Euscorpius

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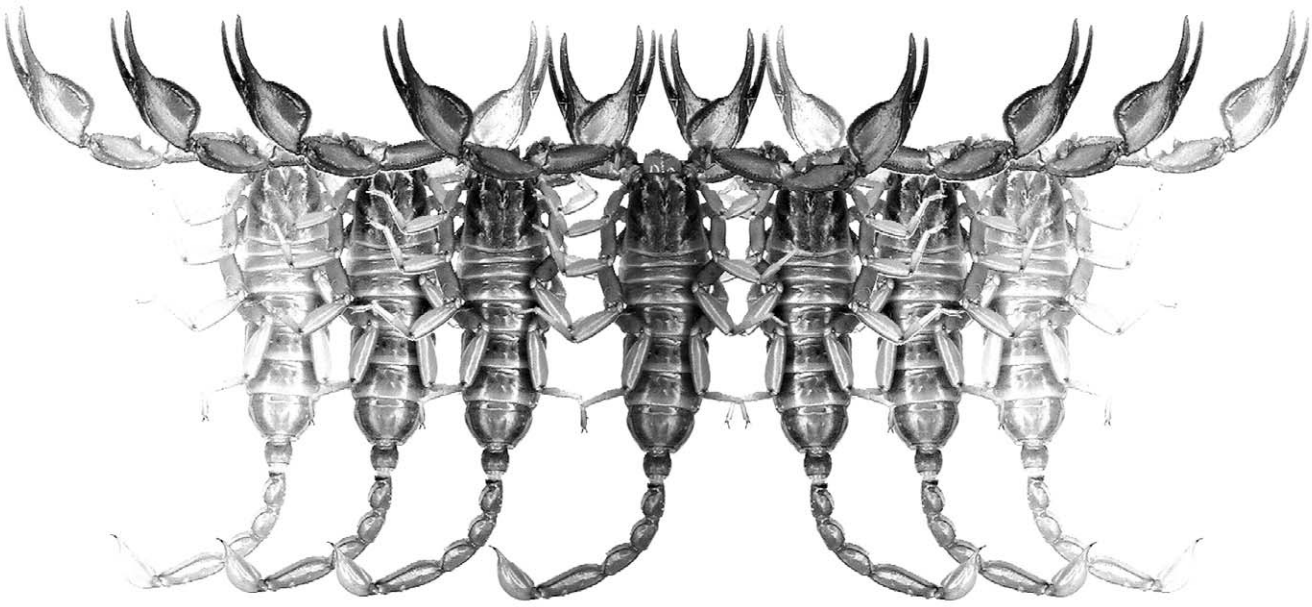

Three New *Chaerilus* from Malaysia (Tioman Island) and Thailand (Scorpiones: Chaerilidae), with a Review of *C. cimrmani*, *C. sejnai*, and *C. tichyi*

František Kovařík, Graeme Lowe & František Šťáhlavský

September 2018 – No. 268

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Publication date: 20 September 2018

http://zoobank.org/urn:lsid:zoobank.org:pub:73665FA8-D9E4-4996-8176-E22BB56086BD

Euscorpius — Occasional Publications in Scorpiology. 2018, No. 268

Three new *Chaerilus* from Malaysia (Tioman Island) and Thailand (Scorpiones: Chaerilidae), with a review of *C. cimrmani*, *C. sejnai*, and *C. tichyi*

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http://zoobank.org/urn:lsid:zoobank.org:pub:73665FA8-D9E4-4996-8176-E22BB56086BD

Summary

Chaerilus majkusi **sp**. **n**. from Malaysia (Tioman Island), *C. neradorum* **sp**. **n**. and *C. stockmannorum* **sp**. **n.** from Thailand are described and fully illustrated with color photographs of live and preserved specimens, as well as of their habitat. They are compared to the species *C. cimrmani* Kovařík, 2012, *C. sejnai* Kovařík, 2005, and *C. tichyi* Kovařík, 2000, which we also illustrate with color photographs of live unpublished specimens. Hemispermatophores of *C. cimrmani*, *C. majkusi* **sp** .**n**., *C. stockmannorum* **sp**. **n**., and *C. tichyi* are illustrated and compared, and we also describe the karyotypes of *C. cimrmani*, *C. majkusi* **sp**. **n**., *C. neradorum* **sp**. **n**., *C. stockmannorum* **sp**. **n**., *C. sejnai* and *C. tichyi*. The diploid numbers of chromosomes range from 76 to 186 and the karyotypes show distinct interspecific variability among analyzed species. *C. stockmannorum* **sp**. **n**. (2n=186) possesses the highest number of chromosomes within the order Scorpiones and the class Arachnida.

Introduction

The chaerilids comprise a small, rather homogeneous family of scorpions that are of special interest as they are hypothesized to be Laurasian relicts (Lamoral, 1980) that appear to occupy a basal position within the order (Sharma et. al., 2015; Soleglad & Fet, 2003). Currently, 39 extant species are recognized, all placed in a single genus *Chaerilus*. They are widely distributed across continents and archipelagoes of tropical southern Asia, with highest numbers of recorded species from Indonesia (9 spp.), Malaysia (9 spp.), China (8 spp.) and Vietnam (7 spp.). However, there probably remains undisclosed chaerilid diversity in many countries in the region because of inadequate scientific collecting. Here we describe three new species uncovered in recently collected material from Malaysia (1 spp.) and Thailand (2 spp.). The latter finding doubles the number of chaerilids reported from Thailand. All of the new species belong to a taxonomic subdivision of the genus characterized by pedipalp movable fingers with higher numbers of granule rows (9–16, typically strongly imbricated) on the dentate margin (Kovařík, 2012; Kovařík & Ojanguren Affilastro, 2013). In addition to comparative analyses of external morphology, we present new information on karyotypes and hemispermatophores of the new species and previously described species.

Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974). Hemispermatophore terminology follows Kovařík et al. (2018). The analysis of the karyotypes was based on chromosome preparations made by the spreading method (e. g. Plíšková et al. 2016). The time of the initial hypotonization (0.075 M KCl) was 30 min and then the tissue was fixed in methanol: glacial acetic acid (3:1) for at least 20 min. The chromosomes were stained with 5% solution in Sörensen phosphate buffer for 30 min. The relative length of the chromosomes was measured by the plugin Levan (Sakamoto & Zacaro, 2009) of the software Image J 1.45r (http://rsbweb .nih.gov/ij). The final calculation of the relative length for the haploid set was based on five metaphases I.

Specimens studied herein are preserved in 80% ethanol and deposited in the first author´s collection (FKCP).

Biometrics: L, length; W, width; D, depth.

Systematics

Family **Chaerilidae** Pocock, 1893

Chaerilus Simon, 1877
(Figs.1–125, Table 1)

Chaerilus Simon, 1877: 238; Kovařík & Ojanguren, 2013: 131–145, figs. 617–776 (complete reference list until 2013); Kovařík et al, 2015: 1–21, figs. 1–91, tables 1–3.
= *Chelomachus* Thorell, 1889: 583 (syn. by Kraepelin, 1899: 157).
= *Uromachus* Pocock, 1890: 250 (syn. by Kraepelin, 1899: 157).

TYPE SPECIES. *Chaerilus variegatus* Simon, 1877.

DIAGNOSIS. Total length 16–80 mm; orthobothriotaxy type B; pedipalp femoral d_3–d_4 trichobothria configuration points toward dorsoexternal carina; pedipalp patella with three ventral trichobothria and pedipalp femur with 9 trichobothria, 4 of them dorsal; cheliceral fixed finger with median and basal denticles flush on surface, not fused into bicusp; ventral edge of cheliceral movable finger crenulated, dorsal edge with single subdistal denticle; ventral surface of cheliceral fixed finger with four denticles; dorsal edge of cheliceral movable finger with a single subdistal denticle; ventral surface of cheliceral fixed finger with denticles; sternum, *type 1*, exhibits subtle wide horizontal compression; maxillary lobes I spatulate; hemispermatophore is *fusiform*; median denticle row (MD) of pedipalp chela finger arranged in *oblique* groups; pedipalp chela exhibits "8-carina" configuration; legs without tibial spurs, but with prolateral and retrolateral pedal spurs; tarsi of legs bear two or four rows of ventral setae and median row of spinules; fifth metasomal segment with a single ventral carina; telson without subaculear tubercle.

CYTOGENETICS. Our cytogenetic analyses of six *Chaerilus* species confirmed the basic cytogenetic characteristics of the family Chaerilidae that are shared with other scorpions. Typical for this arachnid order are the absence of morphologically differentiated sex chromosomes and achiasmatic meiosis in males (e. g. Schneider et al., 2009). Moreover, we found a great range of variation in the diploid number within Chaerilidae (2n=76–186) that is similar to the variation in several other better characterized families with monocentric chromosomes such as Hormuridae (2n= 54–174), Scorpionidae (2n=50–120), and Urodacidae (2n=29–175) (Schneider et al., 2018). Interestingly, *Chaerilus stockmannorum* **sp**. **n**. has the highest known number of chromosomes (2n=186) within the order Scorpiones. The different karyotype characteristics among *Chaerilus* species again emphasize the importance of cytogenetic analysis in the taxonomy of scorpions as was already demonstrated in genera *Heterometrus* (Scorpionidae) (Plíšková et al., 2016) and *Hadogenes* (Hormuridae) (Šťáhlavský et al., 2018).

HEMISPERMATOPHORES. The chaerilid hemispermatophores documented here are similar to those previously reported for the family (Bastawade, 1994; Kovařík et al., 2015; Lourenço & Duhem, 2010; Monod et al, 2017; Stockwell, 1989). All conform to the basic plan of a laterally compressed fusiform structure with relatively large capsule region, relatively short, broad trunk, and a short, posteriorly directed distal lamina. The sperm hemiduct of the capsule is reinforced by a longer, stronger posterior (distal) carina, and a shorter, weaker anterior (basal) carina. As seen in Figs 108–114, the form of the capsule region is well conserved across a variety of species, lacking variation that might provide taxonomically useful characters. Although there appear to be interspecific differences in size and shape of the distal lamina, an example of two individuals of *Chaerilus hofereki* (Figs. 113–114) shows that there can also be large intraspecific differences. Determination of diagnostic interspecific differences, if they exist, will require statistical analysis of morphometrics and shapes of a much larger sample of hemispermatophores from each species.

