**P O L I S H  J O U R N A L  O F  E N T O M O L O G Y**
P O L S K I E  P I S M O  E N T O M O L O G I C Z N E

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# *Ponera testacea* EMERY, 1895 (Hymenoptera: Formicidae) in Poland

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**ABSTRACT.** *Ponera testacea* EMERY was reported for the first time from Poland based on the museum specimens collected on the Małopolska and Lubelska Uplands. This finding was possible due to an investigation of all Polish *Ponera* LATR. specimens kept in the collection of the Museum and Institute of Zoology, PAS in Warsaw, which originally were identified as *P. coarctata* LATR. These museum specimens constitute the materials showing the evidence of most published reports on *Ponera* ants in Poland. All available data on the occurrence of *P. testacea* and *P. coarctata* in Poland are given, and discussed in the context of the slightly different habitat requirements of these two sympatric sibling species. A new simple morphometric method of discriminating them is proposed.

**KEY WORDS:** ants, fauna of Poland, sibling species, *Ponera coarctata*, *Ponera testacea*, morphometrics, taxonomy.

## INTRODUCTION

Species of the genus *Ponera* LATR., as other members of the subfamily *Ponerinae*, belong to the most ancient ants what manifests itself both in their body structure and bionomics. They are small, inconspicuous, slowly mowing hypogeal, mainly carnivorous ants, foraging singly in soil and litter. Colonies are monogynous or facultatively weakly polygynous, with 2-3 queens; they usually number to several tens (rarely more than a hundred) adults, and inhabit simple small nests in humus soil, under moss and stones, in crumbling rocks, etc. (CZECHOWSKI et al. 2002, SEIFERT 2007).

The genus consists of nearly 60 known so far, extant species (BOLTON et al. 2006), distributed mainly in Southern and South-Eastern Asia, Australia and Pacific Islands. Seven species are reported from the Palaearctic region, including three known from the Western Palaearctic and Europe. They are *Ponera coarctata* (LATREILLE, 1802), *P. testacea* EMERY, 1895, and an enigmatic species, *P. sysphinctoides* BERNARD, described from France based on males (BERNARD 1950) and known so far only by the type series. For several decades, *P. testacea*, originally described as *P. coarctata* var. *testacea* by EMERY (1895), after TAYLOR'S (1967) revision, was considered a junior synonym (as an ecotype) of *P. coarctata*. Only recently have CSŐSZ & SEIFERT (2003) recognised it as a good, sibling species of *P. coarctata*. These two species partly co-occur in South and Central Europe.

The range of *P. coarctata* in Europe covers the whole southern part of the continent, from Portugal to the European part of Turkey. It reaches 54°N in Central Europe (SEIFERT 2007); the northernmost localities lie in southern England, The Netherlands, Germany, Poland, and central and southern Russia (but the species is not reported in Belorussia) (see RADCHENKO 2007). Outside of Europe *P. coarctata* is also known in north-western part of North Africa, Asia Minor, Lebanon, Israel, Caucasus, and the Kopet-Dag Mts (CZECHOWSKI et al. 2002). The known range of *P. testacea* is distinctly smaller, and most probably it is underestimated, as this species had not been distinguished (like e.g. in Poland) from *P. coarctata* for a long time. *P. testacea* is reported from Spain, France, Germany, Czech Republic, Slovakia, Switzerland, Austria, Italy, Hungary, Romania, Serbia and Montenegro, Croatia, Bulgaria, and Greece (CSŐSZ & SEIFERT 2003, RADCHENKO 2007 and unpubl., WERNER & WIEZIK 2007, LEGAKIS, unpublished). According to the knowledge to date, in Central Europe (in Germany) it reaches 52°N (SEIFERT 2007).

