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Geographical Distribution of the Genus *Mesobuthus* (Scorpiones: Buthidae) in Mongolia

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Geographical distribution of the genus *Mesobuthus* (Scorpiones: Buthidae) in Mongolia[1]

M. Heddergott, M. Stubbe, W. Stubbe, P. Steinbach & A. Stubbe

Abstract

In the present study, we surveyed the diversity of scorpions in six provinces of Mongolia (Bayankhongor, Khovd, Dundgovi, Dornogovi, Govisümber and Ömnögovi) between 2001 and 2012. A total of 385 individuals were collected at 17 different sites. In addition to opportunistic sampling, animals were collected after detection with ultraviolet light. Only species from the genus *Mesobuthus* have been reported from Mongolia thus far. It was possible to confirm the occurrence of the species *Mesobuthus eupeus mongolicus* and report the presence of *M. martensii martensii* for the first time. We could not confirm the presence of *M. caucasicus przewalskii* and suggest that it does not occur in the country, since earlier records originated from present-day China. We provide initial information on the ecology of the two species we identified. Individuals of *M. eupeus mongolicus* from western Mongolia have a darker pigmentation of the metasomal segments I-IV than individuals from central or southern Mongolia.

Key words: scorpiones, Buthidae, *Mesobuthus eupeus mongolicus*, *M. martensii martensii*, morphometric, ecology, distribution, Mongolia

Introduction

The genus *Mesobuthus* Vachon, 1950 is currently believed to contain 13 species of scorpions (FET & LOWE 2000; LOURENÇO et al. 2009; KOVAŘÍK 2007; SUN & ZHU 2010; SUN et al. 2010; SUN & SUN 2011). It is the geographically most wide-spread genus with the family Buthidae C.L. Koch, 1837, with species occurring from the Balkans in Europe, Anatolia and Iran throughout most of Asia to Japan. Currently there is no species checklist for the genus, which is in no small part due to the large number of subspecies that have been described (FET & LOWE 2000). While some more recent keys are in use (TIKADER & BASTAWADA 1983; VACHON 1958; SUN & SUN 2011), species identification is still mostly based on old keys and the type description of BIRULA (1897, 1900, 1904, 1905, 1911, 1917).

Apart from the reporting of isolated finds, there is very little information on the scorpions of Mongolia, with a complete absence of systematic studies. So far, only species from the genus *Mesobuthus* have been reported with find locations: *Mesobuthus eupeus mongolicus* (Birula, 1911), *M. caucasicus przewalskii* (Birula, 1897) and *M. martensii martensii* (Karsch, 1879) (BIRULA 1911, 1927; STAHNKE 1967; KOVAŘÍK, 1997).

Here, we present and discuss the results of a first comprehensive investigation of the scorpion fauna of Mongolia and perform of review of the existing literature on the subject.

Material and methods

The scorpions were collected during the Mongolian-German Biological Expeditions of the years 2001 to 2012. All animals were collected during daytime under stones, in crevices, and in gaps of walls as well as at night with the help of black light. All specimens, which were stored in 70 % alcohol, were deposited in the collection of the department of zoology of the Martin-Luther

[1] Results of the Mongolian-German Biological Expeditions since 1962, No. 331.

University Halle-Wittenberg (MLUH) and in the first author's private collection (CMH S.). Morphological measurements were taken with a Stereomicroscope Stemi 2000C (Carl Zeiss Microscopy GmbH; Germany) with > 0.001 mm accurate micro-metric ocular. All measurements are given in mm. Measurement were taken based on the methodology by STAHNKE (1970), except in the case of the chela, were methods by VACHON (1952) were used. The morphological terminology follows HJELLE (1990).

List of abbreviations of morphometric rations

Tot_L - total length; Ca_L - carapace length; Ca_AW - carapace anterior width; Ca_PW - carapace posterior width; Fem_L - pedipalp femur length: Fem_W - pedipalp femur width; Pat_L - pedipalp patella length; Pat_W - pedipalp patella length; Ch_L - pedipalp chela length; Ch_W - pedipalp chela width; Met-I_L - metasomal segment I length; Met-I_W - metasomal segment I width; Met-I_H - metosomal segment I height; Met-II_L - metasomal segment I length; Met-II_W - metasomal segment II width; Met-II_H - metosomal segment II height; Met-III_L - metasomal segment III length; Met-III_W - metasomal segment III width; Met-III_H - metosomal segment III height; Met-IV_L - metasomal segment IV length; Met-IV_W - metasomal segment IV width; Met-IV_H - metosomal segment IV height; Met-V_L - metasomal segment V length; Met-V_W - metasomal segment V width and Met-V_H - metosomal segment V height.

Results

Family Buthidae C.L. Koch, 1839

Genus *Mesobuthus* Vachon, 1950

Mesobuthus VACHON (1950): 152; VACHON (1952): 324; VACHON (1958): 141; STAHNKE (1972): 133; TIKADER & BASTAWADE (1983): 186; KOVAŘÍK (1998): 114; FET & BRAUNWALDER (2000): 15-16, fig. 1; FET et al. (2000): 287-288; FET & LOWE (2000): 169; KARATAŞ & KARATAŞ (2001): 297; TERUEL (2002): 75; GANBENTEIN et al. (2003): 412, 417; KARATAŞ & KARATAŞ (2003): 1; SOLEGLAD & FET (2003a): 9, 12, 20, 26, table 2; SOLEGLAD & FET (2003b): 12, 13, 19, 21, 53, 66, 68, 78, 88, 91, figs. 4, 15, 78, tables 3-4, 9; QI et al. (2004): 137; TERUEL et al. (2004): 2, 5; ZHU et al. (2004): 112; FET et al. (2005): 3, 7, 10, 12-13, 22, 29, table 1, fig. 23; KARATAŞ (2005): 1; LOURENÇO et al. (2005): 2-3; PRENDINI & WHEELER (2005): 451, 454, 481, table 3; SHI & ZHANG (2005): 474; DUPRÉ (2007): 7, 13, 17; KARATAŞ (2007): 1; KOVAŘÍK (2007): 1-3, 8, 94; SHI et al. (2007): 216; KOVAŘÍK (2009): 24; LOURENÇO & DUHEM (2009): 38-39, 44, 48, 50; SUN & ZHU (2010): 1; SUN et al. (2010): 35.