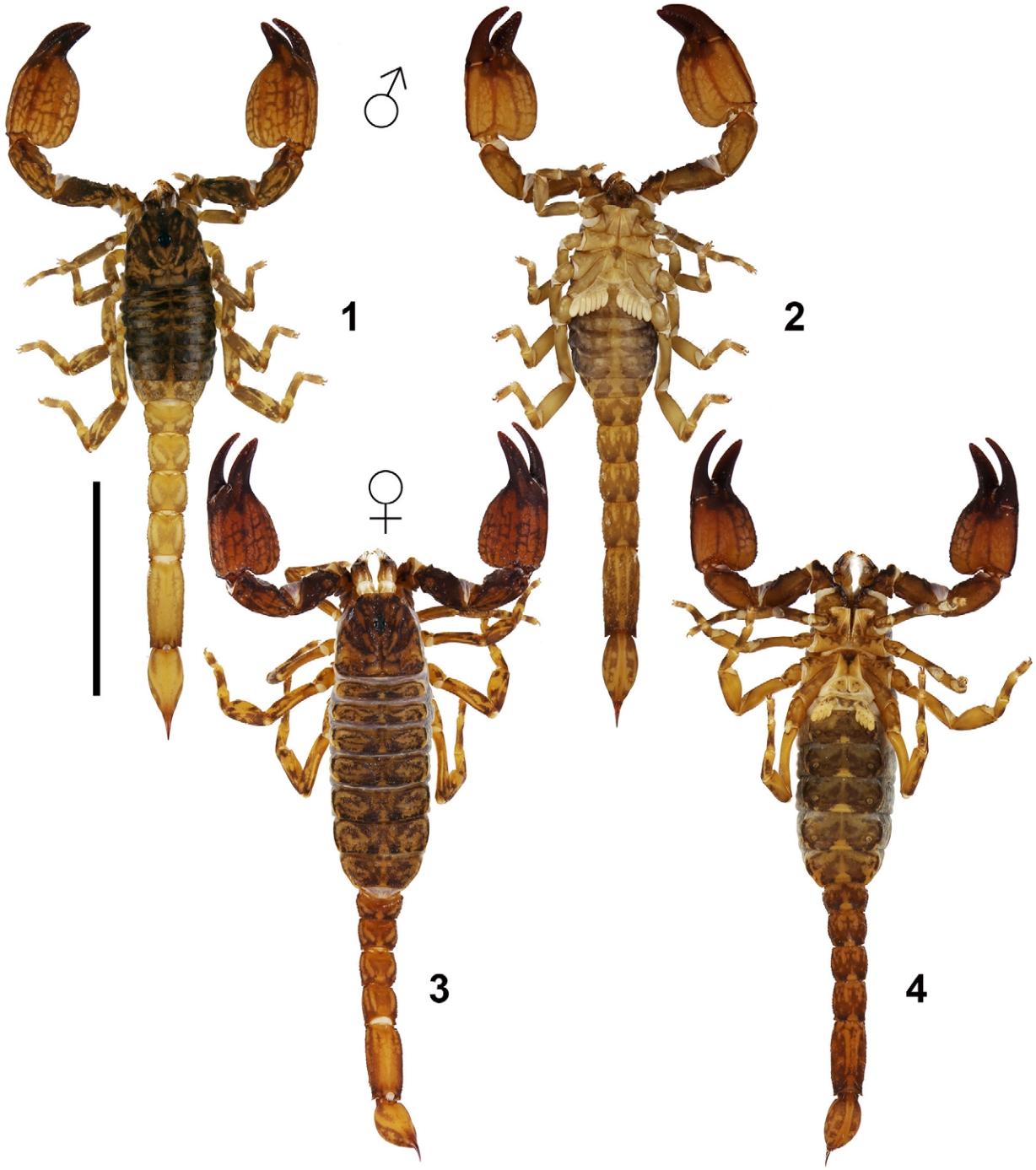
Chaerilus majkusi **sp**. **n**.
(Figs. 1–34, 37, 39–40, 43, 109, 115–116, Table 1)
http://zoobank.org/urn:lsid:zoobank.org:act:CFDA1E06-D868-4A5E-ACB2-7A51F1690BA7

TYPE LOCALITY AND TYPE REPOSITORY. Malaysia, Pahang, Tioman Island, Kampung Genting, tropical forest, 02°45'57"N 104°07'48"E 45 m a.s.l., FKCP.

TYPE MATERIAL. **Malaysia**, Pahang, Tioman Island, Kampung Genting, tropical forest, 02°45'57"N 104° 07'48"E 45 m a.s.l. (Fig. 43), 7. IX.2016, 1♂ (holotype, 1278) 3♂2♀1♂juv (paratypes), leg. D. Ho-ferek & R. Majkus, 3♂2♀8 juvs. (paratypes, 1454–1456, offspring of the female paratype, some of them still alive), bred by D. Hoferek and F. Kovařík, FKCP.

ETYMOLOGY. A patronym in honor of Zdeněk Majkus, Czech Republic, for his friendship and lifelong dedication to arachnids.

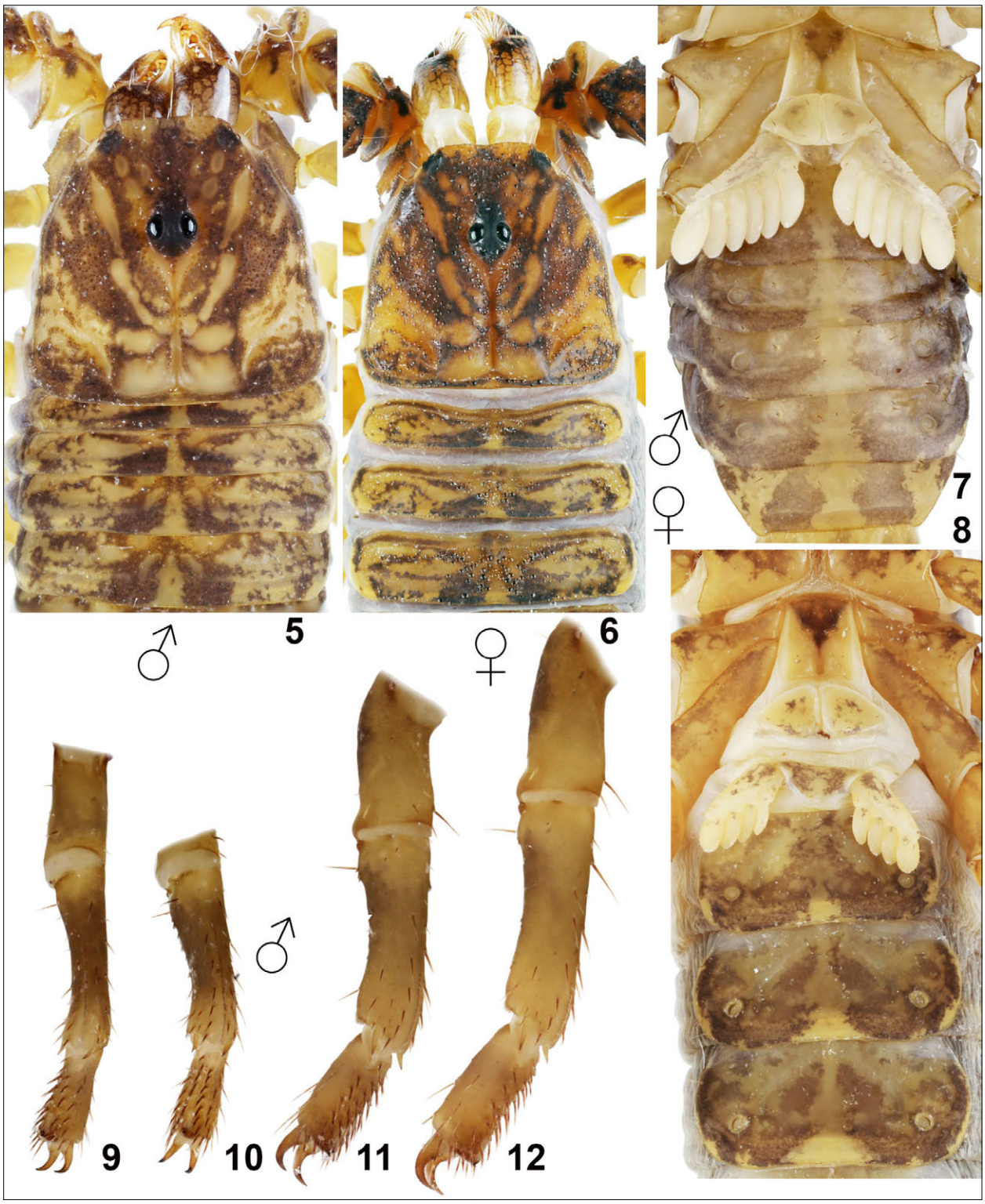
DIAGNOSIS. Total length 25–29 mm. Two pairs of lateral eyes and one pair of median eyes. Male differs from female in having pedipalp chela much wider. Chela length/width ratio in male 1.87; in female 2.28.



Figures 1–4: *Chaerilus majkusi* **sp**. **n**. **Figures 1–2**. Holotype male, dorsal (1) and ventral (2) views. **Figures 3–4**. Paratype female, dorsal (3) and ventral (4) views. Scale bar: 10 mm.

Movable finger of pedipalp with 16 imbricated granule rows. Fingers straight in both sexes. Chela of pedipalp with 7–8 carinae. Pectinal teeth number 6 in males, 4 in females. Carapace granulated. Mesosomal tergites granulated mainly in median area. All sternites smooth without carinae and granules. First metasomal segment with 6 or 8 carinae, second to fourth segments with 6 carinae, ventral metasomal carinae absent. All metasomal segments very sparsely granulated.

DESCRIPTION. Total length 25–29 mm. Two well developed pairs of lateral eyes and one pair of median eyes

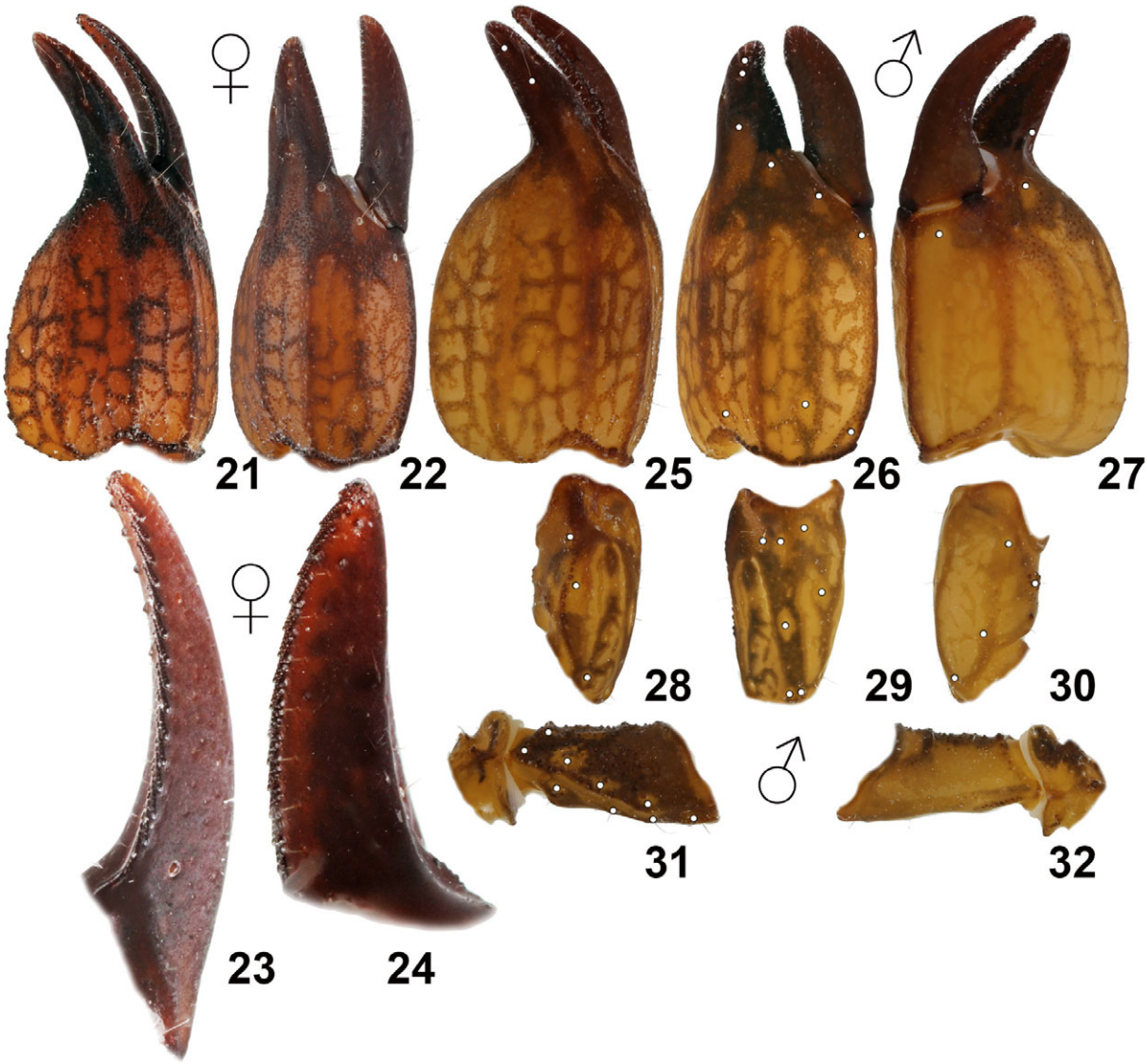


Figures 5–12: *Chaerilus majkusi* **sp**. **n**. **Figures 5**, **7**, **9–12**. Holotype male, carapace and tergites I–IV (5), sternopectinal region and sternites (7), left legs I–IV, retrolateral aspect (9–12). **Figures 6**, **8**. Paratype female, carapace and tergites I–III (6), sternopectinal region and sternites III–V (8).

