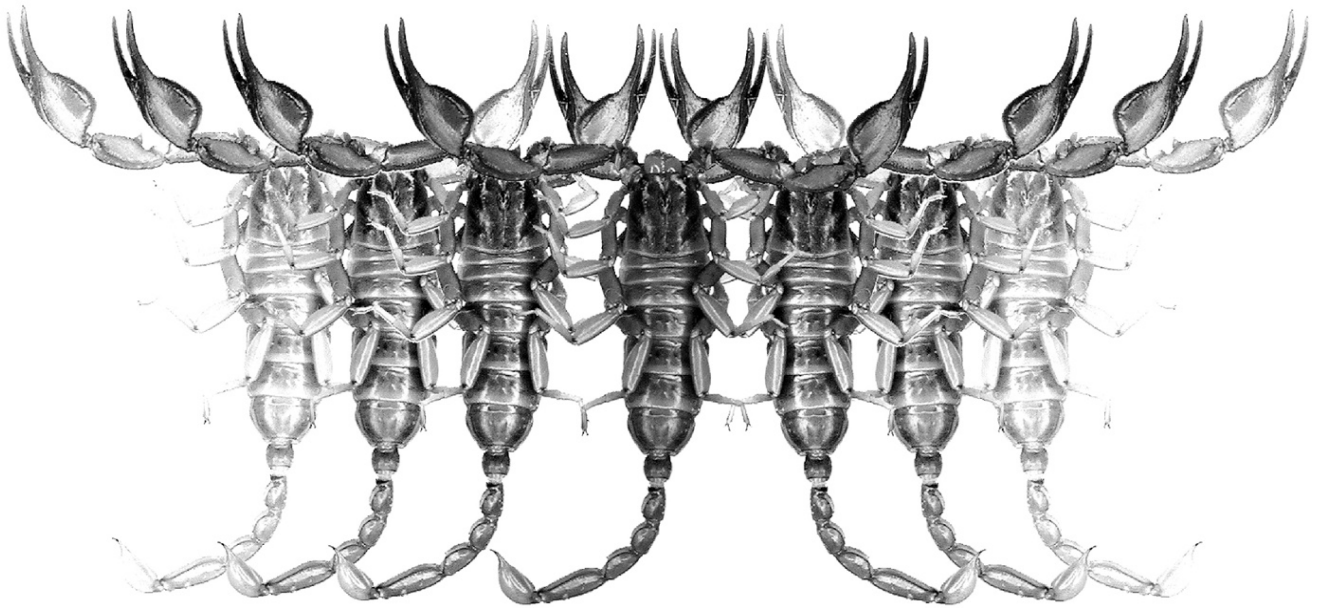


# *Euscorpilus*

Occasional Publications in Scorpiology



*Reddyanus justus* sp. n. from Laos  
(Scorpiones: Buthidae)

František Kovařík, Graeme Lowe & František Štáhlavský

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# *Euscorpius*

## *Occasional Publications in Scorpiology*

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## *Reddyanus justus* sp. n. from Laos (Scorpiones: Buthidae)

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<http://zoobank.org/urn:lsid:zoobank.org:pub:6B0DBB7A-D677-4655-A3B7-9928010145F3>

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### Summary

A new species *Reddyanus justus* sp. n. from Laos is described, fully complemented with color photographs of live and preserved specimens. The new species is characterized by the irregular quadrilateral shape of the subaculear tubercle in males. In addition to analysis of external morphology and hemispermaphore, we also describe the karyotype (2n=12).

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### Introduction

The genus *Reddyanus* Vachon, 1972 includes relatively rare scorpions distributed from India and China (Tibet) in the west, to Melanesia in the east. Kovařík & Štáhlavský (2019) revised 14 Southeast Asian species. Here we describe another species, *Reddyanus justus* sp. n., the first confirmed species from Laos. We also describe its hemispermaphore and karyotype. Previously, hemispermaphores in this genus were only known from Sri Lankan species (Kovařík et al., 2016).

### Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974; Kovařík et al., 2016) and sternum (Soleglad & Fet, 2003). Karyotype analyses were based on chromosome preparations obtained by the spreading technique already used in scorpions (e.g. Kovařík et al., 2009; Sadílek et al., 2015). The chromosomes were stained by 5% Giemsa solution in Sørensen phosphate buffer for 20 min. Five postpachytene were measured using the software Image J 1.45r (<http://rsbweb.nih.gov/ij>) with the plugin Levan (Sakamoto & Zacaro, 2009). The relative length of the chromosomes was calculated for the diploid set.

*Specimen depository*: FKCP (František Kovařík, private collection, Prague, Czech Republic; will in future be merged with the collections of the National Museum of Natural History, Prague, Czech Republic).

*Morphometrics*: D, depth; L, length; W, width.

