

Further observations on scorpion genera *Hadrurus* and *Hoffmannihadrurus* (Scorpiones, Caraboctonidae)

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Abstract

Multiple populations of *Hadrurus pinteri* from Baja California Sur, Mexico have been examined. It is demonstrated that the southern populations of this species have a larger number of accessory trichobothria (neobothriotaxy) than the northern populations, numbers exceeding the maximum currently recorded for the genus. Examination of carapace and chela coloration and its patterns show a close affinity between *H. pinteri* and the dark phase of *H. concolorous*. A new morphometric ratio of the carapace is defined that distinguishes *Hadrurus* from *Hoffmannihadrurus*, further supporting the monophyly of the latter genus.

Keywords

Caraboctonidae, *Hadrurus*, *Hoffmannihadrurus*, neobothriotaxy, Baja California Sur, Mexico

Introduction

Fet and Sologlad (2008) presented a cladistic analysis of scorpion superfamily Iuroidea. In this analysis they demonstrated the monophyly of genus *Hoffmannihadrurus*, a taxon which had been recently synonymized by Francke and Prendini (2008). In this present contribution, new information is presented from the evaluation of additional specimens of *Hadrurus pinteri* Stahnke, 1967 and *H. concolorous* Stahnke, 1967, all from Baja California Sur, Mexico. This information is relevant to the cladistic analysis of Fet and Sologlad (2008) as follows: 1) it supports their hypothesis that the northern

populations of *H. pinteri* are losing accessory trichobothria as demonstrated by a larger number being found in the southern populations; 2) analysis of coloration and its patterns of the carapace and chela of *H. pinteri* show close affinities to the dark phase of *H. concolorous*, not *Hoffmanniadrurus gertschi*, as proposed by Francke and Prendini (2008); and 3) a new morphometric ratio involving the carapace is defined which can be used to diagnostically separate genera *Hadrurus* and *Hoffmanniadrurus*. Items 2 and 3 further support the result of Fet and Soleglad (2008) that confirms the validity of genus *Hoffmanniadrurus*.

Material and methods

Abbreviations: ABDSP, Anza-Borrego Desert State Park, San Diego and Riverside Counties, California, USA.

Depositories: CAS, California Academy of Sciences, San Francisco, California, USA; MES, Personal collection of Michael E. Soleglad, Borrego Springs, California, USA; VF, Personal collection of Victor Fet, Huntington, West Virginia, USA.

Material

The following material was examined for analysis and/or illustrations provided in this paper. It must also be noted that many observations and statistics provided in this paper are augmented, in part, from other data previously collected and discussed in Soleglad (1976), Fet et al. (2001, 2004), Soleglad and Fet (2004), and Fet and Soleglad (2008).

Genus *Hadrurus* Thorell, 1876: *Hadrurus arizonensis arizonensis* Ewing, 1928: Carrizo Badlands, Vallecito Creek, ABDSP, California, USA ♂ (MES), 41.2 mi. E San Luis, Sonora, Mexico, ♂ (MES); *Hadrurus arizonensis austrinus* Williams, 1970: Oakies Landing, Baja California, Mexico, ♂ ♀ (MES); *Hadrurus concolorous* Stahnke, 1969: 8 km S Tambobiche, Baja California Sur, Mexico, ♀ (CAS), 5 mi SW San Miguel de Comondú, Baja California Sur, Mexico, ♂ (CAS), Santa Rosalia, Baja California Sur, Mexico, ♂ ♀ (MES), Las Bombas, Baja California Sur, Mexico, ♂ (MES); *Hadrurus hirsutus* (Wood, 1863): Cabo San Lucas, Baja California Sur, Mexico, 2 ♂ (MES); *Hadrurus obscurus* Williams, 1970: Indian Gorge, ABDSP, California, USA, 2 ♀ (MES); *Hadrurus pinteri* Stahnke, 1969: Oakies Landing, Baja California, Mexico, 3 ♀ 4 ♂ 3 J (MES), Arroyo Calamajué, Baja California, Mexico, 2 ♀ (MES), Punta Trinidad, Baja California Sur, Mexico, 2 ♂ (CAS), San Ignacio, Baja California Sur, Mexico, 2 ♀ (CAS), Bahia Concepción, Baja California Sur, Mexico, ♀ (CAS), 5 mi SW San Miguel de Comondú, Baja California Sur, Mexico, ♂ (CAS), 5–10 mi SW San Miguel de Comondú, Baja California Sur, Mexico, 5 ♂ 4 ♀ (CAS), 5.6 mi SW Loreto, Baja California Sur, Mexico, ♀ (CAS), 7.2 mi SW Loreto, Baja

California Sur, Mexico, ♂ (CAS), 8.3 mi SW Loreto, Baja California Sur, Mexico, ♀ (CAS), 14.7 mi SW Loreto, Baja California Sur, Mexico, ♀ (CAS), Isla Danzante (NW side), Baja California Sur, Mexico, 5 ♀ (CAS), Agua Verde Bay, Baja California Sur, Mexico, 2 ♀ (CAS); *Hadrurus spadix* Stahnke, 1940: Hawthorne, Mineral Co., Nevada, USA (VF).

Genus *Hoffmannihadrurus* Fet & Soleglad, 2004: *Hoffmannihadrurus aztecus* (Pocock, 1902): Tehuacán, Puebla, Mexico, 3 ♂ 1 ♀ (MES), Tomellín, Oaxaca, Mexico, ♂ (MES); *Hoffmannihadrurus gertschi* (Soleglad, 1976), Azcala, Guerrero, Mexico, paratype ♀ (CAS), Iguala, Guerrero, Mexico, ♀ (MES).

Neobothriotaxy in *Hadrurus pinteri*

Neobothriotaxy in *Hadrurus* was first reported by Gertsch and Soleglad (1972: figs 96–107) when the first trichobothrial pattern for this genus was illustrated for *H. arizonensis*. The unusual and complicated pattern exhibited in this genus was later investigated by Soleglad (1976) where he illustrated and provided trichobothria statistics of the chela for eight species (now divided into two genera, *Hadrurus* and *Hoffmannihadrurus*). This analysis of Soleglad (1976) involved the study of over 200 specimens and the description of new species *Hoffmannihadrurus gertschi* (assigned to *Hadrurus* at the time). The most important result of this study was that the major species groups could be diagnosed using chelal trichobothrial patterns alone. These diagnoses were based in most part on the presence/absence and numbers of *accessory trichobothria* on three surfaces of the chela, ventral, internal, and external. In other words, neobothriotaxy could be used in large part to distinguish the species. Years later, Fet et al. (2001) provided the first systematic analysis of the six species of *Hadrurus* using DNA. Supporting this analysis was morphology analyzed from a cladistic perspective; again, neobothriotaxy contributed several characters. The original data set of Soleglad (1976) was expanded by over 50 % with many additional specimens being added, primarily in the “*hirsutus*” group. At this time the sample set was over 600 (i.e., both chelae are considered). Based on the large collection of neobothriotaxy data from these specimens as well as from chactoid scorpion genera (*Anuroctonus* and *Euscorpis*), data that were closely correlated with the specimen’s geographical locality, Soleglad and Fet (2004: 102–106) presented an “accessory trichobothria loss” hypothesis. We will not present this hypothesis here, it is discussed in detail in the aforementioned reference as well as in the most recent work of Fet and Soleglad (2008: 273–277). In the latter reference, germane to this study, it was suggested that the accessory trichobothria were being lost in the northern populations of *H. pinteri*, presumably the direction of the radiation of this species. I.e., the assumption being the species origin is in Baja California Sur, the primary location of the “*hirsutus*” group, which also includes species *H. concolorous* and *H. hirsutus* as well as *H. pinteri*. However, Fet and Soleglad (2008) had very little *H. pinteri* material from the south-

ern area of Baja California, so this assumption of accessory trichobothria loss in the northern half was not based on substantial data.

In this study, we have analyzed a collection of southern populations of *H. pinteri* from the California Academy of Sciences. We tabulated the number of chelal accessory trichobothria of the ventral, internal, and external surfaces and compared it to the data of the northern populations. Figure 1 shows the geographic localities of *H. pinteri* from which the accessory trichobothria data are derived. The northern samples, totaling 13 specimens, are from the northern half of their known range, the majority of specimens from Oakies Landing. The most southern of these specimens is from the Arroyo Calamajué. The southern samples, comprised of 28 specimens, span the entire southern range originally outlined by Williams (1970). The most northern specimens, from Punta Trinidad, are farther north than originally reported by Williams (1970), these specimens not listed in his material examined. San Miguel de Comondú provided the most specimens, ten in number. Interestingly, the range of *H. pinteri*, as stated by Williams (1970) and shown in our map (Fig. 1) is disjunct, roughly 150 km separating the northern and southern ranges. *H. pinteri*, as reported by Williams (1970: 18): "... was never found in predominantly sandy habitats or away from habitats of volcanic origin ...". As can be seen in Fig. 1, the terrain is certainly mountainous, the eastern portion of the peninsula volcanic from Puertocitos to well south of Loreto. What is interesting in this map is that the area of disjunction between the two ranges of *H. pinteri* is also volcanic leading to the conclusion that *H. pinteri* distribution is probably not disjunct. The gap in reported localities is probably due to the lack of collecting in this area. Williams and his associates conducted their monumental collecting expeditions in Baja California during the late 1960s, Williams (1980: 1), in his monograph on the scorpions of Baja California, Mexico, reported that 60,000 specimens were examined from Baja California! However, during this time, access to this particular eastern area of Baja California was difficult if not impossible, as the primary road (unpaved during the time) was on the western side of the peninsula.

Table 1 shows the statistical breakdown of accessory trichobothria for the entire "*hirsutus*" group, involving more than 260 samples. Of importance to this discussion is the breakdown of *H. pinteri* into its northern and southern populations. As predicted by Fet and Sologlad (2008), we see that the southern populations of *H. pinteri* exhibited larger numbers of accessory trichobothria than the northern samples in two of three chelal surfaces, the internal accessory trichobothria showing slightly higher numbers in the northern populations. For the ventral series, the mean value of the southern populations was 8 % larger than that seen in the northern populations, roughly two additional accessory trichobothria on an average. Similarly, the external surface of the southern populations exhibited over a 7 % mean value difference. For the internal series, the northern populations had 1.4 % more accessory trichobothria on an average, though the standard error range maximum value was slightly larger in the southern population.

Of particular interest, we found that the southern populations of *H. pinteri* exhibited the largest number of accessory trichobothria found in the three individual

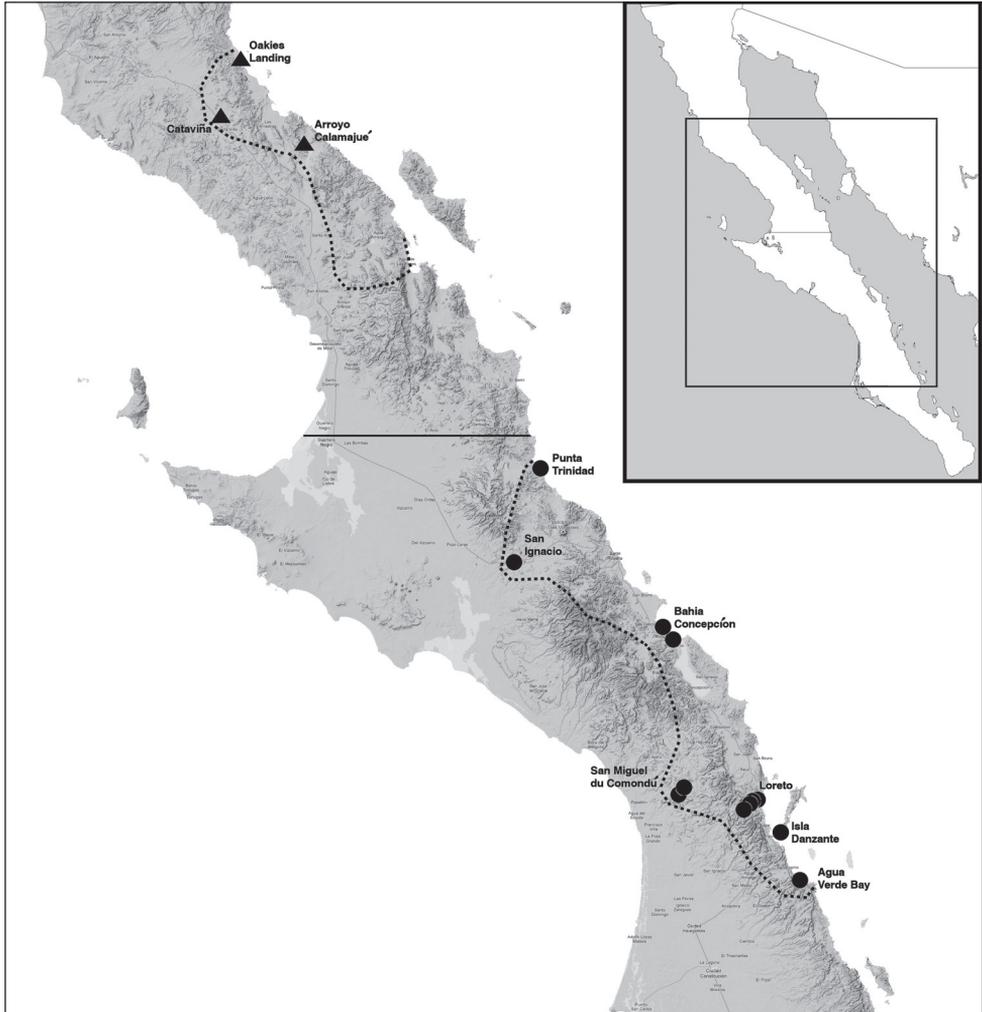


Figure 1. Reported distribution of *Hadrurus pinteri*. The two dotted line areas partition *H. pinteri* distribution into the northern and southern portions of Baja California Peninsula, Mexico. These areas, in general, denote the original distribution reported by Williams (1970: fig. 45). Solid icons indicate localities of specimens used in our statistics, triangles northern specimens and circles southern specimens. Note that localities indicated with icons are labeled with larger text. Boxed inset map indicates the portion of Baja California, Mexico shown in foreground terrain map.

chelal surfaces for the entire genus *Hadrurus* (as well as for its sister genus *Hoffmannihadrurus*). Previously, based on data presented in Fet et al. (2004), the largest number of internal, ventral, and external accessory trichobothria were seven (*H. arizonensis*), 27 (23 accessory, *H. pinteri*), and four (*H. pinteri* and *Hoffmannihadrurus gertschi*), respectively. In these newly examined populations of *H. pinteri* we found seven internal accessory trichobothria in two specimens, from Loreto and Agua Verde Bay, thus matching the maximum counts found in *H. arizonensis*. For the latter species,

Table 1. Statistics showing neobothriotaxy of the pedipalp chela of the *Hadrurus* “*hirsutus*” group. In particular, two disjunct populations of *H. pinteri* are contrasted showing that for two of the three trichobothrial series, the southern population (i.e., Baja California Sur) has the largest number of accessory trichobothria, roughly a 7.5 % increase. MVD = mean value difference; p-value = ANOVA output. Statistical data group: minimum–maximum (mean) (\pm SDEV) [N] {standard error range} (coefficient of variability) (SDEV/mean). * includes orthobothriotaxic trichobothria V_1 – V_4 . Many of the statistics are from previous studies, as well as new material examined in this project. See Sologlad (1976), Sologlad and Fet (2004), Fet et al. (2004), and Fet and Sologlad (2008).

Chela Neobothriotaxy Statistics for <i>Hadrurus</i> “<i>hirsutus</i>” Group		
<i>Hadrurus pinteri</i>, Baja California, Mexico (“Norte” half of peninsula)		
Ventral*	22–26 (24.292) (\pm 1.429) [024] {22.863–25.721} (0.059)	
Internal	5–6 (5.692) (\pm 0.471) [026] { 5.222–6.163} (0.083)	
External	3–4 (3.500) (\pm 0.511) [024] { 2.989–4.011} (0.146)	
<i>Hadrurus pinteri</i>, Baja California Sur, Mexico (“Sur” half of peninsula)		
Ventral*	23–32 (26.245) (\pm 1.870) [053] {24.375–28.115} (0.071)	MVD/p-value: Sur > 8.0%/2.06E-05
Internal	5–7 (5.611) (\pm 0.564) [054] { 5.048–6.175} (0.100)	MVD/p-value: Sur < 1.4%/0.527192
External	3–5 (3.759) (\pm 0.612) [054] { 3.147–4.372} (0.163)	MVD/p-value: Sur > 7.4%/0.074043
<i>Hadrurus pinteri</i>, all of Baja California, Mexico		
Ventral*	22–32 (25.636) (\pm 1.960) [077] {23.677–27.596} (0.076)	
Internal	5–7 (5.637) (\pm 0.534) [080] { 5.104–6.171} (0.095)	
External	3–5 (3.679) (\pm 0.592) [078] { 3.087–4.272} (0.161)	
<i>Hadrurus concolorous</i>		
Ventral*	15–20 (17.804) (\pm 1.170) [158] {16.634–18.974} (0.066)	
Internal	3–5 (4.154) (\pm 0.493) [162] { 3.661–4.647} (0.119)	
External	1–2 (1.226) (\pm 0.420) [159] { 0.807–1.646} (0.342)	
<i>Hadrurus hirsutus</i>		
Ventral*	14–16 (15.682) (\pm 0.568) [022] {15.114–16.250} (0.036)	
Internal	4–5 (4.048) (\pm 0.218) [021] { 3.829–4.266} (0.054)	
External	1–2 (1.048) (\pm 0.218) [021] { 0.829–1.266} (0.208)	

four specimens exhibited seven internal accessory trichobothria, one from ABDSP in California, and three from Sonora, Mexico, all belonging to the pale form of this species (previously referred to as *H. a. pallidus*; synonymized by Fet et al., 2001). Now, comparing *H. pinteri* to *H. arizonensis*, which includes subspecies *H. a. austrinus*, we see that the former species mean value is slightly larger, 5.637 vs. 5.490 (note that 253 samples represent *H. arizonensis*). For the southern populations of *H. pinteri*, we found a specimen with 32 ventral trichobothria (28 accessory), exceeding the previous largest number by five. In addition to the largest ventral number, one specimen (from Punta Trinidad) exhibited 30 ventral trichobothria, five with 29, and four with 28. The largest ventral trichobothria count from the northern half of Baja California is 26. The mean value difference between the two localities in Baja California is 8 %. We encountered no less than five instances of five external accessory trichobothria

(Punta Trinidad, San Miguel de Comondú, and Isla Danzante). This count includes the diagnostic and unique accessory trichobothrium found on the base of the fixed finger. Figures 2–4 illustrate examples of these large accessory trichobothria numbers for each chelal surface.

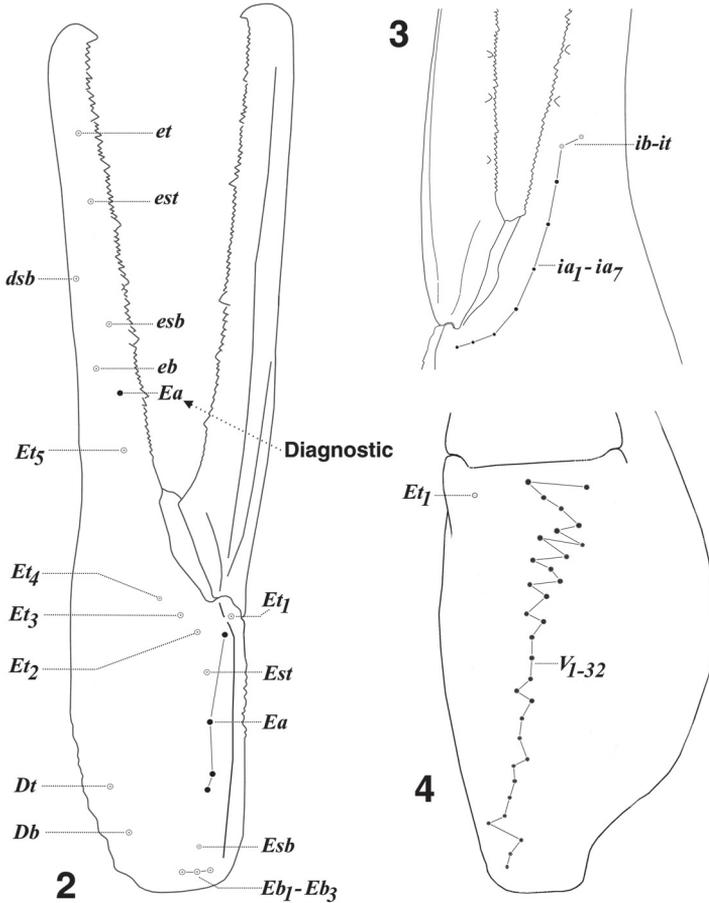
Coloration and Patterns of *Hadrurus* and *Hoffmannihadrurus*

While examining the southern populations of *H. pinteri*, we discovered that two of the specimens were in fact not *H. pinteri*, but *H. concolorous*. Based on coloration and patterns these two specimens certainly looked like *H. pinteri*, only after detailed trichobothrial analysis could we isolate the two specimens from *H. pinteri*. One specimen, from Tambobiche, had a somewhat small number of accessory trichobothria, only 14–15 ventral and three internal. The other specimen, from San Miguel de Comondú, exhibited 18–19 ventral, five internal, and one external accessory trichobothria. In both specimens, the diagnostic accessory trichobothrium on the fixed finger was absent. Of special interest, the specimen from San Miguel de Comondú was contained in a vial with a large *H. pinteri* male, thus they were collected together.

Figures 5–9 show the carapaces of *H. pinteri*, the two *H. concolorous* misidentified for *H. pinteri*, and two additional color phases of *H. concolorous*. The carapaces of *H. pinteri* and the *H. concolorous* from Tambobiche are indistinguishable, both uniformly dark in color. The carapace of the specimen from San Miguel de Comondú is lighter in color, more close to the reddish specimen from Santa Rosalia (Fig. 8). The specimen from the sand dune area in Las Bombas (Fig. 9) is typical of *H. concolorous*, as indicated by its name “concolorous”.

The chela of *H. pinteri* (Fig. 13) and the *H. concolorous* from San Miguel de Comondú (Fig. 14) are indistinguishable. Again, the chela from the Las Bombas specimen (Fig. 15) is typical of the “concolorous” phase of *H. concolorous*.