Figures 13–20: *Chaerilus majkusi* **sp**. **n**. **Figures 13**, **15–17**. Holotype male, metasoma V and telson lateral (13), metasoma and telson, lateral (15), ventral (16), and dorsal (17) views. **Figures 14**, **18–20**. Paratype female, metasoma V and telson lateral (14), metasoma and telson, lateral (18), ventral (19), and dorsal (20) views. Scale bar: 10 mm (15–20).

(Figs. 5–6). The chelicerae (Figs. 33–34) are smooth, yellow and strongly reticulate, anteriorly black. The male differs from the female in having pedipalp chela much wider with short fingers. The chela length/width ratio in the male 1.87; in the female 2.28. The male has relatively larger pectines (Figs. 7 and 8). There is no sexual dimorphism in shape of metasoma and telson. For the position and distribution of trichobothria, see Figs. 25–31. For measurements, see Table 1.

COLORATION (Figs. 1–4). The color is yellowish orange to brown, spotted. Older specimens are darker (see Fig. 39 versus 40).

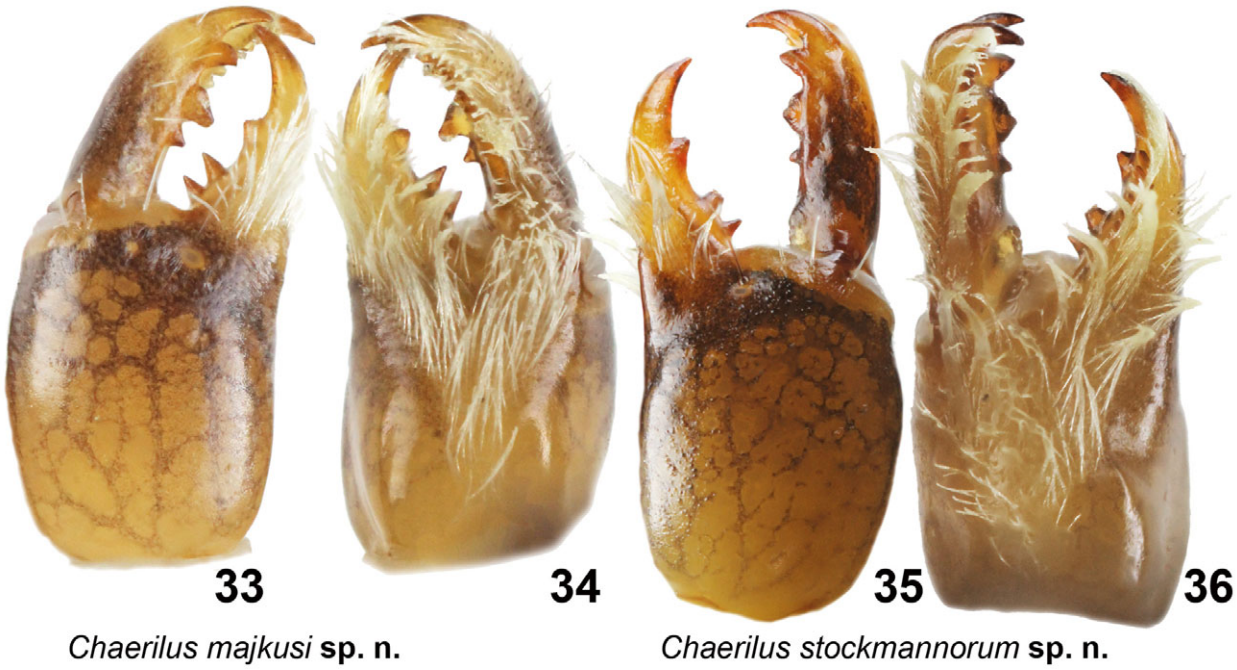


Figures 21–32: *Chaerilus majkusi* **sp**. **n**. **Figures 21**–**24**. Paratype female, pedipalp chela, dorsal (21) and externodorsal (22) views, movable (23) and fixed (24) fingers. **Figures 25**–**32**. Holotype male, pedipalp chela, dorsal (25), externodorsal (26), and ventrointernal (27) views. Pedipalp patella, dorsal (28), external (29) and ventral (30) views. Pedipalp femur and trochanter, dorsal (31) and ventral (32) views. The trichobothrial pattern is indicated in Figures 25–31.

CARAPACE AND MESOSOMA (Figs. 5–8). The carapace is covered by large granules that do not form carinae and are absent from two strips in the median area. The anterior margin of the carapace is almost straight to weakly concave. The mesosomal tergites are irregularly granulated. All sternites are smooth without carinae and granulation. Sternite V with smooth patch indicated. Pectinal teeth number 6 in males, 4 in females.

METASOMA AND TELSON (Figs. 13–20). The first metasomal segment bears 6 or 8 incomplete carinae, the second to fourth bear six incomplete carinae, and the fifth segment bears four carinae. All carinae are composed of sparse, large granules. The spaces between carinae are very sparsely, irregularly granulated, more so on lateral surfaces of all segments and ventral surfaces of segments IV–V. Metasomal segments I–III are ventrally smooth without carinae and granules. All segments are very sparsely hirsute. The telson is elongate, smooth and very sparsely hirsute.

PEDIPALPS (Figs. 21–32). The pedipalp chela is stout with swollen manus in the male. The movable finger bears 16 and the fixed finger 15 imbricated rows of granules. The chela has seven or eight mostly granulated carinae. The carina on the externodorsal surface of the manus may be incomplete. The dorsal and internal surfaces of chela with reticulate granulation



Figures 33–36: Figures 33–34. *Chaerilus majkusi* **sp**. **n**., male paratype, left chelicera dorsal (33) and ventral (34) views. **Figures 35–36**. *Chaerilus stockmannorum* **sp**. **n**., male paratype, right chelicera dorsal (35) and ventral (36) views.

patterns. The patella is smooth with dorsal carina developed and granulated, other carinae are absent or weakly indicated. The femur has four carinae.

LEGS (Figs. 9–12). The legs are sparsely hirsute, without bristlecombs and carinae. The femora and patellae are granulated dorsally, with other surfaces smooth. The tarsomeres bear four rows of spiniform setae. Spiniform setal formula of inner rows is 7–8/7–8: 10–12/10–11: 9–12/9–11: 10–11/10–12; of outer rows is 5–8/5–8 on all legs.

HEMISPERMATOPHORE (Fig. 109). Fusiform, with relatively large capsule region (ca. 650 µm), and relatively short distal lamina (ca. 370 µm) angled posteriorly and apically truncated. Sperm hemiduct of capsule weakly sclerotized, with long posterior carina and shorter anterior carina.

KARYOTYPE (Figs. 115–116). We analyzed the karyotypes of the male holotype and the three male paratypes. The diploid complement of all specimens is 76 chromosomes (Fig. 115). The chromosomes are small and their morphology is not clearly visible during mitotic metaphase. However, the conspicuous constrictions on chromosomes during postpachytene and metaphase I indicate the existence and predominance of bi-armed chromosomes in this species (Fig. 116). The chromosomes gradually decrease in length from 3.38% to 1.65% of the haploid set. We did not identify any heteromorphic bivalent during postpachytene and metaphase I, and we did not observe chiasmata during these phases.

AFFINITIES. *Chaerilus majkusi* **sp**. **n**. is reliably distinguished from all other *Chaerilus* species by the following unique combination of characters: total length 25–29 mm; movable fingers of pedipalp with 16 rows of granules; pedipalp chela wide, stout with swollen manus in the male; pedipalp fingers straight in both sexes; metasomal segments I–III ventrally smooth without carinae and granules; tarsomeres of legs bear four rows of spiniform setae.

Chaerilus majkusi **sp**. **n**. is the third *Chaerilus* species recorded from Tioman Island. This island is of special interest because it is inhabited both by *Chaerilus tichyi* Kovařík, 2000 (Figs. 41–42), the largest known member of the family Chaerilidae (70–80 mm), and by *Chaerilus sejnai* Kovařík, 2005 (Figs. 38) which may be smallest known member of the family (16–22 mm) if we exclude species that were described from juveniles (*Chaerilus kampuchea* Lourenço, 2012 and *Chaerilus sabinae* Lourenço, 1995).

Chaerilus neradorum **sp**. **n**.

(Figs. 44–67, 117–118, Table 1)

http://zoobank.org/urn:lsid:zoobank.org:act:21E8792C-9989-4747-A6BD-FD75CD80F989

TYPE LOCALITY AND TYPE REPOSITORY. Thailand, Samui, 9.46555°N 99.98419°E; FKCP.

Figures 37–38: *Chaerilus majkusi* **sp**. **n**., female paratype (37) and *Chaerilus sejnai* Kovařík, 2005, male (38) in vivo habitus.

Figures 39–40: *Chaerilus majkusi* **sp**. **n**., male holotype (39) and female paratype with newborns (40) in vivo habitus.

TYPE MATERIAL. **Thailand**, Samui, 9.46555°N 99. 98419°E (Fig. 44),1♂ (1216), leg. L. Nerad, FKCP.

