TWO NEW SPECIES OF *EUSCORPIOPS* VACHON, 1980 FROM THAILAND AND MYANMAR (SCORPIONES: EUSCORPIIDAE: SCORPIOPINAE)

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Abstract.— *Euscorpiops artemisae* **sp. nov.** from Myanmar and *Euscorpiops orioni* **sp. nov.** from Thailand are described and compared with other species of the genus *Euscorpiops* Vachon, 1980. A key to the species of *Euscorpiops* is provided. Sexual dimorphism is present, as males of some species have a narrower pedipalp chela than females, while in other species the shape of the chela is the same in both sexes. Males of both new species have the pedipalp chela very narrow, in the male holotype of *E. artemisae* **sp. nov.** the chela length to width ratio is 4.13 and in the male holotype of *E. orioni* **sp. nov.** it is 4.58. In addition to morphological analysis, we describe also the karyotype of male holotype and paratype of *E. orioni* **sp. nov.** Both analyzed specimens have achiasmatic meiosis and the same number of chromosomes (2n=103) with predominance of acrocentric chromosomes gradually decreasing in size. During the first meiotic division we observed one trivalent in both males. This type of multivalent indicates centric fusion or fissions that may cause the differentiation of the karyotypes within the genus *Euscorpiops*.

Key words.— Arachnida, Scorpiones, Euscorpiidae, taxonomy, description, karyotype, Oriental Region, Southeast Asia

INTRODUCTION

The genus *Euscorpiops* represents medium size scorpions of the family Euscorpiidae. This genus was described by Vachon (1980) as a subgenus of the genus *Scorpiops* Peters, 1862, and raised to the status of genus by Lourenço (1998). Vachon (1980) distinguished *Euscorpiops* from *Scorpiops* by the number of external trichobothria on the patella, 17 in *Scorpiops* and 18–21 in *Euscorpiops*. According to Kovařík (2000) the separation of these genera by the number of external trichobothria on the patella is invalid and synonymized

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Euscorpiops with *Scorpiops*. Kovařík (2000: 164) furthermore drew attention to the importance of position of the trichobothrium *Eb3* on the external surface of the chela, using as an example *Scorpiops montanus* Karsch, 1879, in which the position differs from other *Scorpiops* species. Soleglad and Sissom (2001) revised the family Euscorpiidae, in which they placed the subfamily Scorpiopinae and confirmed the validity of the genus *Euscorpiops*. Their conclusion was based on the position of trichobothrium *Eb3* rather than on the number of external trichobothria on the patella. Soleglad and Sissom (2001) also transferred *Scorpiops montanus* to *Euscorpiops* and *Euscorpiops lindbergi* to *Scorpiops*.

The genus *Euscorpiops* currently includes 25 species (Rein 2014, present study) inhabiting the Oriental region reaching from Pakistan to Vietnam (e.g. Kovařík 1993, 2000).

In addition to the analysis of external morphology, we also add description of the karyotype of *E. orioni* sp. nov. The cytogenetic data seem to be useful for taxonomy analysis and may help to differentiate morphologically similar species in different groups of arachnids (e.g. Řezáč *et al.* 2008, Zaragoza and Šťáhlavský 2008, Kovařík *et al.* 2009). The information on chromosomes has so far been available for 96 scorpion species (Schneider *et al.* 2014). The order Scorpiones displays a considerable range of diploid numbers, from 5 in *Tityus bahiensis* (Schneider *et al.* 2009a) to 175 in *Urodacus novaehollandiae* (Shanahan 1989). Nevertheless, the potential application of the cytogenetic data to taxonomy of this arachnid order increases the number of cytogenetic analyses, most of which has so far focused on the families Buthidae and Scorpionidae (see Schneider *et al.* 2014); only one species of the subfamily Scorpiopinae, *Euscorpiops neradi*, has been karyotyped. This species has 2n=48 with chromosomes that may be classified into two categories according to their size (Kovařík *et al.* 2013). For the description of standard karyotype is important to include also analysis of meiosis that may reveal unusual pairing. This approach has the ability to disclose specific rearrangements or hybrids (e.g. Gorlov and Tsurusaki 2000, Schneider *et al.* 2009b). Additional information on the karyotypes plays an important role in the understanding of the species diversity of the genus *Euscorpiops*.

Material and methods

Sampling. Scorpions were collected by ultraviolet (UV) detection at night and excavation of burrows during the day. After collection, the obtained material was preserved by standard methods (e.g. Stahnke 1972). Some specimens were taken alive and maintained in the laboratory conditions for later use in cytogenetic studies. Locality data were recorded using portable GPS units (Garmin Oregon 450). Map background was downloaded from MapBox open source mapping platform system and modified in Zoner Callisto, version 5.0. The scorpions were collected under the authority of Doi Inthanon National Park General Management. Holotypes of new species are permanently deposited in the public collection of Faculty of Science, Charles University in Prague (CUP). Paratypes are deposited in the first author collection (FKCP).

Morphological analysis. The specimens were studied under stereomicroscope and measured using an ocular micrometer. Measurements are given in millimeters unless noted otherwise. Nomenclature and measurements follow Stahnke (1970). Designation and description of trichobothria were used according to Vachon (1974). Morphological terminology follows Stahnke (1970) and Kovařík (2009).

Karyotype analysis. For the karyotype analysis we used gonads of the male holotype and one paratype from the type locality of *E. orioni* sp. nov. The chromosome slides were made by the spreading technique described by Traut (1976). The gonads were hypotonised in 0.075 M KCl for 20 minutes and then fixed in methanol : glacial acetic acid (3:1) for at least 20 minutes. Finally small parts of the tissue were dissociated in a drop of 60% acetic acid on a microscope slide and the suspension was evaporated on a warm histological plate (45°C). The chromosome preparations were stained with 5% Giemsa solution in Sörensen phosphate buffer (pH = 6.8) for 30 minutes. Additionally, we used C-banding according to the standard method of Sumner (1972). In this case the chromosome preparations were stained with DAPI and the color of the photographs was inverted for higher contrast. The chromosomes were observed in an Olympus AX70 Provis microscope and documented with an Olympus DP72 camera. For the measurements of chromosomes we used eleven well spreaded cells. The photographs were analyzed with the software ImageJ 1.45r (http://rsbweb.nih.gov/ij) with the plugin Levan (Sakamoto and Zacaro 2009). This plugin combines and modifies a criterion for classification described by Levan *et al.* (1964) and Green and Sessions (1991). The relative diploid set length (DSL) was calculated for each chromosome as a percentage of the diploid set.

Taxonomy

Family: **Euscorpiidae** Laurie, 1896

Subfamily: **Scorpiopinae** Kraepelin, 1905

Genus: ***Euscorpiops*** Vachon, 1980

Scorpiops Kraepelin 1899: 179 (in part); Sissom 1990: 114 (in part); Kovařík 2000: 164 (in part); Kovařík 2001: 85 (in part).