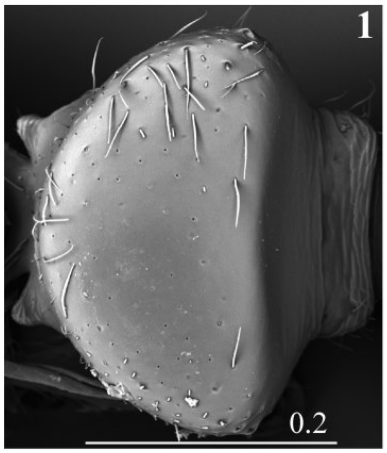
The two species under discussion, besides subtle morphological differences (see CSŐSZ & SEIFERT 2003, CSŐSZ 2003), slightly differ in their ecological requirements. *P. testacea* seems to be stenotopic and more a xerothermophilic species than rather oligotopic and mesoxerophilic *P. coarctata*. In the Carpathian Basin, *P. testacea* is associated with warmer and drier habitats like open xerothermal sandy, rocky limestone and dolomite grasslands, and siliceous rock, avoiding shaded and moister woodland habitats. *P. coarctata*, on the other hand, occurs mainly in mesoxerothermal habitats and is found both in loessy grasslands and in the depths of forests (CSŐSZ & SEIFERT 2003, CSŐSZ 2003).

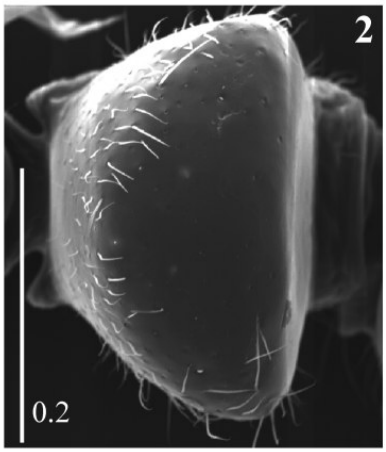
Division of the "old" *P. coarctata* onto two sibling species produced the need for a re-examination of all available collections of this, now recognised as collective, taxon. To a great extent, that task has already been carried out by CSŐSZ & SEIFERT (2003). Here we supplement their work by providing the results of such a correction of the (not very rich) Polish collection of *Ponera* ants kept in the Museum and Institute of Zoology, Polish Academy of Sciences in Warsaw (MIZ). In Poland, ants identified so far as *P. coarctata* were quite rarely found. They were reported in more or less dry sites, dispersed in several regions of the country (see CZECHOWSKI et al. 2002).

## MATERIAL AND METHODS

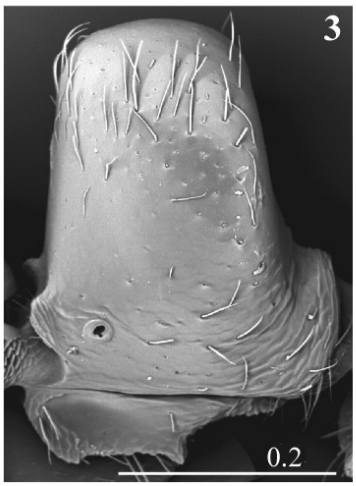
The examined museum "*Ponera coarctata*" materials included specimens originating from six geographical regions of Poland: the Pomeranian Lake District (Gryfiński Landscape Park), Krakowsko-Częstochowska(=Wieluńska) Upland (Ojcowski National Park), Małopolska Upland (Lower Nida Valley), Lubelska Upland (Kazimierz Dolny near Puławy and the nature reserve "Stawska Góra"), Western Beskidy Mts (Beskid Sądecki and Gorce), and Pieniny Mts (for division of Poland into geographical regions see e.g. CZECHOWSKI et al. 2002). The specimens revised constitute the proof materials of several published reports (see Discussion).

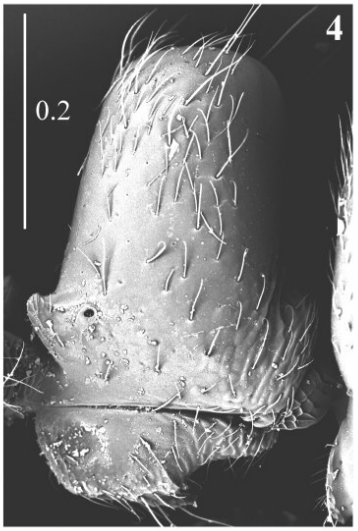
When starting our work on the Polish material of *Ponera*, we followed the methodology of CSŐSZ & SEIFERT (2003) and were able to distinguish *P. testacea* from *P. coarctata* based on that, somewhat complicated basis (it is important to note that these two co-authors proposed two independent morphometric approaches in their joint paper). In the course of our investigations, however, we noticed that the best visible difference between these two species, confirmed also morphometrically, is the shape of the petiole seen from above (as it is distinctively visible on Figs 6 and 7 in CSŐSZ & SEIFERT 2003). In *P. testacea*, the petiole is somewhat lower and thicker at the top. In other words, the anterior face of the petiolar node seems to be more vertical, and less inclined backwards. The petiole is relatively narrower in the dorsal view than in *P. coarctata*. As for the latter feature, to be more precise, the petiolar node dorsum is not really wider or narrower in the species compared (e.g. in relation to the head width); instead, in *P. testacea* it is longer, and because of this it seems to be relatively narrower (Figs 1-4).