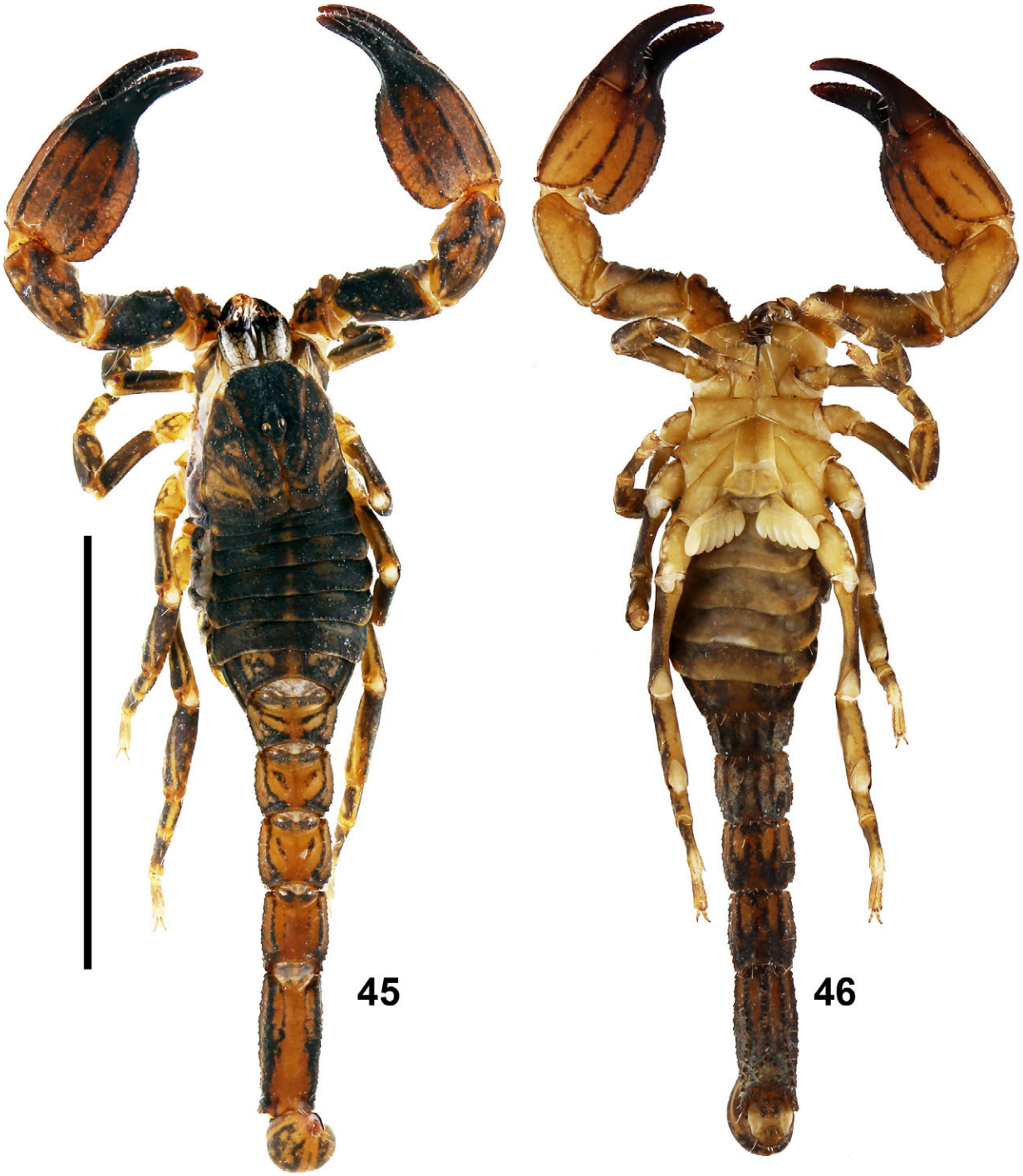
ETYMOLOGY. The specific epithet honors Ladislav Nerad and his wife Hana (Czech Republic) for their invaluable contributions to the knowledge of the scorpion fauna of Thailand.

DIAGNOSIS. Total length of male holotype 23.25 mm. Two pairs of lateral eyes and one pair of median eyes.

Figures 41–42: *Chaerilus tichyi* Kovařík, 2000, male (41) and female (42) topotypes in vivo habitus.

Chela length/width ratio in male 2.4. Movable and fixed fingers of pedipalp with 11 imbricated granule rows. Fingers straight. Chela of pedipalp with 8 carinae. Pectinal teeth number 6 in males. Carapace and tergites sparsely granulated. All sternites smooth without carinae and granules. First metasomal segment with 10

Figures 43–44: *Chaerilus*, collection localities. **Figure 43**. *C. majkusi* **sp**. **n**., type locality. **Figure 44**. *C. neradorum* **sp**. **n**., type locality.

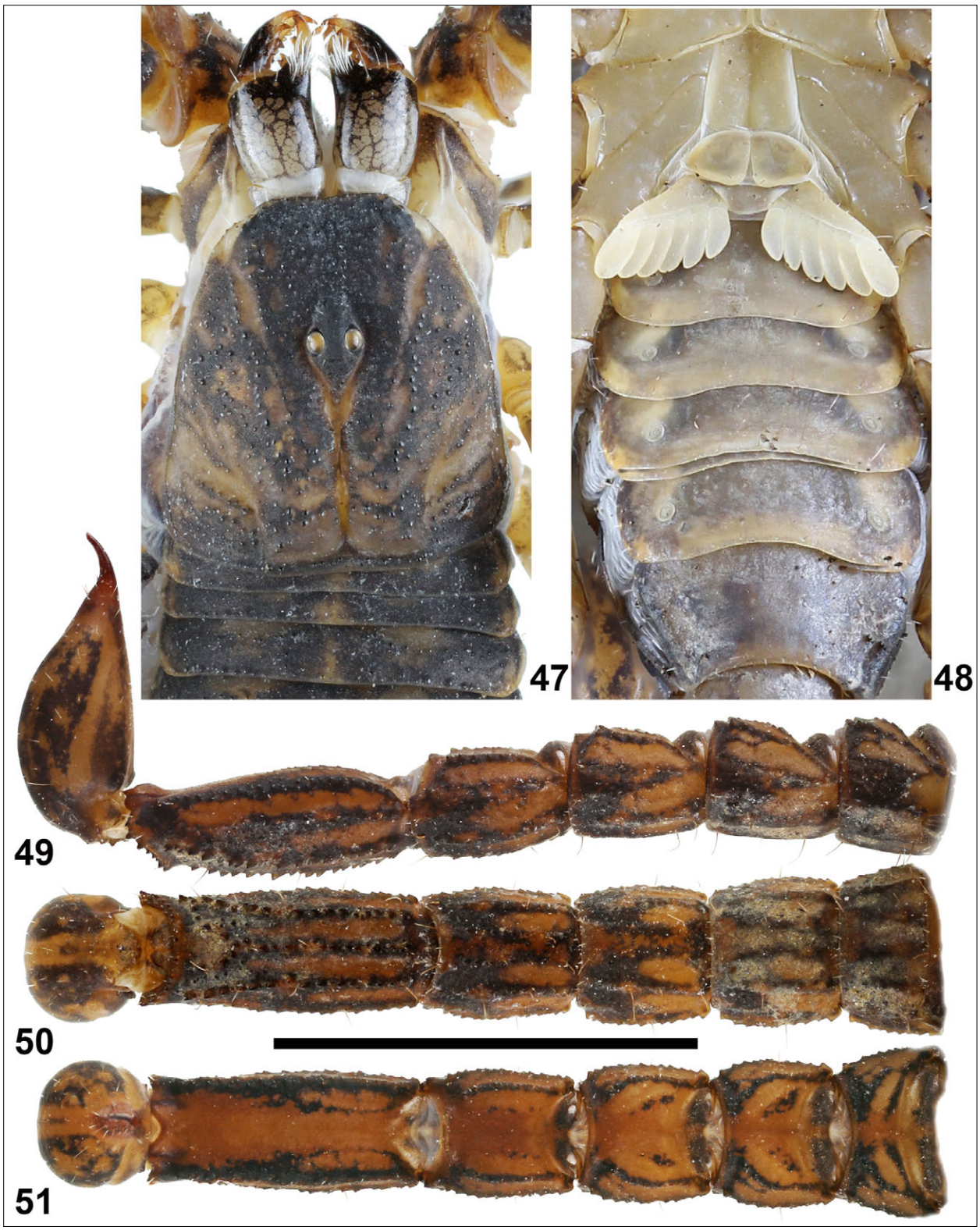


Figures 45–46: *Chaerilus neradorum* **sp**. **n**., holotype male, dorsal (45) and ventral (46) views. Scale bar: 10 mm.

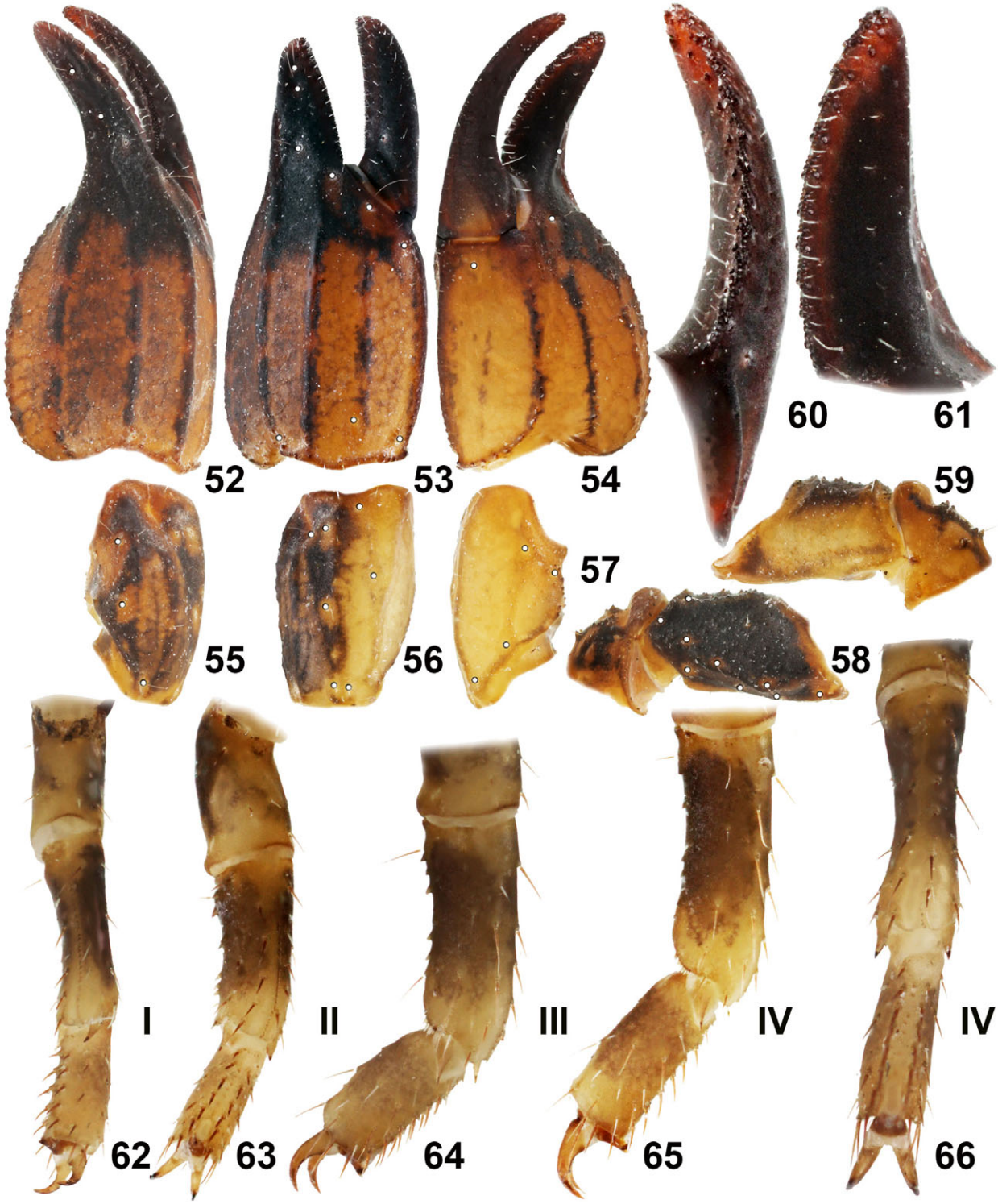
carinae, second to fourth segments with 8 carinae. All metasomal segments very sparsely granulated.

DESCRIPTION. Total length of male holotype 23.25 mm, female unknown. Two well developed pairs of lateral eyes and one pair of median eyes. The chelicerae are finely granulated, yellow and strongly reticulate, anteriorly black. For the position and distribution of trichobothria, see Figs. 52–58. For measurements, see Table 1.

COLORATION (Figs. 45–46). The color is orange to brown, spotted.