### Systematics

#### Family Buthidae C. L. Koch, 1837

*Reddyanus* Vachon, 1972

(Figures 1–51, Table 1)

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*Isometrus (Reddyanus)* Vachon, 1972: 176–177, figs. 14, 16, 18, 20; Vachon, 1982: 90–101, 108–110, figs. 47–67, 88–91; Fet & Lowe, 2000: 150–154; Kovařík, 2003: 5–14, figs. 1–8; Kovařík & Ojanguren, 2013: 184–193, 347–354, 357–360, figs. 1265–1367, 1384–1409.

*Isometrus (Raddyanus [sic])*: Tikader & Bastawade, 1983: 254–311 (in part), figs. 727–770, 841–895.

*Reddyanus* Kovařík et al., 2016: 53–88, figs. 14, 199, 201–220, 225–236, 245–250, 254–402, 409–420, 551–554, 561–570, tables 3–5; Kovařík & Štáhlavský, 2019: 1–45, figs. 1–226, tables 1–4.

TYPE SPECIES. *Isometrus acanthurus* Pocock, 1899

DIAGNOSIS. Medium sized buthids, adults 19–75 mm. Carapace anteriorly emarginate, surface granulate, carinae obsolete except for anterior medians in some species. Three to five pairs of lateral eyes. Cheliceral fixed finger with a single ventral denticle. Sternum type 1, triangular in shape. Pectines with fulcra. Tergites with one median carina. Telson with subaculear tooth pointed or rounded. Pedipalps orthobothriotaxic, type Aβ. Trichobothrium  $d_2$  of femur located internally,  $d_3$  of patella located between dorsomedian





Figures 1–2. *Reddyanus justi* sp. n., male holotype (1) and male holotype (right) with female paratype (2) in vivo habitus.



Dimensions (mm)		<i>Reddyanus justii</i> sp. n.	
		♂ holotype	♀ paratype
Carapace	L / W	4.34 / 3.95	3.58 / 3.53
Mesosoma	L	9.44	12.19
Tergite VII	L / W	2.47 / 3.20	2.20 / 3.33
Metasoma + telson	L	30.22	17.81
Segment I	L / W / D	3.70 / 1.56 / 1.55	2.16 / 1.44 / 1.29
Segment II	L / W / D	4.63 / 1.51 / 1.47	2.67 / 1.26 / 1.28
Segment III	L / W / D	5.09 / 1.34 / 1.42	2.87 / 1.25 / 1.24
Segment IV	L / W / D	5.91 / 1.29 / 1.36	3.34 / 1.22 / 1.22
Segment V	L / W / D	6.55 / 1.23 / 1.31	3.93 / 1.17 / 1.19
Telson	L / W / D	4.34 / 1.25 / 1.25	2.84 / 0.96 / 1.03
Pedipalp	L	15.59	11.91
Femur	L / W	4.07 / 1.22	2.98 / 1.10
Patella	L / W	4.49 / 1.57	3.45 / 1.40
Chela	L	7.03	5.48
Manus	W / D	1.72 / 1.55	1.37 / 1.12
Movable finger	L	3.61	3.07
<b>Total</b>	<b>L</b>	<b>47.00</b>	<b>33.58</b>

**Table 1.** Comparative measurements of adults of *Reddyanus justii* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

and dorsoexternal carina, *db* of chela located between *et* and *est*. Pedipalp movable finger with six rows of granules, several accessory granules and external and internal accessory granules. Pedipalp fixed finger with seven rows of granules and six external and seven internal accessory granules. Legs III–IV without tibial spurs. Tibia and tarsomeres of legs I–III with setae not arranged into bristle combs on dorsal surfaces. Tarsomere II of leg IV with two sparse rows of < 20 spiniform setae on ventral surface. Males of most species with more elongate metasomal segments, and often also a wider pedipalp chela manus than females.

**SUBORDINATE TAXA.** Currently includes 33 species (see Kovařík & Štáhlavský, 2019: 3).

**DISTRIBUTION.** From India and China (Tibet) in the west to Melanesia in the east. For distribution in Southeast Asia see Fig. 51.

***Reddyanus justii* sp. n.**

(Figures 1–51, Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:3FB403D2-AF00-426F-9C4B-109D98750FD0>

