Figure 40: *Calchas nordmanni*, dorsal view (specimens dried). **Left.** Adult female (43 mm), Demirkent – Tortum, Turkey. **Right.** Adult female (45 mm), Demirkent – Tortum, Turkey.

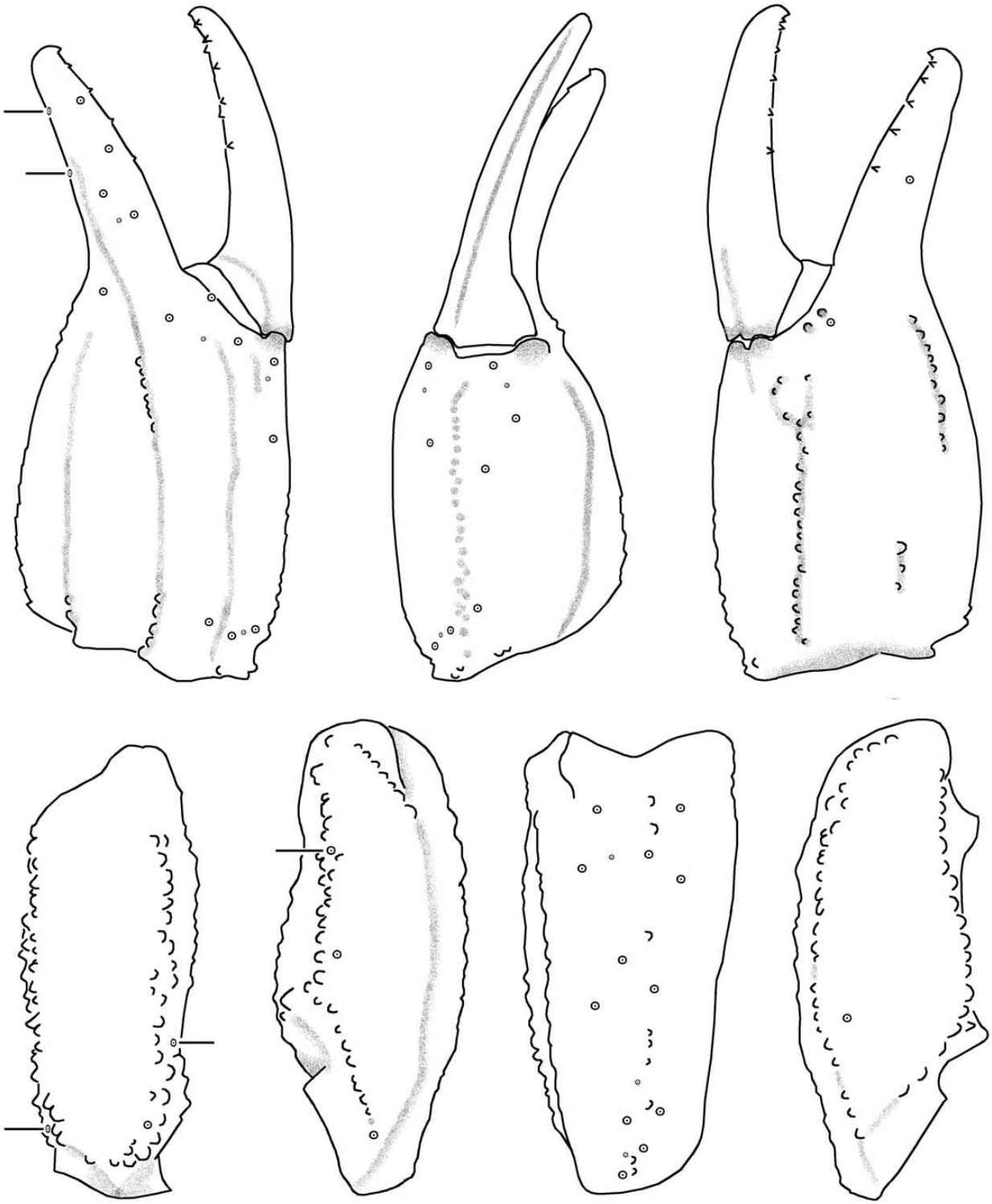


Figure 41: Trichobothrial pattern of *Calchas nordmanni* Birula, female, Tortum, Turkey.

this species in Figure 41. The overall telson structure is consistent with Birula's (1917a: fig. 13; 1917b: Pl. II, figs. 6–7) description (Figs. 28–31), and the coloration and patterns seen in two studied females (Fig. 40) is as described by Birula (1917a, 1917b). Finally, the pectinal tooth counts, male and female, are consistent with those reported by Birula (1917a, 1917b) (Fig. 36).

Calchas birulai Fet, Soleglad et Kovařík, sp. nov.

(Figs. 4–5, 8–9, 13, 15, 16, 20–23, 25, 27, 32–38, 42–58; Tables 2, 3)

REFERENCES:

Calchas nordmanni: Kinzelbach, 1980: 169–174 (in part), fig. 5 (map localities 14–15); Francke & Soleglad, 1981: 245–248 (in part), fig. 20; Kinzelbach, 1982: 58 (in part); Kinzelbach, 1985: Map IV (in part); Kovařík, 1997: 184; Crucitti, 1999: 87 (in part); Kovařík, 1999: 40, 42 (in part); Fet & Braunwalder, 2000: 18 (in part); Sissom & Fet, 2000: 418–419 (in part); Crucitti & Cicuzza, 2001: fig. 7 (in part); Soleglad & Fet, 2003b: 7 (in part), Karataş & Çolak, 2005: 4; Fet & Soleglad, 2008: 256 (in part), fig. 5; Kaltsas et al., 2008: 227 (in part); Kamenz & Prendini, 2008: 43 (in part); Soleglad et al., 2009: 2 (in part).

Paraiurus nordmanni: Vachon & Kinzelbach, 1987: 99, 102, fig. 6 (in part).

Holotype: ♂ (NMW 0843), TURKEY, *Mardin Province*: Mardin, 6 May 1966, J. Eiselt et al. leg. **Paratypes** (11 ♂, 14 ♀, 4 juv.), see list below.

Diagnosis. Small-sized scorpion with heavy chelae, 25–28 mm in length, pectinal tooth counts, 5–6 (6) male and 5–6 (5) female. Coloration yellow-orange with little pigmented patterns. Telson with short, abruptly curved aculeus; subaculear setal pair (SSP) located on aculeus base. Six and five inner denticles (*ID*) and seven and six median denticle (*MD*) groups on the movable and fixed fingers, respectively. Fixed finger of chela shorter than palm, trichobothrium *it* located proximally of fixed finger midpoint. Trichobothrium *dst* is equidistant between *dt* and *db*. Metasomal segment V two times longer than wide.

Distribution. TURKEY: southeast (Adıyaman, Diyarbakır, Gaziantep, Malatya, Mardin, Şanlıurfa, and Siirt Provinces). IRAQ: north (Arbil Province). ?SYRIA (unconfirmed sighting, see Introduction) (see maps in Figs. 38, 42).

Etymology. Species name is a patronym honoring the famous Russian scorpiologist, Alexei Andreevich Byalynitskii-Birula (A. A. Birula) (1864–1937), formerly of the Zoological Institute, St. Petersburg, Russia, the discoverer of *Calchas*.

MALE. Description based on holotype male from Mardin, Turkey. Measurements of the holotype plus three other specimens are presented in Table 3. See Figure 43 for a dorsal view of the male holotype.

COLORATION. Basic color of carapace, mesosoma, metasoma, pedipalps yellow-orange; telson and legs yellow; carinae of pedipalps and metasoma, and leg condyles reddish; chelal finger dentition and telson aculeus a dark brown. No variegated patterns present.

CARAPACE (Fig. 44). Anterior edge with a small median indentation, five small irregularly placed setae visible; interocular area somewhat rough with scatter granulation, though smooth around the immediate area of the median eyes; posterior lateral aspects covered with medium to large granules. Anterior and lateral edges next to lateral eyes with small but conspicuous pointed granules. Mediolateral ocular carinae present and granular, extending to the lateral eyes; lateral eyes number two, the posterior eye slightly larger. Median eyes and tubercle somewhat small, positioned considerably anterior of middle with the following length and width formulas: 100|335 (anterior edge to medium tubercle middle |carapace length) and 40|250 (width of median tubercle including eyes|width of carapace at that point).

MESOSOMA (Fig. 46). Tergites I–II granulated on extreme posterior edge, III–VI with heavier granulation, primarily on posterior half; tergite VII covered with coarse granules with two pairs of granulate carinae. Sternites III–VI smooth and lustrous, VII surface rough; on segment VII, one pair of irregularly granulated lateral carinae and one median pair essentially obsolete with some traces present posteriorly. Stigmata (Fig. 46) are short sub-oval in shape, angled 45 degrees in an anterointernal direction.