Figures 47–51: *Chaerilus neradorum* **sp**. **n**., holotype male, carapace and tergites I–III (47), sternopectinal region and sternites (48), metasoma and telson, lateral (49), ventral (50), and dorsal (51) views. Scale bar: 5 mm (49–51).



Figures 52–66: *Chaerilus neradorum* **sp**. **n**., holotype male, pedipalp chela, dorsal (52), externodorsal (53), and ventrointernal (54) views. Pedipalp patella, dorsal (55), external (56) and ventral (57) views. Pedipalp femur and trochanter, dorsal (58) and ventral (59) views. Movable (60) and fixed (61) fingers. Left legs I–IV, retrolateral/ventral aspects (62–66). The trichobothrial pattern is indicated in Figures 52–58.

Figures 67–68: *Chaerilus neradorum* **sp**. **n**., male holotype (67) and *Chaerilus cimrmani* Kovařík, 2012, male (68) in vivo habitus.

CARAPACE AND MESOSOMA (Figs. 47–48). The entire carapace is covered by large granules which do not form carinae. The anterior margin of the carapace is almost straight to weakly concave. The mesosomal tergites are irregularly, sparsely granulated. All sternites are smooth without carinae and granulation. Sternite V

Dimensions (MM)		*C. majkusi* **sp. n.** ♂ **holotype**	♀ **paratype**	*C. neradorum* **sp. n.** ♂ **holotype**
Carapace	L / W	3.925 / 4.175	3.825 / 4.175	3.850 / 3.550
Mesosoma	L	5.950	10.300	5.300
Tergite VII	L / W	1.375 / 3.525	1.950 / 3.950	2.075 / 3.200
Metasoma & telson	L	17.025	14.625	14.100
Segment I	L / W / D	1.675 / 2.425 / 1.938	1.325 / 2.258 / 1.875	1.350 / 2.250 / 1.650
Segment II	L / W / D	1.800 / 2.013 / 1.838	1.550 / 1.950 / 1.700	1.675 / 1.900 / 1.475
Segment III	L / W / D	2.000 / 1.950 / 1.700	1.700 / 1.825 / 1.600	1.750 / 1.775 / 1.450
Segment IV	L / W / D	2.325 / 1.850 / 1.675	1.950 / 1.725 / 1.550	1.975 / 1.650 / 1.400
Segment V	L / W / D	4.325 / 1.850 / 1.750	3.725 / 1.775 / 1.575	3.425 / 1.550 / 1.366
Telson	L / W / D	4.900 / 1.775 / 1.600	4.375 / 1.750 / 1.525	3.925 / 1.625 / 1.463
Pedipalp	L	12.825	13.325	11.375
Femur	L / W	3.025 / 1.375	3.075 / 1.500	2.525 / 1.325
Patella	L / W	3.250 / 1.500	3.300 / 1.675	2.900 / 1.600
Chela	L	6.550	6.950	5.950
Manus	W / D	3.500 / 2.700	3.050 / 2.500	2.475 / 2.125
Movable finger	L	3.425	3.925	3.175
Total	**L**	**26.90**	**28.75**	**23.25**

Table 1: Comparative measurements of *Chaerilus majkusi* **sp**. **n**. and *Chaerilus neradorum* **sp**. **n**. types. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

with smooth patch weakly indicated. Pectinal teeth number 6 in male holotype.

METASOMA AND TELSON (Figs. 49–51). The first metasomal segment bears 10 carinae, the second to fourth bear eight carinae, and the fifth segment bears seven carinae of which one ventral carina posteriorly branches in a "Y" configuration. All carinae are composed of large, sparse granules. The spaces between carinae are irregularly very sparsely granulated on all surfaces, less so on the dorsal surface. Granules on the dorsal surface may indicated a pair of carinae. All segments are sparsely hirsute. The telson is elongate, smooth and sparsely hirsute.

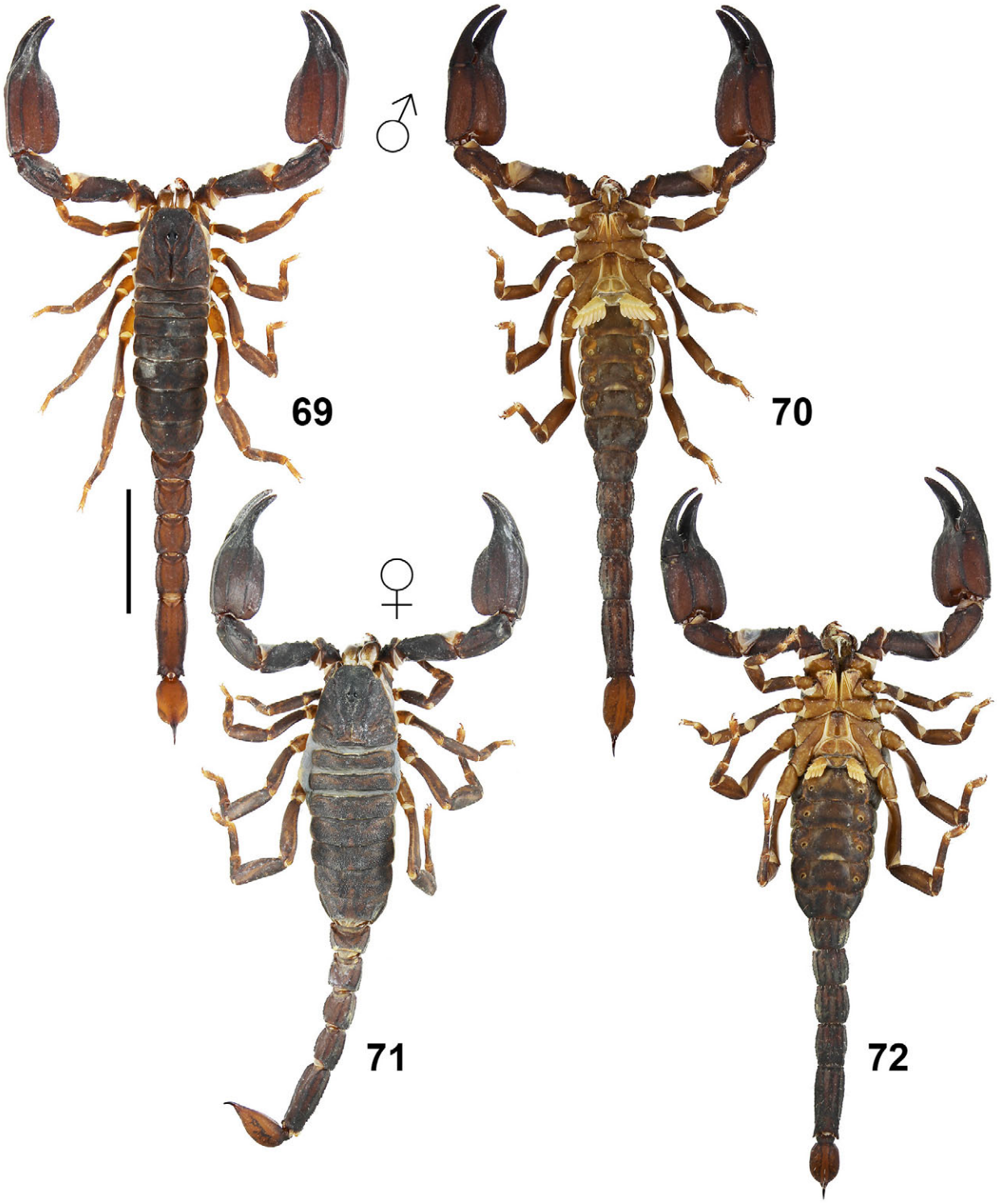
PEDIPALPS (Figs. 52–61). The pedipalp chela is wide and swollen in the male. The movable and fixed fingers of pedipalp bear 11 imbricated rows of granules. The chela has eight partly granulated carinae. The patella has five only weakly indicated carinae and the femur has four or five partly granulated carinae. The spaces between carinae on the femur are covered by unevenly spaced granules. The chela is finely granulated and the patella is smooth except for several solitary granules on their internal surfaces.

LEGS (Figs. 62–66). The legs are sparsely hirsute, without bristlecombs and carinae. The femora and patellae have several granules dorsally, other surfaces are smooth. The patellae have several median spines dorsally. The tarsomeres bear two rows of spiniform setae and 2 – 4 outer spiniform setae. Spiniform setae formula is 5–6/6–7 : 6–7/7–8 : 7–8/8–9 : 7–8/7–9 (omitting outer spiniform setae).

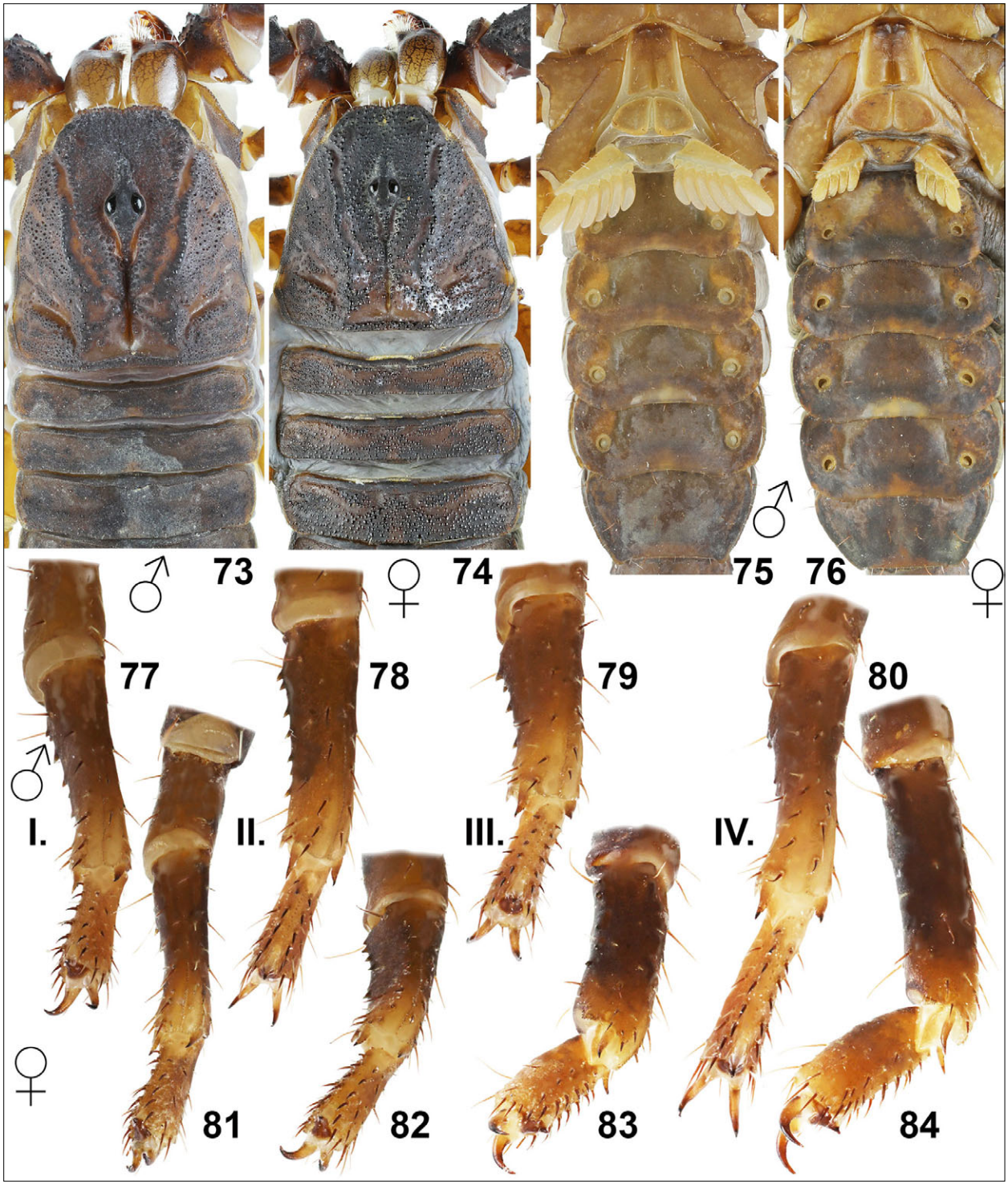
KARYOTYPE (Figs. 117–118). We analyzed the karyotype of the male holotype. The diploid complement of this species is 108 chromosomes in the majority of mitotic metaphases (Fig. 117). However, the chromosomes are small and the correct number is not easy to count in some observed cells as a consequence of an early segregation of some chromatids during mitotic metaphase. This effect is evident especially in segregation of chromosomes during late metaphase I (Fig. 118). It is the reason we cannot exclude even 106 as the correct diploid number of chromosomes in this species. We are not able to specify morphology of the chromosomes at this moment. However, it is evident that they gradually decrease in length from 2.63% to 1.07% of the haploid set. We did not observe chiasmata during postpachytene and metaphase I.