**Figs 1-2.** Worker petiole in *P. testacea* (1) and *P. coarctata* (2) from above (scale bar 0.2 mm).




**Figs 3-4.** Worker petiole in *P. testacea* (1) and *P. coarctata* (2) in profile (scale bar 0.2 mm).

It is difficult to measure correctly the length of the petiolar node dorsum from above. For this reason we implemented another approach – to measure length of the petiolar node dorsum in profile (Fig. 5), calling this measurement $PL_1$ [as opposed to CSŐSZ'S PL (in CSŐSZ & SEIFERT 2003)]. Using this approach we found distinct morphometrical differences between the studied species, based on three measurements ($PL_1$, PW, and HW) and two indices ($PW/PL_1$ and $PL_1/HW$) where PW is the maximum width of petiole from above, and HW is the maximum width of the head in full-face view behind (above) eyes. We tested this approach based on *P. coarctata* and *P. testacea* worker specimens from the collection of A. RADCHENKO to show its discriminating potential. Sixteen specimens of *P. coarctata* from the Crimea (Ukraine) and 12 specimens of *P. testacea* from the Ukraine, eastern Hungary and Armenia were used. The species differed statistically (Student *t*-test) highly significantly in mean values of both indices ($PW/PL_1$: $t = 8.760$, $P < 0.001$; $PL_1/HW$: $t = -8.477$, $P < 0.001$). The most spectacular difference was between values of $PW/PL_1$: $\geq 2$ in *P. coarctata* and $< 2$ in *P. testacea* (Table 1).

Then, based on these two indices, we were able to distinguish among our museum Polish *Ponera* specimens those which met the values of *P. testacea*. At the same time, for comparison, we characterised morphometrically a representative sample of Polish *P. coarctata* specimens.

Measurements were made with Olympus SZX-12 stereoscopic microscope. Scanning photographs acquired using Hitachi S-3400N of the Department of Molecular and Biomet-

ric Techniques of the Museum and Institute of Zoology, Polish Academy of Sciences in Warsaw.


**Fig. 5.** Morphometric measurement of length of the petiolar node dorsum ($PL_1$) in *Ponera* workers in profile.

**Table 1.** Comparison of morphometric characteristics of *P. coarctata* and *P. testacea* workers – the means (± SD) and ranges of measurements (in mm) and indices [*P. coarctata* from Ukraine (Crimea); *P. testacea* from Ukraine, Hungary and Armenia].

| Feature | *P. coarctata* (*n* = 16) | *P. testacea* (*n* = 12) |
|---|---|---|
| $PL_1$ | 0.150 ± 0.008 (0.137-0.163) | 0.164 ± 0.011 (0.143-0.182) |
| PW | 0.326 ± 0.016 (0.286-0.351) | 0.297 ± 0.013 (0.273-0.312) |
| HW | 0.590 ± 0.017 (0.559-0.624) | 0.537 ± 0.019 (0.507-0.559) |
| **$PW/PL_1$** | **2.192 ± 0.117 (2.000-2.381)** | **1.818 ± 0.104 (1.667-1.920)** |
| **$PL_1/HW$** | **0.253 ± 0.014 (0.229-0.278)** | **0.305 ± 0.018 (0.268-0.333)** |

## RESULTS

### Occurrence in Poland

Out of all revised Polish "*P. coarctata*" specimens kept in MIZ (originally determined by B. PISARSKI, W. CZECHOWSKA and J. PĘTAL), those from the Małopolska Upland and a part of the specimens from the Lubelska Upland turned out to be *P. testacea*. They originated from the following localities (Fig. 6):

