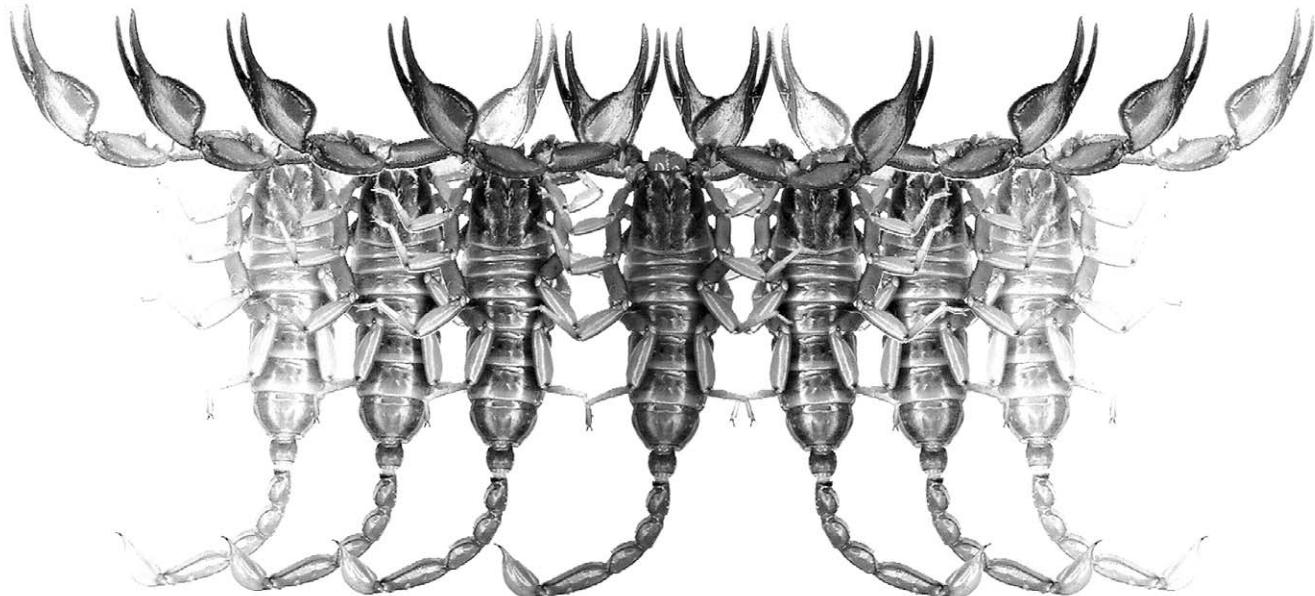


Euscorpius

Occasional Publications in Scorpiology



**Revision of the *Mesobuthus caucasicus* Complex
from Central Asia, with Descriptions of Six New Species
(Scorpiones: Buthidae)**

**Victor Fet, František Kovařík, Benjamin Gantenbein,
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Euscorpius

Occasional Publications in Scorpiology

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Revision of the *Mesobuthus caucasicus* complex from Central Asia, with descriptions of six new species (Scorpiones: Buthidae)

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Summary

A widespread *Mesobuthus caucasicus* complex, which includes some of the most common scorpions found from the Caucasus to China, is revised for the first time based on new extensive collections from Central Asia, using both morphological and DNA marker data. *Mesobuthus caucasicus* (Nordmann, 1840), s.str. is restricted to the Caucasus Mts. Four taxa are elevated to species rank: *M. fuscus* (Birula, 1897) (Tajikistan), *M. intermedius* (Birula, 1897) (Tajikistan), *M. kaznakovi* (Birula, 1904) (Tajikistan, Uzbekistan), and *M. parthorum* (Pocock, 1889) (Afghanistan, Iran, Turkmenistan). Six new species are described: *M. brutus* sp. n. (Iran), *M. elenae* sp. n. (Tajikistan, Uzbekistan), *M. gorelovi* sp. n. (Kazakhstan, Turkmenistan, Uzbekistan), *M. kreuzbergi* sp. n. (Tajikistan, Uzbekistan), *M. mischi* sp. n. (Afghanistan), and *M. nenilini* sp. n. (Uzbekistan). The most common species in Central Asia is a psammophilic *Mesobuthus gorelovi* sp. n., widespread through lowland sand deserts across Turkmenistan (Karakum), Uzbekistan (Kizylkum), and Kazakhstan (north to Baigakum and Moyinkum). A key to all studied species is provided. A DNA phylogeny based on COI and 16S rRNA markers is presented including nine Central Asian species (*M. elenae* sp. n., *M. fuscus*, *M. gorelovi* sp. n., *M. intermedius*, *M. kaznakovi*, *M. kreuzbergi* sp. n., *M. mischi* sp. n., *M. nenilini* sp. n., and *M. parthorum*) and *M. caucasicus* from Turkey. A deep phylogenetic diversity across Central Asia is revealed. Historical biogeographic scenarios for this scorpion group are discussed, including fragmentation in mountain valleys and expansion across sand deserts in Central Asia. The monotypic scorpion genus *Afghanobuthus* Lourenço, 2005 and its single species *A. naumannii* Lourenço, 2005, from Afghanistan, are demonstrated to be junior synonyms, respectively, of *Mesobuthus* Vachon, 1950, and *M. parthorum* (Pocock, 1889) from the same area.

Introduction

Mesobuthus caucasicus (Nordmann, 1840) has not been revised since the pioneering works of Birula (1897, 1904a, 1917). It includes the largest, and one of the most common, scorpion species in the Caucasus and Central Asia, found in diverse habitats from lowland sand deserts to arid mountains. A detailed list of museum material known from the former USSR was published by

Fet (1989). When Birula (1897: 383–388) first revised *Buthus caucasicus*, he defined only two subspecies: a nominotypical “sbsp. typica”, i.e. *Buthus caucasicus caucasicus* (Nordmann, 1840) (Caucasus to Central Asia) and *B. c. przewalskii* Birula, 1897 from China. Within the nominotypical subspecies, Birula (1897) also distinguished three intrasubspecific “forms”: forma α (now *M. caucasicus*); forma β, to which Birula assigned the name *Buthus parthorum* Pocock, 1889 (now *M.*

parthorum); and forma γ (“*intermedia*”, now *M. intermedius*). Two additional taxa from Central Asia were described by Birula as new species: *Buthus fuscus* Birula, 1897 and *B. kaznakovi* Birula, 1904. Already in 1904, Birula had changed the subspecific assignments, considering four full subspecies in *Buthus caucasicus* (an alternative spelling he used at that time): the nomino-typical subspecies (which still included two intra-subspecific “forms”: “*forma typica*” from the Caucasus and “*forma intermedia*” from Central Asia), *B. c. Parthorum*, *B. c. przewalskii*, and *B. c. fuscus*. However, the identity of those subspecies remained unclear to this day, due mainly to lack of specimens from the mountainous Central Asia.

According to Fet (1989) and Fet & Lowe (2000), *Mesobuthus caucasicus* includes six subspecies with a complex synonymy, convoluted taxonomic history, and extremely wide geographic distribution, from Turkey to China. Very little information, and virtually no modern illustrations, exists for scorpions of this complex. One subspecies from Afghanistan, *M. c. parthorum* (Pocock, 1889) was redescribed and illustrated by Vachon (1958), and another, *M. c. przewalskii* (Birula, 1897), was recently redescribed from China (Sun & Zhu, 2010; Sun & Sun, 2011).

Gantenbein et al. (2003) published the first DNA-based phylogeny for *Mesobuthus*, which included six populations from Kazakhstan and Uzbekistan belonging to “*Mesobuthus caucasicus*” that appeared to be a complex of cryptic species. Further, Gantenbein et al. (2005) used DNA marker sequences of “*Mesobuthus caucasicus*” from Central Asia (27 populations) to explore the mitochondrial DNA recombination they discovered in buthid scorpions. However, phylogenetic data based on these DNA sequences have not yet been published.

A detailed account of the systematics and ecology of *Buthus caucasicus* from the Russian Caucasus was published by Birula (1917). Unfortunately, his study of the Central Asian forms remained unfinished due to the political upheaval that followed in Russia. We are honored to continue this effort to commemorate the 100th anniversary of Alexei Birula’s seminal work.

Methods, Material & Abbreviations

Morphology. Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974) and sternum (Soleglad & Fet, 2003).

Molecular Techniques. We used a combination of new and previously published DNA sequence data to analyze two mitochondrial markers (*COI* and *16S*) for ten

Mesobuthus species: *M. caucasicus*, *M. elenae* sp. n., *M. fuscus*, *M. gorelovi* sp. n., *M. intermedius*, *M. kaznakovi*, *M. kreuzbergi* sp. n., *M. mischi* sp. n., *M. nenilini* sp. n., and *M. parthorum* (Tab. 7). New sequence data were generated (by MRG and RK) by isolating genomic DNA from leg tissues using a DNeasy Tissue Kit (Qiagen, Valencia, CA, USA). We sequenced a 778 bp fragment of the mitochondrial gene coding for cytochrome c oxidase subunit I (*COI*) for 16 samples using primers COImodF and LE1r and a 424 bp fragment of the mitochondrial 16S rRNA gene for 15 samples using primers 16SmodF and 40R. Gene fragments were amplified using polymerase chain reactions (PCR) with 50–54°C annealing temperatures and 34 cycles for *COI* and 50°C annealing temperatures and 30 cycles for *16S*. PCR products were purified using ExoSAP-IT (GE Healthcare, Piscataway, NJ, USA). Bidirectional sequencing using the same primers was conducted at the DF/HCC DNA Resource Core (Harvard Medical School, Boston, MA, USA). We manually verified chromatograms, assembled contigs, and generated consensus sequences in Geneious 7.0.2 (Biomatters Ltd, Auckland, New Zealand). Two additional new sequences were obtained by our colleagues at Charles University, (Prague, Czech Republic) for *M. mischi* sp.n. All new sequences were deposited in GenBank under accession numbers MG586931–MG586946 for *COI* and MG586916–MG586930 for *16S*. GenBank accession numbers for previously published sequences (Gantenbein et al., 2005; five species, 33 sequences) are provided in Table 7.

Phylogenetics and Divergence Dating. We used Geneious to align consensus sequences for both loci with MUSCLE (Edgar, 2004). Alignments were checked by eye for accuracy and ends were trimmed to minimize missing characters. We simultaneously assessed phylogenetic relationships and timing of diversification among *Mesobuthus* spp. using BEAST v. 1.8.0 (Drummond et al., 2012). The best-fit model of nucleotide substitution was determined for each gene partition with MEGA7: Molecular Evolutionary Genetics Analysis v. 7.0.21 (Kumar et al., 2015) using the Bayesian Information Criterion. We ran BEAST using the appropriate models (HKY+G for *COI* and HKY+G for *16S*) and an uncorrelated lognormal clock for both genes with a Yule tree prior. Divergence times were estimated using the calibration procedure outlined in Shi et al. (2013). In brief, we used the timing of the refilling of the Mediterranean Basin at the end of the Messinian Salinity Crisis as the time of divergence of *M. cyprius* from *M. gibbosus* (5.3 ± 0.3 Ma), and a 13.8–9.0 Ma timeframe for divergence of *M. gibbosus/M. cyprius* from the other *Mesobuthus* spp. The latter timeframe reflects two events hypothesized by Shi et al. (2013) to isolate Balkan-Anatolian populations from the rest of the

Asian populations; the Bodenian Salinity Crisis and resulting Dinarid-Anatolian Land connection at approximately 13.8 Ma (de Leeuw et al., 2010), and formation of the Mid-Aegean Trench at about 12–9 Ma (Dermitzakis & Papanikolaou, 1981). Using these constraints, we conducted two MCMC runs for 10^8 generations sampled every 10,000 generations. We uploaded the resulting log files to Tracer v. 1.6 (Drummond & Rambaut, 2007) to assess convergence and adequate (>200) ESS values for each parameter. Output trees were summarized with TreeAnnotator v. 1.8.0 (included in the BEAST software package) with the first 20% discarded as burn-in. We visualized the resulting chronogram in FigTree v 1.4.0 (available at: <http://tree.bio.ed.ac.uk/software/figtree>).

Abbreviations. Museums: BMNH, Natural History Museum, London, United Kingdom; FKCP, personal collection of František Kovařík, Prague, Czech Republic; MNHN, Muséum National d'Histoire Naturelle, Paris, France; NMPC, National Museum of Natural History, Prague, Czech Republic; UZMH, Zoological Museum, Helsinki University, Helsinki, Finland; VFPC, personal collection of Victor Fet, Huntington, West Virginia, USA; ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia; ZMUH, Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany; Collectors: LSB, L. S. (Lev Semënovich) Barszczewsky; VF, Victor Fet; AG, Alexander Gromov.

Systematics

Family Buthidae C. L. Koch, 1837

Genus *Mesobuthus* Vachon, 1950 (Figs. 1–327, Tables 1–6)

TYPE SPECIES. *Androctonus eupeus* C. L. Koch, 1839.

SYNONYMY.

Olivierus Farzanpay, 1987 (syn. by Gantenbein et al., 2003: 417). TYPE SPECIES. *Androctonus caucasicus* Nordmann, 1840.

Afghanobuthus Lourenço, 2005, syn. n. TYPE SPECIES. *Afghanobuthus naumannii* Lourenço, 2005 (TYPE LOCALITY AND TYPE REPOSITORY. Afghanistan, North range, Vic Shiberghan, Dasht-e-Leili, 400 m; MNHN) = *Mesobuthus parthorum* (Pocock, 1889), syn. n.

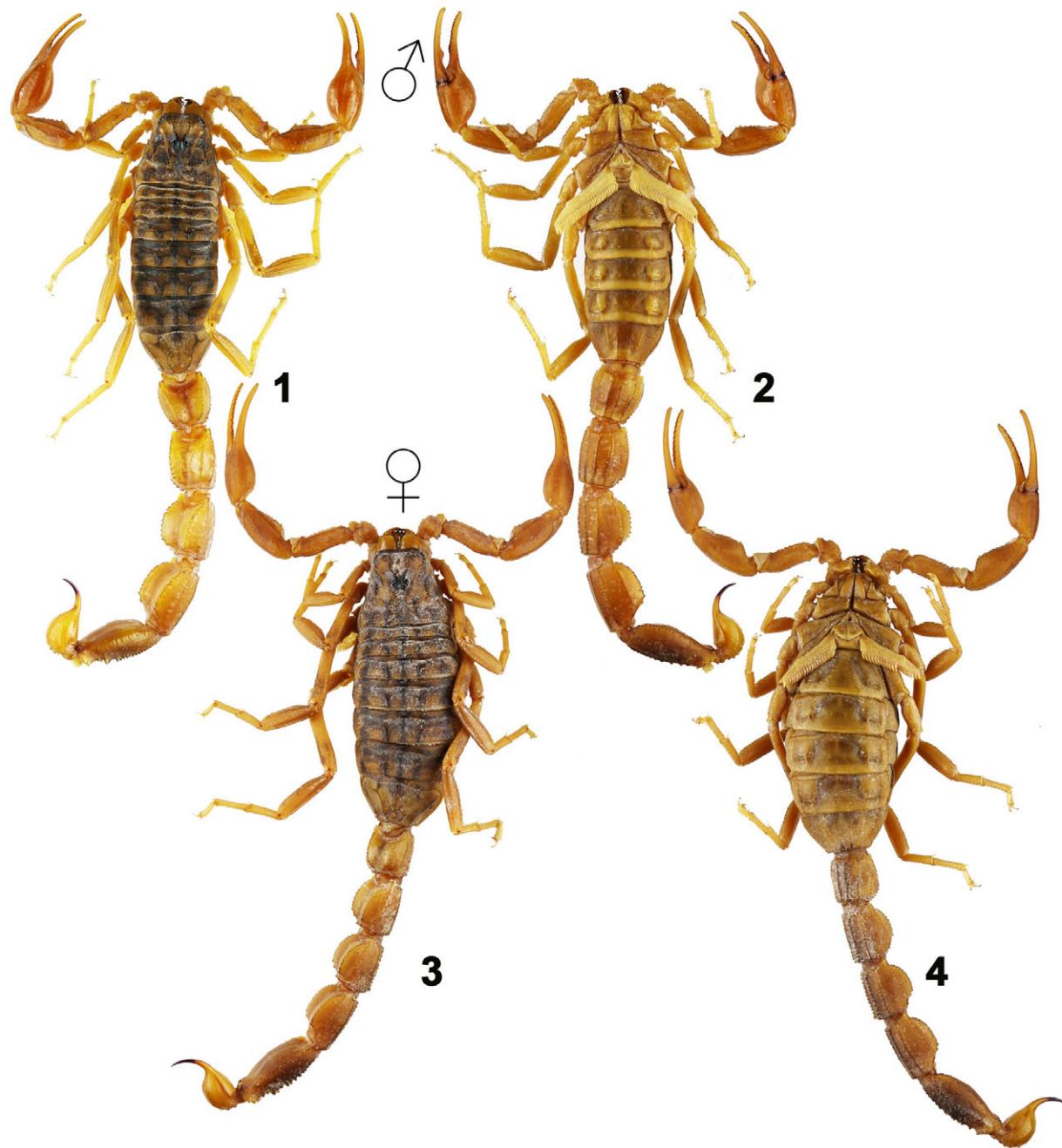
DIAGNOSIS. Medium to large buthids, adults 35–90 mm. Sternum type 1 (Soleglad & Fet, 2003), various degrees of an irregular pentagon in shape. Pedipalps orthobothriotic, type Aβ (Vachon, 1974, 1975), femur tri-

chobothrium d_2 dorsal, patella d_3 dorsal of dorsomedian carina. Chelal trichobothrium db usually located between est and esb , or may be on level with trichobothrium est . Trichobothrium eb clearly on fixed finger of pedipalp. Pectines with fulcra. Dentate margin of pedipalp-chela movable finger with distinct denticles divided into 11–14 linear rows and 5 terminal denticles. Chelicerae with typical buthid dentition (Vachon, 1963, figs. 32–33), fixed finger armed with two denticles on ventral surface. Tergites I–VI granular, with three carinae, tergite VII with 5 carinae. Carapace with distinct carinae, entire dorsal surface nearly planate. First sternite with two granulated lateral stridulatory areas, which however may be reduced in some species. Metasoma elongate, segment I with 10 carinae, segments II–IV with 8–10 carinae. Ventrolateral carinae of metasomal segment V posteriorly usually with several large lobated denticles. Telson elongated or bulbous, bumpy and granulated, without subaculear tooth. Legs III and IV with well developed tibial spurs.

NOTES.

1. The genus *Mesobuthus* underwent significant taxonomic changes since being listed in the *Catalog of the Scorpions of the World* by Fet & Lowe (2000). A new species *M. cypricus* Gantenbein et Kropf, 2000, was described from Cyprus. Gantenbein et al. (2003) synonymized *Olivierus* Farzanpay, 1987, with *Mesobuthus*. *M. nigrocinctus* (Ehrenberg, 1828) from Israel and Lebanon was restored from synonymy (Fet et al., 2000), as well as *M. phillipsii* (Pocock, 1889) from Turkey and Iran (Mirshamsi et al., 2011b). All Indian species were transferred from *Mesobuthus* to *Hottentotta* Birula, 1908 by Kovařík (2007); these were *Hottentotta pachyurus* (Pocock, 1897), *H. rugiscutis* (Pocock, 1897; senior synonym of *Buthus hendersoni* Pocock, 1900); and *H. tamulus* (Fabricius, 1798). *Mesobuthus songi* Lourenço, Qi et Zhu, 2005 was also transferred to *Hottentotta* (Sun et al., 2010; Teruel et Rein, 2010). With the addition of six new species described, and taxonomic changes introduced in this paper, the genus *Mesobuthus* now includes 24 species.

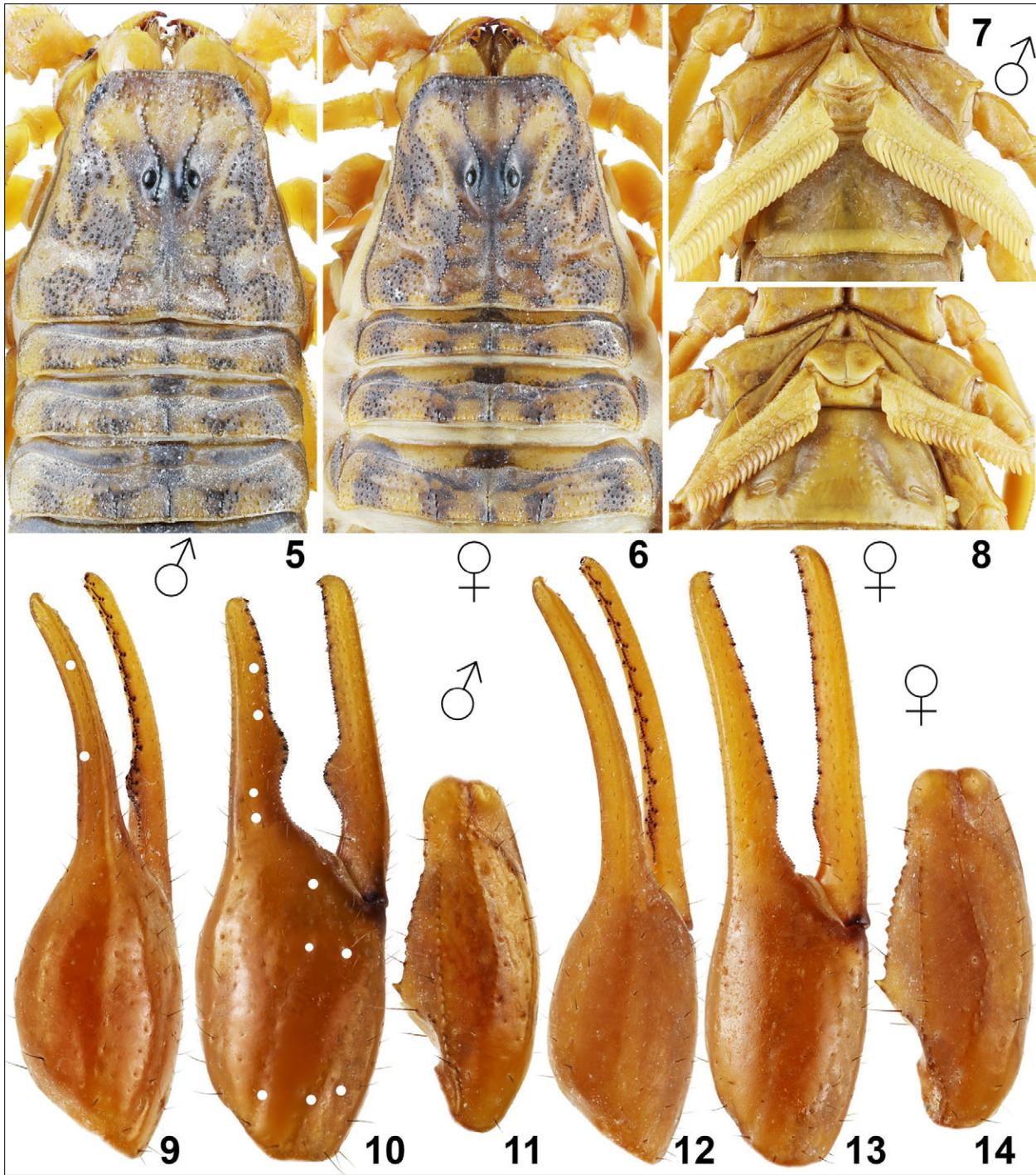
Our key to *Mesobuthus* complexes and species (below) excludes taxa from China, Korea, Mongolia, and Singapore, which we have not analyzed. These are: *M. bolensis* Sun, Zhu et Lourenço, 2010; *M. extremus* (Werner, 1936); *M. karschii* Sun et Sun, 2011; *M. longichelus* Sun et Zhu, 2010; and *M. martensii* (Karsch, 1879). A comment on *M. "caucasicus" przewalskii* is given in the end of this section. *M. agnetis* (Werner, 1936) from Iran remains a dubious taxon, possibly a synonym of *Sassanidotherus zarudnyi* (Birula) (Fet & Lowe, 2000).



Figures 1–4: *Mesobuthus brutus* sp. n. **Figures 1–2.** Holotype male, dorsal (1) and ventral (2) views. **Figures 3–4.** Paratype female, dorsal (3) and ventral (4) views.

2. The monotypic genus *Afghanobuthus*, with a single species *Afghanobuthus naumanni* Lourenço, 2005, is represented by a juvenile from “Afghanistan, North range, Vic Shiberghan, Dasht-e-Leili”, which the author mistook for an adult female. The juvenile status of this specimen is indicated by size and shape of the genital operculum and pectines (see photos of types located on official MNHN website). Lourenço (2005: 111) cited for genus *Afghanobuthus* a unique com-

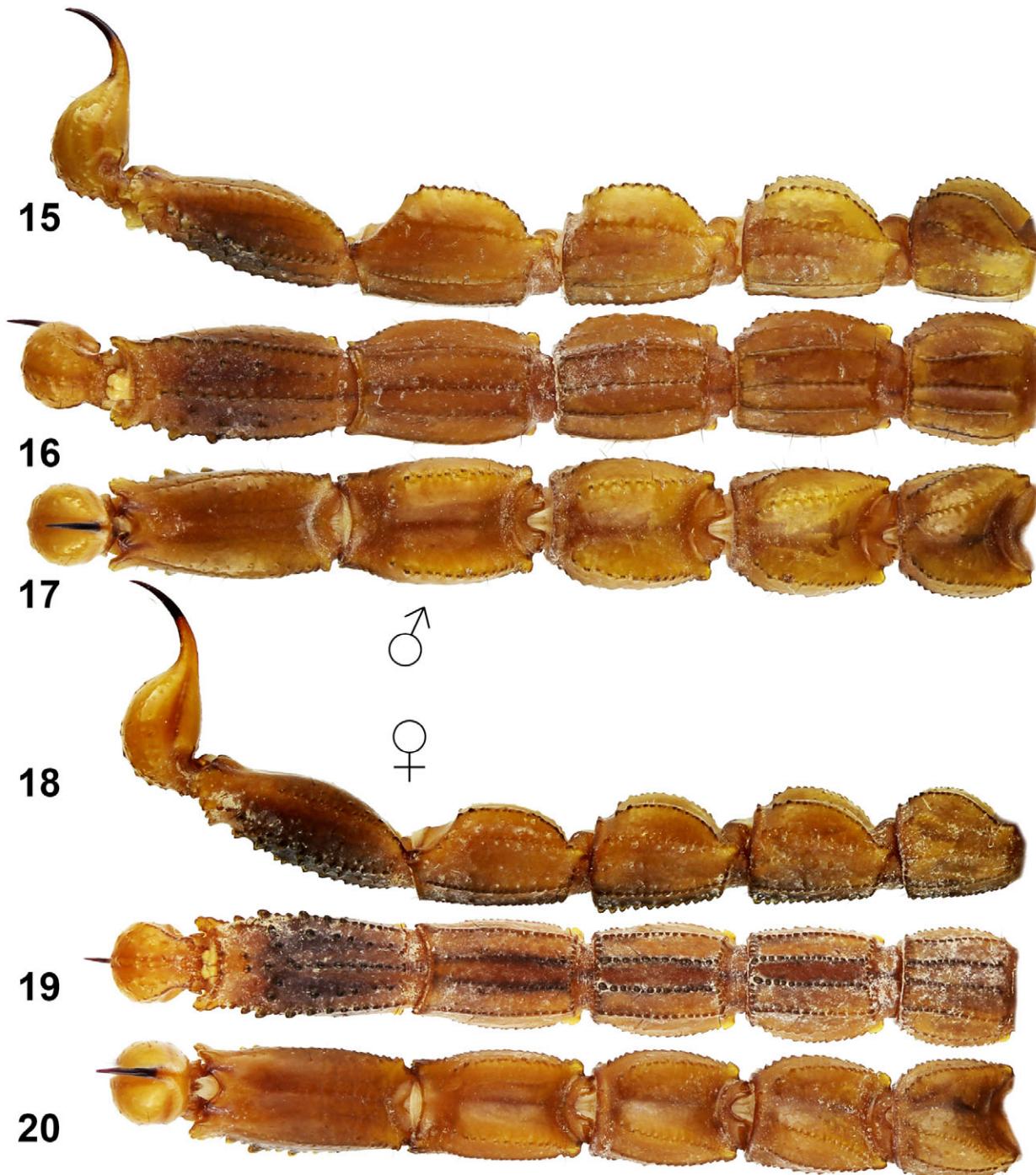
bination of four characters. “(I) Basal denticles of chelicera movable finger absent”. This is not accurate. Some denticles of chelicera are not absent but are not well developed what is typical for most of the studied juveniles of buthids including *Mesobuthus*. “(II) Absence of inner and outer accessory denticles on pedipalp chela fingers”. However, his own figure 2 (Lourenço, 2005: 112) shows some accessory denticles (granules). This character, as we have observed,



Figures 5–14: *Mesobuthus brutus* sp. n. **Figures 5, 7, 9–11.** Holotype male, chelicerae, carapace and tergites I–III (5), sternoplectal region and sternite III (7), pedipalp chela, dorsal (9) and external (10), pedipalp patella dorsal (11). The trichobothrial pattern is indicated in Figures 9–10. **Figures 6, 8, 12–14.** Paratype female, chelicerae, carapace and tergites I–III (6), sternoplectal region and sternite III (8), pedipalp chela, dorsal (12) and external (13), pedipalp patella dorsal (14).

has been misinterpreted by Lourenço. For example Lourenço (2006: 63) wrote: “Due the variability observed in the structure of fixed and movable finger dentition, *Buthacus mahraouii* shows very small ex-

ternal accessory granules which, possibly are not illustrated precisely in my figure”, and disputed validity of the character through “variability”. However, our study suggests that this character is applic-



Figures 15–20: *Mesobuthus brutus* sp. n. **Figures 15–17.** Holotype male, metasoma and telson, lateral (15), ventral (16), and dorsal (17) views. **Figures 18–20.** Paratype female, metasoma and telson, lateral (18), ventral (19), and dorsal (20) views.

able well for the adults but the accessory granules could be smaller or missing in juveniles. “(III) Sternum pentagonal”. This is not accurate. We can define it better as “sternum type 1 (Soleglad & Fet, 2003), various degrees of an irregular pentagon in shape” according to the photos located on the official

MNHN website and fig. 5 in Lourenço (2005: 112). Again we find no difference between *Afghanobuthus* and *Mesobuthus*. **“(IV) Small size”.** In reality the small size 27.3 mm of *Afghanobuthus naumannii* holotype justifies the fact that it is a juvenile of the species whose adults could be 55–85 mm long as

Mesobuthus parthorum inhabiting the same area in Afghanistan.

Apart from the above points, the holotype of *Afghanobuthus naumanni* and a juvenile of *Mesobuthus parthorum* (Fig. 321) match each other precisely in the following key characters: trichobothrial pattern, structure of sternum and genital operculum, pectinal tooth count and lamellar structure, proportions, setation, carination and sculpture of pedipalps, carapace, tergites, sternites, and metasoma, shape and armature of the telson, as well as armature of chelicerae and pedipalp fingers.

The inevitable conclusion is that *Afghanobuthus naumanni* Lourenço, 2005 is a junior synonym of *Mesobuthus parthorum* (Pocock, 1889).

***Mesobuthus brutus* sp. n.**

(Figs. 1–20, 183–188, 265, 274, 285–286, 304, Tables 1, 4–6)

<http://zoobank.org/urn:lsid:zoobank.org:act:7F438C98-0865-4542-B792-E23CB2D8A337>

TYPE LOCALITY AND TYPE REPOSITORY. **Iran**, Qazvin Province, Alamut (FKCP).

TYPE MATERIAL. **Iran**, Qazvin Province, Alamut, 36.44°N 50.59°E, 8 June 2012, 3♂ (holotype, Figs. 1–2, 5, 7, 9–11, 15–17, 183, 185–188, 265, 274, 285 and paratypes, Fig. 304) 2♂ juvs. (paratypes) (FKCP); Zanjan Province, Tarom, 36.95°N 48.9°E, 10 June 2012, 2♀ (paratypes, Figs. 3–4, 6, 8, 12–14, 18–20, 184, 286) (FKCP).

ETYMOLOGY. The species is named in honor of Brutus, the famous Czech rock musical group.

DISTRIBUTION. Iran (Figs. 328, A1).

DIAGNOSIS. Total length of adult males 50–61 mm, 60–62 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Male with fingers proximally more twisted than female. Pedipalp chela length/width ratio 3.13–3.15 in males and 3.58–3.65 in females. Pectinal teeth number 25–28 in males, 20–22 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Carapace and tergites yellowish brown, black pigmented; metasoma, telson, pedipalps and legs yellowish brown, only anterior part of metasomal segment V black. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela lacks carinae. Movable fingers of pedipalps with 13 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae are indicated by

incomplete row of denticles on metasomal segments II and III; fourth with 8 carinae; fifth with 5 carinae. All carinae granulated. Length to width ratio of fourth metasomal segment 1.53–1.57 in males, 1.48–1.62 in females. Telotarsus III ventral setation represented by short and strong spiniform setae. Pedal spur of legs with solitary setae only.

DESCRIPTION. The total length of adult males 50–61 mm, 60–62 females. Trichobothrium *db* on fixed finger of pedipalp is situated between trichobothria *est* and *esb*, near to *est*. Male has the fingers proximally a little more twisted than female. Female has longer and slightly narrower chela of pedipalps. Chelicerae yellow, without reticulation, the tips of teeth on cheliceral fingers are black. For measurements see tables 1 and 4–5.

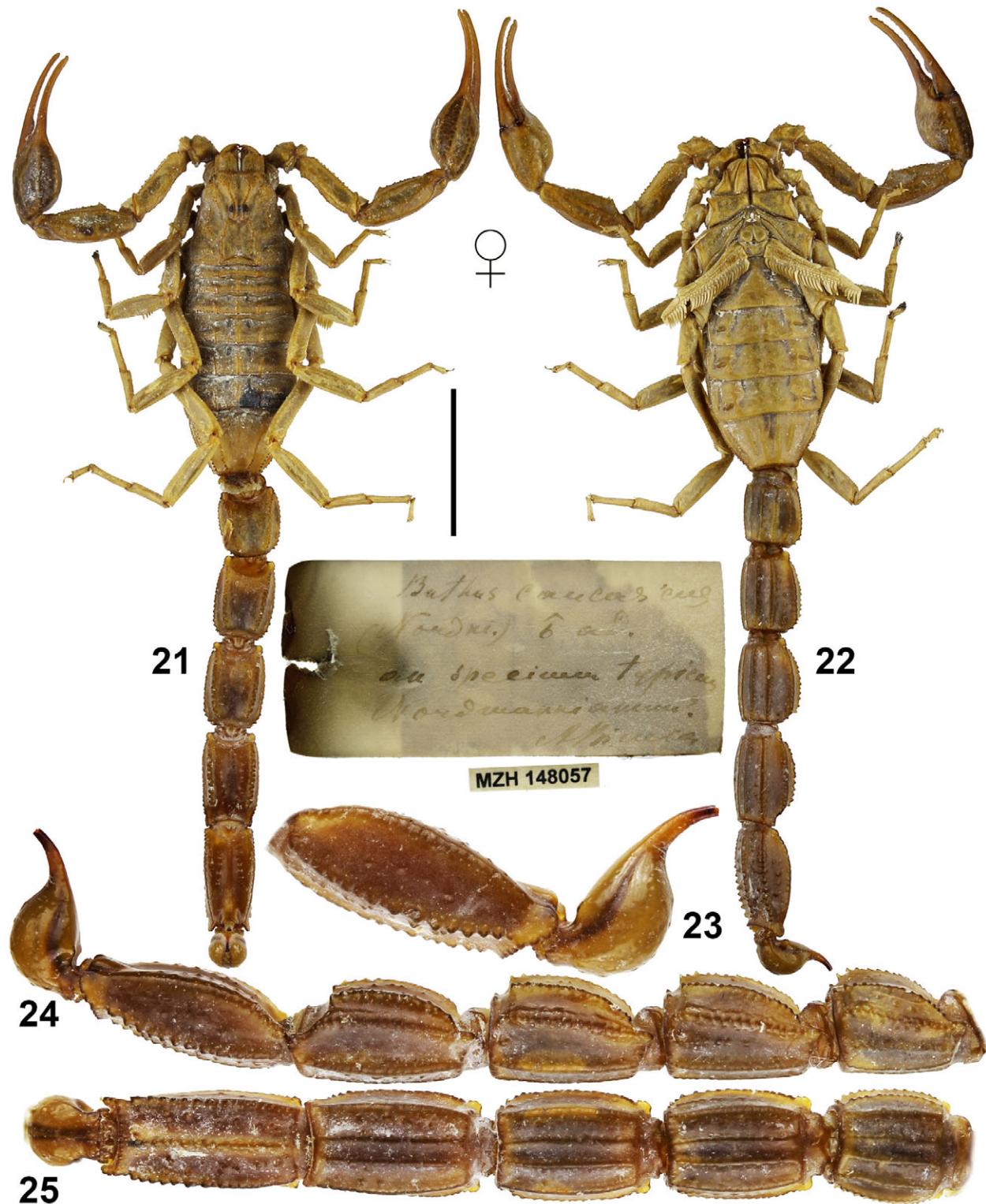
COLORATION (Figs. 1–4). The carapace and tergites are yellowish brown, strongly black pigmented. The metasoma, telson, pedipalps and legs are yellowish brown. The metasoma ventral, mainly segment V black pigmented.

MESOSOMA AND CARAPACE (Figs. 5–8). The carapace is carinate and unevenly covered by granules of varying size; much of the granulation is fine, but some granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 25–28 in males, 20–25 in females. The pectinal marginal tips extend to about end of the sixth sternite in males and third of the sixth sternite in females. The pectines have three marginal lamellae and sixth to eight middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth and sparsely hirsute. The seventh sternite bears four well marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 9–14). The pedipalps are sparsely hirsute and smooth. The femur bears four to five granulated carinae, the middle carina on internal surface could be incomplete indicated by several strong denticles. The patella bears eight carinae from which internal in both sexes and dorsal in females are granulated. The chela is without carinae. The movable fingers of pedipalps bear 13 cutting rows of denticles, every with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 185–188). The tarsomeres bear two rows of short and strong spiniform setae on the ventral surface and numerous macrosetae on the other surfaces. Pedal spur of legs with solitary setae only. Femur bears only several macrosetae. Femur and patella with carinae well developed. Tibial spurs present and long on third and fourth legs and absent in the other legs.