**TYPE LOCALITY AND TYPE REPOSITORY.** Laos, Savannakhet Province, Phine District, 16°53'N 106°01'E; FKCP.

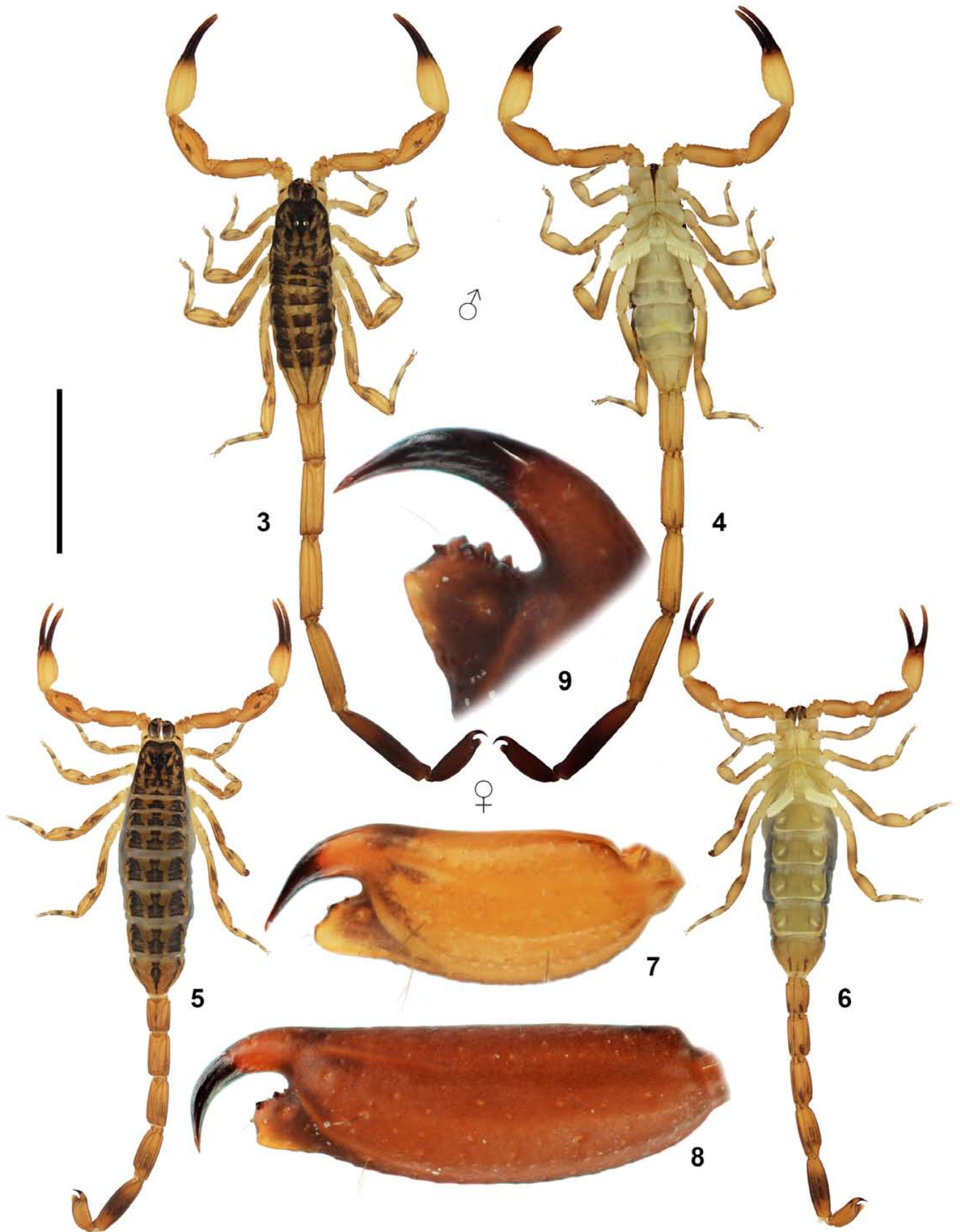
**TYPE MATERIAL.** Laos, Savannakhet Province, Phine District, 16°53'N 106°01'E, March 2020, 1♂ (holotype, No. 1849) 1♂3♀ (paratypes), leg. M. Černička, FKCP.

**ETYMOLOGY.** The specific epithet is a patronym honoring Pavel Just, an arachnologist who has assisted us greatly with our studies on scorpions in the laboratory as well as in the field during the past several years.

**DIAGNOSIS** (♂♀). Adult length up to 33 mm (female) and 47 mm (male). Males with more elongate metasomal segments and telson compared to females. Pedipalps and legs yellow to orange, with reduced brown spots. Manus of pedipalps yellow, fingers reddish black. Metasomal segment I with 10 carinae, segments II–IV with 8 carinae. Metasoma V with 5 carinae, which are reduced in males. Posterior terminal tubercle on dorsolateral carinae of metasoma II–III of both sexes very slightly enlarged. Subaculear tooth broad, in females with terminus rounded, in males beveled and irregular quadrilateral in shape, dorsally with 5–7 granules in 3 rows. Pectinal tooth count 13–14 in males, 12–14 in females.

**DESCRIPTION.** The adults are 45–47 mm (males) and 30–33 mm (females) long. Habitus as shown in Figs. 3–6. For position and distribution of trichobothria of pedipalps see Figs. 24–28 and Figs. 30–31. Sexual dimorphism: adult male with longer metasomal segments and longer, narrower telson.