AFFINITIES. *Chaerilus neradorum* **sp**. **n**. is reliably distinguished from all other *Chaerilus* species by the following unique combination characters: total length of male holotype 23.25 mm; movable and fixed fingers of pedipalp with 11 cutting edges; chela length/width ratio in male 2.4; fingers straight in male.

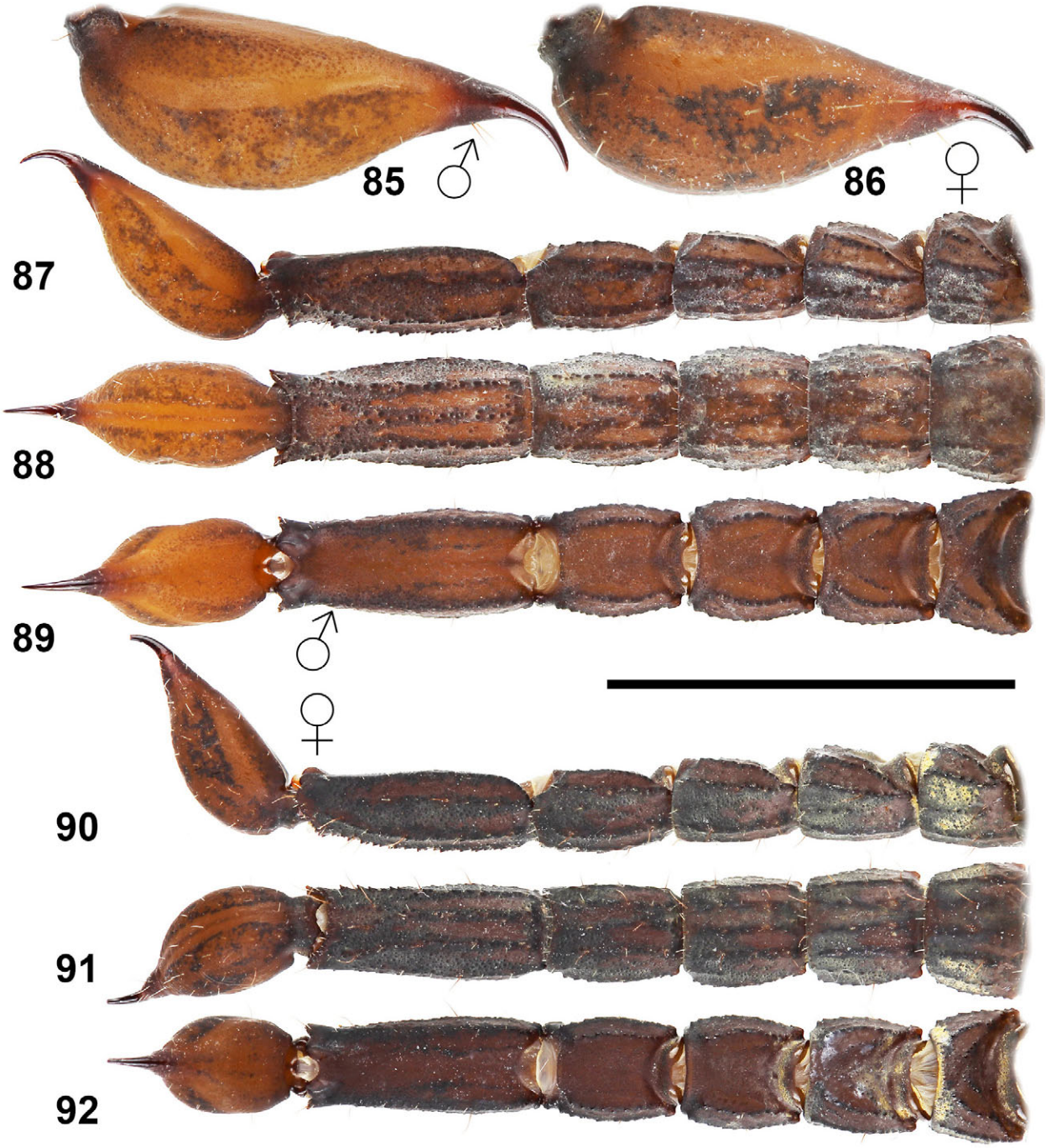
Type locality of *C. neradorum* **sp**. **n**. is inside the area of distribution of *C. cimrmani* Kovařík, 2012 which can be distinguished from *C. neradorum* **sp**. **n**. by larger size (total length of male holotype 23.25 mm for *C. neradorum* **sp**. **n**. vs. 31–42 mm of *C. cimrmani*). Other differences are evident in comparing Figs. 52 versus 105, which shows that the male of *C. cimrmani* has wider, more swollen chelae, shorter chela fingers,



Figures 69–72: *Chaerilus stockmannorum* **sp**. **n**. **Figures 69–70**. Holotype male, dorsal (69) and ventral (70) views. **Figures 71–72**. Paratype female, dorsal (71) and ventral (72) views. Scale bar: 10 mm.



Figures 73–84: *Chaerilus stockmannorum* **sp**. **n**. **Figures 73**, 75, **77–80**. Holotype male, carapace and tergites I–III (73), sternopectinal region and sternites (75), left legs I–IV, retrolateral aspect (77–80). **Figures 74**, **76**, **81–84**. Paratype female, carapace and tergites I–III (74), sternopectinal region and sternites (76), left legs I–IV, retrolateral aspect (81–84).



Figures 85–92: *Chaerilus stockmannorum* **sp**. **n**. **Figures 85**, **87–89**. Holotype male, telson lateral (85), metasoma and telson, lateral (87), ventral (88), and dorsal (89) views. **Figures 86**, **90–91**. Paratype female, telson lateral (86), metasoma and telson, lateral (90), ventral (91), and dorsal (92) views. Scale bar: 10 mm (87–92).

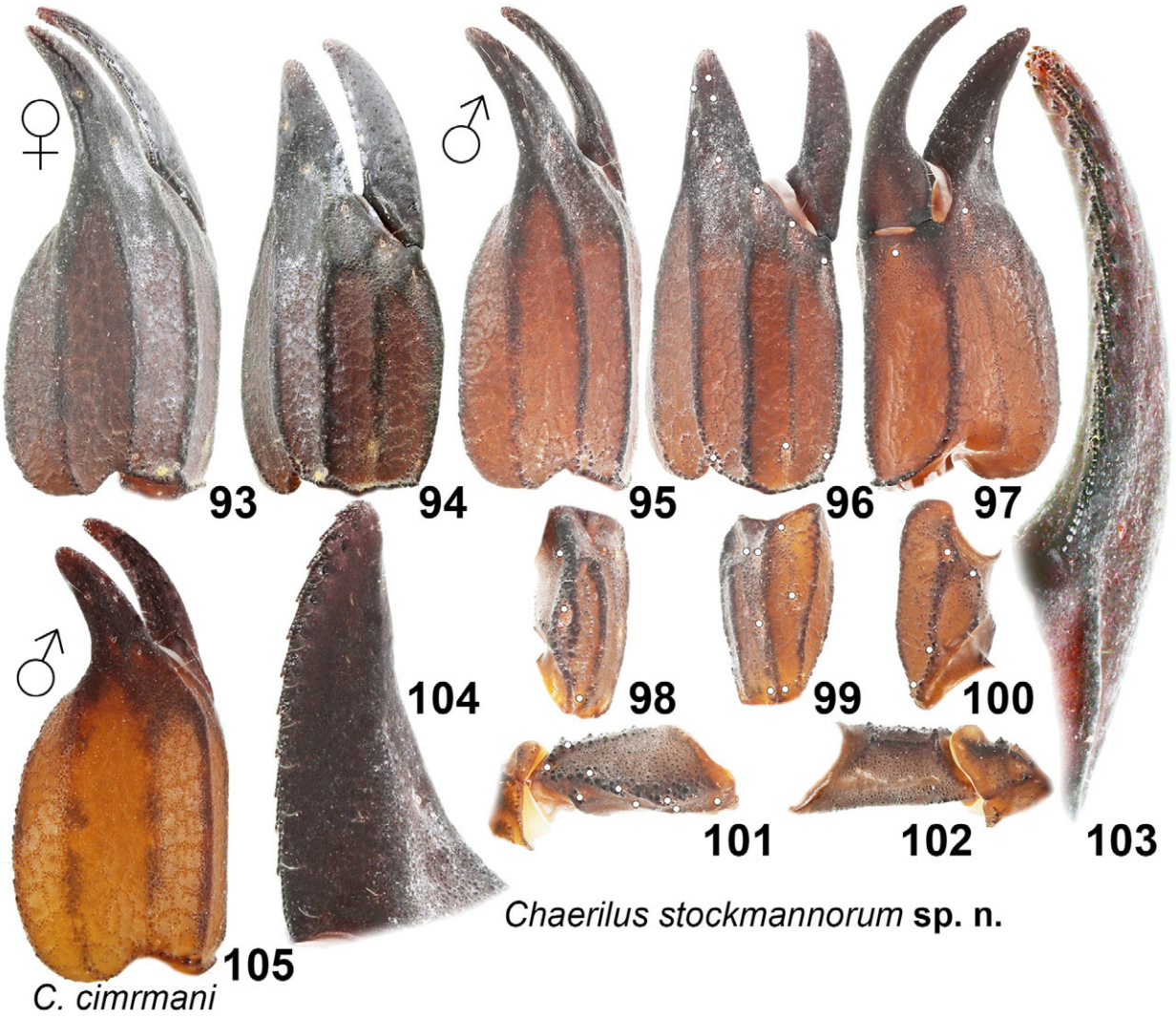
and stronger granulation of carapace and metasomal segments, than the male of *C. neradorum* **sp**. **n**.

***Chaerilus stockmannorum* sp. n.**
(Figs. 35–36, 69–104, 106–107, 111–112, 119–120, Table 2)
http://zoobank.org/urn:lsid:zoobank.org:act:7368D450-5471-47CB-8D52-CB93F25DB21F

TYPE LOCALITY AND TYPE REPOSITORY. Thailand, Trang, 7.565100°N 99.623855°E; FKCP.

TYPE MATERIAL. **Thailand**, Trang, 7.565100°N 99.623855°E, 2♂ (1482) 1♀, local collector.