Olivierus FARZANPAY (1987): 387 [synonym by GANBENTEIN et al. (2003): 417].

Type species: *Androctonus eupeus* C.L. Koch, 1839
Diagnosis: see VACHON (1950) and SISSOM (1990).
Distribution: *Mesobuthus* species occur in Asia, the Balkan Peninsula and Caucasia.

***Mesobuthus eupeus mongolicus* (Birula, 1911)**
(figs. 1-4, 7; tables 1-2)

Buthus eupeus mongolicus BIRULA (1911): 195; BIRULA (1917): 42; BIRULA (1925): 96; BIRULA (1927): 202; TAKASHIMA (1945): 77.

Buthus (*Buthus*) *eupeus mongolicus* Birula: BIRULA (1917): 239.

Mesobuthus eupeus mongolicus (Birula): VACHON (1958): 155, fig. 37; STAHNKE (1967): 61-68, figs. 1-5, tables 1-2; PÉREZ (1974): 27; FARZANPY (1986): 334; FET (1994): 527; KOVAŘÍK (1997): 180; KOVAŘÍK (1998): 114; FET & LOWE (2000): 174; GANTENBEIN et al. (2003): 413, table 1; QI et al. (2004): 138, 142; ZHU et al. (2004): 112; SHI & ZHANG (2005): 474; PARMAKELIS et al. (2006): 2886, 2889, fig. 2, table 1; SHI et al. (2007): 216, 218; SUN & ZHU (2010): 2; SUN & SUN (2011): 67-71, 73, fig. 7-8, table 1.

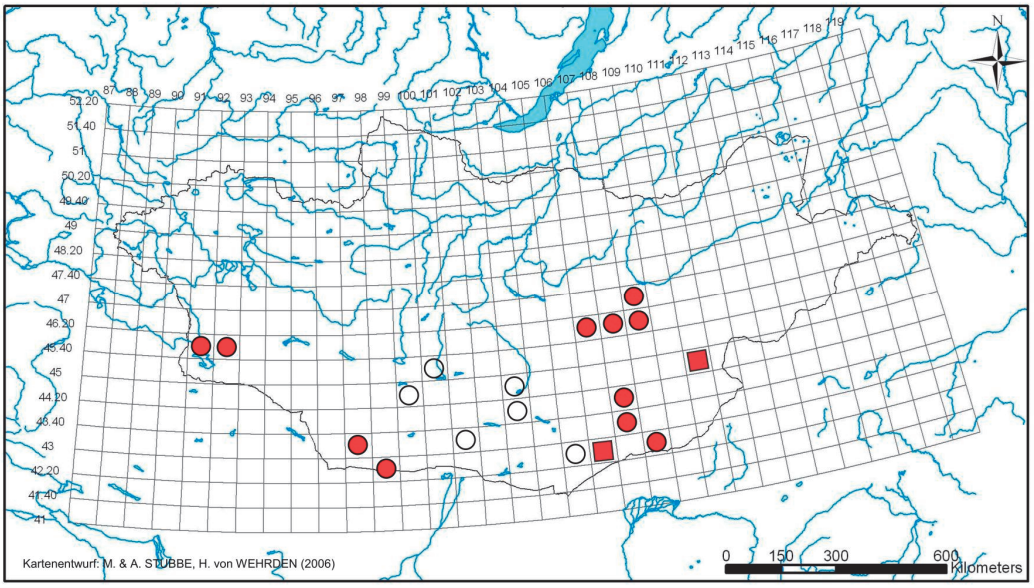

Fig. 1: Records of *Mesobuthus eupeus mongolicus* based on literature review and present findings in Mongolia; ● - actual findings, ○ - references; ■ - actual finding and references.

Fig. 2: A female *Mesobuthus eupeus mongolicus* adopting a defensive stance; photo: M. HEDDERGOTT.

Table 1: Morphometric measurements of *Mesobuthus eupeus mongolicus* males from different Mongolian provinces