**Coloration** (Figs. 1–6). Base color yellow to orange with dark spots. Chelicerae are yellow, strongly reticulated. Fingers of chelicerae are darkly marked. Carapace and mesosoma patterned with 3 dark longitudinal strips. Ventral side of mesosoma yellow to yellowish brown, with several fuscous markings on sternite VII. Pedipalp femur and patella yellow or orange with small reduced dark maculae which are almost

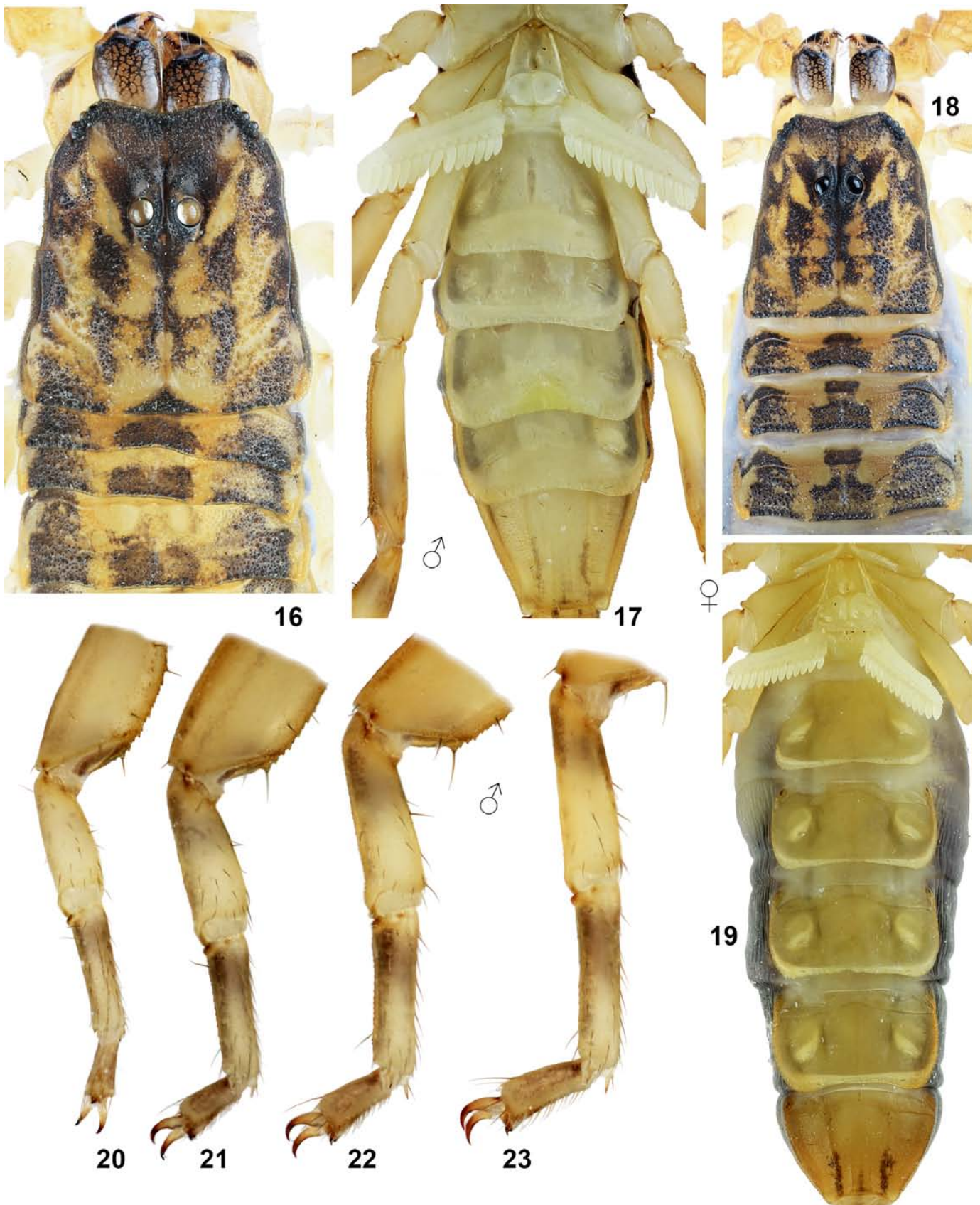


**Figures 3–9:** *Reddyanus justus* sp. n. **Figures 3–4, 8–9.** Male holotype in dorsal (3) and ventral (4) views, and telson lateral (whole view, 8 and detail for subaculear tubercle, 9). **Figures 5–7.** Female paratype in dorsal (5) and ventral (6) views, and telson lateral (7) view. Scale bar: 10 mm (3–6).