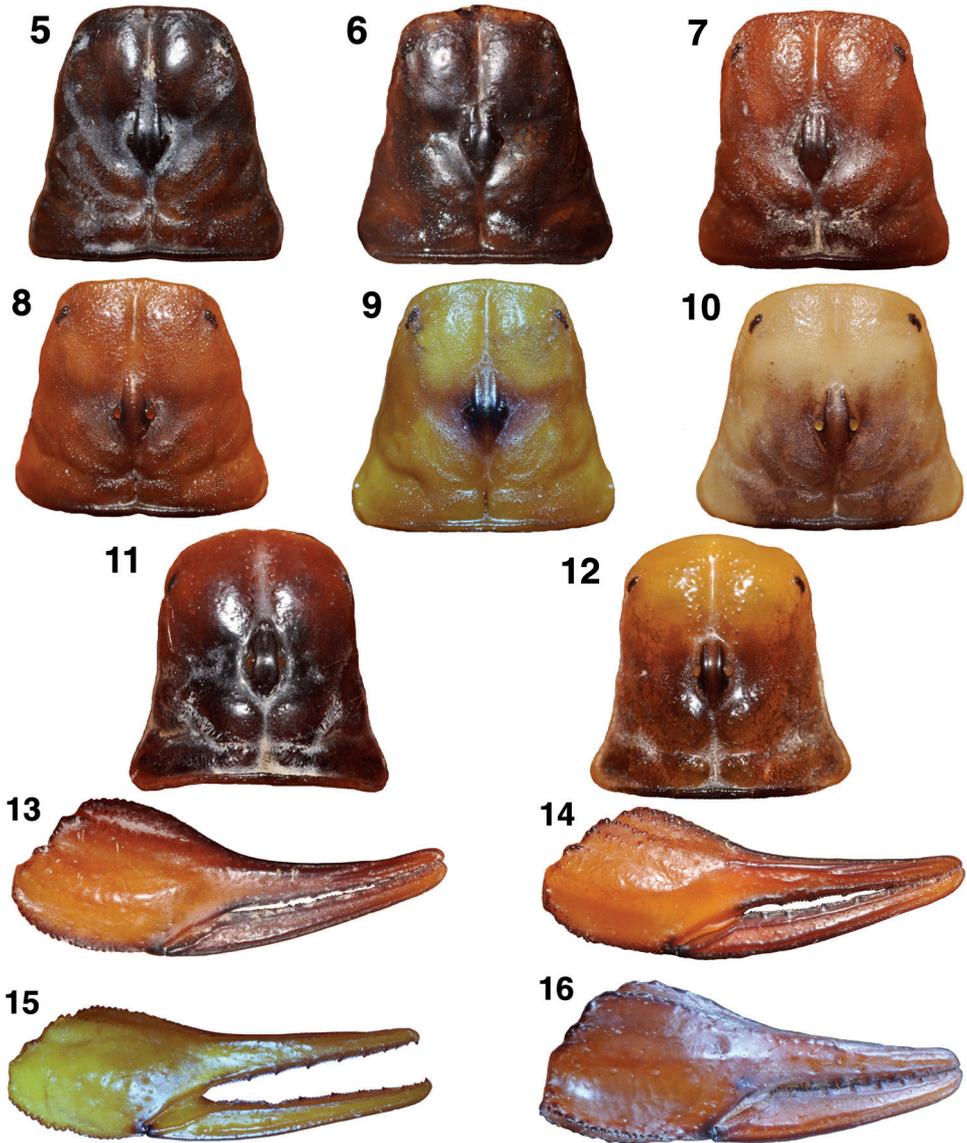
Figures 11–12 show the carapacial coloration and patterns of *Hoffmannihadrurus gertschi* and *H. aztecus*. Although the carapace of *H. gertschi* is considerably darker, its interocular area is lighter in color, exhibiting similar light/dark patterns as seen in its sister species *H. aztecus*. It is clear that the carapace of *H. gertschi* is not patterned as in *Hadrurus pinteri* (Fig. 5). Similarly the chela of *H. gertschi* (Fig. 16) is darker than that seen in *Hadrurus pinteri* (Fig. 13). Francke and Prendini (2008) attempted to associate the carapace and chelal coloration/patterns of *H. gertschi* to that of *Hadrurus pinteri* (their “coloration” characters 2–3, and 5). However, the dark color phase of *H. concolorous* is much closer to *H. pinteri*, a more reasonable association since the two species are closely related and share the same geographical area! The above observations of essentially identical coloration in *H. pinteri* and the dark phase of *H. concolorous* in conjunction with the lack of close compliance to *Hoffmannihadrurus gertschi* further endorses the observations of Fet and Soleglad (2008: 272–273).



Figures 2–4. *Hadrurus pinteri*, chelal neobothriotaxy showing examples of patterns with the *largest number* of accessory trichobothria (closed circles). **2** External view of left chela (reversed), juvenile male, Punta Trinidad, Baja California Sur, Mexico, showing *five* external accessory (*Ea*) trichobothria, including the diagnostic *Ea* on the base of the fixed finger (*db*, *dst*, and *dt* are not shown) **3** Internal view of left chela (reversed), adult female, Loreto, Baja California Sur, Mexico, showing *nine* internal trichobothria, including *ib-it* and *seven* accessory trichobothria (*ia*). Note that the accessory trichobothria reduce in size somewhat as they occur basally **4** Ventral view of right chela, adult female, Bahía Concepción, Baja California Sur, Mexico, showing 32 ventral trichobothria, including *V₁–V₄*, and *Et₁* (note that *V₁–V₄* are not distinguished from accessory trichobothria).

Carapace Morphometrics of *Hadrurus* and *Hoffmannihadrurus*

While studying the carapacial coloration and its patterns in *Hadrurus* and *Hoffmannihadrurus* we observed that the convexed anterior edge exhibited in both genera was considerably more exaggerated in *Hoffmannihadrurus*. This is quite visible in the photographs presented in Figs 5–12 as well as in Fet et al. (2004: figs 57–58) where *Hadrurus pinteri* and *Hoffmannihadrurus aztecus* are shown. We analyzed this difference in



Figures 5–16. Carapaces and chelae of *Hadrurus* and *Hoffmannihadrurus* showing the variability in coloration and its patterns. Of particular interest is the range of variability in *H. concolorous* (**Figs 6–9, 14–15**) exhibiting dark coloration patterns essentially identical to *H. pinteri* (**Figs 5, 13**) to pale yellow with little or no patterns. Also of interest is the darkened posterior half of the carapace in *Hoffmannihadrurus gertschi*, matching the same area that is also darkened in *H. aztecus* **5, 13** *Hadrurus pinteri*, male, San Miguel de Comondú, Baja California Sur, Mexico **6** *H. concolorous*, female, Tambobiche, Baja California Sur, Mexico **7, 14** *H. concolorous*, male, San Miguel de Comondú, Baja California Sur, Mexico (same locality as *H. pinteri* in Fig. 5) **8** *H. concolorous*, male, Santa Rosalia, Baja California Sur, Mexico **9, 15** *H. concolorous*, male, Las Bombas, Baja California Sur, Mexico **10** *H. hirsutus*, male, Cabo San Lucas, Baja California Sur, Mexico **11, 16** *Hoffmannihadrurus gertschi*, female paratype, Azcala, Guerrero, Mexico **12** *H. aztecus*, female, Tehuacán, Puebla, Mexico.

the anterior edge of the carapace in both genera, including all species and subspecies of *Hadrurus*. Several morphometrics were obtained in an attempt to quantify this visible difference between the two genera. From these morphometrics we discovered that the anterior edge (measured from the lateral eyes to the distal aspect of the carapace, see Figure 17) was longer in *Hoffmannihadrurus*. We concluded that the more overt convex aspect seen in the *Hoffmannihadrurus* carapace contributes directly to its elongation. This was evident from two ratios we constructed: the anterior edge length as compared to the carapace length and the anterior edge length as compared to the position of the median eyes. The results derived from these two ratios are nearly identical, so we present here only the latter of the two ratios.

Figure 17 illustrates exactly how these two measurements are taken and Table 2 presents the results involving 30 samples spanning all species of *Hadrurus* (20 samples), and *Hoffmannihadrurus* (ten samples). The sampling included four *Hoffmannihadrurus gertschi*, six *H. aztecus*, and ten samples each from the *Hadrurus* “arizonensis” group (i.e., both *H. arizonensis* subspecies, *H. obscurus*, and *H. spadix*), and the “hirsutus” group (i.e., *H. pinteri*, *H. concolorous*, and *H. hirsutus*). The mean value differences

Table 2. Statistics showing differences in the length of the carapace anterior edge in subfamily Hadrurinae based on the following morphometric ratio: *anterior_edge_length / median_tubercle_position*. See Fig. 17 for methods of measurement. Data shows that the anterior edge of *Hoffmannihadrurus* is approximately 48 % longer than in *Hadrurus*. Large standard error range separation and a very small *p*-value from variance analysis further support the significant statistical difference between the two genera. Statistical data group: minimum–maximum (mean) (\pm SDEV) [N] {standard error range} (coefficient of variability). * Mean value difference, standard error range separation, and analysis of variance. Statistical data derived from specimens examined and the following references: Williams (1970), Stahnke (1971), Sologlad (1976), and Fet et al. (2004).

Carapace Anterior Edge Ratio for Subfamily Hadrurinae	
<i>Hoffmannihadrurus</i>	
<i>H. gertschi</i>	0.351–0.383 (0.3663) [4]
<i>H. aztecus</i>	0.327–0.368 (0.3461) [6]
Genus	0.327–0.383 (0.3542) (\pm 0.0166) [10] {0.338–0.371} (0.047)
<i>Hadrurus</i>	
<i>H. pinteri</i>	0.219–0.257 (0.2320) [4]
<i>H. concolorous</i>	0.219–0.246 (0.2331) [4]
<i>H. hirsutus</i>	0.220–0.250 (0.2349) [2]
<i>H. arizonensis</i>	0.233–0.267 (0.2553) [4]
<i>H. obscurus</i>	0.206–0.253 (0.2322) [4]
<i>H. spadix</i>	0.256–0.260 (0.2584) [2]
Genus	0.206–0.267 (0.2399) (\pm 0.0185) [20] {0.218–0.262} (0.092)

Statistical comparisons between genera:

MVD * = 47.7 %

SERS * = 238.8 %

ANOVA* *p*-value = 6.12E-16

of this morphometric ratio between these genera is 47.7%, implying that in *Hoffmannihadrurus*, the anterior edge of the carapace is roughly 50 % longer than in *Hadrurus*. [note that the carapace of *H. concolorous* from Tambobiche (Fig. 6) was not included in the morphometric sampling due to its obvious damaged anterior edge.] Other relevant statistical indicators are no overlap of the absolute range, over 200 % separation of the standard error range, and a very small ANOVA *p-value* of 6.12E-16.

Fet and Soleglad (2008) presented a detailed cladistic analysis of the superfamily Luroidea demonstrating monophyly of the families Luridae and Caraboctonidae, the subfamilies Caraboctoninae and Hadrurinae, and the genera *Hadrurus* and *Hoffmannihadrurus*. This resulted in the reestablishment of the genus *Hoffmannihadrurus*, which had been recently synonymized by Francke and Prendini (2008). Fet and Soleglad's (2008) approach was to present their cladistic analysis in three successive layers: fundamental characters, low-level characters, and characters based on the accessory trichobothria loss hypothesis. The first layer presented characters that dealt with higher-level systematic aggregates, characters that were assumption- and hypothesis-free. Low-level characters dealt with coloration and its patterns, setation, and etc., which are generally species-level characters. The last layer of characters, based on the loss hypothesis, as its name implies, is a hypothesis, thus formed from a set of assumptions. Although the hypothesis has been studied across three separate scorpion groups involving thousands of scorpions, it is still a hypothesis. It must be noted here that the monophyly of *Hoffmannihadrurus* was demonstrated at the first layer of cladistic analysis, using only fundamental characters. As the other two layers were added, successively, this monophyly was further demonstrated with larger support (i.e., more characters and greater bootstrap/jackknife support).

The new character described above showing differences in the anterior edge length between *Hadrurus* and *Hoffmannihadrurus* represents the *fifth* new character supporting monophyly of *Hoffmannihadrurus* (i.e., four were previously identified by Fet and Soleglad (2008)); these five characters were not included in the analysis by

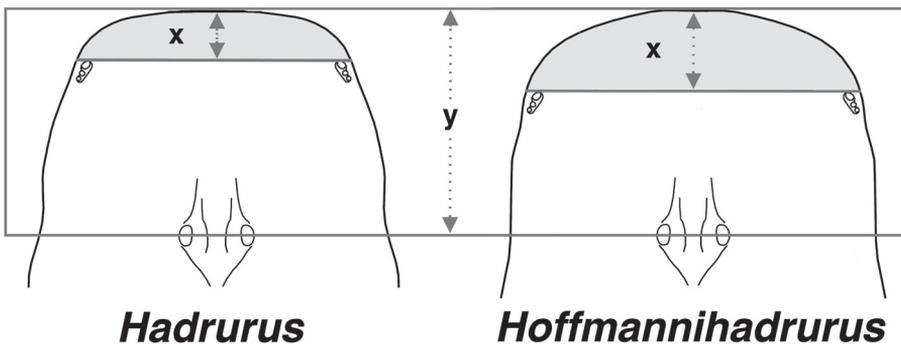


Figure 17. Method of measurement of carapace for genera *Hadrurus* and *Hoffmannihadrurus* for determining morphometric ratio *anterior_edge_length* (x) / *median_tubercle_position* (y). Shaded area indicates *anterior_edge_length*. Diagrammatic drawings based on *Hadrurus pinteri* and *Hoffmannihadrurus gertschi*.

Francke and Prendini (2008). In this study, we added this character to the original cladistic analysis presented by Fet and Soleglad (2008: 265) by adding a new state (= 3) to the fundamental character 23 (carapace anterior edge). We then reinitiated the fundamental and final character cladistic sequences with the following results: for the fundamental sequence, instead of three MPT's (most parsimonious trees) we obtained two; the bootstrap/jackknife results for monophyly of *Hoffmanniadrurus* improved from 68/66 % to 88/83 % (that is, 88/83 percent of the 5000 pseudoreplicates supported this monophyly); for the final sequence, bootstrap/jackknife results for monophyly improved from 99/97 % to 100/98 %; and finally, character 23: state = 3 distributed unambiguously on the *Hoffmanniadrurus* node in both sequences, which is clearly a demonstrated synapomorphy for genus *Hoffmanniadrurus*. Refer to Fet and Soleglad (2008) for details in this cladistic analysis and definitions of specialized terminology.

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We thank Anthea Carmichael, Willis J. Gertsch, Matthew R. Graham, Charles Griswold, František Kovařík, Gary A. Polis, and Darrell Ubick for the loans and/or gifts of specimens. Finally, we extend our gratitude to two anonymous reviewers of this paper.

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A review of the Holarctic genus *Tmeticus* Menge, 1868 (Araneae, Linyphiidae), with a description of a new genus

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Abstract

Eight species attributed to *Tmeticus* are reviewed; five are redescribed and illustrated: *T. affinis* (Blackwall, 1885), *T. bipunctis* (Bösenberg & Strand, 1906), *T. nigriceps* Kulczyński, 1916, *T. ornatus* (Emerton, 1914) and *T. tolli* Kulczyński, 1908. The new genus, *Paratmeticus* gen. n. is erected for *T. bipunctis*, and a new combination is established: *Paratmeticus bipunctis* (Bösenberg & Strand, 1906), **comb. n.** Three species names: *Gonyldidium vile* Kulczyński, 1885, **syn. n.**, *Tmeticus difficilis* Kulczyński, 1926, **syn. n.** and *T. dubius* Kulczyński, 1926, **syn. n.**, are synonymized with *T. tolli* Kulczyński, 1908. Although *G. vile* has date priority over *T. tolli* it is synonymized because of the lack of usage. Three species from Japan attributed to *Tmeticus*: *T. nesperigonoides* Saito & Ono, 2001, *T. nigerrimus* Saito & Ono, 2001 and *T. vulcanicus* Saito & Ono, 2001 are not related to *T. affinis*, the type species of the genus, and their affinities remain unclear. The male of *T. nigriceps* is described for the first time.

Keywords

spiders, Erigoninae, Palaearctic, Nearctic, new synonym, new combination

Introduction

Tmeticus is a small Erigoninae genus with nine species restricted to the Holarctic Region (Platnick 2010). Members of this genus can be easily recognized by their elongate male palp with a small bulbus and a ventral tooth on the patella. Only the type species of the genus, *T. affinis* (Blackwall, 1855), occurs both in the Palaearctic and Nearctic Regions. One species, *T. ornatus* (Emerton, 1914), is restricted to the Nearctic Region. All other species have been recorded from Asia. The highest species diversity of the genus is in Japan, as a result of three recently described species.

While studying the Siberian and Far Eastern Linyphiidae, we encountered certain difficulties in identifying *Tmeticus* species. Only two of the four species occurring in northern Asia, *T. affinis* (Blackwall, 1885) and *T. tolli* Kulczyński, 1908, were properly illustrated. Thus, the main purposes of this study are to provide diagnostic illustrations for each Asian species and to describe a new genus.

Material and methods

Pictures of the general appearance and copulatory organs were made using an Olympus SZX16 stereomicroscope, with an Olympus E-520 camera, and prepared using CombineZM software. Photographs were taken in dishes of different sizes with paraffin in the bottom. Different sized holes were made in the bottom to retain the specimens in the desired position. Scanning electron micrographs were made using a SEM JEOL JSM-5200 scanning microscope. SEM and digital photographs were made in the Zoological Museum, University of Turku. The terminology of the copulatory organs follows Hormiga (2000). The smallest and biggest specimens are reported, all measurements are in millimetres.

Abbreviations

- IBPN** Institute for Biological Problems of the North, Russian Academy of Sciences, Magadan (curator Yu.M. Marusik).
PSU Department of Zoology, Perm State University (curator S.L. Esyunin).
ZMMU Zoological Museum of the Moscow State University (curator K.G. Mikhailov).
ZMUT Zoological Museum, University of Turku (curator S. Koponen).

Tmeticus Menge, 1868

Type species. *Tmeticus leptocaulis* Menge, 1868 (= *T. affinis* (Blackwall, 1855)).

Diagnosis. Males of this genus are easily recognized by possessing a mastidion (large tooth on frontal part of chelicera) and by their elongate palp with patella longer than cymbium, ventral terminal tooth on patella, and thin bulbus (as wide as terminal

part of tibia). Females are recognized by their flat epigyne without a cavity. Males may be confused only with the trans-Palaearctic *Hylyphantes graminicola* (Sundevall, 1830) because it also has a mastidion and a patellar tooth. However, the males of *Hylyphantes* have shorter palp, undivided embolic division and screw-like embolus.

The females of *Tmeticus* may be confused with those of several genera, such as *Oedothorax* Bertkau, 1883 or with *Donacochara speciosa* (Thorell, 1875). However, *Oedothorax* females have a different colour pattern, and *D. speciosa* is notably larger.

Description. Small to medium-sized (2.5–4.1), light to dark-coloured erigonines. Male carapace unmodified and without sulci, it may be uniformly coloured or with a darker cephalic region. Abdomen unmodified, dark, of uniform colour. Male chelicera modified by possessing a mastidion (*Ma*, promarginal tooth). Maxilla with apical-retrolateral spine. Tibial spines 2-2-1-1. TmIV present. TmI 0.65–0.8. Male palp elongate. Femur, patella and tibia longer than wide. Patella with conical, ventral terminal tooth (*Tt*). Tibia with two apophyses (*Ta*). Paracymbium large, with or without (*T. affinis*) distinct apical pocket. Tegulum with distinct sac (*Ts*) and large (*T. tolli*) or small protegulum (*Pt*). Radix with straight apical process (*Ap*), tailpiece (*Tp*) without extension, embolus (*Em*) short and straight, or long and forming a semicircle; embolic membrane (*Me*) large. Epigyne without distinct fovea or openings. Median (=dorsal, *sensu* Hormiga 2002) plate plain or with ridges.

Composition. According to Platnick's (2010) catalogue eight species are listed in this genus: *T. affinis* (Blackwall, 1855) (Holarctic), *T. bipunctis* (Bösenberg & Strand, 1906) (Far East Asia), *T. neserigonoides* Saito & Ono, 2001 (Japan), *T. nigerrimus* Saito & Ono, 2001 (Japan), *T. nigriceps* (Kulczyński, 1916) (Northern Siberia), *T. ornatus* (Emerton, 1914) (USA & Canada), *T. tolli* Kulczyński, 1908 (Siberia) and *T. vulcanicus* Saito & Ono, 2001 (Japan). In fact, there are three more species names within this genus: *T. difficilis* Kulczyński, 1926, *T. dubius* Kulczyński, 1926 and *Gongylidium vile* Kulczyński, 1885. Of these, the first two are listed under *Centromerus*, and the last one under *Oedothorax*. These three names were included in *Tmeticus* by Holm (1973) and Eskov (1994) but were considered as synonyms of *T. tolli*.

On the basis of the present study, we conclude that *Tmeticus* encompasses four species: *T. affinis*, *T. nigriceps*, *T. ornatus* and *T. tolli*. A new genus has been erected for *T. bipunctis*. *Tmeticus neserigonoides* might be correctly placed in this genus, but as we failed to re-examine its specimens, we treat it as *incertae sedis* (see below). Two other Japanese species belong elsewhere, but their correct assignments require further study.

Comments. *Tmeticus* is unusual in the Erigoninae because all its species can be recognized by their carapace colour pattern. Three sibling species: *T. nigriceps*, *T. ornatus* and *T. tolli* cannot be recognized by their embolic division, but the females of these species have distinctly different epigynes.

Interrelationships. *T. affinis* differs from the three other species by the shape of the paracymbium, the straight embolus and the high protegulum with papillae. It also possesses a different type of the tibial apophysis, not originating at the terminal edge of the tibia as in other Erigoninae and other *Tmeticus*, but slightly aside of the edge.

Relationships. In general appearance, male palp structure and cheliceral dentition, the members of this genus are similar to *Hylyphantes graminicola*, but the latter has a different type of embolic division and epigyne. When Wiehle (1956) described *Donacochara speciosa* (Thorell, 1875) he compared it with *T. affinis*. Both species have a long palp, small bulbous, and the chelicera of the male has a mastidion. The embolic division in both species is rather similar, but the radical process and the embolus proper occupy different positions.

The embolic division of *Tmeticus* is similar to those in *Phaulothrix hardyi* (Blackwall, 1850) (cf. Millidge 1977: f. 18), *Lophomma punctatum* (Blackwall, 1841) (Fig. 58) or members of *Oreoneta* Chyzer & Kulczyński, 1894 (Fig. 57). All these genera have a more or less straight, two-armed embolic division (embolus proper + anterior radical process), with the embolus proper situated more dorsally than the process. All three genera have a wide embolic membrane.

Millidge (1977) placed *Tmeticus* in a separate nominative group with *Ostearius* Hull, 1911, *Donacochara* Simon, 1884, *Eboria* Falconer, 1910 and *Sciastes* Bishop & Crosby, 1938. Hormiga (2002) placed *Tmeticus* close to a very heterogeneous group of the higher Erigoninae that includes such unrelated genera (in terms of the structure of the embolic division) as *Walckenaeria* Blackwall, 1833 (twisted radix), *Oedothorax*, *Entelecara* Simon, 1884, *Gonatium* Menge, 1968 and others.