METASOMA (Figs. 49–50). Segments I–IV: dorsal and dorsolateral carinae crenulate; dorsal (I–IV) and dorsolateral (I–III) carinae terminate with spine; lateral carinae crenulate on I, present on one-half of II, on 30 % of III, and absent on IV; ventrolateral and ventromedian carinae crenulate. Dorsolateral carinae of segment IV terminate at articulation condyle. Segment V: dorsolateral carinae crenulate; lateral carinae crenulate for two-thirds of posterior aspect; ventrolateral and single ventromedian carinae crenulate; ventromedian carina not bifurcated, terminating in straight line (Fig. 50). Intercarinal areas of segments I–IV essentially smooth ventrally, with scattered granulation laterally; segment V

	Calchas birulai				*Calchas gruberi*					*Calchas nordmanni*		
	Mardin, Turkey		Ergani, Turkey		Mamure Kalesi, Anamur, Turkey		Belkis, Turkey		Samos Isl. Greece	Tortum, Turkey		Turkey
	Male Type	Female	Male	Female	Female Type	Male	Male	Female	Male	Female	Male	Male
Total length	27.00	25.90	24.60	28.00	31.90	26.25	26.60	28.75	27.40	35.75	31.65	34.20
Carapace length	3.35	3.30	3.15	3.55	4.20	3.25	3.45	3.75	3.35	5.35	4.20	4.45
Mesosoma length	8.50	10.00	7.90	10.30	10.40	9.45	8.95	9.75	9.45	9.45	10.30	8.95
Metasoma length	11.05	9.15	9.85	10.40	12.40	9.80	10.20	10.90	10.60	15.40	12.65	15.35
Segment I length/width	1.30/2.05	1.15/1.80	1.15/1.85	1.45/1.90	1.55/2.35	1.30/1.85	1.25/2.10	1.35/2.25	1.30/2.10	1.90/2.65	1.45/2.20	1.85/2.50
Segment II length/width	1.70/1.80	1.35/1.65	1.45/1.70	1.60/1.80	1.85/2.25	1.45/1.80	1.45/1.90	1.55/2.05	1.60/2.05	2.20/2.45	1.85/2.10	2.30/2.40
Segment III length/width	1.85/1.75	1.55/1.60	1.65/1.70	1.65/1.75	2.00/2.20	1.60/1.80	1.60/1.90	1.75/2.00	1.70/1.90	2.45/2.40	2.05/2.00	2.50/2.35
Segment IV length/width	2.40/1.70	1.95/1.45	2.10/1.60	2.15/1.70	2.65/2.20	2.10/1.75	2.25/1.90	2.40/1.95	2.40/1.85	3.30/2.30	2.70/1.95	3.35/2.15
Segment V length/width	3.80/1.75	3.15/1.55	3.50/1.65	3.55/1.65	4.35/2.10	3.35/1.60	3.65/1.85	3.85/1.95	3.60/1.85	5.55/2.30	4.60/1.80	5.35/2.10
Telson length	4.10	3.45	3.70	3.75	4.90	3.75	4.00	4.35	4.00	5.55	4.50*	5.45
Vesicle length	2.90	2.50	2.50	2.50	3.00	2.30	2.30	2.40	2.35	4.00	3.10	3.65
width/depth	1.90/1.55	1.75/1.25	1.70/1.35	1.70/1.35	2.30/1.80	1.75/1.25	1.80/1.30	1.95/1.40	1.85/1.25	2.45/2.00	1.95/1.45	2.30/1.80
Aculeus length	1.20	0.95	1.20	1.25	1.90	1.45	1.70	1.95	1.65	1.55	1.40	1.80
Pedipalp length	11.75	11.00	10.70	11.80	15.30	10.95	11.55	12.95	11.70	17.75	13.75	15.05
Femur length/width	2.95/1.15	2.75/1.10	2.70/1.05	2.85/1.20	3.55/1.60	2.75/1.15	2.90/1.15	3.15/1.25	2.95/1.15	4.40/1.80	3.35/1.40	3.75/1.45
Patella length/width	2.90/1.25	2.80/1.20	2.60/1.10	2.95/1.20	3.55/1.35	2.85/1.15	3.00/1.15	3.30/2.25	2.95/1.25	4.40/1.90	3.45/1.40	3.55/1.60
Chela length	5.90	5.45	5.40	6.00	8.20	5.35	5.65	6.50	5.80	8.95	6.95	7.75
Palm length	3.15	2.95	2.85	3.15	3.25	2.50	2.65	2.75	2.55	4.55	3.40	3.75
width/depth	2.20/2.65	2.00/2.40	2.15/2.45	2.25/2.75	2.20/2.65	1.60/1.95	1.90/2.20	1.85/2.40	1.85/2.20	3.15/3.65	2.35/2.75	2.80/3.55
Fixed finger length	2.40	2.10	2.00	2.30	3.35	2.50	2.65	3.00	2.70	3.75	2.90	3.40
Movable finger length	3.25	2.95	2.85	3.25	4.30	3.15	3.40	3.95	3.50	4.95	3.95	4.50
Pectines teeth	6-6	5-5	6-6	5-5	7-7	8-8	8-8	7-7	9-9	6-6	7-7	7-7
middle lamellae	4-4	2-2	3-3	3-2	3-3	4-4	5-4	3-5	6-6	3-3	5-5	5-5
Sternum length/width	0.85/1.35	1.05/1.30	0.85/1.15	1.15/1.40	1.15/1.35	1.05/1.35	0.95/1.25	1.05/1.25	0.80/1.05	1.30/1.70	1.15/1.30	1.15/1.35

Table 3: Morphometrics (mm) of *Calchas birulai*, **sp. nov.**, *C. gruberi*, **sp. nov.**, and *C. nordmanni*.

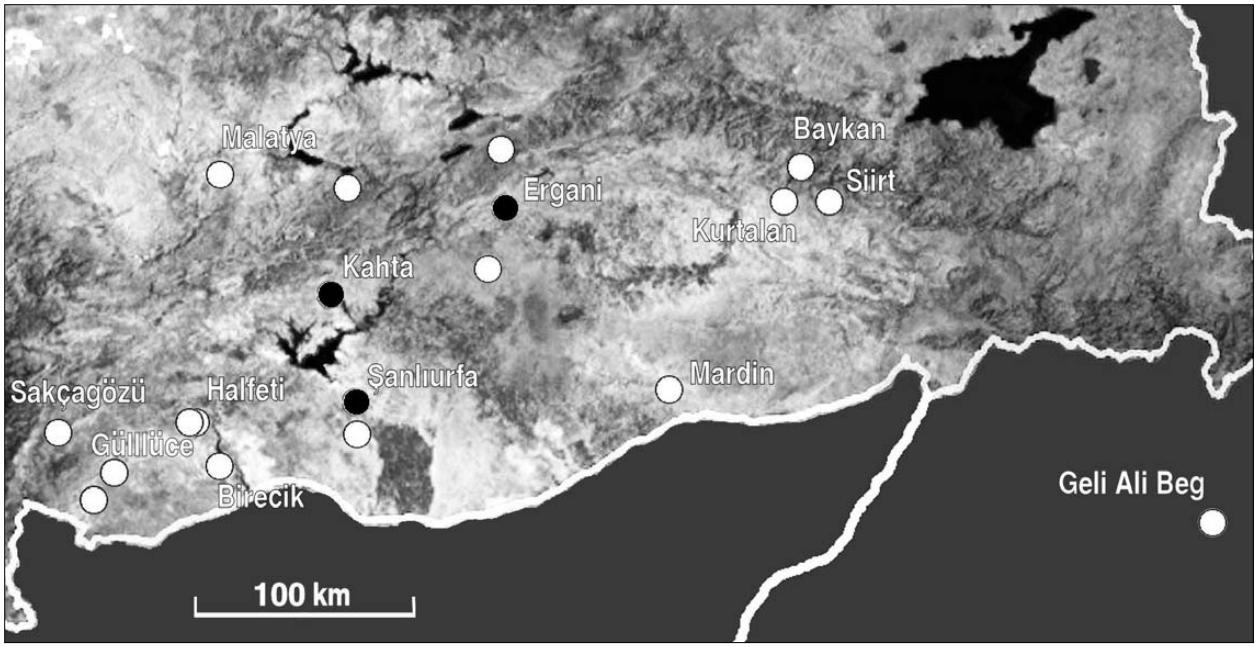


Figure 42: Large-scale range of confirmed localities of *Calchas birulai*, **sp. nov.** (open circles). See general *Calchas* map in Fig. 38.

with heavy granulation on ventral surface. Metasoma essentially void of setation.

TELSON (Figs. 49–50, 51, paratype female from Mardin). Elongated vesicle with short abruptly curved aculeus. Vesicle ventral surface covered with medium sized granules, heavier basally; scattered setae located on ventral surface of vesicle; subaculear setal pair (SSP) located on base of aculeus, distal of vesicle/aculeus juncture.

PECTINES (Fig. 47). Well-developed segments exhibiting length|width formula 340|190 (length taken at anterior lamellae|width at widest point including teeth). Sclerite construction complex, three anterior lamellae and 4/4 middle lamellae; fulcra of medium development. Teeth number 6/6. Sensory areas developed along most of tooth inner length on all teeth, including basal tooth. Small white setae found on anterior lamellae and distal pectinal tooth. Basal piece large, with deep indentation along anterior edge, length|width formula 80|115.

PREPECTINAL PLATE (Fig. 47). Not present in male (see discussion on female below).

GENITAL OPERCULUM (Fig. 47). Sclerites large, subtriangular, approximately as wide as long, separated for most of length. Conspicuous genital papillae present between the sclerites, but not extending beyond the posterior edge (see discussion on female below).

STERNUM (Fig. 47). Type 2, posterior emargination present, well-defined convex lateral lobes, apex visible but not conspicuous; wider than long, length|width formula 85|135; sclerite tapers anteriorly, posterior-width|anterior-width formula 135|108.