Małopolska Upland

- Krzyżanowice Średnie ad Pińczów (UTM DA69), the nature reserve "Krzyżanowice", 11 VIII 1953, 1 male, leg. team of National Zoological Museum [the former MIZ], det. B. PISARSKI as *P. coarctata* var. *testacea*(!).
- Chotel Czerwony ad Busko Zdrój (UTM DA78), the nature reserve "Chotel Czerwony", 21 VIII 1954, 1 worker, leg. B. PISARSKI.
- Pińczów (UTM DA69), forest "Dębina", 26 VIII 1956, 2 workers, leg. team of Zoo logical Institute, PAS [the former MIZ].

Lubelska Upland

- Kazimierz Dolny ad Puławy (UTM EB68), 21 V 1956, 4 workers, leg. A. RIEDEL; 8 VIII 1958, 2 workers, leg. A. RIEDEL; 8 VII 1962, 1 worker, leg. B. PISARSKI.

All the above findings were formerly related to *P. coarctata* in a paper by CZECHOWSKI & CZECHOWSKA (1999). For all remaining museum specimens revised, their previously determined species status, i.e. *P. coarctata*, was confirmed. Available details of all findings of *Ponera* ants in Poland are given in Discussion.

### Morphometry

As it appears from the above, altogether there were 10 worker specimens and one male of *P. testacea* from Poland in the collection. Out of the workers seven specimens fitted for biometrical analysis. They were morphometrically compared with 10 representatives of Polish *P. coarctata* originated from the Pieniny Mts and the Western Beskidy Mts (Table 2).

In respect of the mean values of both indices used, the species differed highly significantly – $PW/PL_1$: $t = 6.842$, $P < 0.001$; $PL_1/HW$: $t = -8.905$, $P < 0.001$ (Student $t$-test). What is more, for each of the two indices, there was a distinct hiatus between ranges of variability of values typical of each of the species (Table 2). At the same time, values of the indices characteristic of *P. testacea* from Poland matched very well with those of Ukrainian and other *P. testacea* (see Material and methods) – $PW/PL_1$: $t = 0.193$, $P > 0.1$; $PL_1/HW$: $t = -0.722$, $P > 0.1$). On the other hand there were some (not very high) statistically significant differences between Polish and Crimean *P. coarctata* – $PW/PL_1$: $t = -2.111$, $P < 0.05$; $PL_1/HW$: $t = 4.416$, $P < 0.001$) (see Tables 1 and 2).

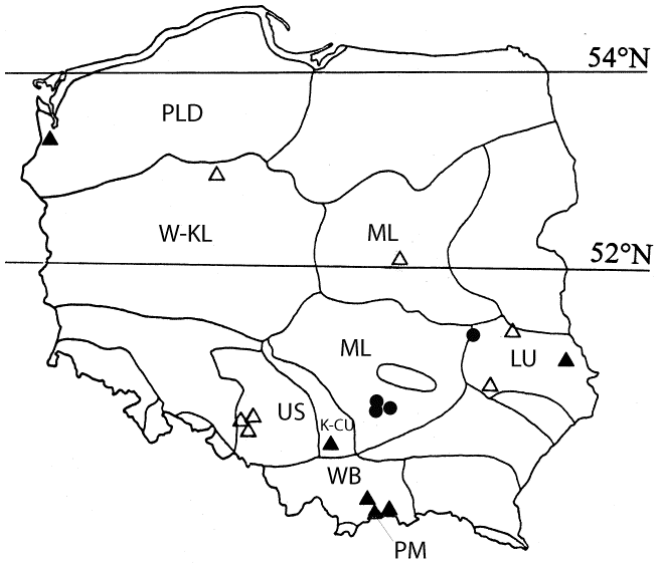



**Fig. 6.** Localities of *Ponera* species in Poland: ● – *P. testacea*, ▲– verified *P. coarctata*, Δ – not verified *P. coarctata* (geographical regions of *Ponera* occurrence: PLD – Pomeranian Lake District, W-KL – Wielkopolsko-Kujawska Lowland, ML – Mazovian Lowland, ML – Małopolska Upland, LU – Lubelska Upland, US – Śląsk Górny, K-CU – Krakowsko-Częstochowska Upland, WB – Western Beskidy Mts, PM – Pieniny Mts).