Scorpiops (*Euscorpiops*) Vachon 1980: 155 (in part); Tikader and Bastawade 1983: 452 (in part); Bastawade 1997: 104 (in part).

Euscorpiops: Stockwell 1989: 120 (in part); Kovařík 1998: 141 (in part); Lourenço 1998: 246 (in part); Fet 2000: 488 (in part); Soleglad and Sissom 2001: 93; Kovařík 2004: 13 and 17; Kovařík 2005: 1; Qi *et al*. 2005: 14; Kovařík 2009: 32; Kovařík 2012: 1; Kovařík *et al*. 2013: 3.

Type species. *Scorpiops asthenurus* Pocock, 1900.

Diagnosis. Total length 24–70 mm. First to fourth metasomal segments with paired parallel ventral median carinae in adults. Pair of median eyes and three or four pairs of lateral eyes present. Movable fingers of pedipalps with granules in two rows. Ventral edge of cheliceral movable finger with 5–7 denticles. Pedipalp patella with 16–21 external trichobothria. Ventral surface of patella bears 6–18 trichobothria. Ventral trichobothrial serie (*V*) on surface of manus bears 4 trichobothria, of which *V4* is always situated on ventral aspect of chela. Trichobothrium *Eb3* on external surface of manus is between trichobothria *Dt* and *Est*. Annular ring at vesicle/aculeus juncture present on at least the male.

Euscorpiops artemisae Kovařík, Košulič, Šťáhlavský, Plíšková, Dongkhamfu et Wongprom sp. nov.
(Figs 1–7, 43–44, 51–52)

Etymology. The name is given after Artemis, the virgin goddess of the hunt and the Moon from Greek mythology. See also etymology under *E. orioni* sp. nov. below.

Figures 1–7. *Euscorpiops artemisae* sp. nov., male holotype, habitus and trichobothrial pattern: 1 – dorsal view; 2 – chela dorsal; 3 – chela external; 4 – chela ventral; 5 – patella dorsal; 6 – patella external; 7 – patella ventral.

Diagnosis. Total length 43.6 mm. Base color uniformly reddish black to black, legs and telson yellow to reddish brown. Pectinal teeth number 8 in male and 7–8 in female. Pectinal area is yellowish brown. External trichobothria on pedipalp patella number 20 (5 *eb*, 2 *esb*, 2 *em*, 5 *est*, 6 *et*); ventral trichobothria on patella number 14–15. Male has narrow pedipalp segments; chela length to width ratio = 4.13 in male holotype. Pedipalp fingers slightly notched in male. Telson elongate. First metasomal segment wider than long.

Description. The total length of male holotype is 43.6 mm. For habitus of male holotype see Fig. 1; adult female is unknown.

Mesosoma and carapace: The tergites are granulated, dorsally with one median carina, and the seventh sternite is sparsely granulated, with four carinae. The entire carapace is granulated, without carinae. The anterior margin of the carapace is markedly depressed in the middle. Lateral ocular tubercles each possess three eyes, of which two are normal and one is reduced. Pectinal teeth number 8 in the male and 7–8 in female.

Metasoma and telson: The metasoma is finely granulated, with sparse, relatively large granules. The first segment bears 10 carinae, the second to fourth segments bear 8 carinae, and the fifth segment bears 7 carinae, all composed of granules some of which are pointed. The dorsolateral carinae of the third and fourth segments posteriorly terminate in a pronounced tooth. The telson is elongate and is sparsely granulated.

Pedipalps: For position and distribution of trichobothria on the patella of pedipalps see Figs 2–7. External trichobothria on the patella number 20 (5 *eb*, 2 *esb*, 2 *em*, 5 *est*, 6 *et*), and ventral trichobothria on the patella number 14–15 (3 × 14, 1 × 15). The femur is granulated and has four or five granulose carinae, and the patella has five carinae with pronounced internal twin tubercles. The manus dorsally bears fine rounded granules, which in the central part form a longitudinal carina. The external surface of the chela is densely covered by minute granules which in the central part also form a longitudinal carina. The movable fingers bear straight double rows of granules with internal and external granules. The pedipalp fingers dentate margins are slightly notched in the male holotype. The notches on the movable and the fixed fingers alternate perfectly, so the fingers close without any gap.

Legs: The tarsomeres of legs are sparsely hirsute, without bristlecombs but with row of spines on ventral surfaces. The femur and patella are granulated on dorsal surfaces and may bear four to six carinae. The femur bears only solitary setae.

Measurements (*in mm*): Total length of male holotype 43.6; carapace length 7.1, width 7.2; metasoma and telson length 22.4; first metasomal segment length 2.2, width 2.6; second metasomal segment length 2.45, width 2.4; third metasomal segment length 2.55, width 2.2; fourth metasomal segment length 3.2, width 2.15; fifth metasomal segment length 5.7, width 2.13; telson length 6.3; pedipalp femur length 8.5, width 2.85; pedipalp patella length 7.2, width 2.7; chela length 15.7; manus width 3.8; movable finger length 7.4.

Type locality. Myanmar, W Mandalay Division, Pagan (Bagan), Nyaung-U.

Type material. Myanmar, W Mandalay Division, Pagan (Bagan), Nyaung-U, 29–31.v.1997, 1♂, 1♀ juv. (holotype and paratype), J. Rejsek leg.

Distribution. Myanmar (known from the type locality only).

Affinities. They are recounted in the key below.

