ± 0.0265, SMIN 68.0 ± 1.93.

Comments

Concluded from the morphology of the female castes, the nearest relative of *sabularum* is obviously *mixtus*. However, the *sabularum* males differ considerably from those of *mixtus* in having much higher ADM and much lower m-cu (see Table 3) and I do not know any clear difference to the *umbratus*, *distinguendus*, *balcanicus*, *affinis*, and *meridionalis* males. Table 4 and 5 give a more detailed comparison of the female castes of *distinguendus*, *sabularum*, and *mixtus*. In the queen, *sabularum* is clearly different from *distinguendus* by its much lower I2FS and much higher HL/HW. A simple product index I = I2FSxHW/HL offered a perfect separation of all examined queens with I = 1.527 ± 0.057 (n = 20, largest 1.631) in *sabularum* and I = 1.813 ± 0.080 (n = 41, smallest 1.698) in *distinguendus*. Other characters significantly different for $p < 0.001$ are HW, SL/HW, HTMAX/HW, GHL, and scutellum hair length (ScuHL). The *sabularum* queen differs from the *mixtus* queen most clearly in SL and ScuHL where we have no overlap of data. Further characters significantly different for $p < 0.001$ are HW, HL/HW, SL/HL, SMAX/SMIN, GHL, MeHL (length of longest hair on mesonotum, dorsal surface), HTMAX/HW, and nHHT. It can be stated that all *sabularum* queens from Romania to N France (the type) showed a constant and unique character combination that gives a clear separation from all other European species. The worker of *sabularum* differs from *mixtus* by its clearly larger GHL with no overlap of data. Significantly different for $p < 0.001$ are furthermore HL and PDF. There is probably no danger that *sabularum* workers could be confused with *distinguendus* if small nest series are investigated: GHL and PDG are much lower and other characters significantly different for $p < 0.001$ are SL/HL, HL/HW, SMAX/SMIN, and nHHT. However, much care and consideration of character combinations is needed to separate the *sabularum* worker from *umbratus* workers with subaverage SL/HL, GHL, and reduced nHHT, but the scape of *umbratus* has always more numerous, longer, and more erect hairs on dorsal plane even in specimens with less developed appendage pilosity. The petiolar scale and the elongated head are additional, more or less diagnostic characters.

Biology

The one nest sample I have taken personally was found under a large stone at the sunny, S-exposed margin of deciduous woodland near Königshain/Görlitz. A single queen from Tharandt was collected from a similar habitat and another nest was taken in a garden in the periphery of Görlitz. Compared to other species, the alates of *sabularum* are found in the nest later (dates: 22. viii, 31. viii, 7. ix, 8. ix) and nuptial flight occurs later (records:

17. ix and 20. x). The interesting finding of alate queens in one nest in April (Lömischau near Bautzen, 25. iv 1966) indicates that sexuals can hibernate when nuptial flight was not performed in autumn of the previous year.

Distribution

L. sabularum is much less abundant than *umbratus* and *mixtus*. For the GDR, I assume the abundance ratio of *sabularum* : *mixtus* : *umbratus* as 1 : 8 : 15. The known European sites are: Malo-les-Bains/N France; Tharandt/distr. Dresden, leg. BRAUNE 17. ix 1967; Lömischau/distr. Bautzen, leg. JORDAN 25. iv 1966; Königshain near Görlitz, leg. SEIFERT 25. x 1981; Görlitz, leg. BALDOVSKI 20. x 1984; S Moravia: Drslavice, leg. BEZDEČKA 31. vii 1985; S Slovakia: Gabčikovo, leg. BEZDEČKA 22. viii 1984; Romania: Bihor, leg. ODEHNAL 8. ix 1983; Romania: Bucium, Detunata, leg. ODEHNAL 7. ix 1983.

Lasius distinguendus EMERY, 1916 (Figs. 5, 15, 24, 34, 43, 53, 54)

Lasius bicornis distinguendus n. ssp. + v. *hybrida* n. var., EMERY, 1916; queen, worker; Bologna/Italy.
Lasius hybridus EMERY, sensu ARNOLDI & DLUSSKY, 1978.

Material studied

55 queens; among them one queen with worker from Bologna/Italy, leg. EMERY 1912, labelled as *Lasius bicornis* FÖRSTER *distinguendus* EMERY, which are reliably type-compared specimens (probably syntypes). 23 workers from seven nests which determination is confirmed by presence of queens and 5 males from two nests with queens. Much more additional workers probably being *distinguendus* were studied but not incorporated into the statistics because of uncertain species identity. The material is from France, Italy, Jugoslavia, Bulgaria, Switzerland, the Ukraine, Armenia, and the major part from Czechoslovakia and GDR.

Description

— Queen: Pubescence on head, alitrunk, and gaster dense and decumbent, producing a rather smooth surface appearance. Genae with few standing hairs. Erect hairs on mesonotum short, normally not longer than 70 μm. Scale shape varying, but generally clearly emarginated (Fig. 5). Dorsal surface of scape with appressed or decumbent pubescence and a low number of small suberect hairs which project at the most 20 μm from cuticular surface (Fig. 15). A similar situation exists on the extensor profile of hind tibia where the number of small suberect hairs ranges individually between 0 and 14.
HW 1689.2 $\pm$ 48.0 (range 1601–1787, n = 43), HL 1442.2 $\pm$ 42.2 (n = 30), HL/HW 0.858 $\pm$ 0.0134 (n = 42), SL/HW 0.746 $\pm$ 0.0141 (n = 42), SL/HL 0.870 $\pm$ 0.0159 (n = 42), SMAX/SMIN 1.255 $\pm$ 0.0709 (n = 31), HTMAX/HTMIN 1.483 $\pm$ 0.0979 (n = 32), I2FS 1.558 $\pm$ 0.0676 (n = 43), GHL 80.5 $\pm$ 9.74 (n = 55), nHHT 8.48 $\pm$ 4.57 (n = 54), PDG 4.85 $\pm$ 0.54 (n = 23), SMAX 139.5 $\pm$ 6.16 (n = 30), SMIN 110.3 $\pm$ 8.21 (n = 33), HTMAX 220.7 $\pm$ 9.55 (n = 32), SL 1261.1 $\pm$ 29.74 (n = 42).

— Worker: Genae always with erect hairs. Whole head, alitrunk, and gaster with many erect hairs and a rather dense decumbent pubescence (see data). Scale shape varying, but generally the dorsal crest is notably notched and the sides converge dorsad (Fig. 24). Dorsal surface of scape with appressed to decumbent pubescence and, in the majority of examples, with few suberect to subdecumbent hairs which project at the most 25 μm from cuticular surface. Extensor profile of hind tibia normally with 2–8 subdecumbent to suberect hairs which may sometimes project up to 50 μm and are mostly consentrated on the proximal profile (Fig. 24).
HL 1056.5 $\pm$ 62.8 (largest 1171, n = 23), HL/HW 1.048 $\pm$ 0.0195 (n = 23), SL/HL 0.869 $\pm$ 0.0142 (n = 23), SL/HW 0.911 $\pm$ 0.0262 (n = 23), SMAX/SMIN 1.367 $\pm$ 0.0863 (n = 23), GHL 104.7 $\pm$ 7.61 (n = 23), nHHT 4.70 $\pm$ 2.69 (n = 22), PDG 11.78 $\pm$ 2.96 (n = 23), PDF 9.96 $\pm$ 1.99 (n = 23), PLG 42.3 $\pm$ 7.29 (n = 16), SMAX 92.7 $\pm$ 9.00 (n = 23), HTMAX/HTMIN 1.382 $\pm$ 0.111 (n = 21).

— Male: Masticatory border of mandibles with 4–7 small denticles in addition the larger

apical and subapical dents (Fig. 34). Sectional view of scape at midpoint nearly rounded. Dorsal surface of scape with subdecumbent pubescence and 1–4 suberect hairs which project up to 20 μm from cuticular surface. Scale shape in frontal view extremely variable, with rounded to emarginated dorsal crest. Extensor profile of hind tibia with 1–3 subdecumbent hairs which protrude up to 20 μm from cuticular surface. Cross vein m-cu in 55 % of wings present.

HW 1114.6 ± 33.6 (n = 5), SL 769.8 ± 16.5 (n = 5), SMAX 85.0 ± 4.4 (n = 5), SMIN 72.8 ± 5.1 (n = 5), SMAX/SMIN 1.17± 0.051 (n = 5), AW 1002.6 ± 61.8 (n = 5), I2FS 1.996 ± 0.117 (n = 5), GHL 91.4 ± 4.2 (n = 5), SCW 364.0 ± 31.5 (n = 5), nHHT 2.0 ± 0.79 (n = 5), PDG 8.2 ± 0.64 (n = 5), m-cu 0.55 ± 0.45 n = 5), ADM 5.0 ± 1.22 (n = 5), SL/HW 0.691 ± 0.027 (n = 5), SCW/HW 0.326 ± 0.021 (n = 5), SL/SMIN 10.61 ± 0.646 (n = 5).

Comments

The best separation of *distinguendus* from its sibling species *umbratus* is given in the queens. Here, a simple product index I = (nHHT x GHL)$^{0.5}$ offers a perfect discrimination of both species with I_{dist} 22.94 ± 7.85 (upper extreme 33.3, n = 39) and I_{umbr} 60.92 ± 9.09 (lower extreme 41.0, n = 42, see Fig. 53). The workers are separable from *umbratus* if three workers per nest are averaged for an index I = PDG x PDF / nHHT, with $I_{umbr} \leq 10$ and $I_{dist} \geq 27$. The distinction of males from those of *umbratus, affinis,* and *balcanicus* n. sp. is a very difficult problem. Already WERNER (1984) failed to detect genitalia differences between these species and I can not risk a statement on discriminating characters from a sample of only five males. However, there is some hope that a multiple character analysis could provide a good separation which should be tested on the basis of larger material.

Biology

The typical habitats are, as far as known, xerothermous grasslands or steppes. The major host species is probably *Lasius alienus* which is often the dominant *Lasius* species at the *distinguendus* sites. *L. distinguendus* is clearly more xerothermophilic than the sibling species *L. umbratus* what results in a pronounced habitat segregation. In the steppes, it frequently seems to construct high mounds. Flight period: 3. vii. – 18. ix., vast majority 12. vii – 10. viii.

Distribution

The northern border of its distribution in Europe is approximately the 53rd degree northern latitude (northernmost site: Zechlin; 53°09′ N, 12°47′ E). Known from Spain, France, Switzerland, Austria, GDR, Poland, Czechoslovakia, Hungary, Bulgaria, Italy, Yugoslavia, and the Ukraine. The easternmost site of which I have seen a queen is Delizhan in Armenia (40°44′ N, 44°54′E).

Lasius umbratus (NYLANDER, 1846) (Figs. 6, 16, 25, 33, 53)

Formica umbrata NYLANDER, 1846; queen, worker, male; Sweden and S Finland.
Formicina belgarum BONDROIT, 1918.

Material studied

90 queens, among them the type of *Formicina belgarum* BONDROIT from Grande Chartreuse, leg. LE FRANCOIS 1917 (R. I. Sc. N. B.); appr. 200 workers from 40 nests; 9 males from six nests (many others were excluded from the statistics because of uncertain species identity). The material is from the whole European distributional range and N Kazakhstan.

Description

— Queen: Pubescence on head, alitrunk, and gaster very dense, more decumbent than appressed and not ideally parallel, thus producing a slightly rough surface appearance. Nearly all body parts including genae with many erect hairs. Erect hairs on mesonotum long, the longest always longer than 75 μm. Scale shape varying but generally clearly emarginated (Fig. 6). Dorsal surface of scape with decumbent or subdecumbent pubescence and very numerous erect or suberect hairs which project at least 25 μm (25–50 μm) from

cuticular surface (Fig. 16). A similar situation exists on the extensor profile of hind tibia where the number of erect or suberect hairs ranges individually from 16 to 56. There is no significant difference in any character between queens from Central Europe and queens from the Ukraine and N Kazakhstan.
HW 1687.8 ± 53.3 (largest 1807, n = 65), HL 1455.1 ± 34.6 (n = 47), HL/HW 0.862 ± 0.0188 (n = 46), SL/HW 0.755 ± 0.0164 (n = 50), SL/HL 0.878 ± 0.0179 (n = 48), SMAX/SMIN 1.315 ± 0.101 (n = 53), HTMAX/HTMIN 1.550 ± 0.109 (n = 38), I2FS 1.564 ± 0.086 (n = 38), GHL 102.7 ± 10.7 (n = 66), nHHT 36.4 ± 9.8 (n = 50), PDG 4.0–5.7, SMAX 144.8 ± 9.46 (n = 53), SMIN 110.4 ± 6.92 (n = 53), HTMAX 229.3 ± 14.5 (n = 39), SL 1276.4 ± 29.7 (n = 47).
Allometry: SL = 0.4241 HW + 559.6.
Note: The I2FS data given by SEIFERT (1982) differ clearly because the transmitted-light precondition necessary for exact meassuring of real segment width and the unequal length of segment sides were not carefully taken into account.

— Worker: Genae always with many erect hairs. Whole head, alitrunk, and gaster with many erect hairs and a dense, not ideally parallel pubescence, giving a rough surface appearance. Scale shape varying, but normally clearly notched and with slightly convex sides converging towards dorsal crest (Fig. 25). Dorsal surface of scape with decumbent to subdecumbent pubescence and suberect to erect hairs of which the longest may project 35 μm from cuticular surface. Extensor profile of hind tibia normally with 10–30 suberect to erect hairs of which the longest project 45 μm.
HL 1066.8 ± 96.5 (largest 1249, n = 108), HW 1026.4 ± 101.8 (n = 108), SL/HL 0.859 ± 0.0156 (n = 108), SL/HW 0.892 ± 0.0267 (n = 108), HL/HW 1.039 ± 0.0214 (n = 108), SMAX/SMIN 1.442 ± 0.106 (n = 109), GHL 85.6 ± 8.17 (n = 119), nHHT 19.3 ± 8.12 (n = 54), PDG 7.33 ± 1.43 (n = 47), PDF 8.45 ± 1.24 (n = 60), PLG approximately 40, I2FS 1.281 ± 0.100 (n = 77), SMAX 101.5 ± 10.94 (n = 109).
Allometry: $HW = 0.576\ HL^{1.0735}$ (r = 0.9822, n = 106), GHL = 0.023 HL + 64.5 (r = 0.2639, n = 99).

— Male: Masticatory border of mandibles with 4–6 small denticles in addition to the larger apical and subapical dents (Fig. 33). Sectional view of scape at midpoint elliptic. Dorsal surface of scape with subdecumbent to suberect pubescence and 2–12 suberect to erect hairs which may protrude up to 30 μm from cuticular surface (Fig. 33). Scale normally with convex sides converging towards the dorsal crest that is normally notched. Cross vein m-cu in 69 % of wings present.
HW 1097.7 ± 59.4 (n = 9, largest 1220), SL 723.1 ± 38.4 (n = 9), SMAX 85.1 ± 3.72 (n = 9), SMIN 67.1 ± 4.37 (n = 9), SMAX/SMIN 1.270 ± 0.057 (n = 9), AW 1059.7 ± 79.9 (n = 9), I2FS 1.92 ± 0.124 (n = 9), GHL 92.1 ± 17.9 (n = 9), SCW 333.8 ± 15.13 (n = 9), nHHT 3.11 ± 1.19 (n = 9), PDG 7.97 ± 1.51 (n = 9), m-cu 0.69 ± 0.53 (n = 9), ADM 4.9 ± 0.64 (n = 9), SL/HW 0.659 ± 0.023 (n = 9), SCW/HW 0.304 ± 0.0088 (n = 9), SL/SMIN 10.80 ± 0.705 (9.51–11.95, n = 9).

Comments

For distinction from *L. distinguendus*, *mixtus*, *meridionalis*, and *jensi* see these species. Although having above-average scape length and large GHL, the type queen of *Formicina belgarum* BONDR. is in all other characters a typical *umbratus*. — The worker type of *belgarum* from Anvers, Oct. 1914 is a normal *umbratus*, except its abnormal, low scale.

Biology

L. umbratus is much less xerothermophilic than all other species except *mixtus*. In Central Europe it rarely occurs on xerothermous grassland or dry sandy heath. However, it is a clearly more eurytopic species than the other species dealt with here. Its habitats range from woodland to open mesophilic pastures, quaries, gardens, hedgerows, waysides in arable land, and it frequently occurs in the periphery of cities where nests are often constructed in the ground walls of houses and workers occasionally forage in cellars. The

major host species is *Lasius niger* and more rarely *L. alienus*, but also *L. emarginatus* is suspected and COLLINGWOOD (1979) names *L. brunneus* as occasional host species. Construction of mounds is seldom observed. Flight period: 2. vii – 27. ix (– 30. x.?), mainly 20. vii – 10. ix.

Distribution

The northern border of its distribution in Europe is along the 62nd degree northern latitude in Norway and Sweden and along the 61st degree N in Finland (COLLINGWOOD, 1979). In S Europe it is much rarer than *distinguendus* and in the east it is continuously distributed to SW Siberia (77°E, 52°N).