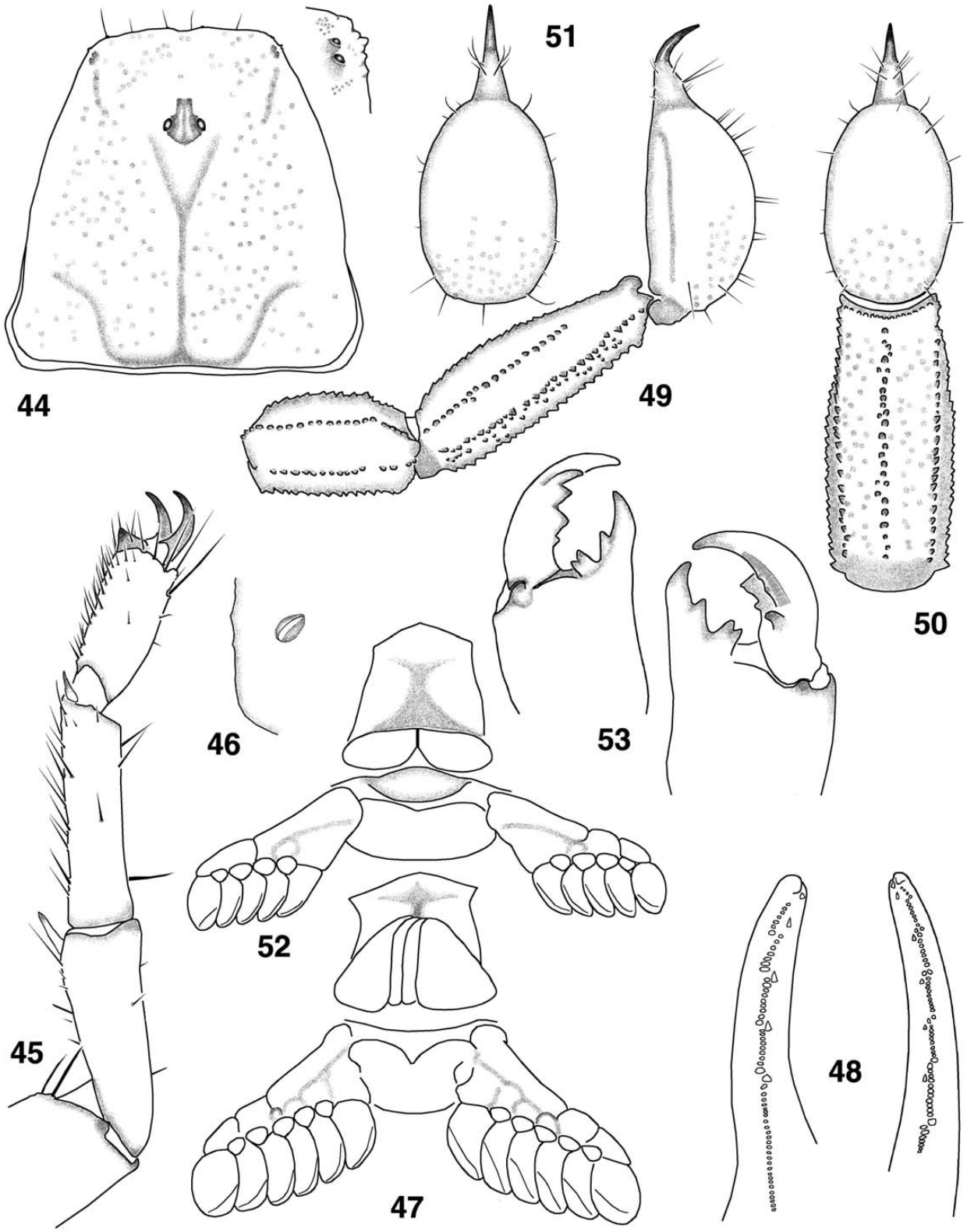
CHELICERAE (Fig. 53, female). Movable finger dorsal edge with one large subdistal (*sd*) denticle; ventral edge with two small pigmented crenulations (*va*) on the distal half, and one large pigmented accessory denticle at finger base; ventral edge with heavy setal brush covering well-developed serrula with over 20 contiguous tines, terminating just before distal tip. Ventral distal denticle (*vd*) considerably longer than dorsal (*dd*). Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

PEDIPALPS (Figs. 48, 54). Short fingered, strong chelae, heavily carinated, no scalloping on chelal fingers, thus not exhibiting sexual dimorphism in this structure. **Femur:** Dorsointernal and ventrointernal carinae serrate, dorsoexternal carina crenulate, ventroexternal rounded. Dorsal and internal surfaces sparsely granulate, ventral smooth, and external surface with line of serrate granules. **Patella:** Dorsointernal and ventrointernal carinae serrate, dorsoexternal granulate, ventroexternal rough rounded, and exteromedian carina granulate. Dorsal, ventral, and external surfaces smooth; external surface with granulate exteromedian carina; internal surface smooth except for weakly developed doubled

Figure 43: *Calchas birulai*, **sp. nov.**, male holotype (NMW), Mardin, Turkey, dorsal view (27 mm).

DPS and single VPS. **Chelal carinae:** Complies with the "8-carinae configuration". Digital (*D1*) carina strong, smooth to granulate; dorsosecondary (*D3*) present on basal half only, smooth; dorsomarginal (*D4*) rounded, continuous, with granules; dorsointernal (*D5*) weak, sparsely granulated; ventroexternal (*V1*) strong and granulated proximally, terminating at external condyle of movable finger; ventrointernal (*V3*) strong and smooth, continuous to internal condyle; external (*E*) strong, continuous, essentially smooth except for proximal one-fifth which is granulate; internal (I) weak, rounded, not continuous, with small granules. **Chelal finger dentition (Fig. 48):** median denticle (MD) row groups oblique and slighting imbricating, numbering 6/6 and 7/7 on fixed and movable fingers; 5/5 and 6/6 internal denticles (*ID*) and 5/5 and 6/6 outer denticles (*OD*) on fixed and movable fingers, respectively. No accessory denticles present. Number of *MD* denticles on movable finger is 55. **Trichobothrial patterns (Fig. 54):** Type C, orthobothriotaxic. See discussion of trichobothria differences between *Calchas* species which highlights the pattern of this male type.

LEGS (Fig. 45). Both pedal spurs present on all legs; tibial spurs present on legs III and IV. Tarsus covered heavily with large socketed setae on ventral surface.



Figures 44–53: *Calchas birulai*, **sp. nov. 44–50.** Male holotype (NMW), Mardin, Turkey. **44.** Carapace showing close-up of lateral eyes. **45.** Leg IV (left, ventral view), showing the tibial spur. **46.** Stigma IV. **47.** Sternum, genital operculum, and pectines. **48.** Chelal fixed and movable finger dentition. **49.** Telson and metasomal segments IV–V, lateral view. **50.** Metasomal segment V and telson, ventral view. **51–52.** Female paratype (NMW), Mardin, Turkey. **51.** Telson, ventral view. **52.** Sternum, genital operculum, prepectinal plate, and pectines. **53.** Female paratype (HNHM), Kavurma Köyü, Diyarbakır Province, Turkey. Chelicerae, ventral and dorsal views.