Judging from the drawings (Figs 35.110, 35.111 in Draney and Buckle 2005), *Tmeticus* can be related to the Nearctic *Nanavia monticola* Chamberlin & Ivie, 1933. The latter species seems to have been mistakenly considered a synonym of *Leptorhoptrum robustum* (Westring, 1851) (see Platnick 2010). Both genera and species were synonymized by Eskov and Marusik (1994) on the basis of a comparison of *L. robustum* and the poor figures of *N. monticola*. *N. monticola* has a very long palpal tibia, and the paracymbium and embolic division are very similar to those of *T. affinis*. The relationships of the two genera and taxonomic status of *Nanavia* Chamberlin & Ivie, 1933 are outside the scope of this study and will be considered elsewhere.

Key to *Tmeticus* species

The males of *T. nigriceps* and *T. ornatus* cannot be distinguished.

1. Carapace uniformly coloured (Figs 10–11, 25–26) **2**
- Cephalic part darker than red/orange thoracic part (Figs 21–24) **3**
2. Carapace red, orange/yellow; occurs in Siberia and the Far East ***T. tolli***
- Carapace reddish brown, with slightly lighter posterior part (Figs 10–11), tibia with two small claw-like apophyses (Figs 1–2, 5, 7), median plate of epigyne square-shaped (Figs 4, 8–9, 19); distributed throughout the Holarctic .
..... ***T. affinis***
3. Cephalic part dark brown (Figs 23–24), epigyne with extended median plate (Figs 18, 43–44); occurs in the tundra zone of Siberia ***T. nigriceps***
- Cephalic part brown (Figs 21–22), epigyne without extension (Figs 17, 47, 48); occurs in southern Canada and the northern United States.... ***T. ornatus***

Species survey

Tmeticus affinis (Blackwall, 1855)

Figs 1–11, 19, 49, 61

Neriene a. Blackwall, 1855: 121 (D♂).

T. a.: Wiehle, 1960: 411, f. 751–756 (♂♀).

T. a.: Merrett, 1963: 410, f. 83A–C (♂).

T. a.: Millidge, 1977: 37, f. 150 (♂).

T. a.: Roberts, 1987: 44, f. 12e (♂♀).

T. a.: Millidge, 1993: 147, f. 32 (♀).

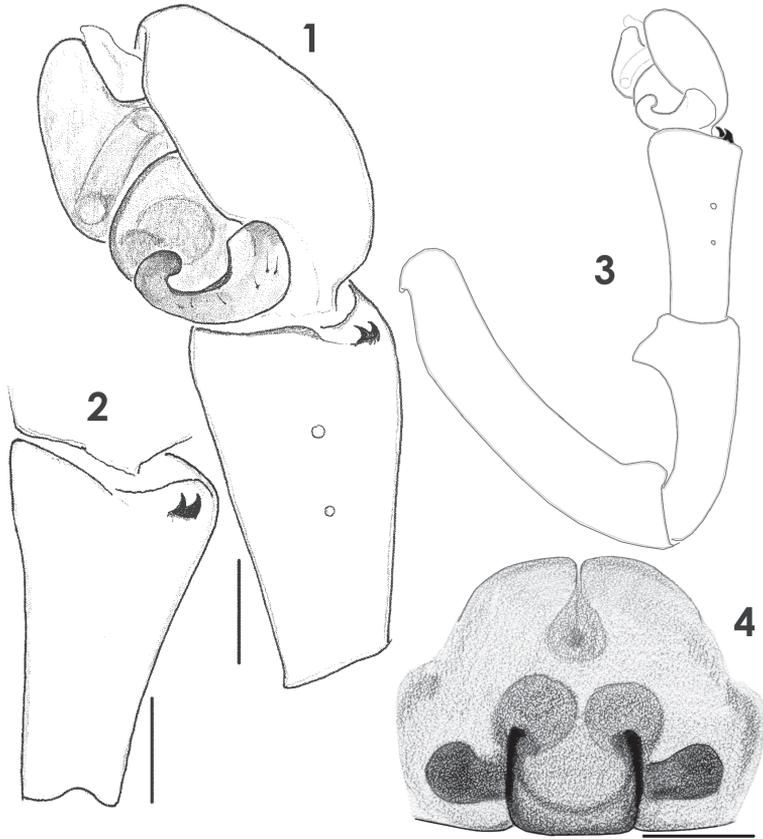
For a complete set of references see Platnick (2010).

Material examined. FINLAND: 2♀ (ZMUT), Turku Ruissalo, 14.11.1966 (M. Saaristo); 2♀ (ZMUT), Turku Ruissalo, sea shore litter, 27.10.1966 (M. Saaristo); 1♂ (ZMUT) Turku Hirvensalo Illoinen, 30.5.1966 (P.T. Lehtinen); 1♀ (ZMUT), Turku Käsämöki Pomponrahka, 30.05.1967 (M. Saaristo); 1♀ (ZMUT) Pori Yyteri, 16.10.1966 (M. Saaristo); 1♀ (ZMUT), Pudasjärvi Hirvaskoski, 12.08.1959 (P.T. Lehtinen); 1♂ (ZMUT), Kuusamo Torankijärvi, 7.7.1966 (M. Saaristo); 1♀ (ZMUT), Kajaani, Koutaniemi, 16.07.1972 (P.T. Lehtinen); 1♂ (ZMUT) Inari Repojoki, 9.7.1961 (O.V. Lindqvist); 1♀ (ZMUT) Utsjoki Kevo, birch forest on lake shore, 20.06.–20.07.1970 (E.T. Linnaluoto). RUSSIA: *Krasnoyarsk* Province, 1♂ 2♀ (ZMMU), Mirnoye, Yenisei River left bank, 23.06.1978 (K.Yu. Eskov); 2♀ (ZMMU), Mirnoye, Yenisei River left bank, 27.07.1979 (K.Yu. Eskov). *Yakutia*, 2♂ 2♀ (ZMUT), El'gyay, big "alas" pond, 24.07.1977 (S. Koponen); 1♂ (ZMMU), western Yakutia, Kempendyay River 80 km up stream from the mouth, riverside meadow, 1–15.08.1988 (K.Yu. Eskov). *Kamchatka* Peninsula, 1♂ 1♀ (IBPN), Talovskoye Lake, Kuyul River, 16.08.1990 (M.B. Skopets). *Chukotka*: 1♂ (ZMMU), Markovo, July 1986 (G. Chernova). CANADA, *Alberta*: 1♂ (only the photo provided by D.J. Buckle has been studied), Caribou Mountain Wildlands, Wentzel Lake, 50°02'N, 114°28'W, sweeping horsetail meadow, 16.07.2003 (T. Johnson).

Diagnosis. This species is easily recognized by its brownish carapace with a darker cephalic region. Males are easily recognized by their palp, which has a characteristic tibial apophysis and embolic division with the anterior radical process equal in length to the embolus proper (embolus longer than anterior radial process in other species). Females are easily recognized by the shape of the epigyne.

Description. For detailed description see Wiehle (1960). ♀ 2.5–3.0, ♂ 2.5–2.8. TmI 0.65–0.75. Carapace reddish brown, rather dark in males. Cephalic region slightly darker than thoracic, but there is no clear demarcation between the two. Abdomen black. Legs orange-brown. Palp as in Figs 1–3, 5–7, 49, 61; epigyne as in Figs 4, 8–9, 19.

Distribution. This species is known all over Eurasia, from western Europe to Kamchatka. In the Nearctic Region, it has been reported from Alberta (Nordstrom & Buckle 2006).



Figures 1–4. Copulatory organs of *Tmeticus affinis*. **1** male palp, retrolateral view **2** palpal tibia, dorso-lateral view **3** whole male palp, retrolateral view **4** epigyne, ventral view. (scale bar 0.1 mm).

***Tmeticus tolli* Kulczyński, 1908**

Figs 15–16, 20, 25–34, 50, 56

Gongylidium vile Kulczyński, 1885: 37, pl. 10, f. 16 (♀), syn. n.

T. t. Kulczyński, 1908: 15, pl. 1, f. 3, 7–8, 22–23 (♂♀).

T. difficilis Kulczyński, 1926: 50 (♀), syn. n.

T. dubius Kulczyński, 1926: 49 (♀), syn. n.

Centromerus t.: Sytshevskaja, 1935: 90.

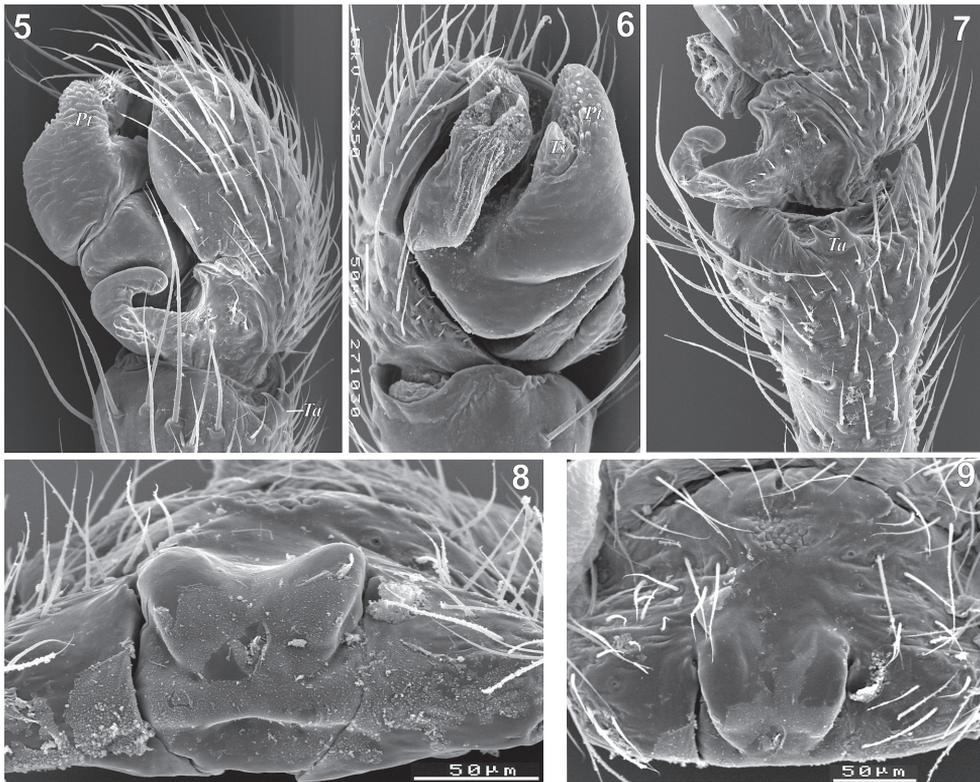
T. t.: Holm, 1973: 89.

T. t.: Eskov, 1994: 107.

T. t.: Hormiga, 2000: 56, f. 29A-I, pl. 67A-F, 68A-F (♂♀).

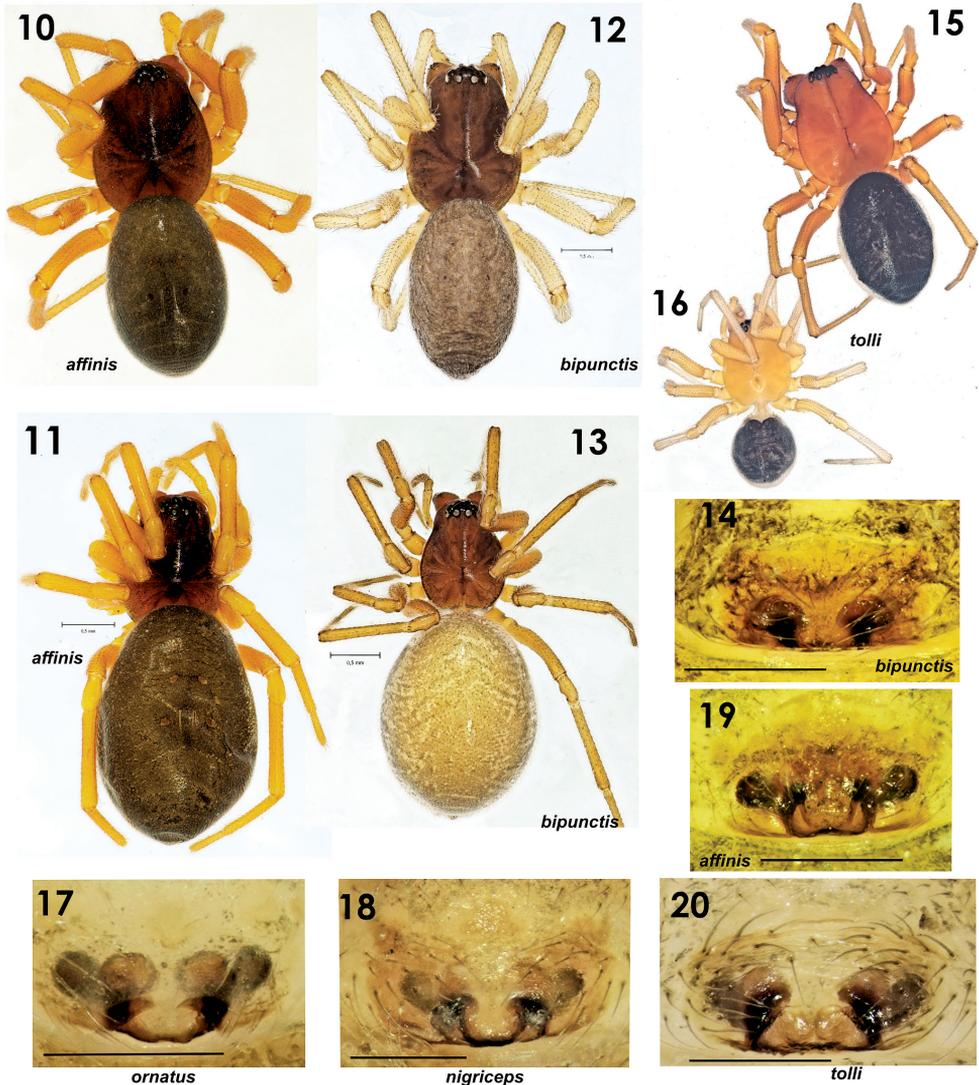
T. affinis: Marusik & Logunov, 1999: 245 (misidentification).

Material examined. RUSSIA: **Krasnoyarsk** Province: 1♂ 2♀ (ZMMU), Mirnoye, Yenisei River left bank, 23.06.1978 (K.Yu. Eskov). **Evenkiya**: 40♂♀ (ZMMU), Tai-



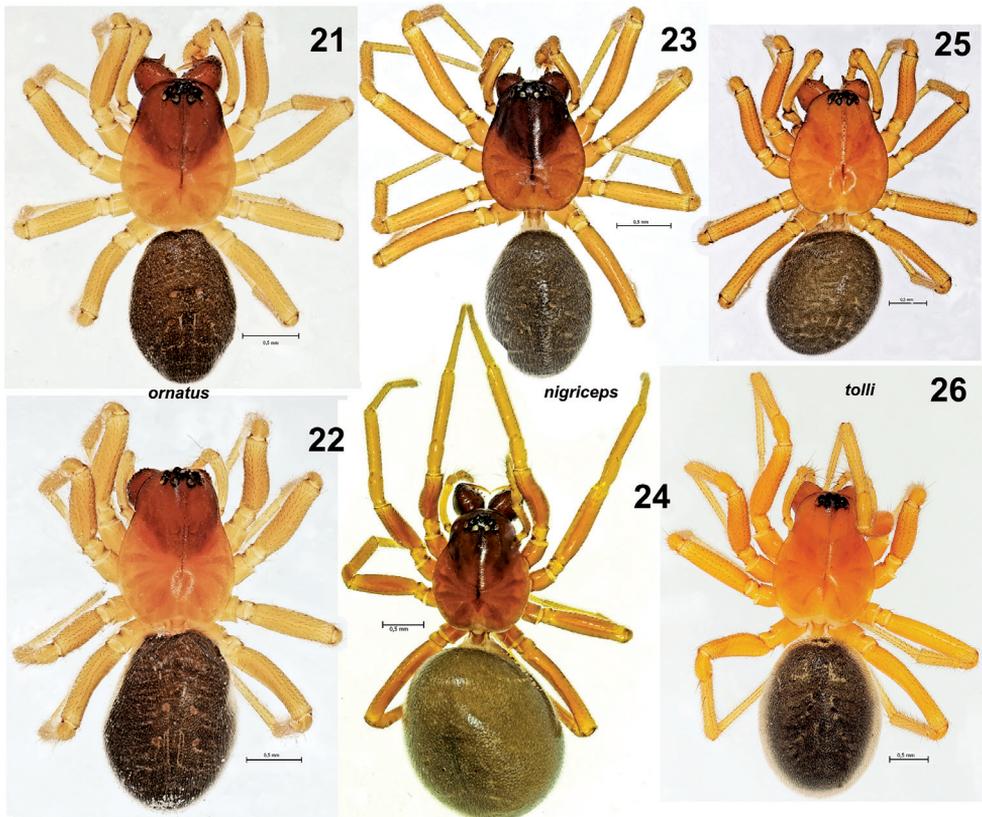
Figures 5–9. Copulatory organs of *Tmeticus affinis*. **5** male palp, retrolateral view **6** male palp, prolateral view **7** male palp, dorsal view **8** epigyne, caudal view **9** epigyne, ventral view. Abbreviations: *Pr* – protegulum; *Ta* – tibial apophysis; *Ts* – tegular sac.

mura River, Neptene River mouth, riparian spruce forest with alder, Summer 1982 (K.Yu. Eskov); 2♀ (ZMMU), Chambe River mouth, meteorological station “Kerbo”, floodplain willow stand, litter, 21.08.1982 (K.Yu. Eskov). **Khabarovsk** Province: 2♀ (IBPN), Okhotski Dist., Gyrbykan R. (Ul’ya River basin), 20.08–15.09.1986 (I.D. Sukatcheva); 1♂ 3♀ (IBPN), Khetana River (tributary of Amka River, Ulya River basin), August 1985 (V.V. Zherikhin). **Maritime** Prov.: 3♂ 2♀ (IBPN), [05], Khanka Lake CW shore, Sosnovy Isl & peninsula nearby, 44°52'N 132°07'E, 17.07.1998 (Yu.M. Marusik). 1♀ (IBPN), [03], Khanka Lake, CE shore, 44°39'N 132°34'E, 15–16.07.1998 (Yu.M. Marusik). **Magadan** Area: 3♂ 2♀ (IBPN), Motykley Bay, 59°30'N 148°50'E, Summer 1994 (E. Izergina); 1♂ 1♀ (IBPN), 137th km of Kolyma Hwy, 60°25'N 151°30'E, Ola River, valley forest, 28.09.1994 (Yu.M. Marusik); 1♂ 2♀ (IBPN), ca 50 km N of Magadan, Khasyn River, environs of Splavnaya Vil., 28.05.1988 (Yu.M. Marusik); 25♂♀ (IBPN), 30km N of Magadan, Snow Valley Vil., Dukcha River valley, 7.10.1984 (Yu.M. Marusik). **Sakhalin** Island: 1♂ 6♀ (IBPN), Okha Dist., Ten’ga River, May 1987 (A.M. Basarukin); 4♀ (IBPN), Tomari Dist., Ainskoye Lake, Ptichya river, 24.05.-10.06.1984 (A.M. Basarukin); 1♀ CE part, Leonidovka River, 8 km SE of Leonidovo Vil., 49°16.506'N 142°58.390'E,



Figures 10–20. Habitus and epigyne of *Tmeticus affinis* (10–11, 19), *Paratmeticus bipunctis* (12–14), *Tmeticus tolli* (15–16, 20), *T. ornatus* (17) and *T. nigriceps* (18). 10, 12, 14–16 male habitus, dorsal view 11, 13 female general appearance, dorsal view 14, 17–20 epigyne, ventral view 15–16 difference in the size between males from the same sample. (scale bar 0.2 mm, if not otherwise indicated).

9.08.2001 (Yu.M. Marusik). **Kamchatka** Peninsula: 2♀ (ZMMU), 40 km from Ust'-Kamchatsk, 09.1973 (A.S. Glikman); 1♂ 4♀ (IBPN), 10–12 km N of Paratunka Vil., Yelizovo Forestry, 53.050°N 158.225°E, 15–28.07.2004 (A.S. Ryabukhin). **MON-GOLIA: Arkhangai** Aimak: 2♂ 2♀ (IBPN) [12], Ondrer-Ulaan, Tsakhir, Chulut gorge 48°07'N 100°22'E, 2100 m, 10–13.06.1997 (Yu.M. Marusik). **Central** (=Tov) Aimak: 1♀ (IBPN), Terelzh Mt., south exposed slope (about 80 km NE of Ulan-Bator, 1988 (S. Heimer).

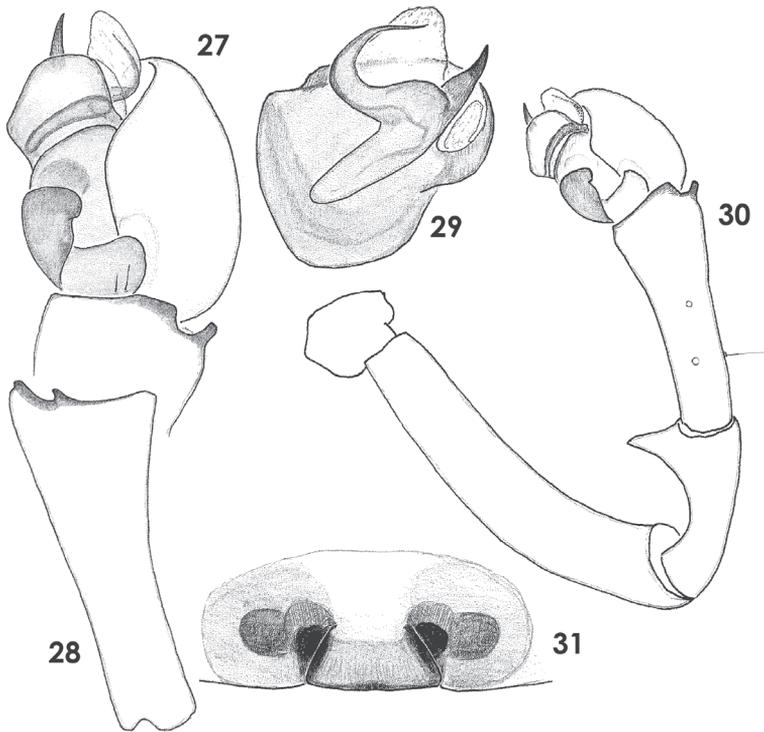


Figures 21–26. Habitus of *Tmeticus ornatus* (21–22), *T. nigriceps* (23–24) and *T. tolli* (25–26). 21, 23, 25 male, dorsal view 22, 24, 26 female, dorsal view.

Diagnosis. *T. tolli* is easily distinguished from the similar *T. ornatus* and *T. nigriceps* by having a uniformly coloured carapace in both sexes.