METASOMA AND TELSON (Figs. 15–20, 183–184). All metasomal segments are only very sparsely hirsute. The metasomal segment I with 10 carinae, II–III with 8 cari-



Figures 21–25: *Mesobuthus caucasicus*, holotype female. Dorsal (21) and ventral (22) views. Metasoma V and telson lateral (23), and metasoma and telson, lateral (24) and dorsal (25) views. The original labels are also included in the plate. Scale bar: 10 mm (21–22).

nae but other two latero median carinae are indicated by incomplete row of denticles, IV with 8 carinae, and V with 5 carinae. All carinae with consistent denticles, larger denticles are present in ventral carinae on segment I–III. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy or smooth with several solitary granules. Ventro-lateral carinae of metasomal segment V posteriorly with several large lobated denticles. The telson is only sparsely hirsute, rather elongate, bumpy and smooth.

NOTES.

Mesobuthus brutus sp. n. is the only species studied by us for which no DNA data are yet available, therefore we cannot place it into our phylogeny. The species is currently known only from the Elburz Mountains of the northern Iran, south from the Caspian Sea, a biogeographic transition zone between the Caucasus to the west (where *M. caucasicus* s.str is found) and the Kopetdagh Mts. to the east.

***Mesobuthus caucasicus* (Nordmann, 1840), s.str.**
(Figs. 21–41, 266, 275, 287–288, 305, 318, 322–323,
Tables 4–6)

Androctonus caucasicus Nordmann, 1840: 731, pl. 1,
fig. 2.

TYPE LOCALITY AND TYPE REPOSITORY. **Georgia**, Tbilisi Province, Tiflis (now Tbilisi); UZMH.

Synonyms:

Buthus caucasicus fischeri Birula, 1905: 121. Syntypes: **Russia**, Chechnya, Yevdokimovskoe (now Itum-Kali), 1 ♂, 1 ♀ (ZISP 104).

References (selected); see Fet (1989) and Fet & Lowe (2000) for a full list before 1998:

Buthus caucasicus sbsp. *typica* forma α *typica*: Birula, 1897: 385.

Buthus caucasicus caucasicus: Birula, 1904b: 38.

Buthus caucasicus caucasicus: Birula, 1917: 59, figs. 3–4; Vachon, 1958: 150.

Buthus caucasicus: Balashov, 1973: 714.

Mesobuthus caucasicus caucasicus: Fet, 1989: 100.

Mesobuthus caucasicus: Fet, 1998: 14; Karatas, 2005: 1; Fet, 2010: 4; Mirshamsi et al., 2011a: 19 (in part); Navidpour, 2015: 12 (in part?).

Olivierus caucasicus caucasicus: Fet & Lowe, 2000: 190.

DISTRIBUTION. Armenia, Azerbaijan, Georgia, Iran, Russia (northern Caucasus), Turkey, Ukraine (native?) (Figs. 328, A2).

TYPE MATERIAL EXAMINED. **Georgia**, Tbilisi Province, Tiflis (now Tbilisi), 41.717°N, 44.78°E, 1 ♀ (holotype,

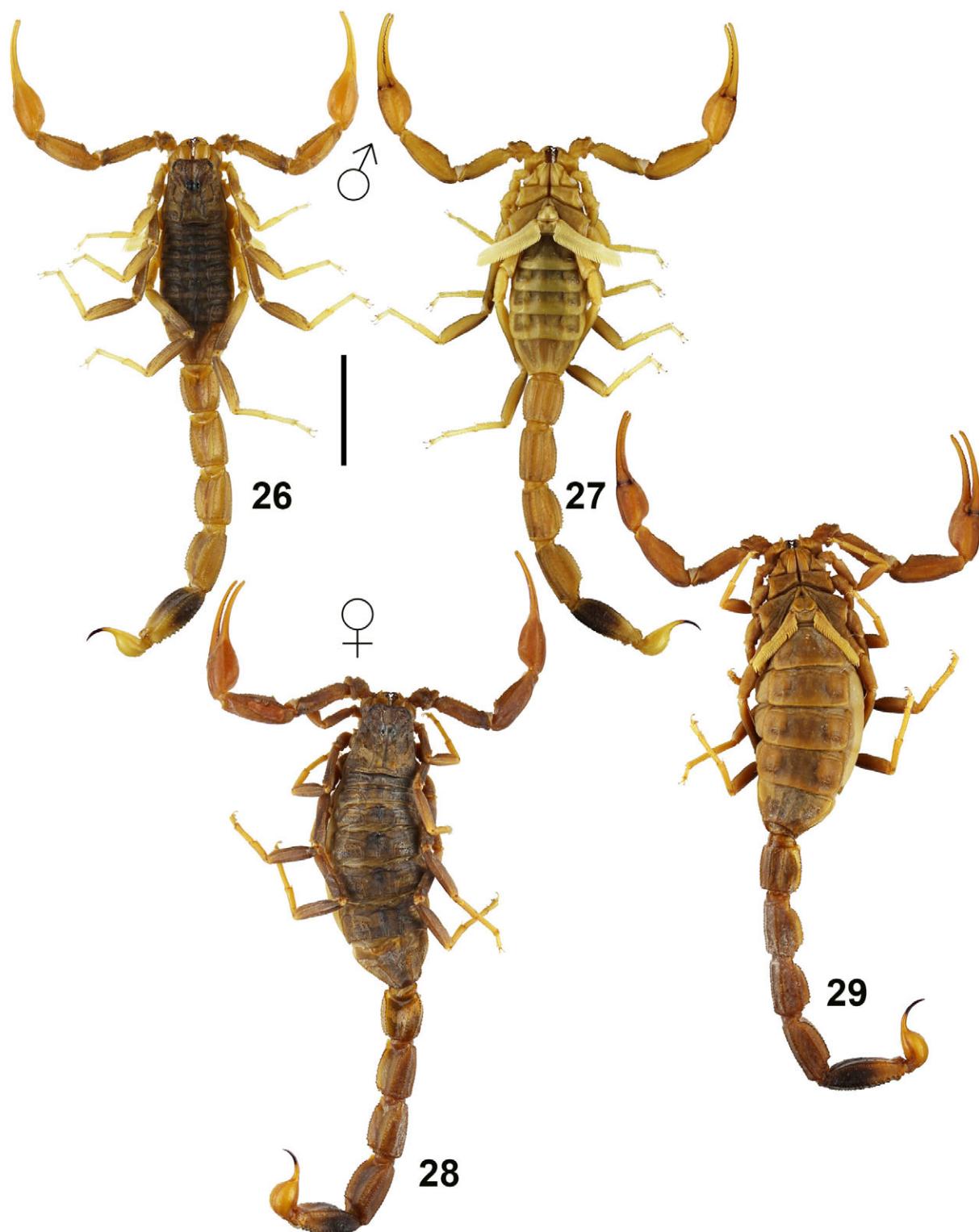
Figs. 21–25), UZMH No. MZH 148057 (redescribed by Birula, 1917: 68; examined.)

OTHER MATERIAL STUDIED. **Iran**, West Azerbaijan Province, 5 km E of Maku, 39.28°N 44.6167°E, 1060 (1100) m a.s.l., 30 April 1997, 1 ♂ juv. (Fig. 318) 1 ♀ juv., leg. M. Kaftan (FKCP); Bastam, 38.91°N 44.99°E, 1270 m a.s.l., 1 ♂ 1 ♀, 30 September – 1 October 1998, leg. P. Kabátek & M. Kaftan (FKCP). **Turkey**, 1 ♀ without precise locality, May 1981, leg. Jarroz (FKCP); İğdir Province, Karakoyunlu District, Gürgen Village, 39.90°N 44.30°E, 889 m a.s.l., 15 May 2012, 2 ♀ (Figs. 28–29, 31, 33, 35, 39–41, 275, 288), leg. H. Koç (FKCP); İğdir Province, Melekli Village, 39.9181°N 44.1263°E, 897 m a.s.l. (Figs. 322–323), 7 July 2012, 1 ♂ (Figs. 26–27, 30, 32, 34, 36–38, 266, 287, 305) 2 ♀, leg. E. A. Yağmur (FKCP).

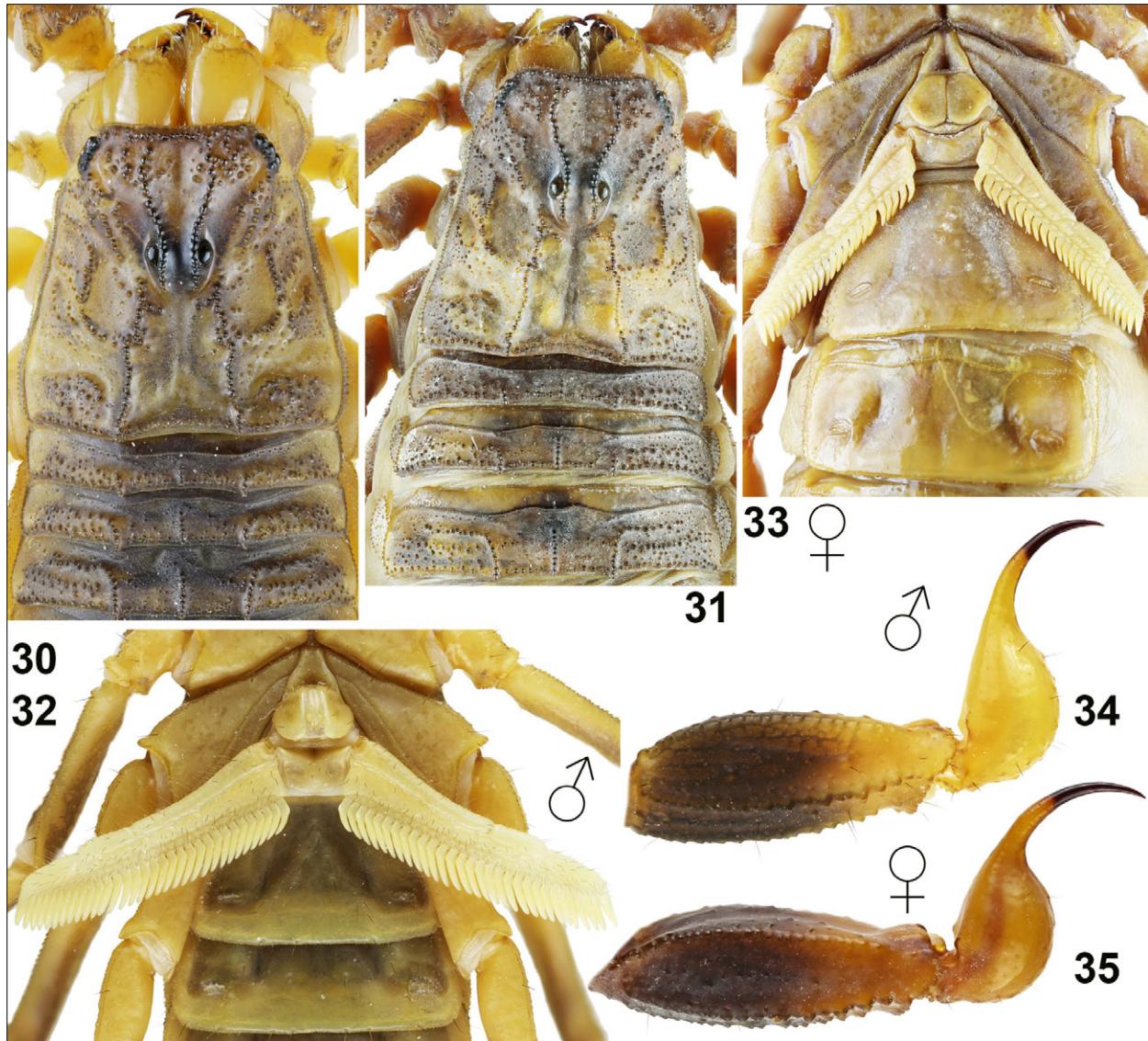
DIAGNOSIS. Total length of adult males 50–55 mm, 58–75 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Male with fingers proximally little more twisted than female. Pedipalp chela length/ width ratio 3.43–3.62 in males and 3.39–3.94 in females. Pectinal teeth number 28–32 in males, 22–25 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Carapace and tergites yellowish brown, black pigmented; metasoma, telson, pedipalps and legs yellowish brown, only anterior part of metasomal segment V black. Femur of pedipalp with 5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela lacks carinae. Movable fingers of pedipalps with 12–13 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae on metasomal segment II could be indicated by several denticles posteriorly; fifth with 5 carinae. All carinae with denticles, dorsal carinae bear larger and sharp terminal denticles. Length to width ratio of fourth metasomal segment 1.73–1.86 in males, 1.70–1.81 in females. Telo-tarsus III ventral setation represented by longer setae in two rows, each containing not more than 15 setae. Pedal spur of legs clearly with solitary setae only.

NOTES.

1. The original description of Nordmann (1840) is extremely brief but the species is easily recognizable. The holotype female exists in the University of Helsinki Zoological Museum, Finland (UZMH), and was examined by us through a kind loan by Pedro Cardoso. The first detailed description was made by Birula (1897: 385–386) based on a specimen from Aralych, now Aralik in İğdir Province, Turkey (39.8667°N, 44.5167°E) (Karataş, 2005). Later, Bir-



Figures 26–29: *Mesobuthus caucasicus*. **Figures 26–27.** Male from Melekli, Turkey, dorsal (26) and ventral (27) views. **Figures 28–29.** Female from Melekli, Turkey, dorsal (28) and ventral (29) views. Scale bar: 10 mm.



Figures 30–35: *Mesobuthus caucasicus*. **Figures 30, 32, 34.** Male from Melekli, Turkey, chelicerae, carapace and tergites I–III (30), sternopectinal region and sternites III–IV (32), metasoma V and telson lateral (34). **Figures 31, 33, 35.** Female from Melekli, Turkey, chelicerae, carapace and tergites I–III (31), sternopectinal region and sternites III–IV (33), metasoma V and telson lateral (35).

ula studied Nordmann's type; full description of the Caucasus form was published by Birula (1917).

2. A considerable confusion surrounded the priority authorship and name spelling (*Scorpio caucasicus* Fischer versus *S. caucasicus* Nordmann); for details see Fet (1998), Fet & Lowe (2000).

3. Our map includes material from Georgia, Iran, and Turkey mentioned in this paper as well as a number of additional localities from Fet (1989). See Fet (1989) for a detailed list of Caucasian populations within modern boundaries of Azerbaijan, Armenia, Georgia,

and Russia. Further, detailed work on these populations is needed; no DNA data exists except of our data from Turkey.

4. Distribution in Iran has been listed as Azerbaijan, Esfahan, Khorasan, Markazi, Semnan, Sistan & Baluchistan, and Tehran Provinces (Mirshamsi et al., 2011a) and remains to be further verified. See also *M. brutus* sp.n. and *M. parthorum*.

5. A single, isolated population from Ukraine is confirmed for Odessa Province (Severinivka, 46.8272°N, 30.5805°E; Balashov, 1973; Fet, 1989); it is un-



Figures 36–41: *Mesobuthus caucasicus*. **Figures 36–38.** Male from Melekli, Turkey, metasoma and telson, lateral (36), ventral (37), and dorsal (38) views. **Figures 39–41.** Female from Melekli, Turkey, metasoma and telson, lateral (39), ventral (40), and dorsal (41) views.

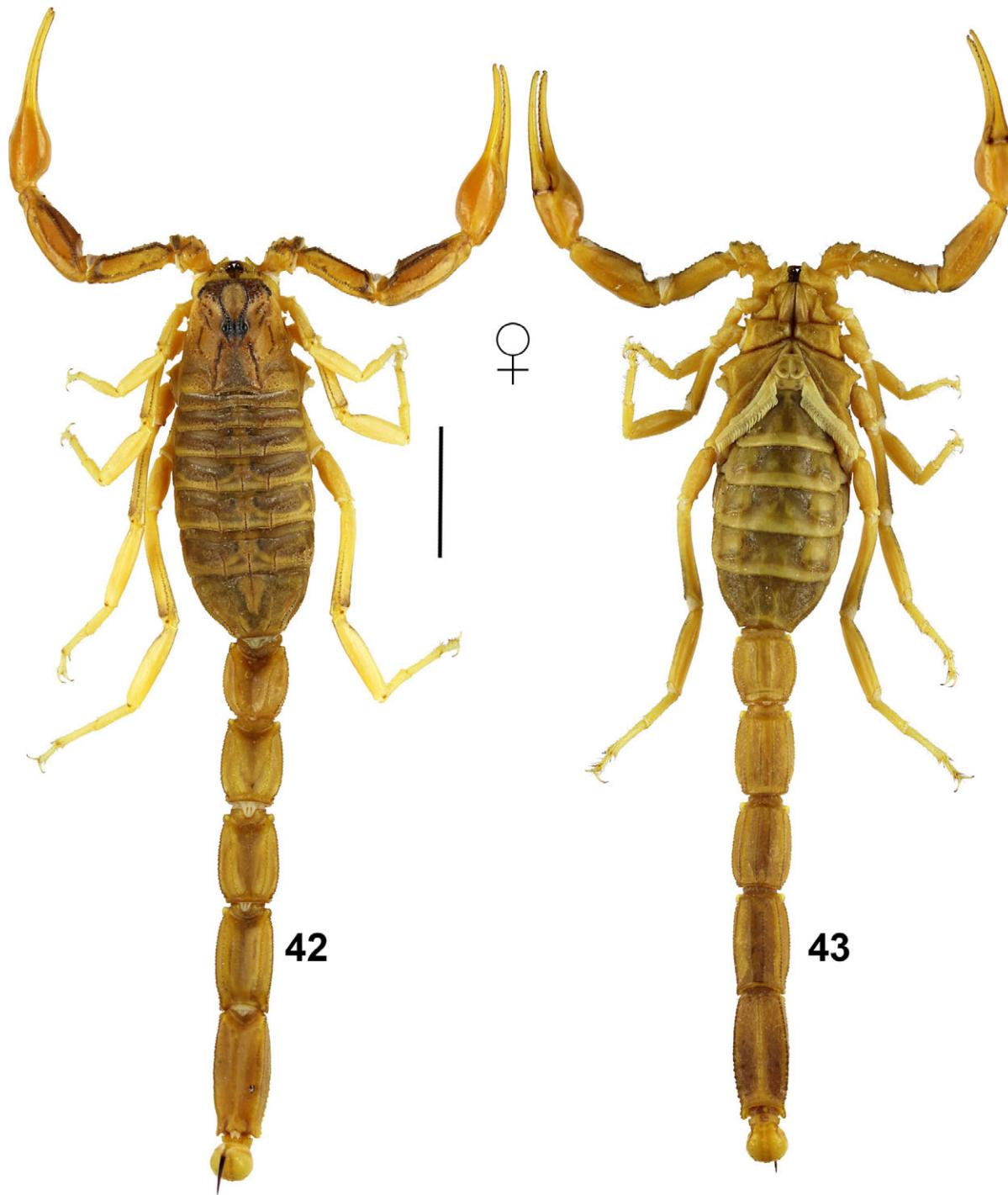
clear whether it is relict or introduced. A record from Kherson Province (Fet, 1989) is based only on pers. com. of Nikolai Vasilyev to VF in the 1980s; no material is known.

6. Within the material of this revision, no subspecies are currently recognized for *M. caucasicus*; but see a note below on *M. "caucasicus" przewalskii* (Birula, 1897).

Mesobuthus elenae sp. n.

(Figs. 42–62, 276, 289, 306, 319, Tables 1, 5–6)
<http://zoobank.org/urn:lsid:zoobank.org:act:A3712442-855C-4175-9BEE-6745C416DC61>

TYPE LOCALITY AND TYPE REPOSITORY. **Uzbekistan**, Surxondaryo Province, Angor District, Kattakum Sands, ca. 4 km NE of Uchkyzyl; FKCP.



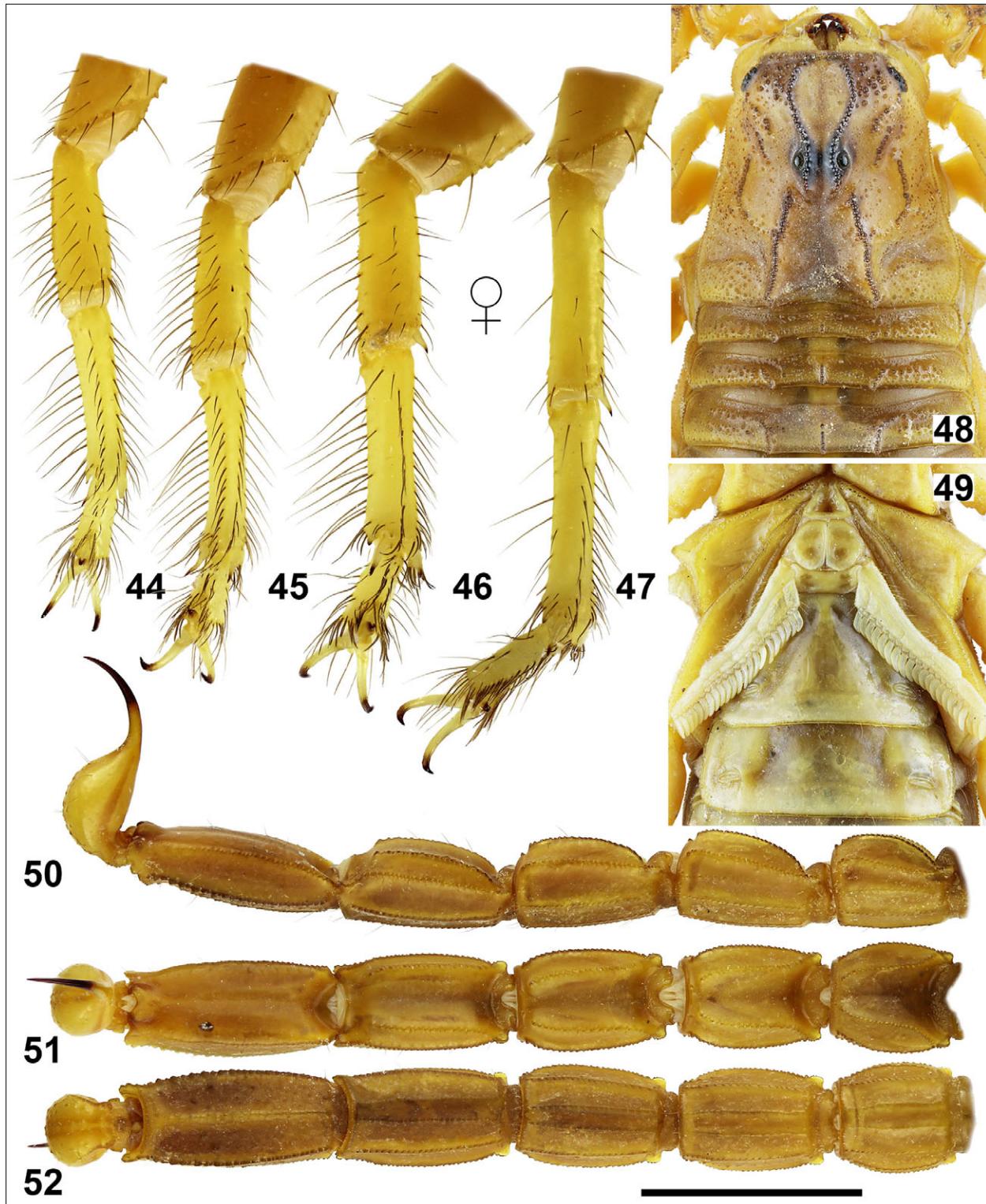
Figures 42–43: *Mesobuthus elenae* sp. n., holotype female, dorsal (42) and ventral (43) views. Scale bar: 10 mm.

REFERENCES:

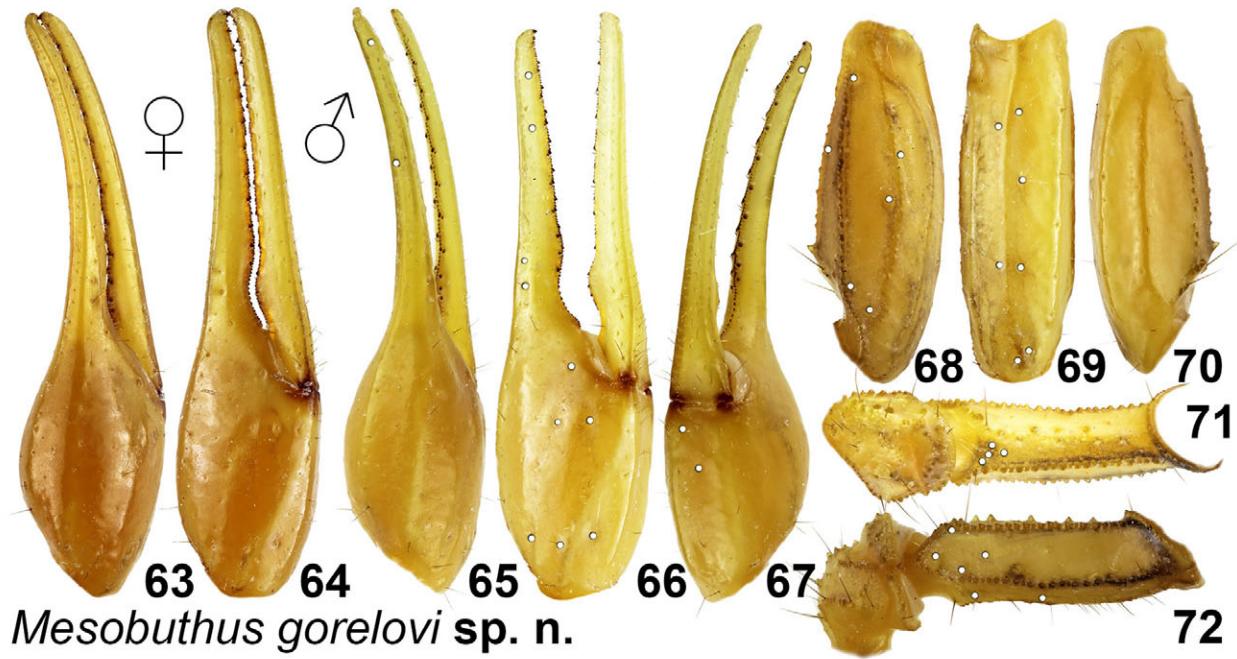
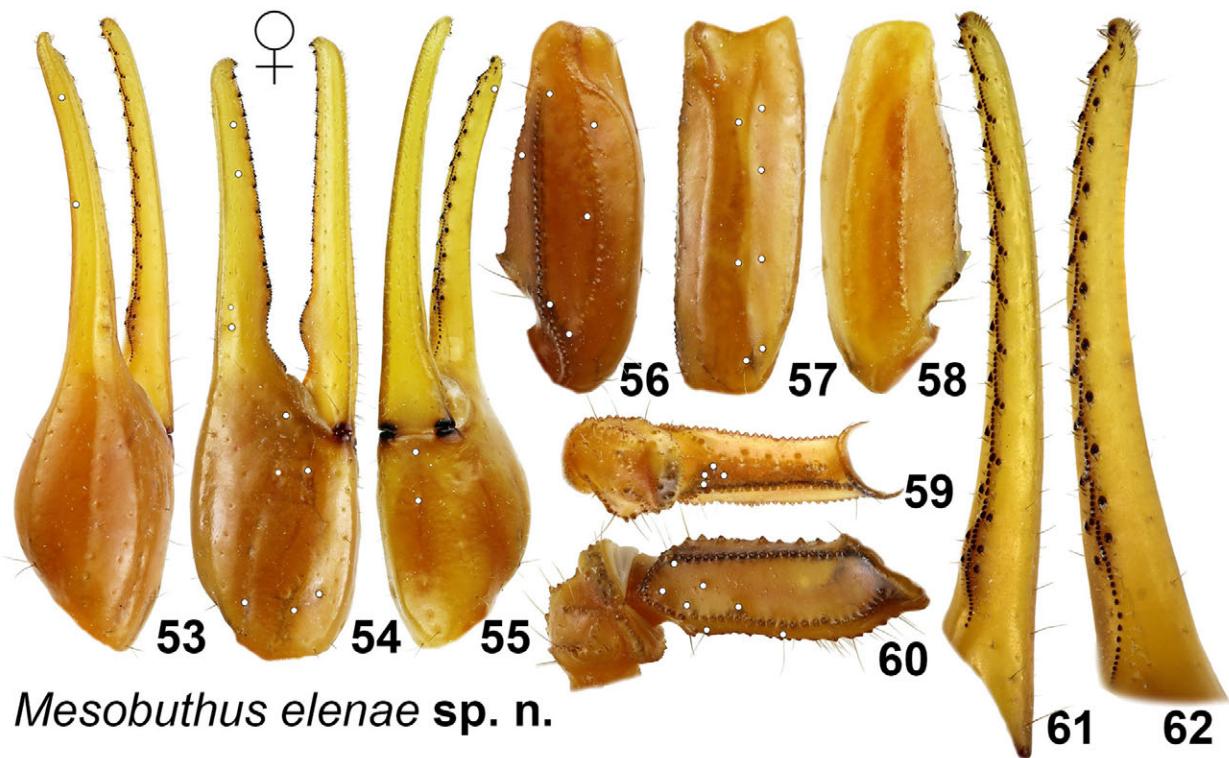
Mesobuthus caucasicus parthorum (nec Pocock, 1889): Fet, 1989: 107 (in part; Jarkurgan; Termez).

Mesobuthus caucasicus (nec Nordmann, 1840): Gantenbein et al., 2003: 413 (in part; Jarkurgan).

ETYMOLOGY. The species is named in honor of Elena Kreuzberg-Mukhina (Ottawa, Canada), a prominent ornithologist and conservationist whose decades of field work were devoted to the Uzbekistan deserts and mountains.



Figures 44–52: *Mesobuthus elenae* sp. n., holotype female, left legs I–IV, retrolateral aspect (44–47), chelicerae, carapace and tergites I–III (48), sternopectinal region and sternites III–IV (49), metasoma and telson, lateral (50), dorsal (51) and ventral (52) views. Scale bar: 10 mm (50–52).



Figures 53–72: Figures 53–62: *Mesobuthus elenae* sp. n., holotype female, pedipalp chela, dorsal (53), external (54), and ventral (55) views. Pedipalp patella, dorsal (56), external (57) and ventral (58) views. Pedipalp femur and trochanter, internal (59) and dorsal (60) views. Movable (61) and fixed (62) fingers. The trichobothrial pattern is indicated in Figures 53–57, 59–60. Figures 63–72: *Mesobuthus gorelovi* sp. n. **Figures 63–64:** Paratype female from Repetek, Turkmenistan. Pedipalp chela, dorsal (63), and external (64) views. **Figures 65–72:** Holotype male. Pedipalp chela, dorsal (65), external (66), and ventral (67) views. Pedipalp patella, dorsal (68), external (69) and ventral (70) views. Pedipalp femur and trochanter, internal (71) and dorsal (72) views. The trichobothrial pattern is indicated in Figures 65–69, 71–72.

DISTRIBUTION. Tajikistan, Uzbekistan (Figs. 328, A3).

TYPE MATERIAL. **Tajikistan**, Khatlon Province, Haartuz District, Kurjalakum Sands, 37.1352°N 68.1577°E, 2 May 2002, 1♀ 2juvs. (♂♀) (paratypes), leg. A. Feodorov (NMPC). **Uzbekistan**, Surxondaryo Province, Angor District, Kattakum Sands, ca. 4 km NE of Uchkyzyl, 37.3722°N 67.2730°E, 28 April 2002, 2♀ (holotype, Figs. 42–62, 276, 289, 306, and paratype) 2juvs. (♂♀, paratypes), leg. VF & AG (FKCP).

OTHER MATERIAL STUDIED. **Uzbekistan**, Surxondaryo Province, Jarkurgan District, ca. 3 km W of Jarkurgan, 37.5055°N 67.3688°E, 365 m a.s.l., 26 April 2002, 1juv., leg. VF & AG (VFPC).

DIAGNOSIS. Total length of adult females 74–80, adult male unknown. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Female with fingers proximally little twisted. Pedipalp chela length/ width ratio 3.54–4.11 in females. Pectinal teeth number 25–27 in males, 21–22 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly white to yellowish brown, black pigmented mainly dorsolateral carinae on pedipalp femur and patella. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela with smooth carinae indicated. Movable fingers of pedipalps with 12 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae on metasomal segment II could be indicated by several denticles posteriorly; fifth with 5 carinae. Dorsal carinae on metasomal segments I–IV composed of consistent small blunt denticles. Length to width ratio of fourth metasomal segment 1.70–1.80 in females. Telotarsus III ventral setation in two rows, each containing more than 16 long setae. Pedal spur of legs densely hirsute.

DESCRIPTION. The total length of adult females 74–80, adult male unknown. Trichobothrium *db* on fixed finger of pedipalp is situated between trichobothria *est* and *esb*, near to *est*. Female has the fingers proximally a little twisted. Chelicerae yellow, without reticulation, the tips of teeth on cheliceral fingers are black. For the position and distribution of trichobothria see Figs. 53–57, 59–60. For measurements see Tables 1 and 5.

COLORATION (Figs. 42–43). The color uniformly white to yellowish brown, black pigmented mainly dorsolateral carinae on pedipalp femur and patella. The black pigment indicated also in ventral surface of metasoma and femur of legs.

MESOSOMA AND CARAPACE (Figs. 48–49). The carapace is carinate and unevenly covered by granules of varying

size; much of the granulation is fine, but some granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 25–27 in males, 21–23 in females. The pectinal marginal tips extend to about half of the fourth sternite in females. The pectines have three marginal lamellae and six to eight middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth and sparsely hirsute. The seventh sternite bears four well marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 53–62). The pedipalps are sparsely hirsute and smooth. The femur bears four to five granulated carinae, the middle carina on internal surface could be incomplete indicated by several strong denticles. The patella bears eight carinae from which internal and dorsal are granulated in females. The chela is smooth but carinae are indicated. The movable fingers of pedipalps bear 12 cutting rows of denticles, every with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 44–47). The tarsomeres bear two rows of long setae on the ventral surface and numerous macrosetae on the other surfaces. Ventral setation of tarsomere II (telotarsus) in two rows which every contains more than 16 long setae. Pedal spur of legs densely hirsute. Femur bears only several macrosetae. Femur and patella with carinae well developed. Tibial spurs present and moderate on third and fourth legs and absent in the other legs.

METASOMA AND TELSON (Figs. 50–52). All metasomal segments are only very sparsely hirsute. The metasomal segment I with 10 carinae, II with 8 carinae but other two lateromedian carinae are indicated by incomplete row of denticles, III–IV with 8 carinae, and V with 5 carinae. All carinae granulated, dorsal carinae on metasomal segments I–IV composed from consistent small blunt denticles. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy with several solitary granules. Ventrolateral carinae of metasomal segment V posteriorly with several large denticles. The telson is only sparsely hirsute, rather elongate, bumpy and smooth.

***Mesobuthus fuscus* (Birula, 1897), stat. n.**
(Figs. 73–96, 268, 278, 290–291, 308, 324–325, Tables 4–6)

Buthus fuscus Birula, 1897: 388.

TYPE LOCALITY AND TYPE REPOSITORY. **Tajikistan**, Hisor District, Hisor; ZISP.

REFERENCES (selected); see Fet (1989) and Fet & Lowe (2000) for full list before 1998:

		<i>M. elenae</i> sp. n.	<i>M. brutus</i> sp. n.	
Dimensions (mm)		♀ holotype	♂ holotype	♀ paratype
Carapace	L / W	8.60 / 9.05	6.20 / 7.65	6.65 / 7.80
Mesosoma	L	19.20	17.10	17.8
Tergite VII	L / W	5.20 / 8.90	4.33 / 6.75	4.30 / 7.65
Metasoma & telson	L	46.52	37.78	35.85
Segment I	L / W / D	5.70 / 5.20 / 4.45	4.65 / 4.75 / 4.10	4.25 / 4.25 / 3.80
Segment II	L / W / D	6.70 / 4.68 / 4.25	5.70 / 4.60 / 4.25	5.10 / 4.15 / 3.90
Segment III	L / W / D	7.20 / 4.60 / 4.20	5.95 / 4.65 / 4.65	5.30 / 4.10 / 3.90
Segment IV	L / W / D	7.82 / 4.60 / 3.86	6.88 / 4.50 / 4.35	6.15 / 3.80 / 3.50
Segment V	L / W / D	9.70 / 4.25 / 3.40	7.85 / 3.85 / 3.38	7.75 / 3.55 / 3.20
Telson	L / W / D	9.40 / 3.45 / 3.10	6.75 / 2.95 / 2.80	7.30 / 3.00 / 2.85
Pedipalp	L	29.95	23.30	22.95
Femur	L / W	7.10 / 2.26	5.65 / 1.70	5.60 / 1.90
Patella	L / W	8.70 / 3.25	6.85 / 2.60	6.75 / 2.75
Chela	L	14.15	10.80	10.60
Manus	L / W / D	4.65 / 3.65 / 3.70	3.95 / 3.45 / 3.15	3.25 / 2.90 / 2.93
Movable finger	L	9.50	6.85	7.35
Total	L	74.32	61.08	60.30

Table 1: Comparative measurements of adults of *Mesobuthus elenae* sp. n. and *M. brutus* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

Buthus caucasicus fuscus: Birula, 1904a: 23; Birula, 1904b: 31.

Mesobuthus caucasicus fuscus: Vachon, 1958: 150; Fet, 1989: 112.