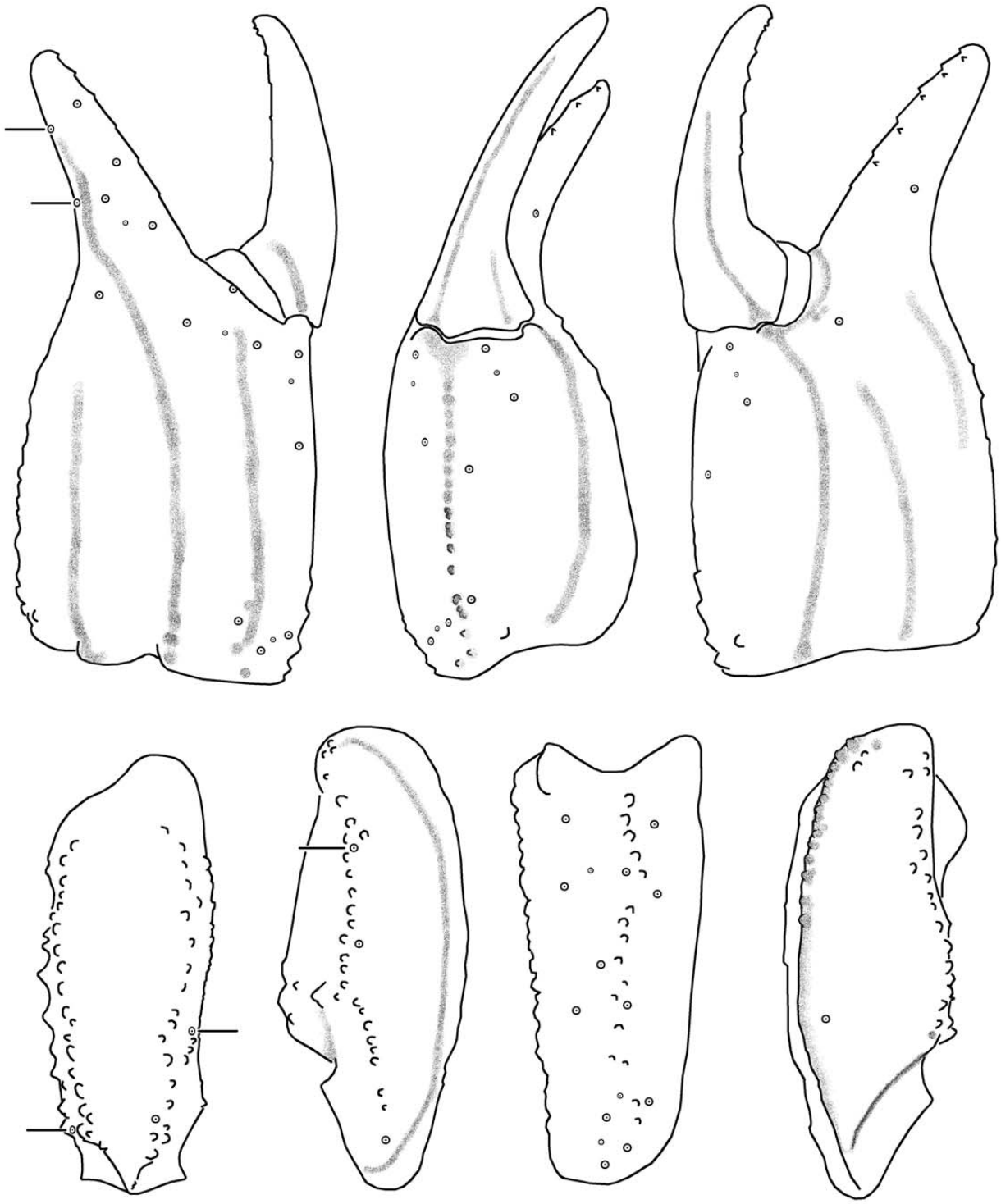


Figure 54: Trichobothrial pattern of *Calchas birulai*, **sp. nov.**, male holotype (NMW), Mardin, Turkey.

HEMISPERMATOPHORE (FIG. 55). In Figure 55 the right hemispermatophore ventral view is illustrated. It is consistent with the *C. birulai* hemispermatophore described in detail elsewhere. The overall structure is simplistic with a straight, parallel, and somewhat wide lamina terminating in a blunt, slightly tapered distal tip. The distal tip is thickened on the external edge exhibiting a slight sclerotization. The lamina base lacks a basal constriction but a slight angled expansion is visible just proximally of the lamina midpoint. At the

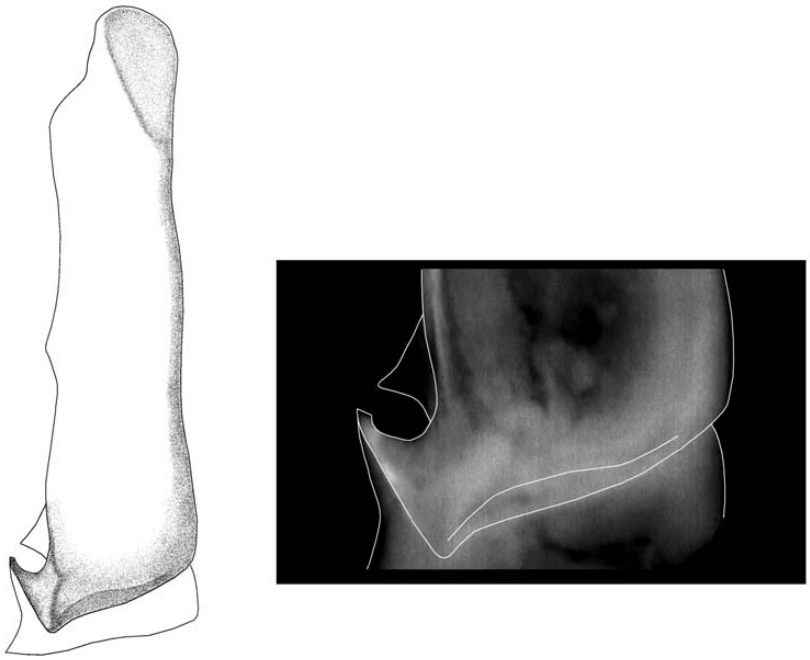


Figure 55: Right hemispermatophore of *Calchas birulai*, **sp. nov.**, male holotype (NMW), Mardin, Turkey. Ventral view and close-up of capsular area showing the truncated distal tip of the acuminate process.

lamina base is a nonpigmented, slightly sclerotized thin pointed internal protuberance. Emanating from the internal aspect of the capsular area is a highly pigmented sclerotized acuminate process terminating in a delicately truncated point.

Female Paratype (Mardin, Turkey, Figs. 51–53). Adult females are approximately the same size as the male, 24.60–27.00 [2] for males, compared to 25.90–28.00 [2] for females. The genders do not exhibit any significant morphometric differences except for the carapace length, which is relatively larger in the female; the female carapace length dominated in every possible ratio calculation. Pectinal tooth counts in the male exceed the female by one tooth over 80 % of the samples, male 5–6 (5.97) [30], female 5–6 (5.15) [26] (see histograms in Fig. 36). The genital operculum of the male is dramatically different from that in the female (Figs. 47, 52). The sclerites, subtriangular in shape, are as long as or longer than wide in the male, whereas in the female the sclerites are short and wide, more than twice as wide as long. Whereas the sclerites are fused medially in the female, they are separated their entire length in the male, exposing significantly developed genital papillae. The prepectinal plate, so conspicuous in the female, is absent in males (Figs. 47, 52). Figures 56–58 show dorsal and ventral views of both male and female specimens, and a locality area (Birecik, Turkey) for this species.

Type material. **Holotype:** ♂ (NMW 0843), TURKEY, *Mardin Province*: Mardin, 37.30°N, 40.733°E, 6 May 1966, J. Eiselt et al. leg. **Paratypes** (11 ♂, 14 ♀, 4 juv.): TURKEY, *Adıyaman Province*: 1 ♀ (FKCP), Nemrut Dağı, 40 km N Kahta, 37.982°N, 38.741°E, 3 July 1993, V. Šejna leg. *Diyarbakır Province*: 1 ♂, 1 ♀ (HNHM), Kavurma Köyü, 10 km NE Ergani, 1400 m a.s.l., 38.267°N, 39.767°E, 27 April 1989, G. Fabian, G. Ronkay & L. Ronkay leg. *Gaziantep Province*: 1 ♀ (NMW 0844), Sakçagözü, 37.198°N, 36.927°E, 26 April 1966, J. Eiselt et al. leg. *Malatya Province*: 1 ♀ (FKCP), Malatya, 38.067°N, 38.0167°E, June 1992, M. Kaftan leg.; 1 ♂ (FKCP), near Birecik, ca. 15–20 km from Syrian border (see Fig. 58), 37°01.185'N, 37°59.348'E, 500 m a.s.l. (collected together with *Compsobuthus matthiesseni* and *Mesobuthus eupeus*), 20 October 2008, A. Funk leg. *Mardin Province*: 3 ♂ 3 ♀ (NMW 0843), Mardin, 6 May 1966, J. Eiselt et al. leg. *Şanlıurfa Province*: 3 ♂ 2 ♀ (NMW 0840), 20 km S Urfa (now Şanlıurfa), 37.15°N, 38.80°E, 1 May 1966, J. Eiselt et al. leg.; 1 ♀ (MNHN RS 6452), Birecik [label: "Bilejdik"], 37.025°N, 37.977°E, 23 April 1971, J. Garzoni leg.; 1 ♂ subad., 2 ♀ subad., 1 ♂ juv., 1 ♀ juv. (HNHM), Halfeti, 37.25°N, 37.867°E, 1990, G. Ronkay leg.; 1 ♂ subad., 2 ♂ juv. (HNHM), Halfeti, valley of Euphrates, 500 m a.s.l., 15–22 April 1990, B. Herzig & G. Ronkay leg. *Siirt Province*: 1 ♂ (NMW 0842), road Siirt–Kurtalan, 16 May 1966, J. Eiselt et al. leg.; 1 ♀ (NMW 0846), Baykan (between Siirt and Bitlis), 38.165°N, 41.780°E, 15 May 1966, J. Eiselt et al. leg.; 1 ♀ (ZMUH A37/72), Siirt, 37.933°N, 41.95°E, 18 June 1972, C. Kosswig leg.

Note: see Eiselt (1967) for detailed itinerary and map of the NMW expedition to southeastern Turkey in 1966.

Additional specimens/localities (not examined): TURKEY: *Adıyaman Province*: 1 specimen (ZSRO 1181),

Figure 56: *Calchas birulai*, **sp. nov.**, dorsal and ventral views. Adult female paratype (FKCP) (24 mm), Nemrut Dağı, Turkey.

Figure 57: *Calchas birulai*, **sp. nov.**, dorsal and ventral views. Adult male paratype (FKCP) (22 mm), Birecik, Turkey.

Figure 58: Turkey, Gaziantep Province, Birecik, 500 m, a.s. l., 37°01.185'N, 37°59.348'E, ca. 15–20 km from the Syrian border. Collection locality of adult male paratype (FKCP) of *Calchas birulai*, **sp. nov.** (see Fig. 57), together with *Compsobuthus matthiesseni* and *Mesobuthus eupeus*.