Description. Both sexes were described in detail by Hormiga (2000). ♀ 2.8–4.1, ♂ 2.5–3.1. TmI 0.68–0.8. Carapace from orange to pale yellow with black median stripe. Abdomen from light brown to blackish. Legs coloured as carapace. Palp as in Figs 27–30, 32, 50, 56, epigyne as in Figs 20, 31, 33–34.

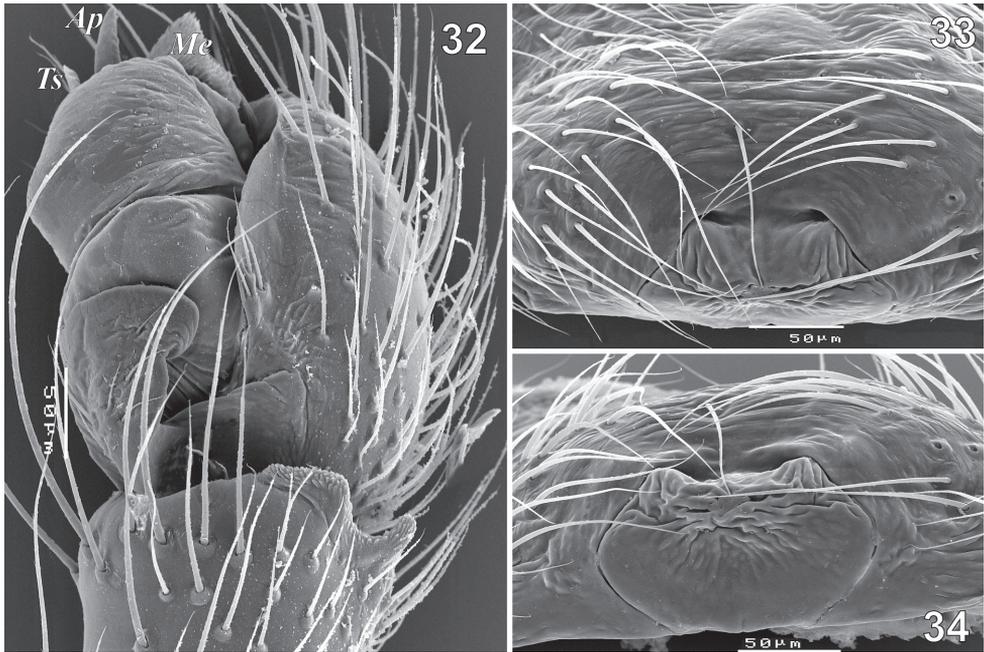
Comments. *T. difficilis* Kulczyński, 1926 was described on the basis of the female holotype from Lake “Kurarotschnoje” (=Kurazhechnoye, ca. 56°10'N, 161°45'E, collected 9.06.1909) and *T. dubius* Kulczyński, 1926 was described on the basis of two females from Lake “Klutshevskoje” (= maybe Klyuchi Vil., c. 60 km from Kurarochnoye Lake). In his descriptions Kulczyński (1926) compared both species with *T. tolli*. Both species were transferred to *Centromerus* (a member of the Micronetinae, a different subfamily) by Reimoser (1919) and this transfer was not contested by Charitonov (1932). Sytschevskaya (1935), who collected in the same places, suggested that both species, in addition to *Gongylidium vile* Kulczyński, 1885 (from Petropavlovsk-Kamchatski) maybe conspecific with *T. tolli*. Holm (1973) agreed with Sytschevskaya



Figures 27–31. Copulatory organs of *Tmeticus tolli*. **27** male palp, retrolateral view **28** palpal tibia, dorso-lateral view **29** bulb, prolateral view **30** – whole male palp, retrolateral view **31** epigyne, ventral view.

(1935). Eskov (1994) and Mikhailov (1997) listed the three species as synonyms of *T. tolli*, but formal synonymies were not proposed. In addition, *G. vile* (listed as *Oedothorax vilus* in Platnick's (2010) catalogue has date priority over *T. tolli*.

Although Kulczyński (1885) compared *G. vile* with European *Oedothorax* (the epigyne of *T. tolli* is very similar to those in *Oedothorax*), he mentioned the colour of the carapace “*flavido-rufo*” (yellow-red = orange), which is typical for *T. tolli* and such coloration is absent from *Oedothorax* species. Furthermore, no *Oedothorax* species has been recorded from Kamchatka. In order to retain stability we suggest suppression of the name *Gongylidium vile* Kulczyński, 1885, because it does not appear in the literature (except for catalogues and nomenclatorial notes), whereas *T. tolli* has been used in more than 25 publications by more than 10 different authors during the past 50 years (Holm 1973; Eskov 1988, 1994; Koponen & Marusik 1992; Marusik et al. 1992, 1993, 2002; Marusik 1993, 2005a-b; Rybalov et al. 2002; Hormiga 2000; Tanasevitch 2006; Trilikauskas & Tanasevitch 2006; etc.). We agree with Eskov about the status of these species and here formally propose three new synonymies: *Gongylidium vile* Kulczyński, 1885, syn. n. = *Tmeticus difficilis* Kulczyński, 1926, syn. n. and *Tmeticus dubius* Kulczyński, 1926, syn. n. = *Tmeticus tolli* Kulczyński, 1908.



Figures 32–34. Copulatory organs of *Tmeticus tolli*. **32** male palp, retrolateral view **33** epigyne, ventral view **34** epigyne, caudal view. Abbreviations: *Ap* – anterior radial process; *Me* – embolic membrane; *Ts* – regular sac.

Distribution. This species is distributed east of Yenisei (Eskov 1994) to Chukotka and southward to central Mongolia (Marusik & Logunov 1999: sub. *T. affinis*), Maritime Province of Russia (present data) and northern Sakhalin (Eskov 1994). *T. tolli* also occurs in northeastern China. YM saw one female specimen of this species in the collection of Baoding University (China).

***Tmeticus nigriceps* (Kulczyński, 1916)**

Figs 18, 23–24, 35–44, 52, 55

Gongylidium n. Kulczyński, 1916: 8, pl. 1, f. 10 (♀).

T. n.: Holm, 1973: 89.

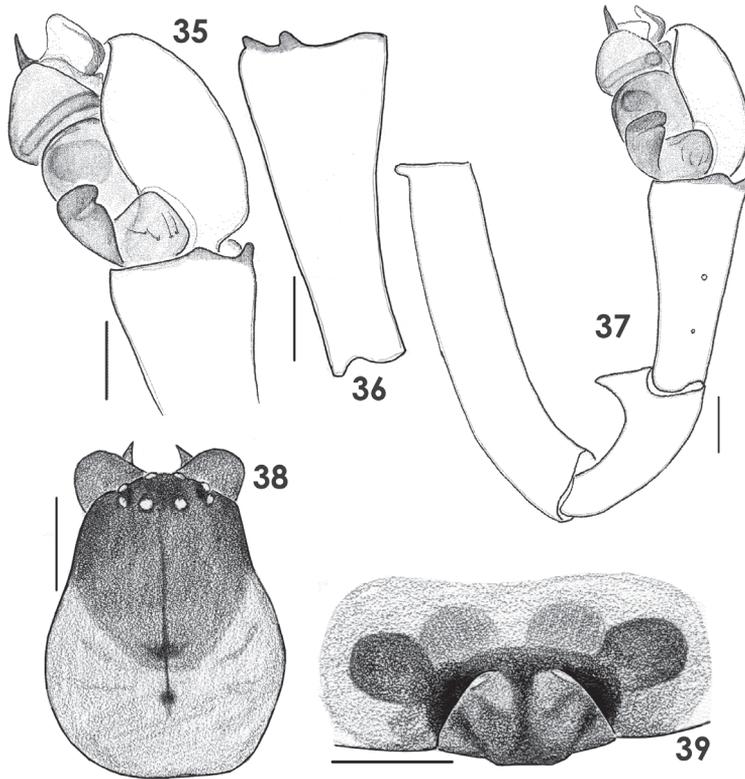
T. n.: Eskov, 1994: 107.

Misidentifications (all refer to *Zornella cultrigera* (L. Koch, 1879) see Holm (1973):

Gongylidium nigriceps: Tullgren, 1955: 355, f. 56 (♀).

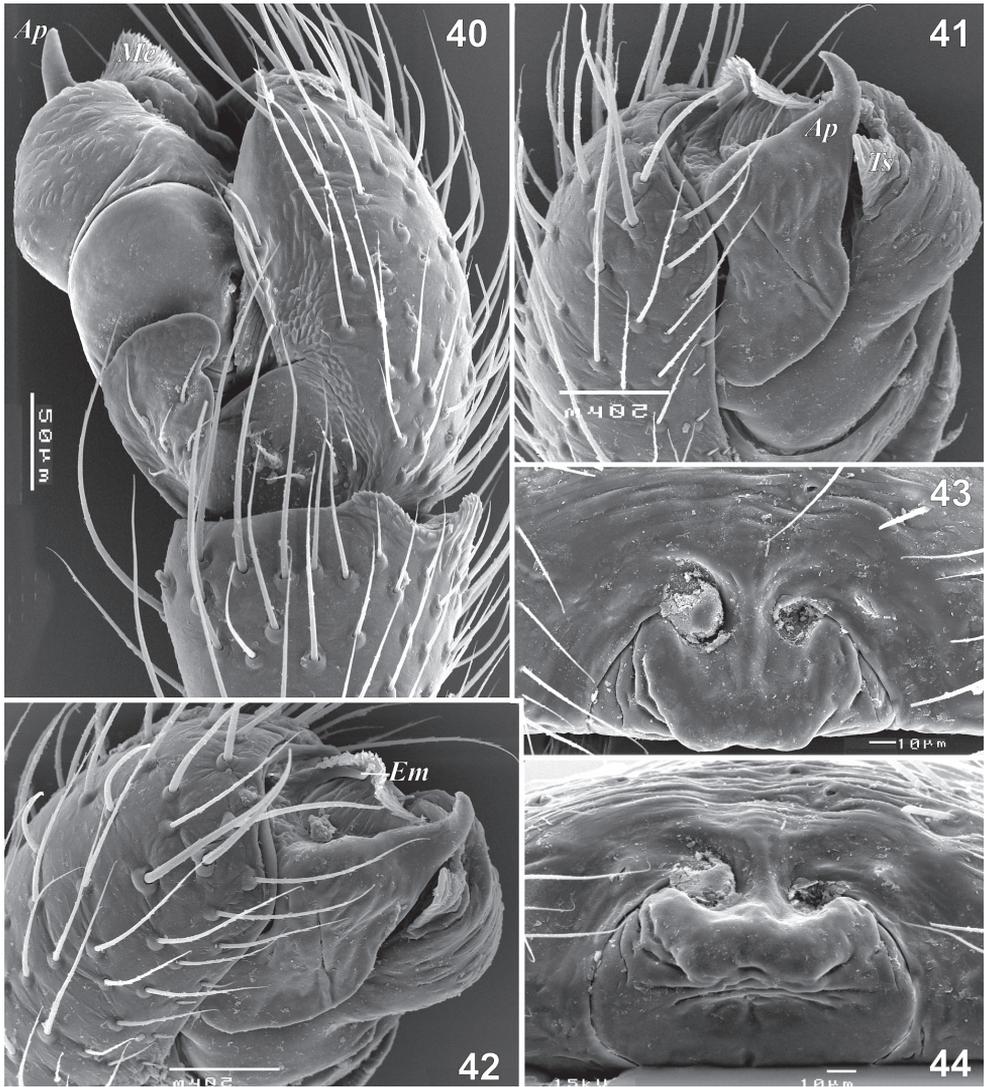
Gongylidium nigriceps: Hauge, 1969: 6, f. 12 (♀).

Material examined. RUSSIA: *Arkhangel'sk* Area: 1♂ (IBPN), Barents Sea, Dolgiy Il-sand, 69°12'N, Summer 2004 (O.L. Makarova). **Polar Ural:** 1♂ (ZMUT), Oktyabrskij, Ob River shore, *Salix viminalis* vegetation, 12.-13.7.1994 (S. Koponen); 1♀ (PSU-95),



Figures 35–39. Copulatory organs and male carapace of *Tmeticus nigriceps*. **35** male palp, retrolateral view **36** palpal tibia, dorso-lateral view **37** whole male palp, retrolateral view **38** male carapace, dorsal view **39** epigyne, ventral view. (scale bar 0.1 mm).

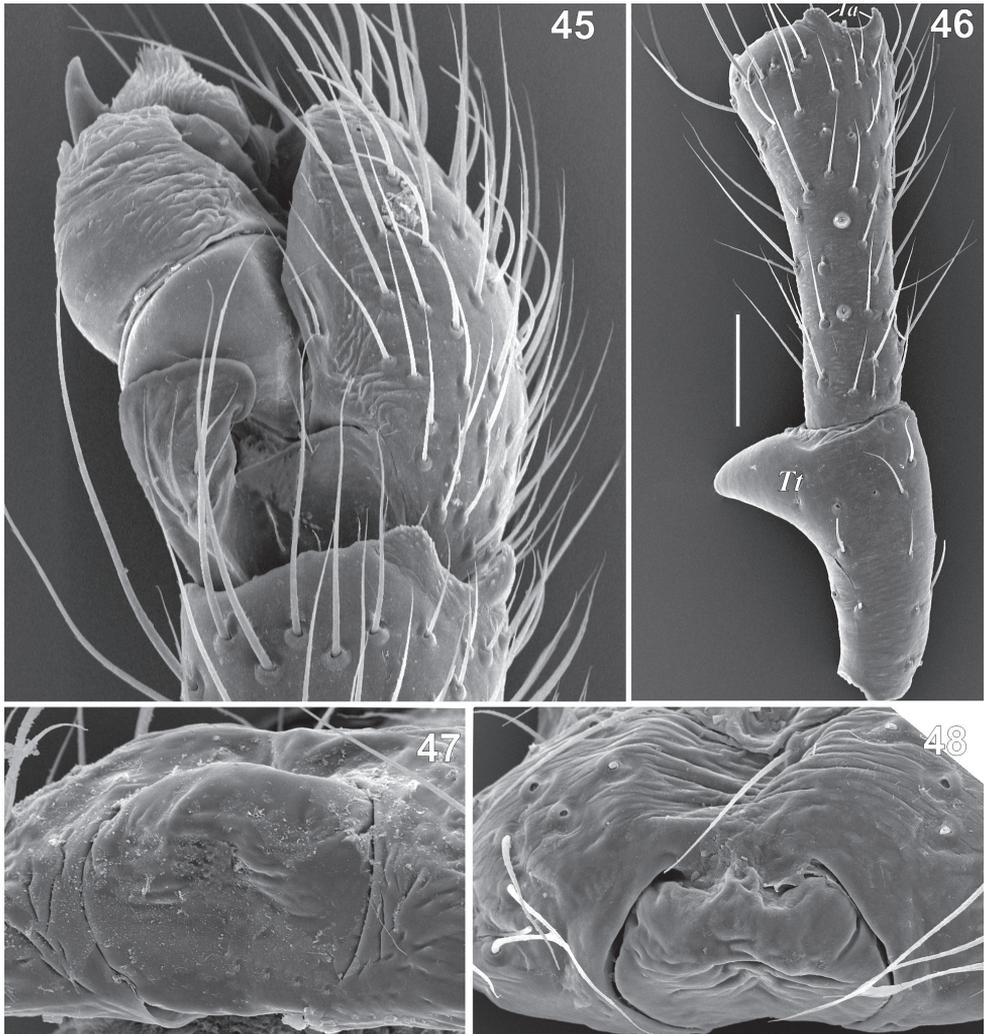
North Ural expedition by Fridolin, sample 36, Sob' River right bank, 4.07.1925 (V. Fridolin). **Yamal Peninsula:** 1♂ 5♀ (ZMMU), Yorkugayakha River, environs of “Canary” trading station, riparian willow stand, 08.07.2002 (D. Osipov); 4♂ 1♀ (ZMMU), south Yamal, Shchuchye Vill, Shchuchya River (A.L. Tikhomirova); 1♂ (PSU-96), South Yamal, Khadyta-Yakha River, meadow valley, pitfall traps, 8.08.1982 (S.L. Esyunin); 1♂ 1♀ (PSU-97), same locality, river bank, drift, 26.07.1981 (S.L. Esyunin). **Taimyr Peninsula:** 1♂ 1♀ (ZMMU), Taimyr Reserve, Novaya River, Ary-Mas Site, 25.07.1992 (A.B. Ryvkin); 10♂ 1♀ (ZMMU), SW Taimyr, Nyapan' Ridge, 70°09'N 87°47'E, *Carex*-moss bog, pitfall trapping, 1–10.08.1999 (D. Osipov); 3♂ (ZMMU), NW shore of Pyasino Lake, 70°04'54"N 87°32'12"E, *Carex* bog with sphagnum tussocks, 10–20.07.1999 (D. Osipov); 3♂ 2♀ NW shore of Pyasino Lake, 70°04'54"N 87°32'17"E, *Carex* bog with sphagnum tussocks, Summer 1999 (D. Osipov); 2♀ (ZMMU), NW shore of Pyasino Lake, Lazannakh Lake, sandy beach, 70°05'47"N 87°26'28"E, 1–10.07.1999 (D. Osipov). **Yakutia:** 2♀ (IBPN), Yana River down flow, environs of Kular Village, 70°35'N, 134°34'E, grass-herb- *Arctagrostis* meadow on the former open mine, Summer, 2000 (N.K.Potapova). **Chukotka:** 2♂ (IBPN), western Chukotka, Chaun River mouth part,



Figures 40–44. Copulatory organs of *Tmeticus nigriceps*. **40** male palp, retrolateral view **41** male palp, prolateral view **42** male palp, dorso-prolateral view **43** epigyne, ventral view **44** epigyne, caudal view. Abbreviations: *Ap* – anterior radial process; *Em* – embolus proper; *Me* – embolic membrane; *Ts* – tegular sac.

68.810°N 170.432°E, Summer, 1986 (A.S. Ryabukhin); 1♂ (IBPN), western Chukotka, Chaun Bay, Pucheveyem River mouth, 25.07.1985 (A.S. Ryabukhin); 1♂ (IBPN) Lamutskoye Vil., 65°32'39"N 168°51'08"E, along creek, 17.08.1968 (Novikova); 1♂ (IBPN), western Chukotka, Markovo Town, July 1986 (G. Chernova); 1♂ (IBPN), Vulvyveyem River upper flow, Gytlenumkuum Stand, 67°10'N 178°E, 8.06.1988 (Yu.M. Marusik).

Diagnosis. *T. nigriceps* is easily distinguished from the other Palaearctic species by the dark cephalic region contrasting with the reddish thoracic area. Only the Nearctic *T. ornatus* has a similar colour pattern. The male palp is almost undistinguishable from



Figures 45–48. Copulatory organs of *Tmeticus ornatus*. **45** male palp, retrolateral view **46** male palpal patella and tibia, retrolateral view **47** epigyne, caudal view **48** epigyne, ventral view. Abbreviations: *Tt* – patellar tooth.

the Siberian *T. tolli* and the Nearctic *T. ornatus*. In addition to the carapace pattern, females can be distinguished by the shape of their epigyne.

Description. ♀ 2.9–3.3, ♂ 2.3–2.7. TmI 0.69–0.72. Carapace orange with dark, blackish cephalic region (Figs 23–24, 38) and chelicera. Legs orange. Abdomen black. Palp as in Figs 35–37, 40–42, 52, epigyne as in Figs 18, 39, 43–44.

Comments. Holm (1973) re-examined the specimens from Sweden identified and recorded as *Gongylidiun nigriceps* by Tullgren (1955) and concluded that they were misidentifications of *Zornella cultrigera* (L. Koch, 1879). The figure of the female epigyne from Norway in Hauge (1969) identified as *G. nigriceps* also refers to *Z. cultrigera*.



Figures 49–53. Retrolateral view of the male palp of *Tmeticus affinis* (49), *T. tolli* (50), *T. ornatus* (51), *T. nigriceps* (52) and *Paratmeticus bipunctis* (53). (scale bar 0.1 mm).

Distribution. This species is known from Dolgiy Island and the Polar Urals to Chukotka (Eskov 1994). It is restricted to the tundra zone.

***Tmeticus ornatus* (Emerton, 1914)**

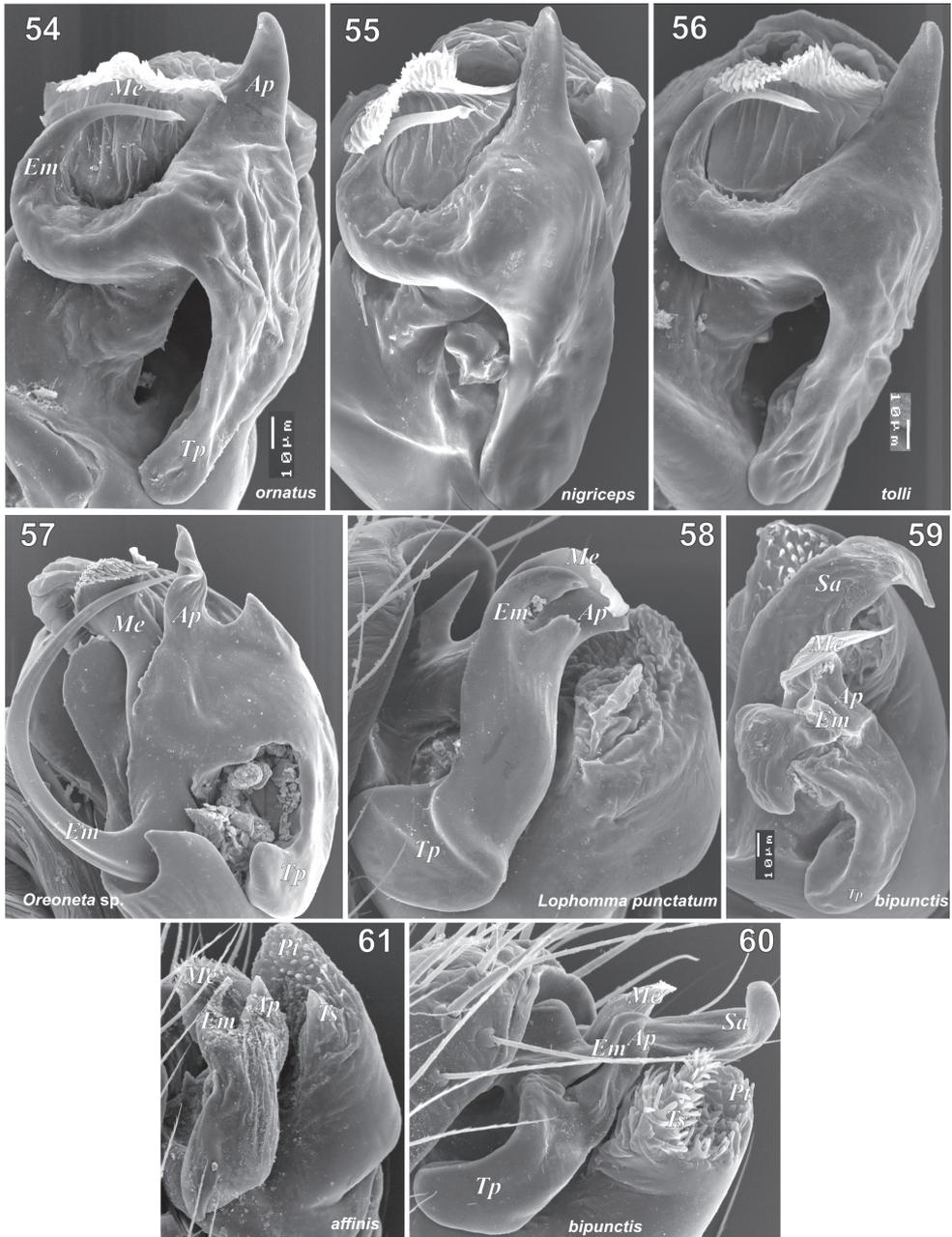
Figs 17, 21–22, 45–48, 51, 54

Gongylidium o. Emerton, 1914: 263, pl. 8, f. 3 (♂).