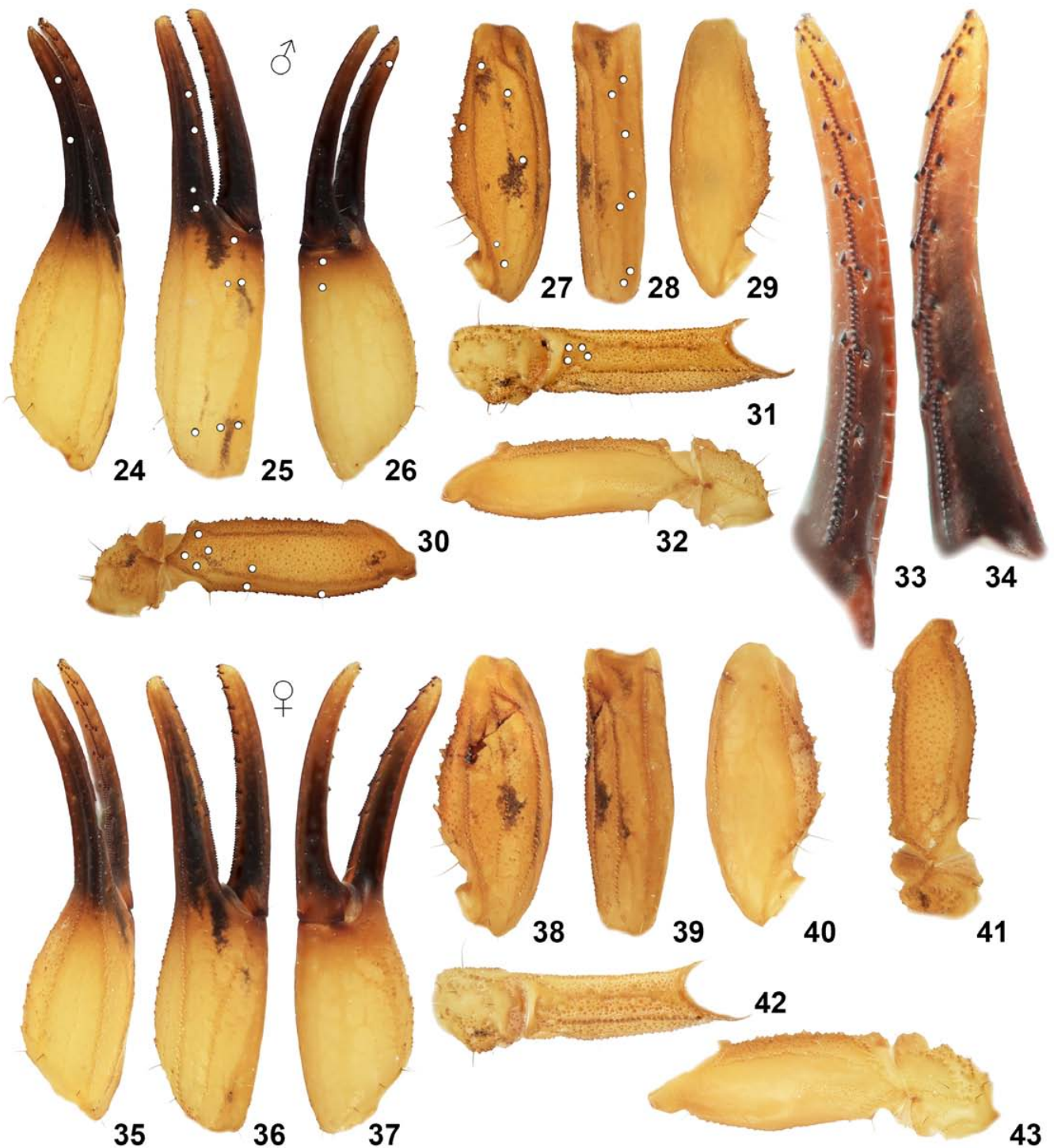
**Figures 10–15:** *Reddyanus justii* sp. n., metasoma and telson. **Figures 10–12.** Holotype male, lateral (10), ventral (11), and dorsal (12) views. **Figures 13–15.** Paratype female, lateral (13), ventral (14), and dorsal (15) views. Scale bars: 10 mm (10–12, 13–15).





**Figures 16–23:** *Reddyanus justus* sp. n. **Figures 16–17, 20–23.** Male holotype, carapace and tergites I–III (16), coxosternal area and sternites (17), and left legs I–IV, retrolateral aspect (20–23). **Figures 18–19.** Female paratype, carapace and tergites I–III (18) and coxosternal area and sternites (19).