Lasius balcanicus n. sp. (Figs. 9, 19, 28, 37, 42, 46–52)

Type material

Holotype: a queen; 1. viii 1980 Obzor, E Bulgaria, leg. K. LIPPOLD, stored in coll. SMNG. – Paratypes: 3 queens and 5 workers from same nest as holotype, coll. SMNG; 3 queens, 3 males, and 3 workers from Nagyteteny, near Budapest, Hungary, leg. J. P. ROESZLER 12. vii 1931, coll. Museum der Natur Gotha; 3 nest samples with 29 workers from Jois and Illmitz (Neusiedler See, E Austria), leg. V. ASSING 1986; two nest samples with 27 workers from Rozen (Pirin mountains, SW Bulgaria), leg. B. SEIFERT 3. ix 1982 and 5. ix 1982; the latter five samples deposited in coll. SMNG; 7 workers from Askania Nova (S Ukraine), leg. MEDVEDYEV, coll. ZMMU.

Description

– Queen (Figs. 9, 19, 46–48): Pubescence on head, alitrunk, and gaster dense and decumbent. Genae with many standing hairs. Dorsum of head, alitrunk, and gaster with many erect hairs; longest hairs on scutellum 215 μm long. Dorsal plane of scape with decumbent to subdecumbent pubescence and 0–5 subdecumbent to suberect hairs, projecting up to 33 μm from cuticular surface. Extensor profile of hind tibia with appressed to decumbent pubescence and 7–17 subdecumbent to erect hairs which project up to 45 μm from cuticular surface. Scape and hind tibia rather flat. Scale in frontal view with straight or convex sides, slightly converging dorsad. Dorsal crest of scale clearly emarginated. Large body size and long scape.

HW 1736.0 $\pm$ 34.6 (largest 1791, n = 7), HL 1500.3 $\pm$ 25.9 (n = 7), HL/HW 0.864 $\pm$ 0.0087 (n = 7), SL/HW 0.812 $\pm$ 0.0120 (n = 7), SL/HL 0.939 $\pm$ 0.0136 (n = 7), SMAX/SMIN 1.530 $\pm$ 0.0825 (n = 7), HTMAX/HTMIN 1.780 $\pm$ 0.143 (n = 7), I2FS 1.707 $\pm$ 0.0952 (n = 7), GHL 144.9 $\pm$ 4.85 (n = 7), nHHT 11.1 $\pm$ 3.26 (n = 7), PDG 7.19 $\pm$ 0.35 (n = 7), SMAX 163.0 $\pm$ 11.2 (n = 7), SMIN 106.9 $\pm$ 7.6 (n = 7), HTMAX 264.9 $\pm$ 7.47 (n = 7), SL 1409.4 $\pm$ 33.0 (n = 7).

– Worker (Figs. 28, 42, 49–51): Genae always with erect hairs. Whole head, alitrunk, and gaster with moderately dense, decumbent pubescence and many erect hairs of which the longest on mesonotum measure 140–150 μm. Dorsal surface of scape with appressed or decumbent pubescence and few subdecumbent to erect hairs which project up to 36 μm from cuticular surface. Extensor profile of hind tibia normally with 3–10 subdecumbent to erect hairs of which the longest may project 45 μm. Dorsal crest of scale in frontal view more or less deeply emarginated; sides of scale converging dorsad. Scape and hind tibia rather flat. Length of maxillary palp segments in a worker with a HW of 1100: I 88, II 154, III 158, IV 118, V 78, VI 68. The ratio (Minimum eye diameter + maximum eye diameter) / (HW + HL) is 0.146 $\pm$ 0.0028 (n = 7).

HL 1063.0 $\pm$ 56.8 (largest 1195, n = 30), HW 1020.5 $\pm$ 65.6 (n = 30), SL/HL 0.881 $\pm$ 0.0133 (n = 30); SL/HW 0.918 $\pm$ 0.0192 (n = 30), HL/HW 1.043 $\pm$ 0.0159 (n = 30), SMAX/SMIN 1.480 $\pm$ 0.0659 (n = 30), HTMAX/HTMIN 1.492 $\pm$ 0.109 (n = 13), HTMAX/HW 0.1372 $\pm$ 0.0058 (n = 30), GHL 104.5 $\pm$ 8.76 (n = 31), nHHT 6.44 $\pm$ 1.71 (n = 31, largest 10.0), PDG 11.53 $\pm$ 3.35 (n = 30), PDF 10.51 $\pm$ 1.94 (n = 30), PLG 47.6 $\pm$ 4.73 (n = 29), SMAX 98.4 $\pm$ 8.61 (n = 30), HTMAX 140.1 $\pm$ 10.24 (n = 30).

— Male (Figs. 37, 52): Masticatory border of mandibles with 4–5 small denticles in addition to the larger apical and subapical dents. Sectional view of scape at midpoint elliptic (SMAX/SMIN: 1.35, 1.35, 1.33). Scape rather long (SL/HW: 0.658, 0.690, 0.699) and tenuous (SL/SMIN: 12.10, 11.32, 12.11). Cross vein m-cu in all three males in both forewings present. Head, alitrunk, and gaster with decumbent and rather dense pubescence (PDG: 6.4, 8.1, 7.1). Occipital part of head, mesonotum, scutellum, metanotum, and whole gaster with erect hairs. Petiolar scale in frontal view with convex sides and emarginated dorsal crest, rather broad (SCW/HW: 0.344, 0.350, 0.345). Dorsal surface of scape with decumbent pubescence and few subdecumbent to suberect hairs which may project up to 27 μm. Extensor profile of hind tibia with decumbent to appressed pubescence and very few subdecumbent to suberect hairs (nHHT: 1.5, 2.0, 2.5) which may project up to 30 μm from cuticular surface. Eyes with erect hairs of which the longest measure 33 μm.
HW 1140, 1067, 1126; SL 750, 736, 787; SMAX 85, 88, 86; SMIN 62, 65, 65; AW 1041, 986, 1030; I2FS 1.84, 1.91, 1.91; GHL 96, 62, 79; SCW 392, 374, 388; ADM 5, 4, 4.

Differential Diagnosis and Comments

The queens are not to be confused with any other European species. *Lasius affinis* has a much lower SL/HL and SL/HW and almost no standing hairs on dorsal plane of scape or extensor profile of hind tibia. *L. distinguendus* has a much lower SL/HL, SL/HW., much shorter GHL, and less flattened appendages. *Lasius umbratus* has a much shorter scape, clearly shorter GHL, and has much more hairs on the appendages. *Lasius meridionalis* differs from *balcanicus* in having a much flatter scape and hind tibia, clearly shorter GHL, more hairy hind tibia and scape, and other scale shape. Workers are more easily to be confused with other species, but considering a character combination and investigating samples of five workers per nest a satisfactorily clear determination should be possible in the majority of the material. Very difficult is the distinction of *balcanicus* workers from those of *distinguendus*. Scape and hind tibia of *balcanicus* are significantly ($p < 0.001$, $p < 0.002$) flatter, PLG is larger ($p < 0.02$), and the ratio SL/HL is significantly larger ($p < 0.001$), but there is much overlap and all other characters (GHL, nHHT, PDG, PDF, and HL/HW) do not differ notably. The separation of workers from those of *meridionalis* may be difficult in some samples; although nHHT, SMAX/SMIN, GHL, and HTMAX/HW are significantly different for $p < 0.001$ (see also Table 2), the overlap range is not very small and a determination using these characters is often probabilistic and uncertain. A possibly good difference appears to be that hairs on mesonotum are notably shorter in *meridionalis* (Figs. 41, 42).
The males of *balcanicus* are easily confused with those to *affinis*, *distinguendus*, *meridionalis*. and *umbratus* and it is impossible to state discriminant characters from only one nest sample with three specimens, particularly because of the very strong variability we usually have in males.

Biology

Apart from the fact that *balcanicus* is surely one of the most xerothermophilic species of the subgenus, nearly nothing is known of its biology. According to LIPPOLD (pers. commun.), the Obzor sample (1. viii 1980) was taken in a garden while swarming in the evening, with large number of alates leaving the nest which was apparently situated under a stone steps. The two samples from Rozen were taken at the base of a tree in a sunny semidry grassland with few fruit-trees at 800 m and from under a stone in a xerothermous south-exposed grassland with sparse vegetation at 1400 m.

Distribution

This species is probably not rare from Bulgaria to the Hungarian Plane and goes westwards to the steppes in the region of the Neusiedler See. The easternmost site so far known is Askania Nova in the steppe of the S Ukraine. Futural records for the southernmost parts of Moravia and Slovakia would not surprise. The northern and southern borders of the know range are marked by the 48th and the 41st degree northern latitude indicating that it is the most southern of the European *Chthonolasius* species.

Lasius meridionalis (BONDROIT, 1919) (Figs. 10, 20, 29, 38, 41, 55)

Formicina meridionalis BONDROIT, 1919; queen, Aveyron (France).
Lasius rabaudi (BONDROIT), sensu WILSON, 1955.
Lasius rabaudi (BONDROIT), sensu COLLINGWOOD, 1963.
Lasius umbratus (NYLANDER), sensu BOURNE, 1976, partim.
Lasius rabaudi (BONDROIT), sensu KUTTER, 1977, partim.
Lasius rabaudi (BONDROIT), sensu ARNOLDI & DLUSSKY, 1978, partim.

Material studied

44 queens, among them the type queen of BONDROIT (R. I. Sc. N. B., I. G. 21.400, Aveyron, leg. Dr. RABAUD); 48 workers from 9 nests; 11 males from four nests. The material is from England, France, Switzerland, FRG, GDR, Italy, Czechoslovakia, and the Ukraine.

Description

— Queen: Pubescence on head more appressed than decumbent and less dense than in *umbratus*. The microsculpture on dorsum of head is very weak which gives, together with the less dense pubescence, a more shining surface appearance compared to *umbratus*. Nearly all body parts including genae with many erect hairs. Scale in frontal view rectangular, with straight, parallel sides and a weakly emarginated or sometimes straight dorsal crest. Dorsal surface of scape with decumbent pubescence and very few to many subdecumbent to erect hairs of which the longest may project 35 μm. Extensor profile of hind tibia with decumbent to subdecumbent pubescence and many (18–50) erect to decumbent hairs which may project up to 60 μm. Scape and hind tibiae very flat. Second funiculus segment much longer than wide. Body colour blackish brown and thus often darker than in *jensi* or *umbratus*.

HW 1626.2 ± 40.4 (1545–1715, n = 35), HL 1401.5 ± 32.4 (n = 35), HL/HW 0.862 ± 0.0143 (n = 35), SL/HL 0.935 ± 0.0167 (n = 35), SL/HW 0.806 ± 0.0167 (n = 35), SMAX/SMIN 1.858 ± 0.138 (n = 35), HTMAX/HTMIN 2.121 ± 0.132 (n = 32), I2FS 1.818 ± 0.126 (n = 32), GHL 106.1 ± 8.21 (n = 32), nHHT 33.4 ± 11.77 (n = 18), PDG 6.76 ± 1.078 (n = 18), PDF 11.08 ± 1.72 (n = 13), SMAX/SL 0.1235 ± 0.00665 (n = 35), SMAX 161.8 ± 8.30 (n = 35), SMIN 87.3 ± 5.90 (n = 35), HTMAX 281.7 ± 13.7 (n = 25). The type queen is near the mean of this standard and so is the one example from S Ukraine (Kharkov), except of its large size (HW = 1715), slightly shorter scape, and slightly less flattened appendages.

— Worker (Figs. 29, 41): Genae always with erect hairs. Whole head, alitrunk, and gaster with many erect hairs and decumbent, moderately dense pubescence. The longest hairs on mesonotum measure 90–110 μm. Petiole scale in frontal view typically with straight, nearly parallel sides and moderately deep emarginated dorsal crest, but scales notably tapering dorsad and having convex sides or such with entire dorsal crest are not infrequent (see fig. 29). Dorsal plane of scape with decumbent pubescence and, normally, with many subdecumbent to erect seta which project up to 35 μm from cuticular surface. However, I have a clear *meridionalis* series (determination confirmed by presence of queens) where the pilosity on dorsal plane of scape is nearly absent, but with the typical profuse pilosity on tibiae. Hind tibiae on extensor profile with 5–40 subdecumbent to erect hairs which may protrude up to 60 μm and with very decumbent pubescence. Scape and hind tibiae clearly flattened. The microsculpture on dorsum of head is very shallow and less dense than in *umbratus* which gives together with the less dense pubescence a more shining surface.

HL 1037.4 ± 107.8 (largest 1193, n = 41), HW 1010.6 ± 120.4 (n = 41), HL/HW 1.029 ± 0.0279 (n = 41), SL/HL 0.874 ± 0.0169 (n = 41), SL/HW 0.901 ± 0.0259 (n = 41), SMAX/SMIN 1.580 ± 0.1467 (n = 41), HTMAX/HW 0.1460 ± 0.0100 (n = 31), GHL 86.0 ± 8.68 (n = 39), nHHT 21.2 ± 9.61 (n = 29), PDG 12.26 ± 2.97 (n = 20), PDF 11.94 ± 2.16 (n = 29), SMAX 100.3 ± 13.15 (n = 41), SMIN 63.6 ± 7.57 (n = 41).

Allometry: $HW = 0.4054\ HL^{1.1261}$ (r = 0.9824, n = 37).

— Male (Fig. 38): Masticatory border of mandibles with 1–7 small denticles in addition to the larger apical and subapical dent. Sectional view of scape at mid-point elliptic. Dorsal surface of scape with decumbent pubescence and few to many subdecumbent to suberect

hairs which may project up to 33 μm from cuticular surface. The dorsal profile of scape, seen in a position where minimum scape diameter lies in the visual plane, is a nearly straight line except the weak curvature at base. The dorsal surface of head is more shining than in *umbratus* due to the finer and more dilute microsculpture. Head, alitrunk, and gaster with decumbent and rather dense pubescence. Extensor profile of hind tibia with decumbent pubescence and 3–18 subdecumbent hairs. Cross vein m-cu in 72 % of forewings present.

HW 1129.5 ± 61.7 (largest 1201, n = 11), SL 746.0 ± 53.9 (n = 11), SMAX 91.1 ± 7.37 (n = 11), SMIN 69.3 ± 6,87 (n = 11), SMAX/SMIN 1.319 ± 0.080 (n = 11), AW 1067.7 ± 111.7 (n = 11), GHL 97.7 ± 18.90 (n = 11), nHHT 8.54 ± 4.44 (n = 11), PDG 9.44 ± 2.04 (n = 11), m-cu 0.72 ± 0.40 (n = 15), ADM 5.45 ± 1.75 (n = 11), SL/HW 0.660 ± 0.0168 (n = 11), SCW/HW 0.322 ± 0.0374 (n = 10), SL/SMIN 10.80 ± 0.638 (n = 11).

Comments

For distinction from *balcanicus* workers and *jensi* workers and queens which sometimes may be similar see these species. The separation of *meridionalis* workers from those of *umbratus* is sometimes difficult. However, a combined consideration of the characters PDF, PDG, SMAX/SMIN, and SL/HL which all are significantly larger in *meridionalis* (all $p < 0.001$) and the examination of three workers per nest should normally make the determination satisfactorily safe. A reliable character for distinction of males from those of *umbratus* seems to be the more shining dorsal surface of head, but clean surfaces and examples to compare directly are needed. The separate species identity of *meridionalis* from *rabaudi* is no matter of question because the types of BONDROIT are clearly different in a number of characters where pubescence density on gaster tergites shows the most striking difference. Thus PISARSKI (1975) and COLLINGWOOD (1979) were right in separating the two.

Biology

It is clearly more xerothermophilic than *umbratus* and *mixtus* but probably less than *jensi*. 14 available habitat records I have from Central Europe were from sandy/gravelly soils, one from a limestone region, and one from a xerothermous granite region. *L. meridionalis* is a typical inhabitant of open parts of sandy heathland but may penetrate into sandy pine woodland along sunny waysides and frequently occurs in sandy xerothermous grasslands. I personally have only one record of *meridionalis* from Central European limestone grasslands where *jensi* is the absolutely dominating *Chthonolasius* species. Thus, the habitat overlap between these morphologically most similar species is very low (about 10 % according to the SCHOENER formula) and syntopic occurrence was noted in only one of the 38 sites with at least one of the two species. A worker series with a queen from a xerothermous limestone grassland near Kazimierz, distr. Puławy/Poland, leg. PISARSKI 7. vii 1962, determined by PISARSKI himself as *meridionalis*, is definitely *jensi*.

The nests of *meridionalis* have sometimes low earth mounds and carton lined chambers seem to be characteristic. The only known host species is *Lasius alienus* and I have no suggestions to other species. Flight period: 14. vii – 10. ix (n = 12), bulk 24. vii – 15. viii. Alates have been found in the nests as soon as late May or June.

Distribution

The northern border of its distribution is approximately at 60°N in Fennosscandia but at 53°N in the British Isles (COLLINGWOOD, 1963, 1979). The southern border of its range is unknown and can not be derived from literature because of confusion with *jensi* and *rabaudi*. I have only one record of *meridionalis* (Kharkov/S Ukraine) from the large areas of the Ukraine, S Russia, the Caucasus and N Kazakhstan but from the same regions 7 records of *jensi* which indicates that *meridionalis* is probably the less continental species.

Lasius jensi jensi SEIFERT, 1982 (Figs. 11, 21, 30, 39, 44, 55)

Lasius jensi SEIFERT, 1982; queen, worker, male; Central Germany.
Lasius meridionalis BONDROIT, sensu PISARSKI, 1975, partim.
Lasius rabaudi BONDROIT, sensu ARNOLDI & DLUSSKY, 1978, partim.