ETYMOLOGY. The specific epithet honors Mark Stockmann and his wife Britta (Germany) for their invaluable

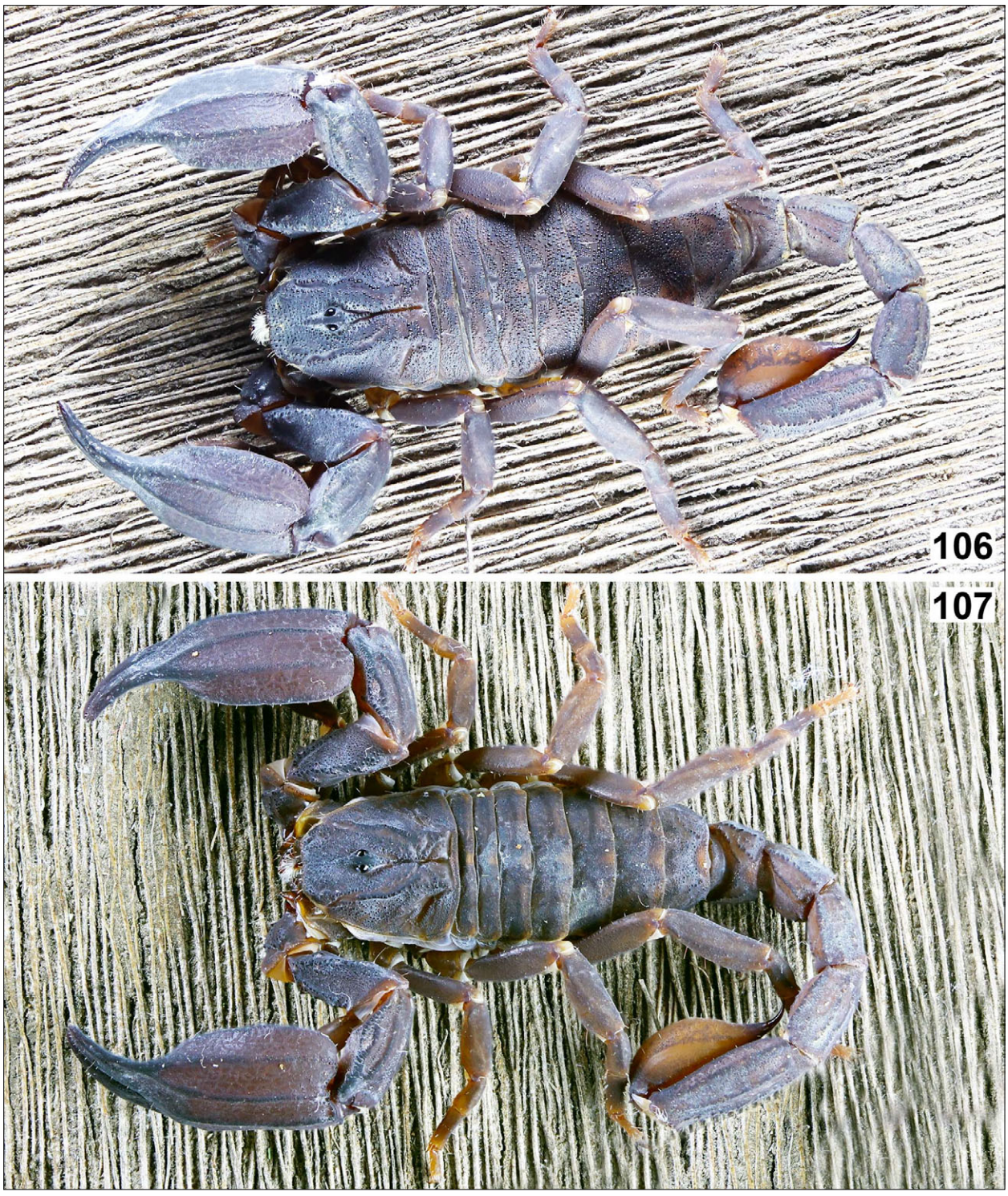


Figures 93–105: **Figures 93–104**: *Chaerilus stockmannorum* **sp**. **n**. **Figures 93–94**. Paratype female, pedipalp chela, dorsal (93) and externodorsal (94) views. **Figures 95–104**. Holotype male, pedipalp chela, dorsal (95), externodorsal (96), and ventrointernal (97) views. Pedipalp patella, dorsal (98), external (99) and ventral (100) views. Pedipalp femur and trochanter, dorsal (101) and ventrointernal (102) views. Pedipalp movable (103) and fixed (104) fingers. The trichobothrial pattern is indicated in Figures 96–101. **Figures 105**. *Chaerilus cimrmani*, male from Thailand, 50 km W of Phetcha Buri, pedipalp chela, dorsal view.

contributions to the knowledge of the worldwide scorpion fauna.

DIAGNOSIS. Total length 45–50 mm. Two pairs of lateral eyes and one pair of median eyes. Chela length /width ratio in males 2.27–2.80. Movable and fixed fingers of pedipalp with 11 imbricated granule rows. Fingers straight. Chela of pedipalp with 8 carinae. Pectinal teeth number 6 in males and 4 in female. Carapace and tergites sparsely granulated in male and densely granulated in female. All sternites smooth without carinae and granules in both sexes. First metasomal segment with 8 or 10 carinae, second to fourth segments with 8 carinae, ventral metasomal carinae absent on metasomal segment V. All metasomal segments rather densely granulated including dorsal surfaces.

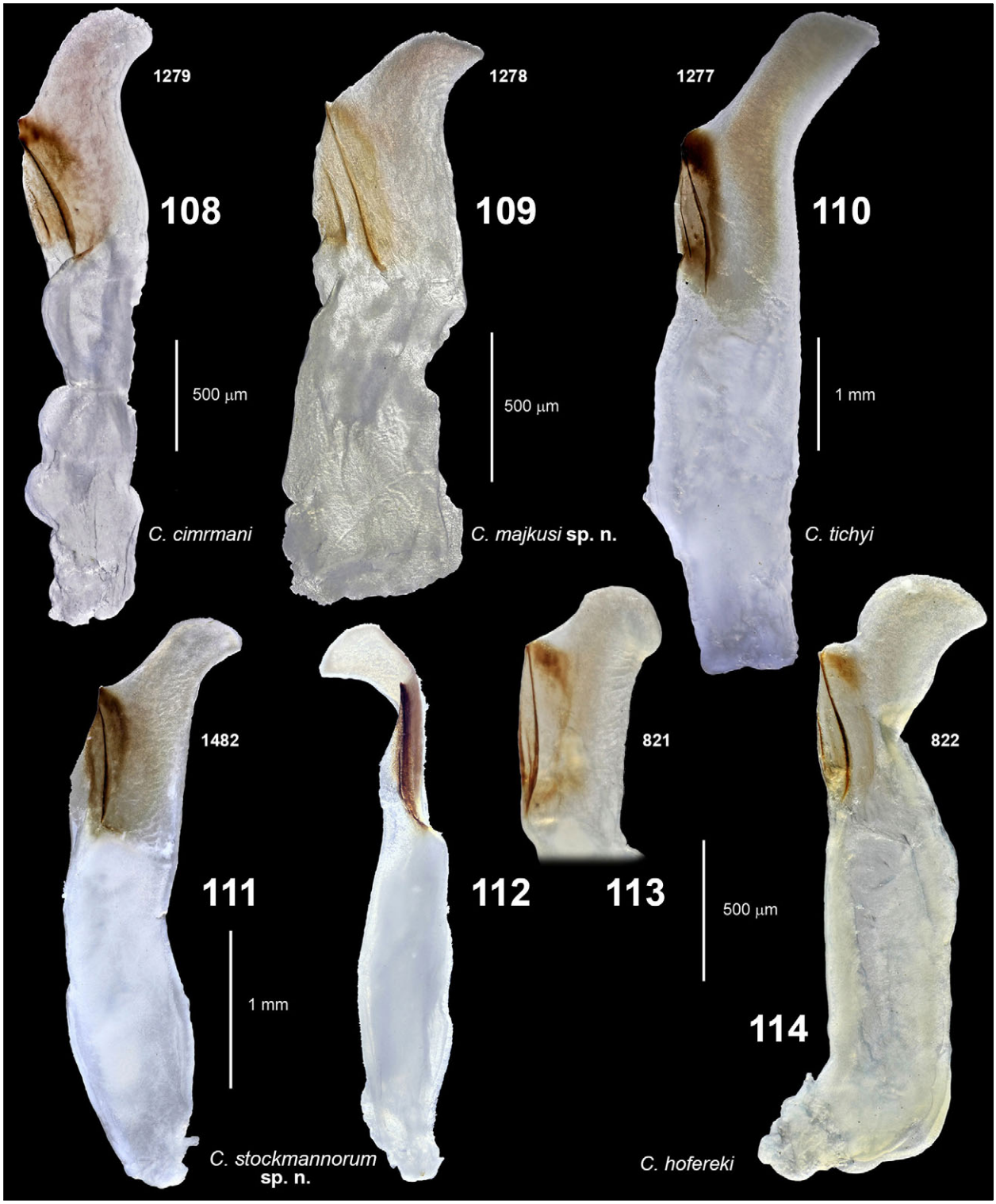
DESCRIPTION. Total length 45–50 mm of both sexes. Two well developed pairs of lateral eyes and one pair of median eyes. The chelicerae (Figs. 35–36) are finely granulated, yellow and strongly reticulate, anteriorly black. For the position and distribution of trichobothria, see Figs. 96–101. For measurements, see Table 2.
COLORATION (Figs. 106–107). The color is reddish brown, spotted; pedipalp chela and telson are red.
CARAPACE AND MESOSOMA (Figs. 73–76). The carapace is covered with large granules which do not form carinae. The anterior margin of the carapace is almost