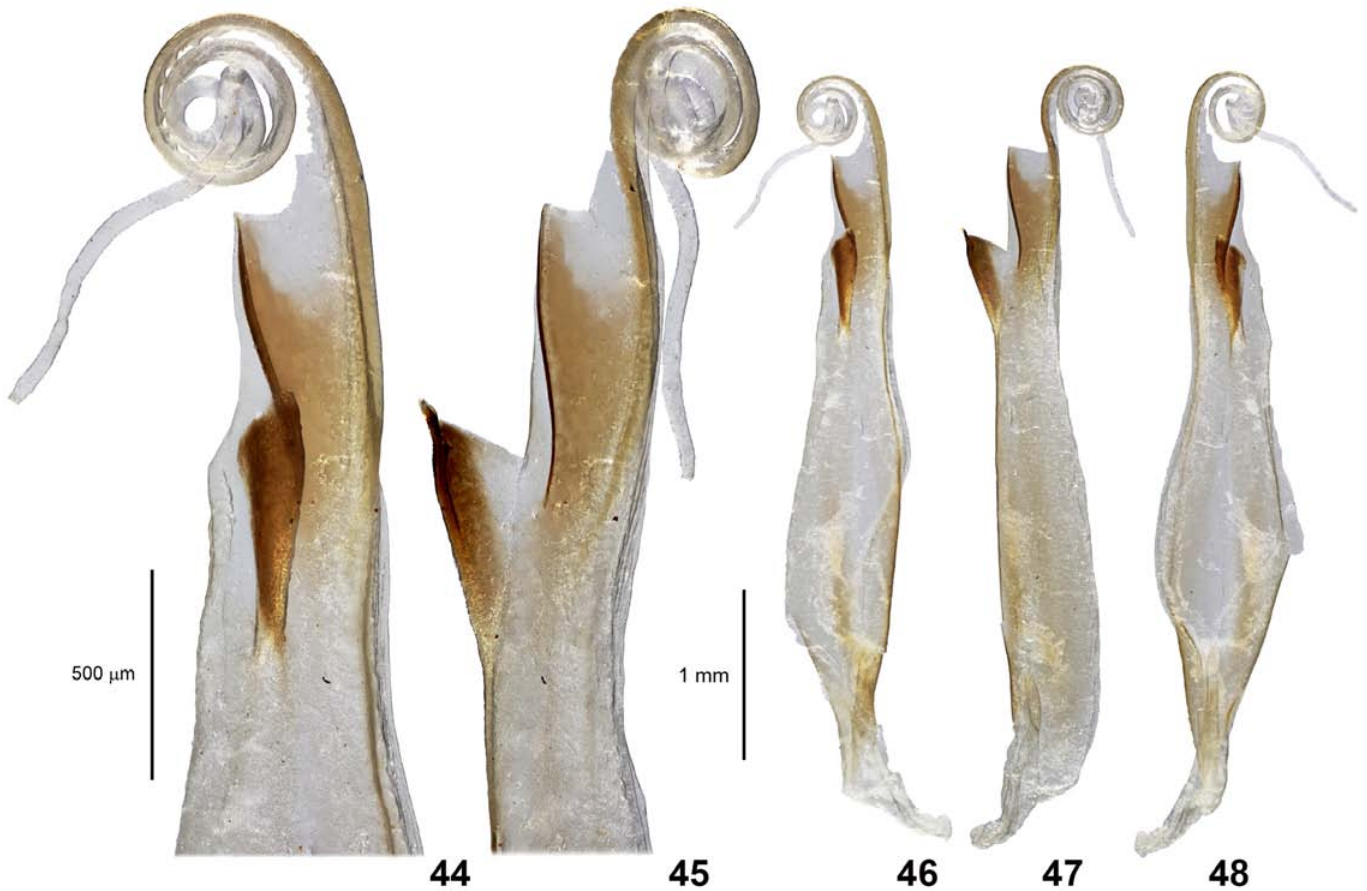




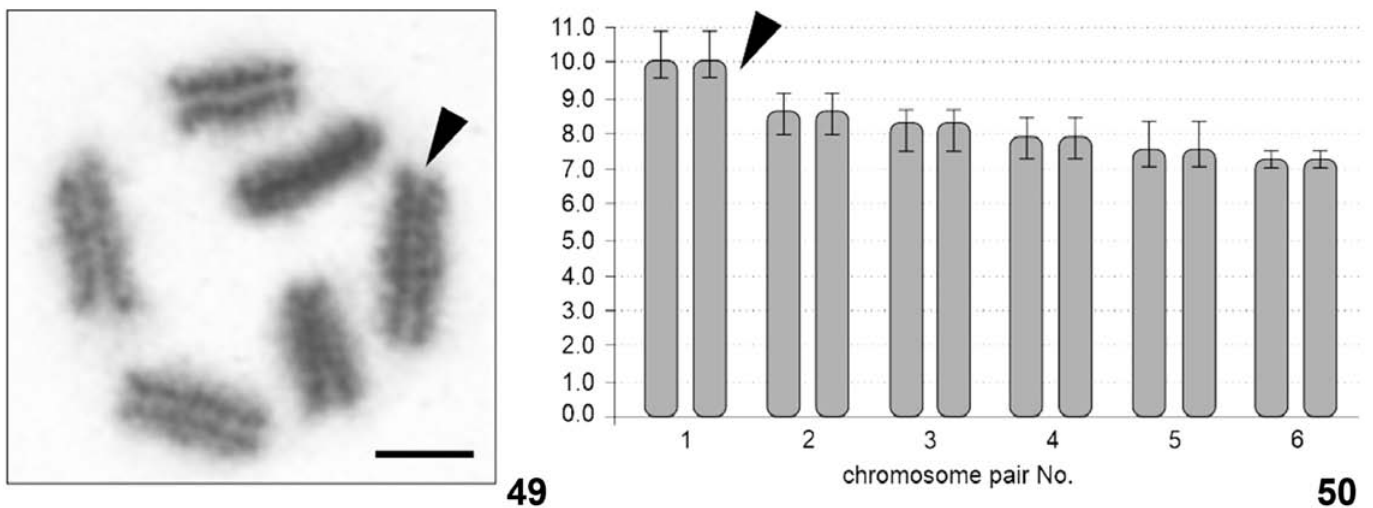
**Figures 24–43:** *Reddyanus justī* sp. n. **Figures 24–34.** Male holotype, pedipalp chela dorsal (24), external (25) and ventral (26) views, patella dorsal (27), external (28) and ventral (29) views, femur and trochanter dorsal (30), internal (31), and ventral (29) views, movable finger (33) and fixed finger (34) dentition. **Figures 35–43.** Female paratype, pedipalp chela dorsal (35), external (36) and ventral (37) views, patella dorsal (38), external (39) and ventral (40) views, femur and trochanter dorsal (41), internal (42), and ventral (43) views. Trichobothrial pattern is indicated in Figures 24–28 and 30–31.

missing on femur. Legs also yellow or orange with black spots. Metasoma is yellowish or reddish brown with black spots, metasoma V darker than metasoma I–IV, telson yellow, red to reddish black.