Material studied

50 queens, appr. 500 workers, and 13 males from altogether 34 different nests. The material is from Germany, Czechoslovakia, Poland, Austria, Bulgaria, and Armenia and includes the type specimens.

Description

— Queen (Figs. 11, 21, 55): Pubescence on head, alitrunk, and gaster rather dense and mostly decumbent. Nearly all these body parts including genae with many erect hairs. Dorsal surface of scape with decumbent pubescence and very few to many subdecumbent to erect hairs which are normally rather short but may sometimes project 35 μm. In the two queens from S Bulgaria and Armenia standing hairs on dorsal surface of scape are perfectly absent. Extensor profile of hind tibia with appresssed to decumbent pubescence and a varying number (6–27) of erect to suberect hairs of which the longest may project up to 45 μm. Scape and hind tibia extremely flat. Second funiculus segment clearly longer than wide. Petiole scale in frontal view with straight sides which are parallel or slightly converge towards the dorsal crest which is in only 3 out of 50 specimens examined weakly emarginated; in the remaining 47 examples the petiole is notably higher or, at least, equally high in median line compared to lateral parts of dorsal crest (Fig. 11). Very characteristic for this species is that many of the examples have a very shallow dent-like projection in the median part of dorsal crest which is never seen in other species.
HW 1488.8 ± 36.7 (largest 1545, n = 28), HL 1331.4 ± 31.8 (n = 28), HL/HW 0.895 ± 0.0155 (n = 28), SL/HW 0.850 ± 0.0127 (n = 28), SL/HL 0.951 ± 0.0118 (n = 28), SMAX/SMIN 2.099 ± 0.119 (n = 28), HTMAX/HTMIN 2.368 ± 0.133 (n = 25), I2FS 1.768 ± 0.0904 (n = 28), GHL 100.4 ± 7.03 (n = 28), nHHT 17.8 ± 4.22 (n = 29), PDG 6.32 ± 0.778 (n = 21), PDF 9.90 ± 0.879 (n = 21), SMAX 169.6 ± 5.67 (n = 28), SMIN 81.0 ± 5.15 (n = 28), SL 1266.2 ± 30.0 (n = 28), SL/SMAX 0.1340 ± 0.0042 (n = 28). The queen from Armenia which is not included in this statistics, that describes European material only, has a typical petiole shape and similar data, except its slightly shorter and less flattened scape.

— Worker (Fig. 30): Genae always with erect hairs. Whole head, alitrunk, and gaster with many erect hairs and decumbent moderately dense pubescence. Dorsal plane of scape with decumbent pubescence and many, sometimes few, subdecumbent to erect hairs which may project up to 50 μm from cuticular surface. Extensor profile of hind tibia with appressed or very decumbent pubescence and, normally, 15–28 erect to suberect hairs projecting up to 50 μm. Series from Bulgaria have longer body hairs (GHL) but fewer hairs on hind tibiae (nHHT) compared to Central European populations. Scale shape in frontal view normally diagnostic: high, with clearly converging sides that run into a bluntly pointed or rounded, non-emarginate apex. Sometimes however, the dorsal crest is very sligthly notched and in two out of 30 nests examined only a minority of the workers showed the typical *jensi* scale but in all others it was faintly notched. Scape and hind tibia on average flatter than in all other species including *meridionalis*, but this characters is sometimes weakly expressed. Pubescence less dense than in *umbratus*, but particularly PDG is more variable as usually seen in other species (sample means range from 8.0 to 18.0). Microsculpture on dorsum of head very faint and less dense than in *umbratus* which gives in combination with the less dense pubescence a more shining surface.
HL 974.0 ± 62.7 (n = 61, largest 1114), HW 922.1 ± 67.2 (n = 61), SL/HL 0.879 ± 0.0185 (n = 59), SL/HW 0.928 ± 0.0192 (n = 59), HL/HW 1.057 ± 0.0175 (n = 59), SMAX/SMIN 1.771 ± 0.170 (n = 57), GHL 84.7 ± 8.95 (n = 59), nHHT 21.70 ± 5.93 (n = 57), PDG 11.84 ± 3.79 (n = 57, positively skewed, smallest 6.0), PDF 10.08 ± 1.45 (n = 57), SMAX 97.8 ± 9.40 (n = 57), HTMAX/HTL 0.1586 ± 0.0053 (n = 27).
Allometry: $HW = 0.4309\ HL^{1.11445}$ (r = 0.9780, n = 57).

— Male (Figs. 39, 44): Restricted to anterior half of masticatory border of mandibles, there exist 0–3 small denticles in addition to the larger apical and subapical dent. Scape clearly flattened; viewing at its dorsal plane, the anterior margin is markedly convex, while posterior margin is straight or concave. Head, alitrunk, and gaster more shining than in

other species except *rabaudi;* surfaces often mirroring and covered by a rather dilute appressed to decumbent pubescence. Dorsal surface of scape with decumbent pubescence and few to many subdecumbent to suberect hairs which may project up to 30 μm. Extensor profile of hind tibia with 2–8 subdecumbent or suberect hairs and decumbent pubescence. Longest hairs on posterior border of 8th sternite normally shorter than 100 μm. Outer margin of mandibles without notable corner at base (Fig. 44). Cross vein m-cu of forewing frequently absent.

HW 987.5 ± 45.8 (n = 13, largest 1038), SL 642.3 ± 44.0 (n = 13), SMAX 89.1 ± 5.33 (n = 13), SMIN 55.9 ± 2.36 (n = 13), SMAX/SMIN 1.595 ± 0.0788 (n = 13), AW 900.5 ± 67.2 (n = 13), I2FS 2.089 ± 0.135 (n = 13), GHL 85.0 ± 11.35 (n = 13), nHHT 3.12 ± 1.96 (n = 13), PDG 12.30 ± 1.66 (n = 13), m-cu 0.269 = 0.439 (n = 13), ADM 1.15 ± 0.80 (n = 13) SL/HW 0.650 ± 0.0301 (n = 13), SCW/HW 0.280 ± 0.0119 (n = 13), SL/SMIN 11.47 ± 0.841 (n =13).

Comments

In the queen, *jensi* can be confused with *meridionalis* only, particularly when the diagnostic scale shape is not expressed, but a combination of characters enables a save determination. A multiple discriminant vector D (see SEIFERT, 1984) calculated with the characters SMAX/SMIN, SL/HW, SL/HL, and SMAX/SL gives a perfect separation of the two species with D = −0.5538 ± 0.2509 (n = 34, largest −0.0238) in *meridionalis* and D = +0.5633 ± 0.1599 (n = 28, smallest +0.1342) in *jensi* (Fig. 55). For distinction from *rabaudi* see this species. The *jensi* worker is normally well characterized by its diagnostic scale if series are examined, but among the 32 nest samples investigated were two problematic series with less flattened scale, higher pubescence density, and a high percentage of workers with faintly notched dorsal crest of petiole scale, thus approaching the *umbratus* condition. One of these nests contained characteristic *jensi* males and in both nests the habitat was typical for *jensi*: a very xerothermous, south-sloped limestone grassland. Furthermore these two series contained a high proportion of workers with laterally asymmetric dorsal margin of petiolar scale, a character that is to a certain degree typical for *jensi*. The *jensi* male is one of the few *Chthonolasius* males that are comparably easy to determine by external morphology or genitalia (see WERNER, 1984). Diagnostic characters are the low number of additional denticles on mandibles which are always restricted to the anterior halv of masticatory border and the very flat scape with bowed frontal edge. For distinction from *rabaudi* males see this species.

Biology

L. jensi is a typical inhabitant of xerothermous limestone grasslands from Central Europe south to Bulgaria and it is the absolutely dominating *Chthonolasius* species in such habitats in Central Germany. The habitat records of my own experience divide into 19 xerothermous grasslands on limestone and 3 xerothermous grasslands on sandy soil. The mean density of *jensi* on 5 positive test plots on limestone was 5.1 nests/100 m² (with 43.5 nests/100 m² of *L. alienus*) but only 0.71 nests/100 m² (with 51.3 nests/100 m² of *L. alienus*) on three positive test plots on sandy grasslands at the northern border of the distributional range. It is surely one of the most xerothermophilic species of the European *Chthonolasius*. Although large areas of the geographical range of *jensi* and *meridionalis* overlap, I have so far only one record for syntopic occurrence. Three direct observations proved that *Lasius alienus* is the host species and from the species composition in other *jensi* sites may be concluded that it is the major (or exclusive?) host. In Dobrostan (Rhodopy mountains/Bulgaria) I found a dealate *jensi* queen in the centre of a *L. alienus* colony on 10. ix 1982, indicating that colony foundation is done immediately after nuptial flight, a fact that is confirmed additionally by results of pitfall trapping (own unpublished results). Among myrmecophilous arthropodes found in mature *jensi* colonies are the blind isopode *Platyarthrus hoffmannseggi* BRANDT and the staphylinid beetle *Homoeusa acuminata* (MÄRK.). Carton lined chambers were observed and sometimes earth mounds are con-

structed of which the largest had a height of 60 cm and a basal diameter of 70 cm. Flight period 13. vii – 5. ix (n = 19), bulk 18. vii – 7. viii (n = 14).

Distribution

The species has a much wider range than earlier believed and is not rare. I have records from at least 22 localities in S Central Germany and from 7 localities in Bohemia, Moravia, and E Slovakia; nearly all these sites are regions rich in shell limestone. The northern border of its distribution in Central Europe runs along the 52nd degree northern latitude (51° 46' in Germany and 51° 20' in Poland). In the karst regions of S Bulgaria it goes to elevations of 1400 m at least and the southernmost site so far known is Delizhan in Armenia (40'N, 44° 54' E).

Lasius jensi longiceps n. subsp. (Figs. 12, 22, 31)

Type material

Altogether 7 queens and 27 workers. – Holotype: a queen; Naurzum, Kustanaj district, N Kazakhstan, leg. A. KAMENSKIJ 9. vii 1940; deposited in coll. ZMMU. – Paratypes: one queen with same data and locality as holotype; 6 workers from Naurzum Kokterek, Kokchetav district, N Kazakhstan, leg. A. KAMENSKIJ 4. vii 1939, coll. ZMMU; 4 queens and 6 workers labelled as "peski Drobysheva" (= sands of Drobyshev), Svyatogorsk, Donetsk, leg. ARNOLDI 13. vi 1937 (No. 7361), coll. SMNG; 4 workers from Streletskaya Step, Kursk district, leg. K. ARNOLDI 26. vi 1964, coll. ZMMU; 3 workers from "N Kazakhstan", leg. ARNOLDI 5. vi 1949, coll. ZMMU; one queen and five workers from Abramovka, Kamensk/Rostov, 20. vi 1949, leg. ARNOLDI, coll. ZMMU; 5 workers from Yekaterinoslavka, S Ural, leg. ARNOLDI 12. viii 1935 (No. 5941), coll. ZMMU.

Description

– Queen: Pubescence on head, alitrunk, and gaster rather dense and decumbent to appressed. Nearly all surfaces of these body parts including genae with numerous erect hairs of which the longest on scutellum measure 150–165 μm. Dorsal surface of scape with decumbent pubescence and few to many subdecumbent to erect hairs which may project up to 40 μm from cuticular surface. Extensor profile of hind tibia with appressed to decumbent pubescence and a varying number (20–48) of erect or suberect hairs of which the longest may project 65 μm. Scape clearly flattened, hind tibia extremely flat. Second funiculus segment much longer than wide. Petiolar scale in frontal view with straight or slightly concave sides, converging towards the dorsal crest that is often broadly rounded and has higher median an submedian portions, but is sometimes very little notched (Fig. 12).
HW 1572.0 ± 23.2 (n = 7, largest 1596), HL 1434.4 ± 16.9 (n = 7), HL/HW 0.913 ± 0.0112 (n = 7), SL/HW 0.830 ± 0.0065 (n = 7), SL/HL 0.909 ± 0.0131 (n = 7), SMAX/SMIN 1.974 ± 0.142 (n = 7), HTMAX/HTMIN 2.671 ± 0.266 (smallest 2.39, n = 7), I2FS 1.843 ± 0.115 (n = 7), GHL 140.1 ± 9.04 (n = 7), nHHT 31.0 ± 11.14 (n = 7), PDG 6.66 ± 0.568 (n = 7), PDF 8.40 ± 1.37 (n = 7), SMAX 156.4 ± 7.14 (n = 7), SMIN 79.3 ± 2.93 (n = 7), HTMAX 285.3 ± 8.14 (n = 7), SL 1304.0 ± 19.6 (n = 7).

– Worker (Fig. 31): Whole head, alitrunk, and gaster with many erect hairs and decumbent or appressed, moderately dense pubescence. The longest hairs on promesonotum measure 135–145 μm. Dorsal plane of scape with very decumbent pubescence and many, sometimes few, subdecumbent to erect hairs of which the longest project 50 μm from cuticular surface. Extensor profile of hind tibia with appressed or decumbent pubescence and, normally, 17–40 erect to suberect hairs, sometimes projecting 65 μm. Petiolar scale high, with convex sides, clearly converging dorsad and running into a bluntly pointed or rounded, non-emarginate apex. Sometimes the dorsal crest is very slightly notched. Scape and hind tibia very flat (significantly flatter than in *meridionalis*). Microsculpture on dorsum of head shallow and less dense than in *umbratus*. Head, trunk, and gaster moderately shining like in *jensi*. Head length index even larger than in *mixtus* or *jensi*.
HL 1034.8 ± 26.9 (n = 19, largest 1096), HW 959.7 ± 46.3 (n = 19), HL/HW 1.080 ± 0.0306 (n = 19), SL/HW 0.947 ± 0.0248 (n = 19), SL/HL 0.877 ± 0.0112 (n = 19), SMAX/SMIN

1.775 ± 0.115 (n = 20), HTMAX/HW 0.1533 ± 0.0060 (n = 20), GHL 106.0 ± 11.95 (n = 20), nHHT 28.6 ± 7.72 (n = 20), PDG 11.19 ± 1.65 (n = 19), PDF 10.74 ± 1.96 (n = 20), SMAX 102.7 ± 6.45 (n = 20).
Allometry: $HW = 0.0149\ HL^{1.5949}$ (r = 0.8623, n = 19).

Comments and Differential Diagnosis
ARNOLDI's label "Lasius umbratus arenicola K. ARNOLDI" of the series from Kamensk/Rostov is a provisoric, taxonomically invalid label since there neither exists a publication with a valid description of "arenicola" nor exist "arenicola" types in the ZMMU collection. The subspecies *longiceps* is significantly different from the nominal subsp. *jensi* in a number of characters, but the overall resemblance is to large in my eyes to favour the hypothesis they might be separate parapatric species. In fact, I have no evidence for sympatric or parapatric occurrence. In the north, the distance between the easternmost *jensi* record (in Poland) and the westernmost *longiceps* site (Kursk) is 1000 km and the situation in between is perfectly unknown and, in the south, the *longiceps* and *jensi* populations are well isolated by strong geographic barriers (Black Sea, main crest of Caucasus, deserts of S Kazakhstan and Middle Asia). The queen of *longiceps* differs from *jensi* in having larger HL, HW, HL/HW, GHL, nHHT and smaller SL/HL, SL/HW, SMAX/SL; all these differences are significant for $p < 0.001$. Furthermore the petiolar scale of *longiceps* queens gives a somewhat less rectangular and more rounded impression in frontal view (Fig. 12). Compared to *meridionalis*, the *longiceps* queen has much larger HL/HW ($p < 0.001$), SL/HW ($p < 0.001$), HTMAX/HTMIN (0.002), GHL (0.001), and smaller PDF (0.001) and HW (0.001). The *longiceps* worker is very similar to *jensi* but has larger HL ($p < 0.001$), HL/HW (0.01), SL/HW (0.001), GHL (0.001), and nHHT (0.001). The petiolar scale is as in *jensi* and thus a normally good character for distinction from *meridionalis* and the larger HL/HW ($p < 0.001$), SL/HW (0.001), GHL (0.001), and nHHT (0.001) provide additional useful discriminative characters.

Terra typica
The new subspecies is known from the steppe zones of the Ukraine, S Russia, and Kazakhstan between 36°E/72° 30'E and 47°N/53°N.

Biology
There is nothing known, except that two sites were situated on sandy soils and that alates are apparently found in the nests a little earlier (13. vi, 20. vi, 9. vii) than in *jensi*.

Lasius rabaudi (BONDROIT, 1917) (Figs. 13, 23, 32, 40, 45)
Formicina rabaudi BONDROIT, 1917; queen; Amélie-les-Bains, E Pyrenées.

Material studied
15 queens including the type queen; 14 nest series of workers with 40 specimens; 7 nest series of males with 19 specimens. The material is from the E Pyrenées, SE Moravia, Slovakia, and Bulgaria.

Description

— Queen (Figs. 13, 23): Pubescence on head, alitrunk, and particularly on gaster very sparse and decumbent, on first gaster tergite more subdecumbent. Cuticular surface of head, alitrunk, and gaster brilliantly shining; all these body parts with numerous and very long erect hairs which are often branched apicad or feather-split. Length of longest hair on scutellum 190–285 μm. Dorsal surface of scape with appressed to decumbent pubescence and few decumbent to erect hairs, the longest projecting up to 50 μm. Extensor profile of hind tibia with appressed to decumbent pubescence and 3–20 subdecumbent to erect hairs which project up to 73 μm from cuticular surface of profile line. Scape flattened, hind tibia very flat. Second funiculus segment much longer than wide. Petiolar scale in frontal view with straight, parallel or dorsad slightly converging sides; dorsal crest more or less emarginated but sometimes nearly straight.