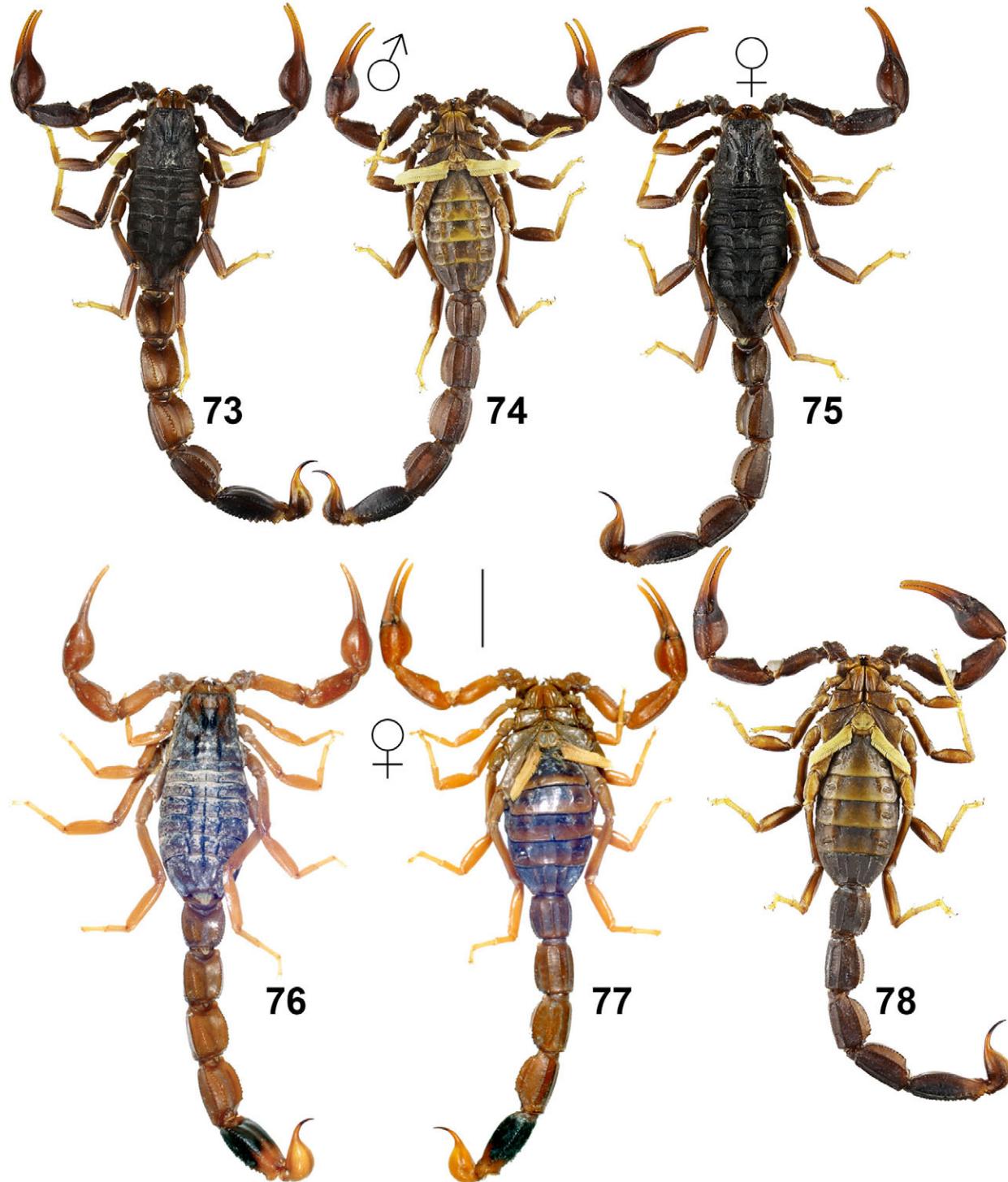
Olivierus caucasicus fuscus: Fet & Lowe, 2000: 191.

DISTRIBUTION. Tajikistan, Uzbekistan (Figs. 328, A4).

TYPE MATERIAL. Syntypes of *Buthus fuscus* Birula, 1897: **Tajikistan**, Hisor District, Hisor (=Gissar), 38.5264°N 68.5381°E, 1887, leg. S. A. Lidsky, 1♀ (ZISP 532); **Uzbekistan**, Tashkent Province, Bostanlyk District, Iskandar (=Iskanderaryk), 1887, leg. S. Lidsky, 2♀ (ZISP 533) (not examined).

MATERIAL EXAMINED. **Tajikistan**, Khatlon Province, Dangara District, E slope of Sanglogh Mt. Range, Kol-kot Kishlak env., 38.2581°N, 069.2512°E, 1346 m a.s.l., 30 April 2015, 5juvs. (♂♀♂), leg. Y. M. Marusik

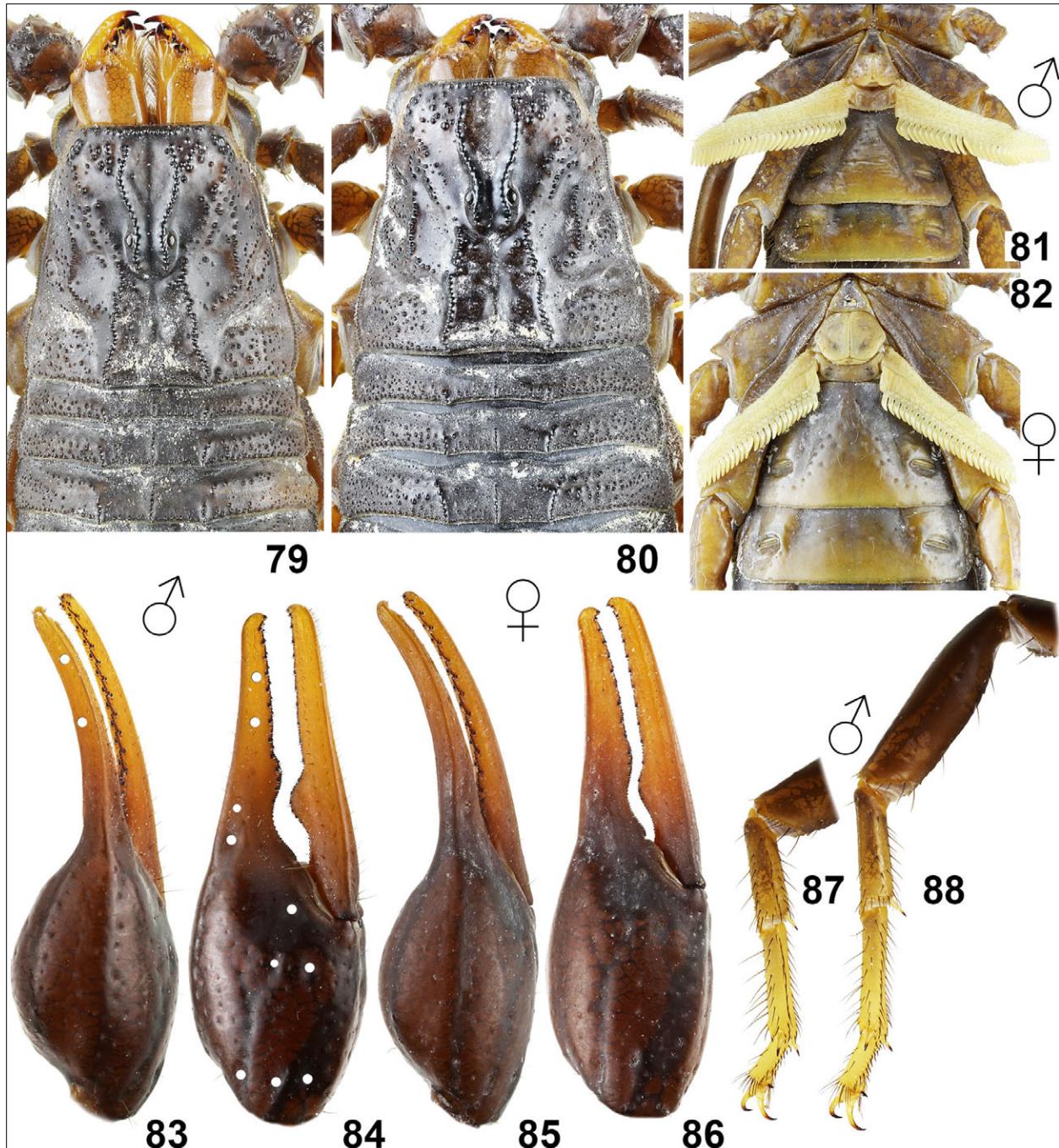
(ZMUM); **Khatlon Province**, Hissar (Gissar) Mts., Ramit Reserve, Darai-Kholmon creek gorge, 38.7561°N 69.3048°E, 1370 m a.s.l., 2 May 2015, 6juvs., leg. Y. M. Marusik (FKCP); **Khatlon Province**, Khodja-Abdukirim District, 38.023°N 68.9461°E, 1♀2juvs. (♂♀), 2 May 2002, leg. A. Feodorov (ZMUM); **Khatlon Province**, Shaartuz District, Babataq Mts., 37.0758°N 68.0196°E, 427 m a.s.l., 20 April 2015, 3juvs., leg. Y. M. Marusik (ZMUM); **Khatlon Province**, Khuroson District, Gan-jina, 37.5830°N 68.5589°E, 1♀juv., 2002, leg. A. Feodorov (ZMUM); **Khatlon Province**, Khuroson District, Ganjina, 37.9617°N 68.5619°E, 716 m a.s.l. (Figs. 324–325), 22 April 2015, 1♂4♀6juvs. (Figs. 73–96, 264, 274, 288–289, 304, both color varieties), leg. Y. M. Marusik (FKCP); **Khatlon Province**, Vakhsh Karatau Mt. Range, Khodjamaston Mt., 38.0042°N 68.9740°E, 1595 m a.s.l., 24 April 2015, 1♀juv., leg. Y. M. Marusik (ZMUM); **Khatlon Province**, Shaartuz District, near Pyandj Town, 37.2125°N 69.1925°E, 387 m a.s.l., 5



Figures 73–78: *Mesobuthus fuscus* from Ganjina, Tajikistan. **Figures 73–74.** Male, dorsal (73) and ventral (74) views. **Figures 75–78.** Two differently colored females, dorsal (75–76) and ventral (77–78) views. Scale bar: 10 mm.

May 2015, 1♀juv., leg. Y. M. Marusik (ZMUM); *Varzob District*, Dagana, 38.34°N 68.99° E, May 1988, 2♀, leg. Křížek (FKCP); *Varzob District*, Varzob Valley,

surroundings of Varzob Lake, meadow, *Artemisia*, 38.67°N 68.7897° E, 985 m a.s.l., 3 May 2015, 1♀2♀ juvs., leg. Y. M. Marusik (NMPC); *Khatlon Province*,



Figures 79–88: *Mesobuthus fuscus* from Ganjina, Tajikistan. **Figures 79, 81, 83–84, 87–88.** Male, chelicerae, carapace and tergites I–III (79), sternoplectinal region and sternites III–IV (81), pedipalp chela, dorsal (83), and external (84) views, left legs III–IV, retrolateral aspect (87–88). The trichobothrial pattern is indicated in Figures 83–84. **Figures 80, 82, 85–86.** Female, chelicerae, carapace and tergites I–III (80), sternoplectinal region and sternites III–IV (82), pedipalp chela, dorsal (85), and external (86) views.

April 2015, 3juvs., leg. R. V. Yakovlev (NMPC). **Uzbekistan**, Surxondaryo-Rabot, 2016, 1♀, leg. A. Ullrich (FKCP).

DIAGNOSIS. Total length of adult male 70 mm, 74–80 females. Trichobothrium *db* on fixed finger of pedipalp

situated between trichobothria *est* and *esb*, near to *est*. Male with fingers proximally little more twisted than female. Pedipalp chela length/ width ratio 2.84 in males and 3.13–3.40 in females. Pectinal teeth number 26–29 in males, 21–25 in females. Pedipalp chela with longer manus and short fixed finger in male. Chelicerae yellow,



Figures 89–96: *Mesobuthus fuscus* from Ganjina, Tajikistan. **Figures 89, 91–93.** Male metasoma V and telson lateral (89), and metasoma and telson, lateral (91), ventral (92), and dorsal (93) views. **Figures 90, 94–96.** Female metasoma V and telson lateral (90), and metasoma and telson, lateral (94), ventral (95), and dorsal (96) views. Scale bars: 10 mm.

with reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, black pigmented metasomal segment V or uniformly blackish brown (melanic form). Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela lacks carinae or carinae could be smooth indicated. Movable fingers of pedipalps with 13–14 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae are indicated by incomplete row of denticles; fourth with 8 carinae; fifth with 5 carinae. All carinae granulated, dorsal carinae bear slightly larger terminal denticles. Length to width ratio of fourth metasomal segment 1.52 in male, 1.61–1.63 in females. Telotarsus III ventral setation represented by short and strong spiniform setae. Pedal spur of legs with solitary setae only.

NOTES.

1. *Buthus fuscus* has not been collected or studied since its description in 1897. Birula's description was based on females only. A brief Latin diagnosis given by Birula (1897: 12–13) says that the species resembles *B. c. intermedius* but differs by dark body color ("fusco vel fumigato"); carapace anterior margin moderately invaginated "nec non granulorum serie regulariter limbato", all intercarinal surfaces "opacis profunde impressis costisque elevatis ac valde expressis," posterior corners "subseriate" granulated. Pedipalp femur "supra laevi", movable finger with 18 series (9 granules each). Pectines 20–21. Female measured was 67 mm, carapace 7.5 mm long. In a brief German text following the Latin diagnosis, Birula said (1897: 13): "This scorpion possibly is only a local variety of *Buthus caucasicus* (Nord.), which is easily distinguished from the first glance by its dark coloration of the entire body (including extremities) and by outstandingly short and thick metasoma, and also by the deeply impressed, smooth intercarinal surfaces on the carapace and wide, nearly square first metasomal segment."

2. Syntypes of *M. fuscus* were collected by S. A. Lidsky in 1887. The Hisor (=Gissar) locality fits the collections made in his 1887 expedition in Buchara (Lidsky, 1888), and is close to Tajikistan localities studied by us. Iskanderaryk (literally, "Alexander's Canal", now Iskandar) was an irrigation canal and estate off Chirchik River built by the Grand Duke Nikolay Konstantinovich Romanov (1850–1918), self-exiled to Tashkent, who lived under the name of Prince Iskander. The identity of this syntype has to be confirmed.

3. A melanic form (phenotype) of *M. fuscus*, unique for the genus, is found in Ganjina, Tajikistan sympatric with the non-melanic form. Their DNA sequence is identical (Fig. 329, Tab. 7).

Mesobuthus gorelovi sp. n.

(Figs. 63–72, 97–114, 267, 277, 292–293, 307, 326, Tables 2, 4–6)

<http://zoobank.org/urn:lsid:zoobank.org:act:F61979C-B-33C0-4B76-B75C-A155EB309205>

TYPE LOCALITY AND TYPE REPOSITORY. **Turkmenistan:** Akhal Province, Tejen District, near Tejen Reservoir, ca. 12 km SSE of Gangaly, 36.92°N 60.83°E, 235 m a.s.l.; FKCP.

REFERENCES (selected); see Fet (1989) and Fet & Lowe (2000) for full list before 1998:

Buthus caucasicus sbsp. *typica forma β parthorum* (nec Pocock, 1889): Birula, 1897: 386 (in part).

Buthus caucasicus parthorum (nec Pocock, 1889): Birula, 1904b: 31 (in part); Birula, 1911: 16 (in part).

Buthus caucasicus parthorum (nec Pocock, 1889): Birula, 1917: 71 (in part).

Buthus caucasicus (nec Nordmann, 1840): Kaplin, 1978: 32.

Mesobuthus caucasicus parthorum (nec Pocock, 1889): Fet, 1980: 224; Fet, 1989: 104–107 (in part); Fet, 1994: 528 (in part); Gromov & Kopdykbaev, 1994: 20.

Mesobuthus caucasicus intermedius (nec Birula, 1897): Gromov & Kopdykbaev, 1994: 20; Sun & Zhu, 2010: 3, figs. 2, 11–13; Sun & Sun, 2011: 61, figs. 3–4, 10.

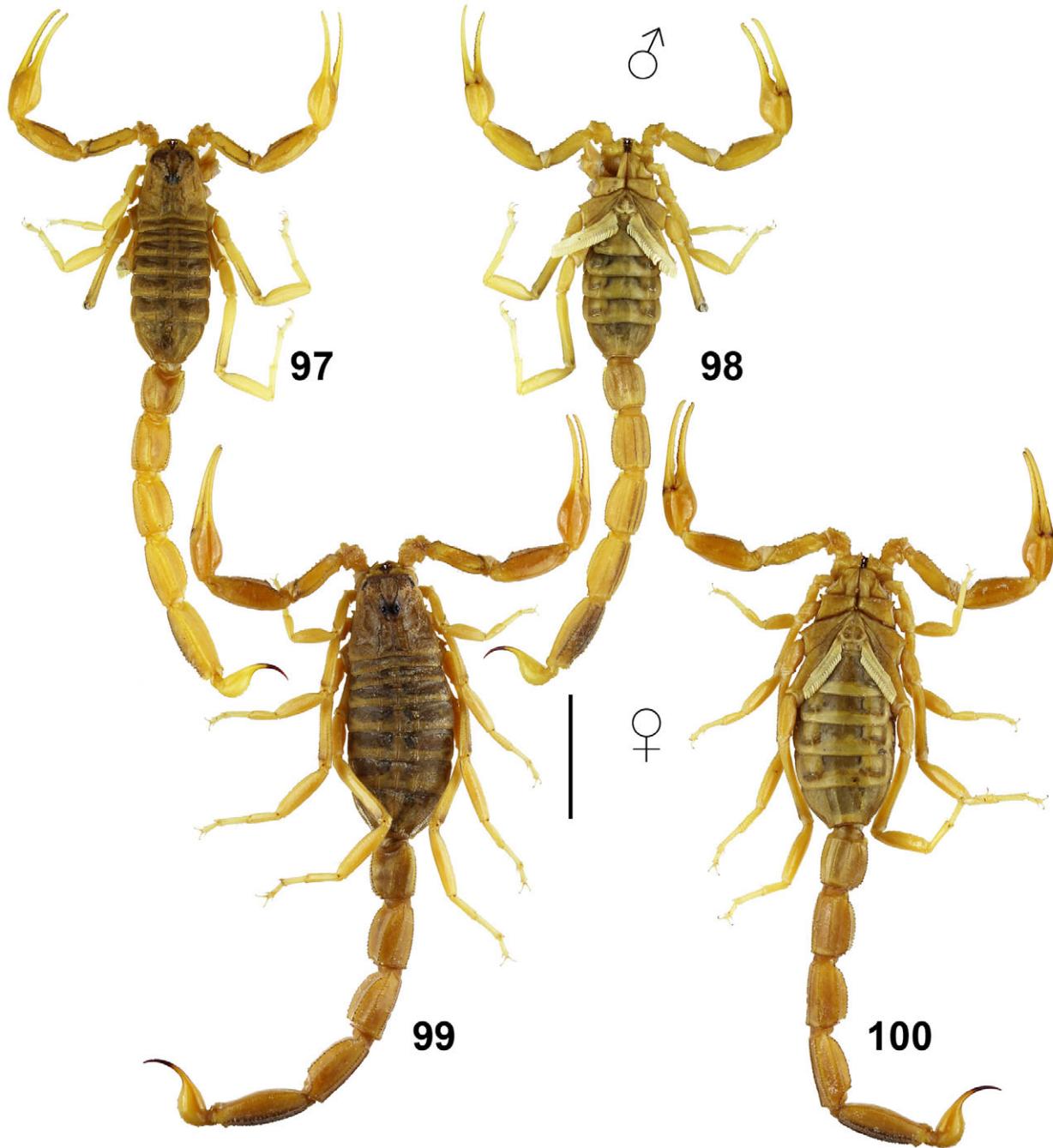
Olivierus caucasicus parthorum (nec Pocock, 1889): Fet & Lowe, 2000: 192 (in part).

Mesobuthus caucasicus (nec Nordmann, 1840): Ganterbein et al., 2003: 413 (in part; Kapchagai; Baigakum; Bukhara; Karakalpak Steppe); Parmakelis et al., 2006: 2886.

ETYMOLOGY. The species is named in honor of Yuri Gorelov (Chernogolovka, Russia), an outstanding naturalist, whose long-term work and life in Turkmenistan (Badghyz Natural Reserve) has been an inspiration and role model for many young zoologists, including VF.

DISTRIBUTION. Kazakhstan, Turkmenistan, Uzbekistan (Figs. 328, A5).

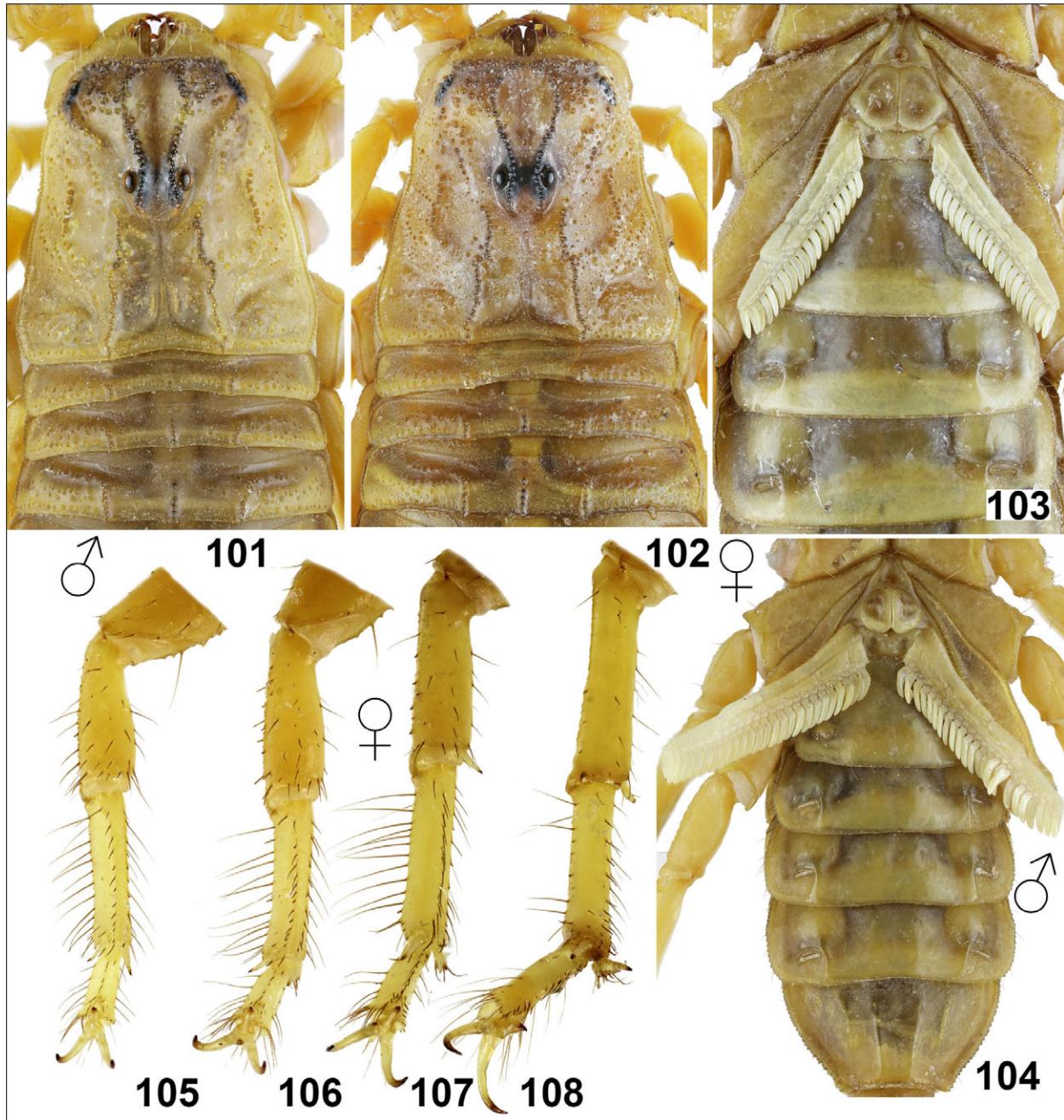
TYPE MATERIAL. **Kazakhstan**, Kyzyl-Orda Province, Chiili District, ca 2.5 km NW of Baigakum, 44.65°N 66.02°E, 127–143 m a.s.l., 25 May 2002, 1♀1♂juv. (paratypes), leg. VF & AG (FKCP); **Zhambyl Province**, Moyinkum Desert, 8 May 1979, 2juvs. (♂♀, paratypes) (ZMUH). **Turkmenistan**, Akhal Province, Ashgabat, Gurtly (Kurtli) Reservoir, 38.00°N 58.37°E, 23 April



Figures 97–100: *Mesobuthus gorelovi* sp. n. **Figures 97–98.** Holotype male, dorsal (97) and ventral (98) views. **Figures 99–100.** Paratype female from Repetek, Turkmenistan, dorsal (99) and ventral (100) views. Scale bar: 10 mm.

1984, 1♀ (paratype), leg. J. Strnad (FKCP); *Akhal Province*, Bakharden, 38.43°N 57.44°E, 26 April 1992, 1♀ (paratype), leg. M. Snížek (FKCP); *Akhal Province*, Tejen District, near Tejen Reservoir, ca. 12 km SSE of Gangaly, 36.92°N 60.83°E, 235 m a.s.l., 3 April 2002, 1♂ (holotype, Figs. 65–72, 97–98, 101, 104, 109–111, 267, 292, 307) 1♀ (Fig. 277) 1♂ juv. (paratypes), leg. VF & AG (FKCP); *Lebap Province*, Charzhev District,

Karakum Desert, Repetek Nature Reserve, 14 April–2 May 1990, 1♀ (paratype), leg. J. Farkač (NMPC), 38.55°N 63.17°E, 201 m a.s.l., 15–18 April 2002, 4♀ (paratypes, Figs. 63–64, 99–100, 102–103, 105–108, 112–114, 293) 1♂ juv. (paratype), leg. VF & AG (FKCP); *Mary Province*, Serketabad District, Badghyz Plateau, N shore of Eroilanduz Depression, 35.68°N 61.82°E, 7 April 2002, 1♂ (paratype), leg. AG (FKCP).



Figures 101–108: *Mesobuthus gorelovi* sp. n. **Figures 101, 104.** Holotype male, chelicerae, carapace and tergites I–III (101), sternopectinal region and sternites (104). **Figures 102–103, 105–108:** Paratype female from Repetek, Turkmenistan, chelicerae, carapace and tergites I–III (102), sternopectinal region and sternites III–V (103) and left legs I–IV, retrolateral aspect (105–108).

Uzbekistan, Buxoro Province, Romitan District, between Buxoro (Bukhara) and Gazli, 12 km NW of Kokushtuvan, 40.0838°N, 64.0672°E, 206 m a.s.l., 11 May 2002, 1♂ 1juv. (paratypes), leg. VF & AG (FKCP); *Fargona [Fergana] Province*, Yazyavan District, Karakalpak Steppe, ca 18 km W of Yazyavan, 40.6580°N, 71.5072°E, 403 m a.s.l. (Fig. 326), 20 May 2002, 2♀ (paratypes), leg. VF (FKCP); *Samarqand*

Province, Qarshi Steppe near Mubarek, 39.33°N 65.08°E, 272 m a.s.l., 10 May 2002, 3juvs. (♂♀) (paratypes), leg. VF (NMPC).

OTHER MATERIAL STUDIED. **Kazakhstan, Almaty Province**, Kapchagai, 43.95°N 77.0667°E, May 2002, leg. A. Feodorov, 1♀ (VFPC); *Almaty Province*, Balkhash District, 5–6 km SE of Bakanas, right bank of Ili River,

sands, 44.77°N 76.33°E, 2–5 June 2000, 3juvs., leg. AG (VFPC); *Jizzak Province*, Farish District, ca. 17.5 SW of Chardara, 41.1365°N 67.7930°E, 288–309 m a.s.l., 24 May 2002, 5juvs., leg. VF & AG (VFPC); *Kyzyl-Orda Province*, Chiili District, ca 2.5 km NW of Baigakum, 44.65°N 66.02°E, 127–143 m a.s.l., 25 May 2002, 3♀1♂1juv., leg. VF & AG (VFPC); *Zhambyl Province*, Khantau Mts., 44.18°N 73.815°E, 637 m a.s.l., 28 May 2002, 1juv., leg. VF & AG (VFPC); *Zhambyl Province*, Moyinkum Sands, SW of Lake Balkhash, 44.1728°N 71.1198°E, 350 m a.s.l., 28 May 2002, leg. AG & S. Morozov, 1♂ (VFPC). **Turkmenistan**, *Akhal Province*, E of Chagaly, 38.13°N 58.48°E, 129 m a.s.l., 31 March 2002, leg. VF & AG, 1♀ (VFPC); *Akhal Province*, Gekdepe District, Gekdepe, 35.27°N 62.35°E, 130 a.s.l., 1 April 2002, 3juvs., leg. AG (VFPC); *Akhal Province*, Tejen District, near Tejen Reservoir, ca. 12 km SSE of Gangaly, 36.92°N 60.83°E, 235 m a.s.l., 3 April 2002, 1♂2juvs., leg. VF & AG (VFPC); *Akhal Province*, Tejen District, Gurudandan Sands, 5 km W of Kazarma, 37.30°N 60.25°E, 184 a.s.l., 2 April 2002, 1♀, leg. VF & AG (VFPC); *Mary Province*, Bairamali District, Karakum Desert, ca. 10.5 km NNE of Zakhmet, 37.85°N 62.58°E, 233 a.s.l., 14 April 2002, 1juv., leg. VF & AG (VFPC); *Lebap Province*, Charzhev District, Karakum Desert, Repetek Nature Reserve, 38.55°N 63.17°E, 201 m a.s.l., 15–18 April 2002, 2♀ 5juvs., leg. VF & AG (VFPC); *Mary Province*, Serketabad District, Badghyz Nature Reserve, Kepele, 35.8°N 61.53°E, 810 a.s.l., 10 April 2002, leg. VF & AG, 1juv. (VFPC); *Mary Province*, Serketabad District, near Oktyabr'skii Well, ca. 5 km WSW of Niyazov adyndaky, sands, 35.67°N 62.02°E, 382–380 a.s.l., 13 April 2002, 1juv., leg. VF & AG (VFPC). **Uzbekistan**, *Buxoro Province*, Romitan District, between Bukhara and Gazli, 12 km NW of Kokushtuvan, 40.0838°N 64.0672°E, 206 m a.s.l., 11 May 2002, leg. VF & AG, 1♀1juv. (VFPC); *Buxoro Province*, S of Buxoro (Bukhara), ca. 7 km S of Navumetan, Yagzakkum Sands, 39.62°N 64.38°E, 20 April 2002, leg. AG, 1♀ (VFPC); *Fargona [Fergana] Province*, Besharyk District, Kairakkum Sands, 12.5 km WNW of Besharyk, 40.4735°N, 70.4503°E, 350–352 m a.s.l., 18 May 2002, 1♀, leg. VF & AG (VFPC); *Fargona [Fergana] Province*, Yazyavan District, Karakalpak Steppe, ca 18 km W of Yazyavan, 40.6580°N 71.5072°E, 403 m a.s.l., 20 May 2002, 1♀2 juv., leg. VF (FKCP); *Samargand Province*, Qarshi Steppe near Mubarek, 39.33°N 65.08°E, 272 m a.s.l., 10 May 2002, 1♀1juv., leg. VF (VFPC).

DIAGNOSIS. Total length of adult males 49–52 mm, 61–70 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers little twisted identically in both sexes. Pedipalp chela length/ width ratio 3.72–4.60 in males and 3.90–4.22 in females. Pectinal teeth number 24–28

in males, 17–23 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, black pigmented dorsal carinae on pedipalp femur and patella, ventral carinae on metasoma, metasomal segment V ventrally, and carapace anteriorly. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulated or smooth carinae. Chela with smooth carinae indicated. Movable fingers of pedipalps with 12 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae on metasomal segment II could be indicated by several denticles posteriorly; fifth with 5 carinae. All carinae granulated by consistent small blunt denticles. Length to width ratio of fourth metasomal segment 1.74–1.91 in males, 1.65–1.88 in females. Telotarsus III ventral setation represented by main row which contains ca 13–15 setae. Second parallel row contains not more than 9 setae. Pedal spur of legs densely hirsute.

DESCRIPTION. The total length of adult males 49–52 mm, 61–70 females. Trichobothrium *db* on fixed finger of pedipalp is situated between trichobothria *est* and *esb*, near to *est*. The fingers are little twisted identically in both sexes. Chelicerae yellow, without reticulation, the tips of teeth on cheliceral fingers are black. For the position and distribution of trichobothria see Figs. 65–69, 71–72. For measurements see tables 2 and 4–5.

COLORATION (Figs. 97–100). The color uniformly yellow to yellowish brown, black pigmented mainly dorso-lateral carinae on pedipalp femur and patella and carapace anteriorly. The black pigment also in ventral surface of metasoma and femur of legs.

MESOSOMA AND CARAPACE (Figs. 101–104). The carapace is carinate and unevenly covered by granules of varying size; much of the granulation is fine, but some granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 24–28 in males, 17–23 in females. The pectinal marginal tips extend to about half of the fifth sternite in males and half of the sixth sternite in females. The pectines have three marginal lamellae and seven to nine middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth and sparsely hirsute. The seventh sternite bears four well marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 63–72). The pedipalps are sparsely hirsute and smooth. The femur bears four to five granulated carinae, the middle carina on internal surface could be incomplete indicated by several strong denticles. The patella bears eight carinae from which inter-



Figures 109–114: *Mesobuthus gorelovi* sp. n. **Figures 109–111.** Holotype male, metasoma and telson, lateral (109), dorsal (110) and ventral (111) views. **Figures 112–114.** Paratype female from Repetek, Turkmenistan, metasoma and telson, lateral (112), dorsal (113), and ventral (114). Scale bars: 10 mm.

nal and dorsal are granulated and other are smooth in both sexes. The chela is without carinae. The movable fingers of pedipalps bear 12 cutting rows of denticles, each with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 105–108). The tarsomere I bears two rows of setae on the ventral surface and numerous macrosetae on the other surfaces. The tarsomere II (telotarsus) with main row which contains ca 13–15 setae and second parallel row contains not more than 9 setae. Pedal spur of legs densely hirsute. Femur bears only several macrosetae. Femur and patella with carinae well developed.

Tibial spurs present and long on third and fourth legs and absent in the other legs.

METASOMA AND TELSON (Figs. 109–114). All metasomal segments are only very sparsely hirsute.

The metasomal segment I with 10 carinae, II with 8 carinae but other two lateromedian carinae are indicated by incomplete row of denticles, III –IV with 8 carinae, and V with 5 carinae. All carinae are granulated by consistent small blunt denticles. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy or smooth with several solitary granules. Ventrolateral carinae of meta-

somal segment V posteriorly with several large denticles. The telson is only sparsely hirsute, elongate, bumpy and smooth.

NOTES.

1. *Mesobuthus gorelovi* sp. n. is the largest and the most common psammophile scorpion in the lowland deserts of Central Asia (Fet, 1980, 1994). This species has been listed for almost 120 years as *Mesobuthus caucasicus parthorum* (formerly *Buthus c. Parthorum*) following the first assignment by Birula (1897). Most specimens available to Birula (1897, 1904a, 1911) were psammophiles that originated from the Karakum Desert (Krasnovodsk, Ashgabat, Anau, Tejen, Repetek etc.), now Turkmenistan. See also Notes under *Mesobuthus parthorum* below.
2. The specimens listed from Almaty Province of Kazakhstan by Sun & Zhu (2010) and Sun & Sun (2011) most likely belong to *M. gorelovi*. We have not studied any material from China, therefore we cannot verify the identity of the Chinese population listed by Sun & Sun (2011).

Mesobuthus intermedius (Birula, 1897), stat. n. (Figs. 115–118)

Buthus caucasicus sbsp. *typica* forma γ *intermedia* Birula, 1897: 387.

TYPE LOCALITY (designated here) AND TYPE REPOSITORY. **Tajikistan:** *Dushanbe Province*, Khoja Obigarm; ZISP.

REFERENCES (selected; in part); see Fet (1989) and Fet & Lowe (2000) for full list before 1998:

Buthus caucasicus forma intermedia: Birula, 1904a: 22; Birula, 1904b: 31.

Buthus caucasicus intermedius: Birula, 1911: 168.

Buthus caucasicus intermedius: Birula, 1917: 71.

Mesobuthus caucasicus intermedius: Vachon, 1958: 150; Fet, 1989: 107–111.

Olivierus caucasicus intermedius: Fet & Lowe, 2000: 191.

DISTRIBUTION. Tajikistan, ?Uzbekistan, ?Kyrgyzstan (Figs. 328, A6).

TYPE MATERIAL:

Lectotype (designated here): 1 ♂, **Tajikistan:** *Dushanbe Province*, Khoja Obigarm, 6 July 1896, leg. L. S. Barszczewsky (ZISP 1180, Figs. 115–116).

Paralectotypes (designated here) (after Fet, 1989: 107–111, with corrections); all dates are given in “Old” (Julian) style; 57 adult specimens and 29 juveniles.

The following list of **paralectotypes** is a reconstructed syntype series of *Buthus caucasicus* sbsp. *typica* forma γ *intermedia* Birula, 1897 (as listed by Fet, 1989; see Notes):

Kazakhstan: *Almaty Province*, Jarkent, 25 June 1890, leg. P. Schmidt, 1 ♀ (ZISP 96); *East Kazakhstan Province*, Tarbagatai Mts., 1871, leg. I. Ya. Slovtsov, 1 ♂ (ZISP 94) (*loc. dub.*). **Kyrgyzstan:** *Osh Province*, Osh, 29 March–24 April 1884, leg. G. T. Grumm-Grzhimailo, 1 ex. (ZISP). **Tajikistan:** *Dushanbe Province*, Khoja Obigarm, 6 July 1896, leg. LSB, 8 ♀ (Figs. 117–118), 1 juv. (ZISP 1180; see also lectotype with the same label); 1896, leg. LSB, 7 juvs. (ZISP 1181); Varzob and Siama (“Siuma”) Rivers confluence, 8 July 1896, leg. LSB, 1 ♀ (ZISP 1176) 1 ♀ (ZISP 1303); *Khujand Province*, Zeravshan Valley, 1892, leg. D. Glazunov, 1 ♀ (ZISP 81); *Rasht District*: Garm, 29 July 1896, leg. LSB, 1 juv. (ZISP 1648); Yakhak, 17 August 1896, leg. LSB, 3 ♂♂ 5 ♀ (ZISP 1179). **Uzbekistan:** *Fargona [Fergana] Province*, Shohimardon (=Shakhimardan), 28–29 May 1893, leg. Trotsina, 5 ♂♂ 3 juvs. (ZISP 79). *Quashquadaryo [Kashkadarya] Province*, Qarshi District, Qarshi, 18 April 1885, leg. G. T. Grumm-Grzhimailo, 3 ♂♂ (ZISP 83); Shahrisabz District, Chopukh (=Chapug) (on Tankhazdarya River), 14 June 1896, leg. LSB, 3 ♀♀ 1 juv. (ZISP 1885); Gilan (=Gilyan), 7 June 1896, leg. LSB, 1 ♂ 1 juv. (ZISP 1257); Kul', 15 June 1896, leg. LSB, 1 ♂ 3 ♀♀ 4 juvs. (ZISP 1178); Shut, 5 June 1896, leg. LSB, 1 ♀ 2 juvs. (ZISP 1173); *Samarqand [Samarkand] Province*, Samarkand, 1871, 1 ♀ (ZISP 80); Samarkand, 1895, leg. LSB, 1 ♀ (ZISP 97); Samarkand, February 1896, leg. LSB, 2 juvs. (ZISP 99); Samarkand, March 1896, leg. LSB, 3 juvs. (ZISP 98); Samarkand, 21 March 1896, leg. LSB, 3 ♂♂ 1 ♀ (ZISP 100); Samarkand, May 1896, leg. LSB, 1 ♀ (ZISP 1195); Samarkand, 4 October 1896, leg. LSB, 1 ♂ (ZISP 1288). *Surxondaryo [Surkhandarya] Province*, Sang-Gardak, 20 June 1896, leg. LSB, 2 ♂♂ 7 ♀♀ 8 juvs. (ZISP 1177); *Toshkent [Tashkent] Province*, Tashkent, leg. A. Nikolsky, 1 ♀ (ZISP 87).