	Bayankhongor			Khovd			Dundgovi			Dornogovi			Govisümber			Ömnögovi		
Parameter	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**
n	**12**			**10**			**10**			**11**			**4**			**16**		
Tot_L	38.5-42.1	40.2	0.87	38.2-42.1	39.8	0.97	39.8-42.9	41.2	0.90	40.0-45.1	41.7	1.33	40.2-41.3	40.5	0.47	39.5-43.8	41.7	1.09
Ca_L	4.20-4.55	4.388	0.126	4.32-4.68	4.530	0.110	4.48-4.88	4.592	0.111	44.4-4.88	4.622	0.146	4.32-4.58	4.510	0.110	4.42-4.89	4.615	0.145
Ca_AW	2.34-2.68	2.531	0.100	2.38-2.58	2.491	0.059	2.55-2.79	2.674	0.085	2.46-2.77	2.628	.091	2.68-2.75	2.702	0.029	2.49-2.71	2.575	0.060
Ca_PW	4.51-5.01	4.700	0.134	4.19-4.77	4.473	0.174	4.58-5.12	4.857	0.170	4.51-5.11	4.850	0.186	4.36-5.14	4.748	0.292	4.56-5.10	4.833	0.129
Fem_L	2.79-3.45	3.149	0.186	3.00-3.45	3.245	0.146	2.47-3.45	3.127	0.310	2.54-3.46	3.027	0.216	3.34-3.52	3.473	0.077	2.79-3.21	3.007	0.110
Fem_W	1.09-1.36	1.248	0.086	1.19-1.42	1.272	0.060	1.02-1.31	1.209	0.084	1.12-1.28	1.205	0.047	1.09-1.34	1.200	0.091	1.01-1.30	1.769	0.083
Pat_L	3.99-4.57	4.234	0.181	4.03-4.58	4.347	0.187	4.06-4.53	4.296	0.138	4.00-4.46	4.270	0.122	4.16-4.51	4.305	0.128	4.01-4.41	4.226	0.112
Pat_W	1.40-1.67	1.521	0.086	1.35-1.80	1.522	0.139	1.45-1.85	1.649	0.108	1.43-1.81	1.620	0.106	1.64-1.85	1.730	0.089	1.48-1.71	1.573	0.068
Ch_L	6.82-7.22	7.014	0.133	6.83-7.31	7.091	0.148	7.03-7.50	7.277	0.160	7.01-7.45	7.267	0.130	6.82-7.25	7.030	0.170	6.79-7.31	7.031	0.124
Ch_W	1.89-2.31	2.094	0.137	1.89-2.24	2.078	0.110	1.88-2.30	2.046	0.123	1.81-2.21	2.035	0.126	1.85-2.01	1.950	0.060	1.75-2.23	1.991	0.117
Met-I_L	2.64-3.26	2.930	0.173	2.60-3.30	2.972	0.223	2.89-3.45	3.081	0.170	2.87-3.22	3.058	0.104	2.78-3.45	2.990	0.268	2.86-3.16	2.991	0.070
Met-I_W	2.39-2.90	2.626	0.166	2.66-2.86	2.759	0.066	2.54-2.79	2.705	0.098	2.53-2.88	2.677	0.101	2.69-2.88	2.770	0.070	2.49-2.78	2.616	0.071
Met-I_H	2.32-3.10	2.707	0.223	2.74-3.10	2.941	0.079	2.58-3.10	2.765	0.168	2.46-3.00	2.768	0.179	2.32-2.89	2.648	0.232	2.51-3.01	2.716	0.147
Met-II_L	2.68-3.20	2.935	0.126	2.83-3.21	2.988	0.116	2.94-3.24	3.098	0.106	2.83-3.31	3.076	0.138	2.84-3.31	3.133	0.176	2.86-3.75	3.050	0.200
Met-II_W	2.09-2.78	2.439	0.183	2.54-2.98	2.706	0.144	2.35-2.68	2.532	0.098	2.33-2.75	2.513	0.116	2.54-2.78	2.608	0.105	2.34-2.63	2.516	0.077
Met-II_H	2.12-2.74	2.397	0.167	2.14-2.54	2.325	0.127	2.21-2.55	2.401	0.109	2.27-2.54	2.409	0.086	2.31-2.54	2.395	0.092	2.24-2.56	2.378	0.083
Met-III_L	2.78-3.31	3.044	0.153	2.91-3.25	3.064	0.097	2.98-3.41	3.179	0.128	2.94-3.30	3.107	0.107	3.01-3.20	3.105	0.074	2.89-3.40	3.064	0.121
Met-III_W	2.41-2.98	2.625	0.162	2.64-2.94	2.772	0.134	2.45-2.88	2.628	0.120	2.45-2.71	2.585	0.067	2.46-2.70	2.592	0.091	2.41-2.84	2.591	0.112
Met-III_H	2.28-2.61	2.457	0.112	2.30-2.72	2.491	0.142	2.12-2.54	2.413	0.128	2.19-2.61	2.377	0.129	2.21-2.50	2.373	0.105	2.21-2.56	2.369	0.103
Met-IV_L	3.43-3.89	3.657	0.160	3.49-4.02	3.753	0.171	3.84-4.31	4.054	0.146	3.88-4.25	4.045	0.117	3.65-4.26	3.985	0.218	3.96-4.26	4.059	0.090
Met-IV_W	2.44-2.81	2.630	0.130	2.46-2.85	2.668	0.126	2.45-2.81	2.624	0.095	2.51-2.70	2.590	0.059	2.54-2.81	2.668	0.128	2.45-2.65	2.547	0.058
Met-IV_H	1.94-2.41	2.104	0.170	1.98-2.41	2.180	0.158	1.97-2.21	2.067	0.079	1.93-2.20	2.056	0.083	1.86-2.23	2.030	0.134	1.94-2.41	2.095	0.016
Met-V_L	4.68-5.12	4.935	0.118	4.89-5.31	5.036	0.128	4.41-5.45	5.206	0.316	4.46-5.45	5.028	0.260	4.84-5.23	5.040	0.153	4.56-5.27	5.020	0.160
Met-V_W	2.44-2.85	2.659	0.140	2.55-2.91	2.766	0.108	2.44-2.70	2.551	0.086	2.36-2.84	2.540	0.128	2.44-2.88	2.620	0.163	2.31-2.61	2.493	0.090
Met-V_H	1.74-2.13	1.947	0.114	1.86-2.10	1.966	0.071	1.84-2.15	1.980	0.100	1.84-2.10	1.935	0.080	1.89-2.11	1.996	0.079	1.85-2.10	1.947	0.081

