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# Three new species of *Olivierus* (Scorpiones: Buthidae) from Kazakhstan and Uzbekistan

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## Abstract

Following Graham *et al.* (2019), the recently described desert species *Olivierus gorelovi* (Fet *et al.*, 2018) from Central Asia is herein restricted to Turkmenistan and southern Uzbekistan. In this contribution, we described other populations formerly included in *O. gorelovi* as three new species: *O. mikhailovi* **sp. n.** (southern Kazakhstan, Uzbekistan), *O. tarabaevi* **sp. n.** (Kazakhstan) and *O. voldemari* **sp. n.** (Uzbekistan: Ferghana Valley).

**Key words**: Scorpion, Central Asia

## Introduction

*Olivierus gorelovi* (Fet *et al.*, 2018) (Scorpiones: Buthidae) was recently described (as *Mesobuthus gorelovi*, formerly a part of "*Mesobuthus caucasicus*" complex) as a widespread psammophilic species from the lowland deserts of Central Asia. Soon after, Graham *et al.* (2019) analyzed genetic patterns across the species‘ range, revealing several allopatric clades that represent multiple different species. They wrote: "Phylogenetic and network analyses, combined with integrative species delimitation, suggest that *M. gorelovi* is probably not a single species and more likely represents another complex of at least five cryptic species." Here, we formally describe three of the DNA-based clades defined by Graham *et al*. (2019) as new species, restricting *Olivierus gorelovi* to Turkmenistan and southern Uzbekistan. Readers are referred to detailed discussion in Fet *et al*. (2018) and Graham *et al.* (2019) for more information.

## Material and Methods

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

*Abbreviations*. FKCP, personal collection of František Kovařík, Prague, Czech Republic (will in future be merged with the collections of the NMPC); NMPC, National Museum of Natural History, Prague, Czech Republic; ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

All measurements are given in mm.

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## Systematics

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

### *Olivierus* Farzanpay, 1987

### Type species *Buthus caucasicus* Nordmann, 1840

*Mesobuthus* (in part): Fet 1989: 105 (in part); Fet 1994: 528 (in part); Gantenbein *et al*., 2003: 413; Fet *et al*. 2018: 1; Graham *et al.* 2019: 801.
*Olivierus*: Fet & Lowe 2000: 192; Kovařík 2019: 1.

The genus currently includes 21 arid species found from the Caucasus to Korean Peninsula (Kovařík 2019; this paper). Most of its members were recently revised by Fet *et al*. (2018). Species of the genus *Olivierus* are distinguished on the basis of morphometrics, metasomal carination, and leg setation. No species-groups are currently distinguished. Several distinct clades have been revealed by DNA phylogeny (Fet *et al*. 2018).

### *Olivierus gorelovi* (Fet, Kovařík, Gantenbein, Kaiser, Stewart & Graham, 2018), s. str.

*Mesobuthus caucasicus parthorum* (nec Pocock, 1889): Fet 1989: 105 (in part); Fet 1994: 528 (in part).
*Mesobuthus caucasicus intermedius* (nec Birula, 1897): Fet 1989: 109–111 (in part).
*Olivierus caucasicus parthorum* (nec Pocock, 1889): Fet & Lowe 2000: 192 (in part).
*Mesobuthus caucasicus* (nec Nordmann, 1840): Gantenbein *et al*. 2003: 413 (in part; Bukhara).
*Mesobuthus gorelovi* Fet *et al*. 2018: 21, figs 63–72, 97–114, 267, 277, 292–293, 307 (Turkmenistan; Uzbekistan, in part); Graham *et al.* 2019: 807 (Southern clade) (Turkmenistan; Uzbekistan, in part).
*Olivierus gorelovi*: Kovařík 2019: 26 (in part).

**Type material**: *Holotype* ♂, **Turkmenistan**, *Akhal Province*: Tejen District, near Tejen Reservoir, ca. 12 km SSE of Gangaly, 36.92°N 60.83°E, 235 m asl, 3.IV.2002, leg. V. Fet & A. Gromov (FKCP) (figs 65–72, 97–98, 101, 104, 109–111, 267, 292, 307 in Fet *et al*., 2018).

*Paratypes*: **Turkmenistan**, *Akhal Province*, same label as holotype, 1♀ (fig. 277 in Fet *et al.*, 2018), 1♂juv.; Ashgabat, Gurtly (Kurtli) Reservoir, 38.00°N 58.37°E, 23.IV.1984, 1♀, leg. J. Strnad (FKCP); Bakharden, 38.43°N 57.44°E, 26.IV.1992, 1♀, leg. M. Snížek (FKCP). *Lebap Province*, Charzhev District, Karakum Desert, Repetek Nature Reserve, 14.IV–2.V.1990, 1♀, leg. J. Farkač (NMPC), 38.55°N 63.17°E, 201 m asl, 15–18.IV.2002, 4♀ (figs 63–64, 99–100, 102–103, 105–108, 112–114, 293 in Fet *et al*., 2018) 1♂juv., leg. V. Fet & A. Gromov (FKCP); *Mary Province*, Serhetabat District, Badghyz Plateau, N shore of Eroilanduz Depression, 35.68°N, 61.82°E, 7.IV.2002, 1♂, leg. A. Gromov (FKCP).

**Distribution**. Turkmenistan; Uzbekistan (southwest: Buxoro Province; Samarquand Province) (Fig. 109).

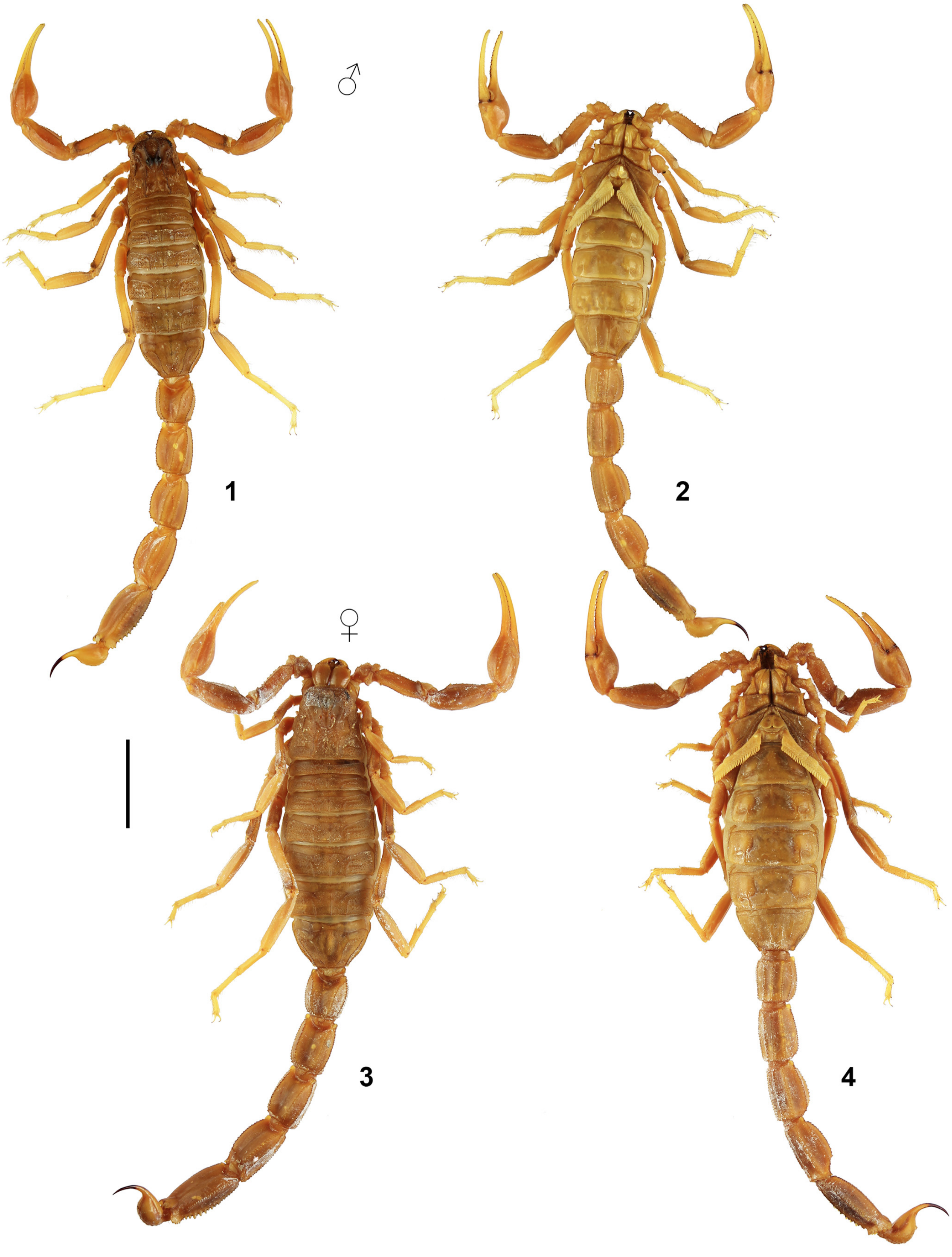
**Description**. (♂♀). Total length of adult males 49–52 mm, 61–70 females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers margins undulate in both sexes. Pedipalp chela length/ width ratio 3.72–4.60 in males and 3.90–4.22 in females. 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 12–13 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 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.