HW 1607.6 ± 54.0 (n = 15, largest 1720), HL 1407.8 ± 44.2 (n = 15), HL/HW 0.876 ± 0.0171 (n = 15), SL/HL 0.956 ± 0.0215 (n = 14), SL/HW 0.839 ± 0.0184 (n = 14), SMAX/SMIN 1.735 ± 0.182 (n = 14, smallest 1.50), HTMAX/HTMIN 2.293 ± 0.174 (n = 15, smallest 2.08), I2FS 1.785 ± 0.147 (n = 14, smallest 1.63), GHL 209.1 ± 28.7 (n = 15, shortest 154), nHHT 14.67 ± 6.41 (n = 15), PDG 31.06 ± 12.58 (n = 15, smallest 9.9), PDF 15.94 ± 3.53 (n = 14, smallest 11.8), SL/SMAX 0.1055 ± 0.0077 (n = 14), SMAX 142.0 ± 12.69 (n = 14), SMIN 82.2 ± 3.09 (n = 14), HTMAX 254.6 ± 10.26 (n = 14), SL 1346.2 ± 62.1 (n = 14).

— Worker (Fig. 32): Whole head, alitrunk, and gaster with many, very long, erect hairs; the longest on promesonotum measure 135–170 μm. Pubescence, particularly on gaster tergites, very sparse; on head and alitrunk more appressed and on gaster tergites decumbent. Cuticular surface of head, alitrunk and especially dorsum of gaster brilliantly shining due to its widely spaced pubescence and micropunctures which are very shallow. Scape flattened, its dorsal surface with decumbent pubescence and few to many subdecumbent to erect hairs, projecting up to 55 μm. Hind tibia flattened, but less than in *jensi* or *meridionalis*; its extensor profile line with more appressed pubescence and few to many subdecumbent to erect hairs of which the longest may project 65 μm. Petiolar scale rather high, in frontal view often with straight, parallel sides and emarginated or entire dorsal crest, but scales approaching the *jensi* standard, having convex sides that converge dorsad to a narrow apex, are not so rare.
HL 1035.3 ± 61.9 (n = 34, largest 1124), HW 982.9 ± 62.8 (n = 34), SL/HL 0.898 ± 0.0193 (n = 34), SL/HW 0.946 ± 0.0183 (n = 34), HL/HW 1.054 ± 0.0178 (n = 34), SMAX/SMIN 1.599 ± 0.115 (n = 34), GHL 120.1 ± 6.63 (n = 34), nHHT 14.5 ± 7.27 (n = 24), PDG 41.00 ± 14.09 (n = 23, smallest 15.9, lowest sample mean 24.1), PDF 13.04 ± 2.45 (n = 23, smallest 9.3), HTMAX/HTL 0.1474 ± 0.0053 (n = 18), SMAX 97.2 ± 6.92 (n = 34), SMIN 60.97 ± 4.60 (n = 34).
Allometry: $HW = 0.6986\ HL^{1.04415}$ (r = 0.9685, n = 34).

— Males (Figs. 40, 45): Masticatory border of mandibles with 1–4 small denticles in addition to the larger apical and subapical dents. Scape flattened; rather similar to scape of *jensi* but with lower SMAX and always concave posterior edge viewing at dorsal plane. Head, alitrunk, and gaster brilliantly shining and, particularly on gaster tergites, with variably dense but often extremely sparse pubescence that is mostly decumbent to subdecumbent. Dorsal surface of scape with decumbent pubescence which is more dilute compared to other species, and with few subdecumbent to suberect hairs which may project 30 μm. Extensor profile of hind tibia with decumbent pubescence and 1–5 subdecumbent to erect hairs. Longest hair on posterior border of 8th sternite longer than 100 μm (normally 125–145 μm). Outer margin of mandibles frequently with notable corner before its articulation with head capsule (Fig. 45).
HW 1024.7 ± 54.3 (n = 19, largest 1110), AW 928.5 ± 73.0 (n = 19), SMAX 82.3 ± 3.82 (n = 19), SMIN 53.9 ± 2.88 (n = 19), SL 662.1 ± 60.0 (n = 19), SMAX/SMIN 1.531 ± 0.0893 (n = 19), SL/HW 0.645 ± 0.032 (n = 19), GHL 109.2 ± 20.8 (n = 19), nHHT 2.03 ± 1.17 (n = 19), PDG 42.44 ± 29.98 (n = 19, minimum 11.2), m-cu 0.750 ± 0.400 (n = 19), SCW/HW 0.299 ± 0.0145 (n = 19), SL/SMIN 12.29 ± 1.016 (n = 19), HW/AW 1.106 ± 0.043 (n = 19).

Comments
The queen is not to be confused: The combination of very high PDG with very long body hairs and long scape gives a perfect separation from all other species (see also Table 1). The type queen from the Pyrenées is in its over-all character combination similar to the Czechoslovakian and Bulgarian material but has above-average scape length ratios, subaverage hair length, and is larger (HW 1720). The *rabaudi* worker has the largest SL/HL, GHL, and PDG of all European *Chthonolasius* and is thus very distinct. However, the separation from *jensi* workers with subaverage pubescence density and above-average scape and hair lengths could be sometimes difficult, particularly since the petiolar scale of *rabaudi* not so rarely approaches to the *jensi* standard. In such cases, the combined

consideration of the characters GHL, PDG, HTMAX/HTL, SMAX/SMIN, and SL/HL on small series is necessary to find a sufficiently save determination. The male is most easily confused with that of *jensi* due to its similarly flat scape and shining surfaces. Differences from *jensi* are the often much larger PDG, the frequent presence of a notable corner at the outer margin of mandibles before its articulation with head capsule, and the longer hairs at posterior margin of 8th sternite (in *rabaudi* longer than 105 μm, in *jensi* normally shorter).

Distribution

Widely distributed and in places abundant in Slovakia and SE Moravia with 20 known localities at least and northern border of range at 49° 20′ N. Known Bulgarian localities: Melnik, Trevna, Obzor, Nessebar.

Biology

According to P. WERNER (pers. comm.), the nests are found in Moravia and Slovakia in xerothermous grasslands or steppes, preferentially but not always on limestone ground. The nests are constructed as in *distinguendus*: frequently with mounds of differing size and apparently lacking the carton lined inner structures as seen in *meridionalis* or *jensi*. Alates were found in the nests from 13. vii – 22. viii (bulk 18. vii – 22. viii). Nuptial flight seems to happen in the night (one observation).

Lasius bicornis (FÖRSTER, 1850) (Figs. 3, 4, 14)

Formica bicornis FÖRSTER, 1850; queen; Aachen/Germany.
Formica incisa SCHENCK, 1852.

Material seen

15 queens, 30 workers, and 5 males from Germany, Czechoslovakia, Bulgaria, Caucasus, S Russia, the Ukraine, and Armenia. Because of the very clear determination of this species which is consistent throughout its range, I resigned to make a more extensive morphometric study and obtained all such data from the Gerichshain/Leipzig series only.

Description

— Queen (Fig. 14): Pubescence on head, alitrunk, and gaster moderately dense and tightly appressed, giving a very smooth surface appearance. Standing hairs on head very sparse, restricted to occipital margin, clypeus, and eyes; genae without hairs. Whole dorsum of alitrunk with long, erect hairs; those on scutellum 250–270 μm long. Scape short and clearly flattened; its dorsal surface and extensor profile of tibiae perfectly smooth, with appressed pubescence only and without standing hairs. Hind tibia rather flat. Long, standing hairs on dorsum of gaster restricted to posterior borders of each tergite and to face of first tergite; the surfaces in between without or only single, isolated hairs. Petiolar scale in frontal view narrow and very high, notably tapering to a very narrow dorsal crest that is deeply cleft; depth of emargination at least as large as its width. The height of scale measured from the level of petiolar stigmata to dorsal crest is always larger than the maximum scale width above the sigmata (in all other species smaller). On the average clearly smaller than all other species delt with here.
HW 1305.8 $\pm$ 17.6 (n = 5, largest 1329), HL 1174.2 $\pm$ 12.4 (n = 5), HL/HW 0.899 $\pm$ 0.0121 (n = 5), SL/HW 0.724 $\pm$ 0.0106 (n = 5), SL/HL 0.805 $\pm$ 0.0060 (n = 5), I2FS 1.486 $\pm$ 0.0720 (n = 5), GHL 162.3 $\pm$ 8.16 (n = 6), SMAX/SMIN 1.940 $\pm$ 0.0682 (n = 5), HTMAX/HTMIN 1.740 $\pm$ 0.0722 (n = 5), nHHT 0.1 $\pm$ 0.22 (n = 5), PDG 7.70 $\pm$ 0.99 (n =5), PDF 8.36 $\pm$ 0.75 (n = 5), SMAX 131.4 $\pm$ 1.341 (n =5), SMIN 67.8 $\pm$ 2.59 (n = 5), HTMAX 186.2 $\pm$ 2.59 (n = 5), AW 1101.6 $\pm$ 13.0 (n = 5), SMAX/SL 0.1389 $\pm$ 0.0030 (n = 5).

— Worker (Fig. 3): Pubescence on head, alitrunk, and gaster moderately dense and appressed, giving a very smooth surface appearance. Head and alitrunk shining. Standing hairs on head very sparse, restricted to occiput and clypeus. Genae, dorsal surface of scape, and tibiae without standing hairs. Alitrunk with numerous erect hairs of which the longest

measure 150–180 μm. Scape short and clearly flattened, its dorsal surface and the extensor profile of hind tibia perfectly smooth, with appressed pubescence only. Standing hairs on dorsum of gaster long and mostly restricted to face of first tergite and posterior borders of each tergite; the surfaces in between with only few or without standing hairs. Petiole scale very high (reaching approximately height of propodeum), tapering to a very narrow dorsal crest that is deeply cleft in frontal view. Data of seven workers from Gerichshain/distr. Leipzig:
HL 1126 ± 30.6 (largest 1157) HW 1080.0 ± 36.5, HL/HW 1.043 ± 0.0095, SL/HL 0.810 ± 0.0119, SL/HW 0.845 ± 0.0125, SMAX/SMIN 1.746 ± 0.040, GHL 119.3 ± 7.95, nHHT 0 ± 0, PDG 7.73 ± 1.32, PDF 11.6 ± 3.74, SMAX 107.0 ± 4.62, SMIN 61.3 ± 3.50.

— Male (Fig. 4): Petiolar scale very high, tapering to a narrow, sharply bicornute dorsal crest; the depth of cleft is at least 20 % of SCW. Head, alitrunk, and gaster with modera tely dense, decumbent pubescence. Scape short and rather flat, its dorsal surface with decumbent to subdecumbent pubescence. Extensor profile of hind tibia smooth, with appressed pubescence and normally without standing hairs; occasionally single short, subdecumbent hairs may be present. Masticatory border of mandibles with 3–6 small denticles in addition to the larger apical and subapical dent. Alitrunk with many, very long, standing hairs; the longest on scutellum measure 225–245 μm. Standing hairs on dorsum of gaster very sparse.
HW 1035.5 ± 27.3, SMAX 88.2 ± 3.40, SMAX/SMIN 1.445 ± 0.0443, SL/HW 0.623 ± 0.0033, GHL 111.0 ± 10.61, nHHT 0.25 ± 0.500, PDG 9.58 ± 1.31, m-cu 0.75 ± 0.500, ADM 4.62 ± 1.25, SCW/HW 0.291 ± 0.0107, SL/SMIN 10.53 ± 0.390, HW/AW 1.065 ± 0.0230, all data obtained from 3 males from Gerichshain and one from Bulgaria.

Comments

The female castes are well characterized by their diagnostic pilosity distribution alone which is not found in other species delt with here. Additionally, the morphometric data show a character combination unusual in European *Chthonolasius*, the petiole scale is characteristic, and the queen is clearly smaller. The diagnostic characters are consistent in the female castes throughout the species range. Literature records are thus more reliable than in the other species, but misidentifications by unskilled determinators are possible, e. g. the alleged *Lasius bicornis* of JORDAN (1968) is in fact *Lasius flavus*. The male seems to be safely distinguishable from males of all other European *Chthonolasius* by its characteristic petiolar scale which is deeply cleft and tapering to a sharp dorsal crest. The depth of cleft is at least 20 % of SCW, while the emargination, if not perfectly absent, is always less deep than 15 % SCW in all other species.

Distribution

Although absent from the British Isles, *L. bicornis* is widely distributed all over continental Europe from 38°N (Peloponnes) to 57°N (Småland, Lettland), but apparently it is nowhere abundant and seldom found. Hitherto unknown sites I recorded while revising several collections are Gerichshain/distr. Leipzig (leg. LIPPOLD 1980), Leipzig City (leg. LIPPOLD 1982), Hanau (coll. DITE), Svyatogorsk/Donetsk (coll. ZMMU) which gives together with credible literature records a total of approximately 29 known sites for Europe. Additional sites outside Europe found while examining the ZMMU collection are Krasnaya Polyana/N Caucasus, Shuntuk Majkop/N Caucasus, Lake Riza/W Caucasus, Goryachij Klyuch/W Caucasus, Tiflis/Georgia, and Delizhan/Armenia.

Biology

All papers so far published report nesting in rotten logs of dead and living trees. The nests at Gerichshain and in Leipzig City were found in hollow trees and alates were observed in the same nest from 5. vii to 6. ix, with nuptial flight beginning in early July but apparently followed by another flights spread over this period (LIPPOLD, personal comm.).

Lasius affinis (SCHENCK, 1852) (Figs. 8, 18, 27, 36)

Formica affinis SCHENCK, 1852; queen, worker, male; Nassau (Germany).
Lasius umbratus (NYLANDER), sensu WILSON, 1955, partim.

Material studied

8 queens: four from Chevremont, Liege/Belgium, leg. BONDROIT 1920; one from Mechelen/Netherlands, leg. VAN BOVEN 1954; three from Prilep/Bulgaria, leg. F. KRAMPL 1981. 30 workers from 10 nests. 20 males from 9 nests. The material is from Spain, Italy, the Netherlands, Belgium, GDR, Yugoslavia, Bulgaria, the Ukraine, Georgia and Azerbajdzhan.

Description:

— Queen (Figs. 8, 18): Pubescence on head, alitrunk, and gaster appressed and dense, producing a very smooth surface appearance. Gena with 1–3 erect hairs only (which is less than in most of the other species). Numerous long, erect hairs on dorsum of head, alitrunk, and gaster; longest hairs on mesonotum 145–165 μm long. Dorsal surface of scape and hind tibia extensor profile perfectly smooth, with appressed pubescence only and without standing hairs; occasionally few subdecumbent hairs may be present projecting up to 15 μm from cuticular surface. Dorsal crest of petiole scale in frontal view deeply emarginated; width of scale small and reducing considerably from base to top.
HW 1530.4 ± 41.2 (largest 1612, n = 8), HL 1354.8 ± 26.1 (n = 8), HL/HW 0.886 ± 0.0100 (n = 8), SL/HW 0.770 ± 0.0140 (n = 8), SL/HL 0.870 ± 0.0140 (n = 8), SMAX/SMIN 1.555 ± 0.159 (n = 8), HTMAX/HTMIN 1.668 ± 0.0356 (n = 8), GHL 155.0 ± 8.57 (n = 8), I2FS 1.465 ± 0.0460 (n = 8), nHHT 0.31 ± 0.70 (n = 8), PDG 5.62 ± 1.17 (n = 8), SMAX 137.9 ± 5.94 (n = 8), SMIN 89.1 ± 7.32 (n = 8), HTMAX 221.6 ± 9.24 (n = 8), SL 1178.6 ± 26.6 (n = 8).

— Worker (Fig. 27): Head, alitrunk, and gaster with many long, erect hairs. Genae without or very few standing hairs (0.59 ± 1.35 for one gena, n = 60). Pubescence on whole body very dense and appressed (or very decumbent), producing a very smooth surface. Dorsal plane of scape with appressed to decumbent pubescence and normally without standing hairs; occasionally 1–3 decumbent to subdecumbent hairs which project up to 20 μm may be present. Extensor profile of hind tibia very smooth, with appressed or decumbent pubescence and normally without standing hairs; occasionally one or two may be present. Scape rather flat. Petiole scale in frontal view considerably tapering towards a narrow dorsal crest which is more or less deeply indented and sometimes bicornute.
HL 1208.0 ± 51.2 (n = 30, largest 1270), HW 1167.7 ± 59.3 (n = 30), HL/HW 1.035 ± 0.0172 (n = 30), SL/HL 0.846 ± 0.0146 (n = 30), SL/HW 0.876 ± 0.0175 (n = 30), SMAX/SMIN 1.460 ± 0.0884 (n = 30), GHL 116.6 ± 7.17 (n = 30), nHHT 0.13 ± 0.29 (n = 30), PDG 6.19 ± 1.07 (n = 17), PDF 7.75 ± 1.40 (n = 17), SMAX 107.3 ± 5.60 (n = 30).
Allometry: $HW = 0.36597\ HL^{1.1368}$ (r = 0.9524, n = 30).