x = mean; s = ±Standard deviation

Literature material: ***Province Bayankhongor***: KOVAŘÍK (1997): Gobi Altaj aimak Mts. Adz Bogd valley of Ih-gol (44°45'N, 95°00'E), 2100 m a.s.l., 17 May 1990, 1♀ immature, leg. G. Fábián, M. Hreblay, L. Peregovits, G. Ronkay. – ***Province Dornogovi***: STAHNKE (1967): 75 km from Zuum-Bajan [= 44°30'N, 110°05'E], 780 m a.s.l, 24 June 1963, 3♂♂ and 3♀♀, leg. Z. Kaszab. – STAHNKE (1967): 19 km south of Sainschanda (Sayn Shanda) [= 44°50'N, 110°08'E], 1000 m a.s.l, 27 June 1963, 5♂♂, leg. Z. Kaszab. – ***Province Ömnögovi***: BIRULA (1927): eastern Gobi-Altai Churchu-mountains locality Chaitschin-chuduk [= 42°25'N, 105°40'E], 3 September 1925, 4♂♂, 4♀♀, 1♂ juv., 2♀♀ juv. and 2 juv., leg. P. Kozlov. – BIRULA (1927): southern Chalcha South-Chalcha on the middle reaches of the Tuin-gol river [= 45°20'N, 100°45'E], 28 July 1926, 2♀♀, 4♂♂and 4♀♀ juv., leg. A. Kiričenko. – STAHNKE (1967): 5 km east of Ulaan Sea [= 44°30'N, 103°30'E], 1010 m a.s.l, 18 June 1964, 1♀, leg. Z. Kaszab. – STAHNKE (1967): 25 km north of Bulgan [= 44°10'N, 103°30'E], 1030 m a.s.l, 18 June 1964, 4♂♂ and 3♀♀, leg. Z. Kaszab. – KOVAŘÍK (1997): South Gobi aimak 9 km NW of Dalanzadgad [= 43°40'N, 104°21'E], 1400 m a.s.l., 22 July 1986, 2♀♀, leg. G. Ronkay. – KOVAŘÍK (1997): Ömnogovi aimak 22 km SE of Gurvantös (43°14'N, 101°47'E), 13 May 1990, 1♂, 1♀, leg. G. Fábián, M. Hreblay, L. Peregovits, G. Ronkay.

New material: ***Province Bayankhongor***: Cagaan Bogd (42°52'49.8''N, 98°51'40.5''E), 1705 m a.s.l, 29-30 June 2011, 13♂♂, 20♀♀ and 14 juv. (MLUH) (CMH S-20114589-20114618), detection UV-light, leg. A. Stubbe, M. Stubbe. - Šar-chulst-bulag (43°18'29.0''N, 97°47'08.1''E), 1215 m a.s.l, 1 July 2011, 1♂ and 4 juv. (MLUH) (CMH S-20114619), detection UV-light, leg. A. Stubbe, M. Stubbe. - ***Province Khovd***: Bulgan-gol 5 km N Somon Bulgan (46°08'43.9''N, 91°29'54.9''E), 1160 m a.s.l, 7 August 2010, 10♂♂, 15♀♀ and 16 juv. (MLUH) (CMH S-201058898-201058921), detection UV-light, leg. A. Stubbe, M. Stubbe, W. Stubbe. - Uenč-gol 10 km S Somon Uenč (45°59'01.3''N, 91°57'46.4''E), 1300 m a.s.l, 8 August 2010, 1♂ and 1 juv. (CMH S-201058924-201058925), detection UV-light, leg. A. Stubbe, M. Stubbe, W. Stubbe. - ***Province Dundgovi***: river valley 1 km south Mandalgovi (45°34'47.4''N, 106°16'48.4''E), 1360 m a.s.l., 8 August 2003, 5♀♀ and 7 juv. (MLUH) (CMH S-20033180-2003182), under stones, leg. M. Heddergott, R. Sommer. – River valley 1 km south Mandalgovi (45°34'47.4''N, 106°16'48.4''E), 1360 m a.s.l., 10 August 2003, 1♂, 2♀♀ and 2 juv. (CMH S-2003190-2003193), detection UV-light, leg. M. Heddergott, R. Sommer. - 7 km northeast Bayanjargalan (45°47'15.5''N, 108°02'38.2''E), 1230 m a.s.l., 9 August 2003, 1♂, 2♀♀ (CMH S-2003195-2003197), detection UV-light, leg. M. Heddergott, R. Sommer. – 2 km south Bayanjargalan (45°43'51.6''N, 107°59'27.6''E), 1210 m a.s.l., 12 August 2003, 8♂♂, 6♀♀ and 12 juv. (MLUH) (CMH S-2003199-2003214), detection UV-light, leg. M. Heddergott, R. Sommer. - ***Province Dornogovi***: 2 km east of Sainshand (44°54'01.5''N, 110°11'01.5''E), 980 m a.s.l., 13 August 2003, 4♂♂, 11♀♀ and 1 juv. (CMH S-200356-200371), detection UV-light, leg. M. Heddergott, R. Sommer. - Galbyn-gobi (42°38'28.6''N, 108°01'35.5''E), 925 m a.s.l, 10 July 2010, 7♂♂, 5♀♀ and 18 juv. (MLUH) (CMH S-20102398-20102410), detection UV-light, leg. A. Stubbe, M. Stubbe, W. Stubbe. - Undagijn-gol (42°37'23.8''N, 109°48'53.6''E), 955 m a.s.l, 25-26 July 2011, 1♀ [CMH S-20111331], detection UV-light, leg. A. Stubbe, M. Stubbe. ***Province Govisümber***: northeast of Choir (46°22'17.3''N, 108°20'32.7''E), 1260 m a.s.l., 14 August 2003, 3♂♂, 3♀♀ and 1 juv. (CMH S-20033145-20033152), detection UV-light, leg. M. Heddergott, R. Sommer. - 5 km southeast of Choir (46°18'31.9''N, 108°26'30.1''E), 1200 m a.s.l., 14 August 2003, 1♂, 2♀♀ and 3 juv. (CMH S-20033159-20033160; CMH S-20033165-20033166), detection UV-light, leg. M. Heddergott, R. Sommer. - ***Province Ömnögovi***: Galbyn-Gobi (42°35'09.4''N, 105°45'44.8''E), 1200 m a.s.l, 1 July 2009, 4♂♂, 1♀ and 21 juv. (MLUH), detection UV-light, leg. A. Stubbe, M. Stubbe. - Dumdajn-gol (42°36'06.6''N, 105°55'39.7''E), 1000 m a.s.l, 3 July 2009, 3♂♂, 2♀♀, 11 juv. (MLUH), detection UV-light, leg. A. Stubbe, M. Stubbe. - Somon Manlaj Bajan-gol (43°35'29.5''N, 107°03'40.1''E), 1195 m a.s.l, 1 August 2009, 2♂♂ and 11 juv. (CMH S-2009268-2009270), detection UV-light, leg. A. Stubbe, M.Stubbe. - Somon Manlaj Bajan-gol (43°35'29.5''N, 107°03'40.1''E), 1195 m a.s.l, 2-4 August 2009, 2♂♂, 4♀♀ and 26 juv. (MLUH) (CMH S-20091685-20091691), detection UV-light, leg. A. Stubbe, M. Stubbe. - Šutegijn Bajan-gol (43°54'19.3''N, 107°43'45.5''E), 1040 m a.s.l, 14 July 2010, 4♂♂, 13♀♀ and 38 juv. (MLUH) (CMH S-20104212-20102429), detection UV-light, leg. A. Stubbe, M. Stubbe, W. Stubbe. - Šutegijn Bajan-