***Olivierus mikhailovi* sp. n.**

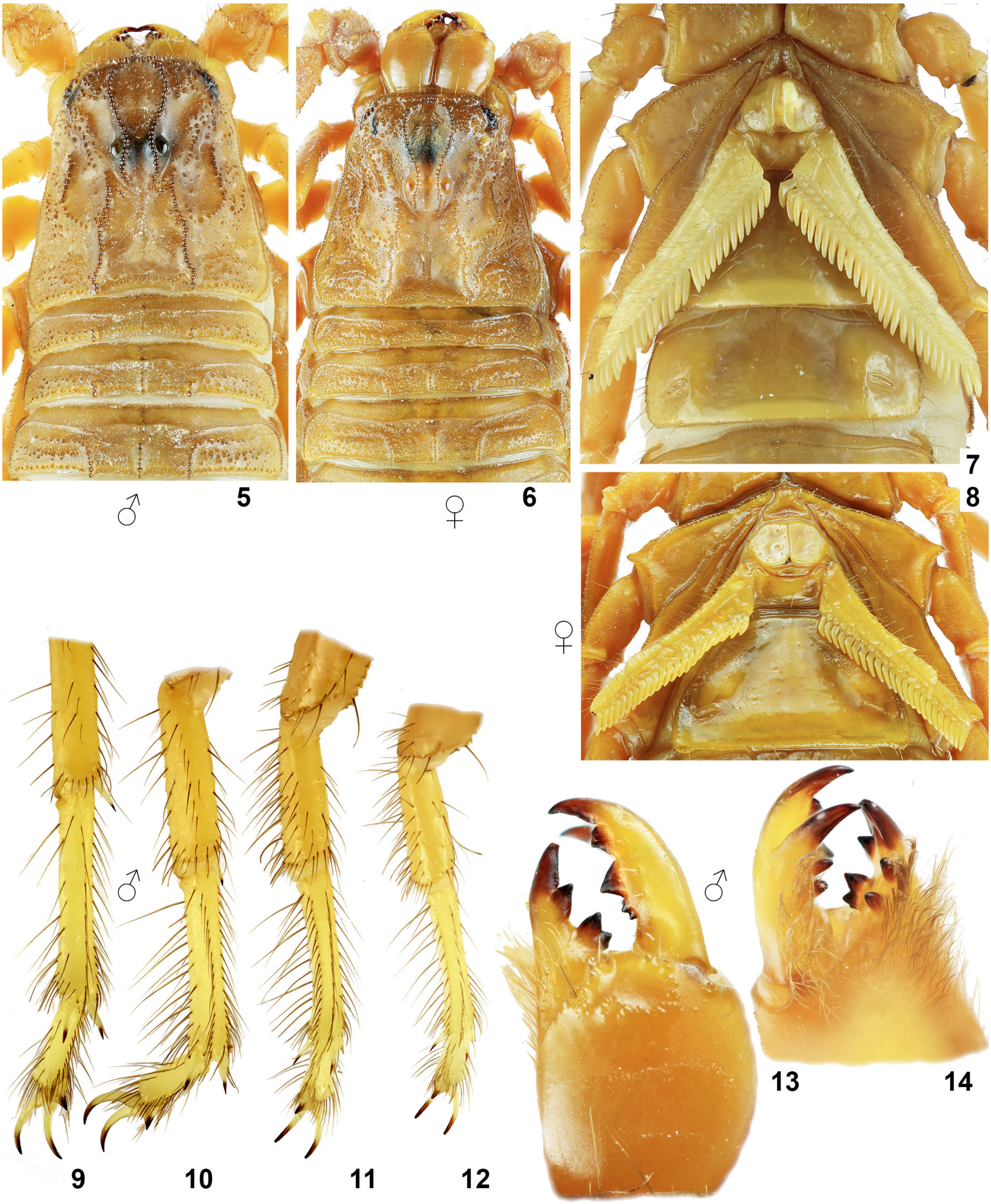
Figs 1–44, Table I

http://zoobank.org/urn:lsid:zoobank.org:act:49D99B6D-4770-46B1-BB15-A204B32E1065

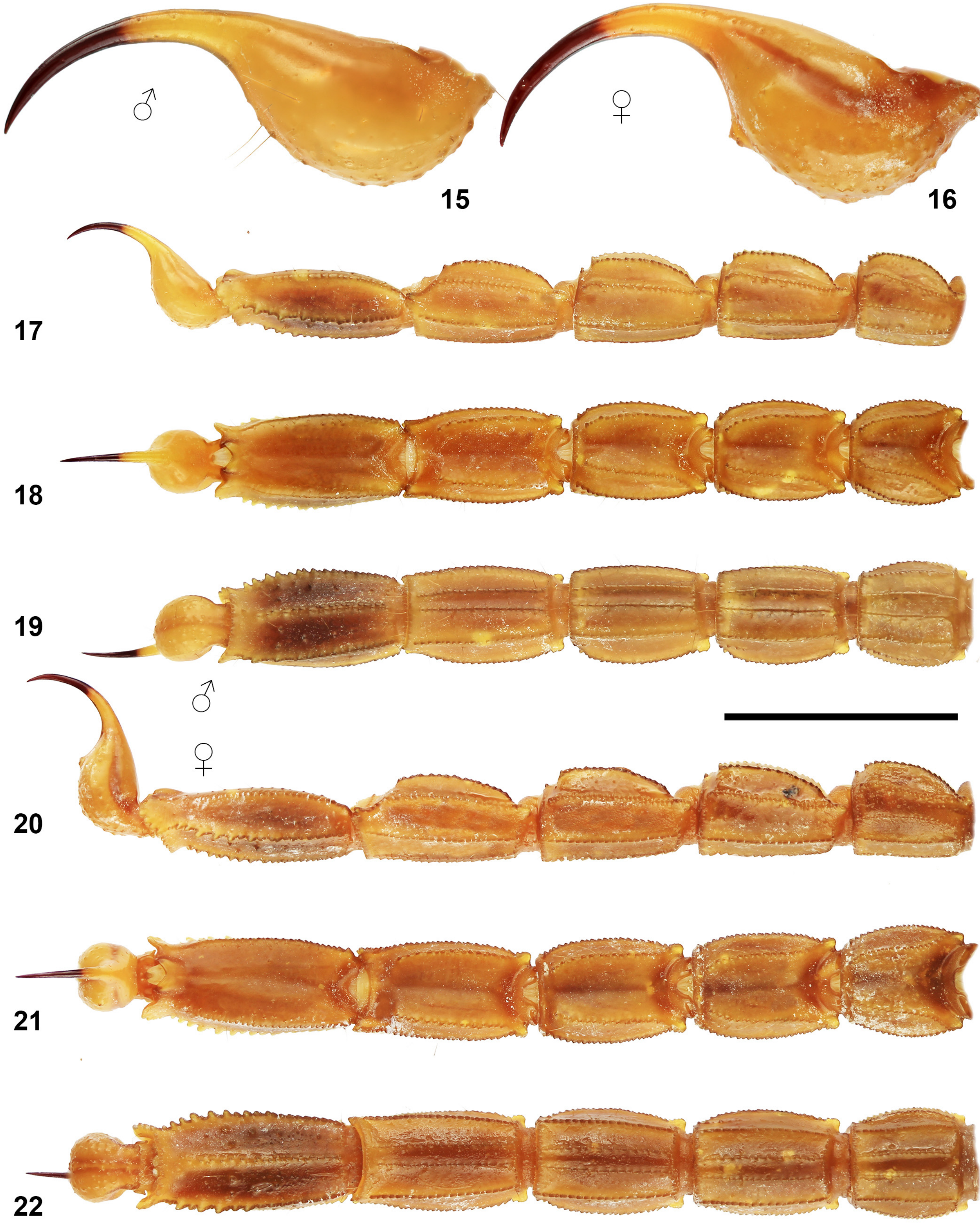
*Mesobuthus caucasicus parthorum* (nec Pocock, 1889): Fet 1989: 106–107 (in part); Fet, 1994: 528 (in part).
*Mesobuthus caucasicus intermedius* (nec Birula, 1897): Fet 1989: 107, 110–111 (in part).
*Olivierus caucasicus parthorum* (nec Pocock, 1889): Fet & Lowe 2000: 192 (in part).
*Mesobuthus gorelovi* Fet *et al.* 2018: 21 (Kazakhstan, in part; Uzbekistan, in part); Graham *et al*. 2019: 801 (Central clade) (Kazakhstan: Chardara; Uzbekistan: Kokushtuvan).