Nemrut Dağı between summit and Horik, 37.93–37.97°N, 38.70–38.73°E site no. VO-1982/52d, 28 September 1982, R. Kinzelbach leg. *Gaziantep Province*: 1 ♂, 1 ♀ (ZDNU 2003/524/1-2), Şahinbey District, Güllüce Village, lower slopes of Mt. Ellezi, 13 September 2003; 1 ♂ (ZDNU 2003/573/1), 1 ♀ (ZDNU 2003/573/2), Şahinbey District, Güllüce Village, 36.983°N, 37.267°E, 21 September 2003 (Karataş & Çolak, 2005); 1 ♂ (AMNH [LP 4333]), Şehitkamil District, Incesu Köyü, 7 May 2005, E. Aydin [Yağmur] leg. (reported as "Antep-Sehitkamil: Incesu Köyü" by Kamenz & Prendini, 2008); 2 specimens (ZSRO 1101), Rumkale, 37.265°N, 37.874°E, 28 April 1987, M. Kasparek leg. *Sanlıurfa Province*: 1 specimen (ZSRO 0358, formerly NMM 0500), Karaçadağ Mts. near Siverek, 1200 m a.s.l., 37.691°N, 39.654°E, 18 April 1981, W. Heinz leg. (Kinzelbach, 1982: 58). IRAQ (north). *Arbil (Erbil, Hawler) Province*. 1 specimen, Geli Ali Beg waterfall, 36.6305°N, 44.4475°E, 21 April 1958, C. Kosswig leg. (ZMUH, no. 9/1958) (R. Kinzelbach, pers. comm., May 2009).

Calchas gruberi Fet, Soleglad et Kovařík, sp. nov.

(Figs. 3, 5–7, 9–11, 14, 17–21, 25–26, 32–38, 59–75; Tables 2–3)

REFERENCES:

Calchas nordmanni: Kinzelbach, 1980: 169–174 (in part), figs. 1–2, 5 (map locality 16); Kinzelbach, 1982: 58 (in part); Kinzelbach, 1985: Map IV (in part); Crucitti, 1999: 87 (in part); Kovařík, 1999: 40, 42 (in part); Fet & Braunwalder, 2000: 18 (in part); Sissom & Fet, 2000: 418–419 (in part); Crucitti & Cicuzza, 2001: fig. 7 (in part); Stathi & Mylonas, 2001: 290, 293; Soleglad & Fet, 2003a: 5, fig. 2; Soleglad & Fet, 2003b: 7 (in part), figs. 19, 23, 52, 96; Fet et al., 2004: 24, figs. 1–4, 41–42 (Megisti listed in error; should be Anamur, NMW 0841); Fet et al., 2006a: 269–271, figs. 6–7; Fet & Soleglad, 2008: 256 (in part); Kaltsas et al., 2008: 227 (in part); Soleglad et al., 2009: 2 (in part), fig. 1.

Paraiurus nordmanni: Vachon & Kinzelbach, 1987: 99, 102, fig. 6 (in part); Sissom, 1988: 272.

Holotype: ♀ (NMW 0847), TURKEY, *Mersin Province*: Mamure Kalesi, Anamur, under stones, 15 May 1969 (F. Ressl). **Paratypes** (6 ♂, 10 ♀, 4 juv.): see list below.

Note: the type locality, Mamure Kalesi, is a famous waterfront Roman fortress, further strengthened by the Ottomans. It is located on Cape Anamur, the southernmost point of the Anatolian Peninsula.

Diagnosis. Small-sized scorpion with medium chelae, 26–36 mm in length, pectinal tooth counts 8–9 (8) male and 7–8 (7) female. Coloration variable, from yellow-orange with little patterns to dark brown and variegated patterns. Telson with bulbous vesicle, with long, wide curved aculeus; subaculear setal pair (SSP) located at vesicle/aculeus juncture. Seven and six inner denticles (*ID*) and eight and seven median denticle (*MD*) groups on the movable and fixed fingers, respectively. Fixed finger of chela longer than palm, trichobothrium *it* located on distal third of fixed finger. Metasomal segment V two times longer than wide.

Distribution. TURKEY: south (Antalya and Mersin Provinces). GREECE: Samos Island, Megisti Island. (see maps in Figs. 38, 59).

Etymology. The species name is a patronym honoring our colleague Dr. Jürgen Gruber, the prominent opilionologist and a veteran curator of Arachnida in 3.Zoologische Abteilung, Naturhistorisches Museum Wien, Austria.

FEMALE. Description based on holotype female from Mamure Kalesi, Anamur, Turkey. Measurements of this holotype plus four paratypes are presented in Table 3. See Figure 60 for a dorsal view of the female holotype.

COLORATION. Basic color of carapace, tergites, metasoma, telson, pedipalps, and legs yellow-orange; carinae of pedipalps and metasoma, and cheliceral dentition a light red; chelal finger dentition and telson aculeus a dark reddish-brown; leg condyles red; sternites and pectines pale yellow. No variegated patterns present.

CARAPACE (Fig. 61). Anterior edge with a small median indentation, equipped with four small irregularly placed setae (others may be broken off); interocular area somewhat rough with scattered granulation, though smooth around the immediate area of the median eyes; posterior lateral aspects covered with medium to large granules. Mediolateral ocular carinae present, extending to the lateral eyes; lateral eyes number two, the posterior eye a little larger. Median eyes and tubercle somewhat small, positioned considerably anterior of middle with the following length and width formulas: 118|420 and 54|338.

MESOSOMA (Fig. 62). Tergites I–III lightly granulated, IV–VI with heavier granulation, primarily on posterior half; tergite VII covered with coarse granules with two pairs of granulate carinae. Sternites III–VI smooth and lustrous, VII covered with small granules; two pair of weak, vestigial carinae present on segment VII. Stigmata (Fig. 62) are short sub-oval in shape, angled 45° in an anterointernal direction.

METASOMA (Figs. 66–67). Segments I–IV: dorsal and dorsolateral carinae crenulate; dorsal (I–IV) and dorsolateral (I–III) carinae terminate with spine, smaller on dorsolateral; lateral carinae crenulate on I and obsolete on II–IV; ventrolateral and ventromedian carinae crenulate. Dorsolateral carinae of segment IV terminate at articulation condyle. Segment V: dorsolateral carinae crenulate; lateral carinae irregularly granulated for two-thirds of posterior aspect; ventrolateral and single ventromedian carinae crenulate; ventromedian carina not bifurcated, terminating in straight line (Fig. 67). Intercarinal areas essentially smooth on I–III, scattered with granulation ventrally on IV–V. Metasoma essentially void of setation.

TELSON (Figs. 66–67, 68, paratype male from Anamur). Bulbous vesicle with long widely curved aculeus. Vesicle surface covered ventrally with medium sized granules, heavier basally; scattered setae located on ventral surface of vesicle; subaculear setal pair (SSP) located at vesicle/aculeus juncture.

PECTINES (Fig. 64). Well-developed segments exhibiting length|width formula 400|160 (length taken at anterior lamellae|width at widest point including teeth). Sclerite construction complex, three anterior lamellae and 3/3 middle lamellae; fulcra of medium development. Teeth number 7/7. Sensory areas developed along most of tooth inner length on all teeth, including basal tooth. Delicate thin, white setae found on anterior lamellae and distal pectinal tooth. Basal piece large, with deep indentation along anterior edge, length|width formula 80|100.

PREPECTINAL PLATE (Fig. 64). Conspicuous lustrous plate, approximately as wide as a gential operculum sclerite; length/width ratio 230/550.

GENITAL OPERCULUM (Fig. 64). Sclerites much wider than long, fused medially. Posterior medial area contracts anteriorly. Genital papillae absent (see discussion on male below).

STERNUM (Fig. 64). Type 2, posterior emargination present, well-defined convex lateral lobes, apex visible but not conspicuous; slightly wider than long, length|width formula 115|135; sclerite tapers anteriorly, posterior-width|anterior-width formula 135|93.