— Male (Fig. 36): Masticatory border of mandibles with 3–6 denticles in addition to the larger apical and subapical dent. Sectional view of scape at midpoint elliptic. Dorsal surface of scape with decumbent to subdecumbent pubescence and frequently with few subdecumbent hairs which protrude 15–20 μm from cuticular surface. Scale shape in frontal view extremely variable: dorsal crest straight, rounded or emarginated. Cross vein m-cu in 72 % of wings present. Alitrunk notably lighter coloured (redish brown) than head ((blackish brown). Pubescence on head more appressed than in *umbratus* or *distinguendus*, thus giving a more smooth surface appearance. Hind tibiae often with few decumbent to subdecumbent hairs.
HW 1084.1 ± 32.9 (n = 15, largest 1147), SL 754.2 ± 24.3 (n = 15), SMAX 90.6 ± 4.03 (n = 15), SMIN 72.9 ± 4.96 (n = 15), SMAX/SMIN 1.251 ± 0.091 (n = 15), AW 1016.1 ± 62.1 (n = 15), I2FS 2.026 ± 0.260 (n = 15), GHL 94.9 ± 7.97 (n = 15), SCW 342.9 ± 24.0 n = 15), nHHT 2.86 ± 2.92 (n = 15), PDG 11.55 ± 3.49 (n = 9), m-cu 0.72 ± 0.38 (n = 20), ADM 5.33 ± 0.65 (n = 19), SL/HW 0.696 ± 0.0162 (n = 15), SCW/HW 0.316 ± 0.0255 (n = 15), SL/SMIN 10.39 ± 0.707 (n = 15).

Comments

The female castes are not to be confused with any other species delt with here, but there is no reliable "somatic" character known which could serve for save distinction of males from those of *umbratus*, *balcanicus*, and *distinguendus* and WERNER (1984) failed to detect differences in genitalia too. However, comparing examples of the four species directly, it should be possible to note the more smooth surface appearance of the *affinis* head which is due to a more appressed pubescence.

Biology

Rotten logs or stumps are reported as typical nest sites by many authors, but also ground nests in grass and heather. The biology is nearly unknown. It is surely a thermophilic species and will often inhabit sunny wood margins. Alates occur on average much earlier (data available: 4. v, 13. v, 2. vi, 7. vi, 7. vii, 8. vii, 17. vii, 21. vii, 18. viii) than in other species, even in the northern parts of its geographic range, which indicates that elder sexual larvae, pupae or even imagines hibernate.

Distribution

The northern border of its range in Central Europe runs approximately along the 53rd degree northern latitude and it goes south to at least the 40th degree (Italy). The southernmost site of which I have seen material is Alazapin in the Talysh mountains in Azerbajdzhan (appr. 38° 46'N, 48° 40'E), leg. ARNOLDI 1929.

Key to Workers

It is sometimes impossible to guarantee a save determination using a brief, dichotomous decision schedule. Often, a character combination is to be considered and small nest series are necessary. For checking determinations see Table 2, descriptions, and figures.

1 Standing hairs on dorsum of gaster mostly restricted to face of first tergite and posterior borders of each tergite; the surfaces in between with only few or without standing hairs. **L. bicornis**

— Whole surface of first gaster tergite with many standing hairs. 2

2 Nest means of 5 workers with following character combination: SL/HL < 0.850, nHHT < 10 (the standing hairs are short and often difficult to separate from the profuse pubescence), GHL < 85, PDG < 6.8, petiole scale relatively low. 3

— Character combination in at least one character different. 4

3 Nest means of GHL < 57. **L. mixtus**

— Nest means of GHL > 57. **L. sabularum**

4 Dorsal surface of scape and hind tibia extensor profile without standing hairs (rarely 1–2 small standing hairs may be present) and with appressed pubescence, giving a perfectly smooth surface; nHHT < 2. Petiole scale in frontal view with narrow dorsal crest which is more or less deeply emarginate and sometimes bicornute. SL/HL 0.831–0.861. **L. affinis**

— Dorsal surface of scape and/or hind tibia extensor profile with few to many standing hairs, nHHT > 2. Petiole scale different. SL/HL frequently larger. 5

5 Pubescence on gaster tergites extremely sparse, nest means of PDG > 21.0, surface of gaster tergites mirroring, GHL 107–133, SL/HL 0.880–0.917. **L. rabaudi**

— Pubescence on gaster tergites not very sparse, nest means of PDG < 21.0 (note that pubescence hairs may be torn off!). 6

6 Petiole scale in frontal view considerably tapering to a bluntly pointed or rounded, non-emarginate dorsal crest (sometimes in a small portion of workers slightly notched); scape clearly flattened, SMAX/SMIN 1.50–2.04. 7

— Dorsal crest of petiole scale in frontal view emarginated (sometimes in a small portion of workers rounded). Scape frequently less flattened, SMAX/SMIN 1.25–1.78. 8

7 Nest means of GHL frequently < 95, HL/HW often < 1.069. Central Europe and Balkans. **L. jensi jensi**

— Nest means of GHL frequently > 95, HL/HW often > 1.069. Steppe zone of E Europe eastwards from 35°E. **L. jensi longiceps**

8 Extensor profile of hind tibia with many standing hairs, nest means of nHHT > 11. 9

— Extensor profile of hind tibia with few standing hairs, nest means of nHHT < 11. 10

9 Scape notably flattened, nest means of SMAX/SMIN 1.46–1.78. Pubescence on head and gaster tergites less dense, nest means of PDG > 9.1. Micropunctures on dorsal surface of head less wide (mean diameter 5–6 μm) and less dense (mean distance of midpoints 14 μm), head surface thus more shining. **L. meridionalis**

— Scape less flattened, nest means of SMAX/SMIN 1.30–1.55. Pubescence on head and gaster tergites more dense, nest means of PDG < 9.1. Micropunctures on dorsum of head wider (mean diameter 7 μm) and more dense (mean distance of midpoints 12 μm), head surface thus more dull. **L. umbratus**

10 Scape longer (SL/HL 0.883), hind tibia and scape flatter (HTMAX/HTMIN 1.490, SMAX/SMIN 1.479); separation from following species difficult. **L. balcanicus**

— Scape shorter (SL/HL 0.869), hind tibia and scape less flattened (HTMAX/HTMIN 1.382, SMAX/SMIN 1.367). **L. distinguendus**

Key to Queens

The determination of queens is comparably clear if considering character combinations (see Table 1 and descriptions) but a dichotomous key like this is not always appropriate to certain problems.

1 Standing hairs on dorsum of gaster restricted to face of first tergite and posterior borders of each tergite; the surface in between without or only single isolated hairs. HW < 1400. **L. bicornis**

— Whole surface of first gaster tergites with many standing hairs. HW > 1400. 2

2 Character combination: GHL > 150, HTMAX/HTMIN > 2.00, and PDG > 9.8. **L. rabaudi**

— Character combination with at least one character below the above values. 3

3 Character combination: I2FS < 1.46, HL/HW > 0.880, GHL < 80. 4

— Character combination with at least one character clearly contradictory. 5

4 GHL 40–58, longest hair on scutellum 55–71 μm and on mesonotum 39–53 μm; SL 1108–1176. **L. mixtus**

— GHL 55–79, longest hair on scutellum 78–116 μm and on mesonotum 52–66 μm; SL 1195–1287. **L. sabularum**

5 Gena with 1–3 erect hairs. Dorsal crest of petiole scale in frontal view narrow (< 360 μm) and deeply emarginated (Fig. 8). Dorsal surface of scape and extensor profile of hind tibia perfectly smooth, with appressed pubescence only and without seta. Occasionally 1–2 subdecumbent hairs projecting up to 15 μm may be present. **L. affinis**

— Gena always with more than 3 erect hairs. Dorsal crest of petiole scale in frontal view wider than 360 μm and not or differently emarginated. Dorsal surface of scape and/or extensor profile of hind tibia not perfectly smooth, with decumbent to subdecumbent pubescence and very few to many standing hairs. 6

6 Longest hairs on mesonotum < 75 μm, GHL often 65–95 μm, SMAX/SMIN 1.14–1.38. Dorsal surface of scape and extensor profile of hind tibia with only few suberect hairs projecting at the most 20 μm from cuticular surface. **L. distinguendus**

— Longest hairs on mesonotum > 75 μm, GHL 85–155. Appendages more hairy and / or flatter. 7

7 Scape and hind tibia clearly flattened (SMAX/SMIN 1.60–2.34, HTMAX/HTMIN 1.86–3.00). 8

— Scape and hind tibia less flattened (SMAX/SMIN 1.15–1.69, HTMAX/HTMIN 1.35–2.06). 10

8 Scape shorter (SL/HW 0.773–0.839), head shorter (HL/HW 0.836–0.886), hind tibia flattening often less extreme (HTMAX/HTMIN 1.86–2.38). Dorsal crest of petiole scale never higher in the median portion than in lateral parts. **L. meridionalis**

— Scape longer (SL/HW 0.817–0.876), head longer (HL/HW 0.864–0.935). Hind tibia often very flat (HTMAX/HTMIN 2.10–3.00). Dorsal crest of petiole scale often higher in the median portion than in lateral parts. 9

9 Central Europe and Balkans SL/HL 0.927–0.975, HL 1270–1395, GHL 88–125; SMAX/SL 0.126–0.142. **L. jensi jensi**

— Steppe zone of E Europe eastwards from 35°E. SL/HL 0.883–0.935, HL 1398–1468, GHL 122–158, SMAX/SL 0.112–0.132. **L. jensi longiceps**

10 Scape long (SL/HL 0.912–0.967, SL/HW 0.788–0.844). Gaster hairs longer (GHL 134–155). Dorsal plane of scape and hind tibia extensor profile normally with few hairs (nHHT $<$ 18). **L. balcanicus**

— Scape shorter (SL/HL 0.842–0.914, SL/HW 0.723–0.788). Gaster hairs shorter (GHL 80–134). Dorsal plane of scape and hind tibia extensor profile normally with many standing hairs (nHHT $>$ 18). **L. umbratus**

Provisional Key to Males

The males of *balcanicus, affinis, distinguendus, sabularum, umbratus* and *meridionalis* are nearly inseparable without experience and could be determined, if at all, under use of direct comparison material and consideration of character combinations. See Table 3 and descriptions.

1 Petiolar scale in frontal view deeply cleft (Fig. 4); depth of cleft at least 20 % of SCW. **L. bicornis**

— Depth of emargination in dorsal crest of petiolar scale always less than 15 % SCW or emargination perfectly absent. 2

2 Dorsal surface of scape with thick suberect to subdecumbent pubescence projecting 15–20 µm from cuticular surface (Fig. 35). Extensor profile of hind tibia with profuse subdecumbent pubescence projecting 12–18 µm. Scape short and subcylindrical, SL/SMIN 8.47–10.26, SL/HW 0.589–0.675, ADM 0–2. **L. mixtus**

— Dorsal surface of scape and extensor profile of hind tibia with subdecumbent to appressed pubescence projecting less than 15 µm (scape) or less than 12 µm (tibia) from cuticular surface. Scape often longer (SL/SMIN 8.97–14.43, SL/HW 0.581–0.745). ADM 0–7. 3

3 Scape less flattened (SMAX/SMIN 1.07–1.47), ADM 3–7. Cuticular surface of head, alitrunk, and gaster not brilliantly shining. **L. affinis / balcanicus / umbratus / distinguendus / meridionalis / sabularum**

— Scape more flattened (SMAX/SMIN 1.35–1.75), ADM 0–4. Cuticular surface of head, alitrunk, and gaster brilliantly shining. 4

4 Longest hair at posterior border of 8th sternite normally shorter than 100 µm. Outer margin of mandibles without notable corner before its articulation with head capsule (Fig. 44). Pubescence less dilute. **L. jensi jensi**

— Longest hair at posterior border of 8th sternite normally 125–145 µm long. Outer margin of mandibles frequently with notable corner before its articulation with head capsule (Fig. 45). Pubescence very dilute. **L. rabaudi**

	mixtus (n=46)	sabula-rum (n=21)	affinis (n=8)	balcani-cus (n=11)	distin-guendus (n=55)	umbratus (n=65)	meridio-nalis (n=35)	jensi (n=28)	longiceps (n=7)	rabaudi (n=15)	bicornis (n=5)
HW	1495.1 39.3	1623.2 29.7	1530.4 41.2	1687.3 75.3	1689.2 48.0	1687.8 53.3	1626.2 40.4	1488.8 36.7	1572.0 23.2	1607.6 54.0	1305.8 17.6
HL/HW	0.913 0.0126	0.897 0.0077	0.886 0.0100	0.866 0.0090	0.858 0.0134	0.862 0.0188	0.862 0.0143	0.895 0.0155	0.913 0.0112	0.876 0.0171	0.899 0.0121
SL/HW	0.763 0.0122	0.768 0.0131	0.770 0.0140	0.819 0.0143	0.746 0.0141	0.755 0.0164	0.806 0.0167	0.850 0.0127	0.830 0.0065	0.839 0.0184	0.724 0.0106
SL/HL	0.836 0.0113	0.856 0.0171	0.870 0.0104	0.945 0.0140	0.870 0.0159	0.878 0.0179	0.935 0.0167	0.951 0.0118	0.909 0.0131	0.956 0.0215	0.805 0.0060
SMAX /SMIN	1.193 0.0589	1.254 0.0573	1.555 0.159	1.496 0.0831	1.255 0.0709	1.315 0.101	1.858 0.138	2.099 0.119	1.974 0.142	1.735 0.182	1.940 0.0682
HTMAX /HTMIN	1.429 0.122	1.489 0.0801	1.668 0.0356	1.837 0.147	1.483 0.0979	1.550 0.109	2.121 0.132	2.368 0.133	2.671 0.266	2.293 0.174	1.740 0.0722
I2FS	1.316 0.0635	1.371 0.0468	1.465 0.0460	1.743 0.104	1.558 0.0676	1.564 0.086	1.818 0.126	1.768 0.090	1.843 0.115	1.785 0.147	1.486 0.0720
GHL	48.2 4.31	64.5 6.55	155.0 8.57	145.2 4.26	80.5 9.74	102.7 10.7	106.1 8.21	100.4 7.03	140.1 9.04	209.1 28.7	162.3 8.16
nHHT	6.67 4.63	11.3 3.67	0.31 0.704	10.77 3.09	8.48 4.57	36.4 9.8	33.4 11.77	17.8 4.22	31.0 11.14	14.67 6.41	0.10 0.22
PDG	4.80 0.25	4.80 0.25	5.62 1.17	7.68 0.90	4.85 0.54	4.85 0.50	6.76 1.078	6.32 0.778	6.66 0.568	31.06 12.58	7.70 0.99
PDF							11.08 1.72	9.90 0.879	8.40 1.37	15.94 3.53	8.36 0.75
SMAX /SL	0.1231	0.1124	0.1170	0.1107 0.0088	0.1110	0.1135	0.1235 0.0066	0.1340 0.0042	0.1201 0.0060	0.1055 0.0077	0.1389 0.0030
SMIN	117.5 7.82	111.7 5.62	89.1 7.32	106.9 7.60	110.3 8.21	110.4 6.92	87.3 5.90	81.0 5.15	79.3 2.93	82.2 3.09	67.8 2.59
HTMAX	234.0 9.36	232.5 7.05	221.6 9.24	257.7 11.83	220.7 9.55	229.3 14.5	281.7 13.7	263.3 9.06	285.3 8.14	254.6 10.26	186.2 2.59

Table 1: Morphological data of queens. Upper numbers in each line are arithmetic means, lower numbers corresponding standard deviations. Data without standard deviations are simply ratios of arithmetic means. Note that few data may have a lower sample size than given at top of the columns (see descriptions). The *balcanicus* data are supplemented by a series from Drienovec/Slovakia, leg. BEZDEČKA 31. iii 1986.

	mixtus (n=13)	sabula-rum (n=11)	affinis (n=15)	balcani-cus (n=3)	distin-guendus (n=5)	umbratus (n=9)	meridio-nalis (n=11)	jensi (n=13)	rabaudi (n=19)	bicornis (n=4)
HW	1029,2 28.8	1146.4 21.8	1084.1 32.9	1111.0 38.7	1114.6 33.6	1097.7 59.4	1129.5 61.7	987.5 45.8	1024.7 54.3	1035.5 27.3
SMIN	69.5 3.18	68.0 1.93	72.9 4.96	64.0 1.73	72.8 5.10	67.1 4.37	69.3 6.87	55.9 2.36	53.9 2.88	61.2 1.89
GHL	66.4 7.24	80.3 8.91	94.9 7.97	79.0 17.0	91.4 4.2	92.1 17.9	97.7 18.9	85.0 11.35	109.2 20.8	111.0 10.61
PDG	11.45 1.96	10.35 2.05	11.55 3.49	7.20 0.85	8.20 0.64	7.97 1.51	9.44 2.04	12.30 1.66	42.44 29.98	9.58 1.31
nHHT	2.25 2.60	2.58 2.39	2.86 2.92	2.17 0.76	2.00 0.79	3.11 1.19	8.54 4.44	3.12 1.96	2.03 1.17	0.25 0.50
m-cu	0.88 0.22	0.273 0.410	0.72 0.38	1.00 0.0	0.55 0.45	0.69 0.53	0.72 0.40	0.269 0.439	0.750 0.400	0.750 0.500
ADM	0.69 0.63	4.27 1.10	5.33 0.65	4.33 0.58	5.00 1.22	4.90 0.64	5.45 1.75	1.15 0.80	2.05 1.03	4.62 1.25
SMAX /SMIN	1.224 0.045	1.297 0.025	1.251 0.091	1.343 0.012	1.170 0.051	1.270 0.057	1.319 0.080	1.595 0.079	1.531 0.089	1.445 0.044
SL /HW	0.632 0.0216	0.644 0.0204	0.696 0.0162	0.682 0.0215	0.691 0.0270	0.659 0.0230	0.660 0.0168	0.650 0.0301	0.645 0.0320	0.623 0.0033
SCW /HW	0.302 0.0209	0.312 0.0120	0.317 0.0255	0.346 0.0032	0.326 0.0210	0.304 0.0880	0.322 0.0374	0.280 0.0119	0.299 0.0145	0.291 0.0107
SL /SMIN	9.367 0.447	10.89 0.546	10.39 0.707	11.84 0.450	10.61 0.646	10.80 0.705	10.80 0.638	11.47 0.841	12.29 1.016	10.53 0.390
HL /AW	1.027 0.023	1.142 0.0265	1.070 0.054	1.090 0.007	1.114 0.046	1,039 0.065	1.063 0.0646	1.099 0.034	1.106 0.043	1.065 0.023