Table 2. Morphometric measurements of *Mesobuthus eupeus mongolicus* females from different Mongolian provinces

	Bayankhongor			Khovd			Dundgovi			Dornogovi			Govisümber			Ömnögovi		
Parameter	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**	**min-max**	**x**	**s**
n	**12**			**10**			**10**			**11**			**4**			**16**		
Tot_L	39.8-43.4	41.7	1.01	38.2-42.2	40.8	1.14	40.2-46.2	43.2	1.61	40.3-45.8	42.8	1.84	41.5-43.1	42.5	0.728	39.8-45.1	42.6	1.72
Ca_L	4.18-4.85	4.455	0.189	4.18-5.04	4.589	0.253	4.35-5.02	4.778	0.164	4.46-5.00	4.806	0.138	4.18-5.02	4.764	0.230	4.52-5.24	4.843	0.182
Ca_AW	2.41-2.81	2.580	0.101	2.21-268	2.468	0.127	2.45-2.92	2.704	0.127	2.59-2.91	2.706	0.104	2.68-2.89	2.738	0.078	2.41-2.86	2.626	0.119
Ca_PW	4.25-5.32	4.760	0.307	4.26-4.94	4.572	0.190	4.65-5.68	5.255	0.284	4.84-5.68	5.230	0.251	4.84-5.48	5.300	0.274	4.71-5.46	5.104	0.181
Fem_L	2.89-3.56	3.240	0.195	2.57-3.51	3.025	0.226	3.45-3.84	3.614	0.118	3.49-3.68	3.624	0.105	3.52-3.92	3.648	0.155	3.45-3.84	3.605	0.125
Fem_W	1.04-1.55	1.258	0.109	1.04-1.54	1.312	0.131	1.16-1.40	1.279	0.052	1.16-1.34	1.269	0.060	1.16-1.38	1.288	0.072	1.12-1.40	1.261	0.075
Pat_L	3.65-4.61	4.252	0.270	4.02-4.61	4.267	0.144	4.04-4.64	4.447	0.172	4.12-4.70	4.488	0.164	4.04-4.61	4.388	0.214	4.21-4.80	4.482	0.140
Pat_W	1.41-1.71	1.575	0.080	1.24-1.78	1.536	0.141	1.58-1.85	1.691	0.086	1.53-1.85	1.683	0.096	1.58-1.76	1.698	0.098	1.40-1.85	1.593	0.118
Ch_L	6.55-7.54	7.151	0.249	6.99-7.41	7.197	0.124	7.15-7.58	7.428	0.139	7.22-7.64	7.420	0.121	7.44-7.55	7.508	0.037	7.12-7.61	7.387	0.117
Ch_W	1.86-2.41	2.151	0.166	1.88-2.26	2.061	0.116	2.01-4.32	2.168	0.102	2.01-2.34	2.221	0.120	2.00-2.21	2.084	0.076	2.06-2.54	2.256	0.118
Met-I_L	2.64-3.42	3.031	0.179	2.78-3.21	3.001	0.129	2.64-3.34	3.154	0.167	2.89-3.51	3.146	0.148	2.60-3.36	3.114	0.275	2.99-3.54	3.184	0.147
Met-I_W	2.40-3.01	2.661	0.147	2.54-2.94	2.759	0.114	2.56-2.94	2.746	0.121	2.55-2.91	2.762	0.106	2.52-2.95	2.762	0.155	2.45-2.91	2.704	0.131
Met-I_H	2.46-3.25	2.851	0.246	2.54-3.10	2.917	0.146	2.45-3.33	2.804	0.202	2.50-3.14	2.726	0.168	2.32-2.89	2.662	0.213	2.46-3.06	2.690	0.132
Met-II_L	2.60-3.41	3.022	0.214	2.58-3.24	2.935	0.177	2.72-3.44	3.200	0.153	2.89-3.51	3.212	0.139	2.72-3.36	3.140	0.219	3.00-3.44	3.212	0.123
Met-II_W	2.01-2.81	2.493	0.192	2.53-3.01	2.758	0.140	2.29-2.90	2.589	0.187	2.49-2.81	2.594	0.113	2.52-2.95	2.534	0.209	2.40-2.73	2.556	0.091
Met-II_H	1.86-2.71	2.393	0.221	2.03-2.56	2.361	0.187	1.68-2.80	2.420	0.302	1.95-2.76	2.371	0.249	2.32-2.89	2.328	0.346	2.00-2.64	2.344	0.198
Met-III_L	2.79-3.14	3.064	0.162	2.88-3.22	3.032	0.227	2.89-3.48	3.206	0.154	2.95-3.44	3.152	0.133	2.96-3.32	3.186	0.136	2.94-3.54	3.154	0.127
Met-III_W	2.34-2.90	2.664	0.148	2.31-3.01	2.701	0.203	2.44-2.84	2.709	0.138	2.54-2.85	2.720	0.121	2.44-2.84	2.680	0.131	2.45-2.81	2.649	0.113
Met-III_H	2.23-2.70	2.475	0.128	2.14-2.84	2.485	0.178	2.12-2.64	2.416	0.179	2.00-2.56	2.382	0.164	1.92-2.56	2.348	0.246	2.01-3.41	2.432	0.237
Met-IV_L	3.45-4.01	3.701	0.173	3.24-4.10	3.819	0.211	3.54-4.25	3.854	0.254	3.54-4.30	3.854	0.222	3.64-4.25	3.876	0.236	3.46-4.25	3.838	0.222
Met-IV_W	2.45-2.86	2.647	0.114	2.34-2.80	2.559	0.131	2.50-2.84	2.693	0.107	2.50-2.91	2.678	0.127	2.48-2.88	2.700	0.134	2.39-3.81	2.735	0.261
Met-IV_H	2.00-2.61	2.255	0.186	1.91-2.51	2.125	0.149	1.94-2.51	2.301	0.150	2.00-2.46	2.391	0.294	1.84-2.56	2.276	0.242	2.01-3.54	2.353	0.290
Met-V_L	4.59-5.41	5.005	0.192	4.59-5.20	5.011	0.133	4.72-5.26	5.029	0.141	4.95-5.22	5.094	0.100	4.72-5.26	5.040	0.198	4.86-5.31	5.072	0.123
Met-V_W	2.40-2.97	2.727	0.170	2.40-2.94	2.735	0.140	2.45-2.96	2.700	0.151	2.53-2.92	2.700	0.130	2.32-2.88	2.756	0.225	2.45-2.94	2.693	0.138
Met-V_H	1.56-2.31	1.957	0.184	1.54-2.06	1.898	0.139	1.96-2.25	2.112	0.083	1.96-2.34	2.097	0.116	1.72-2.24	2.056	0.187	1.93-2.51	2.101	0.137