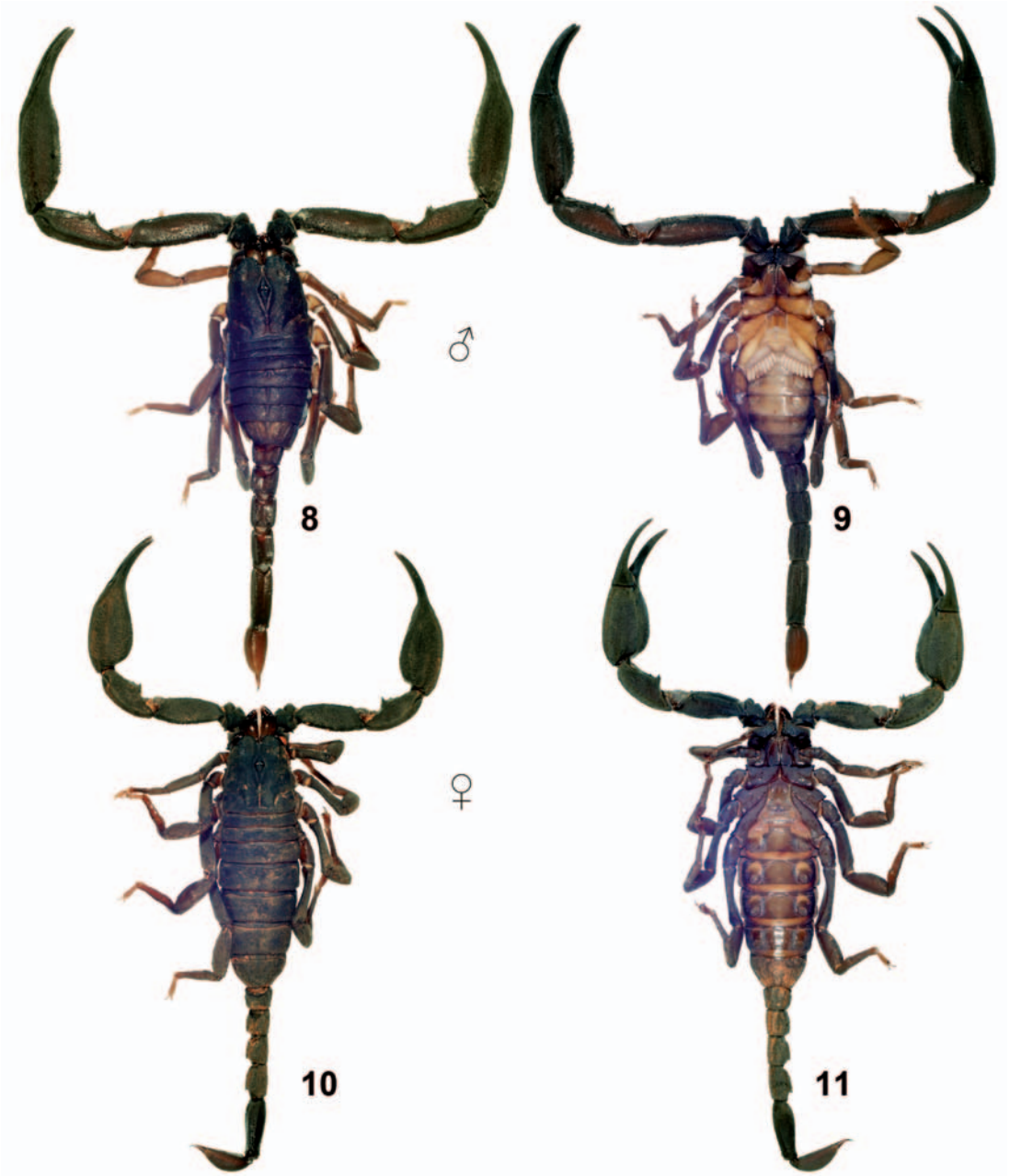
Euscorpiops orioni Kovařík, Košulič, Šťáhlavský, Plíšková, Dongkhamfu and Wongprom sp. nov. (Figs 8–34, 47–55)

Etymology. The scorpion was, according to Greek mythology, created and sent to Earth with the single purpose of killing Orion, the son of Poseidon and a vane hunter who boasted the ability to kill any animal. The scorpion stung Orion, who died. According to another version of the legend, however, he escaped the scorpion and accidentally died by an arrow of Artemis, the virgin goddess of the hunt and the moon, who regretted the accident so much that she installed Orion with his two dogs and a giant scorpion in heavens for all earthlings to see as the constellations of Orion, Lesser and Greater Dogs, and Scorpio. The name is given after Orion, the supernatural hunter of ancient times from Greek mythology.

Diagnosis. Total length 48–66 mm. Base color uniformly reddish black to black, legs and telson yellow to reddish brown. Sternites and pectinal area are yellowish brown. Pectinal teeth number 8–9 in males and 7–8 in females. External trichobothria on pedipalp patella number 19 (5 *eb*, 2 *esb*, 2 *em*, 5 *est*, 5 *et*); ventral trichobothria on patella number 11–13. Male has narrower pedipalp segments than female; chela length to width ratio = 4.58 in male and 3.05–3.44 in female. Pedipalp fingers dentate margin undulate in both sexes. Telson elongate in both sexes, slightly narrower in females. First metasomal segment wider than long in both sexes.

Description. For habitus of male holotype and female paratype see Figs 8–11. Sexual dimorphism is pronounced in the shape of pedipalp segments (see diagnosis and affinities).

Mesosoma and carapace (Fig. 28): The tergites are granulated, with one median carina, and the seventh sternite is sparsely granulated, without carinae. The entire carapace is granulated, without carinae. The anterior margin of the carapace is markedly depressed in the middle. The carapace bears a pairs of median