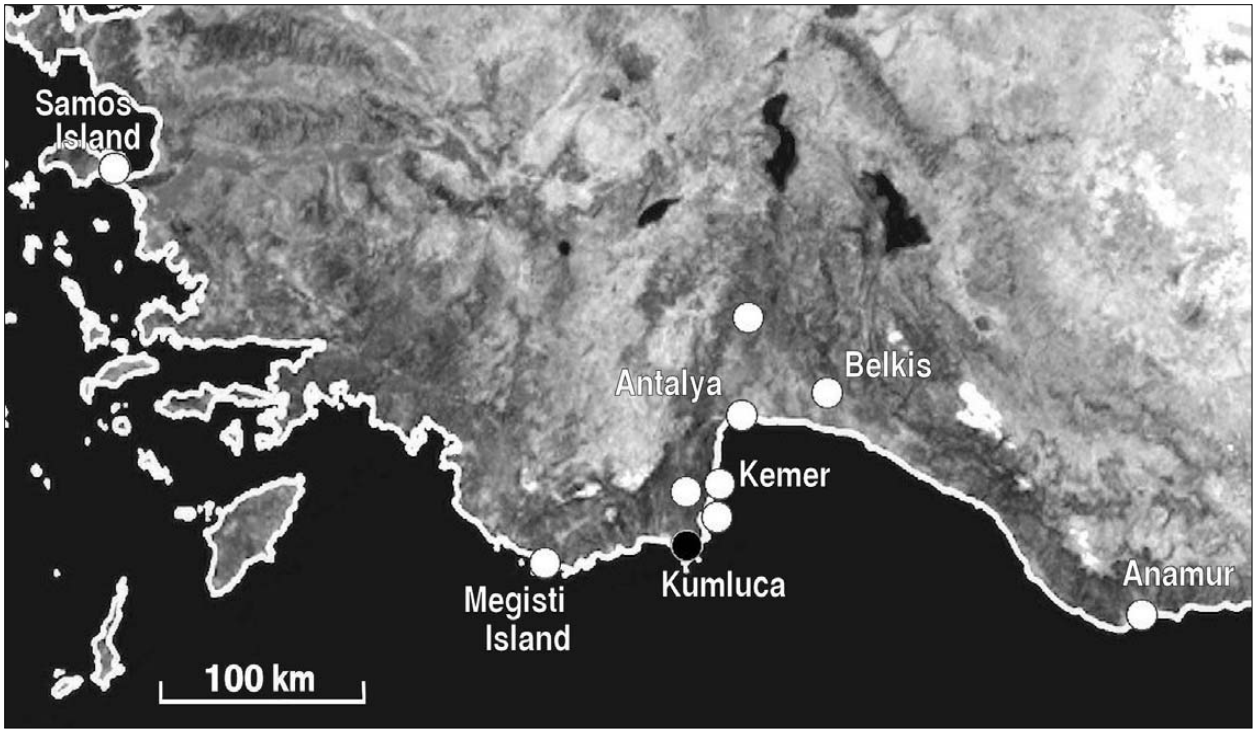


Figure 59: Large-scale range of *Calchas gruberi*, **sp. nov.** (open circles). See general *Calchas* map in Fig. 38.

CHELICERAE (Fig. 69, paratype male from Anamur). Movable finger dorsal edge with one large subdistal (*sd*) denticle; ventral edge with three small crenulations (*va*), two pigmented, on the distal half, and one large pigmented accessory denticle at finger base; ventral edge with heavy setal brush covering well-developed serrula with over 20 contiguous tines, terminating just before distal tip. Ventral distal denticle (*vd*) considerably longer than dorsal (*dd*). Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

PEDIPALPS (Figs. 65, 71). Moderately chelate, heavily carinate species, no scalloping on chelal fingers, thus not exhibiting sexual dimorphism in this structure. **Femur:** Dorsointernal carina serrate, dorsoexternal and ventrointerior carinae crenulate, ventroexternal rounded. Dorsal, ventral, and external surfaces rough, internal surface granulated. **Patella:** Dorsointernal, dorsoexternal, and ventrointernal carinae crenulate, ventroexternal carina granulate, exteromedian carina irregularly crenulate. Dorsal and ventral surfaces rough; external surface with exteromedian carina; internal surface smooth except for weakly developed doubled DPS and VPS. **Chelal carinae:** Complies with the "8-carinae configuration". Digital (*D1*) carina strong, smooth to granulate; dorsosecondary (*D3*) present on basal half only, covered with large granules; dorsomarginal (*D4*) strong, round, continuous, with large granules; dorsointernal (*D5*) weak, sparsely granulated; ventroexternal (*V1*) strong and granulated, terminating at external condyle of movable finger; ventrointernal (*V3*) medium development, continuous to internal condyle, covered with small granules; external (*E*) strong, continuous, and granulated; internal (*I*) weak, rounded, not continuous, with small granules. **Chelal finger dentition (Figs. 65):** median denticle (MD) row groups oblique and slightly imbricating, numbering 7 and 8; 6/6 and 7/7 internal denticles (*ID*) and 6/6 and 7/7 outer denticles (*OD*) on fixed and movable fingers, respectively. No accessory denticles present. Number of *MD* denticles on movable finger is 76. **Trichobothrial patterns (Fig. 71):** Type C, orthobothriotaxic. See discussion of trichobothria differences between *Calchas* species which highlights the pattern of this female type.

LEGS (Figs. 62). Both pedal spurs present on all legs; tibial spurs present on legs III and IV. Tarsus covered heavily with large socketed setae on ventral surface.

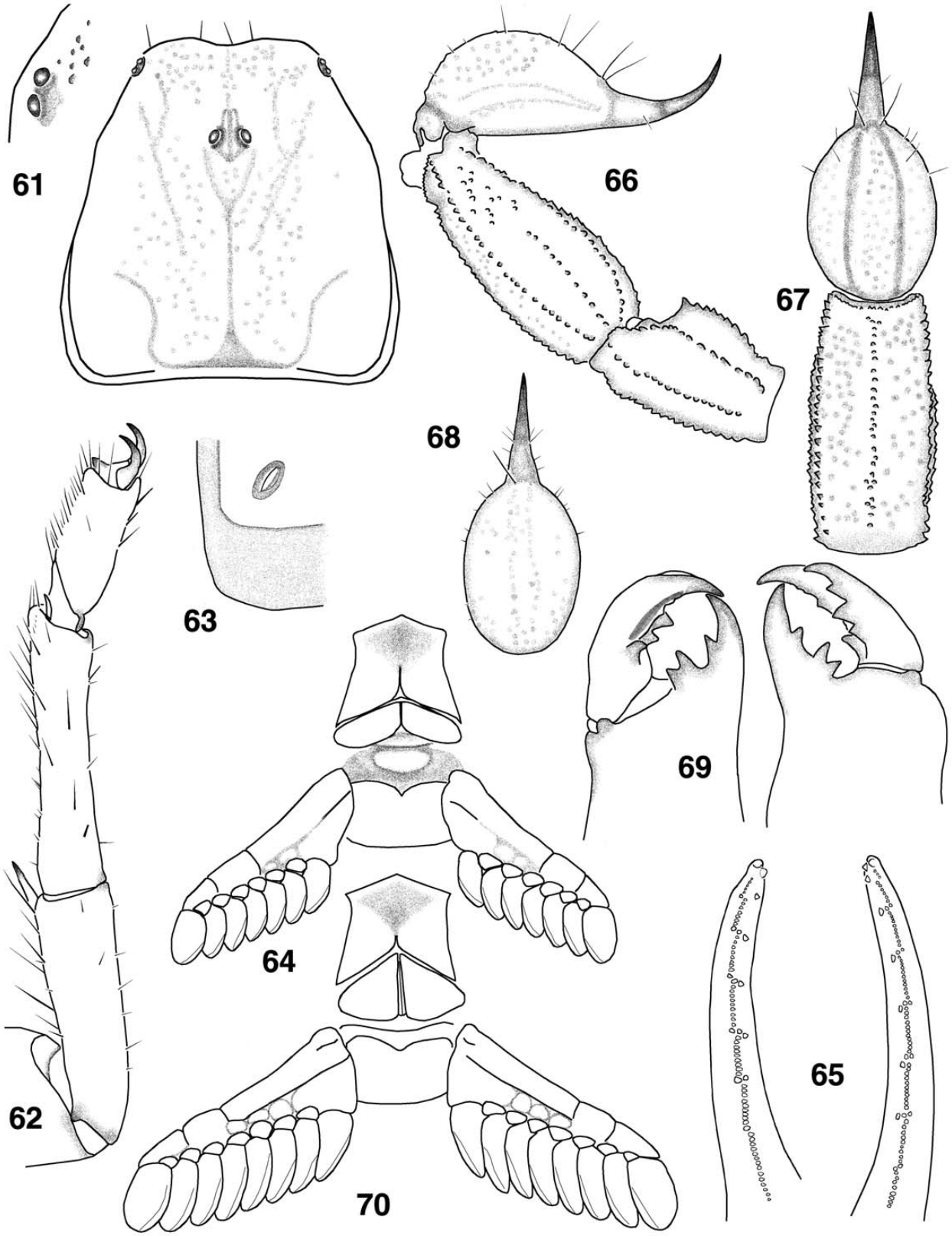
HEMISPERMATOPHORE. Unknown, not found in available males.

Male Paratype (Figs. 68–70, from Anamur). Adult males are approximately the same size as the female, 26.60–27.40 [3] for males, compared to 28.75–31.90 [2] for females. The genders do not exhibit any significant morphometric differences: for example, metasomal segments (L/W), where gender differences are commonly found, mean-value differences ranged only

Figure 60: *Calchas gruberi*, **sp. nov.**, female holotype (NMW), dorsal view (32 mm), Mamure Kalesi, Anamur, Turkey.

0.8–2.4 %. Only the chelal palm showed mean-value differences exceeding ten percent; chela length / palm width 14.9 % and chela length / palm length 12 % (in both cases, based on the female with the longer chela). Pectinal tooth counts in the male exceed the female by one tooth, male 8–9 (8.44) [18], female 7–8 (7.29) [24] (see histograms in Fig. 36). Note that one of the males with nine pectinal teeth is from the Greek island of Samos, off the western coast of Turkey, somewhat removed from the primary range of *C. gruberi* (see maps in Figs. 38, 59). The genital operculum of the male is dramatically different from that in the female (Figs. 64, 70). The sclerites, subtriangular in shape, are as long as or longer than wide in the male whereas in the female, the sclerites are short and wide, more than twice as wide as long. Whereas the sclerites are fused medially in the female, they are separated their entire length in the male, exposing significantly developed genital papillae. The prepectinal plate, so conspicuous in the female, is absent in males (Figs. 64, 70). Figures 72–73 show dorsal and ventral views of two dark colored *C. gruberi* female specimens: one from Antalya (dry, Fig. 72) another from Akseki (live specimen, Fig. 73) as well as the locality area where the latter specimen was collected; and Figures 74–75 show dorsal and ventral views of light colored female and male specimens from Kemer, Turkey.