x = mean; s = ±Standard deviation

gol (43°54'19.3''N, 107°43'45.5''E), 1040 m a.s.l, 24-28 July 2011, 5♂♂, 4♀♀ and 23 juv. (MLUH) (CMH S-20111321-20111330), detection UV-light, leg. A. Stubbe. – Undagijn-gol (42°37'23.8''N, 109°48'53.6''E), 955 m a.s.l, 25-26 July 2011, 1♀ and 1 juv. (MLUH), detection UV-light, leg. A. Stubbe, M. Stubbe.

Diagnosis: The *M. e. mongolicus* specimens identified by the authors in Mongolia corresponded to individuals of the same species identified in neighbouring areas in China (see SUN & SUN 2011).

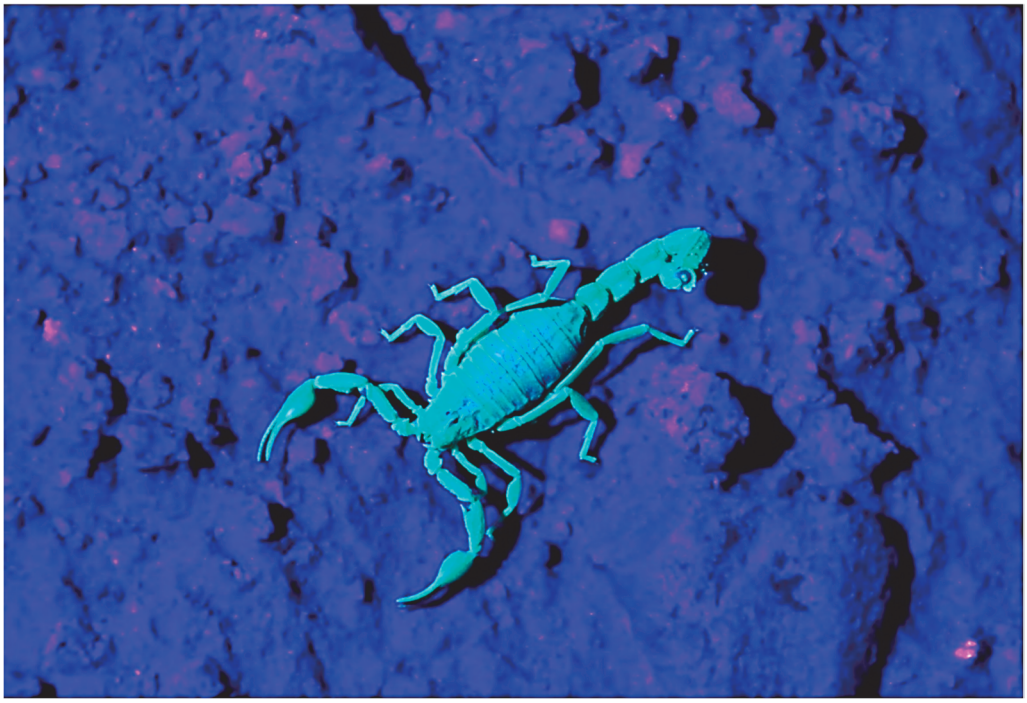

Fig. 3: *Mesobuthus eupeus mongolicus* in UV-light; photo: F.-U. MICHLER.

Distribution: We obtained occurrence records from the Bayankhongor, Khovd, Dundgovi, Dornogovi, Govisümber and Ömnögovi provinces (fig. 1).

Variation: Individuals of the various geographical populations of *M. e. mongolicus* within Mongolia differed in terms of their size and pigmentation of the metasoma segments. Individuals from the Khovd province were characterized by a distinctive dark to light brown pigmentation on the ventral plates of the metasoma segments I-IV. In contrast, no pigmentation or, more rarely, a light brown pigmentation of the same plates were observed in the specimens from the Bayankhongor province, while the dark pigmentation was absent from all individuals sampled in the remaining provinces. In terms of total length, male and female specimens from the province of Khovd were smaller than individuals from the other provinces (tab. 1, 2). Further morphological measurements revealed minor differences between individuals of both sexes from central and western Mongolia (tab. 1, 2).