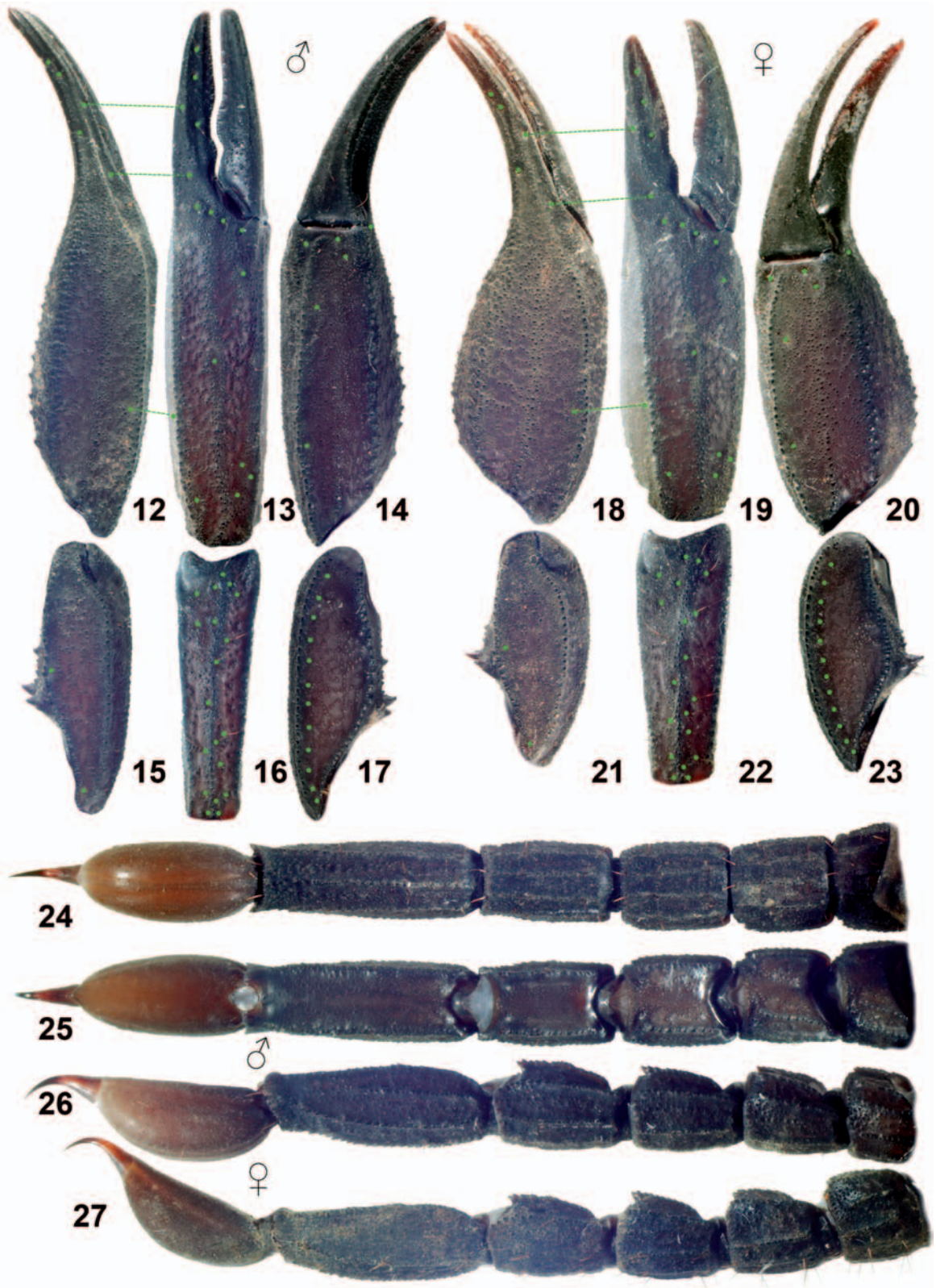


Figures 8–11. *Euscorpiops orioni* sp. nov.: 8–9 – male holotype, dorsal and ventral views; 10–11 – female paratype, dorsal and ventral views.

eyes and three pairs of lateral eyes, of which two are normal and one reduced. Pectinal teeth number 8–9 in males (8 × 8, 2 × 9) and 7–8 in females (9 × 7, 3 × 8).

Metasoma and telson (Figs 24–27): The metasoma is finely granulated, with sparse, relatively large granules. The first segment bears 10 carinae, the second to fourth segments bear 8 carinae, and the fifth segment bears 7 carinae, all composed of granules some of which are pointed. An additional incomplete lateral carina may be present on the second metasomal segment. The dorsolateral carinae of the third and fourth segments posteriorly terminate in a pronounced tooth. The telson is elongate in both sexes, slightly narrower in females (Fig. 26 versus 27), and is sparsely granulated.

Pedipalps: For position and distribution of trichobothria on the patella of pedipalps see Figs 12–23. External trichobothria on the patella number 19 (5 *eb*, 2 *esb*, 2 *em*, 5 *est*, 5 *et*), and ventral trichobothria on the patella number 11–13 (7 × 11, 11 × 12, 3 × 13). The femur is granulated (more so in males) and has four or



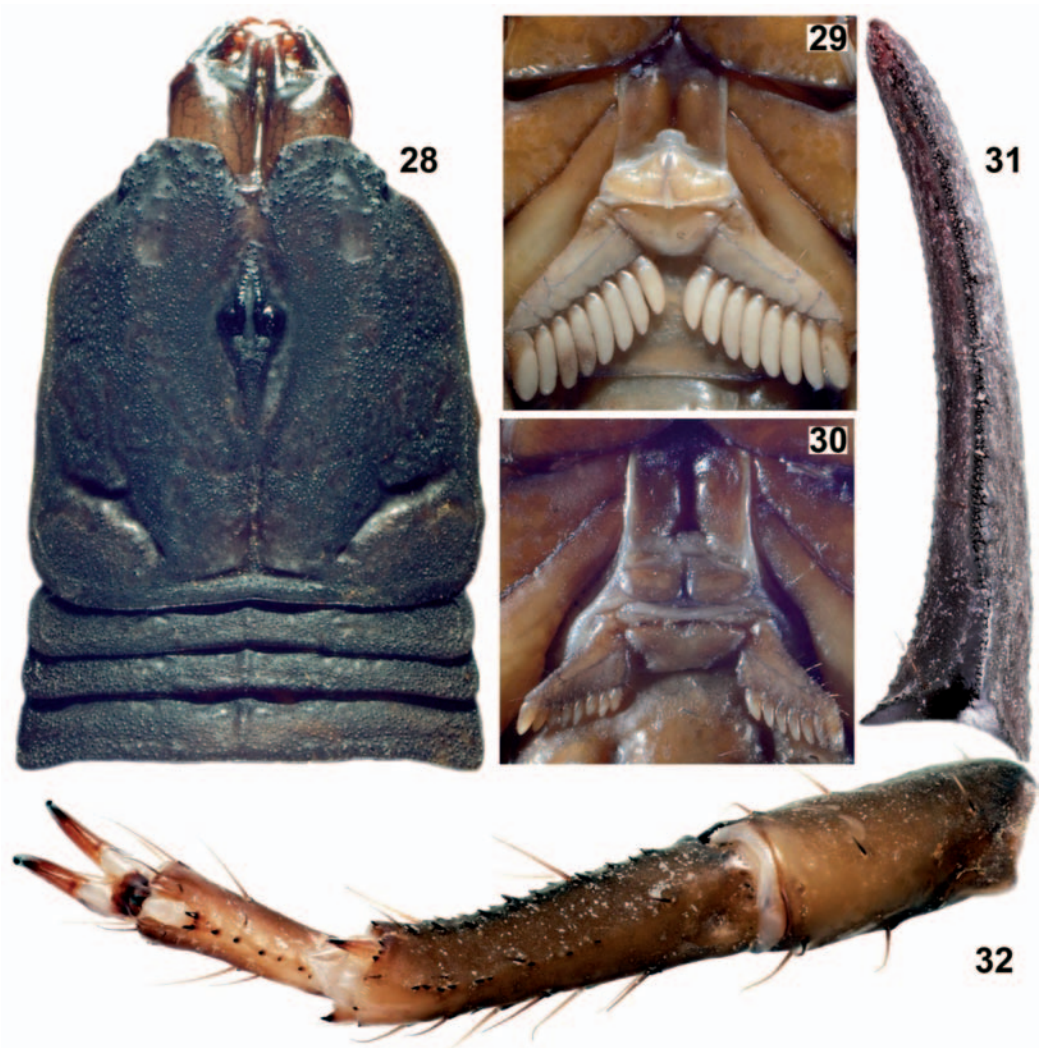
Figures 12–27. *Euscorpiops orioni* sp. nov. 12–17, 24–26 – male holotype, trichobothrial pattern and metasoma with telson ventral (24), dorsal (25) and lateral (26). 18–23, 27 – female paratype, trichobothrial pattern and metasoma with telson lateral. 12 and 18 – chela dorsal; 13 and 19 – chela external; 14 and 20 – chela ventral; 15 and 21 – patella dorsal; 16 and 22 – patella external; 17 and 23 – patella ventral.

five granulose carinae, and the patella has five carinae with pronounced internal twin tubercles. The manus dorsally bears fine rounded granules, which in the central part form a longitudinal carina. The external surface of the chela is densely covered by minute granules which in the central part also form a longitudinal carina. The movable fingers bear straight double rows of granules with internal and external granules (Fig. 31). The pedipalp fingers are undulate in both sexes. The flexures of the movable and the fixed fingers alternate perfectly, so the fingers close without any gap (Fig. 13).