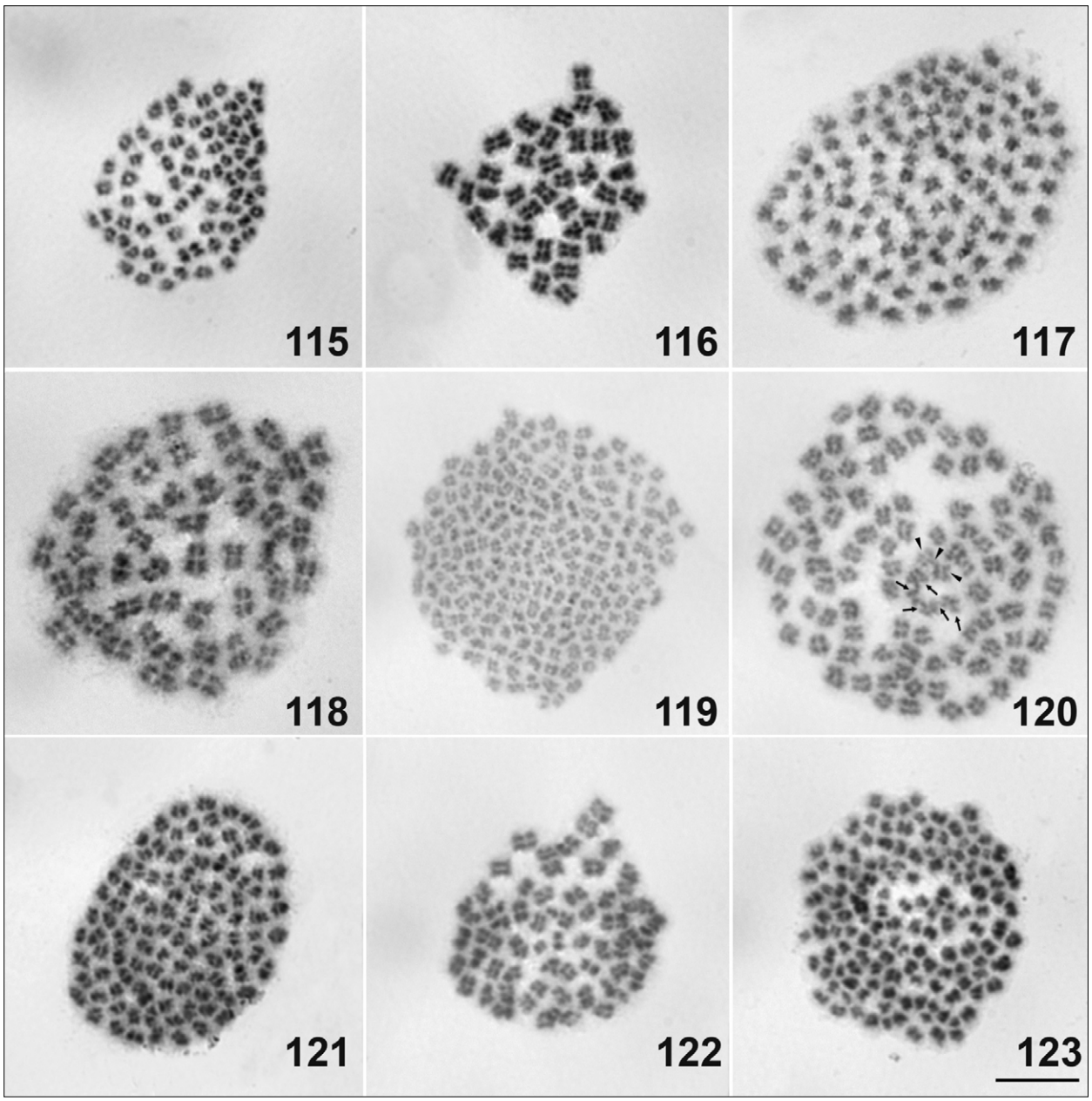
Figures 106–107: *Chaerilus stockmannorum* **sp**. **n**., female paratype (106) and male holotype (107) in vivo habitus.

straight to weakly concave. The mesosomal tergites are irregularly sparsely granulated in males and densely covered by large granules in the female. All sternites are smooth without carinae and granulation. Sternite V with smooth patch developed. Pectinal teeth number 6 in males and 4 in female.

METASOMA AND TELSON (Figs. 85–92). The first metasomal segment bears 8 or 10 carinae, the second to



Figures 108–114: Hemispermatophores of *Chaerilus* species. **Figure 108**. *C.cimrmani*. **Figure 109**. *C.majkusi* **sp**. **n**., male holotype. **Figure 110**. *C.tichyi*. **Figures 111–112**. *C.stockmannorum* **sp**. **n**., male holotype. **Figures 113–114**. *C.hofereki*, samples from two different individuals, capsule region and distal lamina (113) and whole hemispermatophore (114, reproduced from Kovařík et al., 2015). Convex views shown in all figures except Fig 112 (anterior view). Left hemispermatophore shown in all figures except for Fig. 108, which is right hemispermatophore shown in mirror image for comparison. Scale bars: 500 µm (108–109, 113–114), 1 mm (110–112).



Figures 115–123: The chromosomes of *Chaerilus* species. **Figures 115–116**. *C. majkusi* **sp**. **n**., mitotic metaphase (115) and meiotic metaphase I (116). **Figures 117–118**. *C. neradorum* **sp**. **n**., mitotic metaphase (117) and meiotic metaphase I (118). **Figures 119–120**. *C. stockmannorum* **sp**. **n**., mitotic metaphase (119) and meiotic metaphase I (120), arrows show chromosomes in pentavalent and arrowheads show chromosomes in trivalent. **Figure 121**. Mitotic metaphase of *C. cimrmani*. **Figure 122**. Meiotic metaphase I of *C. sejnai*. **Figure 123**. Mitotic metaphase of *C. tichyi*. Scale bar: 10 μm.

fourth bear eight carinae, and the fifth segment bears seven carinae including the ventromedian carina which posteriorly bifurcates in a "Y" configuration. All carinae are composed of large, sparse granules. All metasomal segments are sparsely hirsute and rather densely granulated including dorsal surfaces.

The telson is elongate, densely granulate and sparsely hirsute.

PEDIPALPS (Figs. 93–104). The pedipalp chela is wide and swollen in the male. The movable and fixed fingers of pedipalp bear 11 imbricated rows of granules. The chela has eight marked carinae. The patella has five marked carinae and the femur has four or five granulated carinae. The spaces between carinae are densely covered by granules on the femur and patella. The chela is densely granulated anteriorly and has retic-

Figures 124–125: *Chaerilus tichyi* Kovařík, 2000, female topotype with newborns (124) and juveniles after first ecdysis (125) in vivo habitus.

Dimensions (MM)		*C. stockmannorum* **sp. n.** ♂ **holotype**	*C. stockmannorum* **sp. n.** ♀ **paratype**
Carapace	L / W	6.05 / 6.50	6.35 / 6.85
Mesosoma	L	16.7	15.2
Tergite VII	L / W	3.10 / 5.20	2.40 / 5.62
Metasoma & telson	L	27.08	24.77
Segment I	L / W / D	2.75 / 3.75 / 2.80	2.60 / 3.41 / 2.55
Segment II	L / W / D	3.10 / 3.25 / 2.55	3.07 / 2.95 / 2.30
Segment III	L / W / D	3.33 / 3.10 / 2.45	3.20 / 2.90 / 2.25
Segment IV	L / W / D	3.75 / 2.85 / 2.40	3.55 / 2.70 / 2.27
Segment V	L / W / D	6.65 / 2.80 / 2.46	6.10 / 2.50 / 2.20
Telson	L / W / D	7.50 / 2.95 / 2.60	6.25 / 2.52 / 2.50
Pedipalp	L	22.57	21.38
Femur	L / W	5.40 / 2.16	5.10 / 2.30
Patella	L / W	5.25 / 2.55	5.38 / 2.60
Chela	L	11.92	10.90
Manus	W / D	5.25 / 4.40	4.60 / 4.10
Movable finger	L	6.40	6.40
Total	**L**	**49.83**	**46.32**

Table 2: Comparative measurements of *Chaerilus stockmannorum* **sp**. **n**. types. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

ulate fine granulation patterns centrally and posteriorly. LEGS (Figs. 77–84). The legs are sparsely hirsute, without bristlecombs and carinae. The patellae have several strong spines dorsally. The tarsomeres bear two rows of spiniform setae and 3 – 5 outer spiniform setae. Spiniform setae formula is 7/8 : 7–8/7–9 : 8–9/8–9 : 8–9/8–10 (omitting outer spiniform setae).

HEMISPERMATOPHORE (Figs. 111–112). Fusiform, with relatively large capsule region (ca. 1 mm), and distal lamina of moderate length (ca. 725 μm), angled posteriorly and apically rounded. Sperm hemiduct of capsule well sclerotized, with long posterior carina and shorter anterior carina.

KARYOTYPE (Figs. 119–120). We analyzed one male paratype. We identified 2n=186 in this specimen (Fig. 119). During metaphase I we observed 89 bivalents, one trivalent and the chain from five chromosomes (Fig. 120). We did not observe chiasmata during meiosis in this species.

AFFINITIES. *Chaerilus stockmannorum* **sp**. **n**. is reliably distinguished from all other *Chaerilus* species by the following unique combination of characters: total length 45–50 mm; movable and fixed fingers of pedipalp with 11 imbricated granule rows; chela length/width ratio in males 2.27–2.80; chela fingers straight in male.

The type locality of *C. stockmannorum* **sp**. **n**. lies within the area of distribution of *C. cimrmani* Kovařík, 2012 which can be distinguished morphologically from *C. stockmannorum* **sp**. **n**. by the shape of the chela of males. Figures 95 versus 105 show that the male of *C. cimrmani* has a wider chela with shorter fingers.

Comparative *Chaerilus* material examined, including new records (FKCP).

Chaerilus cimrmani Kovařík, 2012
Thailand: Phetcha Buri, 2 km N of Ban Sa Yoi Non, 12°56'58"N 99°47'44"E, 40 m a.s.l., 16.-18.I.2006, 1♂ (holotype) 1♀ (allotype) 1im. (paratype), leg. S. Bečvář & R. Fouqué; 20 km E of Trang, XI.1998, 1♀ (paratype), leg. Kozmík, FKCP; 50 km W of Phetcha Buri, I. 2016, 1♀ leg. V. Fura, 4♂1♀ (Figs. 68, 105; 1279), offspring of the female, bred by F. Kovařík; Koh Phangan/Thong Nai Pan Yai, 9.773194°N 100.056271° E, 1♀, leg. M. Stockmann.

KARYOTYPE (Fig. 121). We analyzed two males from the locality 50 km W of Phetcha Buri. Both specimens have 2n=104 (Fig. 121). Chromosome pairs 1–49 gradually decrease in length from 2.59% to 1.56% of the haploid set. The last three pairs of chromosomes are distinctly shorter (1.38%, 1.27% and 1.16% of the haploid set). The phases obtained did not allow characterization of the morphology of chromosomes. We did not observe chiasmata during postpachytene and metaphase I.

Chaerilus sejnai Kovařík, 2005
Malaysia, ***Pahang***, ***Tioman Island***, near Paya, IV. 2002, 2♂7♀ (holotype, paratypes), leg. and bred V.

Šejna; Kampung Genting, rocky tropical forest, 02°45'32"N 104°07'24"E 20 m a.s.l., 3.-7. IX.2016, 1♂ (Fig. 38; 1280) leg. D. Hoferek & R. Majkus.

KARYOTYPE (Fig. 122). We analyzed one male from locality Kampung Genting. The chromosomes are small and the possible effect of an early segregation of some chromosomes during observed late metaphase I prevented us from exactly specifying 2n (Fig. 122). The diploid number of chromosomes is most likely 124 or 126. We did not measure the length of the chromosomes because of the low number of suitable cells. However, several exceptionally small chromosomes are evident in this species. We did not observe chiasmata during meiosis.

Chaerilus tichyi Kovařík, 2000
Malaysia, ***Pahang***, ***Tioman Island***, Kampong Genting, 23.-25.II.1998, 1♂ (holotype) 1♀ (paratype No. 1), leg. V. Tichý; 30 km south of Kuala Rompin, 15.IV.1996, 1♀ (allotype) 1juv. (paratype No. 2); Kampung Genting, tropical rocky forest, 02°45'32"N 104°07'24"E, 20 m a.s.l., 3.-7. IX.2016, 2♂2♀ (topotypes, Figs. 41–42, 124–125; 1277), leg. D. Hoferek & R. Majkus.

KARYOTYPE (Fig. 123). We analyzed one male topotype. The observed mitotic metaphases possess 2n=136 (Fig. 123). In this specimen, we observed conspicuous constriction on the majority of bivalents during metaphase I that indicates a predominance of bi-armed chromosomes in the karyotype of this species. However, it was not possible to measure the position of these constrictions and lengths of chromosomes because of the early segregation of some chromosomes during this phase.

Acknowledgments

The authors are very grateful to David Hoferek and Roman Majkus (Czech Republic) and Mark Stockmann (Germany) who helped to obtain specimens in the field and bred them. We are also indebted to David Hoferek and Ladislav Nerad for kindly giving permission to use their photos as Figures 43–44. We are grateful to Jana Štundlová (Czech Republic) for technical assistance during chromosome preparations.

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