Table 3: Morphological data of males. Upper numbers in each line are arithmetic means, lower numbers corresponding standard deviations.

	mixtus (n=30)	sabula-rum (n=34)	affinis (n=30)	balcani-cus (n=34)	distin-guendus (n=23)	umbratus (n=108)	meridio-nalis (n=41)	jensi (n=59)	longiceps (n=20)	rabaudi (n=34)	bicornis (n=7)
HL	1056.3	1117.0	1208.0	1070.1	1056.5	1066.8	1037.4	974.0	1034.8	1035.2	1126.0
	54.9	69.7	51.2	60.0	62.8	96.5	107.8	62.7	26.9	61.9	30.6
HW	990.1	1044.8	1167.7	1029.5	1008.1	1026.4	1010.6	922.1	959.7	982.9	1080.0
	56.1	70.61	59.3	69.5	71.0	101.8	120.4	67.2	46.3	62.8	36.5
HL/HW	1.067	1.069	1.035	1.040	1.048	1.039	1.029	1.057	1.080	1.054	1.043
	0.0128	0.0108	0.0172	0.0171	0.0195	0.0214	0.0279	0.0175	0.0306	0.0178	0.0095
SL/HL	0.839	0.842	0.846	0.883	0.869	0.859	0.874	0.879	0.877	0.898	0.810
	0.0133	0.0095	0.0146	0.0151	0.0142	0.0156	0.0169	0.0185	0.0112	0.0193	0.0119
SL/HW	0.895	0.901	0.876	0.918	0.911	0.892	0.901	0.928	0.947	0.946	0.845
	0.0194	0.0143	0.0175	0.0189	0.0262	0.0267	0.0259	0.0192	0.0248	0.0183	0.0125
SMAX /SMIN	1.227	1.285	1.460	1.479	1.367	1.442	1.580	1.771	1.775	1.599	1.746
	0.0796	0.0598	0.0884	0.0642	0.0863	0.106	0.1467	0.170	0.115	0.115	0.040
HTMAX /HW				0.1372			0.1460		0.1533		
				0.0056			0.0100		0.0060		
HTMAX /HTMIN				1.490	1.382						
				0.099	0.111						
GHL	45.8	70.8	116.6	105.5	104.7	85.6	86.0	84.7	106.0	120.1	119.3
	4.42	7.84	7.17	8.91	7.61	8.17	8.32	8.95	11.95	6.63	7.95
nHHT	7.26	8.81	0.13	6.87	4.70	21.3	21.2	21.7	28.6	14.48	0.0
	6.44	4.94	0.29	2.22	2.69	8.12	9.61	5.93	7.72	7.27	0.0
PDG	5.76	6.26	6.19	11.3	11.78	7.33	12.26	11.84	11.19	41.0	7.73
	0.89	0.82	1.07	3.27	2.96	1.43	2.97	3.79	1.65	14.09	1.32
PDF	8.61	7.41	7.75	10.49	9.96	8.45	11.94	10.08	10.74	13.04	11.60
	1.30	0.94	1.40	1.85	1.99	1.24	2.16	1.45	1.96	2.45	3.74
SMAX	97.9	98.7	107.3	98.6	92.7	101.5	100.3	97.8	102.7	97.2	107.0
	7.71	5.30	5.60	8.24	9.00	10.94	13.15	9.40	6.45	6.92	4.62
PLG	35.1			47.6	42.3						
	5.66			4.73	7.29						

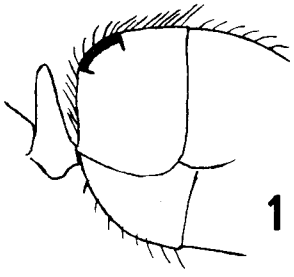
Table 2: Morphological data of workers. Upper numbers in each line are arithmetic means, lower numbers corresponding standard deviations. Note that some of the data may have another sample size as given at top of the columns (see descriptions). The *balcanicus* data are supplemented by a series from Drienovec/Slovakia (leg. BEZDEČKA 31. iii 1986) which I got after the manuscript had been finished.

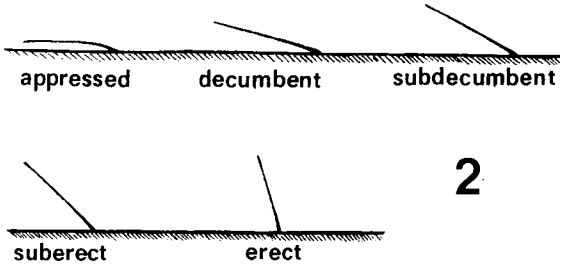
(4: ♀♀)	distinguendus				sabularum				mixtus			
	mean	SD	range	n	mean	SD	range	n	mean	SD	range	n
HW	1689.2	48.0	1601-1787	43	1623.2	29.7	1569-1678	21	1495.1	39.3	1420-1591	46
HL/HW	0.858	0.0134	0.838-0.887	43	0.897	0.0077	0.881-0.912	21	0.913	0.0129	0.883-0.936	45
SL/HL	0.870	0.0159	0.838-0.905	42	0.856	0.0171	0.829-0.888	21	0.836	0.0113	0.803-0.860	45
SL/HW	0.746	0.0141	0.720-0.778	42	0.768	0.0131	0.747-0.792	21	0.763	0.0122	0.739-0.782	45
SMAX /SMIN	1.255	0.0709	1.140-1.420	31	1.254	0.0573	1.120-1.387	20	1.193	0.0589	1.090-1.280	31
SMIN	110.3	8.21	93-127	33	111.7	5.62	104-124	20	117.5	7.82	104-132	31
HTMAX /HTMIN	1.483	0.0979	1.304-1.710	32	1.489	0.0801	1.347-1.659	20	1.429	0.122	1.239-1.689	27
HTMAX	220.7	9.55	202-238	32	232.5	7.05	225-253	20	234.0	9.36	213-249	27
I2FS	1.558	0.0676	1.470-1.730	43	1.371	0.0468	1.262-1.422	20	1.316	0.0635	1.190-1.450	41
SL	1261.1	29.74	1182-1321	42	1246.4	21.7	1195-1287	21	1141.4	18.6	1108-1176	45
GHL	80.5	9.74	63-111	55	64.5	6.55	55-79	21	48.2	4.31	40-58	45
ScuHL	110.7	9.67	92-124	14	95.0	11.48	78-116	20	65.0	3.86	55-71	22
MeHL	63.7	5.85	49-75	14	59.5	7.05	52-66	20	49.0	4.35	39-53	22
nHHT	8.48	4.57	0.5-20	54	11.3	3.67	5-18	21	6.67	4.63	1-20	29
HTMAX /HW	0.1316	0.0053	0.121-0.141	32	0.1432	0.0051	0.138-0.156	20	0.1575	0.0063	0.145-0.170	27

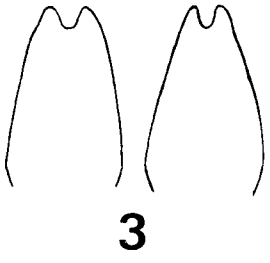
Table 4: Morphological comparison of the queens of *L. distinguendus*, *L. sabularum*, and *L. mixtus*. SCuHL means the length of longest hair on dorsal plane of scutellum and MeHL is the corresponding character for the mesonotum.

(5: ♀♀)	distinguendus				sabularum				mixtus			
	mean	SD	range	n	mean	SD	range	n	mean	SD	range	n
HL	1056.5	62.8	920-1171	23	1117.0	69.70	961-1216	34	1056.3	54.92	913-1177	30
HL/HW	1.048	0.0195	0.986-1.076	23	1.069	0.0108	1.038-1.084	34	1.067	0.0128	1.039-1.091	30
SL/HL	0.869	0.0142	0.834-0.893	23	0.842	0.0095	0.822-0.862	34	0.839	0.0133	0.805-0.873	30
SL/HW	0.911	0.0262	0.838-0.947	23	0.901	0.0143	0.858-0.923	34	0.895	0.0194	0.854-0.940	30
SMAX /SMIN	1.367	0.0863	1.190-1.479	23	1.285	0.0598	1.150-1.429	32	1.227	0.0796	1.10-1.41	30
SMAX	92.7	9.00	76-106	23	98.7	5.30	86-107	32	97.9	7.71	82-112	30
GHL	104.7	7.61	89-119	23	70.8	7.84	60-91	32	45.8	4.42	37-55	30
nHHT	4.70	2.69	1.0-12.0	22	8.81	4.94	2.0-14.0	31	7.26	6.44	0-27.0	25
PDG	11.78	2.96	6.7-17.7	23	6.26	0.82	4.6-8.3	32	5.76	0.89	4.0-7.6	26
PDF	9.96	1.99	7.4-15.9	23	7.41	0.94	5.6-9.9	30	8.61	1.30	6.6-11.6	24

Table 5: Morphological comparison of the workers of *L. distinguendus, L. sabularum,* and *L. mixtus*.







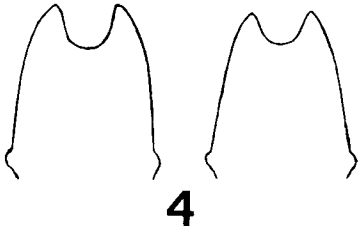
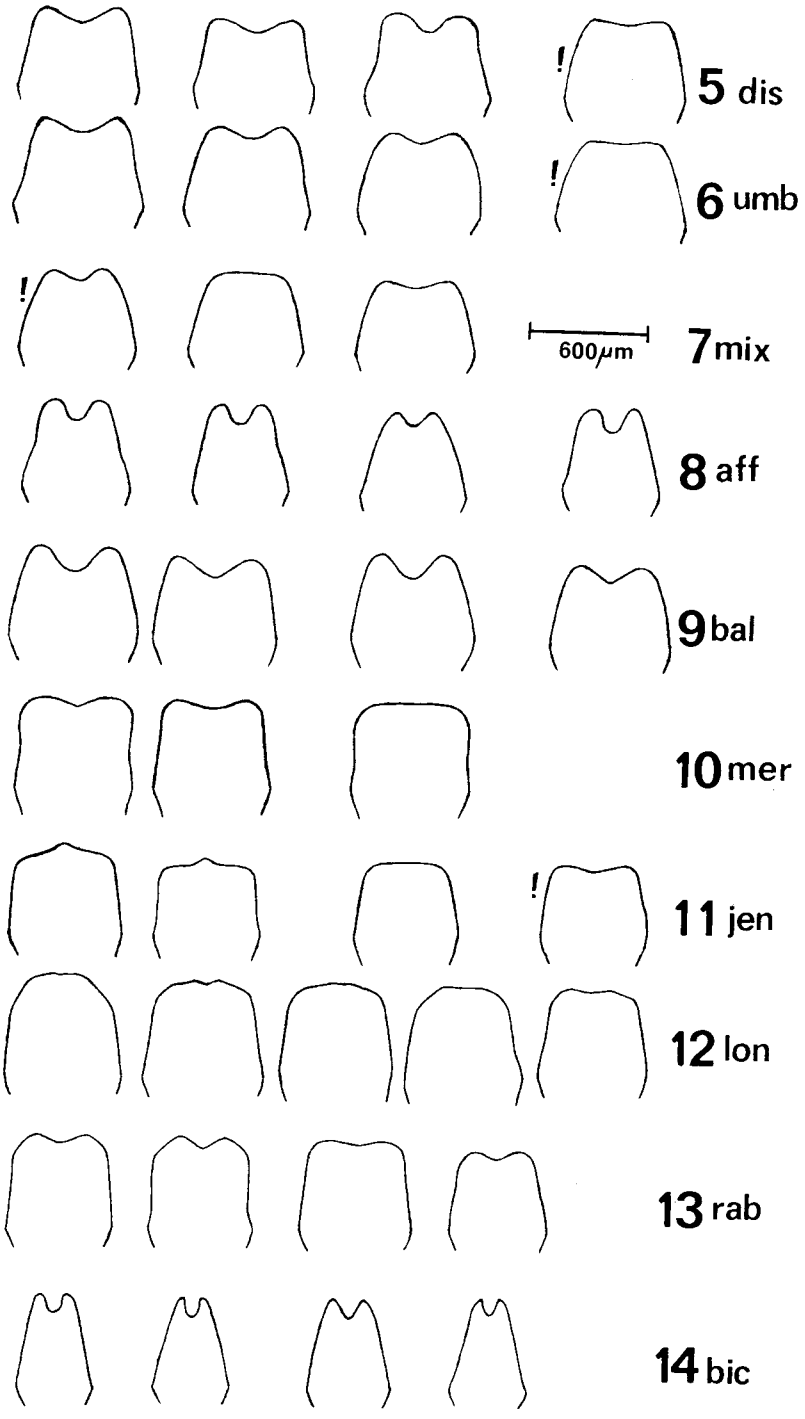
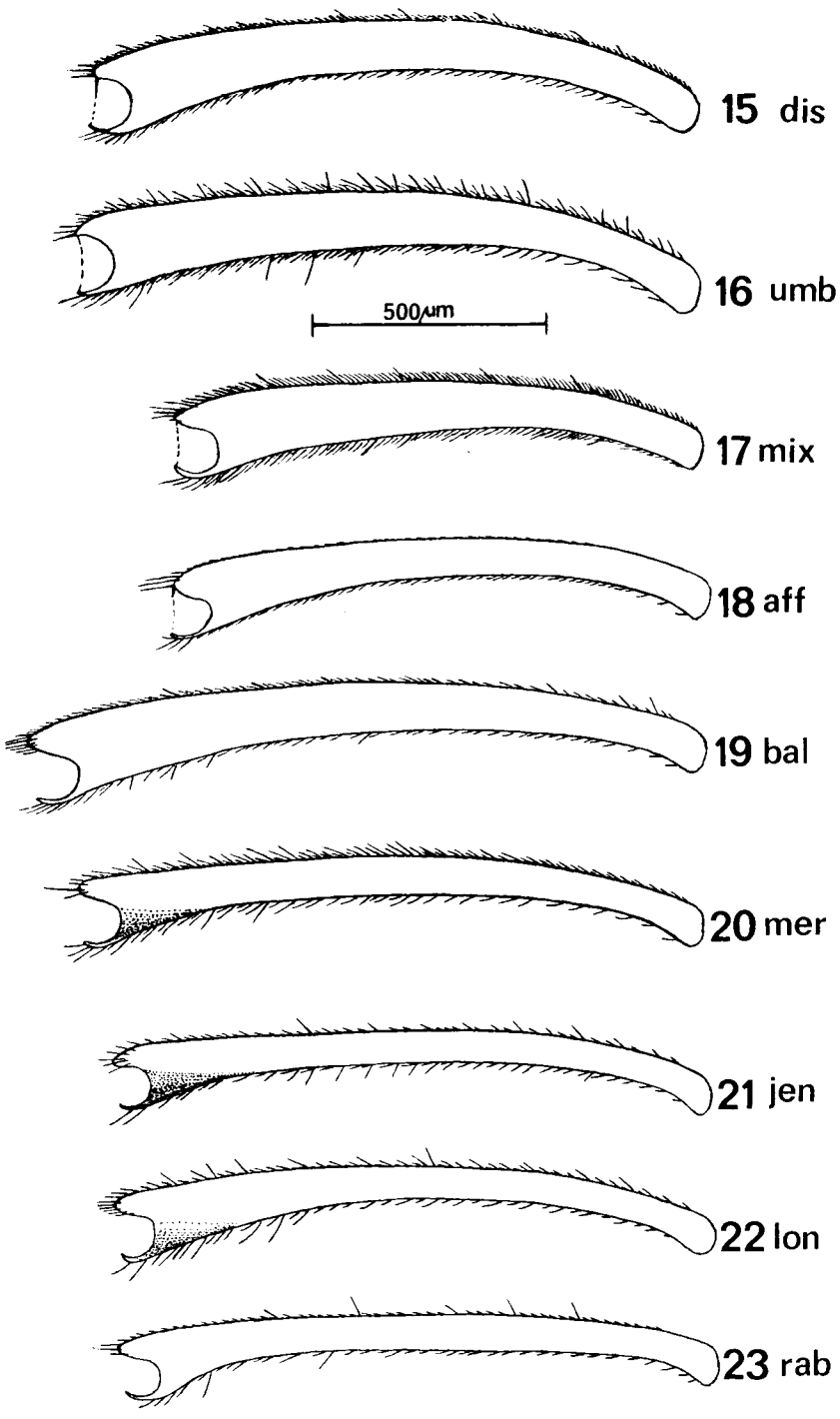