OTHER MATERIAL STUDIED. **Tajikistan:** *Dushanbe Province*, Gissar Mt. Range, 38th km of Varzob Hwy, Takob Gorge, env. of Dehmalik Village, 38.84715°N 68.91°E, 805 m a.s.l., 8 May 2015, leg. Y. M. Marusik & M. Saidov, 2 ♀♀ juvs. (FKCP).

DIAGNOSIS. Total length of adult 55–70. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Male with fingers proximally usually more twisted than female. Pedipalp chela length/ width ratio 3.72–4.60 in males and 3.90–4.22 in females. Pectinal teeth number 21–23 in males, 17–19 in females. Pedipalp chela length/ width ratio 3.50–3.60 in males and 3.70–3.85 in females. Chelicerae



Figures 115–118: *Mesobuthus intermedius*. **Figures 115–116.** Lectotype male, dorsal (115) and ventral (116) views. **Figures 117–118.** Paralectotype, dorsal (117) and ventral (118) views. The original labels are also included in the plate.

yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, black pigmented dorsal carinae on pedipalp femur and patella, ventral carinae on metasoma, metasomal segment V ventrally, and carapace anteriorly. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulated or smooth carinae. Chela with smooth carinae indicated. Movable fingers of pedipalps with 13–14 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae on metasomal

segment II could be indicated by several denticles posteriorly; fifth with 5 carinae. All carinae granulated by consistent small blunt denticles. Telotarsus III ventral setation represented by short and strong spiniform setae. Pedal spur of legs with solitary setae only.

NOTES

1. This taxon was described by Birula (1897: 387) as an intrasubspecific form ("forma γ"), very briefly (one paragraph); no type specimens were designated. In the same work, it was also called by a combination

Buthus caucasicus intermedius (p. 386) and distinguished from another Central Asian intrasubspecific form (“forma β”, to which Birula assigned *Buthus parthorum* Pocock, 1889). Its *terra typica* also was not defined; instead, a very wide range within the Central Asian part of the Russian Empire and its dependencies was indicated, as “Buchara, Ferghana, Semiretchye”. However, by the time the paper was submitted by Birula to the *Annuaire du Musée Zoologique* (10 September 1897), ample material was available in ZISP from the Buchara Khanate, a protectorate of the Russian Empire (now Uzbekistan and Tajikistan). In contrast, only a few specimens were available from Ferghana (now Uzbekistan and Kyrgyzstan) and Semiretchye (now Kazakhstan). The taxon was later treated as a subspecies (starting with Birula, 1904a) but was never revised.

2. Most of the “Buchara” specimens available in ZISP collection were freshly collected by the famous explorers Lev Semenovich Barsczewsky (1849–1910) and Vladimir Ippolitovich Lipsky (1863–1937) in June–August 1896, in their first expedition to the remote mountains of the Buchara Khanate. Barsczewsky’s collection was obtained by ZISP, where Alexei Birula himself at that time was in charge of the 1st Invertebrates Division including Arachnida. Barsczewsky collection is mentioned in the Report of the Zoological Museum for the year 1896 covering materials obtained by ZISP in 1896. The report was published in the same 3d volume of the *Annuaire du Musée Zoologique* (December 1897) where Birula (1897) paper was submitted. Barsczewsky’s travelogue is narrated to a great detail in a voluminous report by his collaborator (Lipsky, 1902). We identified all 9 localities where scorpions were collected in June–August 1896 in Gissaro-Darvaz Mts. The label localities go in a following sequence (original ‘Old Style’ dates and altitudes by Lipsky): [Uzbekistan]: Shut (6722 ft, 5 June) – Gilan (6677 ft, 7 June) – Chopukh (5958 ft, 14 June) – Kul’ (15 June) – Sang-Gardak (4492 ft, 20 June) – [Tajikistan]: Khoja Obigarm (5893 ft, 6 July) – Varzob and Siama Rivers confluence (8 July) – Garm (29 July) – Yakhak (4600 ft, 17 August 1896). For Sang-Gardak, Lipsky (1899: 91) even made a note that “some places had many scorpions and solpugids under stones”. Specimens from seven of these localities (Khoja Obigarm, Sang-Gardak, Varzob/Siama, Shut, Chopukh, Kul’, Yakhak) were later listed as *Buthus caucasicus intermedius* by Birula (1904a: 23), with detailed label information.

3. It is impossible to establish with confidence which exact specimens were seen by Birula by September 1897. Above, we attempted to reconstruct a possible

syntype series as a subset of all available ZISP labels published by Fet (1989), with updated toponymy and administrative division. From this large series, mostly collected by L. S. Barsczewsky in 1896, we select a lectotype from Khoja Obigarm, Tajikistan (38.89°N, 68.821°E) in the Varzob River valley. It is still an easily identifiable type locality, with hot springs (mentioned already by Lipsky); today, a landmark balneological resort. All other syntypes listed above technically become paralectotypes of *Mesobuthus intermedius*. The list definitely contains several taxa, since many populations from the mountains of Central Asia at this time remain unrevised. Identity of paralectotypes from Kazakhstan (Tarbagatai Mts.) is especially doubtful. Barsczewsky’s 1896 collection also yielded a new subspecies of *Mesobuthus eupeus* (C. L. Koch, 1839), *M. e. barsczewskii* (Birula, 1904); its status is currently unclear.

4. Already the next year after the Barsczewsky-Lipsky expedition, in April–August 1897, a prominent explorer A. N. Kaznakov (1871–1933) also collected scorpions (as well as many other animals) in Gissaro-Darvaz and Pamiro-Alai Mts. of Buchara (now Tajikistan and Uzbekistan). Kaznakov’s valuable material was first listed in Birula (1904b) (see also Fet, 1989), and yielded “*Buthus caucasicus intermedius*” as well as a new taxon, *Buthus kaznakovi* Birula, 1904 (see below). Kaznakov collected in Shugnan at least until 30 August 1897 (all dates here and below in original ‘Old Style’), as we could establish from the labels accompanying his specimens belonging to other animal groups. The paper of Birula (1897) was submitted to the *Annuaire du Musée Zoologique* on 10 September 1897 (the issue was published in November 1897). It is highly unlikely that sorted Kaznakov’s material was available to Birula before he finalized his paper in September 1897. This material is listed in the Report of the Zoological museum for the year 1897 covering materials obtained by ZISP in 1897, published in the Volume 4 of the *Annuaire* (December 1898). Kaznakov’s scorpion specimens, with detailed labels, were first mentioned in print only in 1904 (Birula, 1904a: 23) along with Barsczewsky’s 1896 collection. Therefore, scorpions collected by Kaznakov in 1897 are not included into the reconstructed syntype series of *M. intermedius*. At the same time, Kaznakov’s collection contains specimens later identified by Birula as *Buthus caucasicus intermedius* from Uzbekistan and Tajikistan. Among them, there are specimens collected in Akrabat (29 April 1897), “Baba-tau” (Babatag) ([18] May 1897), Igarchi and Sarypul’ (Yakhsu River valley, no exact date, 1897); on the road from Sarypul’ to Talbar (the shortest way to Chil’dara via Talbar Pass) (28–29 May 1897), in



Figures 119–122: *Mesobuthus kaznakovi*. **Figures 119–120.** Male from Ramit, Tajikistan, dorsal (119) and ventral (120) views. **Figures 121–122.** Female from Ramit, Tajikistan, dorsal (121) and ventral (122) views.

Chil'dara (30 May–7 June 1897), and Tutkavul (no exact date, 1897). Kaznakov's collection also yielded a new species, *M. kaznakovi* (Birula, 1904) (see below).

***Mesobuthus kaznakovi* (Birula, 1904), stat. n.**
(Figs. 119–151, 269, 279, 294–295, 309, 316–317,
Tables 4–6)

Buthus kaznakovi Birula, 1904b: 32.

TYPE LOCALITY AND TYPE REPOSITORY. **Tajikistan**, Khatlon Province, road from Sarypul' to Talbar; ZISP.

REFERENCES (selected); see Fet (1989) and Fet & Lowe (2000) for a full list before 1998:

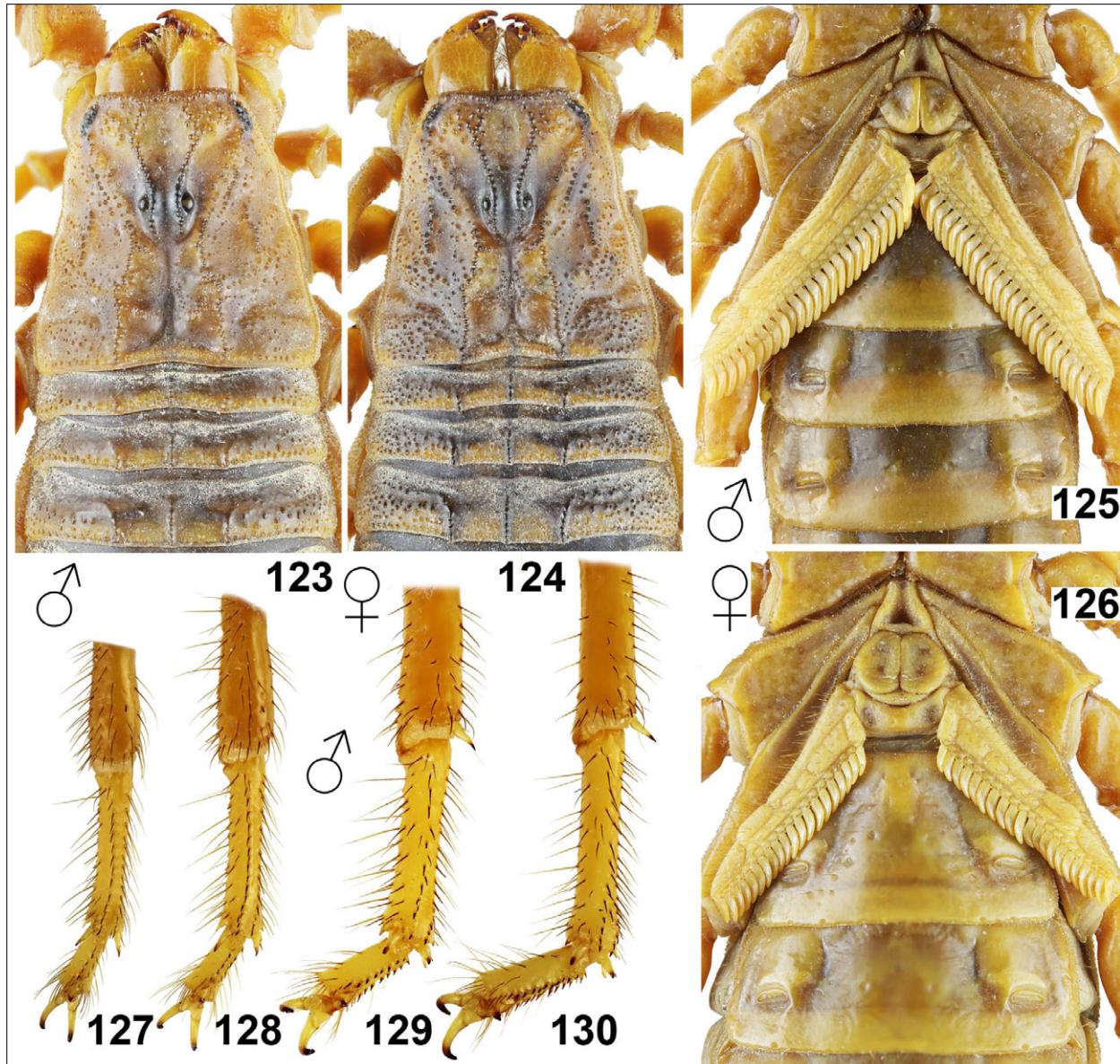
Buthus caucasicus kaznakovi: Birula, 1911: 167;
Birula, 1917: 71.

Mesobuthus caucasicus kaznakovi: Vachon, 1958:

150; Fet, 1989: 112.

Olivierus caucasicus kaznakovi: Fet & Lowe, 2000:
191.

TYPE MATERIAL. Syntypes: **Tajikistan**, Khatlon Province, road from Sarypul' to Talbar, [38.42°N 70.13°E to



Figures 123–130: *Mesobuthus kaznakovi*. **Figures 123, 125, 127–130.** Male from Ramit, Tajikistan, chelicerae, carapace and tergites I–III (123), sternopectinal region and sternites III–V (125), left legs I–IV, retrolateral aspect (127–130). **Figures 124, 126:** Paratype female, chelicerae, carapace and tergites I–III (124), and sternopectinal region and sternites III–IV (126).

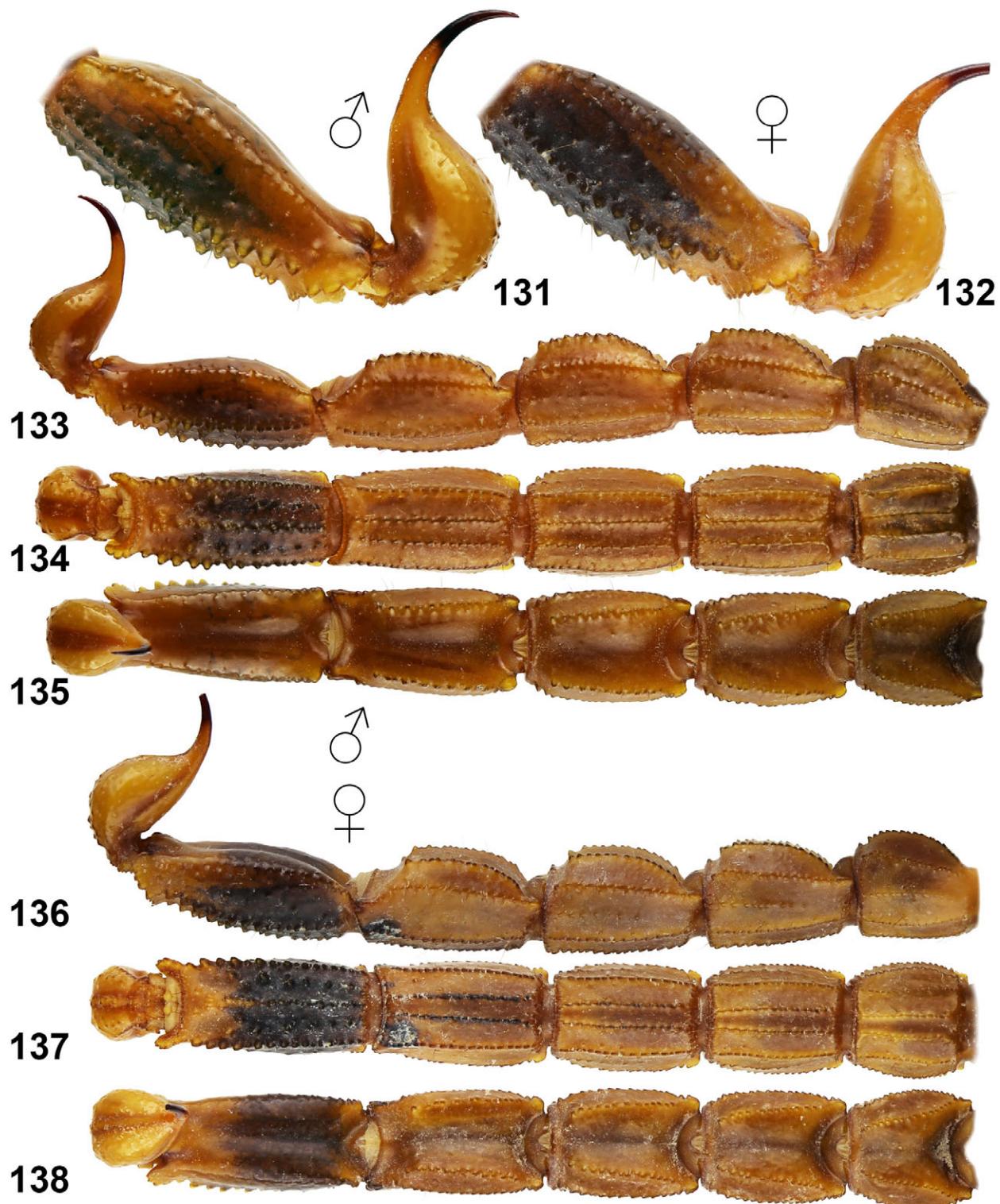
38.60°N 70.35°E] 28–29 May 1897 (Old Style), leg. A. N. Kaznakov, 1♀ (ZISP 1252); *Tavildara District*: Chil'dara (on Obi-Khingou River), 38.78°N 70.30°E, leg. A. N. Kaznakov, 30 May and 17 June 1897 (Old Style), 1♀ (ZISP 1254); Karasu River (tributary of Amudarya), leg. A. N. Kaznakov, 1–3 May 1897 (Old Style), 2 ♀ (not found in ZISP). *Shugnan*, Shakhdara River valley, August 1897, leg. A. N. Kaznakov, “numerous ♀, ♂, and pulli” (not found in ZISP).

MATERIAL STUDIED. **Tajikistan**, *Khatlon Province*, Ramit Nature Reserve (zapovednik), Sardai-Miena River

valley, 38.78°N 69.35°E, 27 June 1962, 1♂ 1♀ (Figs. 119–151, 269, 279, 294–295, 309, 317) (FKCP). **Uzbekistan**, *Jizzakh Province*, a Turkmen village near Zaamin, 39.61°N 68.50°E, November 2010, 2♂ 3♀ 2juvs. (Fig. 316) (FKCP).

DISTRIBUTION. Tajikistan, Uzbekistan (Figs. 328, A7).

DIAGNOSIS. (*based on studied material*) Total length of adult males 68–70 mm, 68–75 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Male with fingers



Figures 131–138: *Mesobuthus kaznakovi*. **Figures 131, 133–135.** Male from Ramit, Tajikistan, metasoma V and telson lateral (131), and metasoma and telson, lateral (133), ventral (134), and dorsal (135) views. **Figures 132, 136–138.** Female from Ramit, Tajikistan, metasoma V and telson lateral (132), and metasoma and telson, lateral (136), ventral (137), and dorsal (138) views.

proximally little more twisted than female. Female has longer and narrower chela of pedipalps. Pedipalp chela length/ width ratio 3.50–3.65 in males and 3.81–3.93 in females. Pectinal teeth number 25–27 in males, 19–23 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma sparsely hirsute. Carapace and tergites yellowish brown, black pigmented; metasoma, telson, pedipalps and legs yellowish brown, only anterior part of metasomal segment V black. Femur of pedipalp with 4–5 granulated carinae. Patella with 8 granulated or smooth carinae. Chela lacks carinae. Movable fingers of pedipalps with 13 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to third with 8 carinae, other two carinae indicated by incomplete row of denticles; fourth with 8 carinae; fifth with 5 carinae. All carinae granulated, dorsal carinae bear slightly larger terminal denticles. Length to width ratio of fourth metasomal segment 1.71–1.79 in males, 1.69–1.71 in females. Telotarsus III ventral setation represented by short and strong spiniform setae. Pedal spur of legs obviously with solitary setae only.

REDESCRIPTION. The total length of adult males 68–70 mm, 68–75 females. Trichobothrium *db* on fixed finger of pedipalp is situated between trichobothria *est* and *esb*, near to *est*. Male has the fingers proximally a little more twisted than female. Female has longer and slightly narrower chela of pedipalps. Chelicerae yellow, without reticulation, the tips of teeth on cheliceral fingers are black. For the position and distribution of trichobothria see Figs. 142–146, 148–149. For measurements see tables 4–5.

COLORATION (Figs. 119–122). The carapace and tergites are yellowish brown strongly black pigmented; the metasoma, telson, pedipalps and legs yellowish brown to black. Metasomal segment V is black mainly in anterior part.

MESOSOMA AND CARAPACE (Figs. 123–126). The carapace is carinated and unevenly covered by granules of varying size; much of the granulation is fine, but some granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 25–27 in males, 19–23 in females. The pectinal marginal tips extend to about third of the fifth sternite in males and third of the fourth sternite in females. The pectines have three marginal lamellae and seven to nine middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth and sparsely hirsute. The seventh sternite bears four well marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 139–149). The pedipalps are sparsely hirsute and smooth. The femur bears four to five gran-

ulated carinae, the middle carina on internal surface could be incomplete indicated by several strong granules. The patella bears eight carinae from which three internal are granulated and other are smooth in males but could be granulated in females. The chela is without carinae. The movable fingers of pedipalps bear 13 cutting rows of denticles, every with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 127–130). The tarsomeres bear two rows of spiniform setae on the ventral surface and numerous macrosetae on the other surfaces. Ventral setation of tarsomere II (telotarsus) represented by short and strong spiniform setae. Pedal spur of legs obviously with solitary setae only. Femur bears only several macrosetae. Femur and patella with carinae well developed. Tibial spurs present and long on third and fourth legs and absent in the other legs.

METASOMA AND TELSON (Figs. 131–138). All metasomal segments are only very sparsely hirsute.

The metasomal segment I with 10 carinae, II–III with 8 carinae but other two lateromedian carinae are indicated by incomplete row of denticles, IV with 8 carinae, and V with 5 carinae. All carinae with denticles, dorsal carinae on metasomal segment I–III bear slightly larger terminal denticles. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy with several solitary granules. Ventrolateral carinae of metasomal segment V posteriorly with several large lobate denticles. The telson is only sparsely hirsute, rather elongate, bumpy and smooth.

NOTES.

Fet (1989) did not list syntypes from Karasu and Shugnan, which could not be located in ZISP.

Mesobuthus kreuzbergi sp. n.

(Figs. 152–182, 270, 280, 296–297, 310, 314, 320, 327,
Tables 2, 4–6)

<http://zoobank.org/urn:lsid:zoobank.org:act:B6D83E08-A735-4492-8DBC-4B553F8EE83A>

TYPE LOCALITY AND TYPE REPOSITORY. **Uzbekistan**, Surxondaryo [Surkhandarya] Province, Uzun District, Babatag Mts., 38.0275°N 68.2458°E, 734–763 m a.s.l. (Fig. 327); FKCP.

REFERENCES:

Mesobuthus caucasicus (nec Nordmann, 1840): Gantenbein et al., 2003: 413 (in part; Babatag).

ETYMOLOGY. The species is named in honor of Alexander Kreuzberg (1956–2012), a prominent lepidopterologist and conservationist whose life's work was devoted to the Uzbekistan's deserts and mountains (see Mukhina-Kreuzberg, 2016).



Figures 139–151: *Mesobuthus kaznakovi*. **Figures 139–141.** Female from Ramit, Tajikistan, Pedipalp chela, dorsal (139) and external (140), and pedipalp patella dorsal (141). **Figures 142–151.** Male from Ramit, Tajikistan, Pedipalp chela, dorsal (142), external (143), and ventral (144) views. Pedipalp patella, dorsal (145), external (146), and ventral (147) views. Pedipalp femur and trochanter, internal (148) and dorsal (149) views. Right chelicera dorsal (150) and ventral (151) views. The trichobothrial pattern is indicated in Figures 142–146, 148–149.

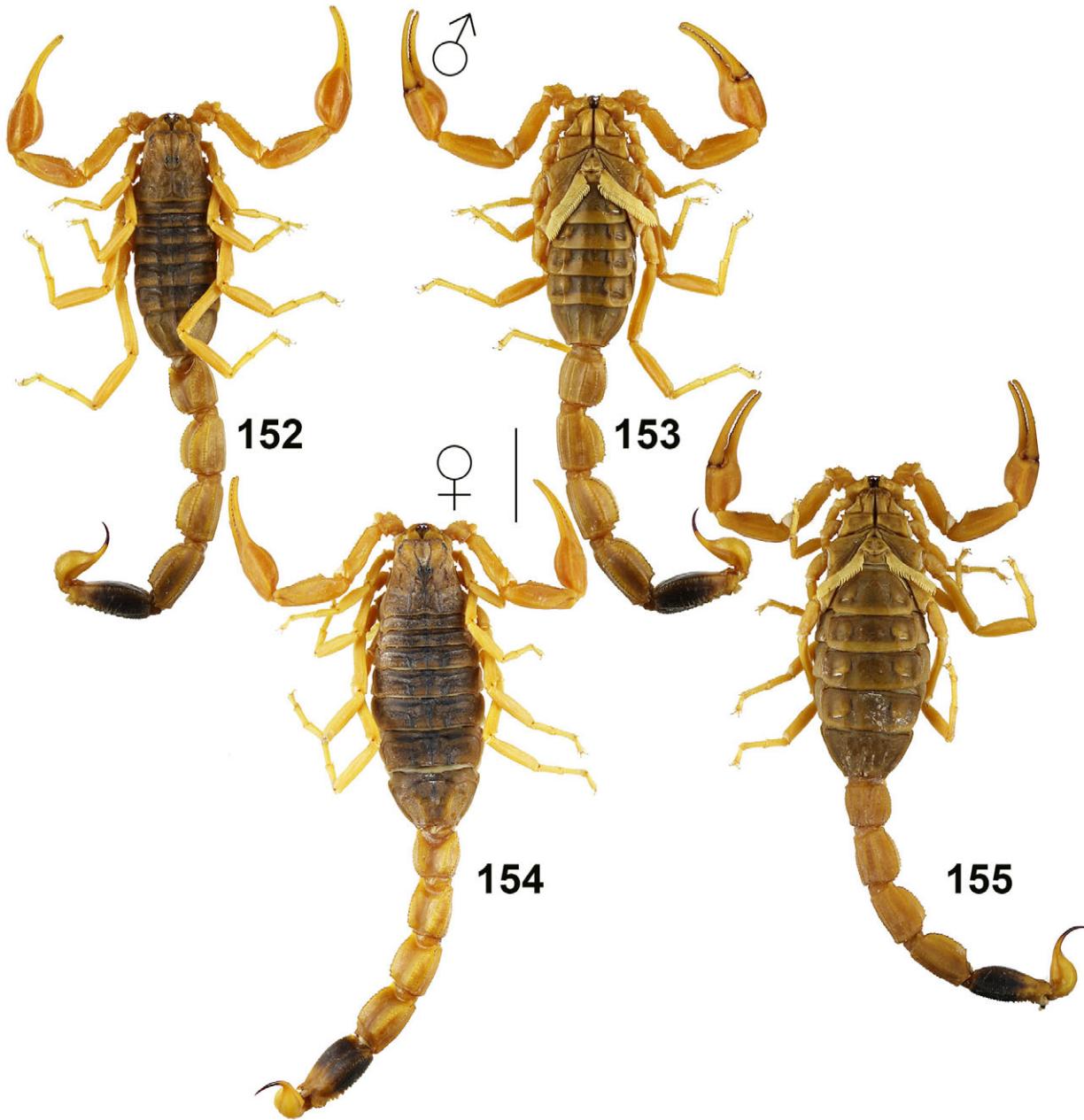
DISTRIBUTION. Tajikistan, Uzbekistan (Figs. 328, A8).

TYPE MATERIAL. **Uzbekistan**, 1♀ (paratype, Fig. 320) without precise location, 2012 (FKCP); *Surxondaryo [Surkhandarya] Province*, Sherabad District, Kuhitang Mts, Lailakansai, [37.67°N 67.02°E for Sherabad], 1200 m a.s.l., 7–9 May 1996, 1♂ 1♀ (paratypes), leg. V. Dolin (FKCP). *Surxondaryo [Surkhandarya] Province*, Uzun District, Babatag Mts., 38.0275°N 68.2458°E, 734–763 m a.s.l., 2♂ 6♀ 7juvs. (♂♀) (holotype and paratypes, Figs. 152–182, 270, 280, 296–297, 310, 314), 4 May 2002, leg. VF (FKCP, NMPC).

OTHER MATERIAL STUDIED. **Tajikistan**. *Khatlon Province*, Shaartuz District, Chiluchor-Chashma, 37.2993°N 68.04375°E, 399 m a.s.l., stony plateau and scree, 19

April 2015, 1juv., leg. Y. M. Marusik (NMPC). **Uzbekistan**, *Surxondaryo [Surkhandarya] Province*, Uzun District, Babatag Mts., 38.0275°N 68.2458°E, 734–763 m a.s.l., 3♂ 10♀ 40juvs. (♂♀), 4 May 2002, leg. VF (VFPC).

DIAGNOSIS. Total length of adult males 65–70 mm, 74–85 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Male with fingers proximally little more twisted than female. Pedipalp chela length/ width ratio 3.15–3.39 in males and 3.35–3.66 in females. Pectinal teeth number 26–30 in males, 20–25 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, only metasomal segments IV–V could be black.

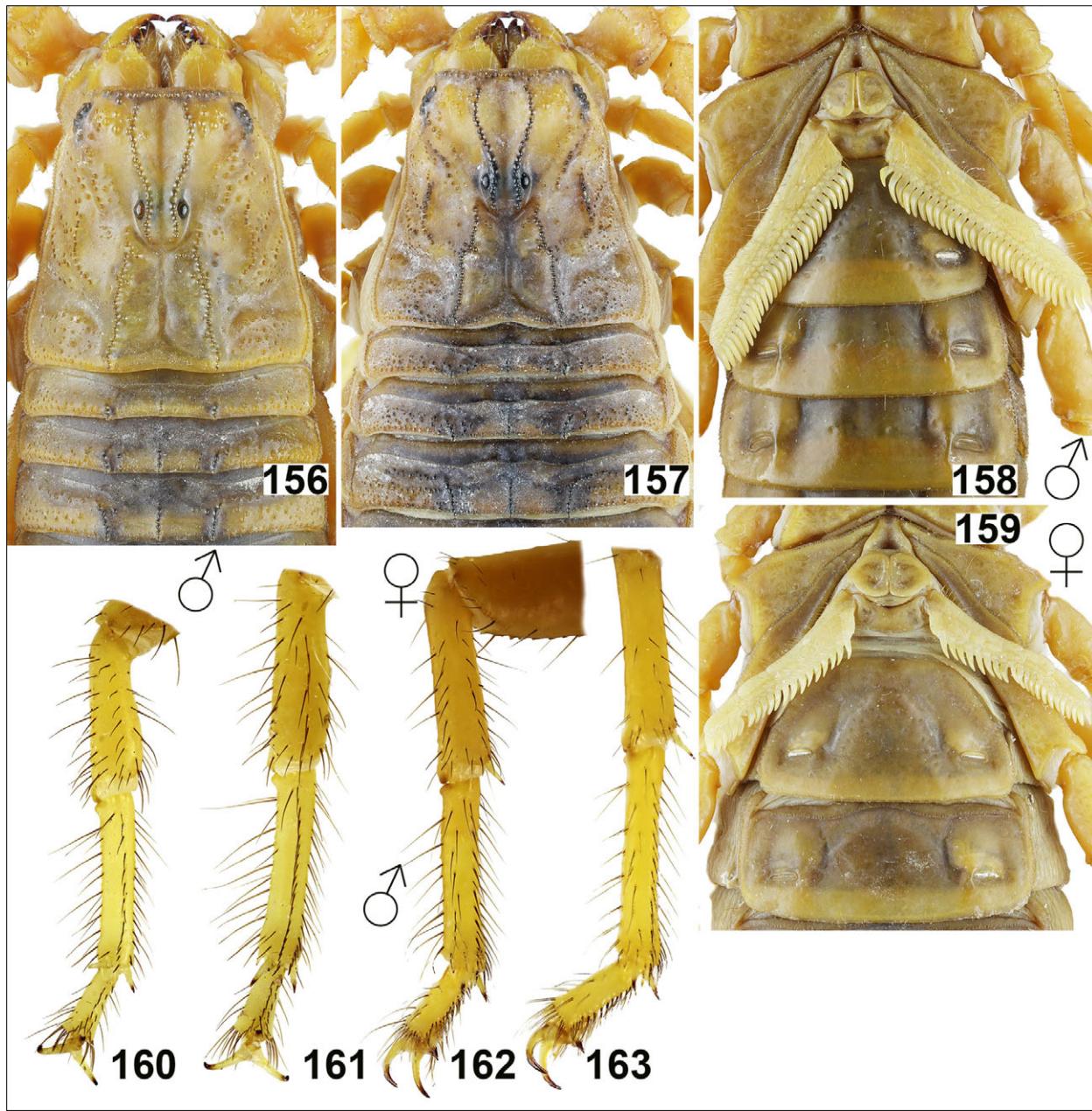


Figures 152–155: *Mesobuthus kreuzbergi* sp. n. **Figures 152–153.** Holotype male, dorsal (152) and ventral (153) views. **Figures 154–155.** Paratype female, dorsal (154) and ventral (155) views. Scale bar: 10 mm.

Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela lacks carinae. Movable fingers of pedipalps with 13 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae are indicated by incomplete row of denticles on metasomal segment II; fourth with 8 carinae; fifth with 5 carinae. All carinae granulated. Length to width ratio of fourth metasomal segment

1.53–1.55 in males, 1.54–1.63 in females. Telotarsus III ventral setation represented by long setae. Pedal spur of legs with solitary setae only.

DESCRIPTION. The total length of adult males 65–70 mm, 74–85 females. Trichobothrium *db* on fixed finger of pedipalp is situated between trichobothria *est* and *esb*, near to *est*. Male has the fingers proximally a little more twisted than female. Female has longer and slightly narrower chela of pedipalps. Chelicerae yellow, without



Figures 156–163: *Mesobuthus kreuzbergi* sp. n. **Figures 156, 158, 160–163.** Holotype male, chelicerae, carapace and tergites I–III (156), sternopectinal region and sternites III–V (158), left legs I–IV, retrolateral aspect (160–163). **Figures 157, 159.** Paratype female, chelicerae, carapace and tergites I–III (157), and sternopectinal region and sternites III–IV (159).

reticulation, the tips of teeth on cheliceral fingers are black. For the position and distribution of trichobothria, see Figs. 173–177, 179–180. For measurements, see Tables 2 and 4–5.

COLORATION (Figs. 152–155). Color uniformly yellow to yellowish brown, only metasomal segments IV–V could be black.

MESOSOMA AND CARAPACE (Figs. 156–159). The carapace is carinate and unevenly covered by granules of varying size; much of the granulation is fine, but some

granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 26–30 in males, 20–25 in females. The pectinal marginal tips extend to about end of the sixth sternite in males and end of the seventh sternite in females. The pectines have three marginal lamellae and eight to nine middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth



Figures 164–169: *Mesobuthus kreuzbergi* sp. n. **Figures 164–166.** Holotype male, metasoma and telson, lateral (164), ventral (165), and dorsal (166) views. **Figures 167–169.** Paratype female, metasoma and telson, lateral (167), ventral (168), and dorsal (169) views.

and sparsely hirsute. The seventh sternite bears four well marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 170–180). The pedipalps are sparsely hirsute and smooth. The femur bears four to five granu-

lated carinae, the middle carina on internal surface could be incomplete indicated by several strong denticles. The patella bears eight carinae from which internal and dorsal are granulated and other are smooth in both sexes. The chela is without carinae. The movable fingers of



Figures 170–180: *Mesobuthus kreuzbergi* sp. n. **Figures 170–172.** Paratype female. Pedipalp chela, dorsal (170) and external (171), and pedipalp patella dorsal (172). **Figures 173–180.** Holotype male. Pedipalp chela, dorsal (173), external (174), and ventral (175) views. Pedipalp patella, dorsal (176), external (177), and ventral (178) views. Pedipalp femur and trochanter, internal (179) and dorsal (180) views. The trichobothrial pattern is indicated in Figures 173–177, 179–180.

pedipalps bear 13 cutting rows of denticles, every with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 160–163). The tarsomeres bear two rows of long setae on the ventral surface and numerous macrosetae on the other surfaces. Telotarsus ventral setation represented by long setae. Pedal spur of legs with solitary setae only. Femur bears only several macrosetae. Femur and patella with carinae well developed. Tibial spurs present and long on third and fourth legs and absent in the other legs.

METASOMA AND TELSON (Figs. 164–169, 181–182). All metasomal segments are only very sparsely hirsute. The metasomal segment I with 10 carinae, II–III with 8 carinae but other two lateromedian carinae are indicated by incomplete row of denticles, IV with 8 carinae, and V with 5 carinae. All carinae with consistent denticles. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy or smooth with several solitary granules. Ventrolateral carinae of metasomal segment V posteriorly with several large lobate denticles. The telson is only sparsely hirsute, elongate, bumpy and smooth.

NOTES.

The first author (VF) collected *M. kreuzbergi* and observed a dense population of this species on the

eastern slope of Babatag Mts. in Uzbekistan, on 30 April–4 May 2002, where it is sympatric (but not syntopic) with a remarkable relict *Pseudochactas ovchinnikovi* Gromov, 1998 (Scorpiones: Pseudochactidae). *P. ovchinnikovi* is also sympatric with *M. fuscus* in Ganjina, Tajikistan.

Mesobuthus mischi sp. n.