**Carapace and mesosoma** (Figs. 16–19). Entire carapace covered with large granules; carinae absent. Anterior margin of carapace is medially emarginate. Tergites I–VI with 1 median carina, tergite VII pentacarinata. All tergites strongly



**Figures 44–48:** *Reddyanus justi* sp. n., left hemispermatophore. **Figures 44–45:** Capsule and flagellum, convex (44) and posterior-convex (45) views. **Figures 46–48:** Whole hemispermatophore, convex (46), posterior-convex (47) and concave (48) views. Scale bars: 500 μm (44–45), 1 mm (46–48).



**Figures 49–50:** *Reddyanus justi* sp. n., male holotype. Postpachytene (49) and ideogram (50) (y axis - % of the diploid chromosome length, dark grey marks chromosomes in multivalent association). Arrowhead indicates a slightly longer pair of chromosomes. Scale bar: 5 μm (49).



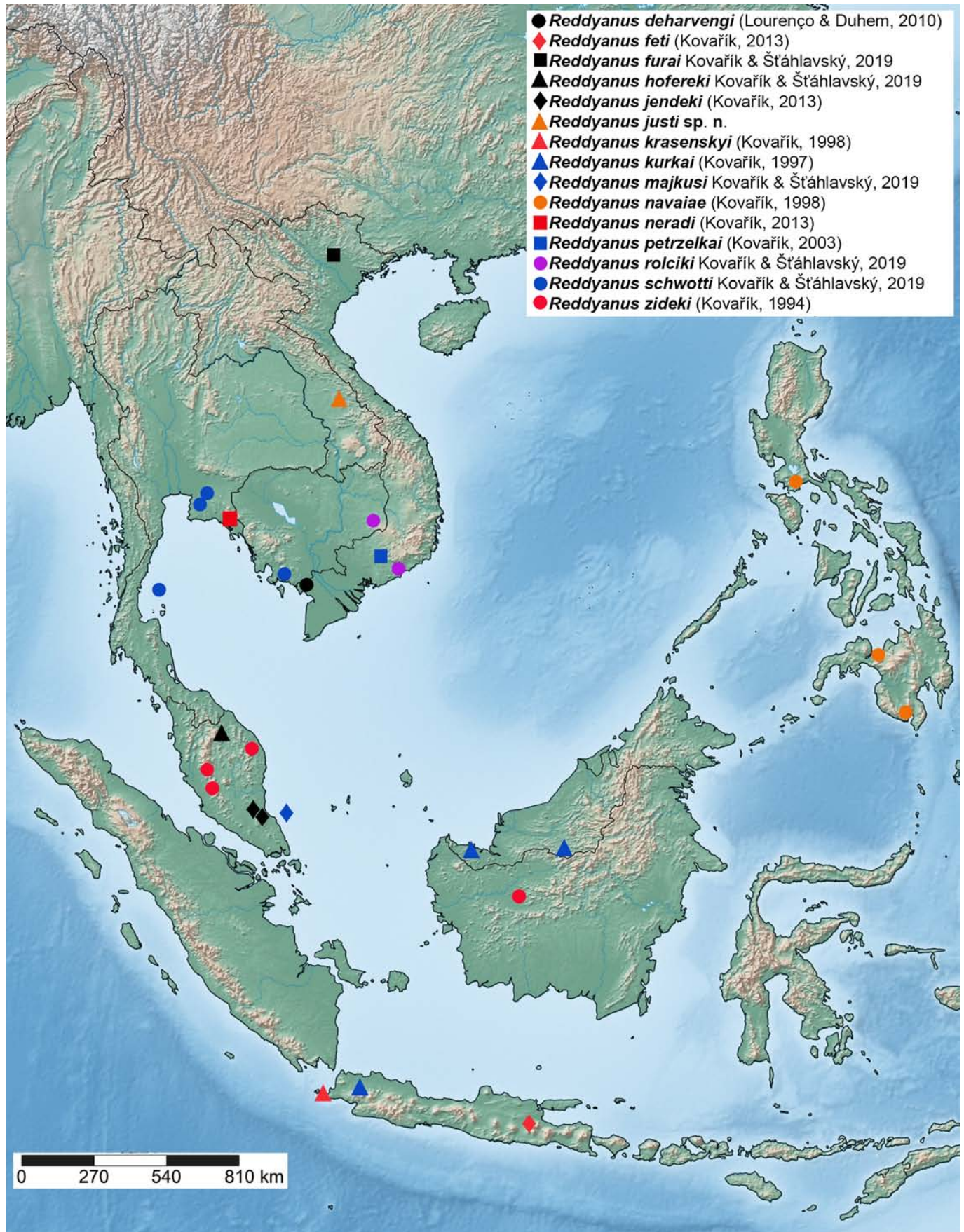


Figure 51. Map showing confirmed distribution of *Reddyanus* spp. in Southeast Asia.