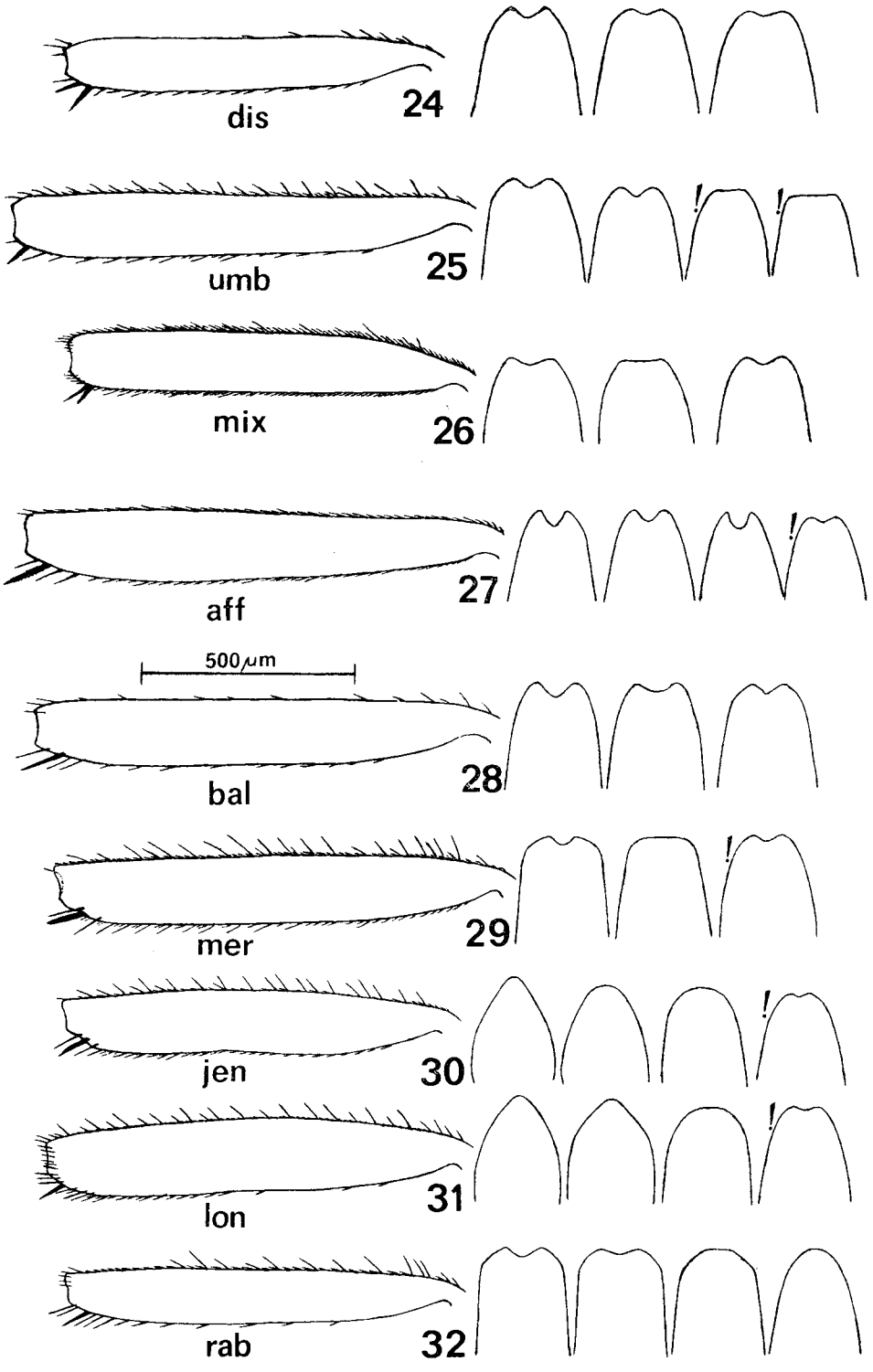
Fig. 1: The black sector indicates the position of hairs of which GHL is to be measured. – Fig. 2: Terminology of pilosity/pubescence. – Fig. 3: Petiole scale of *L. bicornis* worker in frontal view. – Fig. 4: Petiole scale of *L. bicornis* male in frontal view.



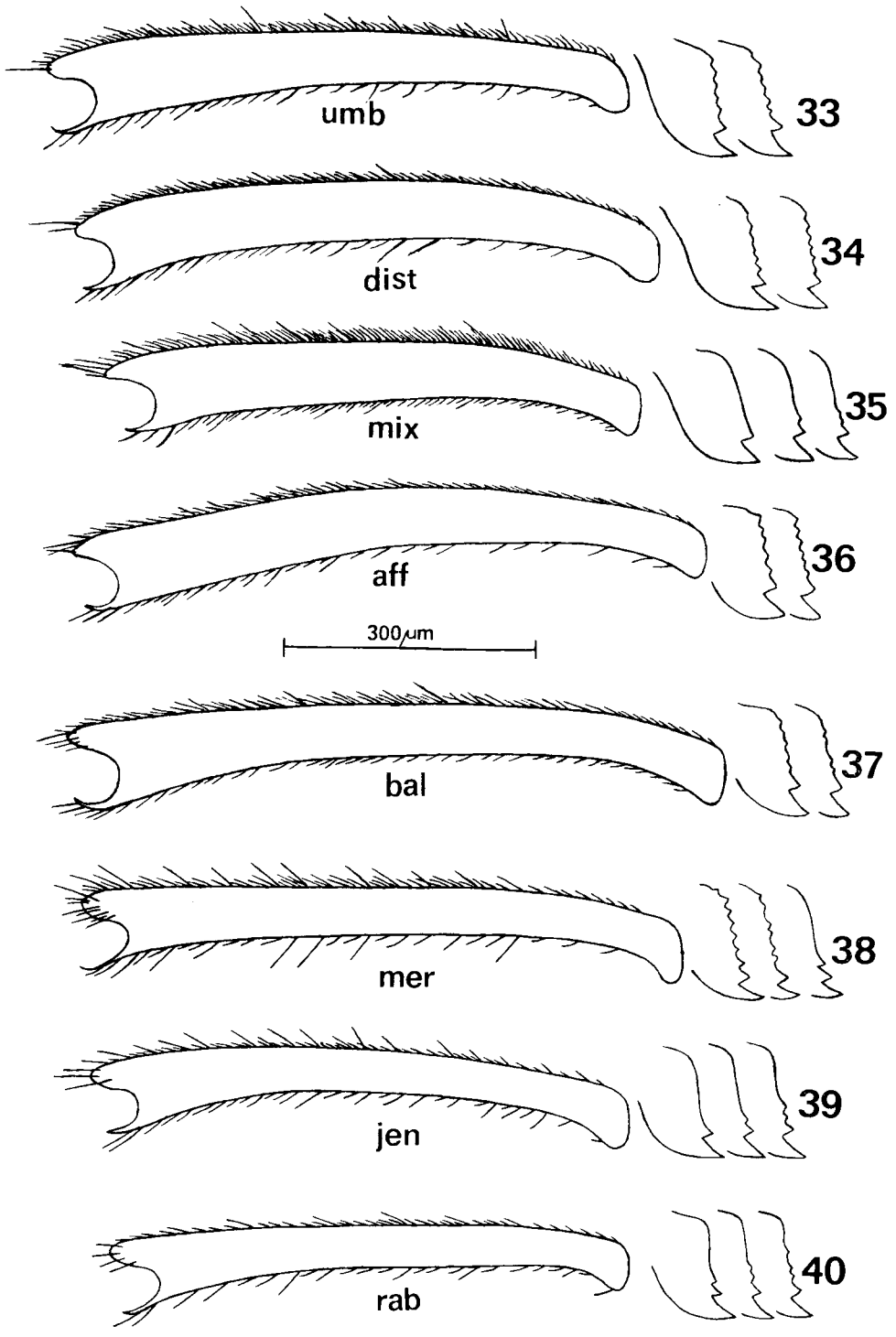
Figs. 5–14: Variability of the petiole scale in queens of *distinguendus, umbratus, mixtus, affinis, balcanicus* n. sp., *meridionalis, jensi jensi, jensi longiceps* n. subsp., *rabaudi,* and *bicornis.* Figures marked with "!" show rare but not abnormal variants which could lead to confusion with other species.



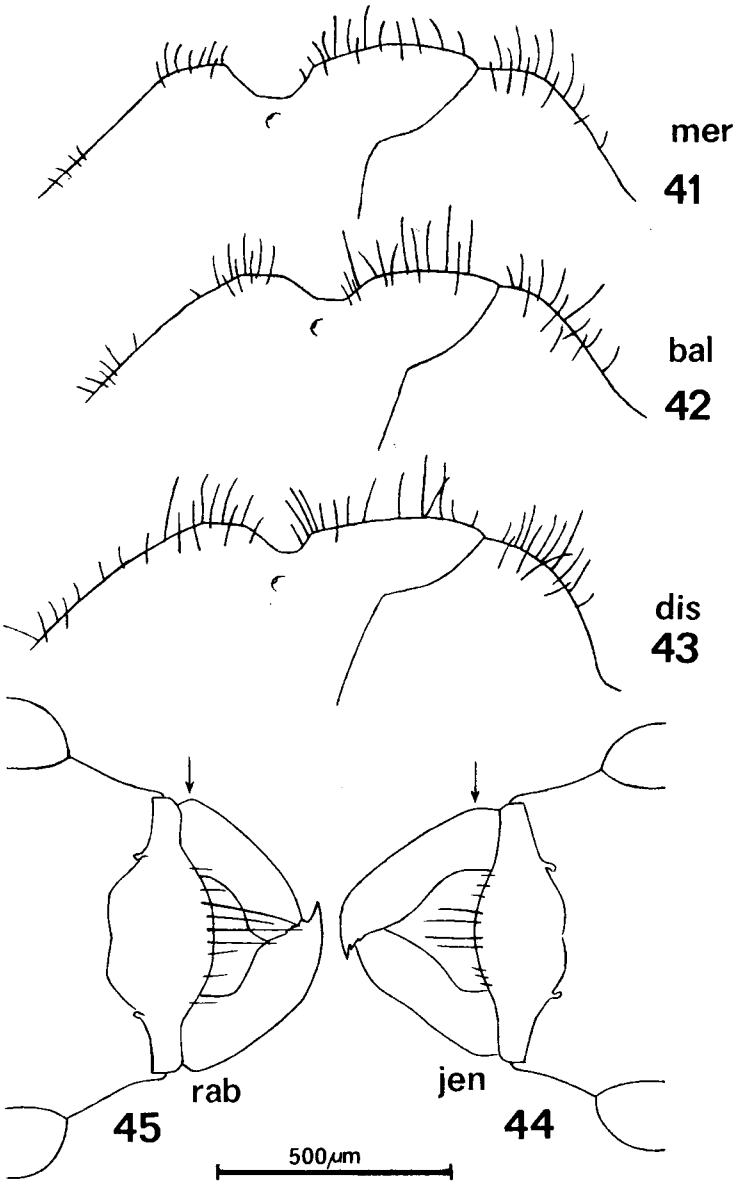
Figs. 15–23: Scape of queens of *distinguendus, umbratus, mixtus, affinis, balcanicus* n. sp., *meridionalis, jensi jensi, jensi longiceps* n. subsp., and *rabaudi* in frontal view as seen in transmitted-light and with smallest diameter in visual plane.



(Legende s. S. 174)



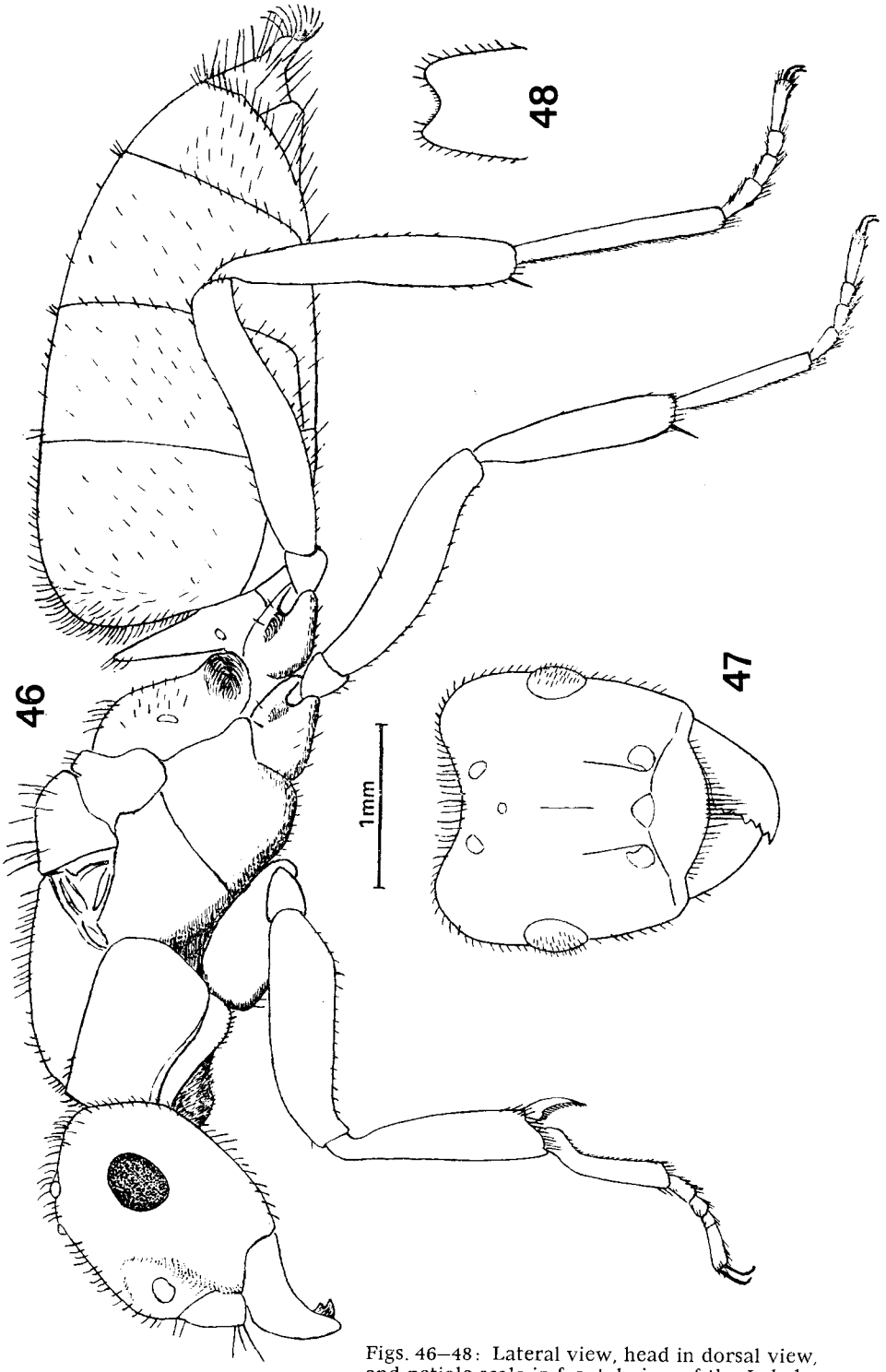
(Legende s. S. 174)



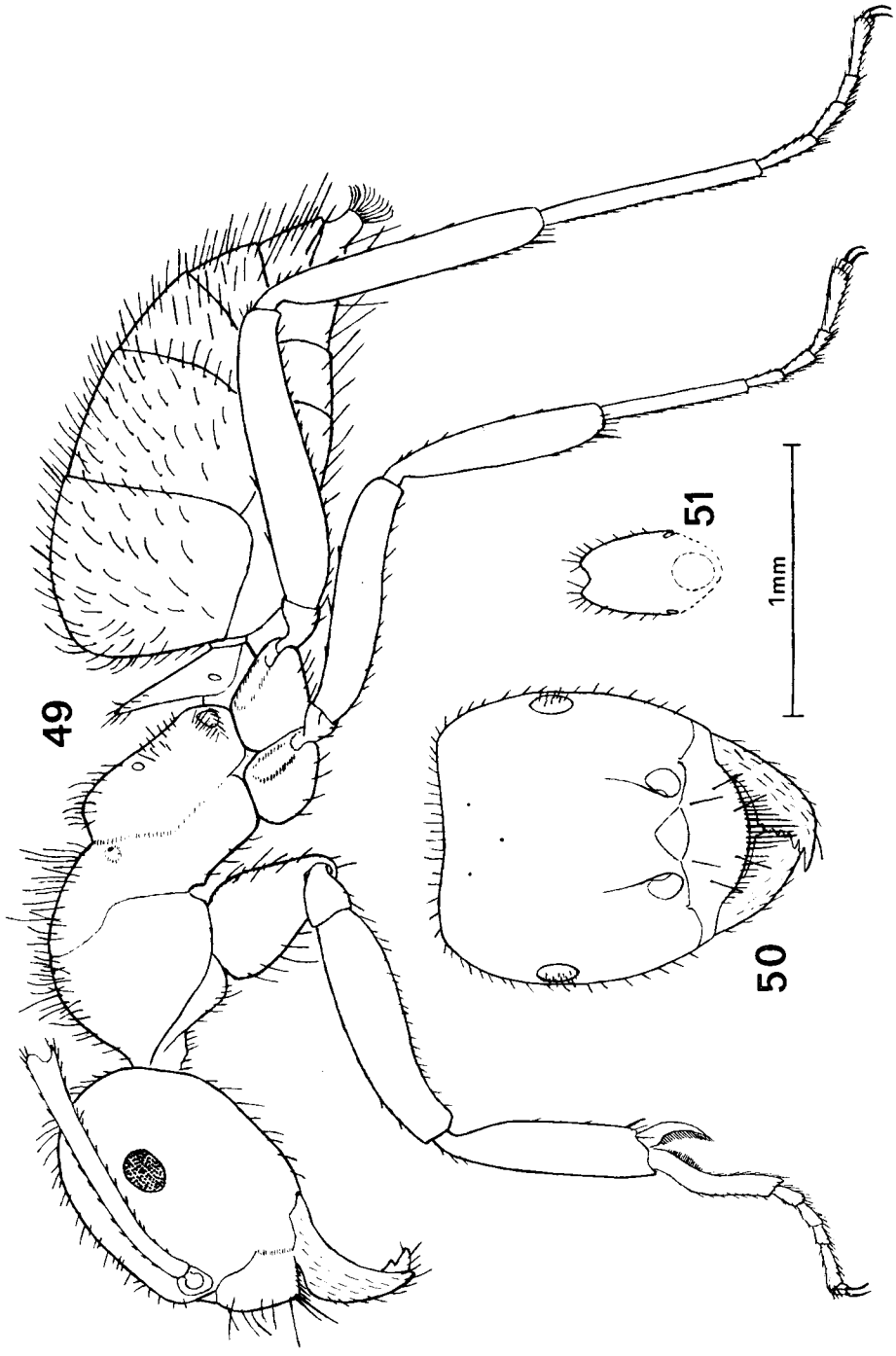
Figs. 41–43: Dorsal parts of alitrunk of *meridionalis, balcanicus* n. sp., and *distinguendus* workers in lateral view. – Figs. 44, 45: Frontal parts of head of *jensi* and *rabaudi* males in dorsal view.