Legs: The tarsomeres of legs are sparsely hirsute, without bristlecombs but with row of spines on ventral surfaces (Fig. 32). The femur and patella are granulated on dorsal surfaces and may bear four to six carinae. The femur bears only solitary setae.

Measurements (*in mm*): Total length of male holotype 49; carapace length 8.6, width 8.1; metasoma and telson length 26.7; first metasomal segment length 2.2, width 3.1; second metasomal segment length 3, width 2.75; third metasomal segment length 3.3, width 2.55; fourth metasomal segment length 4, width 2.5; fifth metasomal segment length 6.7, width 2.3; telson length 7.5; pedipalp femur length 10.8, width 3.2; pedipalp patella length 9.7, width 3.5; chela length 19.7; manus width 4.3; movable finger length 8.9.

Total length of female paratype 57.8; carapace length 8.5, width 8.6; metasoma and telson length 26; first metasomal segment length 2.6, width 3.15; second metasomal segment length 2.7, width 2.7; third metasomal segment length 3.1, width 2.5; fourth metasomal segment length 3.7, width 2.3; fifth metasomal segment length 6.5, width 2.15; telson length 7.4; pedipalp femur

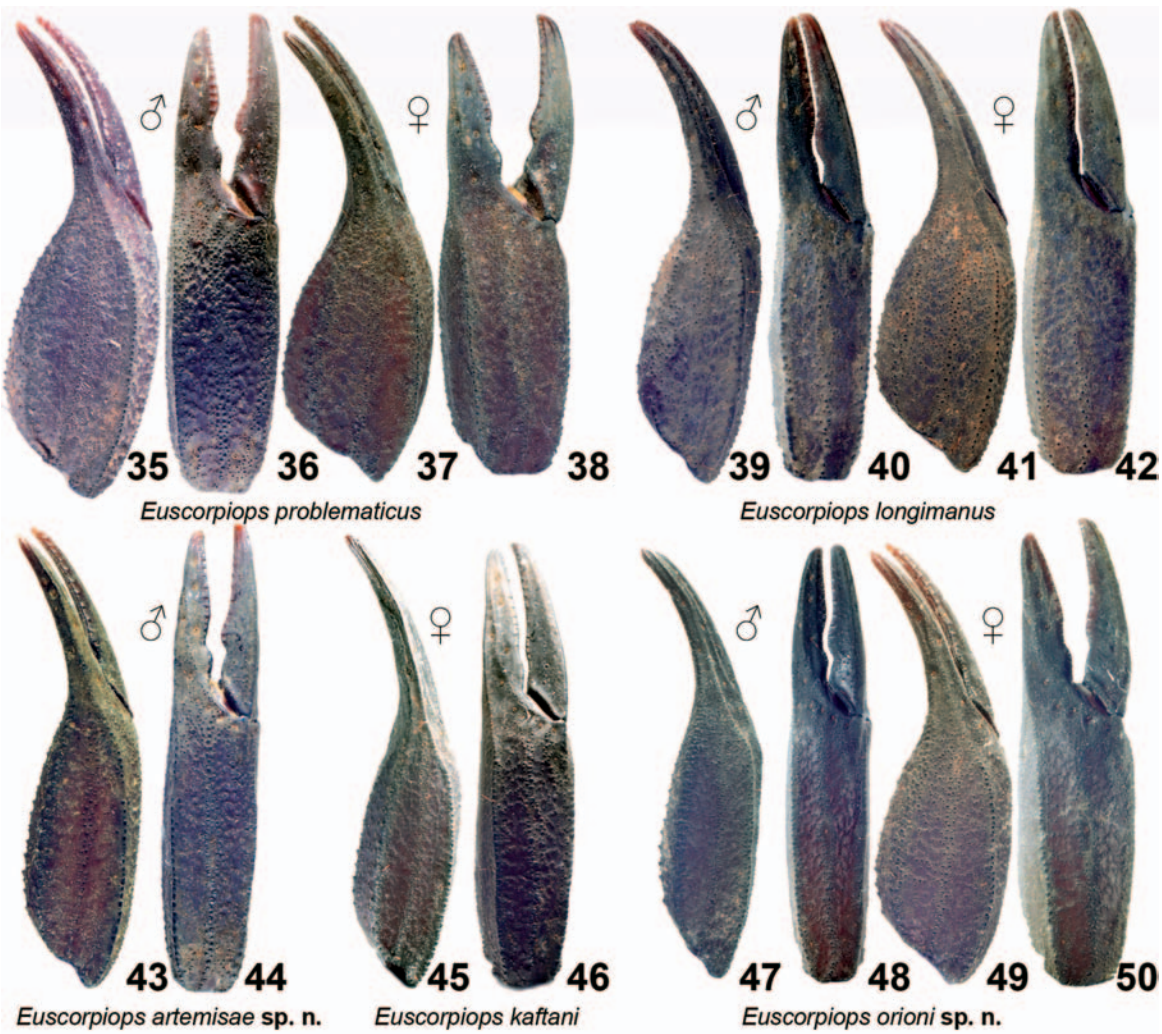


Figures 28–32. *Euscorpiops orioni* sp. nov. 28–29, 31–32: male holotype, carapace with chelicerae and first to third tergites (28), pectinal areas (29), movable finger (31) and fourth leg (32); 30 – female paratype, pectinal areas.

Figures 33–34. *Euscorpiops orioni* sp. nov.: 33 – live specimen, female (paratype); 34 – live specimen, male (paratype).

length 8.9, width 3.1; pedipalp patella length 8.2, width 3.6; chela length 17.2; manus width 5; movable finger length 8.6.