**Table 2.** The means (± SD) and ranges of measurements (in mm) and indices of *P. coarctata* and *P. testacea* workers from Poland (*P. coarctata* from the Pieniny and Western Beskidy Mts; *P. testacea* from the Małopolska and Lubelska Uplands).

| Feature | *P. coarctata* (*n* = 10) | *P. testacea* (*n* = 7) |
|---|---|---|
| $PL_1$ | 0.129 ± 0.008 (0.121-0.143) | 0.160 ± 0.012 (0.154-0.187) |
| PW | 0.295 ± 0.011 (0.275-0.308) | 0.288 ± 0.017 (0.270-0.297) |
| HW | 0.559 ± 0.020 (0.528-0.583) | 0.514 ± 0.011 (0.495-0.528) |
| **$PW/PL_1$** | **2.285 ± 0.094 (2.154-2.455)** | **1.807 ± 0.140 (1.666-1.929)** |
| **$PL_1/HW$** | **0.231 ± 0.008 (0.218-0.245)** | **0.312 ± 0.026 (0.292-0.366)** |

## DISCUSSION

In Germany, and at the same time in Europe, *P. testacea* reaches 52° north. In Poland, its northernmost known locality, Kazimierz Dolny in the Lubelska Upland, is at a latitude of 51°19'N, and those in the Małopolska Upland are situated within 50°22'-50°32'N (Fig. 6). The surroundings of Kazimierz Dolny (at present the Kazimierski Landscape Park) are known for loess and limestone slopes of the Vistula valley, overgrown with xerothermal grasslands and thickets (for a habitat description and the myrmecofauna of that region see PISARSKI 1953). According to the unpublished field notes of B. PISARSKI, the specimens (one nest sample) of *P. testacea* collected in Kazimierz Dolny in 1956 were found on a rocky terrace within a limestone quarry. Specimens collected in the later years originate from nearby places with similar habitat conditions.

All *P. testacea* localities known in the Małopolska Upland are in the Lower Nida Valley (now the Nadnidziański Landscape Park). This is an area with several nature reserves, mainly of xerothermal vegetation developed on limestone (chalk marl) hills with gypsum outcrops in their top parts (KONDRACKI 1966). This region is the only area in Poland where, due to a very thin soil layer, xerothermal grasslands of different types (with a steppe association *Sisymbrio-Stipetum* as the most characteristic one) are climax plant communities (KOSTROWICKI 1966; for physiographical data of the region see also LIANA 1976). The *P. testacea* male from the reserve "Krzyżanowice" was caught in a habitat of the xerothermal grassland of *Seslereto-Scorzoneretum* association on a gypsum substratum. The worker from the "Chotel Czerwony" reserve originated from a region of gypsum outcrops where *Seslereto-Scorzoneretum*, primeval for that habitat, was successively displaced by *Thalictro-Salvietum*, a grassland association. *Thalictro-Salvietum* demands a bit more fertile soil [habitat data according to LIANA (1976)]. The last two workers collected, i.e. those from Pińczów, originated from a clearing within a dry and light oak forest. It should be mentioned that the area of the Lower Nida Valley is the richest centre of xerothermophilic fauna in Poland (see e.g. LIANA 1976, MAZUR 2001).

All the remaining localities of re-investigated *Ponera* ants in Poland belong to *P. coarctata* (Fig. 6) up to the Szczeciński Landscape Park (Pomeranian Lake District, 53°19'N, where this species was found in dry places within fertile beech forest (*Galio odorati-Fagetum*; WŁODARCZYK 2010). The revised museum *Ponera* specimens, whose species status was confirmed as *P. coarctata*, included proof materials of the published reports on *Ponera* ants in Poland: PĘTAL (1961), CZECHOWSKI (1992), CZECHOWSKI & CZECHOWSKA (1999), CZECHOWSKI et al. (2002), and WŁODARCZYK (2010). For the last of these reports, information on the *P. coarctata* occurrence is already quoted above. Specimens being the evidence of PĘTAL'S (1961) study made in the Lubelska Upland originated from Stawska Góra (Stawska Mt.) near Chełm, a nature reserve of steppe vegetation. CZECHOWSKI (1992) and then CZECHOWSKI & CZECHOWSKA (1999) reported *P. coarctata* from the Gorce Mts (Western Beskidy Mts). The species (one nest) was found there in the locality of Ochotnica Górna in a pine forest (a man-made habitat, alien for that region) overgrowing a south-facing slope. CZECHOWSKI & CZECHOWSKA (1999) based on museum