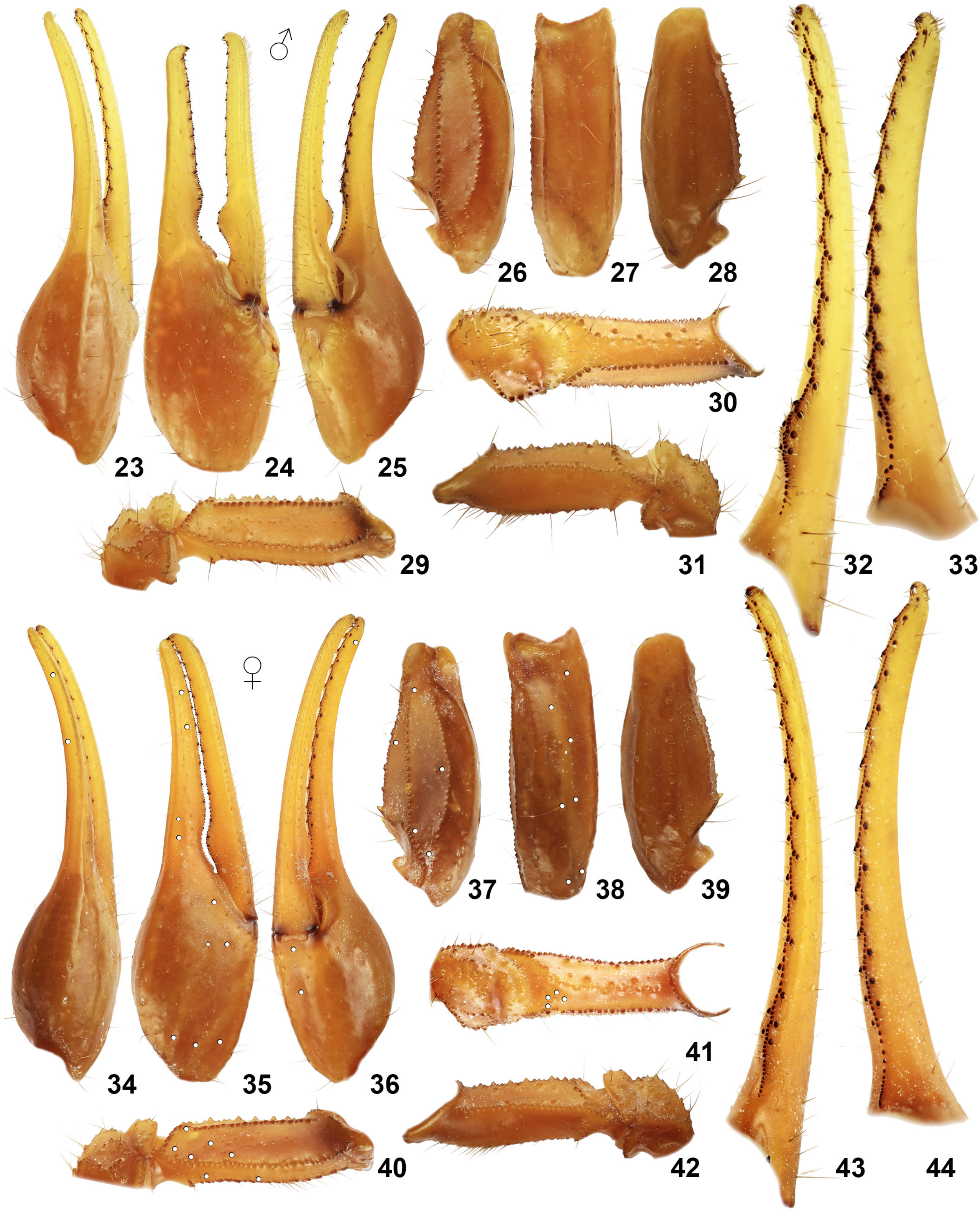

**FIGURES 1–4.** *Olivierus mikhailovi* **sp**. **n**., paratypes from Kazakhstan, Turkistan Province, Beltau Mts. 1–2. Male, dorsal (1) and ventral (2) views. 3–4. Female, dorsal (3) and ventral (4) views. Scale bar: 10 mm.




**FIGURES 5–14.** *Olivierus mikhailovi* **sp**. **n**., paratypes from Kazakhstan, Turkistan Province, Beltau Mts. 5, 7, 9–14. Male, carapace and tergites I–III (5), sternopectinal region and sternite III (7), left legs I–IV, retrolateral aspect (9–12), right chelicera in dorsal (13) and ventral (14) views. Figures 6, 8. Female, chelicerae, carapace and tergites I–III (6), and sternopectinal region and sternite III (8).



**FIGURES 15–22.** *Olivierus mikhailovi* **sp**. **n**., paratypes from Kazakhstan, Turkistan Province, Beltau Mts. Figures 15, 17–19. Male, telson lateral (15) and metasoma and telson, lateral (17), dorsal (18), and ventral (19) views. Figures 16, 20–22. Female, telson lateral (16) and metasoma and telson, lateral (20), dorsal (21), and ventral (22) views. Scale bar: 10 mm (17–22).




**FIGURES 23–44.** *Olivierus mikhailovi* **sp. n.**, paratypes from Kazakhstan, Turkistan Province, Beltau Mts., pedipalp segments. Figures 23–33. Male, pedipalp chela, dorsal (23), external (24), and ventral (25) views. Pedipalp patella, dorsal (26), external (27) and ventral (28) views. Pedipalp femur and trochanter, dorsal (29), internal (30), and ventral (31) views. Movable (32) and fixed (33) fingers dentition. Figures 34–44. Female, pedipalp chela, dorsal (34), external (35), and ventral (36) views. Pedipalp patella, dorsal (37), external (38) and ventral (39) views. Pedipalp femur and trochanter, dorsal (40), internal (41), and ventral (42) views. Movable (43) and fixed (44) fingers dentition. The trichobothrial pattern is indicated in Figures 35–38, 40–41 by white circles.

**TABLE I**. Comparative measurements of types of *Olivierus gorelovi* and *O. mikhailovi* **sp**. **n**. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

| **Dimensions (mm)** | | ***O. gorelovi*** | ***O. gorelovi*** | ***O.mikhailovi* sp. n.** | ***O.mikhailovi* sp. n.** |
|---|---|---|---|---|---|
| | | **♂ holotype** | **♀ paratype** | **♂ holotype** | **♀ paratype** |
| Carapace | L / W | 5.85 / 5.98 | 7.30 / 7.25 | 5.76 / 5.87 | 8.32 / 8.70 |
| Mesosoma | L | 12.1 | 20.6 | 11.69 | 23.85 |
| Tergite VII | L / W | 3.65 / 5.95 | 5.10 / 7.90 | 3.48 / 5.59 | 5.41 / 8.75 |
| Metasoma + telson | L | 33.98 | 40.02 | 33.14 | 42.63 |
| Segment I | L / W / D | 4.05 / 3.70 / 3.10 | 4.90 / 4.25 / 3.55 | 4.06 / 3.64 / 3.04 | 5.50 / 4.82 / 4.32 |
| Segment II | L / W / D | 5.05 / 3.55 / 3.05 | 5.80 / 4.05 / 3.70 | 4.78 / 3.40 / 3.02 | 6.18 / 4.41 / 4.01 |
| Segment III | L / W / D | 5.25 / 3.55 / 3.08 | 6.17 / 4.00 / 3.60 | 4.99 / 3.45 / 2.88 | 6.52 / 4.44 / 3.80 |
| Segment IV | L / W / D | 5.98 / 3.30 / 2.77 | 7.15 / 3.90 / 3.30 | 6.00 / 3.29 / 2.54 | 7.33 / 4.19 / 3.53 |
| Segment V | L / W / D | 7.15 / 3.05 / 2.38 | 8.20 / 3.55 / 2.90 | 6.93 / 3.17 / 2.21 | 9.05 / 4.06 / 3.05 |
| Telson | L / W / D | 6.50 / 2.25 / 2.00 | 7.80 / 2.75 / 2.55 | 6.38 / 2.16 / 2.13 | 8.05 / 2.91 / 2.63 |
| Pedipalp | L | 21.85 | 24.7 | 21.02 | 28.21 |
| Femur | L / W | 5.15 / 1.50 | 5.75 / 1.80 | 4.84 / 1.46 | 6.36 / 1.99 |
| Patella | L / W | 6.40 / 2.25 | 7.25 / 2.70 | 6.09 / 2.19 | 8.02 / 2.94 |
| Chela | L | 10.3 | 11.7 | 10.09 | 13.83 |
| Manus | W / D | 3.35 / 2.77 / 2.75 | 3.31 / 2.90 / 3.00 | 2.85 / 2.60 | 3.13 / 3.56 |
| Movable finger | L | 6.95 | 8.39 | - | 9.42 |
| **Total** | **L** | **51.93** | **67.92** | **50.59** | **74.8** |

**Type Material**: *Holotype* ♂ (fragmented, Table 1), **Uzbekistan**, *Buxoro [Bukhara] Province*, Romitan District, between Buxoro (Bukhara) and Gazli, 12 km NW of Kokushtuvan, 40.0838°N, 64.0672°E, 206 m asl, 11.V.2002, leg. V. Fet & A. Gromov (FKCP). The holotype is a part of the paratype series of *O. gorelovi*.

*Paratypes* (FKCP; Figs 1–44, Table 1): **Uzbekistan**, *Buxoro Province*, same label as holotype, 1 juv. (part of paratype series of *O. gorelovi*). **Kazakhstan**, *South Kazakhstan Province*, 5 km west of Chardara (Shardara), 41.2705°N 67.8839°E, 250 m asl, 23–24.V.2016, 1♀juv., leg. P. Kučera; *Turkistan Province*, Beltau Mts., 41.8413°N 68.5417°E, 392 m a. s. l., 12–13.V.2017, 1♂3♀1juv., leg. A. A. Fomichev.

**Other material studied: Uzbekistan**, *Buxoro Province*, same label as holotype, 1♀juv. (fragmented, VF-3030-8) (FKCP).

**Distribution**. Kazakhstan (South Kazakhstan Province; Turkistan Province); Uzbekistan (Buxoro Province) (Fig. 109).

**Etymology.** The new species name is a patronym honoring Kirill G. Mikhailov (Moscow), a prominent Russian arachnologist and publisher.

**Diagnosis.** This cryptic species differs from *O. gorelovi* by the following molecular characters: *COI* differs by 15 nucleotide substitutions and an uncorrected p-distance of 0.0325 (see Table III; data for type locality haplotypes).

**Description**. (♂♀). Total length of adult males 50–52, 68–75 in adult females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers margins undulate in both sexes, little bit more in males. Pedipalp chela length/ width ratio 3.5–3.7 in males and 4.3–4.5 in females. Pectinal teeth number 26–28 in males, 21–23 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, black pigmented 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 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 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 1.8–1.9 in males, 1.7–1.8 in females. Telotarsus III ventral setation represented by main row which contains ca 15 setae. Second parallel row contains not more than 9 setae. Pedal spur of legs hirsute.