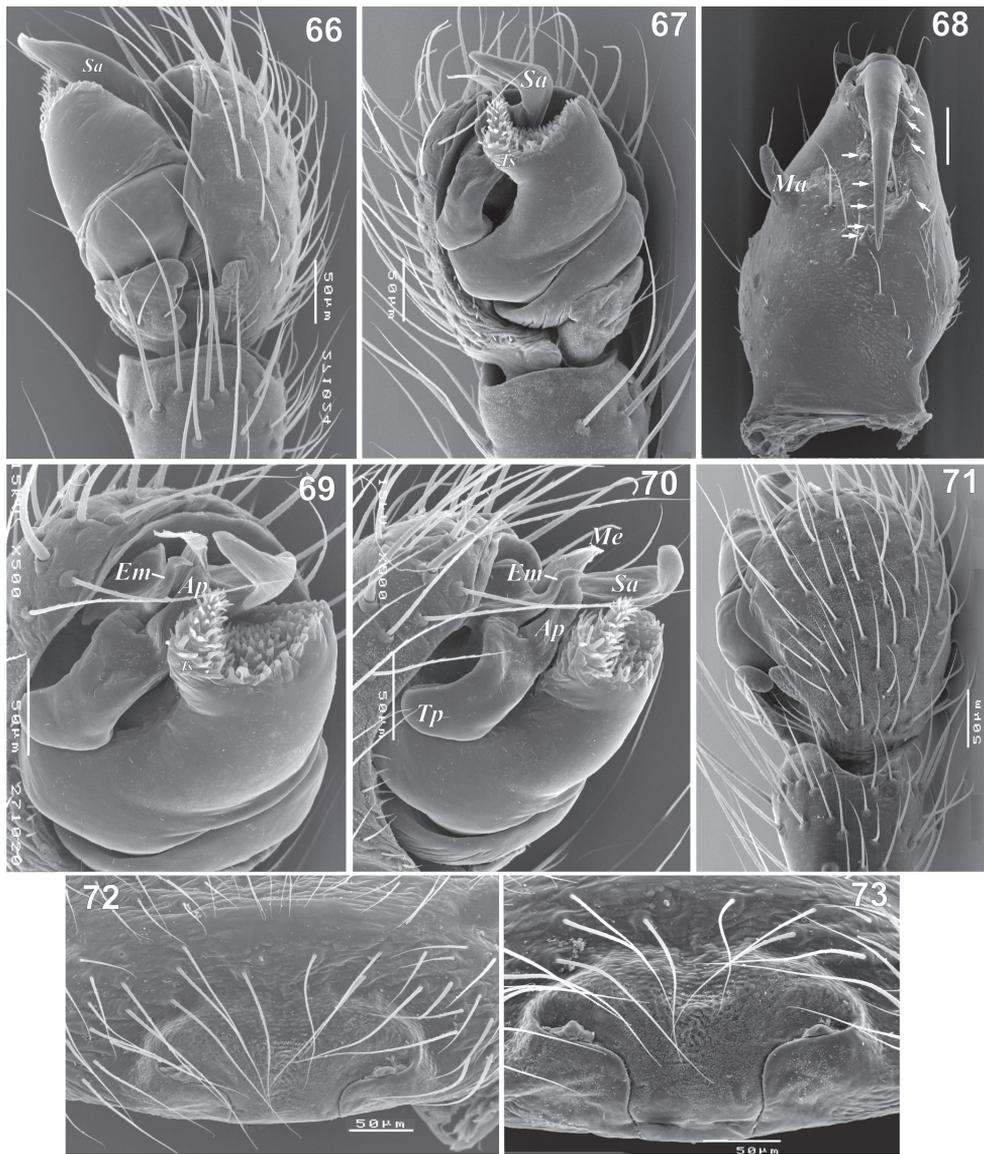
T. o.: Bishop & Crosby, 1935: 227, pl. 18, f. 22–26 (♂♀).

T. o.: Paquin & Dupérré, 2003: 122, f. 1284–1286 (♂♀).

Material examined. CANADA: 4♂ 4♀ (ZMMU), **Saskatchewan**, Lady Lake, sedge tops – flooded marsh, 13–15.04.1971 (D.J. Buckle); 3♂ 3♀ (ZMUT), same locality, marsh, late April, 1978 (J.V. Buckle).

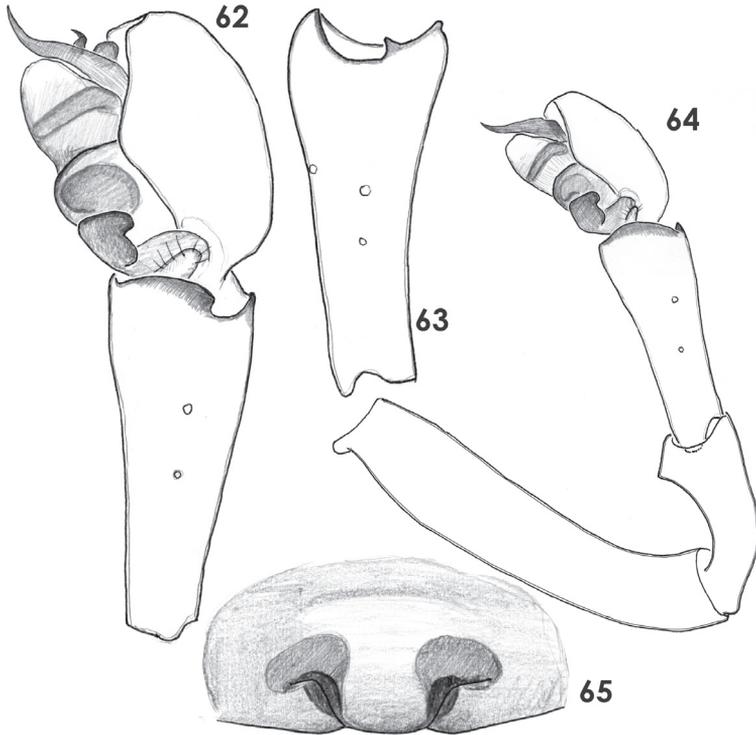


Figures 54–61. Embolic division of *Tmeticus ornatus* (54), *T. nigriceps* (55), *T. tolli* (56), *Oreoneta* sp. (57), *Lophomma punctatum* (58), *Paratmeticus bipunctis* (59–60) and *T. affinis* (61). Abbreviations: *Ap* – anterior radial process; *Em* – embolus proper; *Ma* – mastidion; *Me* – embolic membrane; *Pt* – protegium; *Sa* – distal suprategular apophysis; *Tp* – tailpiece; *Ts* – tegular sac.



Figures 62–65. Copulatory organs of *Paratmeticus bipunctis*. **62** male palp, retrolateral view **63** male palpal tibia, dorso-retrolateral view **64** whole male palp **65** epigyne, ventral view.

Diagnosis. Differs from *T. affinis*, which also occurs in the Nearctic Region, by the carapace colour (black cephalic region and red-orange thoracic area in *T. ornatus*, carapace uniformly brown in *T. affinis*). The males are easily separated by their tibial apophyses (one apophysis with a claw-like processes in *T. affinis*



Figures 66–73. Copulatory organs and male chelicera of *Paratmeticus bipunctis*. **66** male palp, retro-lateral view **67** male palp, ventral view **68** male chelicera inner view **69** male palp, from above **70** male palp, prolateral view **71** male palp, dorsal view **72–73** epigyne, ventral and caudal view. Arrows show the cheliceral teeth. Abbreviations: *Ap* – anterior radial process; *Em* – embolus proper; *Ma* – mastidion; *Me* – embolic membrane; *Sa* – distal suprategular apophysis; *Tp* – tailpiece; *Ts* – tegular sac.

and two separate apophyses in *T. ornatus*); the females have distinctly different epigynes.

Description. ♂ 2.5–3.3, ♀ 2.8–3.5. TmI 0.73–0.78. Carapace orange with darker cephalic region. Abdomen dark. Palp as in Figs 45–46, 51, 54. Epigyne as in Figs 17, 47–48.

Distribution. This species has a trans-Nearctic distribution, recorded from British Columbia to Quebec and south to New York (Buckle et al. 2001). It does not occur north of 55°N and has a more southern distribution in comparison to the Palaearctic *T. affinis*, *T. tolli* and *T. nigriceps*.

Species Incertae Sedis

The three species from Japan assigned to *Tmeticus* remain unstudied and belong elsewhere (see ‘Comments’ below).

***Tmeticus neserigonoides* Saito & Ono, 2001**

T. n. Saito & Ono, 2001: 9, f. 15–20 (♂♀).

T. n.: Ono et al., 2009: 304, f. 638–642 (♂♀).

Comments. Judging from the available figures, this species might belong in *Tmeticus*. The male has a long palp with a patellar tooth. However, the chelicera appears to lack a mastidion and the tibial apophyses are absent. Figures of the male palp are unclear, TmI index (0.59) is lower than in *Tmeticus* species (>0.63).

***Tmeticus nigerrimus* Saito & Ono, 2001**

T. n. Saito & Ono, 2001: 13, f. 26–31 (♂♀).

T. n.: Ono et al., 2009: 304, f. 643–647 (♂♀).

Comments. This species is clearly not related to *T. affinis* or other members of the genus due to the short palpal patella lacking a tooth in the male, embolic division of a different shape, the relatively long tibial apophysis, lack of a mastidion, epigyne with a septum and some other additional characters. The correct generic placement remains unclear.

***Tmeticus vulcanicus* Saito & Ono, 2001**

T. v. Saito & Ono, 2001: 11, f. 21–25 (D♂♀).

T. v.: Ono et al., 2009: 304, f. 648–652 (♂♀).

Comments. This species is clearly not related to *T. affinis* or other members of the genus due to the short palpal patella lacking a tooth in the male, embolic division of a different shape (anterior radical process absent), and some other characters. The correct generic placement remains unclear.

***Paratmeticus* gen. n.**

urn:lsid:zoobank.org:act:3F57381F-374C-4D90-9312-24A8419BF422

Type species. *Oedothorax bipunctis* Bösenberg & Strand, 1906.

Etymology. Prefix “Para” - indicates the resemblance of this genus to *Tmeticus*. The gender is masculine.

Diagnosis. The new genus is easily distinguished from the similar *Tmeticus* by lacking distinct tibial apophyses, and in having the papillate tegular sac larger than the protegulum, a slightly twisted embolic division, a sharply pointed embolic membrane

and a large distal suprategular apophysis, longer than the embolic division. In contrast to *Tmeticus*, the median plate of the epigyne in the new genus is widest in the anterior region, rather than in the posterior region.

Description. Medium-sized erigonine spiders. Uniformly coloured, male carapace without modifications, male chelicera with mastidion, inner row with 4 inner teeth and 5 outer teeth (all smaller than inner teeth). TmI 0.63–0.65. Male palp elongate, with patella as long as tibia, tibia lacks apophyses, distal suprategular apophysis longer than embolic division; embolic division slightly twisted with two arms: anterior radical process and embolus proper; embolus parallel to process with lamellate basal process; epigyne without cavity, median plate widest anteriorly.

Composition. The type species only.

***Paratmeticus bipunctis* (Bösenberg & Strand, 1906), comb. n.**

Figs 12–14, 53, 59–60, 62–73

Oedothorax b. Bösenberg & Strand, 1906: 162, pl. 12, f. 258 (♀).

Tmeticus japonicus Oi, 1960: 152, f. 50–51 (♂).

Tmeticus japonicus: Chikuni, 1989: 58, f. 56 (♂♀).

Tmeticus japonicus: Eskov, 1994: 107.

Tmeticus b.: Saito & Ono, 2001: 7, f. 10–14 (S, ♀).

Tmeticus b.: Ono et al., 2009: 304, f. 634–637 (♂♀).

Material examined. RUSSIA: **Sakhalin** Island: 1♂ 4♀ (IBPN), Okha Dist., 5–7 km N of Kolendo Vil., 22–23.08.1991 (A.M. Basarukin); 1♂ 2♀ (IBPN), Pil'tun Bay, 06.-0.7.1991 (A.M. Basarukin); 1♂ 1♀ (IBPN), Okha Dist., Ten'ga River, May 1987 (A.M. Basarukin); 10♂ 26♀ (IBPN), Korsakov Dist., Tunaiga Lake south shore, 26.09.1991 (A.M. Basarukin). **Kuril** Isles, 4♂ 3♀ (IBPN), Paramushir Isl. NE shore, environs of Severo-Kuril'sk, 50°40'N 156°06'E, 10.08–15.09.1996 (Yu.M. Marusik); 2♂ 1♀ (ZMMU), Iturup Island, Dobroye Nachalo Bay, Lesozavodskoye, mixed forest, 14.08.1994 (K.Yu. Eskov). **Kamchatka** Peninsula, 6♂ 2♀ (IBPN), 10–12 km N of Paratunka Vil., Yelizovo Forestry, 53.050°N 158.225°E, 15–28.07.2004 (A.S. Ryabukhin).

Description. Well described by Saito & Ono (2001) and Ono et al. (2009). Total length: ♂ 2.5–3.2, ♀ 2.8–3.5. Carapace 1.29–1.57 long, 1.0–1.24 wide, slightly larger in males. Chelicera in male with mastidion. TmI 0.63–0.65. Carapace dirty brownish, sternum and chelicerae brown. Abdomen dark grey-blackish. Palp as in Figs 53, 59–60, 62–67, 69–71, epigyne as in Figs 14, 65, 72–73.

Distribution. Kamchatka (south part), 8 islands in Kuril Archipelago (Shikotan, Kunashir, Iturup, Urup, Simushir, Ketoi, Shiashkotan, Paramushir, but seems to occur on all large islands); Sakhalin and Japan (Hokkaido, Honshu and Kyushu).

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A new species of *Harpactea* (Araneae, Dysderidae) from Aegean region of Turkey

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Abstract

A new species of the spider genus *Harpactea* Bristowe, 1939 is described from the Aegean region of Turkey – *Harpactea erseni* **sp. n.** (males only). Detailed morphological description and illustrations of the new species are provided. The relationships of the new species are discussed.

Keywords

Dysderidae, *Harpactea*, new species, Turkey

Introduction

The family Dysderidae C. L. Koch, 1837 is represented by 504 species in 24 genera worldwide (Platnick 2010). *Harpactea* Bristowe, 1939 is a species rich genus with 155 described taxa and is particularly diverse in the Mediterranean region (Platnick 2010). Most of the species appear to be endemics with restricted distributions in the Medi-

terranean, with only a few found in adjacent areas (Rezâc 2008). So far, 19 species of *Harpactea* have been recorded from Turkey, 17 of which are endemic to the country (Bayram et al. 2010). However, most of these species are still poorly known and have not been revised since their original descriptions. Nevertheless, the diversity of *Harpactea* in Turkey is high in comparison to well-studied adjacent countries such as Azerbaijan (14 species), Bulgaria (19 species), Georgia (10 species) and Greece (24 species) (Bosmans and Chatzaki 2005; Otto and Dietzold 2006; Lazarov 2010; Lazarov and Naumova 2010; Van Keer and Bosmans 2010).

During our surveys of the Turkish spider fauna we found one undescribed species of *Harpactea* in the Aegean region, which is described herein.

Material and methods

Three males were collected from İzmir province in the Aegean region of Turkey (Fig. 1) using a hand aspirator. The specimens were preserved in 70% ethanol and deposited in the Museum of the Turkish Arachnological Society. Digital images of the pedipalp were taken with a Leica DFC290 digital camera attached to a Leica M205 C stereomicroscope and 5–15 photographs were taken in different focal planes and combined. All measurements are in mm. Terminology for the body measurements and copulatory organ structures were taken from Chatzaki and Arnedo (2006). The following abbreviations were used in the text: **AL**, abdominal length; **CL**, carapace length; **CW_{max}**, maximum carapace width; **CW_{min}**, minimum carapace width; **AME**, anterior median eyes; **PLE**, posterior lateral eyes; **PME**, posterior median eyes; **AMEd**, diameter of anterior median eyes; **PLEd**, diameter of posterior lateral eyes; **PMEd**, diameter of posterior median eyes; **ChF**, length of cheliceral fang; **ChG**, length of cheliceral groove; **ChL**, total length of chelicera (lateral external view); **Ta**, tarsus; **Me**, metatarsus, **Ti**, tibia; **Pa**, patella; **Fe**, femur; **Tr**, trochanter; **C**, coxa; **D**, dorsal; **Pl**, prolateral; **Rl**, retrolateral; **V**, ventral; **CO**, conductor; **E**, embolus; **T**, tegulum; **MTAS**, Museum of the Turkish Arachnological Society, Ankara, Turkey.

Taxonomy

Harpactea Bristowe, 1939

Harpactea erseni sp. n.

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Figs 2–9

Material examined: Holotype ♂ (MTAS) **İzmir Province**, Yamanlar Mountain, Karagöl [38°33'26.00"N; 27°13'11.00"E], 28. XI. 2008, under stones, leg. K.B.Kunt. Paratypes: 2 ♂ (MTAS) same data as holotype.



Figure 1. Type locality of *Harpactea erseni* sp. n. (*).

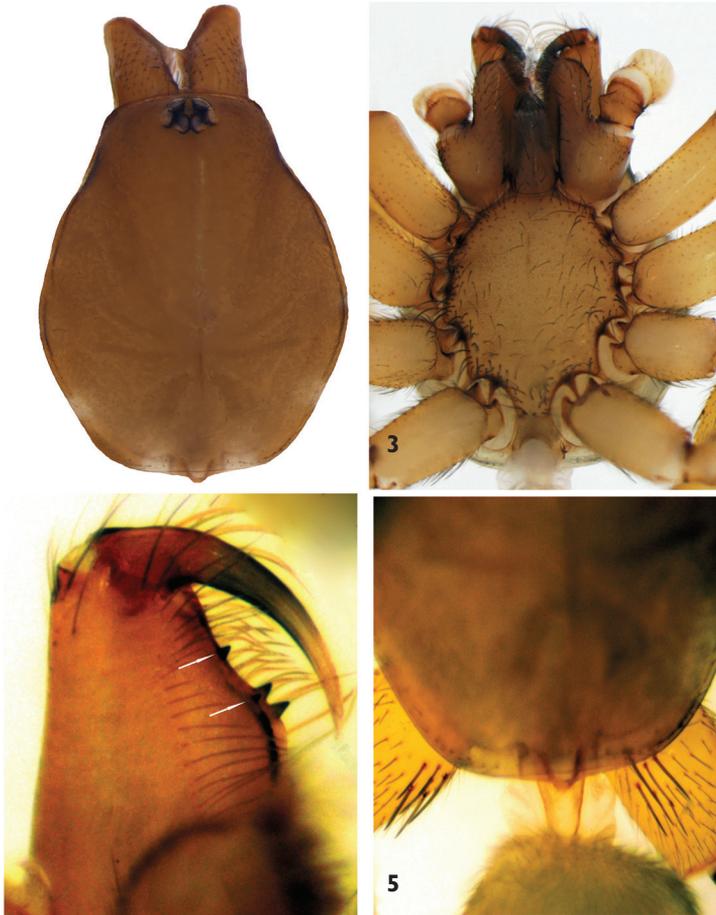
Derivatio nominis: The new species is dedicated to “Ersen Aydın Yağmur” who made a great contribution to our knowledge of Turkish scorpions and who is a good friend of the authors.

Diagnosis: *Harpactea erseni* sp. n. differs from other Turkish *Harpactea* species (see Nosek 1905; Alicata 1974; Brignoli 1978a-b; Brignoli 1979; Bayram et al. 2009) in the structure of the pedipalp of the male. However, the palpal structures of *Harpactea erseni* sp. n. are close to *H. strandjica* Dimitrov, 1997 and *H. terveli* Lazarov, 2009 described from Bulgaria (see Lazarov 2009). The new species can be distinguished from *H. terveli* by the different shape of the embolus and conductor; and from *H. strandjica* by having a thinner, curved embolus without a bifurcated tip.

Comments: *Harpactea* is one of the most endemic and speciose dysderid genera in Turkey, with 17 endemics (Bayram et al. 2010). Most of the endemic species have restricted distributions and occur at high elevations, such as the mountain ranges of the Mediterranean, and the north and central Anatolian regions. This distribution pattern presumably results from the combination of topography, proximate biogeographical subregions, the high number of different biotopes and the climate of Anatolia, all of which play a special role in speciation. In short, the Anatolian *Harpactea* fauna is characterized by a high level of local endemism, and by limited co-occurrence of species in the adjacent zoogeographical regions. However, one question can be raised regarding the newly described species: is the male a specimen of a previously described species known only from the female (presumably from Turkey or neighboring countries)? According to our morphometric data, our samples are larger than all previously described *Harpactea* species from Turkey (see Brignoli 1978a–b), supporting our conclusion that it is in fact a new species, rather than the male of a previously described female.

Measurements (holotype): AL 4.05; CL 3.45; CWmax 2.25; CWmin 1.35; AMEd 0.15; PLEd 0.13; PMEd 0.10; ChF 0.76; ChG 0.34; ChL 1.35 mm. Leg measurements are given in Table 1.