Karyotype: The diploid complement of the male holotype and one paratype is composed of 103 monocentric chromosomes (Fig. 53). The chromosomes gradually decrease in size from 1.8% to 0.36% of DSL. During the first meiotic division we did not observe chiasmata between the homologous chromosomes. This type of male achiasmatic meiosis is typical for the order Scorpiones (e.g. Schneider *et al*. 2009b). Despite the standard bivalents we found one trivalent in both analyzed males (Fig. 54). This fact explains the odd diploid number in the analyzed specimens. We used C-banding because the morphology of the chromosomes is not clearly visible in standard chromosome slides stained directly with Giemsa (see Fig. 54). We found one metacentric bivalent (pair No. 2) and two subtelocentric bivalents (pairs No. 6, 7); the rest of bivalents may be classified as acrocentrics, nevertheless some of them have no visible centromeric region (e.g. pairs No. 41, 46, 50, 51). Some chromosomes possess additional blocks of constitutive heterochromatin at the distal part (pairs No. 16, 25, 26, 36) (Fig. 55). The trivalent consists of one large metacentric chromosome (largest within the karyotype – 1.86 % of DSL) and two smaller acrocentric chromosomes (1.03% and 0.77% of DSL) (Figs 54–55). Size and morphology of chromosomes within the trivalent indicate heterozygous centric fusion or fission. The centric fusion or fission may play an important role in the differentiation of the karyotype within *Euscorpiops*. However the



Figures 35–50. Pedipalp chela of *Euscorpiops* species. 35–38 – *E. problematicus* (Kovařík, 2000); (35–36 – male holotype, 37–38 – female); 39–42 – *E. longimanus* (Pocock, 1893), (39–40 – male, 41–42 – female); 43–44 – *E. artemisae* sp. nov., male holotype; 45–46 – *E. kaftani* (Kovařík, 1993), female; 47–50 – *E. orioni* sp. nov. (47–48 – male holotype, 49–50 – female paratype); 35, 37, 39, 41, 43, 45, 47, 49 – chela dorsal; 36, 38, 40, 42, 44, 46, 48, 50 – chela external.

determination of decreasing (fusion) or increasing (fission) of diploid number in karyotype evolution of *Euscorpiops* is possible after analysis of additional species. The second largest chromosomes (pair No. 2) (1.74% of DSL) are only other metacentric chromosomes in karyotype and their origin may also be explained by centric fusion. We have information only on one other species of *Euscorpiops*, *E. neradi*, which has 2n=48 with the chromosomes of very different size (Kovařík *et al.* 2013).

Variability. Trichobothria on the external surface of the patella do not vary in number (19 in all types), but the series *est* and *et* (terminology according to Vachon 1974) vary markedly in position (Fig. 16 versus 22). In several paratypes the trichobothrium *est*3 is situated very close to *et* trichobothria and could thus be interpreted as an *et* trichobothrium (4 *est* and 6 *et* instead of 5 *est* and 5 *et*).

Type locality. Thailand, Chiang Mai Province, Doi Inthanon, Mae Pan Waterfall track trail, 18°31'N, 98°27'E, 1175 m a.s.l.

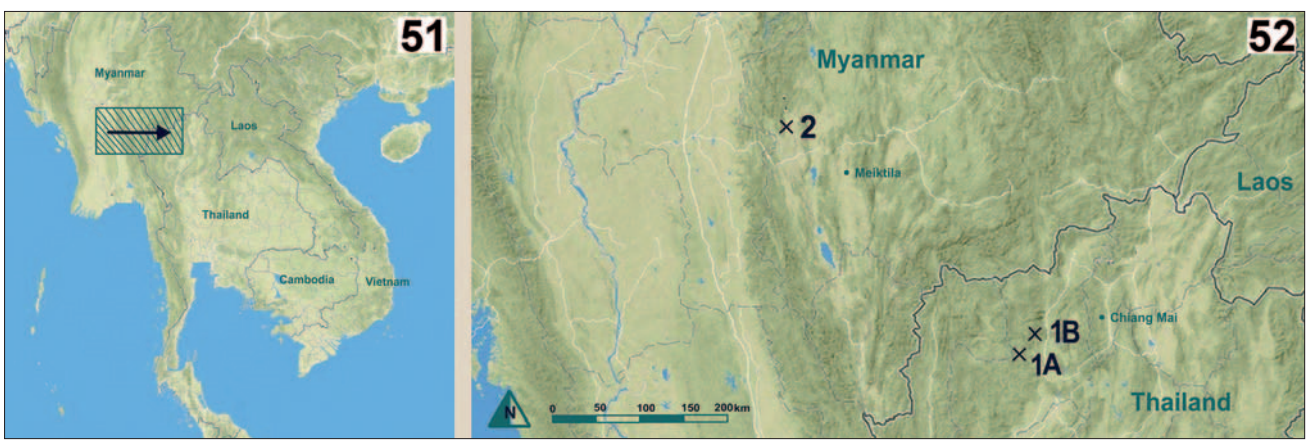
Type material. Thailand, Chiang Mai Province, Doi Inthanon, Mae Pan Waterfall track trail, 18°31'N, 98°27'E, 1175 m a.s.l., 25.XI.2013, 3 ♂♂ (holotype and paratypes), 3 ♀♀, 1♂ juv. (paratypes), O. Košulič leg.; Chiang Mai Province, Doi Inthanon, 18°24'N, 98°32'E, 945 m a.s.l., 26.XI.2013, 3 ♀♀, 1♂ juv. (paratypes), O. Košulič and W. Dongkhamfu leg.

Distribution. Thailand (known from the two localities only – see Fig. 52).

Ecological notes. Specimens of this species have mainly been discovered at night by ultraviolet detection in rocky fissures and deep burrows in the steep soil walls. The area where scorpions were collected was sheltered by evergreen rain forest characterized by very humid conditions (presence of many waterfalls). Adults and juveniles specimens of *E. orioni* were observed in ambush positions resting inverted on overhanging surfaces of rock or soil walls. Some of them occupied more protected places in fissures of cracked rock walls. When disturbed, the scorpions escaped and hide deeper in the rock fissure or soil burrow.