◀
Figs. 24–32: Hind tibia of workers as seen in transmitted-light and with largest diameter in visual plane. Petiole scales of workers in frontal view; figures marked with "!" show infrequent but not abnormal variants which could lead to confusion with other species. From top to bottom: *distinguendus, umbratus, mixtus, affinis, balcanicus* n. sp., *meridionalis, jensi jensi, jensi longiceps* n. subsp., and *rabaudi*.

◀
Fig. 33–40: Variability of mandibular dentition and of scape in males of *umbratus, distinguendus, mixtus, affinis, balcanicus* n. sp., *meridionalis, jensi jensi, and rabaudi* in frontal view and seen as in transmitted-light, with minimum scape diameter in visual plane.



Figs. 46–48: Lateral view, head in dorsal view, and petiole scale in frontal view of the *L. balcanicus* n. sp. queen.



Figs. 49–51: Lateral view, head in dorsal view, and petiole scale in frontal view of the *L. balcanicus* n. sp. worker.

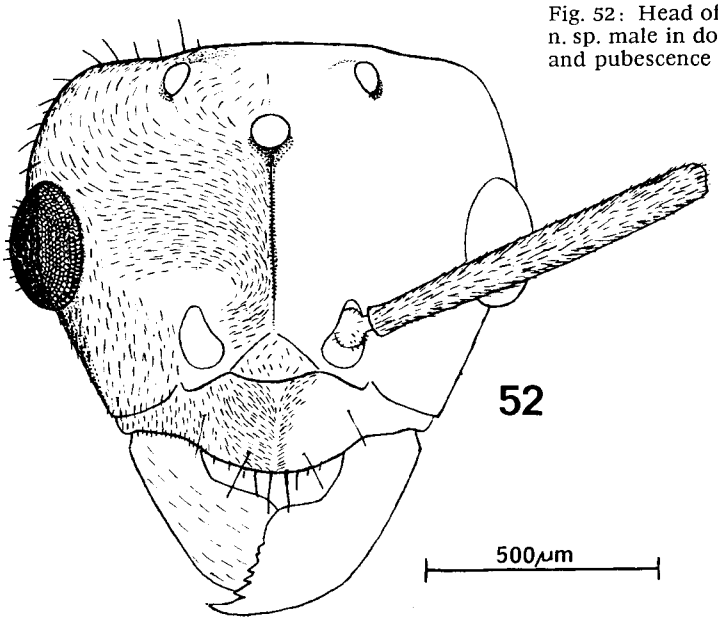


Fig. 52: Head of *L. balcanicus* n. sp. male in dorsal view; pilosity and pubescence partially omitted.

Summary

The paper gives evidence for the existence of ten morphospecies and one distinct subspecies of the ant subgenus *Chthonolasius* RUZSKY in Europe: *Lasius mixtus* (NYL.), *L. sabularum* (BONDR.), *L. distinguendus* EMERY, *L. umbratus* (NYL.), *L. balcanicus* n. sp., *L. meridionalis* (BONDR.), *L. jensi jensi* SEIFERT, *L. jensi longiceps* n. subsp., *L. rabaudi* (BONDR.), *L. bicornis* (FÖRSTER), and *L. affinis* (SCHENCK). A comparably easy distinction of species is given in the queens, while determination of workers is sometimes problematic even if sufficiently large nest samples are examined. The separation of males is most difficult in the majority of species. This necessitated that only males which determination was proved by direct association with female castes in nest samples could be incorporated into the study and explains the relatively low numbers of evaluated males. Considering the diagnostic queens, the most similar of all species pairs is *L. distinguendus/umbratus* where we have strong differences only in pilosity data while body proportions are nearly equal. However, clear differences in geographic distribution and habitat selection give much hope that these two as well as the eight other morphospecies could be confirmed as biospecies by futural investigators. The distribution of each species is outlined and brief informations on biology, as far as known, are given. Keys are provided for all three castes which is often problematic, especially when combinations of many characters have to be considered to find decisions.

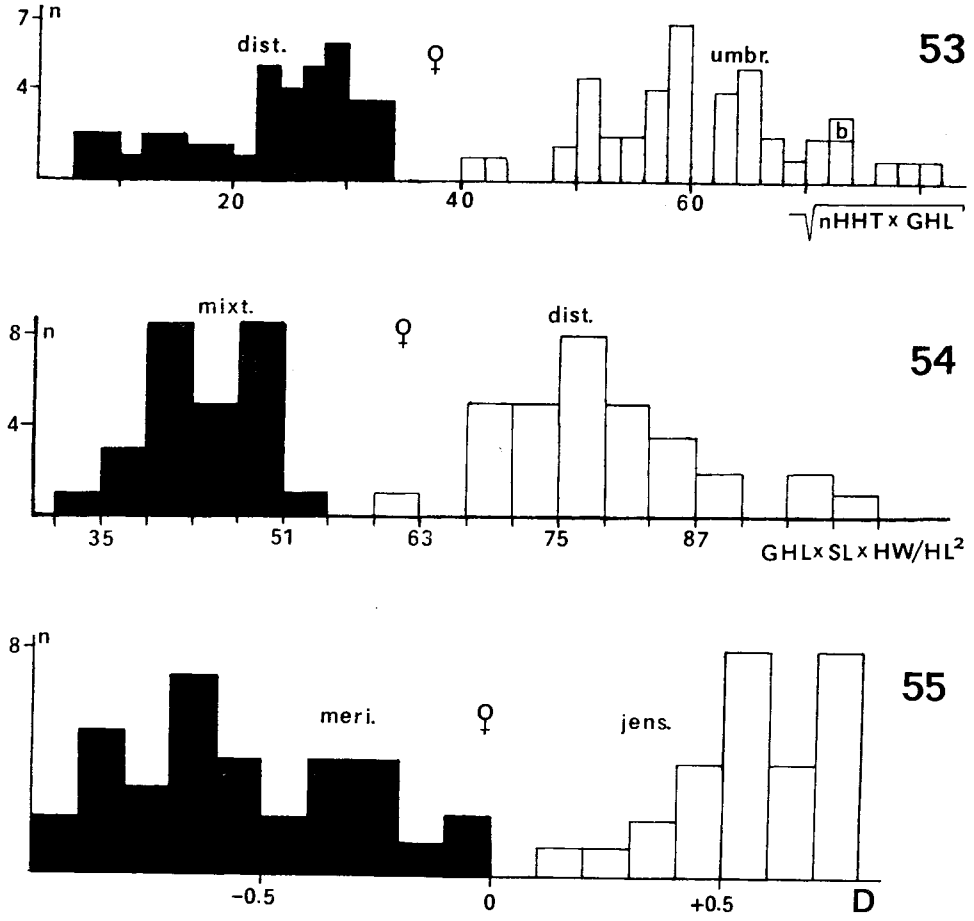
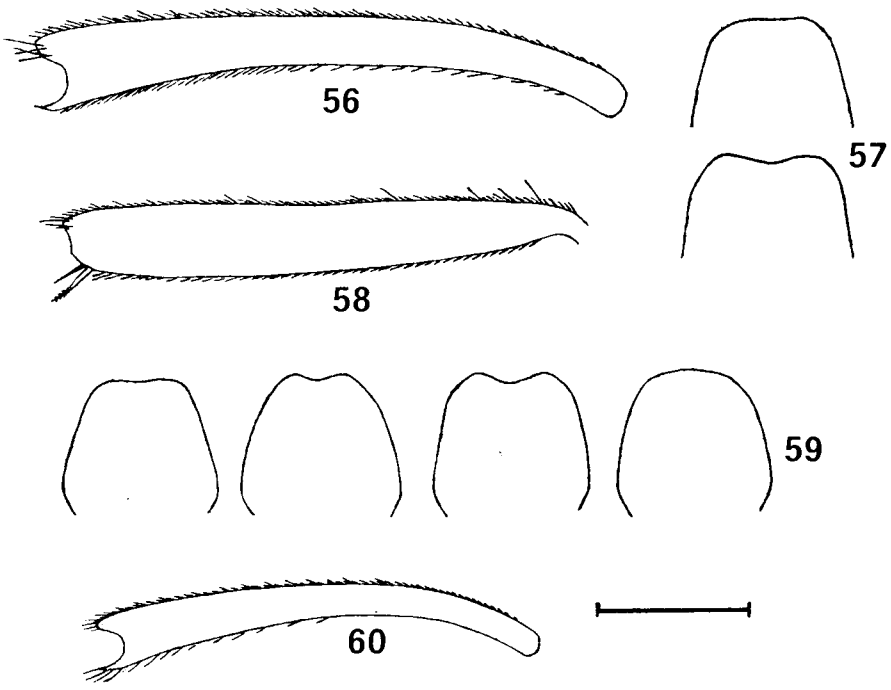


Fig. 53: Separation of *L. distinguendus* and *umbratus* queens by square root of the product nHHT x GHL. The square marked with "b" shows the value of the type queen of *Formicina belgarum* BONDROIT. – Fig. 54: Separation of *L. mixtus* and *distinguendus* queens by a simple product index. – Fig. 55: Separation of *L. meridionalis* and *jensi jensi* queens by a multiple discriminant vector using the characters HW, HL, SL, SMAX, SMIN (see p. 157, comments).

Zusammenfassung

REVISION DER EUROPÄISCHEN ARTEN DES AMEISEN-SUBGENUS CHTHONOLASIUS

In der vorliegenden Arbeit wird die Existenz von zehn Morphospezies und einer distinkten Subspezies des Subgenus *Chthonolasius* RUZSKY für das Gebiet von Europa nachgewiesen: *Lasius mixtus* (NYL.), *L. sabularum* (BONDR.), *L. distinguendus* EMERY, *L. umbratus* (NYL.), *L. balcanicus* n. sp., *L. meridionalis* (BONDR.), *L. jensi jensi* SEIFERT, *L. jensi longiceps* n. subsp., *L. rabaudi* (BONDR.), *L. bicornis* (FÖRST.), und *L. affinis* (SCHENCK). Eine vergleichsweise einfache Unterscheidung der Arten ist bei den Königinnen gegeben, während die Bestimmung der Arbeiter manchmal sehr problematisch ist – selbst wenn



Figs. 56–60: *Lasius sabularum*. – Fig. 56: Scape of queen in frontal view as seen in transmitted-light and with smallest diameter in visual plane. – Fig. 57: Petiolar scales of queens in frontal view. – Fig. 58: Hind tibia of workers as seen in transmitted-light and with maximum diameter in visual plane. – Fg. 59: Variability of petiolar scale in workers, frontal view. – Fig. 60: Scape of worker as seen in transmitted-light and with minimum midpoint diameter in visual plane. – The scale bar equals 328 μm for all figures except Fig. 57 where it equals 528 μm.

ausreichend große Nestserien vorliegen. Die Unterscheidung der Männchen ist bei den meisten Arten äußerst schwierig, weshalb nur die Männchen in die Darstellung aufgenommen werden konnten, deren Bestimmung durch direkte Assoziation mit weiblichen Kasten in einer Nestprobe abgesichert ist. Das erklärt die relativ geringe Zahl der datenmäßig ausgewerteten Männchen. Innerhalb der im Durchschnitt sehr charakteristischen Königinnen ist *L. distinguendus/umbratus* das ähnlichste Artenpaar, bei dem wir zwar starke Unterschiede in der Behaarung nachweisen können, aber nahezu gleiche Körperproportionen und Absolutmaße finden. Wegen deutlicher Unterschiede in der geographischen Verbreitung und Habitatwahl besteht jedoch berechtigte Hoffnung, daß diese beiden ebenso wie die anderen acht Morphospezies in zukünftigen Untersuchungen als Biospezies bestätigt werden könnten. Die Verbreitung jeder Art wird umrissen und kurze Informationen zur Biologie, soweit diese bekannt ist, werden gegeben. Die für alle drei Kasten aufgestellten Bestimmungsschlüssel sind oft problematisch, vor allem dann, wenn Kombinationen mehrerer Merkmale zur Entscheidungsfindung benötigt werden.

References

ARNOLDI, K. V. & G. M. DLUSSKY, 1978: Formicidae. In: Opredyelityel nasyekomykh yevropeijskoj chasti SSSR III/1: 555. Leningrad.

BONDROIT, J., 1917: Notes sur quelques Formicidae de France. – Bull. Soc. Ent. Fr. **86**: 174–177.

—, 1918: Le fourmis de France et de Belgique. – Ann. Soc. Ent. France, Paris **87**: 1–174.

—, 1919: Notes diverses sur les fourmis d'Europe. – Annales Soc. Ent. Belg. **59**: 143–158.

BOURNE, R. A., 1973: A taxonomic study of the ant genus *Lasius* Fabricius in the British Isles (Hymenoptera, Formicidae). – J. Ent. (B) **42**: 17–27.

COLLINGWOOD, C. A., 1963: The *Lasius (Chthonolasius) umbratus* species complex in North Europe. – The Entomologist **96**: 145–158.

—, 1979: The Formicidae of Fennoscandia and Denmark. – Fauna Entomologica Scandinavica **8**. Klampenborg.

—, 1982: Himalayan ants of the genus *Lasius* (Hymenoptera, Formicidae). – Systematic Entomology **7**: 283–296.

EMERY, C., 1916: Formiche d'Italia nuove o critiche. – Rend. Sess. R. Acc. Sci. Bologna 1915–1916, pp. 53–66.

FÖRSTER, A., 1850: Hymenopterologische Studien. 1tes Heft. Formicariae. – Jahresberichte höh. Bürgerschule Aachen, Ernst Ter Meer Verl., 74 pp.

JORDAN, K. H. C., 1968: Die Ameisenfauna der Oberlausitz. – Abh. Ber. Naturkundemus. Görlitz **43**/3: 12.

KUTTER, H., 1977: Fauna Insecta Helvetica 6 – Hymenoptera, Formicidae. Zürich.

NYLANDER, W., 1846: Additametum adnotationum in monographiam formicarum borealium Europae. – Acta Soc. Sci. Fenn. T. **II**, pp. 1041–1062.

PISARSKI, B., 1975: Mrowki – Formicoidea. Katalog Fauny Polski, No. 23. Warszawa.

RUZSKY, M. D., 1913: Myrmecologische Notizen. – Arch. Naturg. **79**, A 9: 59–63.

SCHENCK, C. F., 1852: Beschreibung nassauischer Ameisenarten. – Jahrb. Ver. Naturkunde Nassau **8**, Wiesbaden: 3–149.

SEIFERT, B., 1982: *Lasius (Chthonolasius) jensi* n. sp. – eine neue temporär sozialparasitische Erdameise aus Mitteleuropa. – Reichenbachia Mus. Tierkd. **20**/10: 85–96.

—, 1984: Nachweis einer im Freiland aufgetretenen Bastardierung von *Leptothorax nigriceps* Mayr und *Leptothorax unifasciatus* (Latr.) mittels einer multiplen Diskriminanzanalyse. – Abh. Ber. Naturkundemus. Görlitz **58**/7: 1–8.

WERNER, P., 1984: Užiti kopulačnich organů a terminalnich sternitů zadečku v diagnostice samců mravenců rodu *Lasius*. – Thesis, 138 p., Praha.

WILSON, E. O., 1955: A Monographic Revision of the Ant Genus *Lasius*. – Bull. Mus. Comp. Zool. Harvard **113**: 1–199.

Address of the author:

Dr. B. Seifert, Staatliches Museum für Naturkunde Görlitz

PSF 425, Görlitz, DDR – 8900