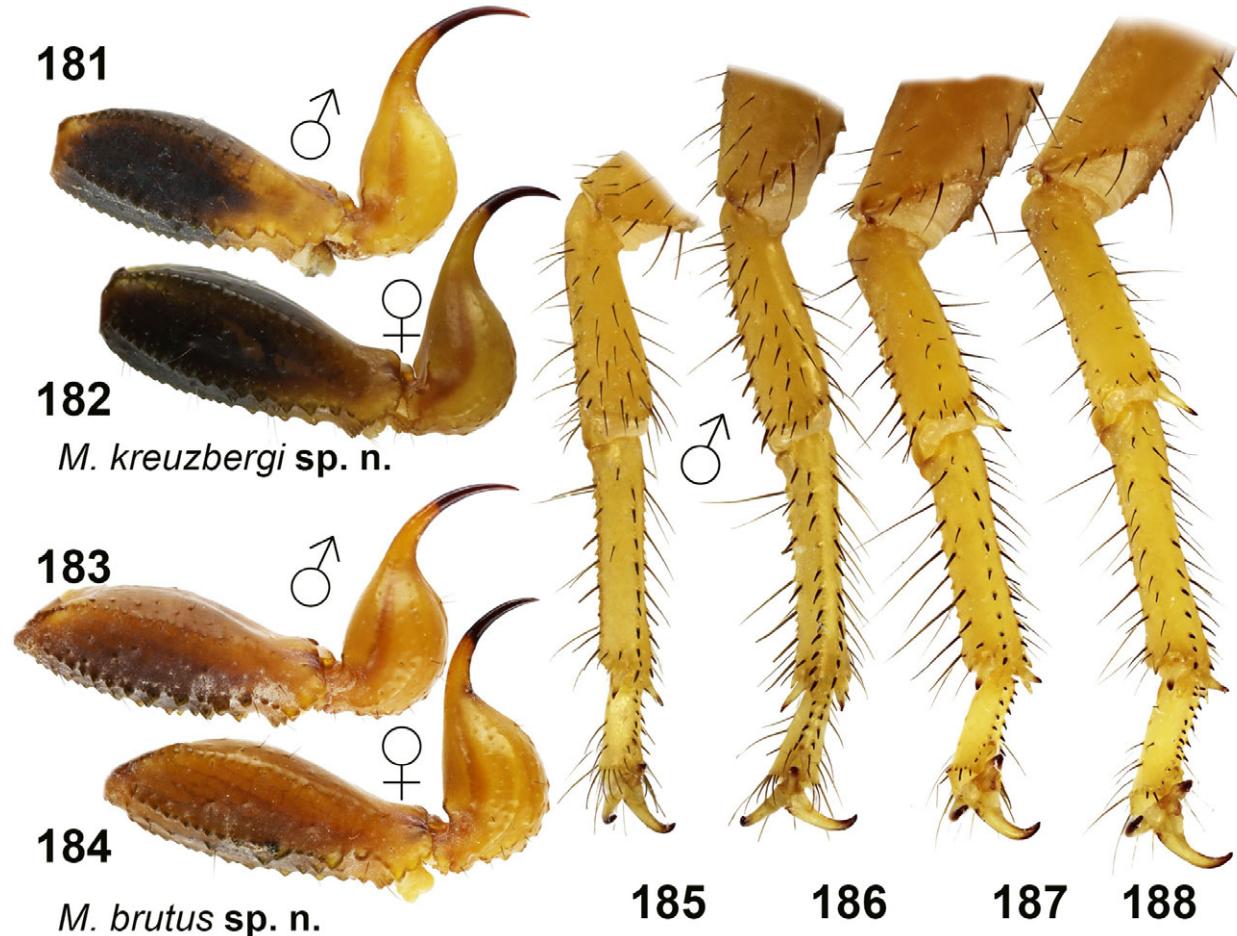
(Figs. 189–216, 271, 281, 298–299, 311, Tables 3–6)
<http://zoobank.org/urn:lsid:zoobank.org:act:A9F691F9-4098-46C8-A43B-8CB472188341>

TYPE LOCALITY AND TYPE REPOSITORY. **Afghanistan, Balkh Province,** Hazara Toghai village, 37.22°N 67.21°E, 300 m a.s.l. (FKCP).

ETYMOLOGY. The species is named in honor of Michael Misch, for his contributions to the knowledge of Afghanistan's scorpiofauna.

DISTRIBUTION. Afghanistan (Figs. 328, A9).

TYPE MATERIAL. **Afghanistan, Balkh Province,** Hazara Toghai village, 37.22°N 67.21°E, 300 m a.s.l., October–December 2012, 1♂ (holotype, Figs. 189–190, 193, 195, 197–204, 210–216, 271, 281, 298, 311) 2♀ (paratypes, Figs. 191–192, 194, 205–209, 299), leg. M. Misch (FKCP); **Herat Province,** Herat City, 34.34°N 62.20°E,



Figures 181–188: Figures 181–182: *Mesobuthus kreuzbergi* sp. n., metasoma V and telson lateral of male (181) and female (182). Figures 183–188: *Mesobuthus brutus* sp. n., metasoma V and telson lateral of male holotype (183) and female paratype (184), and left legs I–IV, retrolateral aspect of male holotype (185–188).

2013, 1♀ (paratype), leg. M. Misch (FKCP); *Kunduz Province*, Kunduz City, 36.73°N 68.87°E, 400 m a.s.l., 5 February 1966, 1♀ (Fig. 196) 4juvs. (♀♂) (paratypes, NMPC, ZMUH), 25 May 1966, 1♂ 1♀ (paratypes), leg. Šimek (FKCP); *Kunduz Province*, Kunduz, Chahar Dara District, 36.69°N 68.80°E, 1♀ (paratype), 2012, leg. M. Misch (FKCP). *Parwan Province*, Jabal Saraj, 35.12°N 69.24°E, 1♀ (paratype) (FKCP).

DIAGNOSIS. Total length of adult male 71 mm, 64–71 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Male with fingers proximally more twisted than female. Pedipalp chela length/ width ratio 2.95 in males and 3.11–3.62 in females. Pedipalp chela bulby with short manus and elongate fixed finger in male. Pectinal teeth number 25–26 in males, 20–24 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Carapace and tergites yellowish brown, black pigmented; metasoma, telson, pedipalps

and legs yellowish brown only anterior part of metasomal segment V black. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela lacks carinae. Movable fingers of pedipalps with 13–14 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae are indicated by incomplete row of denticles on metasomal segments II and III; fourth with 8 carinae; fifth with 5 carinae. Dorsal and lateral carinae granulated, ventral carinae on metasomal segments I–IV smooth, dorsal carinae bear larger terminal denticles. Length to width ratio of fourth metasomal segment 1.54 in males, 1.50–1.65 in females. Telotarsus III ventral setation represented by short and strong spiniform setae. Pedal spur of legs with solitary setae only.

DESCRIPTION. The total length of adult male 71 mm, 64–71 females. Trichobothrium *db* on fixed finger of pedi-

		<i>M. gorelovi</i> sp. n.		<i>M. kreuzbergi</i> sp. n.	
Dimensions (mm)		♂ holotype	♀ paratype	♂ holotype	♀ paratype
Carapace	L / W	5.85 / 5.98	7.30 / 7.25	7.85 / 8.10	8.80 / 9.50
Mesosoma	L	12.10	20.60	16.6	25.05
Tergite VII	L / W	3.65 / 5.95	5.10 / 7.90	5.35 / 8.15	6.55 / 9.90
Metasoma & telson	L	33.98	40.02	44.67	46.53
Segment I	L / W / D	4.05 / 3.70 / 3.10	4.90 / 4.25 / 3.55	5.25 / 5.30 / 5.03	5.75 / 5.95 / 5.10
Segment II	L / W / D	5.05 / 3.55 / 3.05	5.80 / 4.05 / 3.70	6.70 / 5.25 / 5.25	6.75 / 5.65 / 5.15
Segment III	L / W / D	5.25 / 3.55 / 3.08	6.17 / 4.00 / 3.60	7.07 / 5.15 / 5.30	7.15 / 5.55 / 5.03
Segment IV	L / W / D	5.98 / 3.30 / 2.77	7.15 / 3.90 / 3.30	8.20 / 5.10 / 4.78	8.20 / 5.30 / 4.75
Segment V	L / W / D	7.15 / 3.05 / 2.38	8.20 / 3.55 / 2.90	9.20 / 4.40 / 3.80	9.55 / 4.80 / 4.15
Telson	L / W / D	6.50 / 2.25 / 2.00	7.80 / 2.75 / 2.55	8.25 / 3.35 / 3.00	9.13 / 3.90 / 3.60
Pedipalp	L	21.85	24.70	29.25	31.85
Femur	L / W	5.15 / 1.50	5.75 / 1.80	7.10 / 2.05	7.75 / 2.45
Patella	L / W	6.40 / 2.25	7.25 / 2.70	8.55 / 3.10	9.00 / 3.60
Chela	L	10.30	11.70	13.60	15.10
Manus	L / W / D	3.35 / 2.77 / 2.75	3.31 / 2.90 / 3.00	4.00 / 4.10 / 4.20	5.00 / 4.45 / 4.45
Movable finger	L	6.95	8.39	9.06	10.10
Total	L	51.93	67.92	69.12	80.38

Table 2: Comparative measurements of adults of *Mesobuthus gorelovi* sp. n. and *M. kreuzbergi* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

palm is situated between trichobothria *est* and *esb*, near to *est*. Male has the fingers proximally a little more twisted than female. Female has longer and slightly narrower chela of pedipalps. Chelicerae yellow, without reticulation, the tips of teeth on cheliceral fingers are black. For the position and distribution of trichobothria, see Figs. 211–216. For measurements, see tables 3–5.

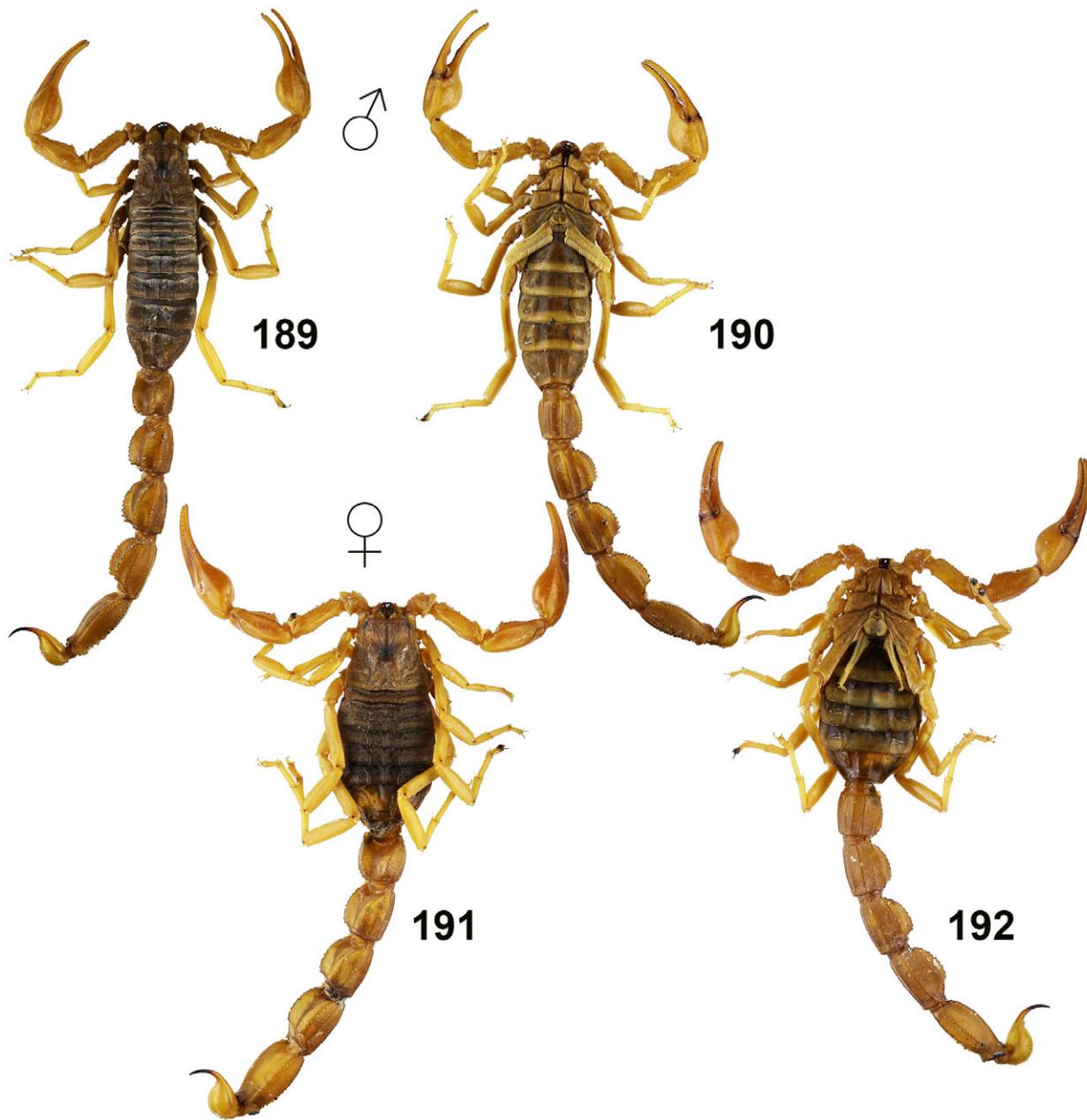
COLORATION (Figs. 189–192). The carapace and tergites are yellowish brown, black pigmented. The metasoma, telson, pedipalps and legs are yellowish brown, only anterior part of metasomal segment V is black.

MESOSOMA AND CARAPACE (Figs. 193–196). The carapace is carinate and unevenly covered by granules of varying size; much of the granulation is fine, but some granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 25–26 in males, 20–24 in females. The pectinal marginal tips extend to half of the sixth sternite in males and third of the sixth sternite in females. The pectines

have three marginal lamellae and nine middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth and sparsely hirsute. The seventh sternite bears four well marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 208–216). The pedipalps are sparsely hirsute and smooth. The femur bears four to five granulated carinae, the middle carina on internal surface could be incomplete indicated by several strong granules. The patella bears eight carinae from which internal and dorsal in both sexes are granulated. The chela is without carinae, bulbous with short manus and elongate fixed finger in male. The movable fingers of pedipalps bear 13–14 cutting rows of denticles, every with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 197–200). The tarsomeres bear two rows of short and strong spiniform setae on the ventral surface and numerous macrosetae on the other surfaces. Pedal spur of legs with solitary setae only. Femur bears only



Figures 189–192: *Mesobuthus mischi* sp. n. **Figures 189–190.** Holotype male, dorsal (189) and ventral (190) views. **Figures 191–192.** Paratype female from Hazara Toghai, Afghanistan, dorsal (191) and ventral (192) views.

several macrosetae. Femur and patella with carinae well developed. Tibial spurs present and short on third and fourth legs and absent in the other legs.

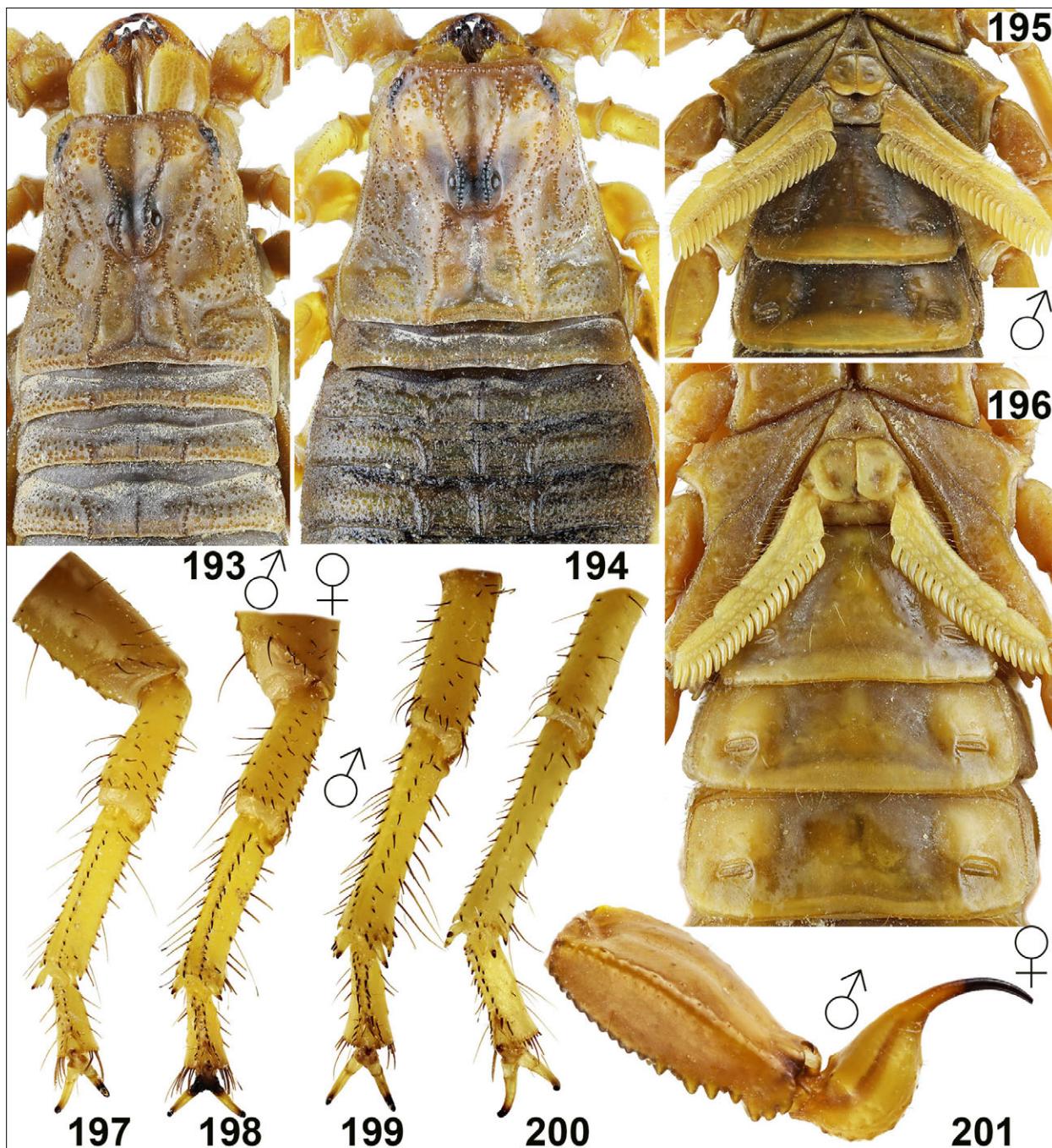
METASOMA AND TELSON (Figs. 201–207). All metasomal segments are only very sparsely hirsute.

The metasomal segment I with 10 carinae, II–III with 8 carinae but other two latero median carinae are indicated by incomplete row of denticles, IV with 8 carinae, and V with 5 carinae. Dorsal and lateral carinae are granulated, dorsal carinae bear larger terminal denticles. Ventral carinae on metasomal segments I–IV are smooth. Ven-

tralateral carinae of metasomal segment V posteriorly with several large lobate denticles. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy or smooth with several solitary granules. The telson is only sparsely hirsute, rather elongate, bumpy and smooth.

***Mesobuthus nenilini* sp. n.**

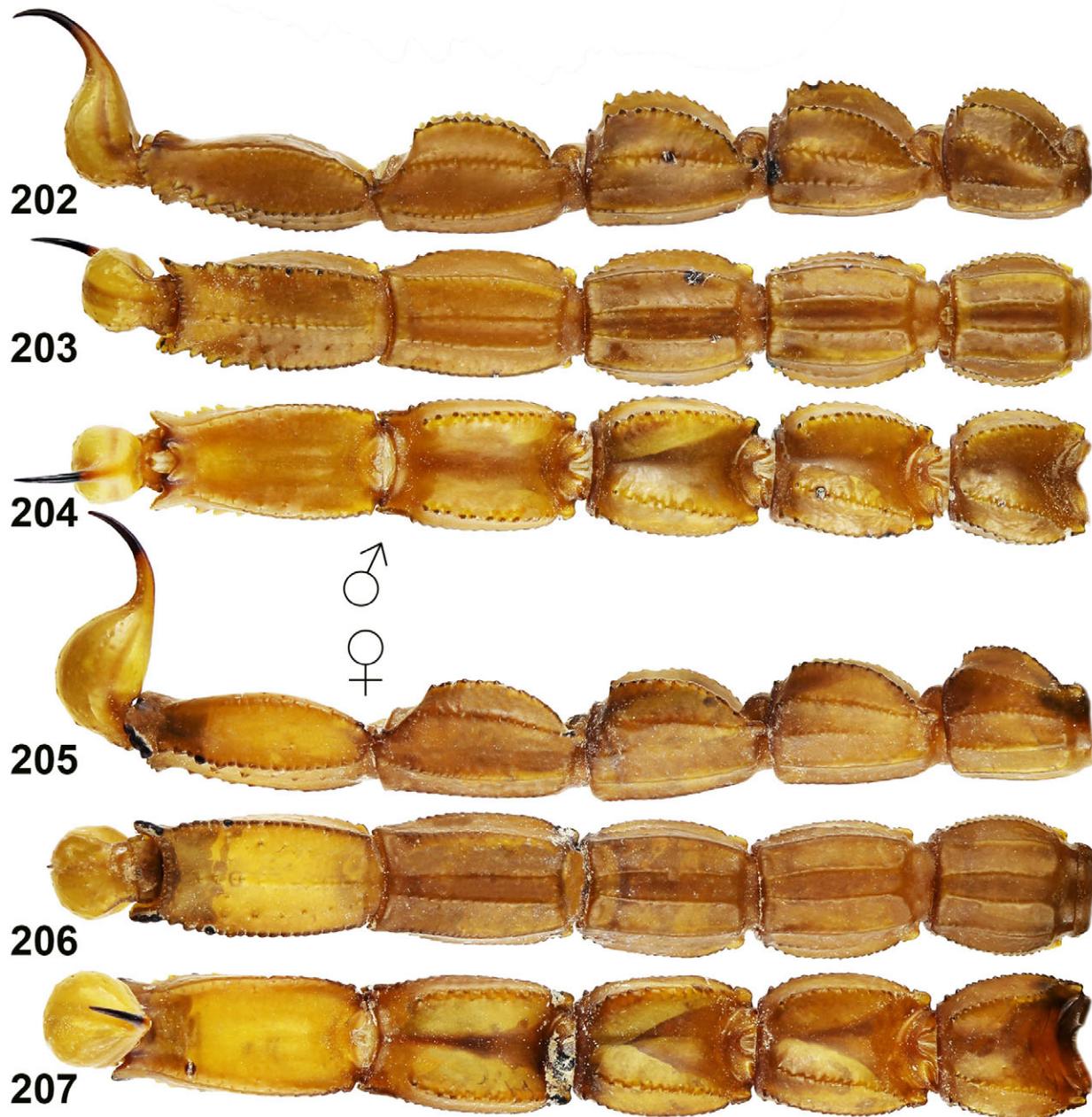
(Figs. 217–245, 272, 282, 300–301, 312, 315, Tables 3–6)
<http://zoobank.org/urn:lsid:zoobank.org:act:65D7A1F0-D43A-448C-A017-48D652DEEF77>



Figures 193–201: *Mesobuthus mischi* sp. n. **Figures 193, 195, 197–201.** Holotype male, chelicerae, carapace and tergites I–III (193), sternopectinal region and sternites III–IV (195), right legs I–IV, retrolateral aspect (197–200), and metasoma V and telson lateral (201). **Figure 194.** Paratype female from Hazara Toghai, Afghanistan, chelicerae, carapace and tergites I–III. **Figure 196.** Paratype female, from Kunduz, Afghanistan, sternopectinal region and sternites III–V.

TYPE LOCALITY AND TYPE REPOSITORY. **Uzbekistan**, Namangan Province, Mingbulak District, ca. 1.5 km SSW of Novbahor, 40°72'N 70°07'E, 350–360 m a.s.l. (FKCP).

ETYMOLOGY. The species is named in honor of Andrei Nenilin (1960–1986), an incredibly talented young zoologist from Uzbekistan whose many contributions were critical for developing arachnology in Central Asia.



Figures 202–207: *Mesobuthus mischi* sp. n. **Figures 202–204.** Holotype male, metasoma and telson, lateral (202), ventral (203), and dorsal (204) views. **Figures 205–207.** Paratype female from Hazara Toghai, Afghanistan, metasoma and telson, lateral (205), ventral (206), and dorsal (207) views.

DISTRIBUTION. Uzbekistan, ?Kyrgyzstan (see Notes) (Figs. 328, A10). 222–223, 232–234, 282, 301), leg. VF & AG (FKCP, NMPC).

TYPE MATERIAL. **Uzbekistan**, Namangan Province, Mingbulak District, ca. 1.5 km SSW of Novbakhor, 40.72°N 70.07°E, 350–360 m a.s.l., 16 May 2002, 1♂ (holotype, Figs. 217–218, 221, 224–231, 237–245, 272, 300, 312, 315) 2♀3juvs.(♂♀) (paratypes, Figs. 219–220,

OTHER MATERIAL STUDIED. **Uzbekistan**, Namangan Province, Mingbulak District, ca. 1.5 km SSW of Novbakhor, 40.72°N 70.07°E, 350–360 m a.s.l., 16 May 2002, 5juvs., leg. VF & AG (VFPC); Namangan Province, Pap District, SE foothills of Kurama Mts., ca.



Figures 208–216: *Mesobuthus mischi* sp. n. **Figures 208–209.** Paratype female from Hazara Toghai, Afghanistan. Pedipalp chela, dorsal (208) and external (209) views. **Figures 210–216.** Holotype male. Pedipalp chela, dorsal (210), external (211), and ventral (212) views. Pedipalp patella, dorsal (213) and external (214) views. Pedipalp femur internal (215) and pedipalp femur and trochanter dorsal (216) views. The trichobothrial pattern is indicated in Figures 211–216.

14 km NW of Khanabad, Rizaksai Valley, 40.9585°N 70.6568°E, 1308 m a.s.l., 15 May 2002, leg. VF & AG, 1♀ (VFPC); Pap District, SE foothills of Kurama Mts., ca. 5.5 km NW of Khanabad, 40.9083°N, 70.7562°E, 859 m a.s.l., 16 May 2002, leg. VF & AG, 1juv (VFPC).

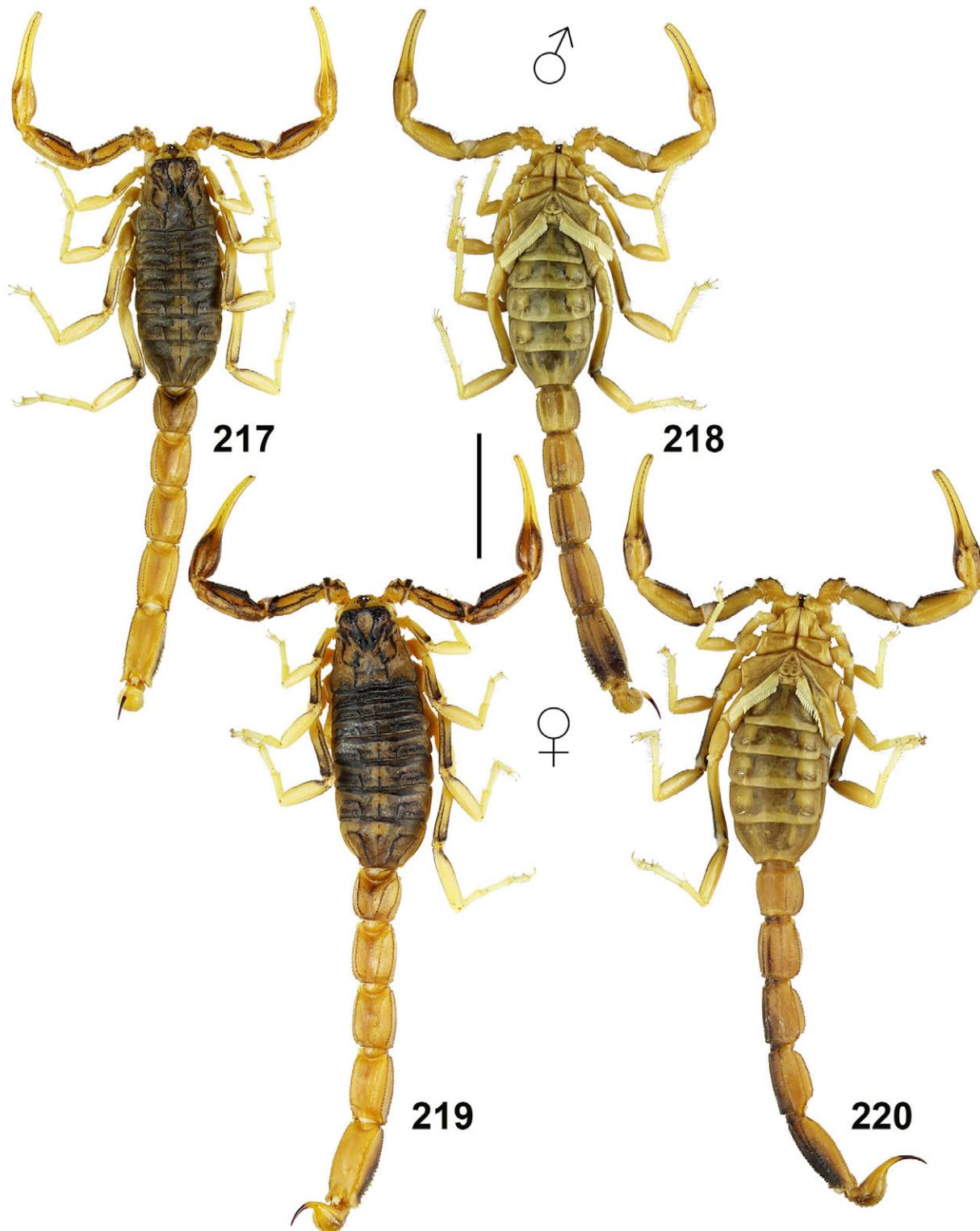
DIAGNOSIS. Total length of adult male 51.5 mm, 50–58 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers little twisted, identically in both sexes. Pedipalp chela length/ width ratio 4.31 in male and 4.09–4.30 in females. Pectinal teeth number 26–28 in males, 21–24 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Carapace and tergites yellowish black, pigmented; metasoma, telson, pedipalps and legs basicly yellowish brown, black pigmented whole pedipalps dorsal, femur of legs, and metasoma ventrally. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela with smooth conspicuous carinae. Movable fingers of pedipalps with 13 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae on metasomal segment II could be indicated by several denticles posteriorly; fifth with 5 carinae. All carinae with consistent small blunt denticles. Length to width ratio of fourth metasomal segment 1.73 in male, 1.62–1.68 in females. Telotarsus III ventral setation repre-

sented by long setae in two rows, each containing not more than 15 setae. Pedal spur of legs with several setae.

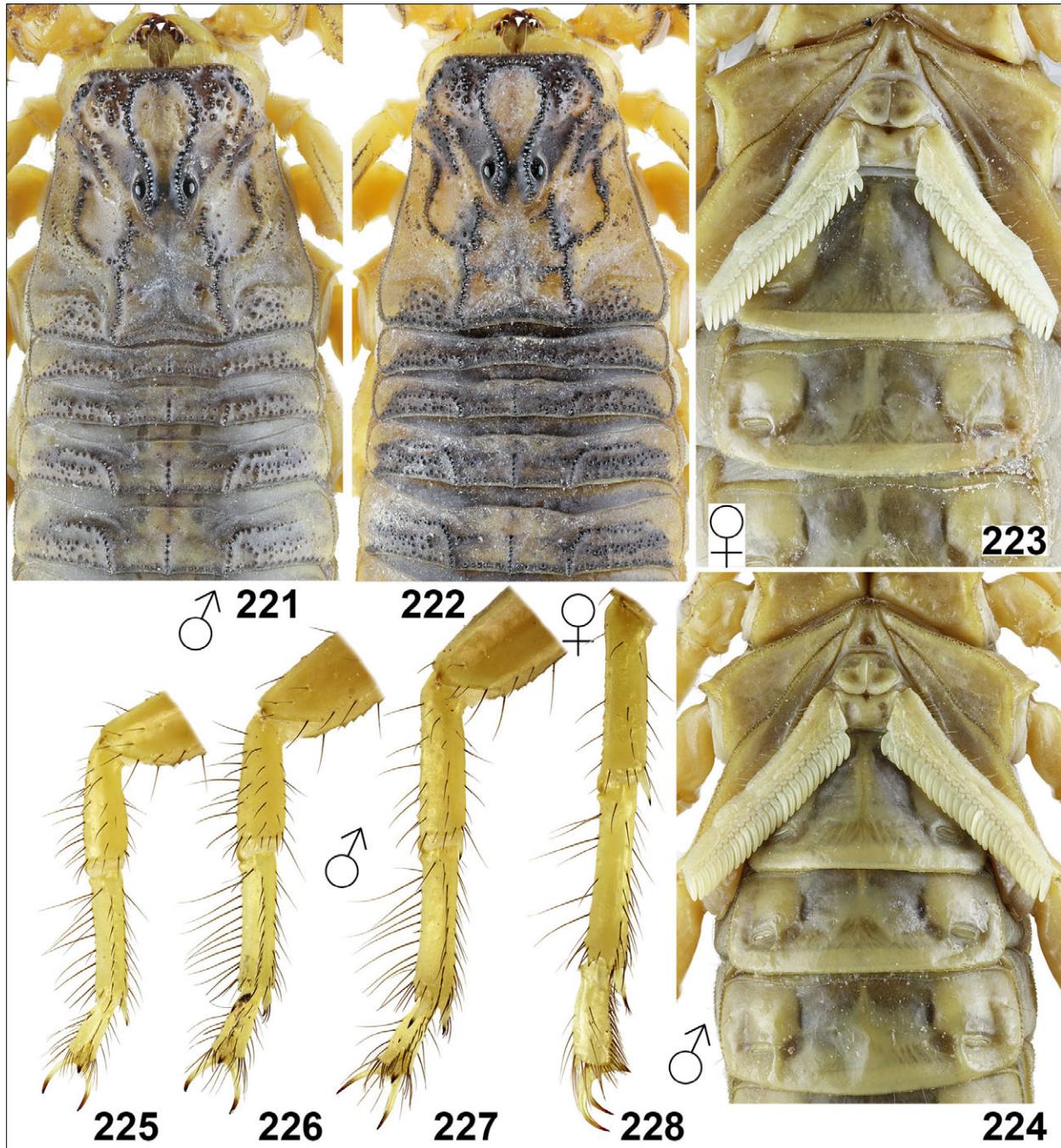
DESCRIPTION. The total length of adult 51.5 mm, 50–58 females. Trichobothrium *db* on fixed finger of pedipalp is situated between trichobothria *est* and *esb*, near to *est*. The fingers are little twisted identically in both sexes. Chelicerae yellow, without reticulation, the tips of teeth on cheliceral fingers are black. For the position and distribution of trichobothria, see Figs. 237–241, 243–244. For measurements see tables 3–5.

COLORATION (Figs. 217–220). The carapace and tergites yellowish black, strongly pigmented. The metasoma, telson, pedipalps and legs are basicly yellowish brown. Black pigmented are whole pedipalps dorsal, femur of legs, and metasoma ventrally.

MESOSOMA AND CARAPACE (Figs. 221–224). The carapace is carinate and unevenly covered by granules of varying size; much of the granulation is fine, but some granules are larger and distinctly rounded. Tergites I–VI bear three carinae and are granulated, with some intercarinal granules small and others larger and rounded. Tergite VII is pentacarinate. The pectinal tooth count is 26–28 in males, 21–24 in females. The pectinal marginal tips extend to about half of the sixth sternite in male and third of the sixth sternite in females. The pectines have three marginal lamellae and eight to nine middle lamellae. The lamellae bear numerous long setae, each fulcrum with three to five setae. All sternites are smooth and sparsely hirsute. The seventh sternite bears four well



Figures 217–220: *Mesobuthus nenilini* sp. n. **Figures 217–218.** Holotype male, dorsal (217) and ventral (218) views. **Figures 219–220.** Paratype female, dorsal (219) and ventral (220) views. Scale bar: 10 mm.



Figures 221–228: *Mesobuthus nenilini* sp. n. **Figures 221, 224–228.** Holotype male, chelicerae, carapace and tergites I–IV (221), sternopectinal region and sternites III–V (224), left legs I–IV, retrolateral aspect (225–228) views. **Figures 222–223.** Paratype female, chelicerae, carapace and tergites I–IV (222), sternopectinal region and sternites III–V (223).

marked granulate carinae. The other sternites bear two furrows.

PEDIPALPS (Figs. 235–245). The pedipalps are sparsely hirsute and smooth. The femur bears four to five granulated carinae, the middle carina on internal surface could be incomplete indicated by several strong granules. The patella bears eight carinae from which internal

and dorsal are granulated and other are smooth in both sexes. The chela is with smooth conspicuous carinae. The movable fingers of pedipalps bear 13 cutting rows of denticles, every with external and internal denticles present, and five terminal denticles.

LEGS (Figs. 225–228). The tarsomeres bear two rows of setae on the ventral surface and numerous macrosetae on



Figures 229–234: *Mesobuthus nenilini* sp. n. **Figures 229–231.** Holotype male, metasoma and telson, lateral (229), dorsal (230), and ventral (231) views. **Figures 232–234.** Paratype female, metasoma and telson, lateral (232), dorsal (233), and ventral (234) views.

the other surfaces. Telotarsus III ventral setation in two rows which every contains not more than 15 setae. Pedal spur of legs obviously with solitary setae only. Femur bears only several macrosetae. Femur and patella with carinae well developed. Tibial spurs present and long on third and fourth legs and absent in the other legs.

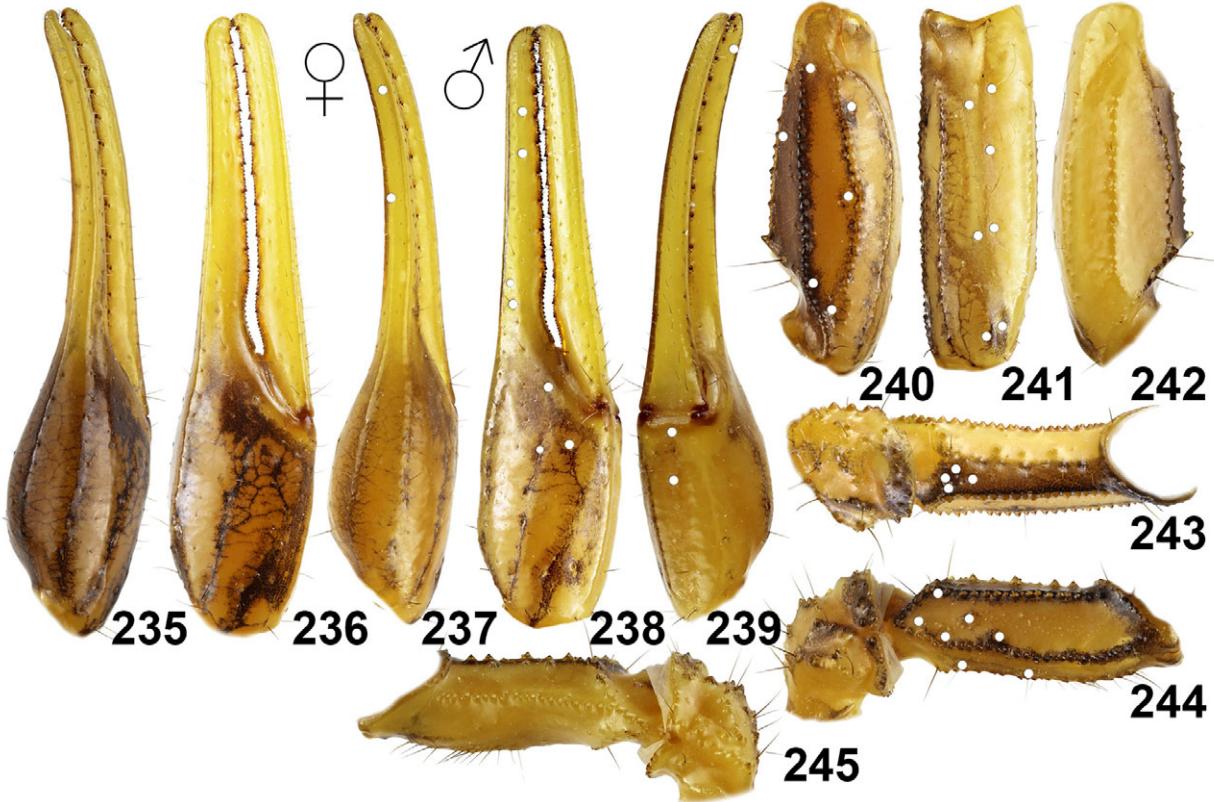
METASOMA AND TELSON (Figs. 229–234). All metasomal segments are only very sparsely hirsute.