specimens (leg. E. DAUKSZA et A. KOSTROWICKI, 1956), reported *P. coarctata* also from Beskid Sądecki, another range of the Western Beskidy Mts, from a not specified habitat at Piwniczna and Nowy Sącz, as well as from the Pieniny Mts. Material from the last region amounted to ca. 120 nest samples of *P. coarctata*. They were collected in xerothermal grasslands (*Origano-Brachypodietum*) on the limestone soil of warm and dry slopes. A vague mention in CZECHOWSKI et al. (2002) on *P. coarctata* in the Ojcowski National Park [Krakowsko-Częstochowska(=Wieluńska) Upland] concerns a colony found in a limestone brush-covered grassland.

There remains unchecked reports on "*P. coarctata*" by NOWOTNY (1931), from the Upper Silesia, KULMATYCKI (1922) from the Wielkopolsko-Kujawska Upland, part of that by PĘTAL (1961) from the Lubelska Upland, PISARSKI (1982) from the Mazovian Lowland, and WOYCIECHOWSKI (1985) from the Pieniny Mts, as well as that of BRISCHKE (1888; see below). In principle, one may consider WOYCIECHOWSKI'S *P. coarctata* (one worker found in a xerotermal grassland) as indirectly verified based on all the other *Ponera* samples from the Pieniny Mts, which turned out to be *P. coarctata* (see above).

Voucher specimens of NOWOTNY'S (1931) and KULMATYCKI'S (1922) reports do not exist. In the latter case (Wielkopolsko-Kujawska Lowland) "*P. coarctata*" was found in Janowiec Wielkopolski near Żnin "in a garden", so in all likelihood, it was true *P. coarctata*. In the former case (Upper Silesia), the species was reported from Szymiszów and Góra Świętej Anny near Strzelce Opolskie and Gogolin near Krapkowice with only a slight mention about the habitat: calcareous, warm and only moderately dry. It is worth adding, that Góra Świętej Anny (St. Anna Mt.) is a basaltic-limestone hill (406 m a.s.l.), an ancient extinct volcano.

Nest samples of PĘTAL'S (1961) "*P. coarctata*" from two localities, Wandzin near Lubartów and Kraśnik (both in the Lubelska Upland) also did not survive, and the validity of their identification cannot be verified. According to the author's information, at Wandzin two workers and a dealate queen were found "in a nest of *Formica exsecta* Nyl." (whatever that means), and at Kraśnik the colony nested "on a high railway embankment". PISARSKI (1982) reported "*P. coarctata*" vaguely from "Mazovia" (supposedly the report was about environs of Warsaw), however no specimens from the Mazovian Lowland were found in the collection. Recently *P. coarctata* was found in the Botanical Garden in the centre of Warsaw (H. BABIK, unpublished). For known localities of *P. coarctata*, both verified and not verified, in Poland see Fig. 6.

The oldest and the most vague record of *P. coarctata* within the territory of present-day Poland reports this species from the "Western and Eastern Prussia" (BRISCHKE 1888), i.e. from somewhere in the Pomeranian and/or Masurian Lake Districts. The locality(-ies) is (are) not specified. The report had to concern true *P. coarctata* because of too northern latitude (north of 53°) as for *P. testacea*.

The above survey confirms the findings of CSŐSZ & SEIFERT (2003) and CSŐSZ (2003): *P. coarctata* appears as an oligotopic species, capable of living both in open and wooded habitats as long as they are sufficiently, but not extremely dry and warm. This makes it

different from *P. testacea* which is a rather unconditional stenotope of xerothermal grasslands.

An important "by-product" of the presented study are newly proposed morphometric indices which, strongly reducing the number of necessary measurements, make separation of these two sibling species much easier than the ways proposed by CSŐSZ AND SEIFERT (2003) and CSŐSZ (2003).

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