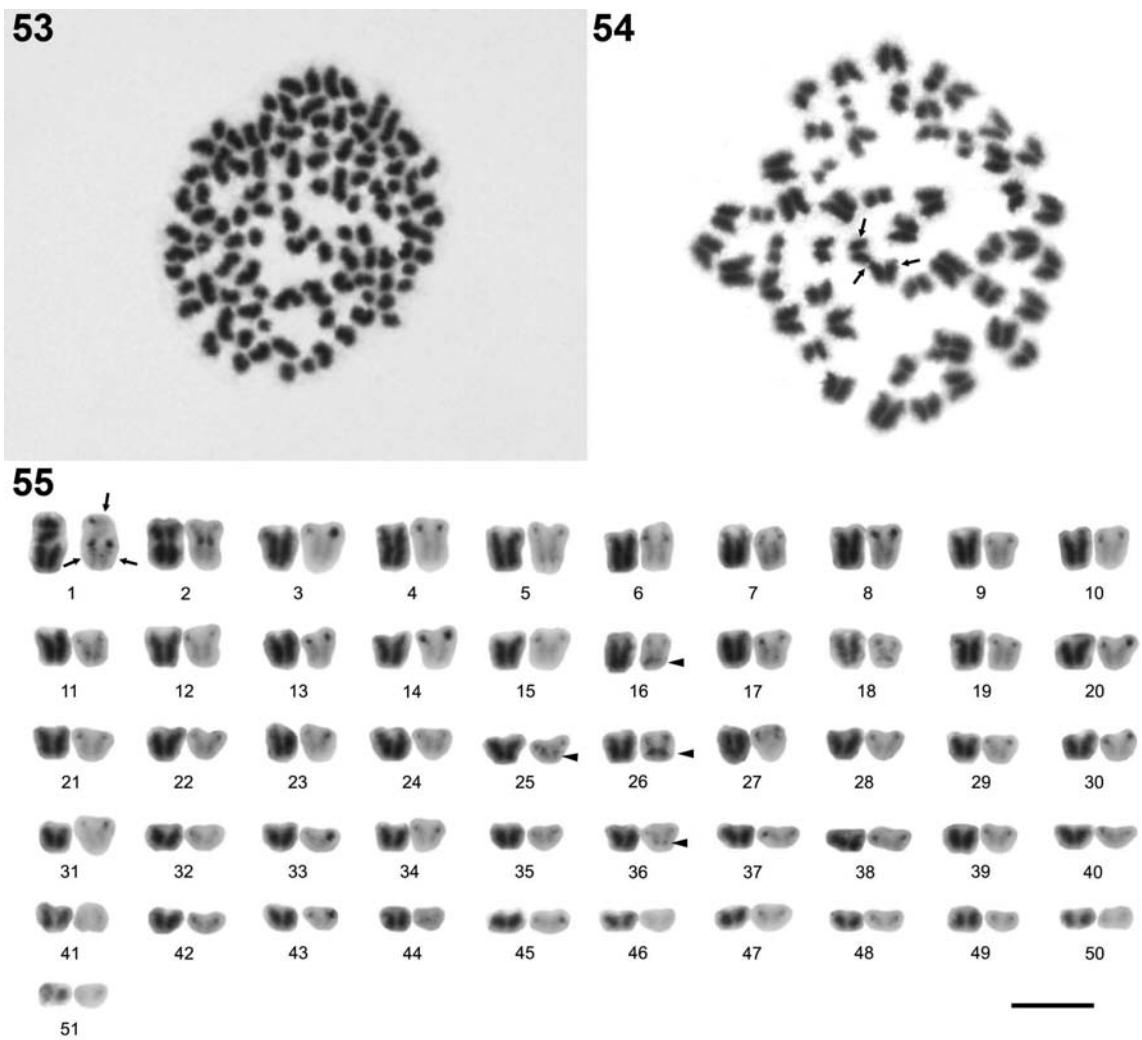
Affinities. The described features distinguish *E. orioni* sp. nov. from all other species of the genus. They are recounted in the key below. *E. orioni* sp. nov. belongs to a complex of species whose adults reach 40–70 mm, have a relatively narrow chela (pedipalp chela length to width ratio is greater than 3) and the number of trichobothria on the pedipalp patella is 18–21 external and 10–15 ventral. This complex contains 13 species which can be divided into two groups on sexual dimorphism expressed in the shape of pedipalp chela. In most of these species both sexes have nearly identical ratio between the chela length and width (Fig. 35 versus 37). These species are *E. binghamii* (Pocock, 1893) (Myanmar, Thailand), *E. kubani* Kovařík, 2004 (northern Laos), *E. problematicus* (Kovařík, 2000) (Thailand), *E. puerensis* Di *et al.*, 2010b (China – Yunnan), *E. thaomischorum* Kovařík, 2012 (Vietnam), *E. validus* Di *et al.*, 2010a (China – Yunnan), *E. yangi* Zhu *et al.*, 2007 (China – Yunnan), and probably also *E. beccaloniae* Kovařík, 2005 from Myanmar (the female of this species is unknown, but the shape of the chela in the male holotype is similar to that in males of the other cited species).

The male is unfortunately unknown in *E. kaftani* (Kovařík, 1993) (Vietnam); the female has the narrowest chela of all 13 species. Its chela length to width ratio is 4.4 (Fig. 45), whereas in females of the other species it is 3.0–3.6 (Figs 37, 41 and 49).



Figures 51–52. Distribution maps of *Euscorpiops artemisae* sp. nov. and *E. orioni* sp. nov. in Southeast Asia: 51 – Larger scale terrain map of Southeast Asia with geopolitical borders and highlighted distribution range of the new species; 52 – Smaller scale terrain map showing locations of the new species. 1A – type locality of *E. orioni* sp. nov., 1B – second location of described paratypes of *E. orioni* sp. nov., 2 – type locality of *E. artemisae* sp. nov.

Only in four species of this group (*E. artemisae* sp. nov., *E. longimanus*, *E. orioni* sp. nov., *E. xui*) the males have markedly narrower pedipalp chela than the females (Figs 39 versus 41). *E. longimanus* (Pocock, 1893) (Bangladesh, India) was erroneously recorded from Myanmar (Henderson 1913: 132; Kovařík 2000: 188), where it apparently has been confused with others species (e.g. *E. artemisae* sp. nov., *E. binghamii*, *E. beccaloniae* or *E. problematicus*), which explains differences of published data on morphometry of the chela. Pocock (1893) regarded the holotype of *E. longimanus* as a female, but his figure (fig. 12, plate XIV, Pocock, 1893) makes it evident that in reality it is a male. After measuring all the specimens we can state that this species has the chela length to width ratio of 3.63–4.23 in males and 3.2–3.45 in females. *Euscorpiops xui* Sun et Zhu, 2010 (China – Yunnan) has the chela length to width ratio 4.14 in males and 3.56 in females. The males of *E. orioni* sp. nov. thus have the narrowest pedipalp chela in the group (length to width ratio 4.58 in males and 3.05–3.44 in females, Figs 47–50). We place here also *E. artemisae* sp. nov., whose adult female is unknown but the male has the chela markedly narrow (Fig. 43). Its chela length to width ratio is 4.13, which is one of the characters distinguishing *E. artemisae* sp. nov. from *E. orioni* sp. nov. Another difference is the presence of 20 external trichobothria on the pedipalp patella (*E. orioni* sp. nov. has 19) and of 14–15 ventral trichobothria on the patella (other cited species have 10–13).