Description: Carapace light brown, with smooth surface and distinct fovea. AME, PLE and PME closely grouped; AME separated (Fig. 2). Sternum, labium, gnathocoxae and chelicerae yellowish-brown. Sternum with long, thin hairs near the margin (Fig. 3). Cheliceral groove with four teeth: retromargin with two teeth, including a tiny one at the base of the groove; promargin with two strong teeth of equal size close to each other. Top of the labium and gnathocoxae with short, strong hairs, sparsely distributed (Fig. 4). Abdomen greyish-light brown, with short, thin blackish hairs over the entire surface. Legs yellowish-light brown with sparse blackish setae. Leg IV > Leg I > Leg II > Leg III. Tarsi with three claws. Tarsi III and IV with fine scopulae. Legs III and IV with fine metatarsal scopulae covering slightly less than the distal half of



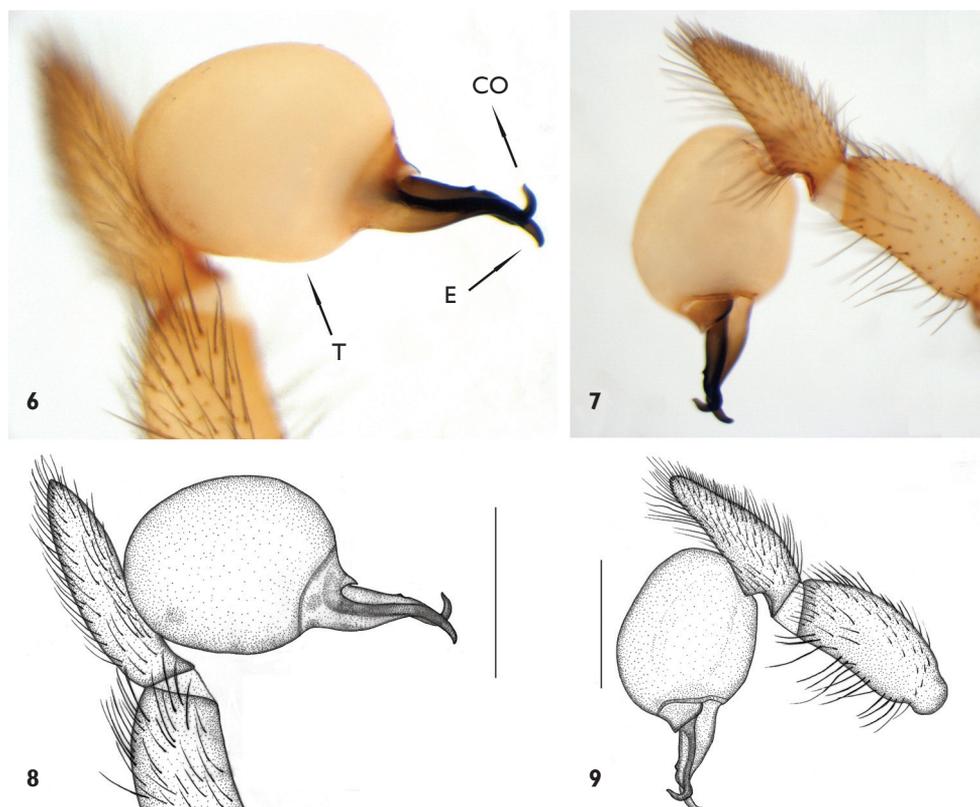
Figures 2–5. *Harpactea erseni* sp. n. **2** Carapace **3** Sternum **4** Right chelicer, ventral view **5** Coxae IV, dorsal view.

the segment (ventral surface only). Dorsal part of coxae III and IV with 2–6 spines (Fig. 5). Details of leg spination are given in Table 2.

Palpal organ with globular bulb and curved, black embolus tapering towards the tip. Conductor same colour as embolus and hook-shaped at the tip and with a tuberculum on the mid-part (Figs 6–9). Female unknown.

Table 1. Leg measurements of *Harpactea erseni* sp. n.

Legs	I	II	III	IV
C	1.65	1.28	0.88	1.20
Tr	0.52	0.34	0.34	0.37
Fe	3.15	2.63	2.45	3.00
Pa	1.20	1.76	1.23	1.50
Ti	2.55	2.46	2.02	3.38
Me	2.63	2.25	2.15	2.63
Ta	0.80	0.83	0.83	0.84
Total	12.50	11.55	9.90	12.92



Figures 6–9. *Harpactea erseni* sp. n., general appearance of right bulb **6–8** Prolatateral view **7–9** Retrolateral view **CO** Conductor **E** Embolus **T** Tegulum (Scale lines: 0.5 mm)

Table 2. Leg spination of *Harpactea erseni* sp. n.

Legs	I	II	III	IV
C	0	0	2-3 D	5-6 D
Tr	0	0	0	0
Fe	2 Pl	1, 1 Pl	2, 2, 2 D	1, 2, 2 D, 2-4 Rl
Pa	0	0	1 D	1 Rl
Ti	0	0	6 Pl, 1 Rl, 2, 1, 2 V	1, 1, 1 Pl, 1, 1 Rl, 5-6 V
Me	0	0	6 Pl, 1, 1 Pl, 5-6 V	3 Pl, 4 Rl, 3-5 V
Ta	0	0	0	0

Discussion

According to the classification of Deeleman-Reinhold (1993), *H. erseni* sp. n. belongs in the *rubicunda* (D) species group which is characterized by having a globular palpal body, a massive embolus and conductor and patellae-coxae with spines. Up until now 20 (including the new species) *Harpactea* species have been reported from Turkey. Although the diversity of this genus in Turkey is comparatively high, it can be expected that the actual diversity will be even higher because many regions with favourable habitats for *Harpactea* remain to be studied in Turkey. Therefore, we expect that more species will be found in the future.

Acknowledgements

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Aleocharine rove beetles (Coleoptera, Staphylinidae) associated with *Leptogenys* Roger, 1861 (Hymenoptera, Formicidae) I. Review of three genera associated with *L. distinguenda* (Emery, 1887) and *L. mutabilis* (Smith, 1861)

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Abstract

Three myrmecophilous genera of Aleocharinae (Staphylinidae) associated with *Leptogenys distinguenda* (Emery, 1887) and *L. mutabilis* (Smith, 1861) are reviewed with descriptions of new taxa: *Maschwitzia* Kistner, 1989, *Togpelenys* Kistner, 1989 and *Witteia* Maruyama & von Beeren, **gen. n.** (type species: *Witteia dentilabrum* Maruyama & von Beeren, **sp. n.**). The following new combinations are proposed: *Zyras* (s. lat.) *aenictophila* (Kistner, 1997), **comb. n.** (ex *Maschwitzia*), *Zyras* (s. lat.) *dichthadiaphila* (Kistner in Kistner et al., 2003), **comb. n.** (ex *Maschwitzia*), *Maschwitzia derougemonti* (Pace, 1984), **comb. n.** (ex *Wroughtonilla* Wasmann, 1899), *Maschwitzia watanabei* (Maruyama, 2004), **comb. n.** (ex *Wroughtonilla*), *Maschwitzia dilatata* (Pace, 2005), **comb. n.** (ex *Wroughtonilla*), *Witteia borneensis* (Pace, 1986), **comb. n.** (ex *Wroughtonilla*). These genera belong to the *Wroughtonilla* genus group of the tribe Lomechusini.

Keywords

Myrmecophily, *Maschwitzia*, *Togpelenys*, *Witteia* gen. n., *Wroughtonilla* genus group, new species, new combination, Malaysia, new host record

Introduction

The ant genus *Leptogenys* Roger, 1861 belongs to the subfamily Ponerinae. Some of its members show army ant-like behavior (Maschwitz et al. 1989, Kronauer 2009). Many *Leptogenys* species harbor various groups of myrmecophilous insects comparable to the myrmecophile richness of the classic army ants of the subfamilies Dorylinae, Aenictinae and Ecitoninae (Witte et al. 2008). Rove beetles associated with *Leptogenys* ants have been studied by several authors based on the material collected by ant researchers (Wasmann 1899; Kistner 1975, 1989; Kistner et al. 2008; Hlaváč and Janda 2009). The rove beetles associated with *Leptogenys* ants show strict host-species specificity, i.e. one rove beetle species is associated with only one host ant species (Maruyama, unpublished data; von Beeren and Witte, personal observations). In this article we present the first known exception to this rule, with *Maschwitzia ulrichi* Kistner, 1989 occurring in two closely related *Leptogenys* host species. The already described species, *M. ulrichi* and *Togpelenys gigantea* Kistner 1989 were recorded from colonies of *Leptogenys distinguenda* (Emery, 1887) at Ulu Gombak in Peninsular Malaysia (Kistner 1989). Although the former species was recorded from a *L. borneensis* colony (Kistner et al. 2008), this is most probably based on a misidentification (Maruyama et al. 2010). Recently, the junior author (CvB) collected a series of rove beetles from *L. distinguenda* colonies and from one *L. mutabilis* (Smith, 1861) colony in Peninsular Malaysia. The material included an unknown species with an autapomorphy, which did not allow it to be assigned to any known genus.

In the present article, we revise some of the rove beetle genera associated with *Leptogenys* ants. This first part of the series reviews the genera which are associated with *L. distinguenda* and *L. mutabilis*, including descriptions of some new taxa and some new combinations.

Materials and methods

The rove beetles were collected in spring and autumn 2008 and 2009 in a well regenerated dipterocarp rainforest in the Field Studies Centre of the University of Malaya in Ulu Gombak, Malaysia (03° 19.4796' N, 101° 45.1630' E, altitude 230 m) and near the Institute of Biodiversity in Bukit Rengit, Malaysia (03°35.779 N, 102°10.814' E, altitude 72 m). Nests of the nocturnal host ants were located during the night by backtracking *Leptogenys* raiding trails. Since all rove beetles follow the host ant migrations, we detected them on these occasions and collected them with aspirators (for further information see Witte et al. 2008). The specimens were put in 1.5 ml plastic tube containing 80 % ethanol for morphological studies.

The methods of dissecting and line drawings followed Maruyama (2006). Dissected genitalia and mouthparts were mounted in Euparal on a small glass plate (10 × 5 mm), and subsequently glued onto a paper card (6 × 5 mm) and pinned under the

respective specimen (Maruyama 2004). Photographs were taken with a Canon EOS Kiss X1 with a macro lens MP-E 65, and then combined by the automontage software CombineZM. Specimens are deposited in the senior author's collection in the Kyushu University Museum (KUM) and in the Bavarian State Collection of Zoology (Munich, Germany). Measurements are given in millimeters and are abbreviated as follows: antennal length (AL); body length (BL); fore body length, from front margin of head to apices of elytra (FBL); hind tibial length (HTL); head length (HL); head width (HW); pronotal length (PL); pronotal width (PW).

Leptogenys distinguenda is sometimes treated as a subspecies of *L. processionalis* Jerdon, 1851 known from India (Emery 1911; Bolton 1995). However, the taxonomy of *Leptogenys* species in Asia has been poorly studied, and identifications of the known species remain confusing (Ito pers. comm.). We tentatively follow the current papers citing *L. distinguenda* as a distinct species (e.g., Witte and Maschwitz 2000), until a revisional study of all Asian *Leptogenys* species is completed. Both of the ant species in the present paper are illustrated (Figs 1–4) to specify our identifications of the species.

***Maschwitzia* Kistner, 1989**

Fig. 5

Maschwitzia Kistner, 1989: 301 (original description).

Type species. *Maschwitzia ulrichi* Kistner, 1989.

Diagnosis. This genus is closely allied to *Witteia* in general appearance, especially pronotal shape, but may easily be distinguished from it by having a generalized labrum, not strongly sclerotized and without projections; the simple mandibles, their inner edges not emarginate at middle; the straight lateral projections of the labial apodeme; the much smaller eyes; the shorter antennae; and the shorter legs.

Comments. Kistner et al. (2008) transferred *Trachydonia aenictophila* Kistner, 1997 and *T. dichthadiaphila* Kistner, 2003 to *Maschwitzia*. However, they are apparently not members of *Maschwitzia*, nor even closely related in view of the absence of the autapomorphies of *Wroughtonilla* Wasmann, 1899 and its allied genera (see Discussion). Though the genus *Zyras* Stephens, 1835 is heterogeneous, apparently non-monophyletic and not well defined yet, they can be placed in *Zyras* (s.lat.) by sharing the general diagnostic features of the genus (e.g., Fenyés 1920) and excluded from *Maschwitzia*, as follows:

Zyras (s. lat.) *aenictophila* (Kistner in Kistner et al. 1997), **comb. n.**

Zyras (s. lat.) *dichthadiaphila* (Kistner in Kistner et al. 2003), **comb. n.**

Trachydonia Bernhauer, 1928 has been placed as a subgenus of *Zyras*, but Kistner et al. (2003) raised it to generic status. At least *Zyras aenictophila* and *Z. dichthadiaphila* are not members of *Trachydonia*. They are also not members of the subgenus *Zyras*. The genus *Zyras* should be subdivided into several genera based on a phylogenetic analysis, and then adequate systematic affiliation of these two species may be found.

The following four species are known in *Maschwitzia*.



Figures 1–4. Host ants. **1** *Leptogenys distinguenda*, lateral view **2** ditto, head **3** *L. mutabilis*, lateral view **4** ditto, head.

***Maschwitzia ulrichi* Kistner, 1989**

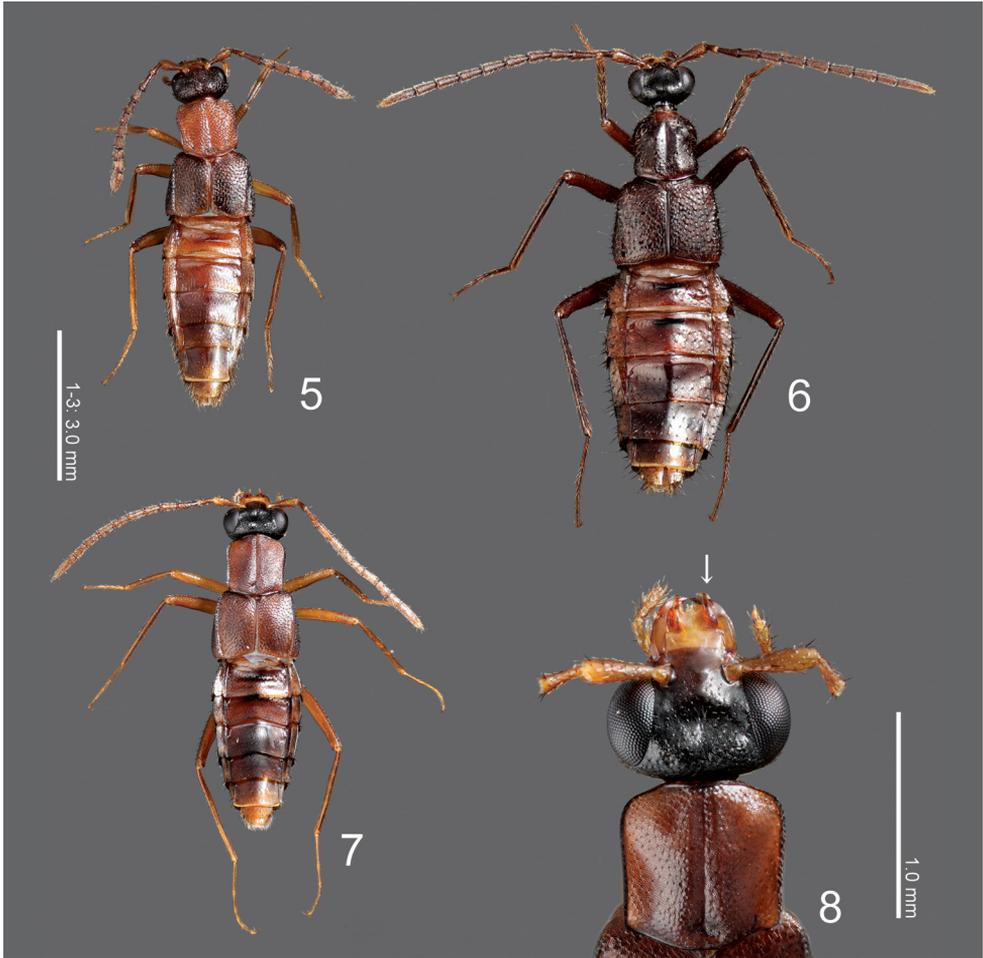
Fig. 5

Maschwitzia ulrichi Kistner, 1989: 307 (original description).

Trachydonia leptogenophila Kistner in Kistner et al., 2003: 386 (original description);
Maruyama, 2004: 96 (synonymized with *M. ulrichi*).

Type locality. Ulu Gombak, Selangor, Malaysia.

Additional records. Ulu Gombak (University Malaya Field Studies Centre, 03°19.479 N, 101°45.170 E, 220–250 m alt.), Selangor, Malaysia, VIII 2008, C. von Beeren from the colony of *Leptogenys distinguenda* (10); same data, but III 2009, C.



Figures 5–8. Type species of the genera *Maschwitzia*, *Togpelenys* and *Witteia* **5** *Maschwitzia ulrichi*, dorsal habitus **6** *Togpelenys gigantea*, dorsal habitus **7** *Witteia dentilabrum* gen. et sp. n., dorsal habitus **8** ditto, head and pronotum, dorsal view.

von Beeren and V. Witte (12); same data, but VIII 2009, C. von Beeren (10); same data, but IX 2009, Y. Nakase (6); same data, but III 2010, C. von Beeren from the colony of *L. mutabilis* (2); Bukit Rengit, Pahang, Malaysia (03°35.779 N, 102°10.814' E, altitude 72 m): C. von Beeren and V. Witte (8).

Distribution. Peninsular Malaysia.

Symbiotic hosts. *Leptogenys distinguenda* and *L. mutabilis*.

Diagnosis. This species is closely similar to *M. watanabei* in general appearance, but is distinguished from it by the pronotum being narrower around the posterior margin and the aedeagus being different in shape, especially with the apical part of the median lobe being strongly widened apically and not excavated paramerally.

Comments. Two specimens were collected for the first time from the end of a migration column of *Leptogenys mutabilis* (new host record).

***Maschwitzia derougemonti* (Pace, 1984), comb. n.**

Wroughtonilla derougemonti Pace, 1984: 460 (original description).

Type locality. Kalaw, Myanmar

Distribution. Myanmar.

Symbiotic host. Unknown.

Diagnosis. The aedeagal shape is clearly different from the other congeners in particular the parameral crest is larger and the apical lobe longer.

Comments. Only the holotype and one paratype are known. The original description by Pace (1984) agrees well with the characteristics of the other congeners. The symbiotic host is probably, *Leptogenys distinguenda* or its related species. However, Asian species of *Leptogenys* are in need of revision, and distributions of most known species, including *L. distinguenda*, are still uncertain.

***Maschwitzia watanabei* (Maruyama, 2004), comb. n.**

Wroughtonilla watanabei Maruyama, 2004: 92 (original description).

Type locality. Bolikhamsai (Borikhamxay), Laos.

Distribution. Laos.

Symbiotic host. Unknown.

Diagnosis. This species is closely similar to *M. ulrichi* in general appearance, but is distinguished from it by the pronotum being wider around the posterior margin and by the different shape of the aedeagus, especially the apical part of the median lobe being less widened apically and largely excavated paramerally.

Comments. Only the holotype is known. The symbiotic host is probably *Leptogenys distinguenda* or a related species, although *L. distinguenda* is not recorded from Laos at present.

***Maschwitzia dilatata* (Pace, 2005), comb. n.**

Wroughtonilla dilatata Pace, 2005: 147 (original description).

Type locality. Umrang, East Khasi Hills, Meghalaya, India.

Distribution. Meghalaya, India.

Symbiotic host. Unknown.

Diagnosis. This species is closely similar to *M. ulrichi* in general appearance, but is distinguished from it by the pronotum being wider around the posterior margin and by the different shape of aedeagus, especially the apical part of the median lobe being less widened apically and largely excavated paramerally.

Comments. Only the holotype has been known. The original description by Pace (2005) agrees well with the characteristics of the other congeners and he noted that this species is allied to *M. derougemonti*. The symbiotic host is probably *Leptogenys distinguenda* or a related species.

***Togpelenys* Kistner, 1989**

Fig. 6

Togpelenys Kistner, 1989: 308 (original description).

Type species. *Togpelenys gigantea* Kistner, 1989.

Diagnosis. This genus is clearly distinguished from the other genera of *Wroughtonilla* group by the combination of the following character states: eyes extremely large; pronotum without superior marginal line of the pronotal hypomeron; pronotal disc quite convex, with a shallow and large longitudinal depression; pronotum and elytra covered with long, suberect macrosetae; and abdomen large, expanded, much wider than elytra.

Distribution. Peninsular Malaysia.

Comments. Only the type species *T. gigantea* Kistner, 1989 has been known in the genus. Probably further species will be found from the regions around Peninsular Malaysia, e.g., Sumatra, Borneo and Java.

***Togpelenys gigantea* Kistner, 1989**

Fig. 6

Togpelenys gigantea Kistner, 1989: 312 (original description).

Type locality. Ulu Gombak, Selangor, Malaysia.

Additional record. Bukit Rengit (03°35.779 N, 102°10.814 E; 72 m alt.), Pahang, Malaysia, III 2009, C. von Beeren and V. Witte (2 males).

Distribution. Peninsular Malaysia.

Symbiotic host. *Leptogenys distinguenda*.

Diagnosis. This species is easily distinguished from the other species of *Wroughtonilla* as well as its allied genera by the generic diagnosis.

Comments. Rare species, newly recorded from Pahang. In the type locality, Ulu Gombak, Selangor, no additional specimen has been collected despite more than 40 colonies having been examined in the last few years (von Beeren and Witte,

personal observations; the type series were collected in 1982). We are not sure whether this is due to environmental changes in Ulu Gombak or simply due to rarity of this species.

***Witteia* Maruyama & von Beeren, gen. n.**

urn:lsid:zoobank.org:act:B3D89EA2-4867-40F5-9817-E6E108D0BA2B

Figs 7–18

Type species. *Witteia dentilabrum* sp. n.

Etymology. Dedicated to Dr. Volker Witte for his contribution to the biology of *Leptogenys* ants and their symbionts. Gender, feminine.

Diagnosis. This genus is similar to *Maschwitzia* Kistner, 1989 in body shape and punctuation of body surface, but may easily be distinguished from it by the labrum being strongly sclerotized and with a pair of spines; the inner margins of the mandibles emarginate at middle; the lateral projections of the labial apodeme curved apically; the extremely large eyes; the longer antennae; and the longer legs.

Description. Body (Fig. 7) elongate, flattened; surface of fore body (Fig. 8) weakly rugose, reticulated, somewhat matte.

Head (Figs 7–8) transverse, with eyes extremely large, somewhat shorter than head, with a round depression above; clypeus truncate apically. Labrum (Figs 8–9) strongly sclerotized, with a pair of projections laterally (Figs 9: arrow). Mandibles asymmetrical, strongly curved, each apex acutely pointed; inner margin of left mandible (Fig. 10) shallowly emarginate; that of right (Fig. 11) rather largely emarginated. Mentum (Fig. 12) trapezoidal, with several thick setae, with sparse pseudopores. Labium (Fig. 13) broad; prementum with a setal pore and 2 real pores near base, with several pseudopores around inner ridges; apodeme without median projection, with lateral projection curved apically; ligula long, each lobe with a large setulum and three small setula; labial palpus with segment I long and apically dilated; segment II half as long as I; segment III thin, parallel-sided, slightly shorter than II.

Pronotum (Figs 7–8) with disc well margined, slightly convex, with a narrow longitudinal groove medially and a pair of depressions postero-laterally. Mesocoxal cavity well margined; process of metaventrite narrow, pointed at apex.