Ecology: The Mongolian distribution area of *M. e. mongolicus* includes areas of deserts and semi-deserts, as well as adjacent transitional steppes. The species' habitat is characterized by a dry or semi-arid continental climate. Summer months are generally dry and hot, compared to a dry and cold climate during winter months. The period from May to October represents the main activity phase of the scorpions. All individuals were sampled in dry river valleys or flat or hilly landscapes, dominated by scree and low vegetation. Individuals captured during the day were

generally hiding in flat crevices close to the ground, in small hollows under rocks, or underground in ca. 10 cm deep burrows along roots of shrubs. On one occasion, three individuals were discovered under a piece of bark of a rotten tree in a dry riverbed at a height of 1 m.

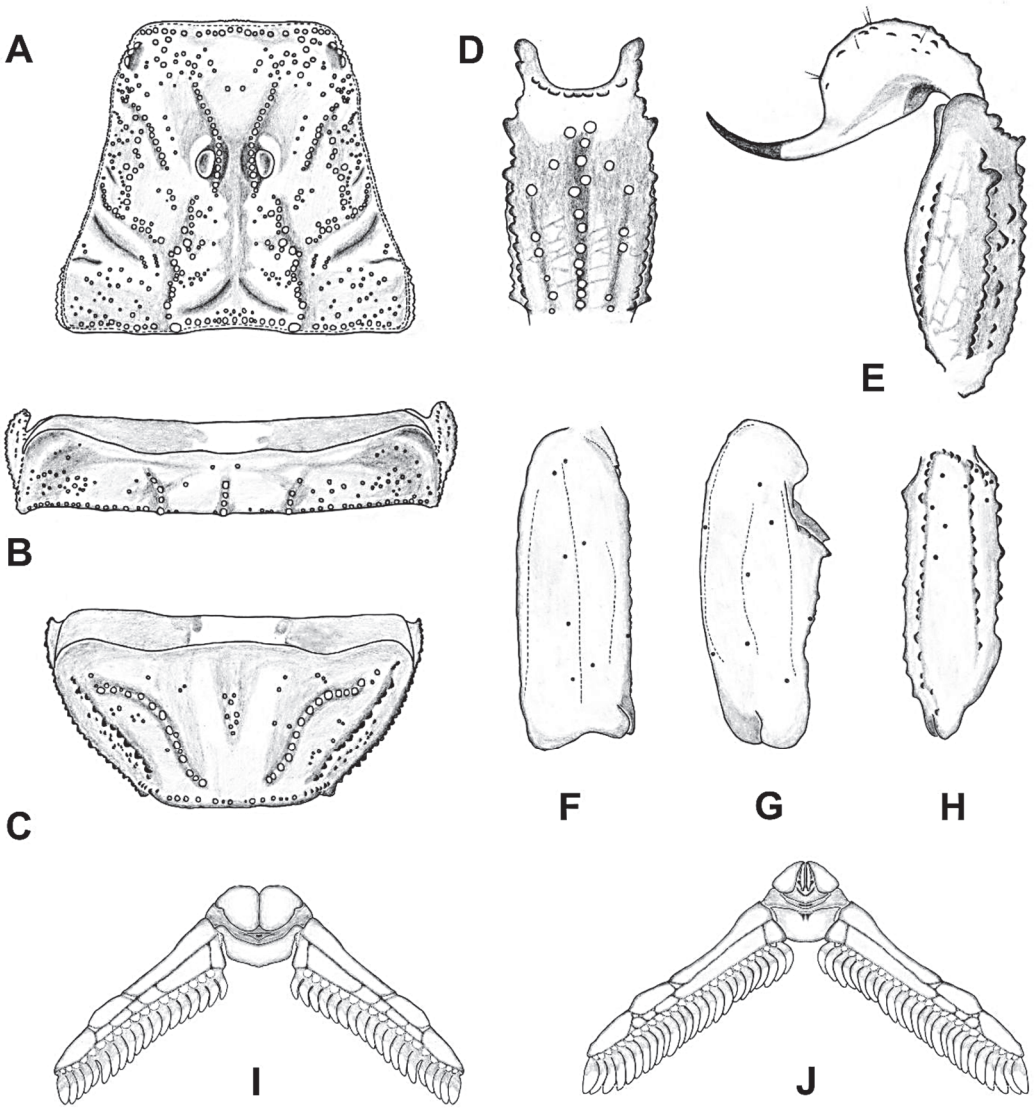

Fig. 4: *Mesobuthus eupeus mongolicus* from Alxa Youqi (39°12'N, 101°42'E) in China (amended by SUN & SUN 2011). A – I: female; J: male. A – carapace dorsal; B – segment III of tergite dorsal; C – segment VII of tergite dorsal; D – metasomal segment V ventral; E – metasomal segment V and telson lateral; F and G – patella external and dorsal; H – femur dorsal; I and J – genital operculum and pectines ventral.

***Mesobuthus martensii martensii* (Karsch, 1879)**
(fig. 5-6, 8; table 3)

Buthus martensii KARSCH (1879): 112; KISHIDA (1939): 51-67, plate I-IV.

Buthus confucius SIMON (1880): 124-125 [synonym by KARSCH (1881): 219].

Buthus conficius [sic] Simon: POCOCK (1889a): 336-337, plate V-X, fig. 2a; POCOCK (1889b): 116; BIRULA (1898): 133-134; BIRULA (1927): 205-209; KÄSTNER (1941): 231.

Buthus martensi Karsch: KRAEPELIN (1899): 25-26; WU (1936): 115-117, fig. 1; TAKASHIMA (1944): 51-53; TAKASHIMA (1945): 75; VACHON (1948): 61, fig. 4; ISSHIKI & YONEZAWA (1960): 117-123; SONG et al. (1982): 22-25, fig. 1-7; SONG (1998): 508, fig. 30:1.