Figures 53–55. Chromosomes of male *Euscorpiops orioni* sp. nov. (2n = 103): 53 – spermatogonial metaphase; 54 – late metaphase I.; 55 – meiotic karyotype based on late metaphase I, left location – chromosomes stained with Giemsa, right location – the same chromosomes after C-banding stained with DAPI (color inversion). Arrows indicate chromosomes intrivalent. Arrowheads indicate additional blocks of constitutive heterochromatin at distal parts of chromosomes. Scale bar = 10 μm.

Key to species of *Euscorpiops* Vachon, 1980

1. External trichobothria on patella number 16–17 . . . . . **2**
–. External trichobothria on patella number 18–21 (Fig. 6) **6**
2. External trichobothria on patella number 16 (5 *eb*, 2 *esb*, 2 *em*, 3 *est*, 4 *et*). Ventral trichobothria on patella number 6. Total length 24–28 mm . . . . . ***E. neradi*** Kovařík *et al.* 2013 Thailand
–. External trichobothria on patella number 17. Ventral trichobothria on patella number 7–18. Total length 42–60 mm **3**
3. Ventral trichobothria on patella number 7–10 . . . **4**
–. Ventral trichobothria on patella number 11–18 . . . . . ***E. montanus*** (Karsch 1879) India, Pakistan . . . . . ***E. shidian*** Zhu *et al.*, 2005 China – Yunnan
4. Ventral trichobothria on patella number 7 . . . . . ***E. bhutanensis*** (Tikader and Bastawade 1983) Bhutan
–. Ventral trichobothria on patella number 8–10 . . . **5**
5. Ventral trichobothria on patella number 8–9 . . . . . ***E. karschi*** Lourenço *et al.* 2005 China – Tibet
–. Ventral trichobothria on patella number 10 . . . . . ***E. vachoni*** Zhu *et al.* 2005 China – Yunnan
6. External trichobothria on patella number 20–21 (5 *eb*, 2 *esb*, 2 *em*, 5–6 *est*, 5–6 *et*) **7**
–. External trichobothria on patella number 18–19 . . . **9**
7. Total length 50–70 mm. Chela length to width ratio in male lower than 4. Ventral trichobothria on patella number 12–13 . . . . ***E. binghamii*** (Pocock 1893) Myanmar, Thailand
–. Total length 38–45 mm. Chela length to width ratio in male higher than 4. Ventral trichobothria on patella number 14–15 . . . . . **8**
8. Chela length to width ratio in male holotype 6.7. Male fingers of pedipalps straight . . . . . ***E. alexandreanneorum*** Lourenço 2013 Laos
–. Chela length to width ratio in male holotype 4.13. Male fingers of pedipalps slightly flexed (Fig. 3) . . . . . ***E. artemisae*** sp. nov. Myanmar
9. *est* trichobothria on patella number 3–4 . . . . . **10**
–. *est* trichobothria on patella number 5 (Fig. 6) . . . **22**
10. Chela length to width ratio lower than 2.8 . . . . . **11**
–. Chela length to width ratio higher than 2.9 . . . . . **12**
11. Ventral trichobothria on patella number 9 . . . . . ***E. sejnai*** Kovařík 2000 Vietnam
–. Ventral trichobothria on patella number 10–11 . . . . . ***E. puerensis*** Di *et al.* 2010 China – Yunnan
12. *eb* trichobothria on patella number 5 (Figs 16 and 22) **14**
–. *eb* trichobothria on patella number 6 . . . . . **13**
13. Total length 54–65 mm. Chela length to width ratio 3.5 (female) to 4.15 (male) . . . . . ***E. xui*** Sun et Zhu 2010 China – Yunnan
–. Total length 39–45.3 mm. Chela length to width ratio 3.1–3.2 in both sexes . . . . . ***E. kubani*** Kovařík 2004 northern Laos
14. Chela length to width ratio of adults higher than 3.9 . . . . . **15**
–. Chela length to width ratio of adults lower than 3.8. . . . . **16**
15. Ventral trichobothria on patella number 12–13 . . . . . ***E. kaftani*** (Kovařík 1993) (Vietnam) (the ratio in female is higher than 4.2)
–. Ventral trichobothria on patella number 7–8 . . . . . ***E. kamengensis*** Bastawade 2006 India – Arunachal Pradesh
16. Male pedipalp fingers flexed **18**
–. Male pedipalp fingers nearly or entirely straight, may be slightly undulate (Fig. 40) **17**
17. Chela length to width ratio 3.63–4.23 in males . . . . . ***E. longimanus*** (Pocock 1893) Bangladesh, India
–. Chela length to width ratio 3.3–3.6 in both sexes . . . . . ***E. karschi*** Lourenço *et al.* 2005 China – Tibet . . . . . ***E. yangi*** Zhu *et al.* 2007 China – Yunnan
18. External surface of chela densely covered by minute granules. Ventral trichobothria on patella number 9–11, very rarely 12 . . . . . **19**
–. External surface of chela smooth, with less than 40 large, rounded granules most of which form a medial carina. Ventral trichobothria on patella number 12. . . . . ***E. beccaloniae*** Kovařík 2005 Myanmar
19. Sexual dimorphism expressed in shape of pedipalp fingers **20**
–. Sexual dimorphism not readily apparent, fingers flexed identically in both sexes . . . . . ***E. thaomischorum*** Kovařík 2012 Vietnam
20. Pedipalp fingers in male flexed, in female nearly straight (very slightly undulate) **21**
–. Pedipalp fingers flexed in both sexes, but strongly in males and only weakly in females . . . . . ***E. validus*** Di *et al.* 2010 China – Yunnan
21. Ventral trichobothria on patella number 8–9. Pectinal teeth number 5–6. . . . . ***E. asthenurus*** (Pocock 1900) Bhutan, India, Myanmar
–. Ventral trichobothria on patella number 10, rarely 9. Pectinal teeth number 7–8 . . . . . ***E. kubani*** Kovařík 2004 northern Laos

22. Ventral trichobothria on patella number 11–13 . . . **23**
–. Ventral trichobothria on patella number 7–9 . . . **25**
23. Chela length to manus width ratio in adult female higher than 4.2 (Fig. 45) . . . . . ***E. kaftani*** (Kovařík 1993) Vietnam
    Chela length to manus width ratio in adult female 3.0–3.4 . . . . . **24**
24. Chela length to width ratio 3.0–3.3 in both sexes . . . . . ***E. problematicus*** (Kovařík, 2000) Thailand
–. Male has narrower chela of pedipalp than female, length to width ratio 4.58 in male (Fig. 47) and 3.05–3.44 in female (Fig. 49) . . . . ***E. orioni*** sp. nov.
25. Ventral trichobothria on patella number 9 . . . . . ***E. novaki*** Kovařík 2005 China – Tibet
–. Ventral trichobothria on patella number 7–8 . . . . . ***E. kamengensis*** Bastawade 2006 India – Arunachal Pradesh

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