Elytra (Fig. 7) apically widened, laterally with a pair of rather high carinae, that are slightly curved inwards.

Legs (Fig. 7) very long, thin; femora slightly narrowed apically near apex; tibiae somewhat widened around middle to basal 1/3, their bases constricted; tibiae very thin, filiform.

Abdomen (Fig. 7) fusiform, flattened, widest around apex of segment III; surface smooth, sparsely punctured, shining. Median lobe of aedeagus (Figs 16–17) with long and narrow apical part, with a small projection near base of apical part (Fig. 16: arrow). Paramere with apical lobe slightly widened apically.

***Witteia dentilabrum* Maruyama & von Beeren, sp. n.**

urn:lsid:zoobank.org:act:EF84731E-0E8D-486B-859B-DBD89510FC8A

Figs 7–18

Etymology. Referring to the lateral projections on the labrum which is a unique character state in *Witteia*.

Type series. Holotype, male, Ulu Gombak (University Malaya Field Studies Centre, 03°19.479 N, 101°45.170 E, 220–250 m alt.), Selangor, Malaysia, III 2009, C. von Beeren and V. Witte, from a colony of *Leptogenys distinguenda* (KUM). Paratypes: same data as holotype (2 males, 1 female); same data, but VIII 2008, C. von Beeren (10); same data, but VIII 2008, C. von Beeren (8); same data, but IX 2009, Y. Nakase (2).

Type locality. Ulu Gombak, Selangor, Malaysia.

Distribution. Peninsular Malaysia.

Symbiotic host. *Leptogenys distinguenda*.

Diagnosis. This species is closely similar in general appearance to *Witteia borneensis* (Pace, 1986), comb. n., from Sabah, Borneo, but is distinguished from it by the larger body and the smaller apical part of the spermatheca.

Description. Body (Fig. 7) color reddish brown, but head completely black, mouthparts, legs, apex of abdomen lighter, medial areas of abdominal segments V and VI infuscate. Head (Figs 7–8) sparsely covered with setae; surface finely reticulated. Antennae (Figs 7–8) long, filiform; all segments longer than wide; segments III–X almost twice as long as wide; segment XI elongate. Pronotum (Figs 7–8) subquadrate, subparallel-sided, slightly wider than long (width/length = 1.11–1.18); surface moderately covered with minute setae, with some minute macrosetae laterally. Abdomen with anterior margins of sternites IV–VI produced medially; tergite VIII (Fig. 14) crenulate apically, with 8 macrosetae; sternite VIII (Fig. 15) rounded apically.

Male: sternite VIII with 11–12 macrosetae. Median lobe of aedeagus (Figs 16–17) with large parameral crest; apical part roundly convex paramerally; apical lobe slightly trilobed; copulatory piece with a short flagellum.

Female: sternite VIII with 8–9 macrosetae. Spermatheca (Fig. 18) with basal part dilated apically, coiled near base, curved near apex; apical part short.

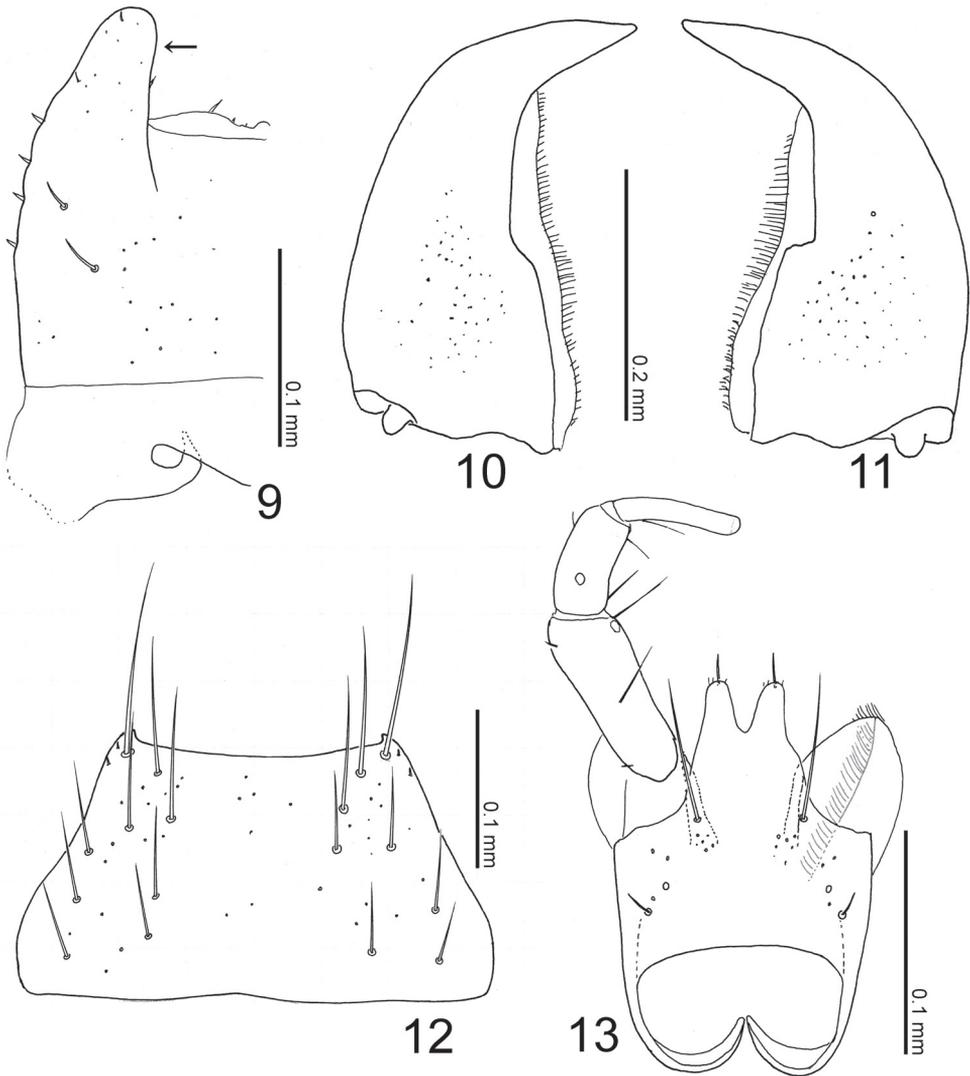
Measurements: BL, \approx 4.2–5.1; FBL, \approx 1.8–2.0; HL, 0.660–0.738; HW, 0.887–0.988; AL, \approx 2.8–3.1; PL, 0.806–0.950; PW, 0.725–0.800; HTL, 1.238–1.438.

Comments. Commonly found in *L. distinguenda* colonies together with *Maschwitzia ulrichi*, but less frequent than the latter species.

***Witteia borneensis* (Pace, 1986), comb. n.**

Wroughtonilla borneensis Pace, 1986: 204.

Type locality. Pangi, Sabah, Malaysia.

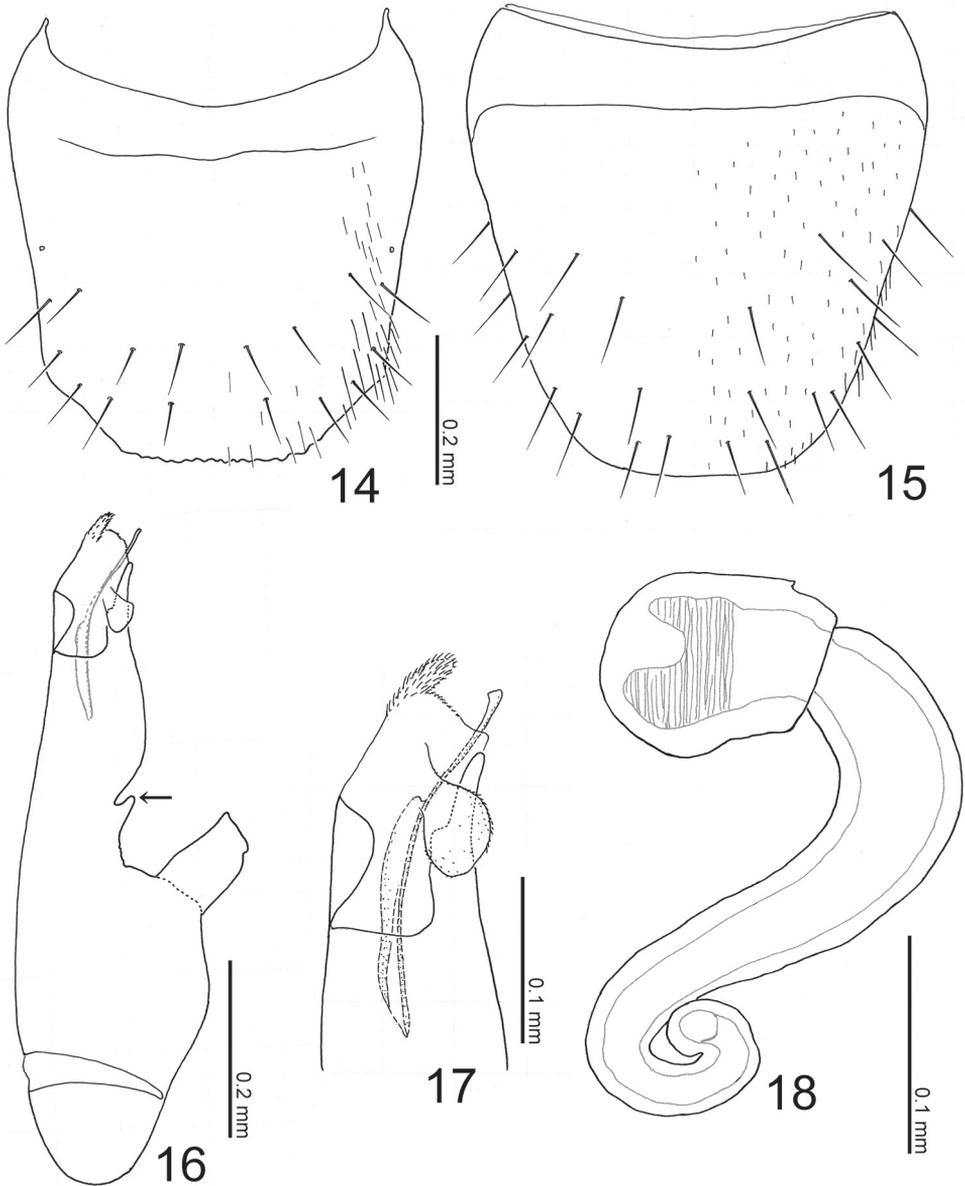


Figures 9–13. Mouthparts of *Witteia dentilabrum* gen. et sp. n. **9** labrum, left side, dorsal view **10** left mandible, dorsal view **11** right mandible, dorsal view **12** mentum, ventral view **13** labium, ventral view.

Diagnosis. This species is closely similar in general appearance to *Witteia dentilabrum* sp. n. from Selangor, Malaysia, but is distinguished from it by the smaller body (3.0 mm) and the larger apical part of the spermatheca.

Distribution. Sabah, Borneo; Burma.

Comments. This species was described based on a single specimen from Sabah, Borneo. In the original description Pace (1986) illustrated the habitus and spermatheca. The habitus illustration shows the labrum with a pair of projections that is an autapomorphy of *Witteia*. This species is probably associated with *Leptogenys distinguenda*.



Figures 14–18. Terminalia of *Witteia dentilabrum* gen. et sp. n. **14** Male tergite VIII, dorsal view **15** male sternite VIII, ventral view **16** median lobe of aedeagus, lateral view **17** ditto, apical part **18** spermatheca.

Discussion

The genera *Maschwitzia*, *Togpelenys* and *Witteia* are closely allied to *Wroughtonilla* (one species from India, Sri Lanka, Malaysia) and they belong to the *Wroughtonilla* genus-group (here proposed) of the subtribe Myrmedonina of the tribe Lomechusi-

ni, together with the genera *Aenictonia* Wasmann, 1900 (10 species from tropical Africa, one species from Thailand), *Anommatochara* Wasmann, 1915 (one species from tropical Africa), *Leptogenoxenus*, 1975 (one species from Philippines) and *Neowroughtonilla*, 1989 (one species from Malaysia). All members of this genus-group are associated with *Leptogenys* ants as far as known, except for species of *Aenictonia* and *Anommatochara* which are associated with *Dorylus* Fabricius, 1793 and/or *Aenictus* Shuckard, 1840 ants. The genera of this group share the following apomorphic character states: head with “neck”, a constricted postoccipital suture; pronotum with a longitudinal median groove; elytra with a pair of carinae laterally; and apical lobe of aedeagal median lobe elongate.

When Hlaváè and Janda (2009) described the genus *Leptogenopapus* (species from Papua New Guinea, associated with *Leptogenys breviceps* Viehmeyer, 1914), they stated that it is closely related to *Leptogenoxenus*. However, *Leptogenopapus* does not share the character states mentioned above. Because the type species *Leptogenopapus mirabilis* is in its general appearance extremely modified for myrmecomorphy, it is possible that the apomorphic character states in the *Wroughtonilla* group cited above have been secondarily lost or modified in this species. However, the aedeagal shape, which is normally not modified along with modification of external morphology to the myrmecophilous habitat, of *Leptogenopapus mirabilis* is very different from those of the *Wroughtonilla* group. *Leptogenopapus* does not belong to the *Wroughtonilla* genus-group.

Witteia is established as a new genus due to a strong autapomorphy, the presence of the projections on the labrum, by which it is clearly distinguished from *Maschwitzia* which is similar overall in general appearance. This character state is unique in the Lomechusini, possibly not present in any other aleocharine genera. Several other character states further distinguish *Witteia* from *Maschwitzia* (see Diagnosis of both the genera), though their polarities remain uncertain. We were reluctant to establish *Witteia* based on this single autapomorphy. However, considering generic concepts of the *Wroughtonilla* genus-group, which seem relatively narrow, the present establishment of the new genus seems reasonable at present. Phylogeny-based, ideally molecular phylogeny-based systematic revisions will be needed in the future.

Leptogenys distinguenda has been known as the only host of *M. ulrichi*. However, it was collected also from colonies of *L. mutabilis* (new record above). This is the only confirmed example of *Leptogenys*-associated aleocharine species that parasitizes more than one species of *Leptogenys* ants. *Leptogenys distinguenda* and *L. mutabilis* are morphologically very similar which suggests their close phylogenetic relationships, and this probably allows *M. ulrichi* to parasitize both species. In other myrmecophilous aleocharine species of Lomechusini, some of the Asian species of the genus *Pella* Stephens, 1835 have been known to host more than one ant species of *Lasius* spp. that are also very closely related, i.e., they belong to the same subgenus (Maruyama 2006).

Acknowledgments

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Aleocharine rove beetles (Coleoptera, Staphylinidae) associated with *Leptogenys* Roger, 1861 (Hymenoptera, Formicidae) II. Two new genera and two new species associated with *L. borneensis* Wheeler, 1919

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Abstract

Two new genera and two new species of Aleocharinae (Staphylinidae) from Malaysia are described: *Parawroughtonilla* Maruyama, **gen. n.** (type species: *Parawroughtonilla hirsuta* Maruyama, **sp. n.**), *Leptogenonia* Maruyama, **gen. n.** (type species: *Leptogenonia roslii* Maruyama, **sp. n.**), which are associated with *Leptogenys borneensis* Wheeler, 1919. They are closely related and share a unique character state of the aedeagus.

Keywords

Myrmecophily, *Parawroughtonilla* gen. n., *Leptogenonia* gen. n., *Wroughtonilla* genus group, new species, Malaysia

Introduction

Recently, the junior authors (CvB and VW) collected two species of rove beetles from colonies of *Leptogenys borneensis* Wheeler, 1919 that apparently belong to different genera of the tribe Lomechusini (subfamily Aleocharinae). Kistner et al. (2008) identified them

as “*Maschwitzia ulrichi*” and “*Neowroughtonilla steghausae*” that are known to be associated with colonies of *L. distinguenda* (Emery, 1887) and *L. diminuta* (F. Smith, 1857) respectively (Kistner 1989), and they recorded both for the first time with *L. borneensis*. However, the *Leptogenys*-associated rove beetles generally have strict host specificity, i.e., one rove beetle species is associated with only one or two closely related host ant species (Maruyama, unpublished data; von Beeren and Witte, personal observations). The first author found that the identifications of Kistner et al. (2008) are not correct, and both species can not conclusively be assigned to any known aleocharine genera and species.

This paper, the second part of the series on aleocharine rove beetles associated with *Leptogenys*, describes two new genera and two new species associated with *Leptogenys borneensis*, including discussion of their systematic positions.

Materials and methods

Between August 2007 and September 2009 a total of 11 months of field work was performed in a regenerated, secondary dipterocarp lowland rainforest at the Field Studies Centre of the University of Malaya (Kuala Lumpur), which is located in Ulu Gombak, Malaysia (03°19.4796'N, 101°45.1630'E, altitude 230 m). We located *L. borneensis* (Figs 1–2) nest sites by back-tracking ant raiding trails. Accordingly, we marked the nest sites and checked every 30 min for an approaching ant migration between 8 p.m. and 3 a.m. Since both rove beetle species take part in the ants' migrations, they can be detected and collected with the help of aspirators during these activities. Their behavior was observed in the laboratory in ant nest fragments (for further information on methods see Witte et al. 2008). After behavioral analysis, the specimens were stored in 90% Ethanol.

Morphological analyses were performed as in the first part of this series (Maruyama et al. 2010). Specimens are deposited in the senior author's collection in the Kyushu University Museum (KUM). Measurements are given in millimeters and are abbreviated as follows: antennal length (AL); body length (BL); fore body length, from front margin of head to apices of elytra (FBL); hind tibial length (HTL); head length (HL); head width (HW); pronotal length (PL); pronotal width (PW).

Taxonomy

Parawroughtonilla Maruyama, gen. n.

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Figs 3, 6–14

Type species. *Parawroughtonilla hirsuta* Maruyama, sp. n.

Etymology. A combination of the Greek *para-*, meaning near, and *Wroughtonilla* Wasmann, 1899, a closely related genus. Gender, feminine.



Figures 1–2. *Leptogenys borneensis*. **1** lateral view **2** head.

Diagnosis. This genus is rather similar to *Togpelenys* Kistner, 1989 in body shape and punctuation of body surface, but may easily be distinguished from it by the smaller eyes, and the abdomen being densely covered with setae.

Description. Body (Fig. 3) elongate, slightly flattened; surface of fore body strongly rugose, shining.

Head (Fig. 3) transverse, depressed above, widest at eyes that are large, less than 1/2 as long as head; clypeus truncate apically. Labrum weakly emarginate antero-medially, with 2 setae and 4 long setulae along anterior margin, with sparse pseudopores around lateral areas. Mandibles (Figs 6, 7) almost symmetric, gently curved, each apex acutely pointed; inner margin of left mandible (Fig. 6) with a small notch. Mentum (Fig. 8) trapezoidal, with several thick setae, with sparse pseudopores. Labium (Fig. 9) broad; prementum with a setal pore, in which seta is rather long, and 2 real pores in its inner side, with several pseudopores around real pores and base of medial seta; apodeme without median projection, with lateral projection short, curved apically; ligula long, each lobe with 2 large setula; labial palpus with segment I long and apically dilated; segment II 2/3 as long as I; segment III thin, narrowed apically, slightly shorter than II.

Pronotum (Fig. 3) slightly convex, with a broad longitudinal groove medially; sides weakly margined, i.e., superior marginal line somewhat obscured by rugose punctures continuing from disc. Mesocoxal cavity well margined; process of metaventrite narrow, pointed at apex.

Elytra (Fig. 3) apically widened, laterally with a pair of carinae that are not clear, with large rugose punctures.



Figures 3–5. **3** *Parawroughtonilla hirsuta* gen. et sp. n., dorsal habitus **4** *Leptogenonia roslii* gen. et sp. n., dorsal habitus **5** ditto, head and pronotum, dorsal view

Legs (Fig. 3) very long, thin; femora slightly narrowed apically; tibiae somewhat widened from around middle to basal 1/3, their bases constricted; tibiae somewhat thin.

Abdomen (Fig. 3) rather expanded, widest around segment IV; surface densely punctured, shining. Median lobe of aedeagus (Fig. 12) with apical lobe covered by exposed inner sac which is fused with apical margin of aedeagus and well sclerotized. Paramere with apical lobe slightly widened apically, somewhat constricted around middle.

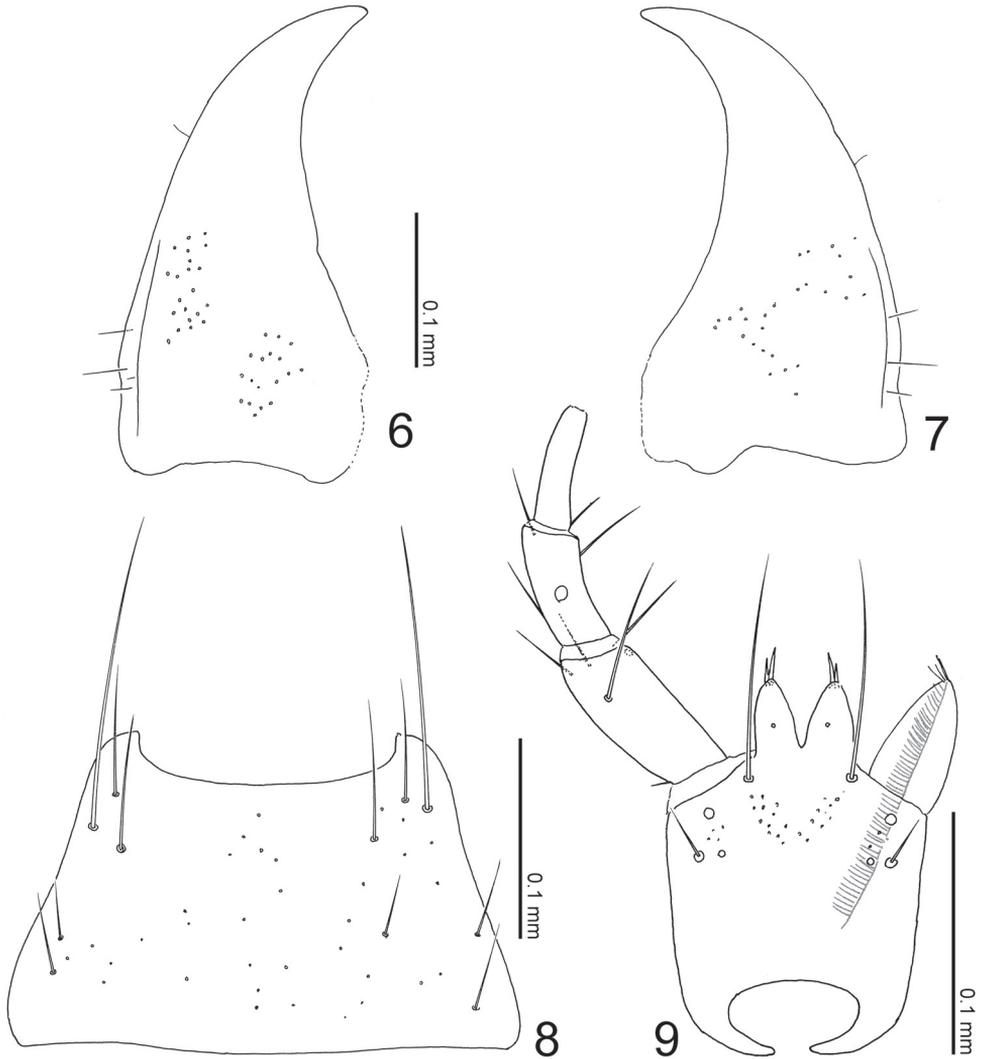
***Parawroughtonilla hirsuta* Maruyama, sp. n.**

urn:lsid:zoobank.org:act:8C50277F-D6DA-4118-A57D-08B755272381

Figs 3, 6–14

Etymology. In referring the hairy body.