Type material. TURKEY. **Holotype**: 1 ♀ (NMW 0847), *Mersin Province*: Mamure Kalesi, Anamur, 36.078°N, 32.834°E, under stones, 15 May 1969, F. Ressl leg. **Paratypes** (6 ♂, 10 ♀, 4 juv.): *Mersin Province*: 2 ♀ (NMW 0847), Mamure Kalesi, Anamur, under stones, 15 May 1969, F. Ressl leg.; 1 ♂, 1 ♂ juv. (partially dismembered and used for SEM) (NMW 0841), 15 km by road W of Anamur, 36.078°N, 32.817°E, 18 May



Figures 61–70: *Calchas gruberi*, **sp. nov. 61–67.** Female holotype (NMW), Mamure Kalesi, Anamur, Turkey. **61.** Carapace showing close-up of lateral eyes. **62.** Leg IV (left, ventral view), showing the tibial spur. **63.** Stigma III. **64.** Sternum, genital operculum, prepectinal plate, and pectines. **65.** Chelal fixed and movable finger dentition. **66.** Telson and metasomal segments IV–V, lateral view. **67.** Metasomal segment V and telson, ventral view. **68–70**. Male paratype (NMW), Anamur, Turkey. **68.** Telson, ventral view. **69.** Chelicerae, vental and dorsal views. **70.** Sternum, genital operculum, and pectines (note lack of prepectinal plate conspicuous in female).

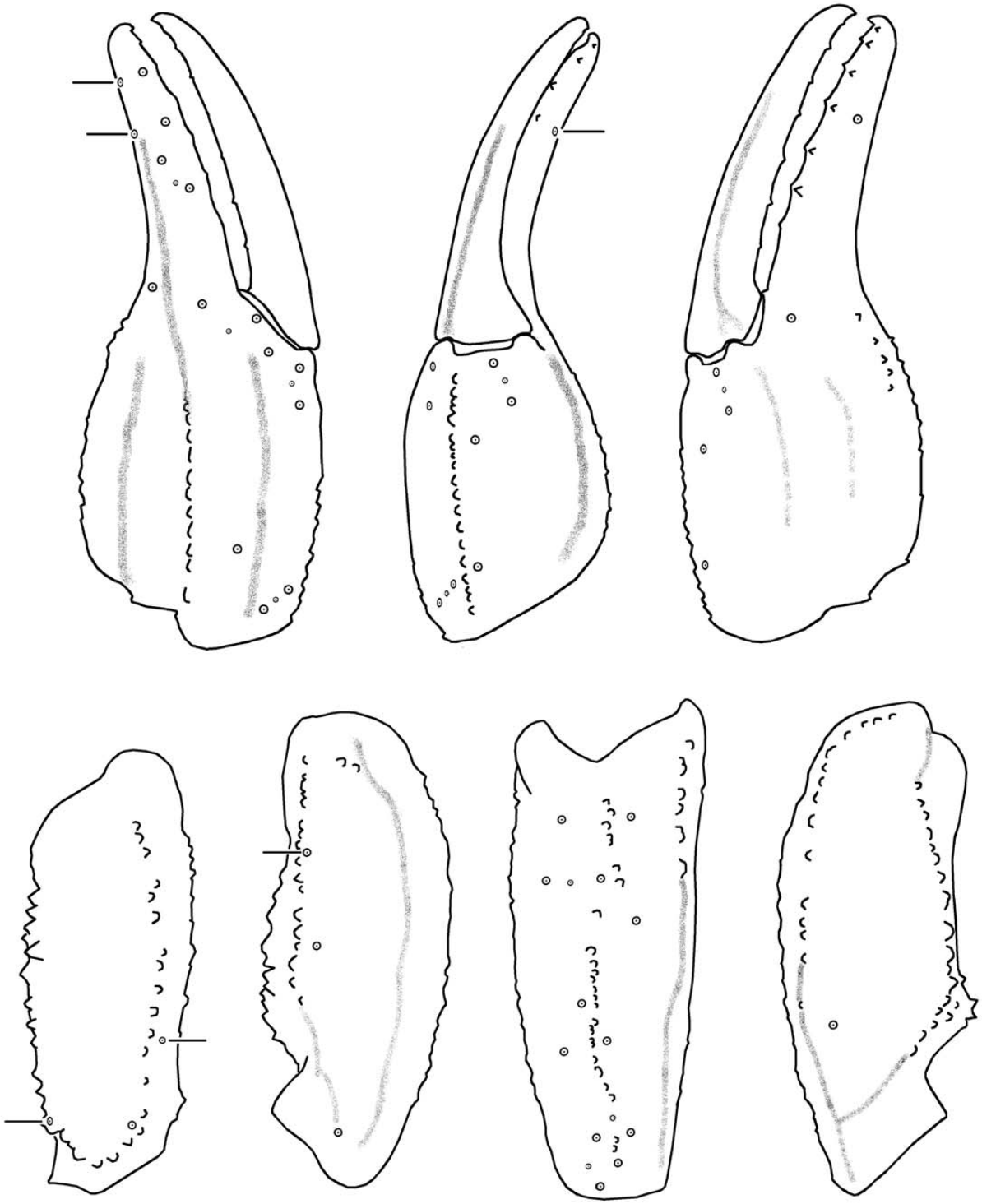


Figure 71: Trichobothrial pattern of *Calchas gruberi*, **sp. nov.**, female holotype (NMW), Mamure Kalesi, Anamur, Turkey.

1969, G. Pretzmann leg. *Antalya Province*: 1 ♂, 1 ♀ (NMW 0848), Belkıs (Aspendos), 36.939°N, 31.172°E, near ruins, under stones, 16 May 1965, F. Ressl leg.; 1 ♂, 1 ♀ (NMW 0838/VF; specimens partially dismembered and used for SEM), mountains N of Antalya, 36.913°N, 30.69°E, 19 May 1969, J. Koller & F. Ressl leg. (together with *Iurus*); 1 juv. (damaged) (MNHN RS 7024), Olympos, 36.403°N, 30.474°E, 30 July 1974; 1

Figure 72: *Calchas gruberi*, **sp. nov.**, dorsal and ventral views. Adult female paratype (FKCP), Antalya, Turkey.

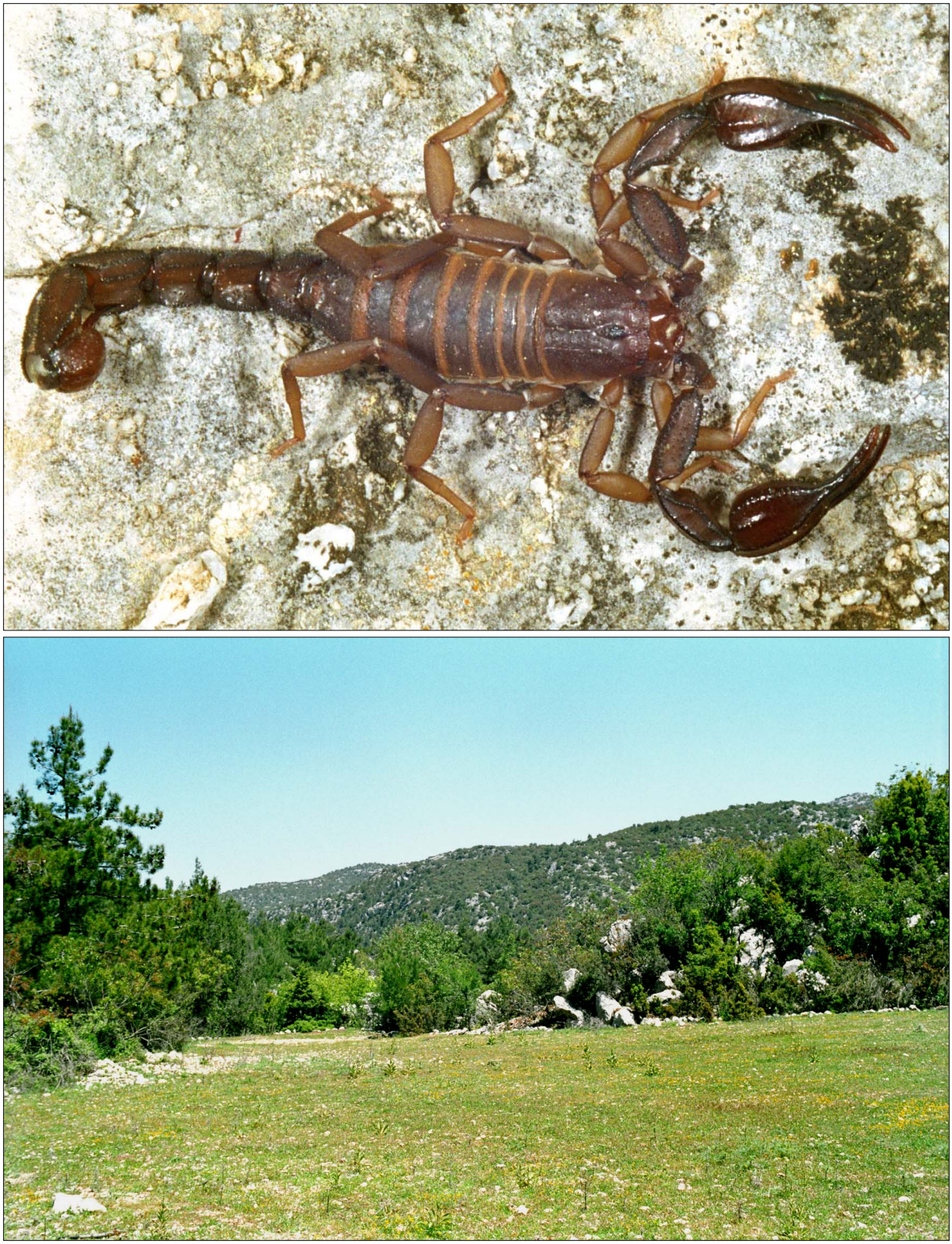


Figure 73: Adult female paratype (FKCP) of *Calchas gruberi*, **sp. nov.**, (top) and collection locality, 12 km S. Akseki, Turkey (bottom).