The metasomal segment I with 10 carinae, II with 8 carinae but other two lateromedian carinae are indicated by incomplete row of denticles, III–IV with 8 carinae, and V with 5 carinae. All carinae are with consistent small blunt denticles. The dorsal surface of all segments is smooth in the middle and bumpy on margins. Other surfaces are bumpy or smooth with several solitary gran-

ules. Ventrolateral carinae of metasomal segment V posteriorly with several large denticles. The telson is only sparsely hirsute, elongate, bumpy and smooth.

NOTES.

This distinct new species is known currently only from the foothills of the Kurama Mts. in Uzbekistan, reaching a maximum altitude of 859 m a.s.l. *Mesobuthus nenilini* sp. n. is a biogeographically important faunal element since it is so far the only “caucasicus complex” representative identified in the great Western Tien Shan mountain system. The Kurama (or Kuraminsky) mountain range is a spur of the larger Chatkal (or Chatkalsky) range. The Chatkal Moun-



Figures 235–245: *Mesobuthus nenilini* sp. n. **Figures 235–236.** Paratype female. Pedipalp chela, dorsal (235) and external (236) views. **Figures 237–245.** Holotype male. Pedipalp chela, dorsal (237), external (238), and ventral (239) views. Pedipalp patella, dorsal (240), external (241), and ventral (242) views. Pedipalp femur and trochanter internal (243), dorsal (244) and ventral (245) views. The trichobothrial pattern is indicated in Figures 237–241, 243–244.

tains limit the Fergana Valley from the northeast, forming the most western extension of the Tien Shan at the political boundary of Uzbekistan and Kyrgyzstan.

The other five species identified in our revision from the mountains of Uzbekistan and Tajikistan (*M. elenae* sp. n., *M. fuscus*, *M. intermedius*, *M. Kaznakovi*, and *M. kreuzbergi* sp. n.) are found within the western part of the Pamiro-Alai mountain system, usually addressed as Gissaro-Darvaz (or Gissaro-Alai). The Gissaro-Darvaz, which houses very high biodiversity, is geographically well separated from the Western Tien Shan (that lies mainly within Kyrgyzstan borders). We did not study any material from Kyrgyzstan but there are a number of specimens that might belong to *M. nenilini* sp. n. that should be further analyzed. These include the ZISP collections from Kyrgyzstan listed as “*M. caucasicus intermedius*” by Fet (1989: 108).

***Mesobuthus parthorum* (Pocock, 1889), stat. n.**
(Figs. 246–264, 273, 283–284, 302–303, 313, 321,
Tables 4–6)

Buthus parthorum Pocock, 1889: 113, pl. 13, fig. 3.
TYPE LOCALITY AND TYPE REPOSITORY. Iran, Razavi Khorasan Province, between Harirud Valley and Meshed; BMNH.

REFERENCES (selected) (see Fet & Lowe, 2000 for full list before 1998):

- Buthus caucasicus* sbsp. *typica* forma β *parthorum* (in part): Birula, 1897: 386.
- Buthus caucasicus* *parthorum* (in part): Birula, 1904b: 31; Birula, 1911: 16.
- Buthus caucasicus* *parthorum* (in part): Birula, 1917: 71.
- Mesobuthus caucasicus* *parthorum*: Vachon, 1958: 150, figs. 32–35; Fet, 1980: 224 (in part); Fet, 1989: 104–107 (in part); Fet, 1994: 528 (in part).
- Mesobuthus caucasicus* *intermedius* (nec Birula, 1897): Fet, 1989: 107–111 (in part); Fet, 1994: 529 (in part).
- Olivierus caucasicus* *intermedius* (nec Birula, 1897): Fet & Lowe, 2000: 191 (in part).
- Olivierus caucasicus* *parthorum*: Fet & Lowe, 2000: 192 (in part).
- Mesobuthus caucasicus* (nec Nordmann, 1840): Mirshamsi et al., 2011a: 19 (in part); Stewart, 2012: 245; Navidpour, 2015: 12 (in part; Khorasan).
- Afghanobuthus naumannni* Lourenço, 2005: 111–114, figs. 1–9, syn. n.

DISTRIBUTION. Afghanistan, Iran (northeast), Turkmenistan (south) (Figs. 328, A11).

		<i>M. mischi</i> sp. n.		<i>M. nenilini</i> sp. n.	
Dimensions (mm)		♂ holotype	♀ paratype	♂ holotype	♀ paratype
Carapace	L / W	7.55 / 7.70	8.80 / 9.25	6.25 / 6.60	6.80 / 7.50
Mesosoma	L	19.62	17.10	13.10	15.30
Tergite VII	L / W	5.10 / 7.60	6.05 / 9.50	4.05 / 6.05	4.40 / 7.40
Metasoma & telson	L	43.83	45.30	32.11	35.78
Segment I	L / W / D	5.40 / 5.35 / 4.75	5.40 / 5.65 / 4.75	3.85 / 3.80 / 3.15	4.35 / 4.25 / 3.70
Segment II	L / W / D	6.58 / 5.30 / 4.75	6.60 / 5.60 / 4.75	4.55 / 3.55 / 3.10	5.15 / 3.95 / 3.50
Segment III	L / W / D	6.95 / 5.05 / 4.95	6.90 / 5.40 / 4.85	4.85 / 3.55 / 3.05	5.43 / 3.90 / 3.43
Segment IV	L / W / D	7.95 / 5.15 / 4.63	8.25 / 5.25 / 4.80	5.70 / 3.30 / 3.00	6.30 / 3.75 / 3.25
Segment V	L / W / D	8.90 / 4.83 / 3.70	9.15 / 4.70 / 3.90	6.70 / 3.13 / 2.55	7.50 / 3.75 / 2.90
Telson	L / W / D	8.05 / 3.10 / 2.85	8.65 / 3.60 / 3.60	6.46 / 2.35 / 2.20	7.05 / 2.55 / 2.35
Pedipalp	L	27.55	29.28	20.45	22.50
Femur	L / W	6.35 / 1.90	6.95 / 2.28	4.75 / 1.58	5.25 / 1.78
Patella	L / W	7.80 / 2.95	8.23 / 3.35	6.00 / 2.22	6.60 / 2.45
Chela	L	13.40	14.10	9.70	10.65
Manus	L / W / D	4.30 / 4.55 / 4.50	4.70 / 4.25 / 4.35	3.10 / 2.25 / 2.25	4.1 / 2.60 / 2.60
Movable finger	L	9.10	9.40	6.60	7.30
Total	L	71	71.20	51.46	57.88

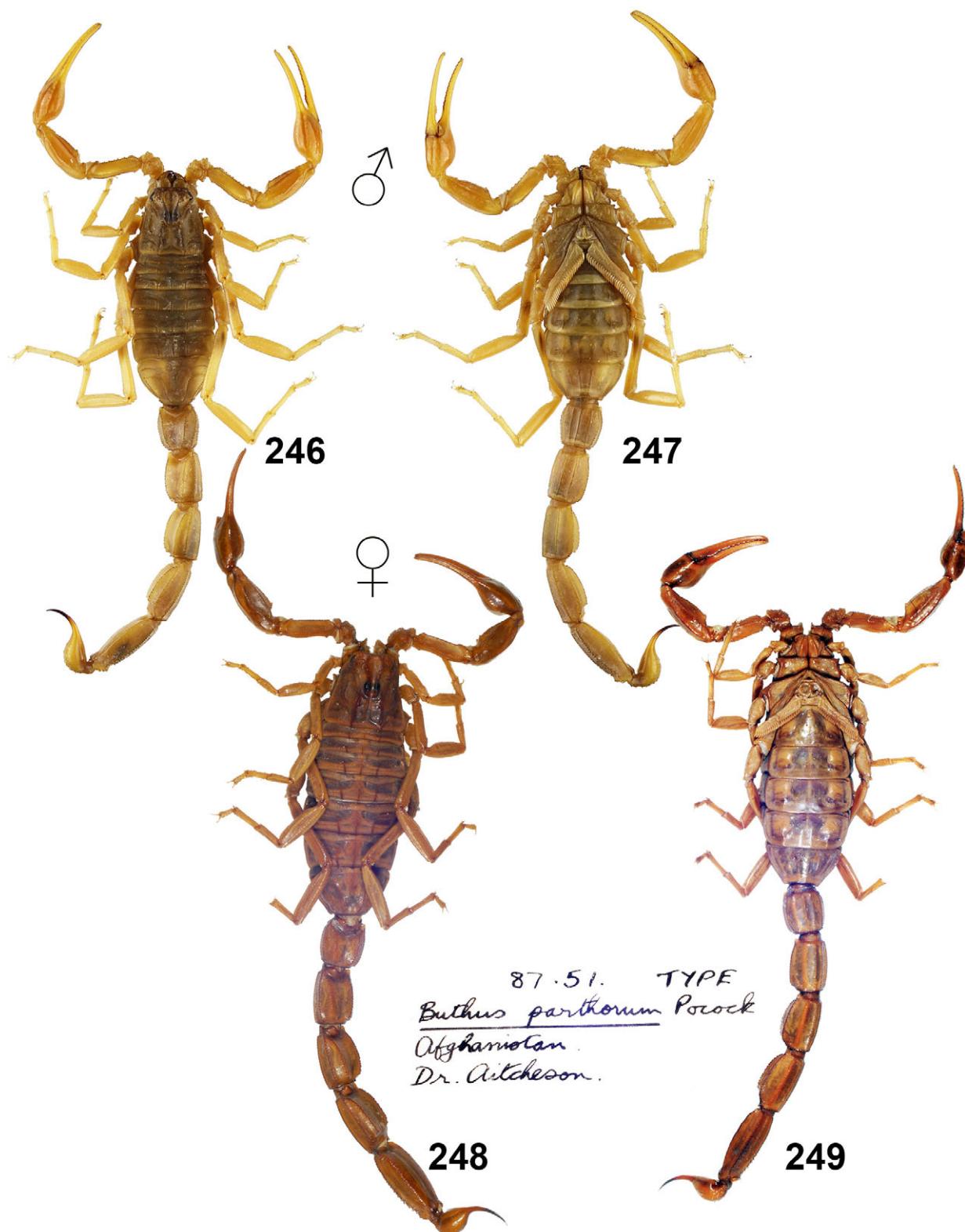
Table 3: Comparative measurements of adults of *Mesobuthus mischi* sp. n. and *M. nenilini* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

TYPE MATERIAL. **Iran**, Razavi Khorasan Province, between Harirud Valley and Meshed (Mashhad), 1♀ (holotype, Figs. 248–249), 36.00°N 60.25°E (approximated), leg. Dr. Aitchison [1888], BMNH No. 87.51 (examined).

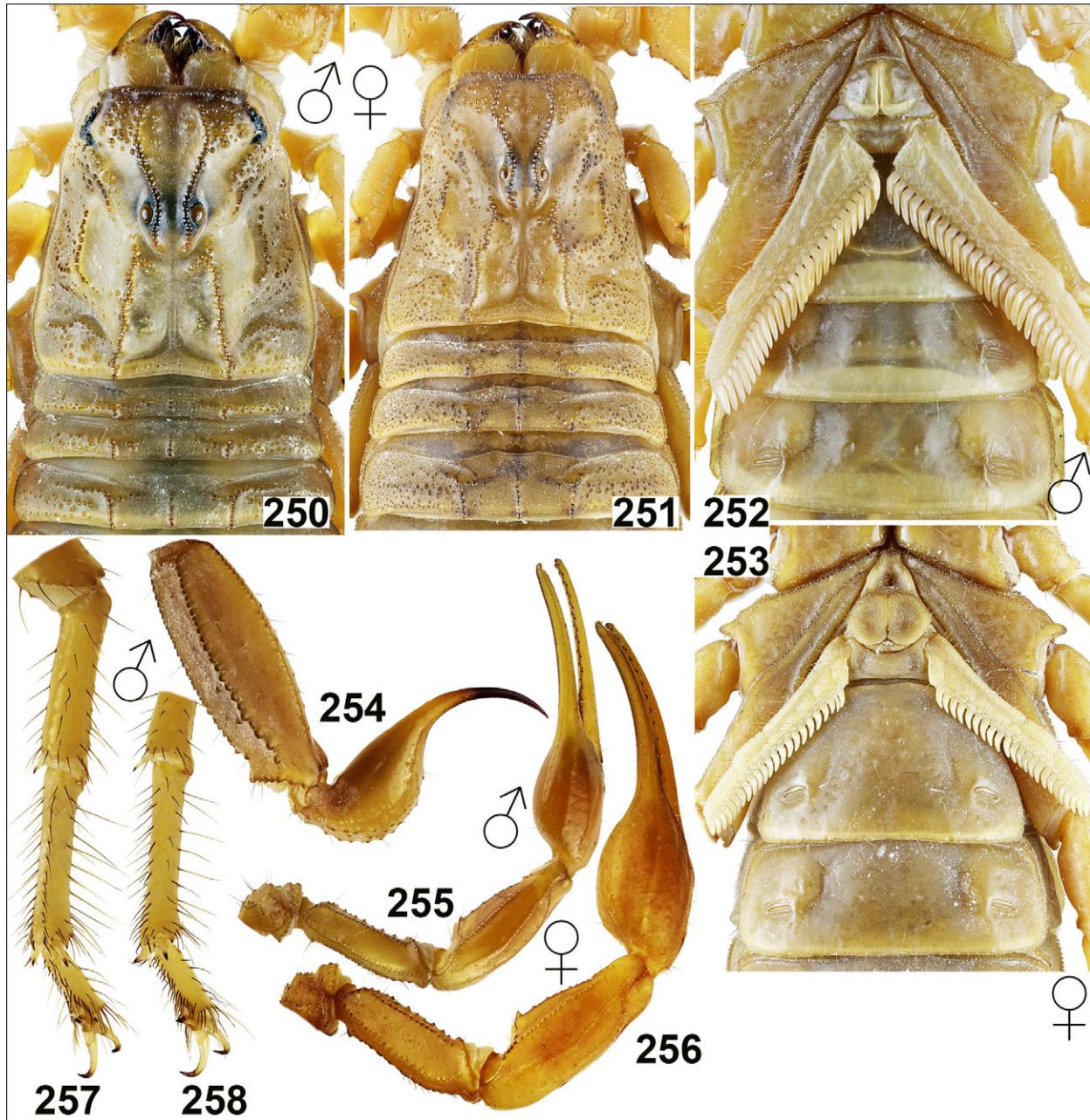
OTHER MATERIAL STUDIED. **Afghanistan**, north, 2012, 1♀1♂, leg. M. Misch (FKCP); *Balkh Province*, Kholm District, Kholm Town area, 36.6736°N 67.6997°E, 550 m a.s.l., 2012, 2♀1♂juv. (Figs. 251, 253, 256, 262–264, 284, 303, 321, compared with holotype), leg. M. Misch (FKCP); *Balkh Province*, Mazar e Sharif City, 36.70°N 67.117°E, 2012, 1♂5juvs.(♂♀), leg. M. Misch (FKCP); *Balkh Province*, Badakhshan, Feyzabad Town, 37.1122°N 70.5514°E, 1400 m a.s.l., 2012, 1♂juv., leg. M. Misch (FKCP); *Ghazni Province*, W of old Ghazni city, 33.56°N 68.41°E, 2200 m a.s.l., 2009, 2♂1♀ (Figs. 246–247, 250, 252, 254–255, 257–264, 273, 283, 302, 313), leg. A. Stewart (FKCP); *Ghazni Province*, 33.50591°N 68.41155°E, 2300 m a.s.l., 2009, 1♀, leg. A. Stewart (NMPC); *Jowzjan Province*, Aqcha, 36.90°N 66.21°E,

1964, 1♀1♂juv. (FKCP); *Kunduz Province*, Chahar Dara District, [36.69°N 68.80°E], 1♂, 2011, leg. M. Misch (FKCP). **Turkmenistan**, Mary Province, Serketabad District, Serketabad, 38.28°N 62.40°E, 667 m a.s.l., 5 April 2002, leg. VF & AG, 1♂juv., (NMPC), 1 juv. (VFPC); *Mary Province*, Serketabad District, Kushka River valley, right bank, ca. 1.5 km NNE of Chemenibit, 35.47°N 62.4°E, 521 m a.s.l., 5 April 2002, leg. VF & AG, 1♀ (VFPC); *Mary Province*, Serketabad District, Badghyz Plateau, Chainury Sands, ca 42 km NW of Chemenibit, 35.65°N 61.83°E, 452 m a.s.l., 6 April 2002, 4juvs.(♂♀), leg. VF & AG (NMPC).

DIAGNOSIS. Total length of adult males 55–64 mm, 70–85 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers little twisted, identically in both sexes. Pedipalp chela length/ width ratio 3.62–4.03 in males and 3.52–4.09 in females. Pectinal teeth number 26–30 in males, 20–24 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hir-



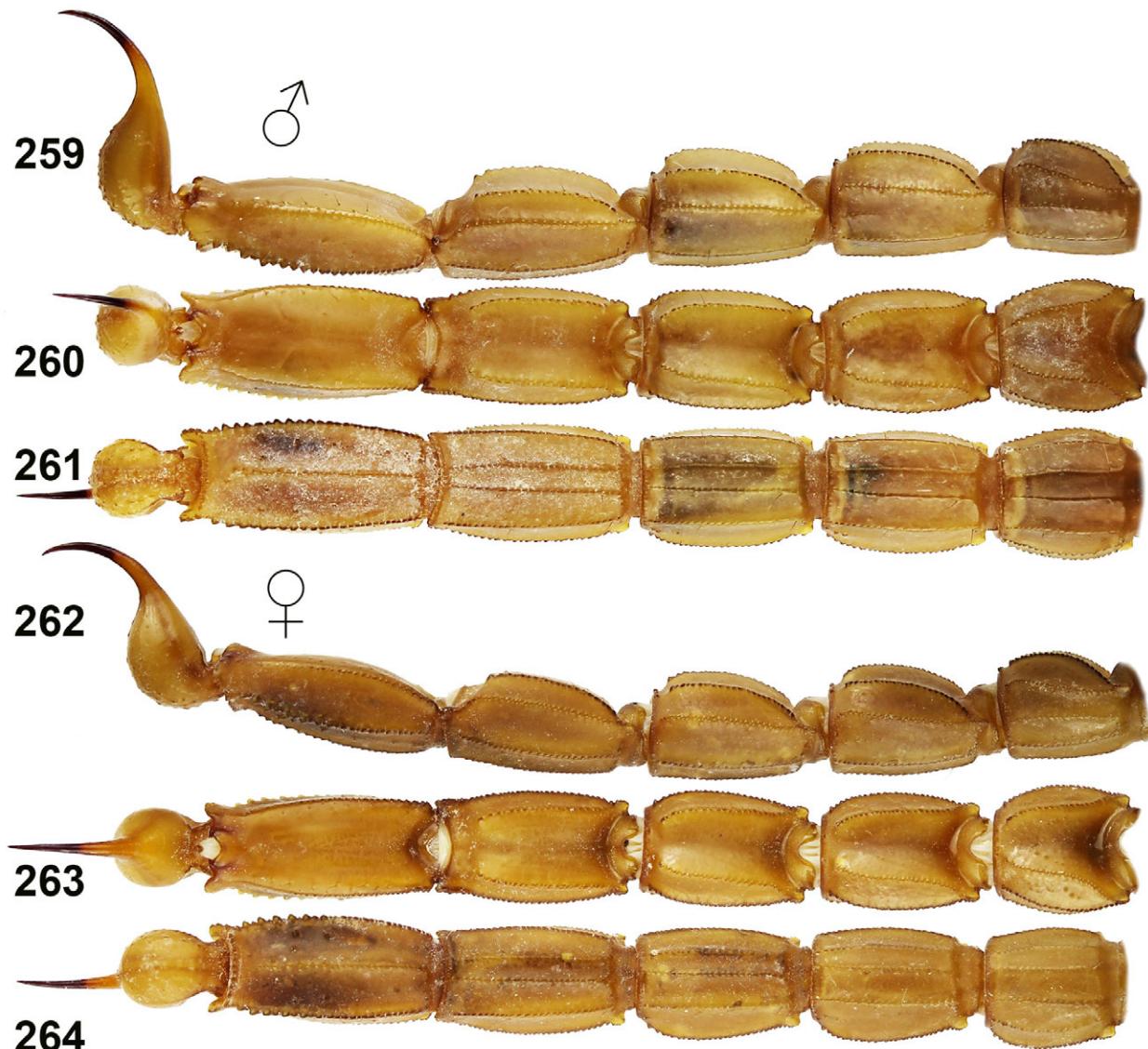
Figures 246–249: *Mesobuthus parthorum*. **Figures 246–247.** Male from Ghazni, Afghanistan, dorsal (246) and ventral (247) views. **Figures 248–249.** Holotype female, dorsal (248) and ventral (249) views. The original label is also included in the plate.



Figures 250–258: *Mesobuthus parthorum*. **Figures 250, 252, 254–255, 257–258.** Male from Ghazni, Afghanistan, chelicerae, carapace and tergites I–III (250), sternopectinal region and sternites III–V (252), metasoma V and telson lateral (254), right pedipalp dorsal (255), and right legs III–IV, retrolateral aspect (257–258). **Figures 251, 253, 256.** Female from Kholm, Afghanistan, chelicerae, carapace and tergites I–III (251), sternopectinal region and sternites III–IV (253), right pedipalp dorsal (256).

sute. Color uniformly white to yellowish grey; pedipalp segments dorsally and metasomal segment V could be black pigmented. Femur of pedipalp with 4–5 granulate carinae. Patella with 8 granulate or smooth carinae. Chela obviously lacks carinae. Movable fingers of pedipalps with 12–14 cutting rows of denticles and 5 terminal denticles. Seventh sternite bears 4 well marked

granulate carinae. First metasomal segment with 10 carinae; second to fourth with 8 carinae, other two carinae on metasomal segment II could be indicated by several denticles posteriorly; fifth with 5 carinae. Dorsal carinae on metasomal segments I–IV composed of consistent small blunt denticles. Length to width ratio of fourth metasomal segment 1.64–1.79 in males, 1.61–



Figures 259–264: *Mesobuthus parthorum*. **Figures 259–261.** Male from Ghazni, Afghanistan, metasoma and telson, lateral (259), dorsal (260), and ventral (261) views. **Figures 262–264.** Female from Kholm, Afghanistan, metasoma and telson, lateral (262), dorsal (263), and ventral (264) views.

1.70 in females. Telotarsus III ventral setation represented by longer setae in two rows. Pedal spur of legs with solitary setae only.

NOTES.

- Pocock (1889) described this species based on a single female that we examined through a kind loan by Janet Beccaloni. The holotype was collected by the British naturalist James Edward Tierney Aitchison in a previously unexplored area, which now lies within three countries: Iran (northeast, Khorassan Province), Afghanistan (northwest; Herat Province), and Turkmenistan (south; Mary Province, Serketabad District).

Aitchison's travels were part of exploration during the Afghan Delimitation Commission that established the final border between Afghanistan and Russian Empire (in its newly annexed Transcaspian Region). While most Aitchison's trips were within Afghanistan (and none within the Russian Empire), some ventured into northeastern Iran; his detailed travelogues and maps are published (Aitchison, 1888). As he traveled "between Harirud Valley and Meshed (now Mashhad)", Aitchison would have traversed low-altitude Paropamisus Mts. from Afghanistan to Iran. Harirud River (under the name Tejen River) forms the modern border between Iran and Turkmenistan. We approximate the type locality (which is not precisely de-

Ratios of Adult Males	<i>M. brutus</i> sp.n. (n = 4)	<i>M. caucasicus</i> (n = 2)	<i>M. fuscus</i> (n = 1)	<i>M. gorelovi</i> sp. n. (n = 3)	<i>M. kaznakovi</i> (n = 4)
Metasomal segment I (L/W)	0.98–0.99	1.08–1.15	1.00	1.09–1.20	1.09–1.11
Metasomal segment II (L/W)	1.24–1.25	1.40–1.45	1.20	1.40–1.44	1.35–1.40
Metasomal segment IV (L/W)	1.53–1.57	1.73–1.86	1.52	1.74–1.91	1.71–1.79
Metasomal segment IV (L/D)	1.53–1.58	1.94–1.97	1.68	2.16–2.27	1.79–1.89
Metasomal segment V (L/W)	2.04–2.11	2.04–2.37	1.95	2.30–2.40	2.05–2.28
Metasomal segment V (L/D)	2.30–2.31	2.48–2.70	2.17	3.00–3.05	2.37–2.48
Telson (L/D)	2.29–2.44	2.79–2.88	2.59	3.23–3.25	2.30–2.75
Pedipalp chela (L/W)	3.13–3.15	3.43–3.62	2.84	3.72–4.60	3.50–3.65
Pedipalp chela (L) / mov. fing. (L)	1.56–1.58	1.52–1.56	1.54	1.45–1.48	1.56–1.58
Total (L)	50–61	50–52	70	49–52	68–70

Ratios of Adult Males	<i>M. kreuzbergi</i> sp. n. (n = 2)	<i>M. mischi</i> sp. n. (n = 1)	<i>M. nenilini</i> sp. n. (n = 1)	<i>M. parthorum</i> (n = 5)
Metasomal segment I (L/W)	0.99–1.07	1.01	1.01	1.03–1.09
Metasomal segment II (L/W)	1.28–1.31	1.24	1.28	1.30–1.42
Metasomal segment IV (L/W)	1.53–1.55	1.54	1.73	1.64–1.79
Metasomal segment IV (L/D)	1.68–1.73	1.72	1.90	1.80–1.93
Metasomal segment V (L/W)	2.09–2.16	1.84	2.14	2.05–2.24
Metasomal segment V (L/D)	2.30–2.56	2.41	2.63	2.69–2.77
Telson (L/D)	2.54–2.80	2.82	2.94	2.41–2.92
Pedipalp chela (L/W)	3.15–3.39	2.95	4.31	3.62–4.03
Pedipalp chela (L) / mov. fing. (L)	1.49–1.54	1.47	1.47	1.42–1.48
Total (L)	65–70	71	51.46	55–64

Table 4: Comparison among *Mesobuthus* species (specimens), based upon selected morphometric ratios of adult males. Abbreviations: length (L), width (W), depth (D).

fined) to be at 36.00°N 60.25°E. Our specimens from Kushka River valley (Turkmenistan, 35.47°N 62.40° E) match Pocock's holotype morphologically and are the closest to type locality.

2. Biogeographically, the “tri-state area” discussed above belongs to the Paropamisus Mts., which are the northernmost, low-altitude latitudinal massif of Hindu Kush range. Paropamisus lies within northeast Iran and northwest Afghanistan, but also extends slightly into modern Turkmenistan at its southernmost point, in Kushka River valley next to Serketabad (formerly Kushka, or Gushgy) town; Kushka River flows from Paropamisus Mts. northward where, within lowland desert, it joins Murghab River near Iolotan, Turkmenistan. Zoogeographic composition of Paropamisus northern foothills and Kushka River valley is quite different from other Turkmenistan mountains, i.e. Kopetdagh Mts. to the west, and Koytendagh (formerly Kugitang) Mts. to the east. It is not surprising to find the clear allopatry between *M. parthorum*, limited to the very south of Turkmenistan (northern foothills of Paropamisus, ca. 600–700 m a.s.l. and Chainur Sands near Kushka Valley) and *M.*

gorelovi sp.n., the most widespread species in the lowland deserts of Central Asia. Notably, *M. gorelovi* sp.n. is found in Turkmenistan not only in the lowland desert of Karakum but also into desert plateaus such as Badghyz (up to 810 m a.s.l., Kepele).

3. The name *Mesobuthus caucasicus parthorum* (as *Buthus c. parthorum*) has been applied to the lowland desert populations found in Turkmenistan for almost 120 years, following the first assignment by Birula (1897). Birula apparently never analyzed Pocock's type, but the ZISP collection at his time contained specimens from Paropamisus Mts. (“south of Kushka”, coll. by K. Ahnger, ZISP 1208; Fet, 1989: 106). However, the majority of specimens available to Birula (1897, 1904a) were psammophiles that originated from the populations inhabiting lowland Karakum Desert (Krasnovodsk, Ashgabat, Anau, Tejen, Repetek, etc.), all assigned by us to *Mesobuthus gorelovi* sp. n. Diagnostic characters that Birula (1897) provided for his *Buthus caucasicus parthorum* and *B. c. intermedius* were inconclusive, which led to his listing of both “subspecies” as found sympatrically in Repetek (Birula, 1911).

Ratios of Adult Females	<i>M. brutus</i> sp.n. (n = 2)	<i>M. caucasicus</i> (n = 5)	<i>M. elenae</i> sp. n. (n = 3)	<i>M. fuscus</i> (n = 5)	<i>M. gorelovi</i> sp. n. (n = 7)
Metasomal segment I (L/W)	0.96–1.00	1.08–1.14	1.06–1.09	1.02–1.04	1.01–1.15
Metasomal segment II (L/W)	1.16–1.23	1.30–1.45	1.37–1.43	1.23–1.30	1.29–1.44
Metasomal segment IV (L/W)	1.48–1.62	1.70–1.81	1.70–1.80	1.61–1.63	1.65–1.88
Metasomal segment IV (L/D)	1.47–1.76	1.89–2.06	2.02–2.04	1.60–1.63	2.02–2.30
Metasomal segment V (L/W)	2.06–2.18	2.00–2.14	2.17–2.33	2.06–2.20	1.98–2.46
Metasomal segment V (L/D)	2.28–2.42	2.47–2.63	2.72–2.85	2.30–2.49	2.80–2.98
Telson (L/D)	2.35–2.43	2.59–2.81	2.74–3.03	2.52–2.57	3.05–3.25
Pedipalp chela (L/W)	3.58–3.65	3.39–3.94	3.54–4.11	3.13–3.40	3.90–4.22
Pedipalp chela (L) / mov. fing. (L)	1.44–1.56	1.39–1.50	1.48–1.51	1.59–1.63	1.39–1.53
Total (L)	60–62	58–73	74–80	74–80	61–70

Ratios of Adult Females	<i>M. kaznakovi</i> (n = 4)	<i>M. kreuzbergi</i> sp. n. (n = 6)	<i>M. mischi</i> sp. n. (n = 5)	<i>M. nenilini</i> sp. n. (n = 2)	<i>M. parthorum</i> (n = 6)
Metasomal segment I (L/W)	1.02–1.07	0.94–1.04	0.96–1.06	0.99–1.02	1.04–1.05
Metasomal segment II (L/W)	1.31–1.45	1.16–1.27	1.18–1.26	1.26–1.30	1.23–1.39
Metasomal segment IV (L/W)	1.69–1.71	1.54–1.63	1.50–1.65	1.62–1.68	1.61–1.70
Metasomal segment IV (L/D)	1.69–1.86	1.56–1.72	1.70–1.81	1.94–1.95	1.65–1.74
Metasomal segment V (L/W)	2.01–2.26	1.98–2.25	1.92–2.05	1.94–2.00	2.17–2.19
Metasomal segment V (L/D)	2.47–2.64	2.30–2.48	2.35–1.60	2.82–3.00	2.46–2.78
Telson (L/D)	2.50–2.66	2.52–2.72	2.40–2.42	2.76–2.84	2.60–2.89
Pedipalp chela (L/W)	3.81–3.93	3.35–3.66	3.11–3.62	4.09–4.30	3.52–4.09
Pedipalp chela (L) / mov. fing. (L)	1.45–1.52	1.48–1.56	1.50–1.52	1.42–1.46	1.45–1.46
Total (L)	68–75	74–85	64–71	50–58	70–85

Table 5: Comparison among *Mesobuthus* species (specimens), based upon selected morphometric ratios of adult females. Abbreviations: length (L), width (W), depth (D).

4. For Afghanistan, a single record was published by Vachon (1958) as *M. caucasicus parthorum* from Kabul, with a redescription and illustrations (Vachon, 1958: 150, figs. 32–35).

Other Taxa (not examined)

Mesobuthus "caucasicus" przewalskii (Birula, 1897)

Buthus caucasicus przewalskii Birula, 1897: 387.
TYPE LOCALITY AND TYPE REPOSITORY. **China**: Xinjiang Uygur Autonomous Region, Lobnor Lake and Cherchen Oasis, ZISP 545(111).

REFERENCES (selected); see Fet (1989) and Fet & Lowe (2000) for full list before 1998:

Buthus caucasicus przewalskii: Birula, 1917: 71.

Buthus caucasicus przewalskii: Birula, 1904a: 24.

Mesobuthus caucasicus przewalskii: Vachon, 1958: 150; Fet, 1989: 111; Sun & Zhu, 2010: 4, figs. 3, 14–16;

Sun & Sun, 2011: 60, figs. 1, 2, 10.

Olivierus caucasicus przewalskii: Fet & Lowe, 2000: 192.

DISTRIBUTION. China, Mongolia, ?Uzbekistan, ?Tajikistan.

TYPE MATERIAL. Syntypes: 5 specimens, **China**: Xinjiang Uygur Autonomous Region, Lobnor Lake and Cherchen Oasis, ZISP 545(111) (not examined).

NOTES.

1. We did not examine any material from these populations. This taxon, which probably deserves species status, currently remains an unassigned “subspecies of *M. caucasicus*”.

2. Birula (1904b) listed under this subspecies also some specimens from Uzbekistan and Tajikistan (ZISP); their identity has not been revised. See Fet (1989) for the full list of labels.

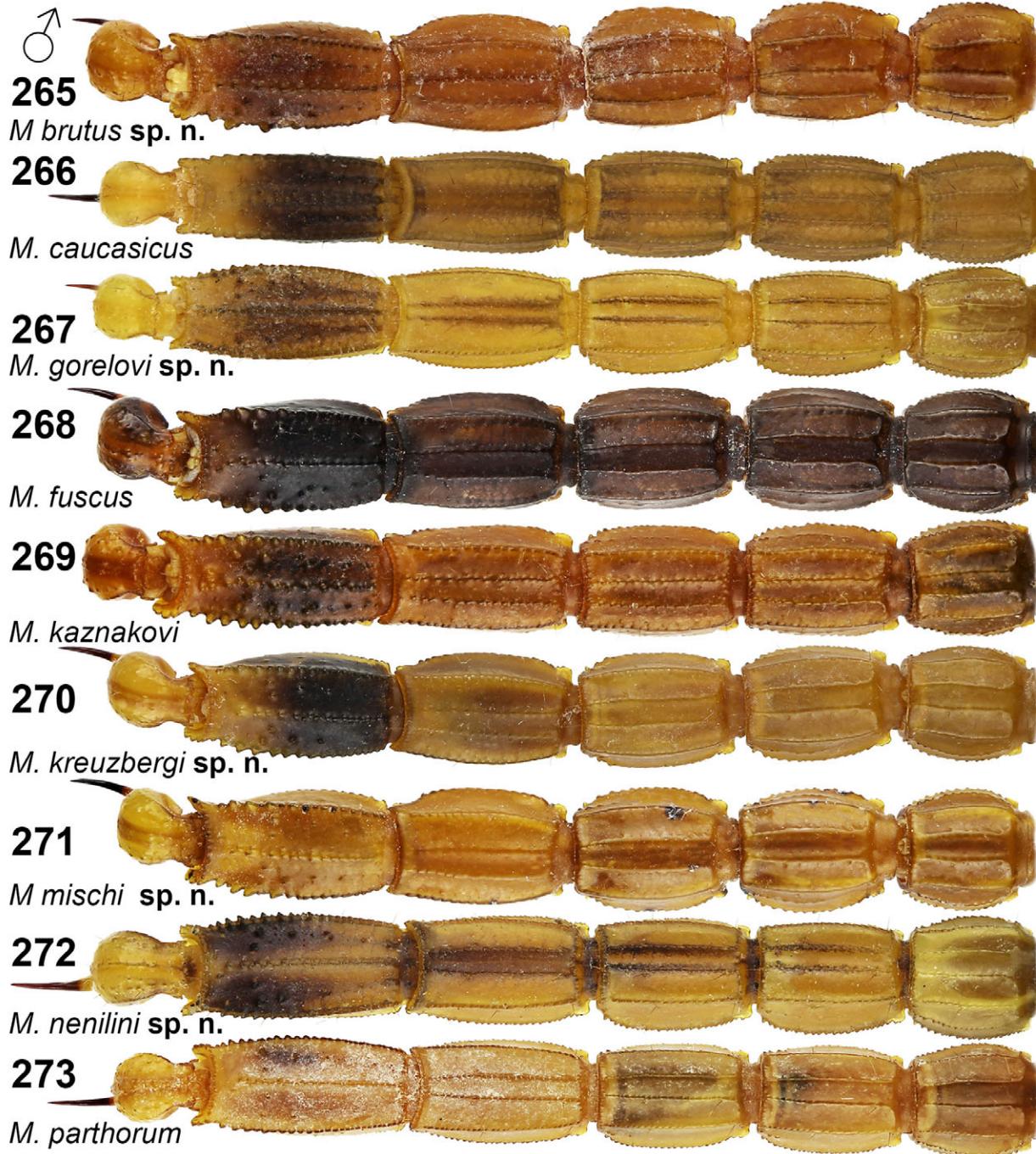
**Key to *Mesobuthus* complexes and species
(excluding taxa from China, Korea and
Mongolia)**

1. Metasomal segment IV with 10 carinae *Mesobuthus cyprius* Gantenbein et Kropf, 2000; *M. gibbosus* (Brullé, 1832); *M. nigrocinctus* (Ehrenberg, 1828)
 - Metasomal segment IV with 8 carinae (Fig. 133). 2
2. Movable fingers of pedipalps with 11–12 cutting rows of denticles. 12th row without external and internal denticles. *Mesobuthus eupeus* (C. L. Koch, 1839) complex including *M. macmahoni* (Pocock, 1900), *M. phillipsii* (Pocock, 1889), and *M. vesiculatus* (Pocock, 1899).
 - Movable fingers of pedipalps with 12–14 cutting rows of denticles. If there are only 12 rows of denticles, the 12th row is always with external and internal denticles (Figs. 304–313). *M. caucasicus* complex 3
3. Pedipalp chela broad, length/width ratio 2.84–3.39 in males and 3.11–3.65 in females. 4
 - Pedipalp chela length/ width ratio 3.43–4.60 in males and 3.39–4.22 in females. 7
4. Telotarsus III ventral setation represented by short and strong spiniform setae (Fig. 274). 5
 - Telotarsus III ventral setation represented by long setae (Fig. 280). *M. kreuzbergi* sp. n.
5. Total length 64–80 in females. Chela very broad in male, length/ width ratio 2.84–2.95. 6
 - Total length 50–62 mm in both sexes. Chela length/ width ratio 3.13–3.15 in male. *M. brutus* sp. n.
6. Pedipalp chela bulbous with short manus and elongated fixed finger in male (Fig. 298). Chelicerae without reticulation (Fig. 193). *M. mischi* sp. n.
 - Pedipalp chela with longer manus and short fixed finger in male (Fig. 290). Chelicerae with reticulation (Fig. 79). *M. fuscus* (Birula, 1897), stat. n.
7. Telotarsus III ventral setation represented by short and strong spiniform setae (Fig. 279). 9
 - Telotarsus III ventral setation represented by long setae (Figs. 275–277). 8
8. Telotarsus III ventral setation with a main row which contains ca 13–15 setae. The second paralel row contains not more than 9 setae (Fig. 277). *M. gorelovi* sp. n.
 - Telotarsus III ventral setation represented by two rows with similar number of setae (Fig. 276). 10
9. Pectinal teeth number 25–27 in males, 19–23 in females. *M. kaznakovi* (Birula, 1904), stat. n.