Type series. Holotype, male, Ulu Gombak (University Malaya Field Studies Centre, 03°19.479 N, 101°45.170 E, 230 m alt.), Selangor, Malaysia, VIII 2008, C. von



Figures 6–9. Mouthparts of *Parawroughtonilla hirsuta* gen. et sp. n. **6** left mandible, dorsal view (protheca not shown) **7** right mandible, dorsal view (ditto) **8** mentum, ventral view **9** labium, ventral view.

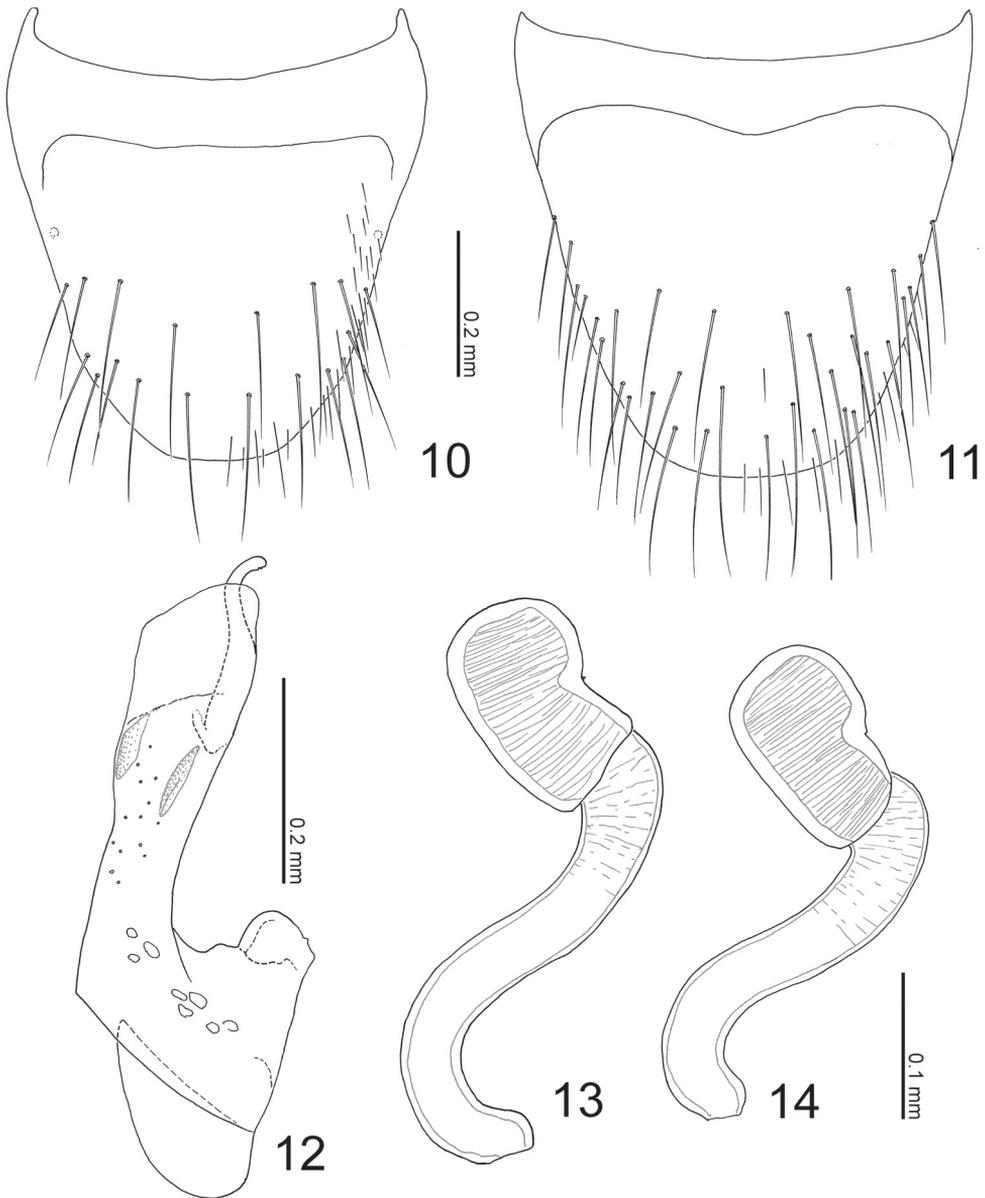
Beeren, from the colony of *Leptogenys borneensis* (mouthparts and terminalia dissected and mounted in Euparal) (KUM). Paratypes: same data as holotype (1 female, 2 sex?); same data, but III 2008, C. von Beeren & V. Witte (3 males, 1 female).

Type locality. Ulu Gombak, Selangor, Malaysia.

Distribution. Peninsular Malaysia.

Symbiotic host. *Leptogenys borneensis*.

Diagnosis. This species is similar to *Togpelenys gigantea* in general appearance, but distinguished from it by the smaller body, the dense setation on the body surface and the



Figures 10–14. Terminalia of *Parawroughtonilla hirsuta* gen. et sp. n. **10** Male tergite VIII, dorsal view **11** male sternite VIII, ventral view **12** median lobe of aedeagus, lateral view **13, 14** spermathecae.

presence of a superior marginal line of the pronotal hypomeron. This species is found together with *Leptogenonia roslii* in the same host colony, and can be easily distinguished from it by the larger body and the longer and denser setation on the body surface.

Description. Body (Fig. 3) color reddish brown, but head and elytra slightly darker. Head (Fig. 3) moderately covered with long erect setae; surface somewhat rugose. Anten-

nae (Fig. 3) long; all segments longer than wide; segments III–X almost twice as long as wide; segment XI elongate. Pronotum (Fig. 3) longer than wide (width/length = 0.86), subparallel-sided, with anterior margin rounded, with posterolateral corners angled, produced laterally; surface moderately covered with long erect setae, which are poorly differentiated from macrosetae. Elytra (Fig. 3) moderately covered with long erect setae. Abdomen (Fig. 3) with sternites moderately covered with long erect setae, with tergite VIII (Fig. 10) rounded apically, with 9 macrosetae; sternite VIII (Fig. 11) rounded apically; tergite IX with 4 macrosetae; tergite X with 5 macrosetae postero-laterally.

Male: sternite VIII (Fig. 11) with around 18 macrosetae. Median lobe of aedeagus (Fig. 12) with short parameral crest; apical lobe curved near apex.

Female: sternite VIII with 14–16 macrosetae. Spermatheca (Figs 13–14) with basal part slightly dilated apically, twice curved near base and apex; apical part short.

BL, \approx 4.1–4.5; FBL, \approx 2.1–2.3; HL, 0.606–0.623; HW, 0.715–0.740; AL, \approx 2.4–2.6; PL, 0.825–0.881; PW, 0.708–0.756; HTL, 1.270–1.350.

***Leptogenonia* Maruyama, gen. n.**

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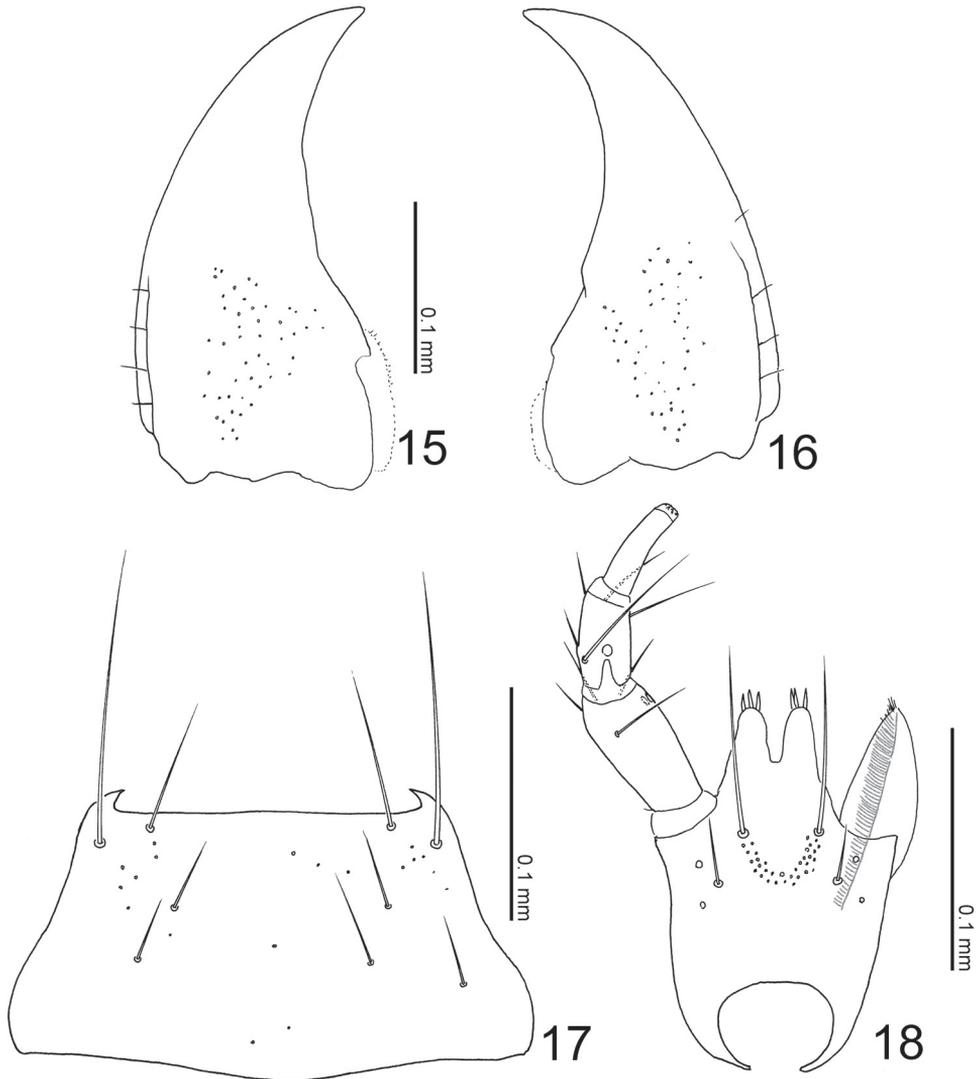
Type species. *Leptogenonia roslii* Maruyama, sp. n.

Etymology. A combination of the host ant genus name *Leptogenys* and “-nia” that is the end of a lomechusine genus name *Myrmedonia* Erichson, 1837, in the same manner as *Aenictonia* Wasmann, 1900 which is associated with *Aenictus* ants.

Diagnosis. This genus is similar to *Maschwitzia* Kistner, 1989 in body shape and punctuation of body surface, but may easily be distinguished from it by the smaller body, the head with post-ocular ridges (Fig. 5: arrow), the temples being convex and the shorter legs. The head capsule structure is similar to those of *Aenictonia* and *Anommatochara* Wasmann, 1915 but is distinguished from those genera by the elytra without a pair of medial carinae.

Description. Body (Fig. 4) elongate, flattened; surface of fore body rugose, matte.

Head (Figs 4, 5) transverse, depressed above, with post-ocular ridges (Fig. 5: arrow), widest at temples that are quite convex; occiput convex, with a pair of small tubercles; eyes large, less than 1/4 as long as head; clypeus truncate apically. Labrum weakly emarginate antero-medially, with 3 setae and 3 long setulae along anterior margin, sparsely with pseudopores around lateral areas. Mandibles (Figs 15–16) almost symmetric, gently curved, each apex acutely pointed; inner margin of right mandible (Fig. 16) with a small notch. Mentum (Fig. 17) trapezoidal, with several thick setae, very sparsely with pseudopores. Labium (Fig. 18) broad; prementum with a setal pore, in which seta is very long, and 2 real pores in its outer side, with several pseudopores around base of medial seta; apodeme without median projection, with lateral projection short, curved apically; ligula long, each lobe with 3 large setula; labial palpus with segment I long and apically dilated; segment II 4/3 as long as I, with membranous notch; segment III thin, narrowed apically, slightly as long as II.

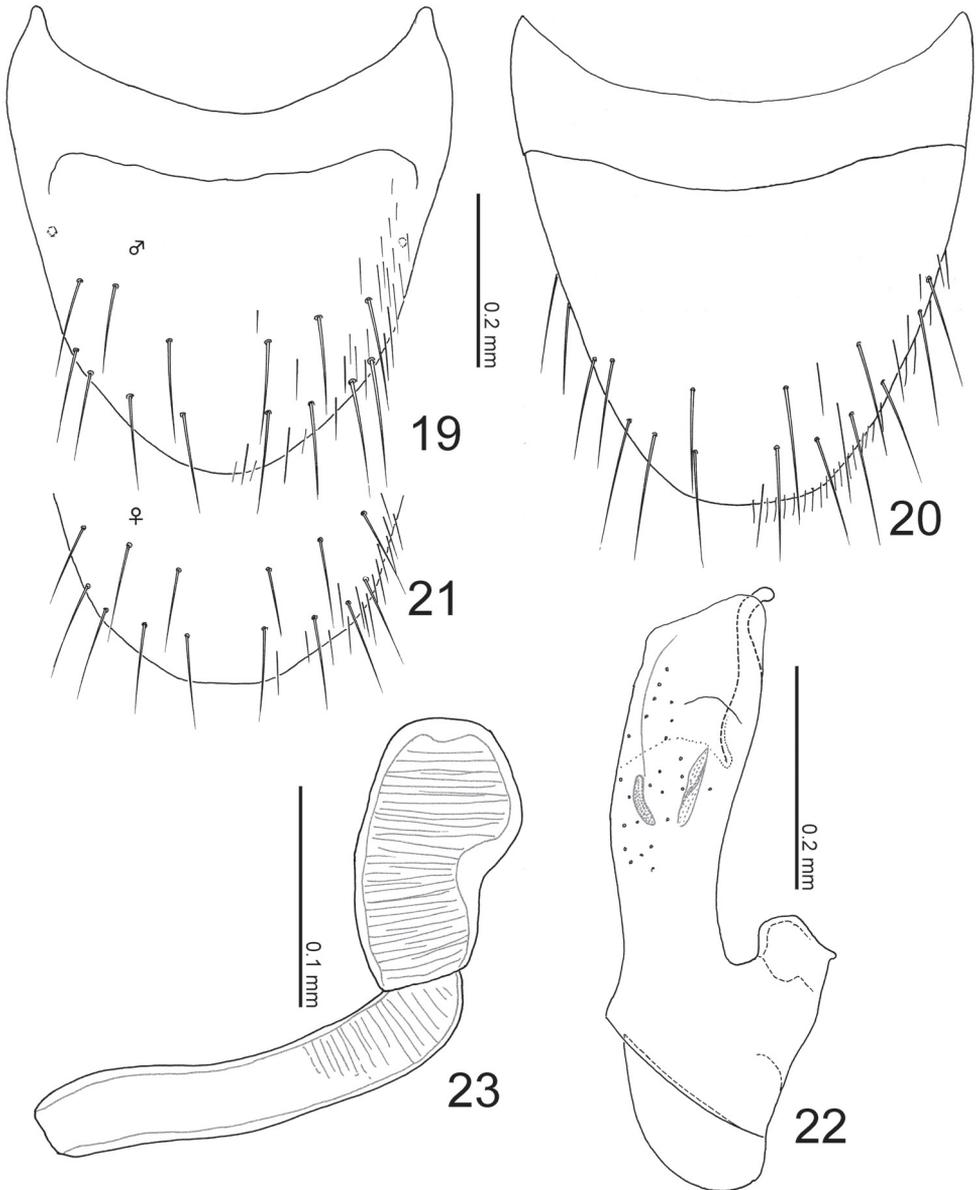


Figures 15–18. Mouthparts of *Leptogenophila roslii* gen. et sp. n. **15** left mandible, dorsal view (prostheca not shown) **16** right mandible, dorsal view (ditto) **17** mentum, ventral view **18** labium, ventral view.

Pronotum (Fig. 4) slightly convex, with a broad longitudinal groove medially, its lateral lines convex as a pair of carinae, sides well margined and elevated, depressed along margins. Mesocoxal cavity well margined; process of metaventrite narrow, rounded at apex.

Elytra (Fig. 4) apically widened, laterally with a pair of carinae; postero-inner margin of elytron obliquely truncate.

Legs (Fig. 4) moderate in length; femora slightly narrowed apically near apex; tibiae somewhat widened from around middle to basal 1/3, their bases constricted; tarsi somewhat thin.



Figures 19–23. Terminalia of *Leptogenophila roslii* gen. et sp. n. **19** Male tergite VIII, dorsal view **20** male sternite VIII, ventral view **21** female tergite VIII, apical part, dorsal view **22** median lobe of aedeagus, lateral view **23** spermatheca.

Abdomen (Fig. 4) slightly expanded, widest around segment IV, well convex above; surface densely punctured, matte; segments II-IV emarginated posteromedially; segments III and IV with a pair of large depressions around base. Median lobe of aedeagus (Fig. 22) with apical lobe covered by exposed inner sac which is fused with apical margin of aedeagus and well sclerotized. Paramere with apical lobe slightly widened apically.

***Leptogenonia roslii* Maruyama, sp. n.**

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Figs 4–5, 15–23

Etymology. Dedicated to Dr. Rosli Hashim for his great support to field researchers in the Peninsular Malaysia that has resulted in numerous contributions to the knowledge on tropical animals.

Type series. Holotype, male, Ulu Gombak (University Malaya Field Studies Centre, 03°19.479 N, 101°45.170 E, 220–250 m alt.), Selangor, Malaysia, III 2009, C. von Beeren & V. Witte, from the colony of *Leptogenys borneensis* (KUM). Paratypes: same data as holotype but VIII 2008, C. von Beeren (1 female, 1 sex?: KUM).

Type locality. Ulu Gombak, Selangor, Malaysia.

Distribution. Peninsular Malaysia.

Symbiotic host. *Leptogenys borneensis*.

Diagnosis. This species is similar to the members of the genus *Maschwitzia* but is easily distinguished from them by the smaller body and the shorter legs. This species is found together with *Parawroughtonilla hirsuta* in the same host colony, but it can be easily distinguished by the smaller body and the shorter and sparser setation on the body surface, especially by elytra lacking any setae.

Description. Body (Fig. 4) color pale reddish-brown, but head, pronotal lateral margins, elytra and abdominal segments V–VI darker. Head (Figs 4–5) moderately covered with short recumbent setae; surface somewhat rugose. Antennae (Fig. 3) long; all segments longer than wide; segments III–X almost 1.5 times as long as wide; segment XI conical. Pronotum (Fig. 4) longer than wide (width/length = 0.88–0.91), with anterior margin truncate, constricted around basal 1/3, with posterolateral corners rounded, produced laterally; surface without setae. Elytra (Fig. 4) with surface moderately covered with short recumbent setae. Abdomen (Fig. 4) with sternites moderately covered with long recumbent setae, with tergites moderately covered with very short recumbent setae; tergite VIII (Figs 19, 21) with 7 macrosetae; sternite VIII (Fig. 20) rounded apically, with 8 macrosetae; tergite IX with 4 macrosetae; tergite X with 4 macrosetae postero-laterally.

Male: tergite VIII rounded apically. Median lobe of aedeagus (Fig. 22) with short parameral crest; apical lobe curved near apex.

Female: tergite VIII slightly truncate apically. Spermatheca (Fig. 23) with basal part almost straight but slightly curved at apex; apical part large, 1/2 as long as basal part.

BL, \approx 3.4–4.3; FBL, \approx 1.8–2.0; HL, 0.538–0.555; HW, 0.625–0.644; AL, \approx 2.0–2.1; PL, 0.725–0.748; PW, 0.644–0.656; HTL, 0.913–0.925.

Behavioral observations

Both rove beetle species are highly integrated in the host ant society. They move undisturbed in between migrating ants, interact frequently with their host ants in laboratory nests and are overall treated peacefully. Both species fed on host diet (crickets) in

laboratory nests, and they never preyed on any life stage of their host ants, suggesting a kleptoparasitic lifestyle (von Beeren et al. in press).

Discussion

Kistner et al. (2008) recorded *Maschwitzia ulrichi* and *Neowroughtonilla steghausae* from *Leptogenys borneensis*. This report is based on the material collected by CvB and VW and represents misidentifications of these species. *Leptogenys*-associated rove beetles are highly host species specific as mentioned above. The authors CvB and VW have not collected any other species than *Parawroughtonilla hirsuta* and *Leptogenonia roslii* in their examinations of eight different *Leptogenys borneensis* colonies after the report of Kistner et al. (2008). At least around the type locality Ulu Gombak, Malaysia, *P. hirsuta* and *L. roslii* are the only myrmecophilous rove beetles found in *L. borneensis* colonies.

Parawroughtonilla and *Leptogenonia* both belong to the *Wroughtonilla* genus-group along with several other genera sharing several character states (Maruyama et al. 2010).

Parawroughtonilla hirsuta and *Leptogenonia roslii* are considerably different in their habitus, i.e., head, pronotum and abdominal structures. However, the states of the median lobe of aedeagus are almost the same, especially the apical lobe covered by the exposed inner sac which is completely fused with apical margin of median lobe and well sclerotized. This character state is apparently apomorphic and unique within the *Wroughtonilla* genus-group, i.e. it could be a synapomorphy for both species.

Leptogenonia is well characterized by the head structure: presence of the post-ocular ridges, the well convex temples and the occiput with a pair of tubercles. These character states are also observed in the genera *Aenictonia* and *Anommatochara* of the *Wroughtonilla* genus group that are mainly distributed in Africa (one species *Aenictonia thailandica* Seevers, 1965 is known from Thailand) which are associated with the army ant genera *Aenictus* Shuckard, 1840 and *Dorylus* Fabricius, 1793. However, the states of the aedeagus are very different between *Leptogenonia*, *Aenictonia*, and *Anommatochara*. Some *Leptogenys* species show army-ant life habits, comparable to the classic army ants of Ecitoninae, *Aenictus* and *Dorylus* (Kronauer 2009). Therefore similarities of the head structures evolved probably convergently between these aleocharines inhabiting colonies of army ants and ants that have army-ant life habits.

Acknowledgments

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