Figure 74: *Calchas gruberi*, **sp. nov.**, dorsal and ventral views. Adult paratype female (FKCP) (34 mm), Kemer, Turkey.

Figure 75: *Calchas gruberi*, **sp. nov.**, dorsal and ventral views. Adult paratype male (FKCP) (36 mm), Kemer, Turkey.

Figure 76: Part of scorpion collection in Naturhistorisches Museum Wien (NMW), curated by Dr. Jürgen Gruber (1999).

♀, near Antalya, 1994 (FKCP); 2 ♀, 1 juv. (FKCP), 12 km S of Akseki, 11–12 May 2006, F. Kovařík leg.; 3 ♂, 2 ♀, 1 juv. (FKCP), Kemer, May 2009; 1 ♀ (NMM 0250), 15 km NE of Kumluca, 36.546°N, 30.283°E, 12 August 1972, R. Kinzelbach leg. (Kinzelbach, 1982: 58; the same specimen was reported as "20 km N of Kumluca, 12 August 1972" by Kinzelbach, 1980).

Note: see Pretzmann (1972) for a detailed itinerary and map of the NMW expedition to Turkey in 1969.

Other material examined: GREECE, 1 ♀ juv. (NMHC 81.1.7.9/VF; specimen dismembered and partially used for DNA studies), Megisti (=Kastelorizo) Island, 36.149°N, 29.594°E, I. Stathi leg.; 1 ♂ (FMNH), Samos Island, 37.757°N, 26.977°E, Mt. Spiliani, 2 km N Pithagorion, S slope, 23 April 1979, A. Riedel leg.

Note: we do not include Greek island specimens, identified here as *C. gruberi*, in the type series of *C. gruberi*; a further detailed study of Samos and Megisti populations is warranted.

Other specimens/localities (material not examined): TURKEY, *Antalya Province*: 1 specimen (NMW 0845), 46 km by road N of Antalya, 865 m, mountain pass, 21 May 1969, G. Pretzmann leg. GREECE, Megisti (=Kastelorizo) Island (Stathi & Mylonas, 2001: "big population").

Biogeography

Kaltsas et al. (2008: 238) mentioned that "the biogeography of the monotypic genus *Calchas* still remains a mystery to scientists." We are glad to offer here a window to this mystery.

Figures 38, 39, 42, and 59 present the current ranges of three species described and discussed in the present paper, based on all known records. The observed disjunction follows modern ecological barriers. The ecologically diverse territory of the Anatolian Peninsula (historical Asia Minor) is divided into a number of biogeographic provinces or regions. Three disjunct species of *Calchas* tend to fall under three separate regions as described for the Anatolian scorpiofauna by Crucitti & Cicuzza (2001).

Already the range of *Calchas nordmanni* depicted by Kinzelbach (1985) and Vachon & Kinzelbach (1987: 99, fig. 6) reflected three widely disjunct populations; additional records expanded boundaries of their ranges,

but the disjunction remains. The geographic range of *Calchas nordmanni* Birula, 1899 (*sensu stricto*) is limited to Çoruh River valley (Black Sea watershed) in northeastern Turkey, i.e. mainly in the very east of Black Sea Region; it does not cross the mountain ranges stretching between Erzurum and Kars. The geographic range of *Calchas birulai* **sp. nov**. covers a large area in southeastern Turkey, across Gaziantep, Adıyaman, Malatya, Sanlıurfa, Diyarbakır, Mardin, and Siirt Provinces, and reaches to northern Iraq. This range covers the entire East Anatolian Region as defined by Crucitti & Cicuzza (2001). *C. nordmanni* and *C. birulai* are clearly separated by the high mountain ranges of Güneydoğu Toroslar, Hakkari, Munzur, and Bingöl. The geographic range of *Calchas gruberi* **sp. nov**. at this moment is limited to a small portion of southern Turkey along the Mediterranean coast, from Kumluca to Anamur, within the Mediterranean Region. On the east, it is well separated by the Taurus Mountains from the range of *C. birulai*. The populations from Greek islands (Samos and Megisti) are currently also assigned to *C. gruberi* but should be a subject of a more detailed study, with a possible clarification of Samos locality.

The disjunct distribution of *Calchas*, therefore, appears to be a textbook illustration of allopatric speciation, with three species that seem to occupy different ecological regions. Although it is hard to speculate about the timing of this disjunction, it does not have to be very recent (i.e. Pleistocene). Modern evolution of scorpiofauna in the Aegean-Anatolian area, at species level and below, was traced in the recent DNA-based studies of Greek researchers (Parmakelis et al., 2006a, 2006b). It is believed to have been influenced by tectonic fragmentation for both a widespread *Mesobuthus gibbosus* (Buthidae) and a more localized *Iurus dufoureius* (Iuridae). It is generally accepted that the Aegean-Anatolian area was represented by a single landmass (Agäis) in the Upper to Middle Miocene (23–12 Mya), with the subsequent fragmentation due to tectonic events of 12–5 Mya (Stathi & Mylonas, 2001).

Hrbek et al. (2004) in their detailed DNA-based work on historical biogeography of Central Anatolian fish, conclude that "geologically complex areas of the Near East contain many phylogenetically deeply divergent lineages, some showing reproductive isolation, that are otherwise morphologically difficult to differentiate. We suggest this is most likely due to fragmentation of previously contiguous areas into a parapatric series of ecologically equivalent regions." The case of *Calchas* seems to be more straightforward: there are three distinct morphospecies in three ecologically different regions.

Acknowledgments

We are, first and foremost, happy to thank Dr. Jürgen Gruber, a famous expert in Opiliones and a veteran curator of Arachnida in 3.Zoologische Abteilung, Naturhistorisches Museum Wien, Austria (Fig. 76). During more than 20 years, Dr. Gruber kindly encouraged and greatly facilitated the scorpion systematic studies by our research group based on rich NMW collections, which resulted in many discoveries (Fet & Soleglad, 2002, 2007; Fet et al., 2003, 2004; Gantenbein et al. 2002; Kovařík & Fet, 2006; Scherabon et al., 2000; Soleglad & Fet, 2003a, 2003b, etc.). Dr. Gruber discovered and loaned to us a large series (25 specimens) from Turkey collected by NMW expeditions in 1966 and 1969, which has never been published. This material yielded both new species of *Calchas*.

We also thank Dr. Gruber's colleagues, Drs. Verena Stagl and Christoph Hörweg, for their help with NMW collection and logistics. V.F. was hosted in Vienna by Drs. Gruber and Stagl during his unforgettable visits to NMW in 1988, 1999, and 2005. The last visit was in part supported by the Fulbright Scholar Program.

Dr. Ragnar Kinzelbach was especially instrumental in sharing with us his original unpublished material and data, including the first locality for Iraq and a possible sighting in Syria.

Figure 77: Peter Jäger (left), holding a jar with Ragnar Kinzelbach's scorpion specimens, and a local volunteer in Naturhistorisches Museum Mainz (NMM) (1999).

We are grateful to all other colleagues who kindly loaned and shared comparative material, information, and literature with us, including but not limited to: James Boone, Matt Braunwalder, Pierangelo Crucitti, László Dányi, Hieronymus Dastych, Jason Dunlop, Balázs Farkas, Benjamin Gantenbein, Arnold Gegechkori, Matthew Graham, Peter Jäger (Fig. 77), Dimitris Kaltsas, Viktor Krivochatsky, Wilson Lourenço, Sándor Mahunka, Moyses Mylonas, Vera Pkhakadze, Carsten Renker, Petra Sierwald, Iasmi Stathi, Ersen Yağmur, and Jiří Zídek, as well as the late Adel Hamwi, Gershom Levy, Andrey Nenilin, Gary Polis, and Max Vachon. We thank Andrej Funk, the author of Birecik locality photo (Fig. 58), for his permission to use it. Above all, we are indebted to all naturalists who during over 100 years collected rare specimens studied in this paper: J. Bradka, K. Deryugin, J. Eiselt, G. Fabian, A. Funk, J. Garzoni, W. Heinz, B. Herzig, M. Kaftan, M. Kasparek, R. Kinzelbach, E. König, J. Koller, C. Kosswig, B. Lindholm, R. Nergr, P. Nesterov, G. Pretzmann, F. Ressl, A. Riedel, G. Ronkay, L. Ronkay, V. Šejna, I. Stathi, M. Tsabar, and Yu. Voronov.

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