## *Olivierus tarabaevi* sp. n.

Figs 45–85, Table II

http://zoobank.org/urn:lsid:zoobank.org:act:BF1FB341-4A45-4B1D-BACF-F063BA20B18B

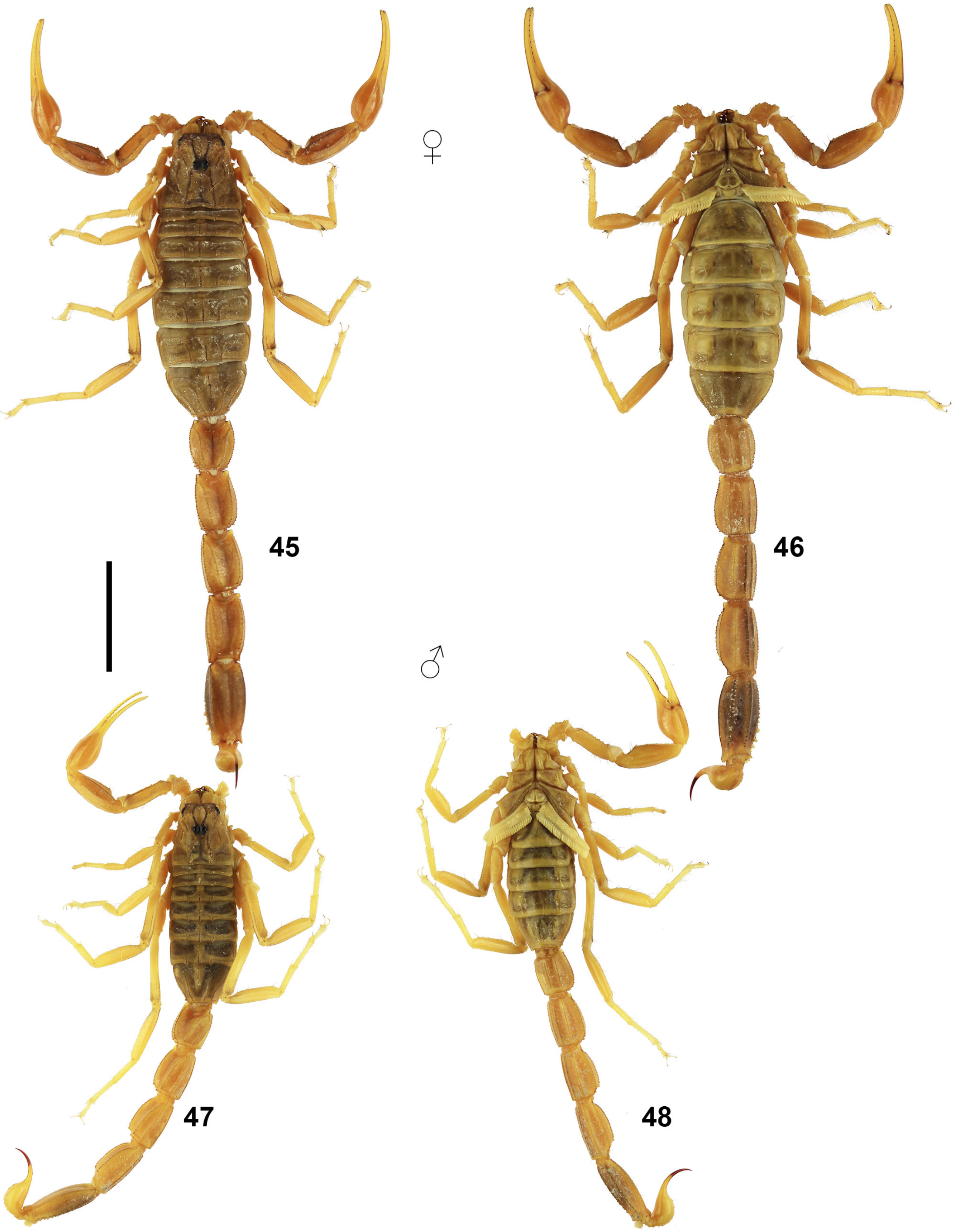
*Mesobuthus caucasicus parthorum* (nec Pocock, 1889): Fet 1989: 104 (in part); Fet 1994: 528 (in part).

*Mesobuthus caucasicus intermedius* (nec Birula, 1897): Fet 1989: 107 (in part); Gromov & Kopdykbaev 1994: 20; Sun & Zhu 2010: 3, figs 2, 11–13; Sun & Sun 2011: 61, figs 3–4, 10.

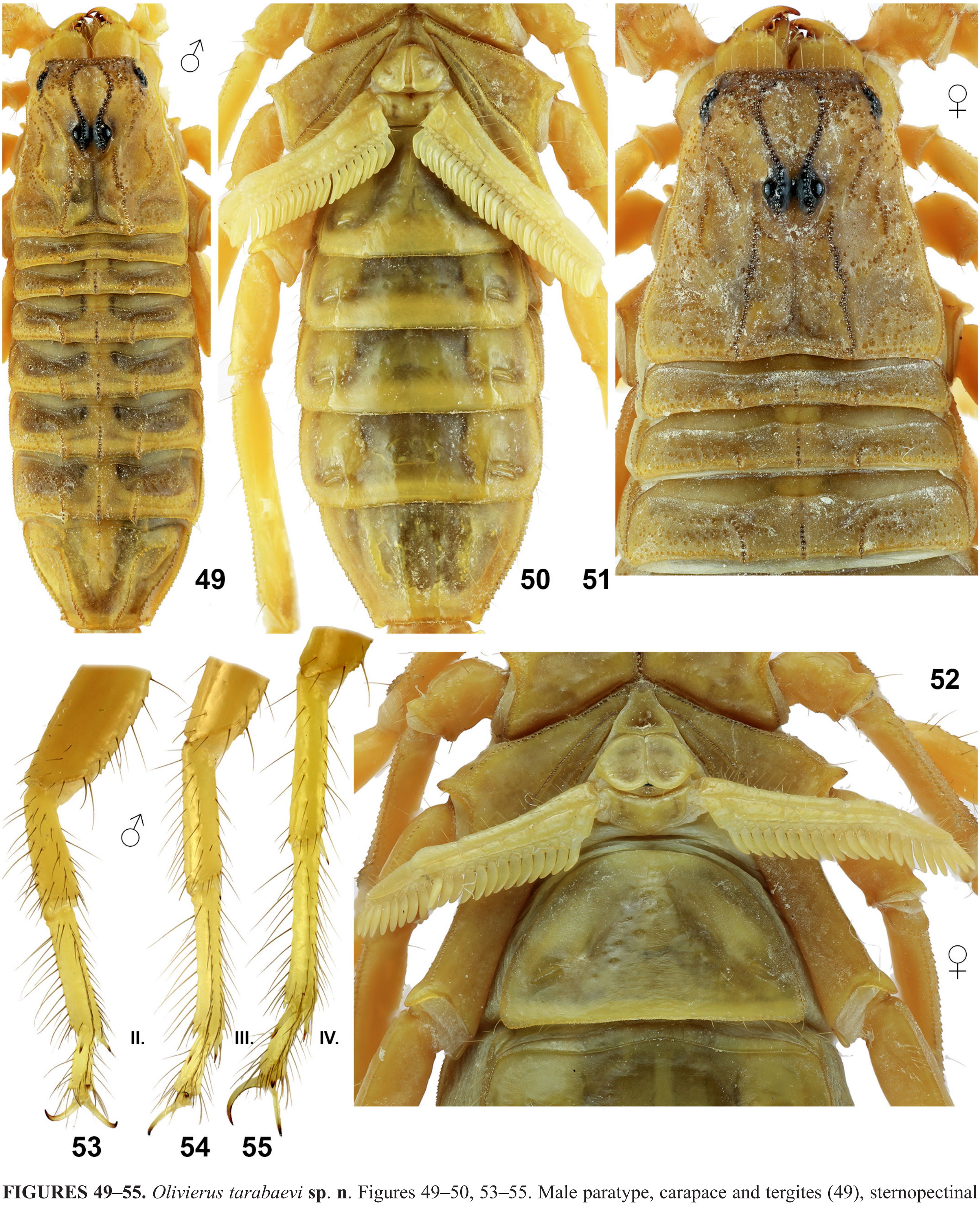
*Olivierus caucasicus parthorum* (nec Pocock, 1889): Fet & Lowe 2000: 192 (in part).

*Mesobuthus caucasicus* (nec Nordmann, 1840): Gantenbein *et al.* 2003: 413 (Kazakhstan, in part: Baigakum; Kapchagai)