- Pectinal teeth number 21–23 in males, 17–19 in females. *M. intermedius* (Birula, 1897), stat. n.
- 10. Telotarsus III ventral setation in two rows, each containing more than 16 long setae. Pedal spur of legs densely hirsute (Fig. 276). *M. elenae* sp. n.
 - Telotarsus III ventral setation in two rows, each containing not more than 15 setae. Pedal spur of legs only with solitary setae (Fig. 282). 11
- 11. Total length 50–58 mm in both sexes. Chela length/width ratio 4.31 in male. Pedipalp chela with conspicuous carinae (Fig. 300). *M. nenilini* sp. n.
 - Total length 50–64 mm in males and 58–85 mm in females. Chela length/width ratio 3.43–4.03 in male. Carination on pedipalp chela inconspicuous (Fig. 287–288). 12
- 12. Color light, yellow to white (Fig. 317). Dorsal carinae on metasomal segments I–IV composed of consistent small blunt denticles (Fig. 259).
 - *M. parthorum* (Pocock, 1889), stat. n.
 - Color rather darker, yellowish brown to black. Dorsal carinae on metasomal segments I–IV composed of sharp denticles, which markedly increase in size posteriorly (Fig. 36). *M. caucasicus* (Nordmann, 1840), s. str.

Biogeography

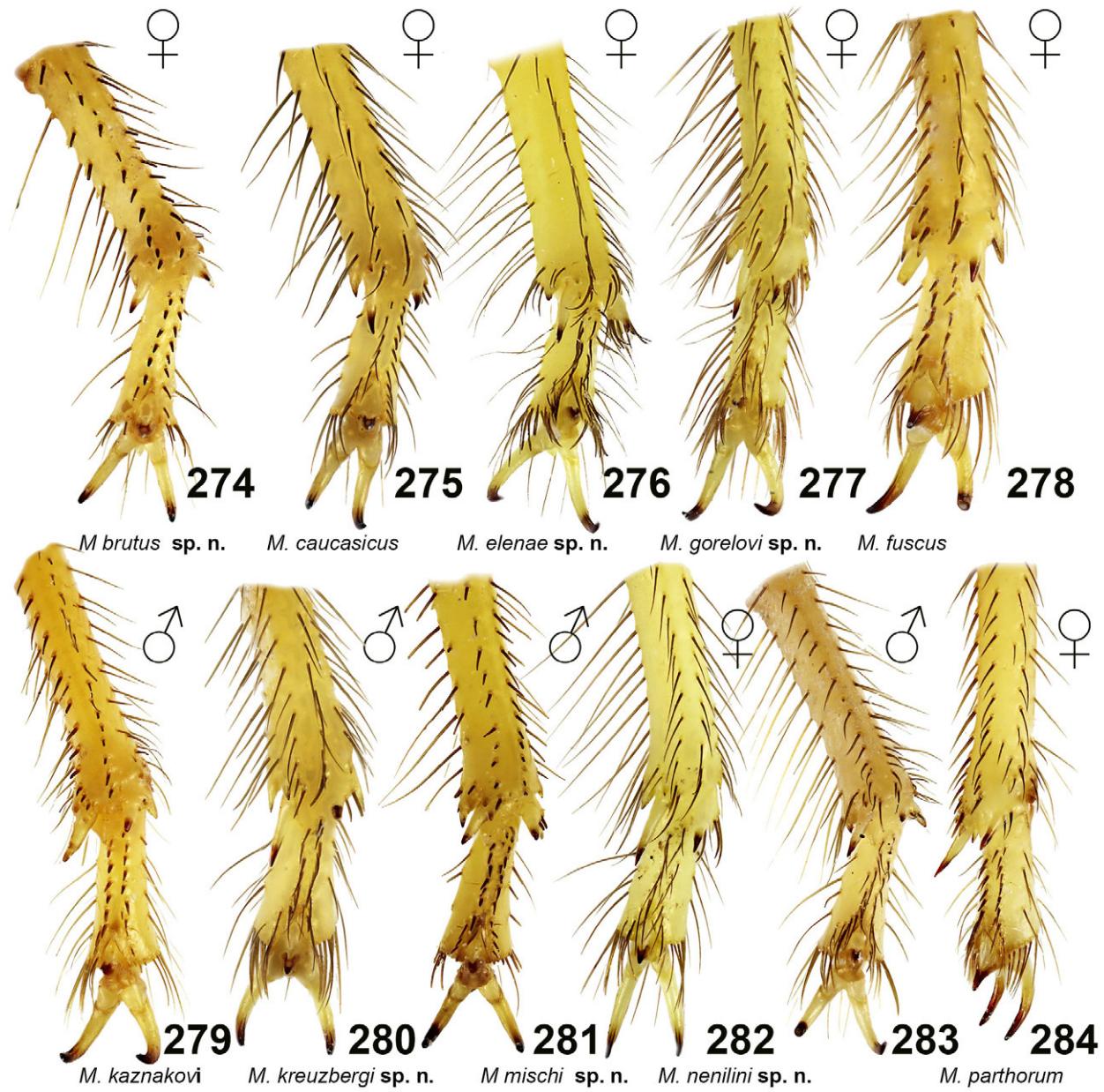
The dynamic biogeographic history of Central Asia is well-known, and likely had a profound impact on the diversification of *Mesobuthus*. The region's fauna, flora and geology have been thoroughly studied. However, prior to the 1990s, most of the existing literature on the subject was published in Russian. Information on Central Asian biogeography was rarely translated to English, and thus remained largely inaccessible to the global research community. The most comprehensive biogeographic review was generated for Coleoptera (Kryzhanovsky, 1965), while the remaining data on the fauna and biogeography of Central Asia are scattered in Russian journals as dozens of papers covering specific taxa and regions. After the demise of the USSR in 1991, the former Soviet Central Asia was fragmented politically into five independent countries (Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, and Turkmenistan). Since then, the rate and quality of zoological research from the region has decreased markedly. Of these five countries, only a comprehensive review of the ecology and biogeography of Turkmenistan has been published in English (Fet & Atamuradov, 1994), and very few studies of Central Asian biogeography have incorporated molecular phylogenies. Our research group and its collaborators were the first to use molecular phylogenetics (based on DNA sequence data) to study the biogeography of scorpions from the Central Asian deserts (Gantenbein et al., 2003; Graham et al., 2012).



Figures 265–273: *Mesobuthus*, metasoma and telson ventral of males. **Figure 265.** *M. brutus* sp. n., holotype. **Figure 266.** *M. caucasicus*, Turkey. **Figure 267.** *M. gorelovi* sp. n., holotype. **Figure 268.** *M. fuscus*, Tajikistan. **Figure 269.** *M. kaznakovi*, Tajikistan. **Figure 270.** *M. kreuzbergi* sp. n., holotype. **Figure 271.** *M. mischi* sp. n., holotype. **Figure 272.** *M. nenilini* sp. n., holotype. **Figure 273.** *M. parthorum*, Afghanistan.

Our time-calibrated phylogeny (Fig. 329) suggests that *Mesobuthus* is an ancient genus with a time to most recent common ancestor (TMRCA) estimate in the Miocene (14.1 – 8.7 Ma; mean = 11.4 Ma). Diversification of *Mesobuthus*, as with many animal and plant groups of Central Asia, is clearly connected to the

region's geomorphology; such as landscape fragmentation driven by mountain uplift and substrate modifications during the formation of sand and clay deserts. Furthermore, enclaves of sand desert within mountain valleys contributed to local evolution of psammophilic fauna, with narrow endemics found at

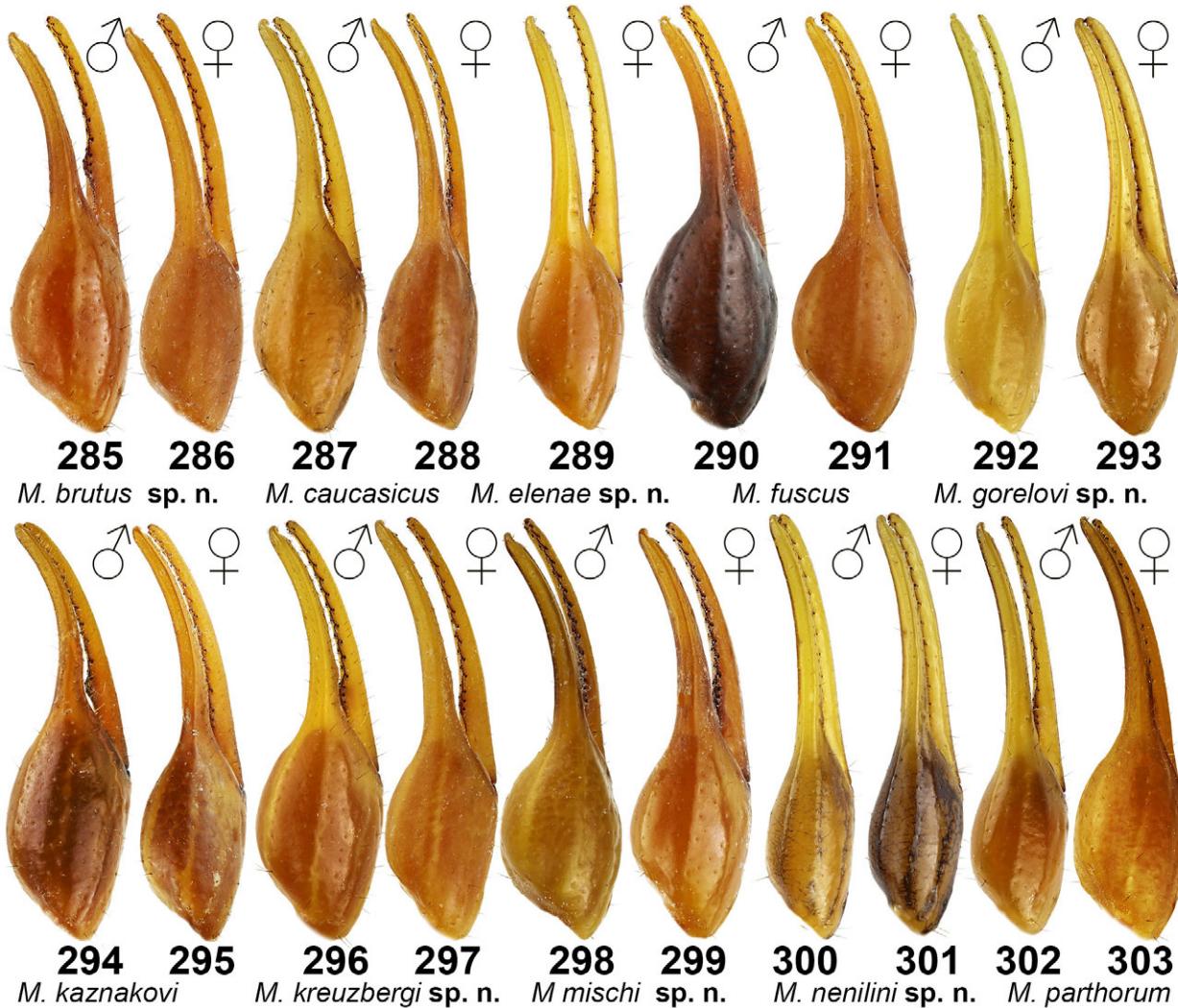


Figures 274–284: *Mesobuthus*, tarsomeres of third leg. **Figure 274.** *M. brutus* sp. n., male holotype. **Figure 275.** *M. caucasicus*, female from Turkey. **Figure 276.** *M. elenae* sp. n., female holotype. **Figure 277.** *M. gorelovi* sp. n., female paratype from type locality. **Figure 278.** *M. fuscus*, female from Tajikistan. **Figure 279.** *M. kaznakovi*, male from Tajikistan. **Figure 280.** *M. kreuzbergi* sp. n., female paratype. **Figure 281.** *M. mischi* sp. n., male holotype. **Figure 282.** *M. nenilini* sp. n., female paratype. **Figure 283–284.** *M. parthorum*, male from Ghazni, Afghanistan (283) and female from Kholm, Afghanistan (284).

considerable altitude. The influence of the interplay of deserts and arid mountains on the Central Asian biota is not unlike that observed and well-studied in scorpions of the North American Southwest (Bryson et al., 2013a, 2013b; Graham et al., 2013a, 2013b, 2017).

In Central Asia, geological data (Atamuradov, 1994) emphasize two major types of late Cenozoic paleogeographical changes, mountain uplift and eustatic changes of the ancient Caspian Sea (a remnant of the

Tethys Sea). Great alluvial deserts, primarily the Karakum and the Kizylkum, have been formed as a result of deposits by the Amudarya and Syrdarya Rivers (reviewed in Graham et al., 2012). Modern mountain chains in Central Asia were created by constant uplift since Miocene, forming several major ranges with a very complex system of valleys cut by many tributaries of the Amudarya and Syrdarya Rivers. The major mountain systems in the eastern Central Asia are Gissaro-Darvaz,



Figures 285–303: *Mesobuthus*, pedipalp chela dorsal. **Figure 285–286.** *M. brutus* sp. n., male holotype (285) and female paratype (286). **Figure 287–288.** *M. caucasicus*, male (287) and female (288) from Turkey. **Figure 289.** *M. elenae* sp. n., female holotype. **Figure 290–291.** *M. fuscus*, differently colored male (290) and female (291) from Tajikistan. **Figure 292–293.** *M. gorelovi* sp. n., male holotype (292) and female paratype (293). **Figure 294–295.** *M. kaznakovi*, male (294) and female (295) from Tajikistan. **Figure 296–297.** *M. kreuzbergi* sp. n., male holotype (296) and female paratype (297). **Figure 298–299.** *M. mischi* sp. n., male holotype (298) and female paratype (299). **Figure 300–301.** *M. nenilini* sp. n., male holotype (300) and female paratype (301). **Figure 302–303.** *M. parthorum*, male (302) and female (303) from Afghanistan.

Pamiro-Alai, and Tien-Shan, with some summits exceeding 5,000 m. These ranges, and partially the Amudarya River, form a lengthy natural boundary of the studied region (Uzbekistan, Tajikistan, Kyrgyzstan) with Afghanistan, India and China. In the west, the largely desert Turkmenistan is bordered by the Caspian Sea, while a lower range of the Kopetdagh Mountains separates Turkmenistan from Iran. Within this geographic setting, we observed several trends of regional fragmentation and substrate specialization.

Although posterior probabilities were low for more ancient nodes (likely due to saturation of mtDNA markers), our phylogenetic analysis suggest that *M.*

mischi sp. n. from Afghanistan formed the most basal position and was quite divergent from a clade containing the remaining species of the ‘*Mesobuthus caucasicus* complex.’ Morphologically, however, this new species mostly closely resembles *M. kaznakovi* (Birula, 1904), suggesting that *Mesobuthus* may harbor cryptic species due to conserved morphology. Further study of *M. mischi* sp. n. and the completely unexplored region it was collected from is warranted.

At around 10 Ma, a clade containing *M. gibbosus* and *M. cyprius* appears to have diverged and spread toward Western Asia (Anatolia), eventually occupying the westernmost part of modern genus’s range. *M. mar-*



Figures 304–315: *Mesobuthus*, pedipalp movable (304–313) and fixed (314–315) fingers. **Figure 304.** *M. brutus* sp. n., male paratype. **Figure 305.** *M. caucasicus*, male from Turkey. **Figure 306.** *M. elenae* sp. n., female holotype. **Figure 307.** *M. gorelovi* sp. n., male holotype. **Figure 308.** *M. fuscus*, female from Tajikistan. **Figure 309.** *M. kaznakovi*, male from Tajikistan. **Figure 310, 314.** *M. kreuzbergi* sp. n., male holotype. **Figure 311.** *M. mischi* sp. n., male holotype. **Figure 312, 315.** *M. nenilini* sp. n., male holotype. **Figure 313.** *M. parthorum*, male from Afghanistan.

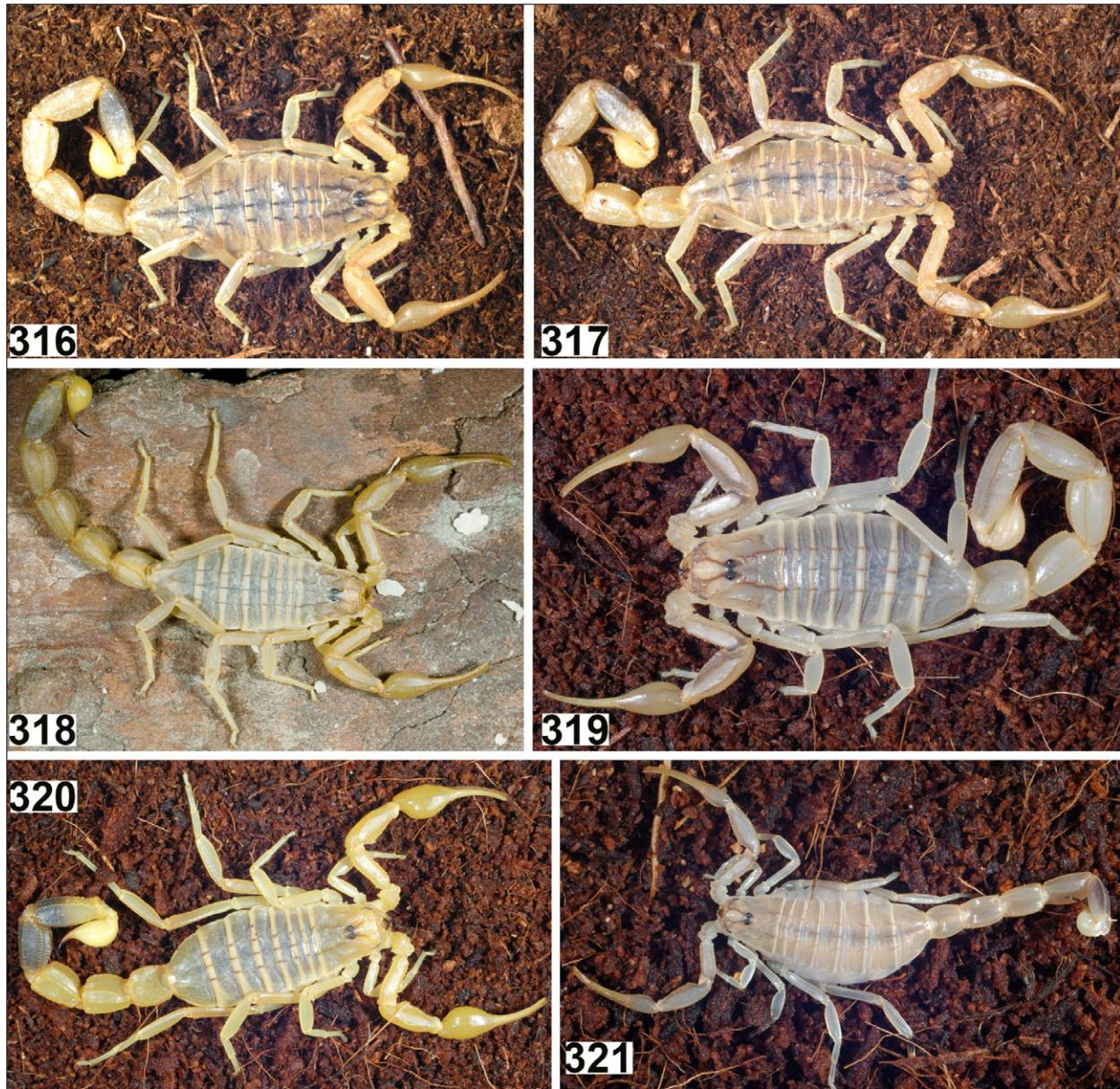
tensii then diverged from a clade containing the remaining species in the late Miocene (10.7 – 5.1 Ma; mean = 8.0) while expanding to the east, to the desert lowlands during aridization through Mongolia and all of China, as far as Korea. Interestingly, *M. martensii* is not closely related to *M. gorelovi* sp. n., the only widespread lowland species in Central Asia.

Although node support is low, our chronogram suggests that the majority of Central Asian *Mesobuthus* species share a common ancestor during the late Miocene (mean = 6.7 Ma). Our eight samples of the largely psammophilic *M. gorelovi* sp. n., which spans the deserts of Central Asia, are supported as monophyletic (0.99 pp). The species contains significant phylogeographic structure, with our five specimens from Turkmenistan forming a clade distinct from populations in Uzbekistan and Kazakhstan. Although not formally described until now, *M. gorelovi* sp. n. is one of the most common scorpion species in Central Asia, found widespread in the lowland deserts and exhibiting psammophilic adaptations such as sand combs. The species is also ecologically dominant (Fet, 1994) and the largest scorpion in the studied region. The distribution of *M. gorelovi* was likely affected by transgressions of the Caspian Sea, especially in the Pliocene and further in the Pleistocene, when it was divided by the Amudarya

River, as found in other co-distributed buthids (Graham et al., 2012). Divergence within *M. gorelovi* was estimated to have occurred in this timeframe (5.2 – 1.4 Ma; mean = 3.1 Ma). Although the northern *M. gorelovi* clade is not strongly supported (0.72 pp), the two main clades within *M. gorelovi* occur on either side the Amudarya River, consistent with the hypothesis of Pliocene vicariance.

The remaining eight species form a clade with poor support (0.34 pp). Most of them are found in Central Asia (plus Iran and Afghanistan), the center of *Meso-buthus* diversity. Among these species we distinguish the following four further clades, each comprised of two sister species:

1. A strongly supported (1.0 pp) Central Asian clade of *M. fuscus* and *M. kreuzbergi* sp. n., both isolated in the Gissar and Babatag ranges of the Gissaro-Darvaz Mts. in southeastern Uzbekistan and southwestern Tajikistan. Divergence of these sister species is dated to the late Miocene to early Pleistocene (6.0 – 1.7 Ma, mean = 3.7 Ma).
2. Another strongly supported (1.0 pp) Central Asian clade, including *M. nenilini* sp. n. from the Kurama Mts. north of the Ferghana Valley of Uzbekistan (possibly a Tien Shan mountain species), and its



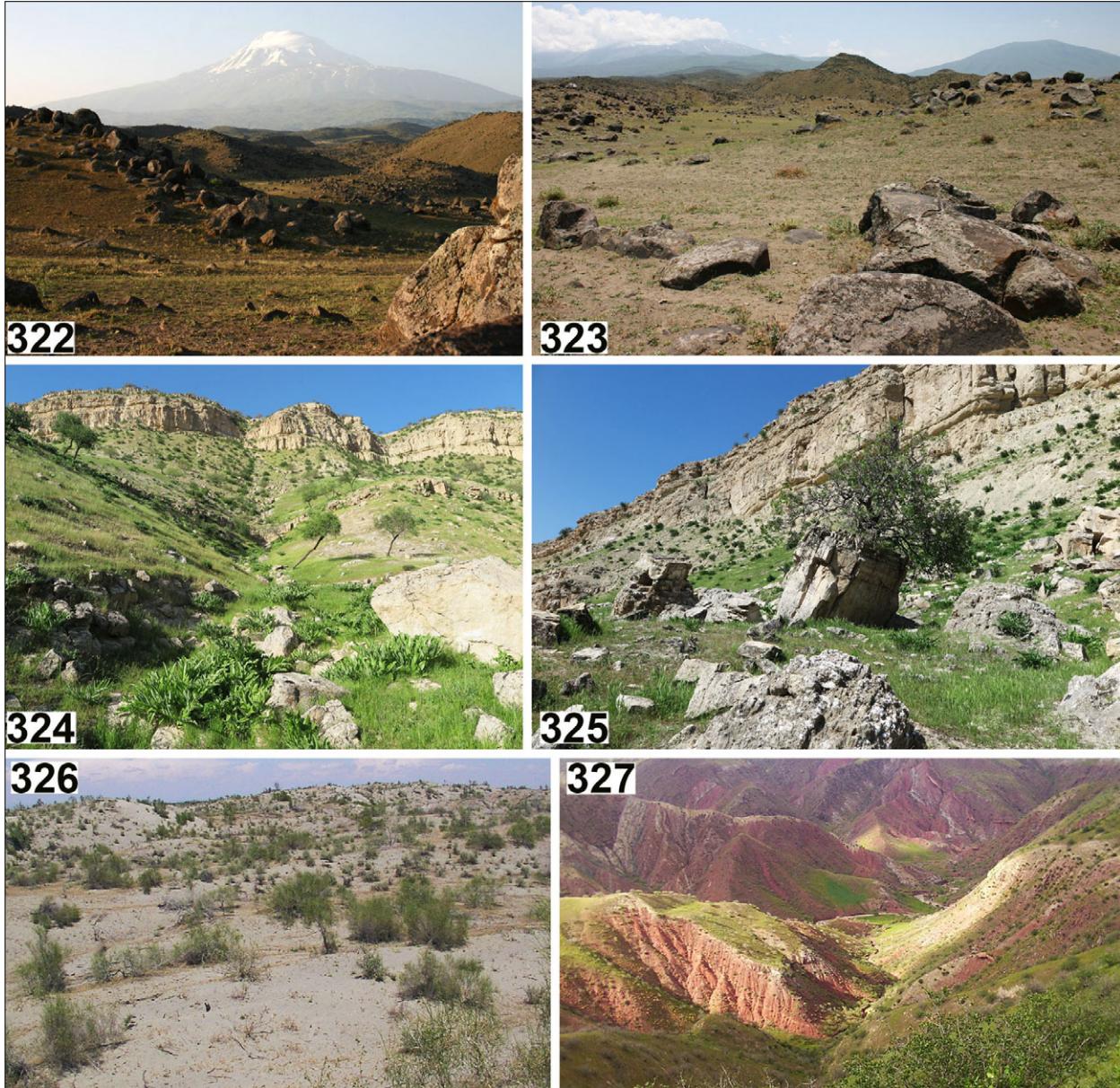
Figures 316–321: *Mesobuthus*, live specimens. **Figure 316.** *M. kaznakovi*, female from Uzbekistan. **Figure 317.** *M. kaznakovi*, male from Tajikistan. **Figure 318.** *M. caucasicus*, female from Iran. **Figure 319.** *M. elenae* sp. n., female. **Figure 320.** *M. kreuzbergi* sp. n., female paratype. **Figure 321.** *M. parthorum*, juvenile from Afghanistan.

clade, *M. kaznakovi*, found in the Gissaro-Darvaz Mts. (Uzbekistan and Tajikistan). The divergence of these sister species is dated to the Pliocene and Pleistocene (4.8 – 1.2 Ma; mean = 2.9 Ma).

3. A weakly supported clade (0.86 pp) comprised of *M. caucasicus* s.str. and *M. intermedius*. The former probably migrated to the West during an aridization cycle. This must have happened via northern Iran, and north to the Russian Caucasus and northeastern Turkey, and not through very high mountains, as

compared to sympatric *M. eupeus*. Interestingly, *M. intermedius* remains isolated in the Gissaro-Darvaz Mts. of Tajikistan. The divergence of these sister species is dated to the late Miocene to early Pleistocene (5.7 – 1.5 Ma; mean = 3.6 Ma).

4. A strongly supported (1.0 pp) “southern” clade containing *M. parthorum* from Iran, Afghanistan, and a small area in the very south of Turkmenistan (foothills of Paropamisus Mts.), and the psammophilic *M. elenae* sp. n. isolated in the Amudarya



Figures 322–327: *Mesobuthus*, localities. **Figures 322–323.** *M. caucasicus*, Turkey, İğdır Province, Melekli Village. **Figures 324–325.** *M. fuscus*, Tajikistan, Khatlon Province, Khuroson District, Ganjina. **Figure 326.** *M. gorelovi*, Uzbekistan, Fargona Province, Yazyavan. **Figure 327.** *M. kreuzbergi*, Uzbekistan, type locality.

Valley of southwestern Tajikistan and southeastern Uzbekistan. Divergence of these sister species is dated to the Pliocene and Pleistocene (4.9 – 1.6 Ma; mean = 3.1 Ma).

Much of this diversity was probably a result of vicariance events in the mountains of Central Asia, centered in the Pliocene, caused by range fragmentation due to the mountain uplift of Gissaro-Darvaz and Pamiro-Alai, which were very active in this epoch. At the same time, the area experienced cycles of aridization and humidification due to the fluctuations in the level of

the Caspian Sea, causing local adaptation among fragmented scorpion populations. Additional samples and genetic markers could reveal further insight into the complex evolutionary history of Central Asian *Mesobuthus*.

Acknowledgments

The 2002 field mission to Central Asia (Kazakhstan, Turkmenistan, and Uzbekistan) that provided a bulk of the studied specimens was supported by the National

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
<i>M. brutus</i> sp. n.	♂	—	—	—	—	—	—	—	2	3	3	1	—	—	—	—
	♀	—	—	—	2	1	1	—	—	—	—	—	—	—	—	—
<i>M. caucasicus</i>	♂	—	—	—	—	—	—	—	2	8	12	21	21	11	1	1
	♀	1	1	2	4	20	34	26	15	2	1	—	—	—	—	—
<i>M. elenae</i> sp. n.	♂	—	—	—	—	—	—	—	1	2	5	—	—	—	—	—
	♀	—	—	—	—	—	12	7	—	—	—	—	—	—	—	—
<i>M. fuscus</i>	♂	—	—	—	—	—	—	—	—	2	3	4	6	1	—	—
	♀	—	—	1	—	3	12	6	12	3	—	—	—	—	—	—
<i>M. gorelovi</i> sp. n.	♂	—	—	—	—	—	—	1	6	10	14	5	3	—	—	—
	♀	1	3	7	16	15	17	17	1	—	—	—	—	—	—	—
<i>M. kaznakovi</i>	♂	—	—	—	—	—	—	—	—	1	3	1	—	—	—	—
	♀	—	—	1	4	1	2	1	—	—	—	—	—	—	—	—
<i>M. kreuzbergi</i> sp. n.	♂	—	—	—	—	—	—	—	—	—	1	6	7	5	3	—
	♀	—	—	—	1	1	12	23	11	4	—	—	—	—	—	—
<i>M. mischi</i> sp. n.	♂	—	—	—	—	—	—	—	—	3	1	—	—	—	—	—
	♀	—	—	—	3	2	1	3	6	—	—	—	—	—	—	—
<i>M. nenilini</i> sp. n.	♂	—	—	—	—	—	—	—	—	—	1	2	1	2	—	—
	♀	—	—	—	—	2	5	8	1	—	—	—	—	—	—	—
<i>M. parthorum</i>	♂	—	—	—	—	—	—	—	—	3	8	5	4	2	1	—
	♀	—	—	—	2	8	8	6	1	—	—	—	—	—	—	—

Table 6: Comparison among *Mesobuthus* species, based upon pectinal teeth number. Data from selected specimens studied in this revision; additional data for *M. caucasicus* (Caucasus) from ŽISP collection (Fet, 1989) scored by VF in 1987-88.

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Finally, VF would like also to thank his late mentors, Gary A. Polis (California, USA) and Oleg L. Kryzhanovsky and Yaroslav I. Starobogatov (both of St. Petersburg, Russia) for their great support of his desert scorpion studies.

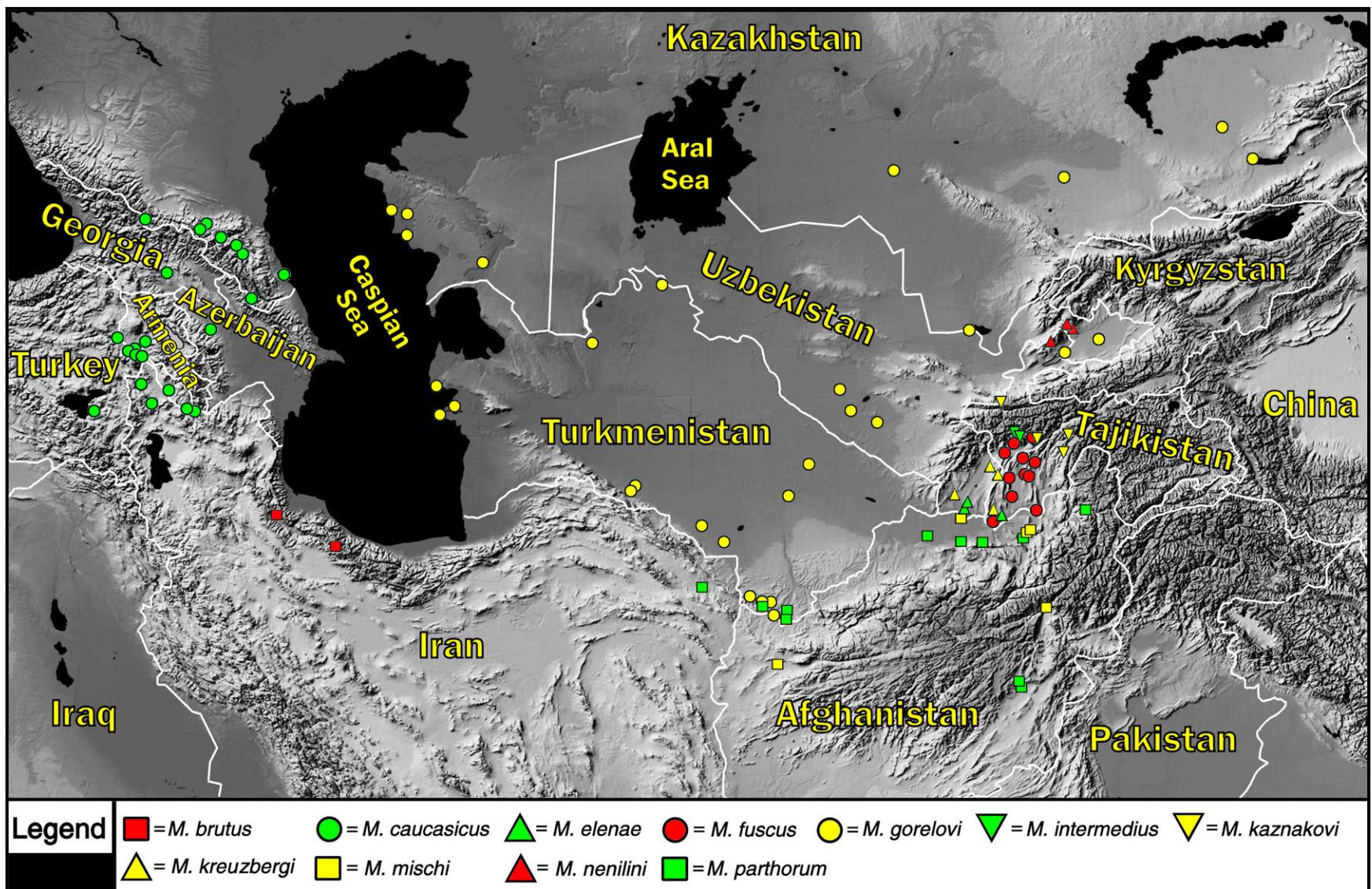


Figure 328: Distribution map showing all species examined in this study. See Appendix A for distribution maps of each species.