granulated. Pectinal tooth count 13–14 in males, 12–14 in females. Pectine marginal tips extending to posterior end of sternite III in males, to 3/4 of sternite III in females. Pectines with 3 marginal lamellae, 6–7 middle lamellae. Lamellae and fulcra bear numerous pale microsetae. Sternites smooth with 2 parallel furrows, except sternite VII which bears 4 carinae and is granulated. Granulation also present on lateral margins of sternite VI. Posterior medial area of sternite V with a glabrous zone well developed in males, reduced in females.

**Metasoma and telson** (Figs. 7–15). Metasomal segment I with 10 carinae, segments II–IV with eight carinae. Metasoma V with 5 carinae which are reduced in males. Vesicle of telson in males with a ventral carina, in females with ventral and lateral carinae. Metasoma with intercarinal surfaces sparsely granulated, with the exception of metasoma V of males which is smooth. Posterior terminal tubercle on dorsolateral carinae of metasoma II–III of both sexes very slightly enlarged. Telson longer and narrower in males than females. Subaculear tubercle broad in lateral profile, with terminus rounded in females, beveled in males which have a tubercle with irregular quadrilateral shape. Tubercle dorsally with 5–7 granules in three rows.

**Pedipalps** (Figs. 24–43). Pedipalps very sparsely hirsute. Femur with 5 granulated carinae, patella with 7 granulated carinae. Chela with 4–5 carinae which are granulated in both sexes and more strongly developed in females. Chela sparsely granulated, patella and femur are rather densely granulated except ventrally. Chela movable finger with 6 rows of granules, fixed finger with 7 rows; fingers bearing 6 external accessory granules, 5–6 internal accessory granules.

**Legs** (Figs. 20–23). Femora with 3–4 carinae, patellae with 5 carinae, both granulated. Legs without tibial spurs. Tibia and tarsomeres of legs with macrosetae not arranged serially as bristle combs on dorsal surfaces. Tarsomere II of leg IV with two sparse rows of < 20 spiniform setae on ventral surface.

**Hemispermatothore** (Figs. 44–48). Flagelliform, with flagellum long, narrow and coiled. Capsule relatively large, ca. half as long as trunk. Sperm hemiduct simple, undivided, long, with one prominent carina; posteriorly fused to base of flagellum. Basal lobe large, triangular in profile with sharp vertex. Trunk short, broad. Measurements: trunk length 2.5 mm, capsule length 1.12 mm, uncoiled flagellum length 3.89 mm.

**Karyotype** (Figs. 49–50). Diploid number of these specimens was 12 chromosomes. The first pair of chromosomes was slightly longer (each chromosome from this pair forms 10.10 % of the diploid set), whereas the remaining chromosomes gradually decreased in length from 8.68 % to 7.32 % of the diploid set. Only bivalents without chiasmata were observed during male meiosis, and no centromeres on the chromosomes. These characteristics are typical for scorpions in the family Buthidae (e. g. Mattos et al., 2013) and the lower number of chromosomes appears to be typical of the genus *Reddyanus* ( $2n=11-17$ ) (Kovařík & Štáhlavský, 2019).

**Measurements.** See Table 1.

**AFFINITIES.** The described features distinguish *Reddyanus justus* sp. n. from all other species of the genus. The new species is characterized by the irregular quadrilateral shape in lateral profile of the subaculear tubercle in males, which is a unique character within the genus (Fig. 9 versus figs. 209–214 in Kovařík & Štáhlavský, 2019: 40). The morphologically closest species is *R. petrzekai* (Kovařík, 2003) (see also a key in Kovařík & Štáhlavský, 2019: 43) from Vietnam which has a large subaculear tubercle that is rounded (Fig. 9 versus fig. 210 in Kovařík & Štáhlavský, 2019: 40) and stronger dark maculation on its pedipalp segments (Figs. 24–30 versus fig. 199 in Kovařík & Štáhlavský, 2019: 39).

**REMARKS.** The capsule structures and overall dimensions of the hemispermatothore of *Reddyanus justus* sp. n. are similar to those recorded for other species of the genus (i. e., *R. basilicus* (Karsch, 1879), *R. ceylonensis* Kovařík et al., 2016 and *R. loebli* (Vachon, 1982); cf. Kovařík et al., 2016). These species also exhibit a simple, monocarinate sperm hemiduct, large triangular basal lobe and long, coiled flagellum. This provides additional support for our hypothesis that these features may be diagnostic for the genus (Kovařík et al., 2016), although the hemispermatothores of other *Reddyanus* species have yet to be studied.

**DISTRIBUTION.** Laos (Fig. 51).

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