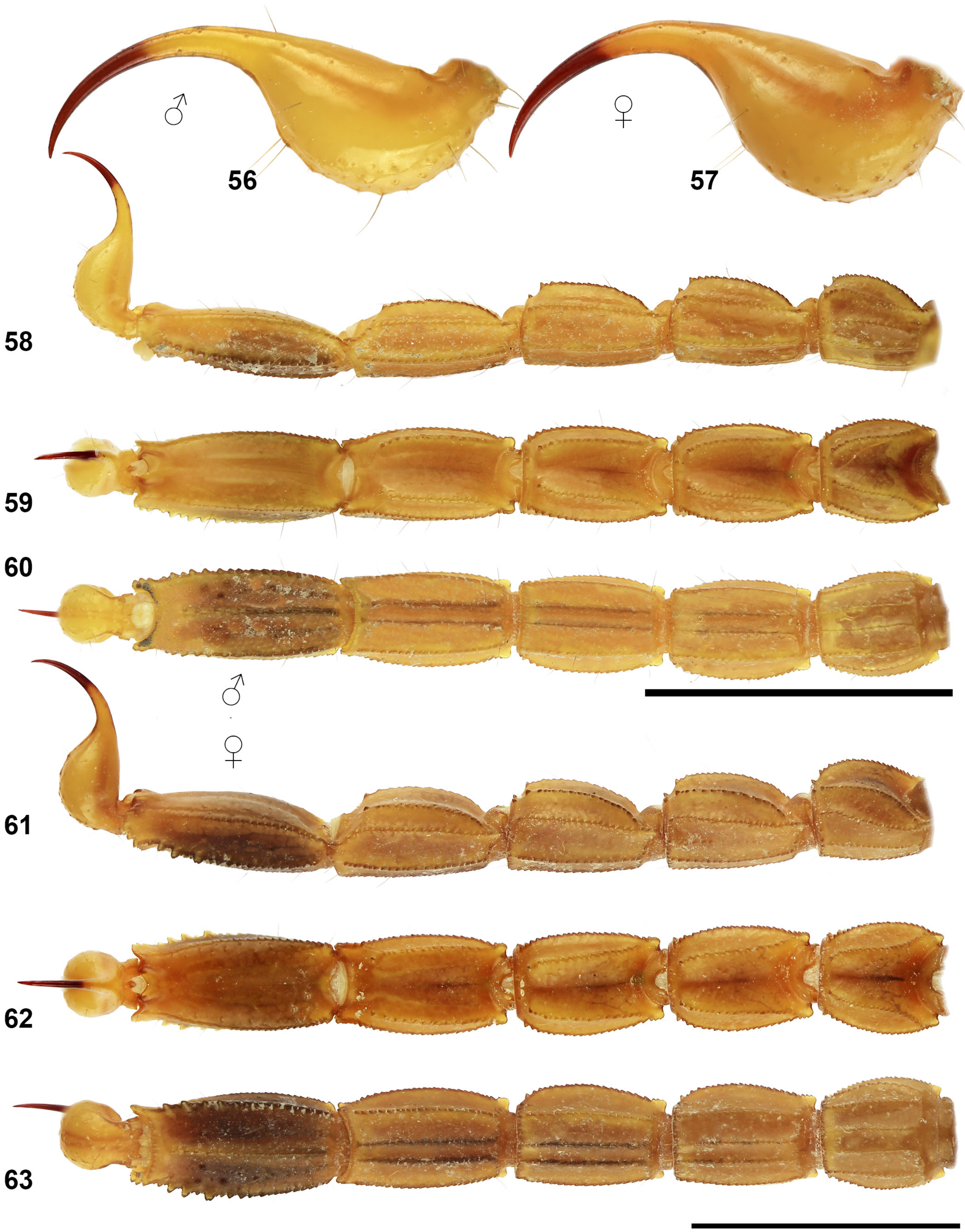
*Mesobuthus gorelovi* Fet *et al*. 2018: 21 (Kazakhstan, in part); Graham *et al.* 2019: 807 (Northern clade) (Kazakhstan, in part: Baigakum; Kapchagai)



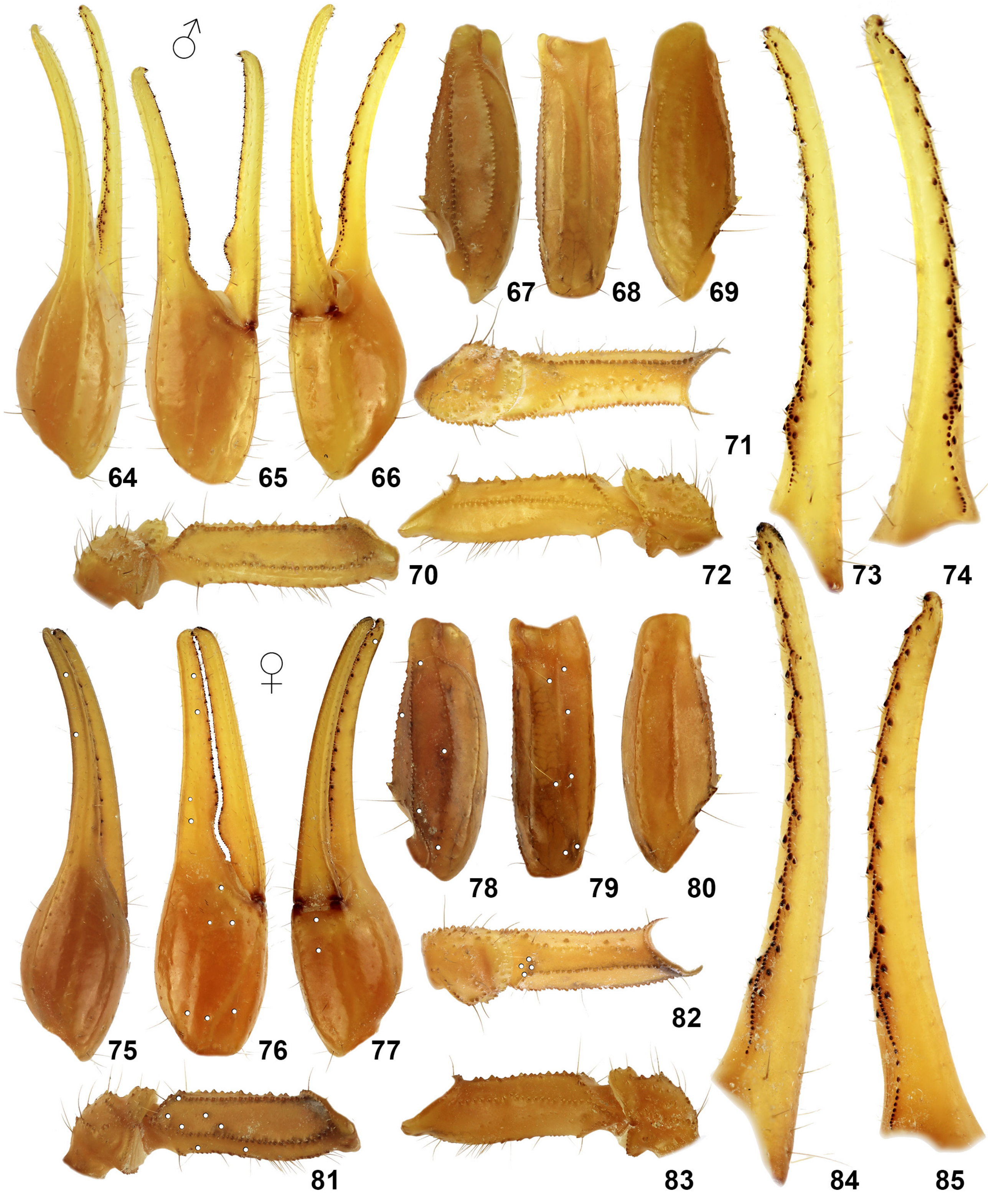

**FIGURES 45–48.** *Olivierus tarabaevi* **sp**. **n**. Figures 45–46. Female holotype, dorsal (45) and ventral (46) views. Figures 47–48. Male paratype, dorsal (47) and ventral (48) views. Scale bar: 10 mm.




**FIGURES 49–55.** *Olivierus tarabaevi* **sp**. **n**. Figures 49–50, 53–55. Male paratype, carapace and tergites (49), sternopectinal region and sternites (50), left legs II–IV, retrolateral aspect (53–55). Figures 51–52. Female holotype, chelicerae, carapace and tergites I–III (51), and sternopectinal region and sternite III (52).




**FIGURES 56–63.** *Olivierus tarabaevi* **sp**. **n**. Figures 56, 58–60. Male paratype, telson lateral (56) and metasoma and telson, lateral (58), dorsal (59), and ventral (60) views. Figures 57, 61–63. Female holotype, telson lateral (57) and metasoma and telson, lateral (61), dorsal (62), and ventral (63) views. Scale bar: 10 mm (58–60, 61–63).




**FIGURES 64–85.** *Olivierus tarabaevi* **sp. n.**, pedipalp segments. Figures 64–74. Male paratype, pedipalp chela, dorsal (64), external (65), and ventral (66) views. Pedipalp patella, dorsal (67), external (68) and ventral (69) views. Pedipalp femur and trochanter, dorsal (70), internal (71), and ventral (72) views. Movable (73) and fixed (74) fingers dentition. Figures 75–85. Female holotype, pedipalp chela, dorsal (75), external (76), and ventral (77) views. Pedipalp patella, dorsal (78), external (79) and ventral (80) views. Pedipalp femur and trochanter, dorsal (81), internal (82), and ventral (83) views. Movable (84) and fixed (85) fingers dentition. The trichobothrial pattern is indicated in Figures 76–79, 81–82 by white circles.