	Ingroup Species	Label	Tree label	GenBank accession numbers	
				<i>COI</i>	
1	<i>Mesobuthus caucasicus</i> (Nordmann, 1840)	Turkey: İğdir Province: Melekli Village, 39.9181°N, 44.1263°E, 897 m a.s.l., 7 July 2012, leg. E.A. Yağmur (FKPC)	Mcaucasicus_TR	MG586931	MG586916
2	<i>Mesobuthus elenae</i> sp.n.	Uzbekistan: Surxondaryo Province: Jarkurgan District, ca. 3 km W of Jarkurgan, 37.5055 N, 67.3688°E, 365 m a.s.l., 26 April 2002, leg. VF & AG (VFPC)	Melenae_UZ1	MG586932	AJ550677
3	<i>M. elenae</i> sp.n.	Uzbekistan: Surxondaryo Province: Angor District, Kattakum Sands, ca. 4 km NE of Uchkyzyyl, 37.3722°N 67.2730°E, 28 April 2002, leg. VF & AG (VFPC); type locality.	Melenae_UZ2a	AJ783524	n/a
			Melenae_UZ2b	AJ783525	AJ783571
				n/a	AJ783572
4	<i>M. elenae</i> sp.n.	Tajikistan: Khatlon Province: Haartuz District, Kurjalakum Sands, 37.1352°N 68.1577°E, 2 May 2002, leg. A. Feodorov (VFPC)	Melenae_TJ1a	MG586933	MG586917
			Melenae_TJ1b	AJ783604	AJ783546
			Melenae_TJ1c	AJ783605	AJ783547
5	<i>Mesobuthus fuscus</i> (Birula, 1897)	Tajikistan: Khatlon Province, Khuroson District, Ganjina, 37.9617°N 68.5619°E, 716 m a.s.l., 22 April 2015, leg. Y. M. Marusik (FKCP); both color varieties.	Mfuscus_TJ1a (non-melanistic)	MG586934	MG586918
			Mfuscus_TJ1b (melanistic)	MG586935	MG586919
			Mfuscus_TJ1c (melanistic)	MG586936	MG586920
6	<i>M. fuscus</i> (Birula, 1897)	Tajikistan: Khatlon Province, Vaksh Karatau Mt. Range, Khodjamaston Mt. 38.0042°N 68.9740°E, 1595 m a.s.l., 24 April 2015, leg. Y. M. Marusik (FKCP)	Mfuscus_TJ2 (melanistic)	MG586937	MG586921
7	<i>M. gorelovi</i> sp.n.	Kazakhstan: Kyzyl-Orda Province: Chiili District, ca. 2.5 km NW of Baigakum, 44.65°N, 66.02°E, 143-127 m a.s.l., 25 May 2002, leg. VF & AG (VFPC)	Mgorelovi_KZ	MG586938	MG586922
8	<i>M. gorelovi</i> sp.n.	Turkmenistan: Akhal Province: Tejen District, near Tejen Reservoir, ca. 12 km SSE of Gangaly, 36.92°N, 60.83°E, 235 m a.s.l., 3 April 2002, leg. VF & AG (VFPC); type locality.	Mgorelovi_TU1	MG586939	MG586923
9	<i>M. gorelovi</i> sp.n.	Turkmenistan: Mary Province: Serketabad	Mgorelovi_TU2a	MG586945	MG586924

		District, Badghyz Nature Reserve, Kepele, 35.8°N, 61.53°E, 810 m a.s.l., 10 April 2002, leg. VF & AG (VFPC)	Mgorelovi_TU2b	AJ783614	AJ783556
10	<i>M. gorelovi</i> sp.n.	Turkmenistan: Lebap Province: Charzhev District, East Karakum Desert, Repetek Nature Reserve, 38.55°N 63.17°E, 201 m a.s.l., 15-18 April 2002, leg. VF & AG (VFPC)	Mgorelovi_TU3a	MG586946	MG586925
			Mgorelovi_TU3b	AJ783515	AJ783563
11	<i>M. gorelovi</i> sp.n.	Uzbekistan: Buxoro Province: Romitan District, between Bukhara and Gazli, 12 km NW of Kokushtuvan, 40.0838°N 64.0672°E, 206 m a.s.l., 11 May 2002, leg. VF & AG (VFPC)	Mgorelovi_UZ1	AJ783521	AJ783569
12	<i>M. gorelovi</i> sp.n.	Uzbekistan: Fergana Province: Yazyavan District, Karakalpak Steppe, ca. 18 km W of Yazyavan, 40.6580°N 71.5072°E, 403 m a.s.l., 20 May 2002, leg. VF & AG (VFPC)	Mgorelovi_UZ2	AJ550696	AJ550678
13	<i>Mesobuthus intermedius</i> (Birula, 1897)	Tajikistan: Dushanbe Province, Gissar Mt. Range, 38th km of Varzob Hwy, Takob Gorge, env. of Dehmalik Village, 38.84715°N 68.91°E, 805 m a.s.l., 8 May 2015, leg. Y. M. Marusik & M. Saidov (FKCP).	Mintermedius_TJ1a	MG586940	MG586926
			Mintermedius_TJ1b	MG586941	MG586927
14	<i>Mesobuthus kaznakovi</i> (Birula, 1904)	Uzbekistan: Jizzakh Province, a Turkmen village near Zaamin, 39.61°N 68.50°E, November 2010 (FKCP; Buthid002)	Mkaznakovi	MG586944	MG586928
15	<i>Mesobuthus kreuzbergi</i> sp.n.	Uzbekistan: Surxondaryo Province: Uzun District, Babatag Mts., E slope, 7 km W of Okmachit, 38.20°N 68.05°E, 1132 m a.s.l., 30 April 2002, leg. VF & AG (VFPC); type locality.	Mkreuzbergi_UZ	AJ550697	AJ550679
16	<i>M. kreuzbergi</i> sp.n.	Tajikistan: Khatlon Province, Shaartuz District, Chiluchor-Chashma, 37.2993°N 68.04375°E, 399 m a.s.l., 19 April 2015, leg. Y. M. Marusik (NMPC; MRG 1640)	Mkreuzbergi_TJ	MG586942	MG586929
17	<i>Mesobuthus mischi</i> sp.n.	Afghanistan: Balkh Province, Hazara Toghai village, 37.22°N 67.21°E, 300 m a.s.l., October-December 2012, leg. M. Misch (FKCP; Buthid027)	Mmischi	MG586943	MG586930
18	<i>Mesobuthus nenilini</i> sp.n.	Uzbekistan: Namangan Province: Pap District, SE foothills of Kurama Mts., ca. 5.5 km NW of Khanabad, 40.9083°N 70.7562°E, 859 m a.s.l., 16 May 2002, leg. VF & AG (VFPC)	Mnenilini_UZ1	AJ783522	AJ783569

19	<i>M. nenilini</i> sp.n.	Uzbekistan: Namangan Province: Pap District, SE foothills of Kurama Mts., ca. 14 km NW of Khanabad, Rizaksai Valley, 40.9585°N 70.6568°E, 1308 m a.s.l., 15 May 2002, leg. VF & AG (VFPC)	Mnenilini_UZ2	AJ783518	AJ783566
20	<i>Mesobuthus parthorum</i> (Pocock, 1889)	Turkmenistan: Mary Province: Serketabad District, Badghyz Plateau, Chainury Sands, ca. 42 km NW of Chemenibit, 35.65°N 61.83°E, 452 m a.s.l., 6 April 2002, leg. VF & AG (VFPC)	Mparthorum_TU1a	AJ783612	AJ783554
			Mparthorum_TU1b	AJ783514	AJ783562
21	<i>M. parthorum</i> (Pocock, 1889)	Turkmenistan: Mary Province: Serketabad District, Kushka River valley, right bank, ca. 1.5 km NNE of Chemenibit, 35.47°N 62.40°E, 521 m a.s.l., 5 April 2002, leg. VF & AG (VFPC)	Mparthorum_TU2	AJ783516	AJ783564
22	<i>M. parthorum</i> (Pocock, 1889)	Turkmenistan: Mary Province: Serketabad District, Serketabad, 38.28°N 62.40°E, 667 m a.s.l., 5 April 2002, leg. VF & AG (VFPC)	Mparthorum_TU3a	AJ783606	AJ783548
			Mparthorum_TU3b	AJ783613	AJ783555
Outgroup Species					
23	<i>Buthus ibericus</i> Lourenço et Vachon, 2004		Bibericus	GQ168524	n/a
24	<i>Buthus occitanus</i> (Amoreux, 1789)		Boccitanus	EU523755.1	EU523755.1
25	<i>Mesobuthus cyprius</i> Gantenbein et Kropf, 2000		Mcyprius	AJ550698	n/a
26	<i>M. eupeus</i> (C. L. Koch, 1839)		Meupeus	AJ550701	AJ550688
27	<i>M. gibbosus</i> (Brullé, 1832)		Mgibbosus	DQ310883.1	DQ310846.1
28	<i>M. martensii</i> (Karsch, 1879)		Mmartensii	Q340065.1	DQ340065.1

Table 7: Label data for ingroup specimen vouchers, labels used on the phylogenetic tree, and GenBank accession numbers for samples used in the phylogenetic analysis (Fig. 329).

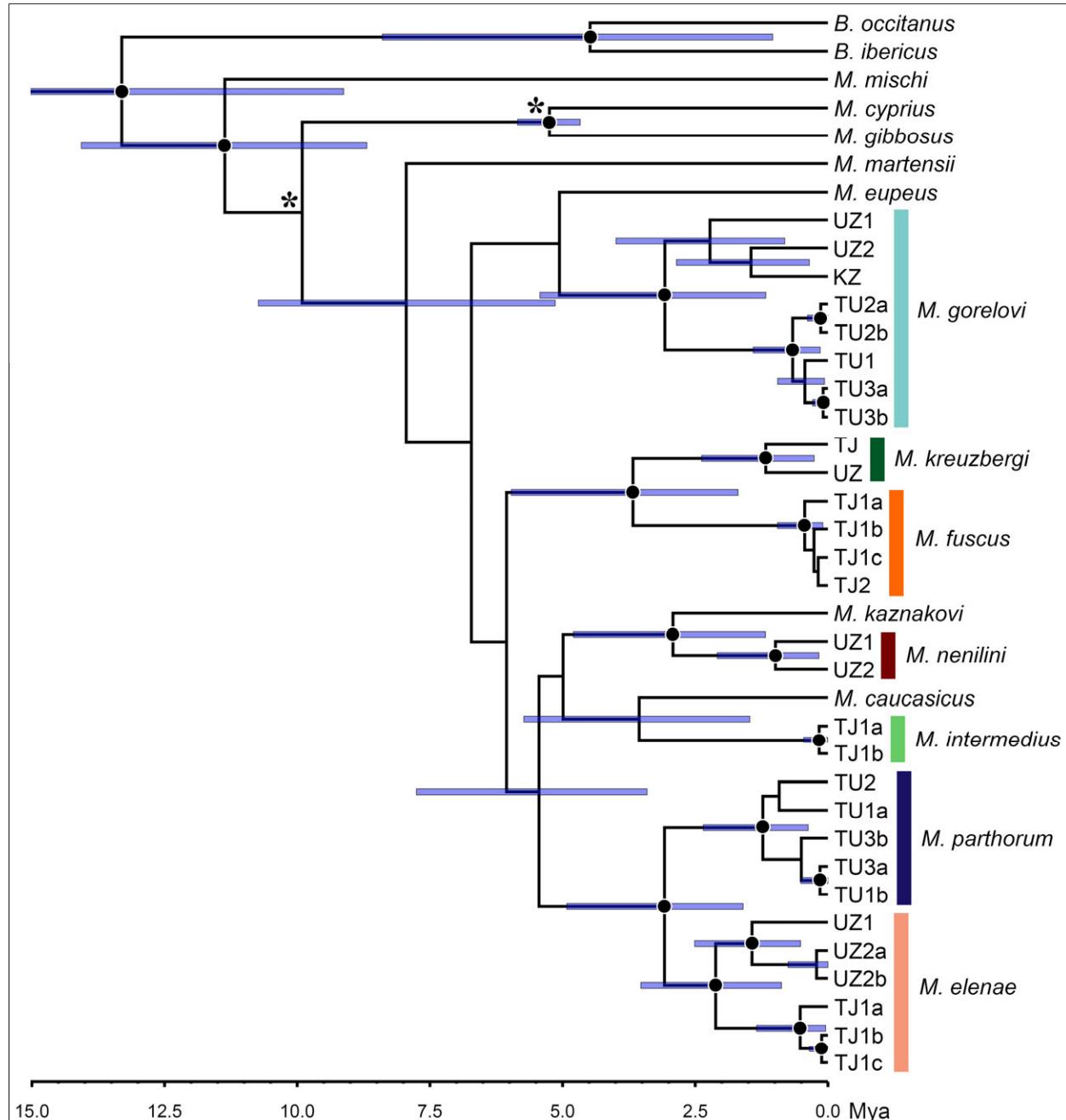


Figure 329: A time-calibrated phylogeny for *Mesobuthus* constructed using *16S* and *COI* sequences with BEAST (version 1.8.0). Bars representing highest posterior densities (95%) around mean date estimates are displayed for nodes with posterior probabilities greater than 0.50. Black circles indicate nodes with posterior probabilities greater than 0.95. Calibration points are labeled with asterisks (see text for details). *Buthus occitanus* and *B. ibericus* are included as outgroups.

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Appendix A Individual Distribution Maps for *Mesobuthus* Species

This Appendix contains distribution maps for each *Mesobuthus* species discussed in this paper. In each map the type locality specimen is indicated with a circle with a red '+' and specimen(s) used in the DNA analysis are indicated with a circle with a 'green' lower half. Compare these individual maps with the map shown in Figure 328 which shows the distribution of all eleven *Mesobuthus* species.

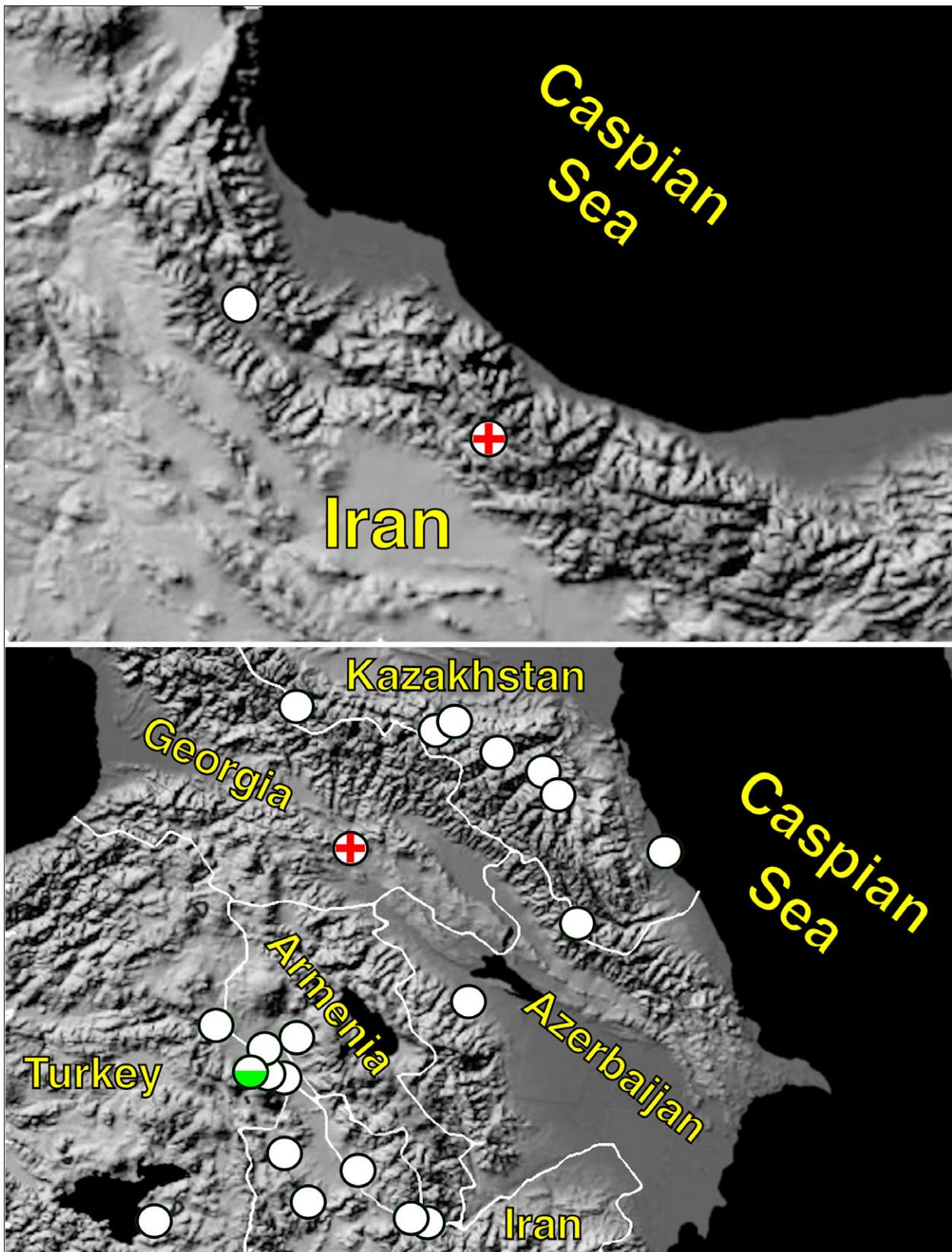


Figure A1–A2: *Mesobuthus brutus*, sp. n. (top) and *M. caucasicus* (bottom) distribution maps. Circle with red ‘+’ indicates type locality and circle with ‘green’ lower half indicates DNA sample.

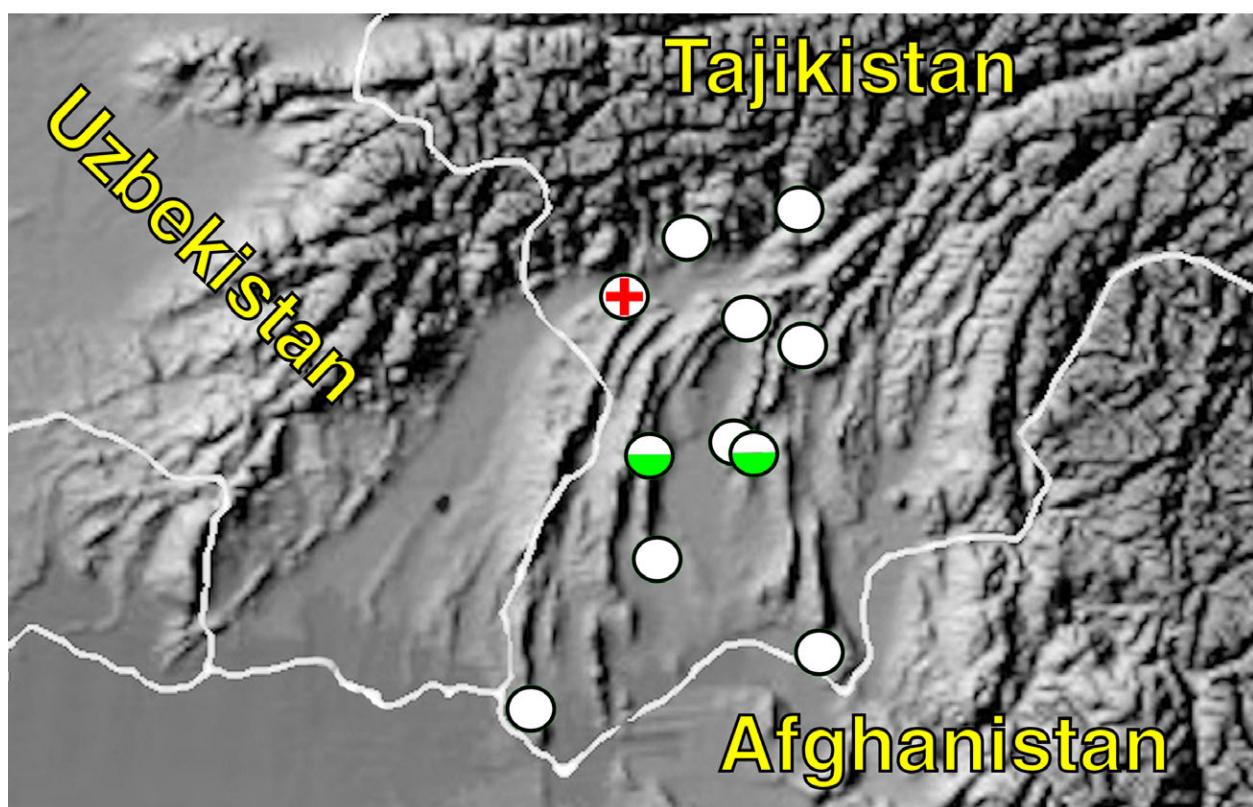
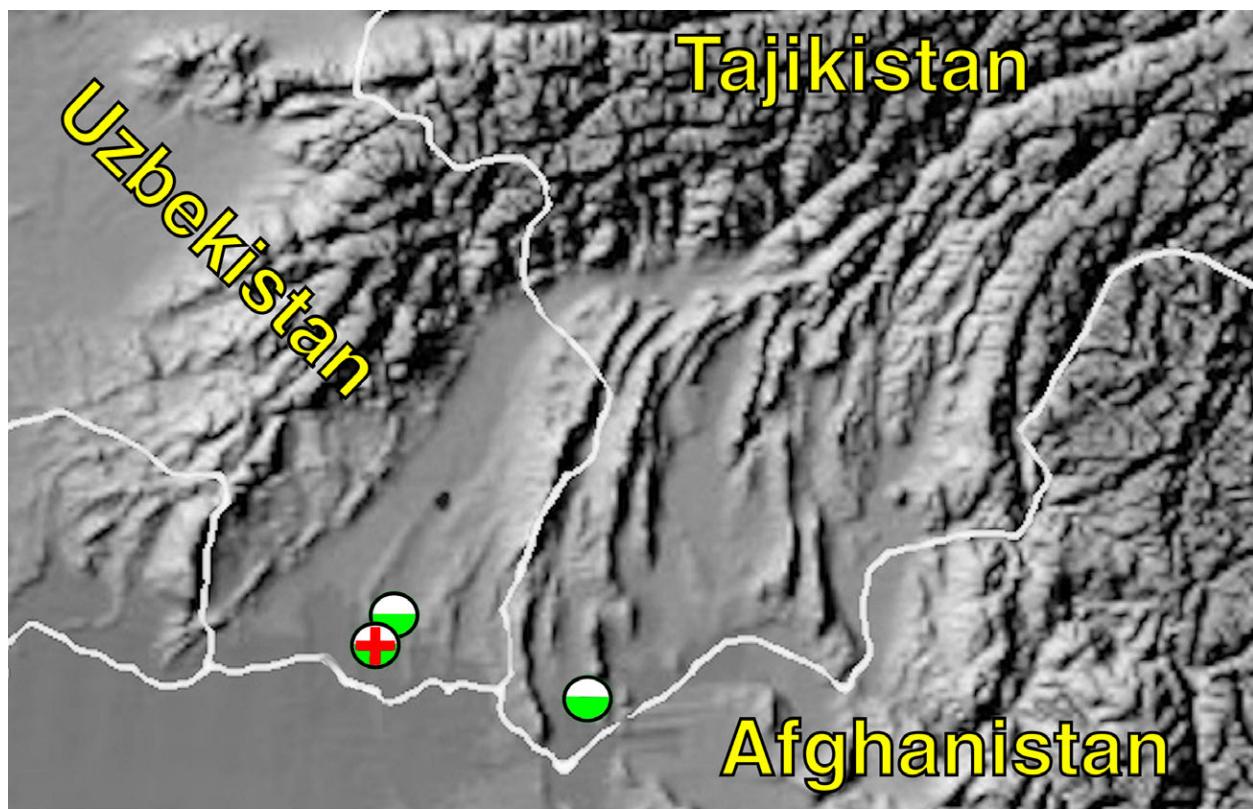


Figure A3–A4: *Mesobuthus elenae*, sp. n. (top) and *M. fuscus* (bottom) distribution maps. Circle with red '+' indicates type locality and circle with 'green' lower half indicates DNA sample.

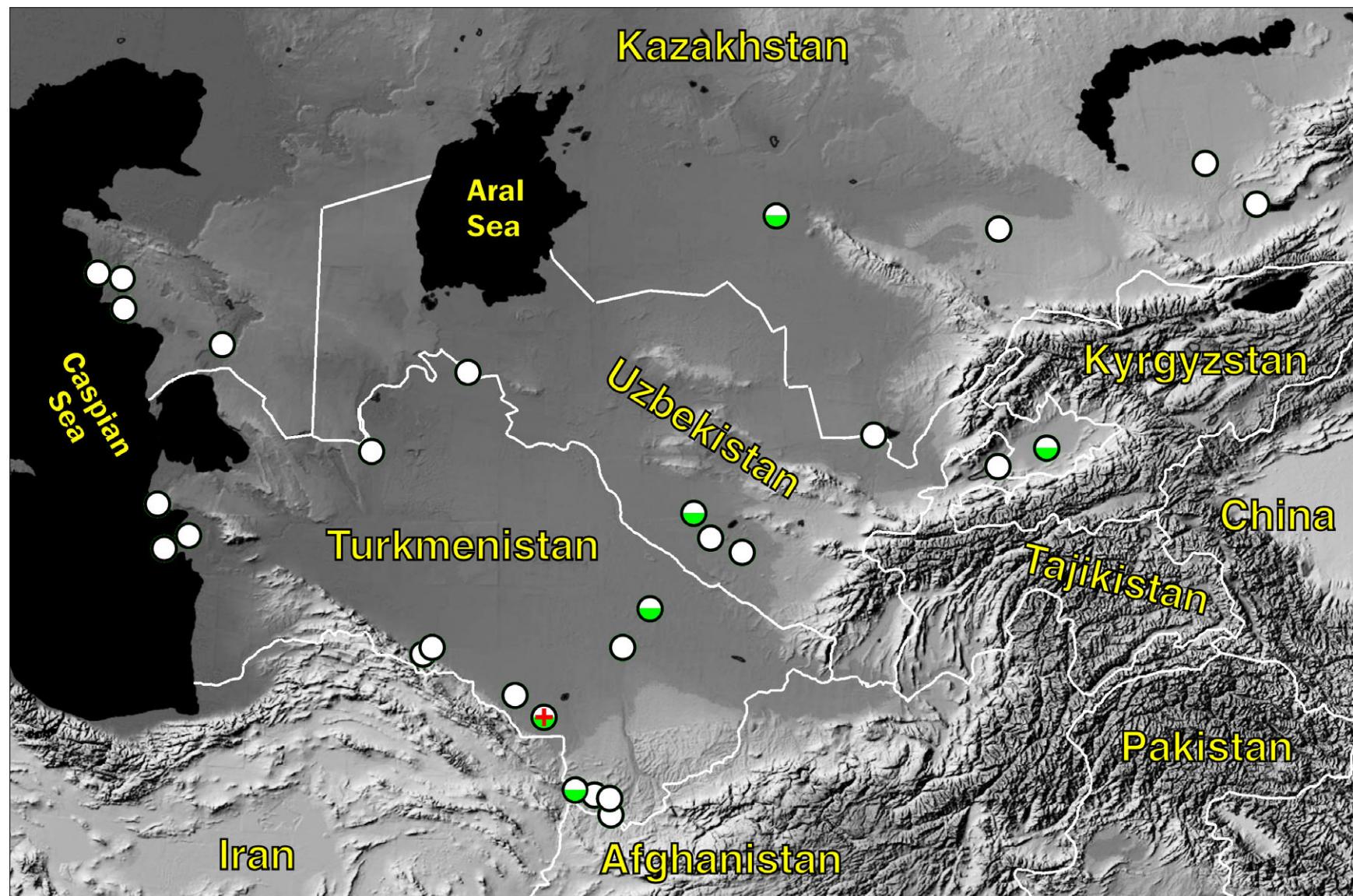


Figure A5: *Mesobuthus gorelovi*, sp. n. distribution map. Circle with red '+' indicates type locality and circle with 'green' lower half indicates DNA sample.

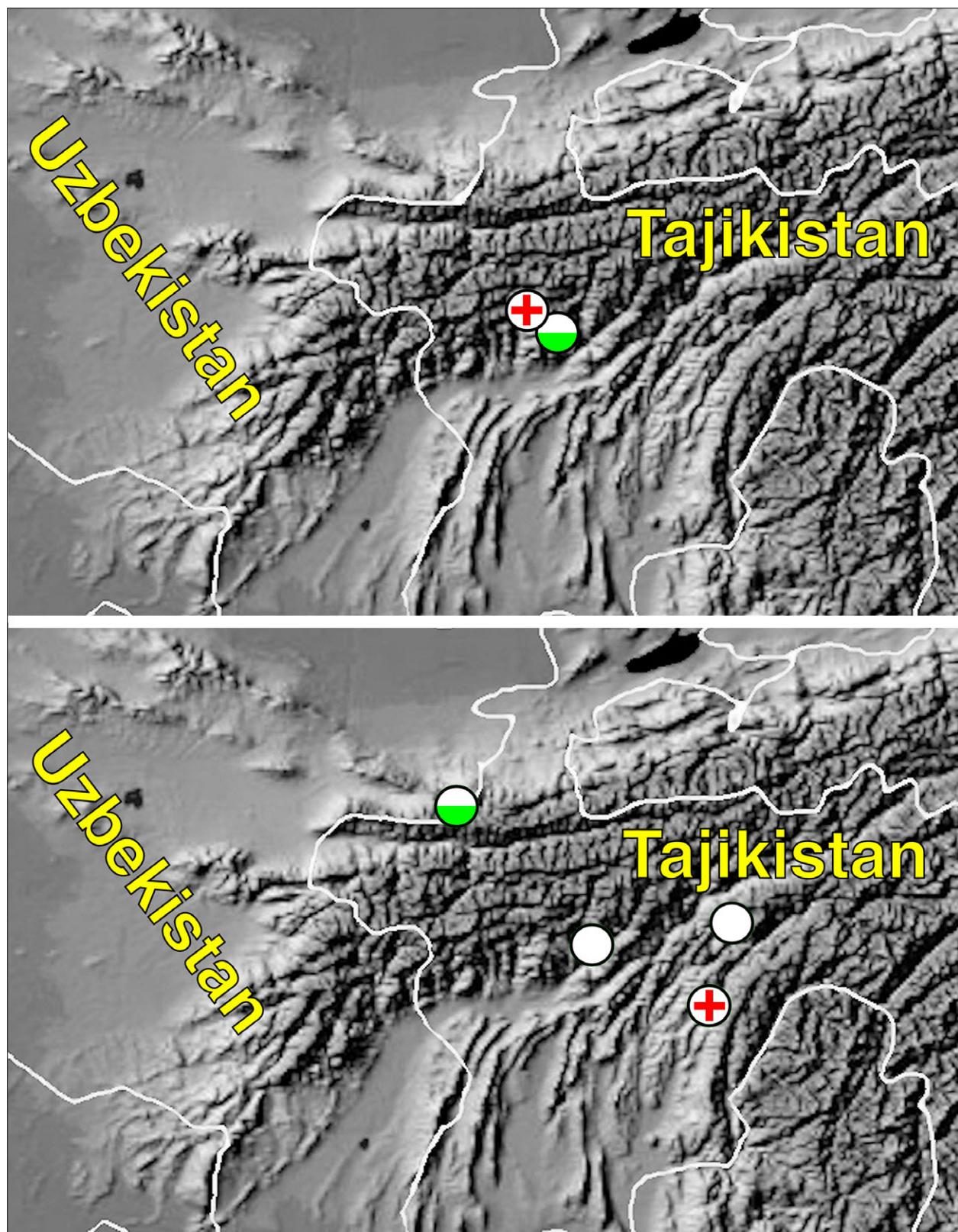


Figure A6–A7: *Mesobuthus intermedius* (top) and *M. kaznakovi* (bottom) distribution maps. Circle with red ‘+’ indicates type locality and circle with ‘green’ lower half indicates DNA sample.

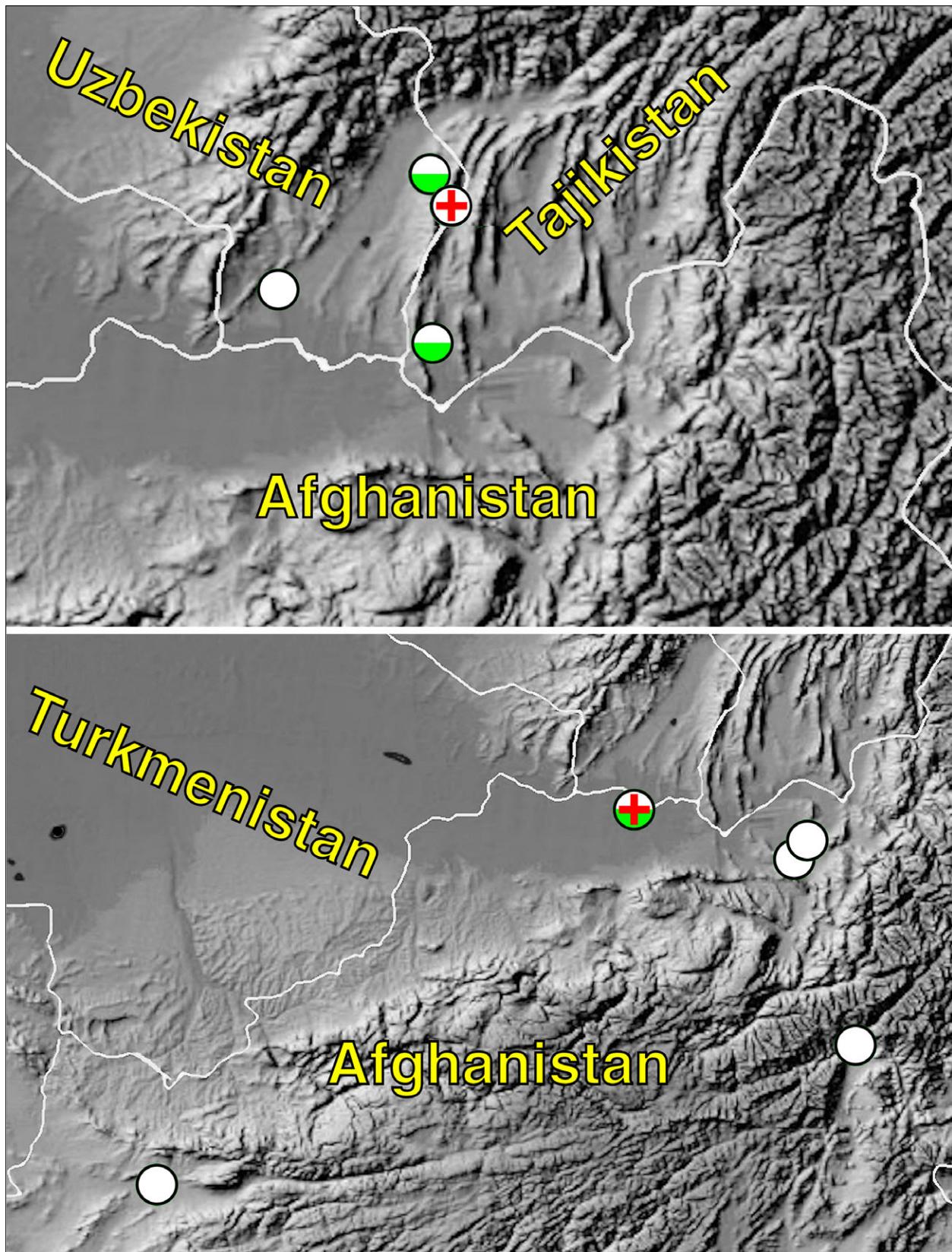


Figure A8–A9: *Mesobuthus kreuzbergi*, sp. n. (top) and *M. mischi*, sp. n. (bottom) distribution maps. Circle with red ‘+’ indicates type locality and circle with ‘green’ lower half indicates DNA sample.

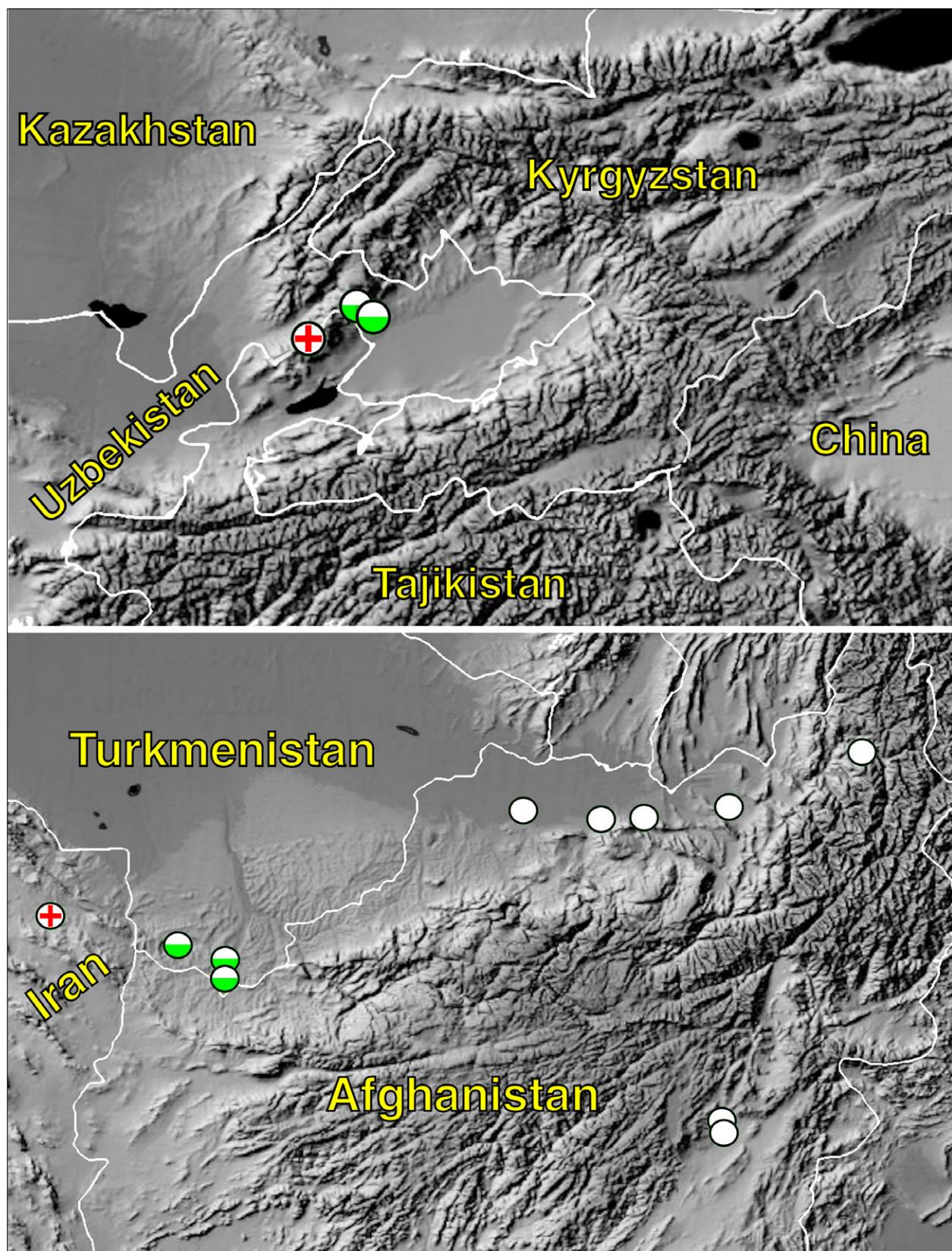


Figure A10–A11: *Mesobuthus nenilini*, sp. n. (top) and *M. parthorum* (bottom) distribution maps. Circle with red ‘+’ indicates type locality and circle with ‘green’ lower half indicates DNA sample.