**TABLE II**. Comparative measurements of types of *Olivierus tarabaevi* **sp**. **n**. and *O. voldemari* **sp**. **n**. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

| Dimensions (mm) | | ***O. tarabaevi* sp. n.** ♀ **holotype** | ***O. tarabaevi* sp. n.** ♂ **paratype** | ***O. voldemari* sp. n.** ♀ **holotype** |
|---|---|---|---|---|
| Carapace | L / W | 6.76 / 7.11 | 5.34 / 5.43 | 7.84 / 8.03 |
| Mesosoma | L | 18.94 | 12.03 | 17.64 |
| Tergite VII | L / W | 4.85 / 7.32 | 3.45 / 5.05 | 4.66 / 8.03 |
| Metasoma + telson | L | 36.06 | 31.06 | 38.64 |
| Segment I | L / W / D | 4.59 / 4.15 / 3.32 | 3.78 / 3.26 / 2.72 | 4.99 / 4.69 / 3.98 |
| Segment II | L / W / D | 5.35 / 3.90 / 3.33 | 4.57 / 3.12 / 2.75 | 5.69 / 4.34 / 3.81 |
| Segment III | L / W / D | 5.48 / 3.83 / 3.19 | 4.60 / 3.08 / 2.64 | 5.91 / 4.34 / 3.59 |
| Segment IV | L / W / D | 6.18 / 3.63 / 3.00 | 5.57 / 2.89 / 2.44 | 6.74 / 4.07 / 3.28 |
| Segment V | L / W / D | 7.56 / 3.56 / 2.63 | 6.57 / 2.78 / 2.05 | 8.06 / 3.99 / 2.86 |
| Telson | L / W / D | 6.90 / 2.48 / 2.31 | 5.97 / 1.84 / 1.81 | 7.25 / 2.10 / 2.06 |
| Pedipalp | L | 23.20 | 20.37 | 25.81 |
| Femur | L / W | 5.33 / 1.69 | 4.84 / 1.30 | 5.85 / 1.95 |
| Patella | L / W | 6.74 / 2.40 | 5.92 / 2.04 | 7.49 / 2.74 |
| Chela | L | 11.13 | 9.61 | 12.47 |
| Manus | W / D | 2.68 / 2.75 | 2.32 / 2.43 | 2.98 / 3.01 |
| Movable finger | L | 7.59 | 6.24 | 8.23 |
| **Total** | **L** | **61.76** | **48.43** | **64.12** |

**Type material**: *Holotype* ♀ (Figs 45–46, 51–52, 57, 61–63, 75–85, Table 2), **Kazakhstan**: *Kyzylorda Province*, Shieli (Chiili) District, ca 2.5 km NW of Baigakum (=Djulek, Dzhulek), 44.65°N 66.02°E, 127–143 m asl, 25.V.2002, leg. V. Fet & A. Gromov (VF-3003) (FKCP). The holotype is a part of the paratype series of *O. gorelovi*.

*Paratypes* (FKCP): **Kazakhstan**: *Almaty Province,* Kapchagai, 4 km down to Ili River, V.2002, 43.85°N 77.0667°E, 1♀ (fragmented), leg. A. Gromov (VF-3009). *Kyzylorda Province*, same label as holotype, 1♂juv. (part of paratype series of *O. gorelovi*), 1♂ (figs 47–50, 53–56, 58–60, 64–74, Table 2) 1juv (fragmented), leg. V. Fet & A. Gromov.

**Other material studied: Kazakhstan**: *Kyzylorda Province*, same label as holotype, 137 m asl, 1juv (fragmented), leg. V. Fet & A. Gromov (FKCP).

**Distribution**. Kazakhstan (Almaty Province; Kyzylorda Province) (fig. 109).

**Etymology.** The new species name is a patronym honoring Chingis Tarabaev (1951–1999), a prominent Kazakh arachnologist who was instrumental in promoting arachnological research in Kazakhstan.

**Diagnosis.** This cryptic species differs from *O. gorelovi* by the following molecular characters: *COI* differs by 16 nucleotide substitutions and a p-distance of 0.0390 (see Table III; data for type locality haplotypes).

**Description**. (♂♀). Total length of adult male 48, 64–66 in adult females. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers margins undulate in both sexes. Pedipalp chela length/width ratio 4.14 in male and 4.1–4.2 in females. Pectinal teeth number 24–27 in males, 19–22 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, black pigmented 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 12–13 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 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 1.9 in male, 1.7–1.8 in females. Telotarsus III ventral setation represented by main row which contains ca 15 setae. Second parallel row contains not more than 9 setae. Pedal spur of legs hirsute.

**Notes.** The type locality of *Olivierus tarabaevi* **sp. n.** is Baigakum (formerly Djulek) in the Kyzylkum Desert near Syr Darya River (Kazakhstan, Kyzylorda Province). There, the very first biological observations on Central

Asian scorpions were made by Evgenii N. Pavlovsky a century ago (Pavlovsky 1916a,b). The world-famous Baikonur spaceport (established in 1955) is located nearby. The locality was last visited by VF and A. Gromov in May 2002; based on their field material, Baigakum was also designated as a type locality for two other scorpion species: *Anomalobuthus pavlovskyi* Teruel, Kovařík & Fet, 2018 and *Orthochirus melanurus* (Kessler, 1874) (Kovařík *et al.* 2020; Teruel *et al.* 2018).

### *Olivierus voldemari* sp. n.

Figs 86–91, Table II

http://zoobank.org/urn:lsid:zoobank.org:act:1B864830-7C95-439B-A33D-2DA98947EC76

*Mesobuthus caucasicus intermedius* (nec Birula, 1897): Fet 1989: 110 (Uzbekistan, in part).
*Olivierus caucasicus parthorum* (nec Pocock, 1889): Fet & Lowe 2000: 192 (in part).
*Mesobuthus caucasicus* (nec Nordmann, 1840): Gantenbein *et al*. 2003: 413 (in part; Karakalpak Steppe).
*Mesobuthus gorelovi* Fet *et al.* 2018: 24 (Uzbekistan, in part); Teruel *et al.* 2018: 38; Graham *et al.* 2019: 801 (Eastern clade) (Uzbekistan, in part: Besharyk; Yazyavan).

**Type material**: *Holotype* ♀ (figs 86–108, Table 2): **Uzbekistan**: *Fargona [Fergana] Province*. Yazyavan District, Karakalpak Steppe, ca 18 km W of Yazyavan, 40.6580°N, 71.5072°E, 403 m asl, 20.V.2002, leg. V. Fet (FKCP). The holotype is a part of the paratype series of *O. gorelovi*.

*Paratypes* (FKCP): **Uzbekistan**: *Fargona Province*. Besharyk District, Kairakkum Sands, 12.5 km WNW of Besharyk, 40.4735°N, 70.4503°E, 350–352 m a. s. l., 18.V.2002, 1♀ (without pedipalp), leg. V. Fet & A. Gromov (VF-3027); same label as holotype, 1♀ (part of the paratype series of *O. gorelovi*).

**Distribution.** Uzbekistan (Fargona Province) (fig. 109).

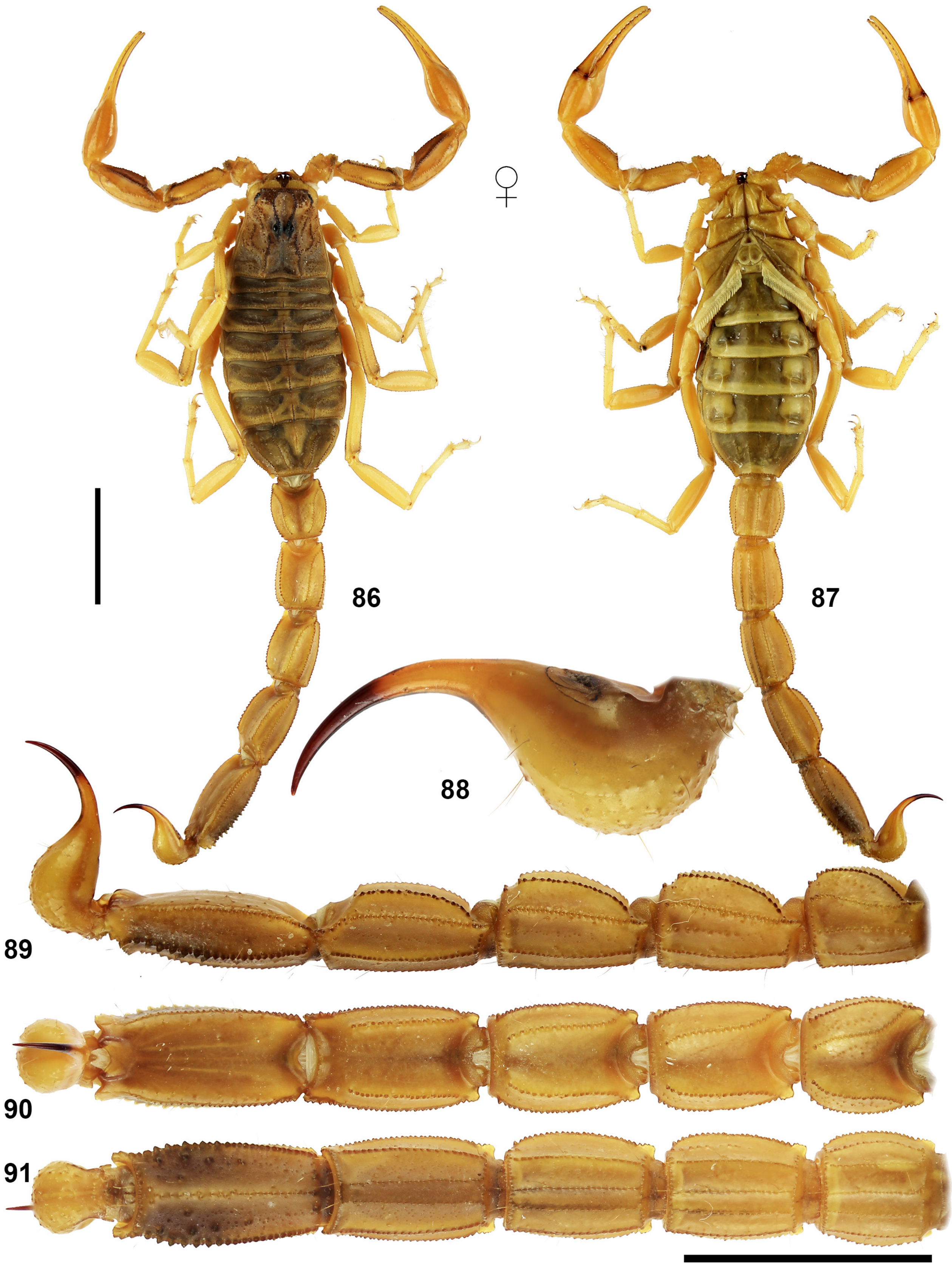
**Etymology.** The new species name is a patronym honoring Voldemar-Alexander Kreuzberg (1916–2009), a prominent naturalist and entomologist who lived and worked in Uzbekistan.

**Diagnosis.** This cryptic species differs from *O. gorelovi* by the following molecular characters: *COI* differs by 24 nucleotide susbtitutions and an uncorrected p-distance of 0.0521 (see Table III; data for type locality haplotypes).

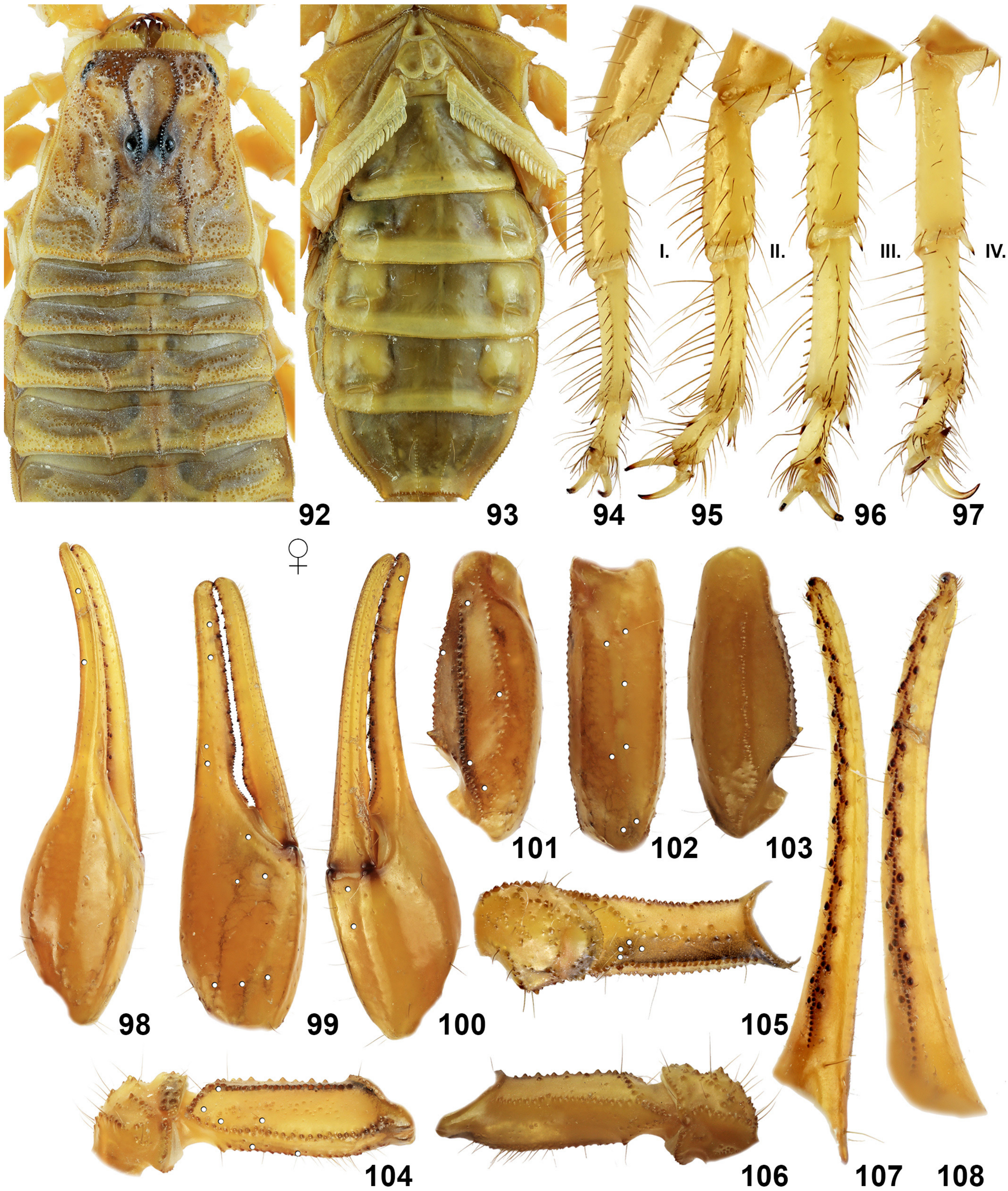
**Description**. (♀). Total length of adult female 64–66 mm, male unknown. Trichobothrium *db* on fixed finger of pedipalp situated between trichobothria *est* and *esb*, near to *est*. Fingers margins undulate in females. Pedipalp chela length/ width ratio 4.1–4.2 in females. Pectinal teeth number 22–23 in females. Chelicerae yellow, without reticulation. Pedipalps and metasoma very sparsely hirsute. Color uniformly yellow to yellowish brown, black pigmented 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 12–13 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 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 1.65 in females. Telotarsus III ventral setation represented by main row which contains ca 15 setae. Second parallel row contains not more than 9 setae. Pedal spur of legs hirsute.

**Notes.** (1) The new species is described from the isolated sands of the Ferghana Valley of Uzbekistan, at the border with Tajikistan. In the last 100 years, the Ferghana Valley sands have all but disappeared due to irrigation. On 18–20.V.2002, our field expedition (VF, A.V. Gromov) visited two isolated, remaining sand massifs of the modern Fargona Province, Uzbekistan (Kairakkum Sands in Besharyk District and "Karakalpak Steppe" in Yazyavan District). We found a dense population of *O. voldemari* **sp. n.**; at the same time, we did not find another endemic scorpion known only from this sand massif, *Anomalobuthus zarudnyi* (Birula, 1911) (formerly *Psammobuthus zarudnyi*; see Teruel *et al.* 2018: 37).

(2) In the handwritten catalog of A.A. Birula's collection (ZISP), some specimens of *Olivierus* from Aulie-Ata (Taraz, Kazakhstan) and Andizhan (Ferghana Valley, Uzbekistan) were labeled "*Buthus caucasicus ferganensis*"; this taxon was never described or published (Fet 1989: 102).




**FIGURES 86–91.** *Olivierus voldemari* **sp**. **n**., female holotype. Figures 86–87. Dorsal (86) and ventral (87) views. Figures 88–91. Telson lateral (88) and metasoma and telson, lateral (89), dorsal (90), and ventral (91) views. Scale bar: 10 mm (86–87, 89–91).




**FIGURES 92–108.** *Olivierus voldemari* **sp**. **n**., female holotype. Figures 92–97. Carapace and tergites I–IV (92), sternopectinal region and sternites (93), left legs I–IV, retrolateral aspect (94–97). Figures 98–108. Pedipalp segments, chela, dorsal (98), external (99), and ventral (100) views. Pedipalp patella, dorsal (101), external (102) and ventral (103) views. Pedipalp femur and trochanter, dorsal (104), internal (105), and ventral (106) views. Movable (107) and fixed (108) fingers dentition. The trichobothrial pattern is indicated in Figures 99–102, 104–105 by white circles.

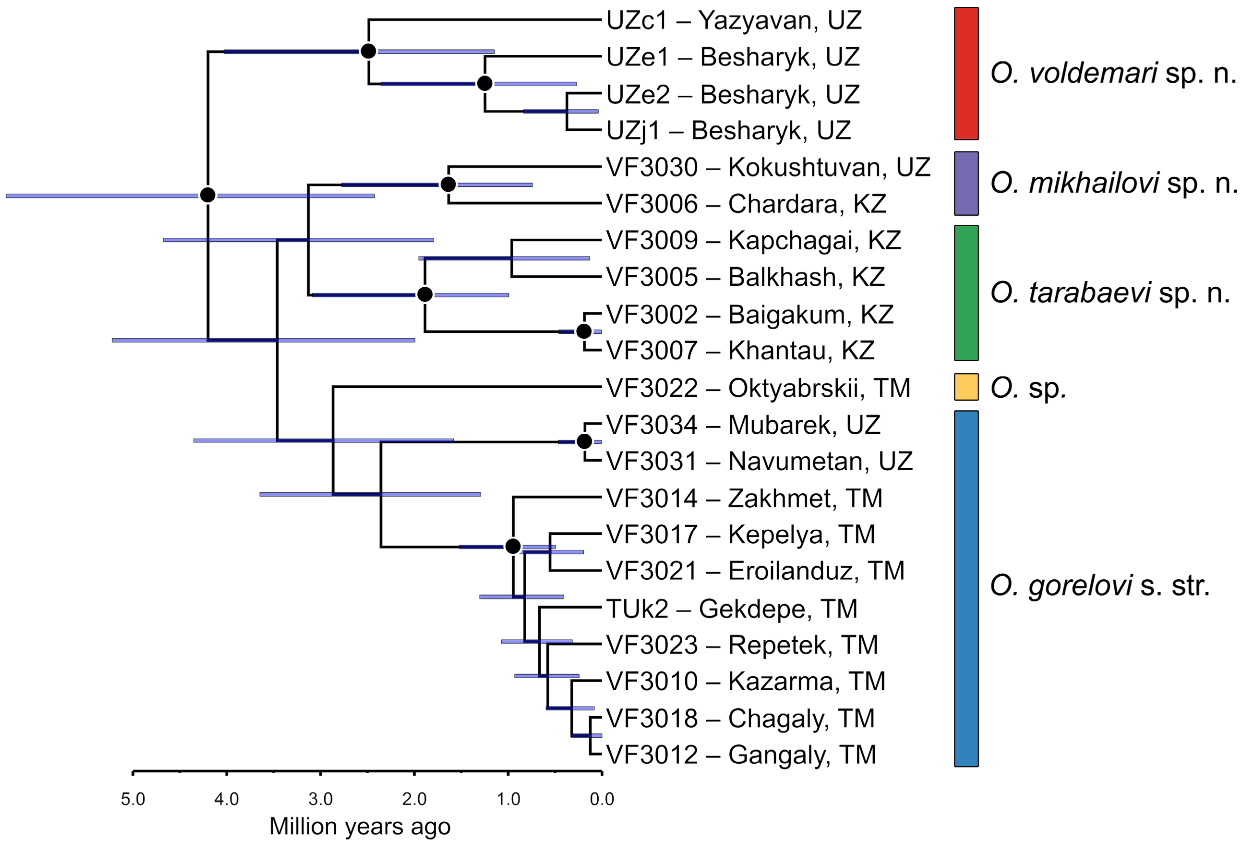



**FIGURE 109.** A time-calibrated phylogeny for *Olivierus* species in Central Asia: *Olivierus mikhailovi* **sp. n.**, *O. tarabaevi* **sp. n.**, *O. voldemari* **sp. n.**, and *O. gorelovi* (adapted from Graham *et al.*, 2019, fig. 4). The tree is based on two mitochondrial (*COI* & *16S*) and one nuclear (*ITS-2*) markers. Horizontal bars represent highest posterior densities (95%) around mean date estimates. Nodes with black dots were supported with high posterior support (>95). Vertical bars represent different species based on the most conservative consensus of three species delimitation approaches (PTP, GMYC, & ABGD). Abbreviations: KZ, Kazakhstan; TM, Turkmenistan; UZ, Uzbekistan. See Graham *et al.* (2019) for additional information.

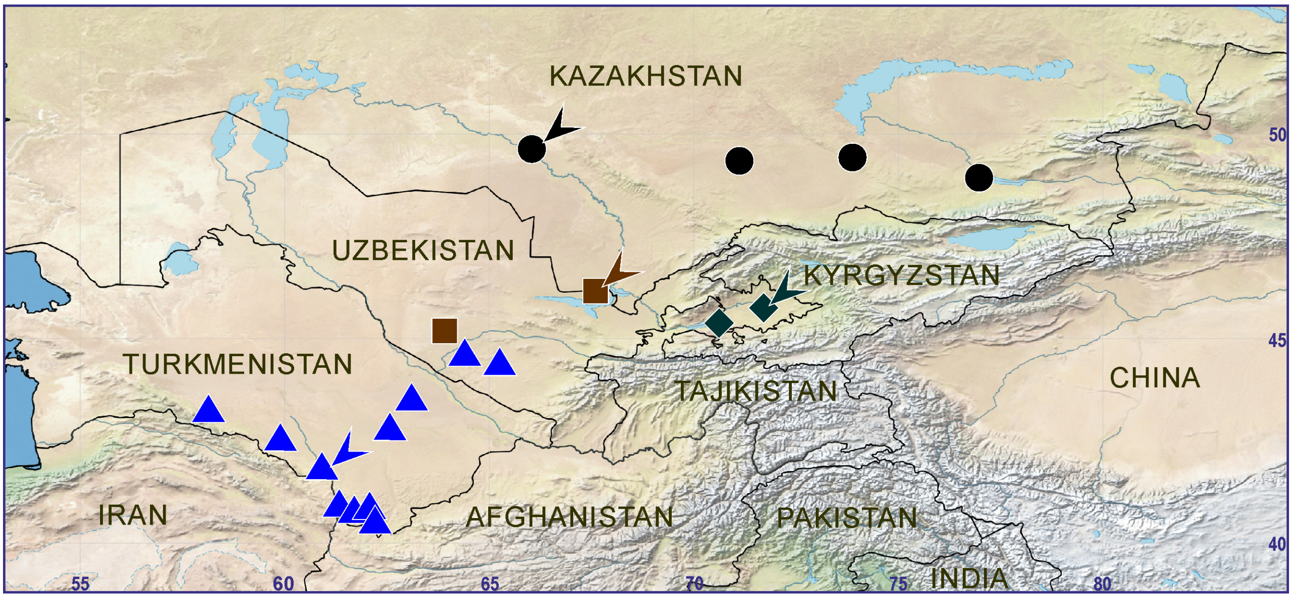



**FIGURE 110.** Distribution of four *Olivierus* species in Central Asia: *Olivierus mikhailovi* **sp. n.** (square), *O. tarabaevi* **sp. n.** (circle), *O. voldemari* **sp. n.** (diamond), and *O. gorelovi* (triangle) (after Graham *et al.*, 2019, fig. 1). Type localities of each species are marked by an arrow. Note Zeravshan River (tributary of Amu Darya) separating the ranges of *O. mikhailovi* **sp. n.** and *O. gorelovi*.

**TABLE III.** Molecular diagnostic characters for three new cryptic species compared to a *COI* reference sequence from *O. gorelovi* (based on type locality haplotypes).

| Species | Position and diagnostic nucleotide | uncorrected p-distance |
|---|---|---|
| *O. mikhailovi* ***sp. n.*** | 165, A; 171, A; 216, A; 270, A; 273, A; 279, G; 321, C; 345, G; 354, A; 405, A; 408, A; 450, G; 468, A; 483, T; 537, A | 0.0325 |
| *O. tarabaevi* ***sp. n.*** | 159, T; 171, A; 189, A; 204, G; 216, A; 243, A; 273, T; 279, G; 321, C; 345, G; 357, A; 462, A; 468, A; 471, C; 486, G; 537, A; | 0.0390 |
| *O. voldemari* ***sp. n.*** | 113, T; 115, G; 145, T; 159, T; 165, A; 171, A; 174, G; 177, C; 189, A; 216, A; 257, G; 258, G; 263, G; 279, G; 357, A; 376, G; 384, G; 408, G; 450, G; 456, G; 468, A; 471, C; 555, G; 561, A | 0.0521 |

## Discussion

Published mitochondrial data on *O. gorelovi* revealed significant phylogeographic structure, with two main clades estimated to have origins in the Pliocene or Pleistocene (Fet *et al*. 2018, fig. 329; Graham *et al.* 2019, fig. 4). The authors concluded that the clades were likely a product of vicariance due to transgressions of the Caspian Sea and the Amu Darya River, as has been proposed previously for co-occurring scorpions in the region (Graham *et al*. 2012b). This was after sea levels dropped, causing most of the Aral Sea Basin to transition to dry land (Atamuradov 1994). Samples from the isolated sands of the Ferghana Valley of Uzbekistan, which are described here as *O. voldemari* **sp. n.**, were estimated to have diverged earliest (see fig. 109). Aridification progressed east to west as the surrounding mountains were uplifted (Burtman *et al*. 1996), making intermountain basins like the Ferghana Valley among the first to become isolated.

Graham *et al*. (2019) demonstrated that the remaining three clades probably shared a common ancestor in the Pliocene or early Pleistocene, and possibly diverged at about the same time. The authors referred to these as the Northern, Central, and Southern clades. Here, we restrict *O. gorelovi* s. str. to the Southern clade identified by Graham *et al*. (2019), which includes all populations from Turkmenistan and two samples from southern Uzbekistan (Buxoro Province, Navumetan; Samarquand Province, Mubarek). The Northern clade, described here as *O. tarabaevi* **sp. n.,** is represented by individuals from four sites in the lowlands of south-central Kazakhstan with no obvious intervening barriers to gene flow. We herein describe the Central clade as *O. mikhailovi* **sp. n.,** which is represented by two sites located, and presumably somewhat isolated, between the Amu Darya and Syr Darya rivers. The mean time to most recent common ancestor (TMRCA) estimates for *O. tarabaevi* **sp. n.** and *O. mikhailovi* **sp. n.** are both in the late Pliocene to mid Pleistocene (fig. 109). The TMRCA estimate for *O. gorelovi* is a bit older, ranging from the mid Pliocene to early Pleistocene. Available genetic data hint that these species, especially *O. gorelovi* s. str. underwent range expansions from smaller Pleistocene refugia as the deserts warmed following the Last Glacial Maximum. Additional sampling would enable a test of demographic hypotheses.

Our three new species and *O. gorelovi* form a complex of recently divergent clades (p-distances 0.0325 to 0.521); for comparison, p-distances among several other, more divergent species of Central Asian *Olivierus*, isolated by mountain ranges, vary from 0.065 to 0.156 (our data). Divergence of other sister species, such as *O. parthorum* (Pocock, 1889) vs *O. elenae* (Fet *et al.*, 2018), is estimated at late Miocene to early Pleistocene, mean 3-4 Mya.

We must emphasize that the full morphological differentiation among four abovelisted species is problematic, as the species represent a cryptic species complex (Tables I–II). Additional material might reveal more consistent morphological differences, but the material is currently difficult to obtain. The clades, furthermore, are diverse, especially the Southern clade (*O. gorelovi* s. str.), so morphological data from additional material may reveal more cryptic species in the complex. Specifically, multivariate methods would be ideal for illuminating morphological distinctions among the species, as has been done successfully with closely related *Vaejovis* scorpions (Vaejovidae) that are morphologically similar (Graham *et al*. 2012a).

## Acknowledgments

The 2002 field mission to Central Asia (Kazakhstan, Turkmenistan, and Uzbekistan) that provided most of the studied specimens was supported by the National Geographic Society (USA) Research and Exploration Fund (grant 7001–0001 to VF). Alexander Gromov (Bingen am Rhein, Germany) provided a great help during the field work across Central Asia in March–May 2002. Collection permits were granted by the ministries of natural resources of Kazakhstan, Turkmenistan, and Uzbekistan. We are grateful to Alexander Fomichev (Barnaul, Russia), Alexander Gromov, and Pavel Kučera (Prague, Czech Republic) who all generously supplied additional specimens for our studies. We thank Edward A. Myers (Washington, DC, USA) and Ronald C. Kaiser (Willimantic, CT, USA) for their contribution to revealing the cryptic *Olivierus* species. We thank Yuri Marusik (Magadan, Russia), Alexander K. Stewart (Canton, NY, USA), and Ersen A. Yağmur (Manisa, Turkey) for their comments on the manuscript.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