Buthus nigrocinctus [(nec *Androctonus nigrocintus* (Ehrenberg, 1828)]: THORELL (1893): 360-361.

Mesobuthus martensi (Karsch): VACHON (1950): 153; VACHON (1952): 325; PÉREZ (1974): 26; KOVAŘÍK (1992): 183.

Mesobuthus martensii (Karsch): KOVAŘÍK (1998): 115; SHI & ZHANG (2005): 474; SHI et al. (2007): 216-223, figs. 1-3, table 1; ZHANG & ZHU (2009): 1-17, figs. 1-18, tables 1-8; SUN & ZHU (2010): 10.

Mesobuthus martensii martensii (Karsch): FET & LOWE (2000): 178; QI et al. (2004): 137-143, figs. 1-19, table 1; ZHU et al. (2004): 113; SUN & SUN (2011): 71-73, figs. 9, table 1.

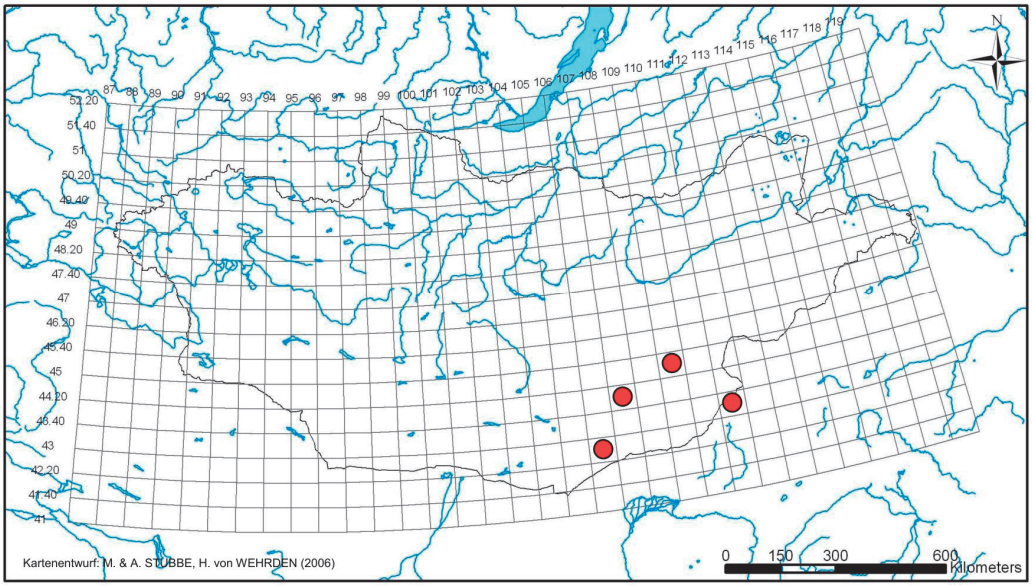

Fig. 5: Records of *Mesobuthus martensii martensii* in Mongolia

First record: ***Province Dornogovi***: 1.5 km northwest of Zamyn-Üüd (43°43'47.1''N, 111°52'59.1''E), 920 m a.s.l, 23 June 2001, 2♂♂ (CMH S-200189), under stone on road, leg. M. Heddergott, D. Riesenbach. - 2 km east of Sainshand (44°54'01.5''N, 110°11'01.5''E), 980 m a.s.l., 13 August 2003, 1♂ (CMH S-200354), under stone block, detection UV-light, leg. M. Heddergott, R. Sommer. – ***Province Ömnögovi***: Šutegigi Bajan-gol (43°54'19.3''N, 107°43'45.5''E), 1040 m a.s.l, 24-28 July 2011, 1 juv. (MLUH), detection UV-light, leg. A. Stubbe. - Undagijn-gol (42°37'23.8''N, 109°48'53.6''E), 955 m a.s.l, 25-26 July 2011, 1♂ and 3♀♀ (MLUH) (CMH S-2011201), detection UV-light, leg. A. Stubbe, M. Stubbe.

Table 3: Morphometric measurements of *Mesobuthus martensii martensii* males and females from Mongolia

	♂♂			♀♀		
Parameter	**min-max**	**x**	**s**	**min-max**	**x**	**s**
n	**4**			**3**		
Tot_L	51.3-53.7	52.2	0.88	56.2-58.1	57.3	0.79
Ca_L	5.42-5.52	5.485	0.039	5.56-5.98	5.773	0.172
Ca_AW	2.81-3.27	3.043	0.176	3.18-3.47	3.353	0.125
Ca_PW	5.89-6.41	6.230	0.202	6.58-7.05	6.847	0.197
Fem_L	5.21-5.59	5.413	0.177	5.02-5.31	5.197	0.127
Fem_W	1.07-1.37	1.248	0.112	1.32-1.49	1.420	0.073
Pat_L	5.53-6.11	5.893	0.233	5.68-5.97	5.853	0.125
Pat_W	2.02-2.13	2.115	0.068	2.43-2.91	2.737	0.219
Ch_L	10.0-10.8	10.5	0.33	10.7-11.6	11.10	0.403
Ch_W	2.59-2.92	2.708	0.126	2.70-2.93	2.847	0.104
Met-I_L	3.85-4.32	4.023	0.184	4.37-4.52	4.450	0.062
Met-I_W	3.51-3.81	3.673	0.107	3.72-3.92	3.810	0.083
Met-I_H	3.77-4.02	3.912	0.103	3.61-3.89	3.730	0.118
Met-II_L	4.53-4.82	4.630	0.112	4.79-4.87	4.827	0.033
Met-II_W	3.57-3.68	3.723	0.105	3.46-3.68	3.583	0.092
Met-II_H	3.53-3.72	3.663	0.078	3.52-3.81	3.633	0.127
Met-III_L	5.07-5.35	5.230	0.101	5.21-5.54	5.430	0.157
Met-III_W	3.38-3.61	3.530	0.092	3.24-3.51	3.417	0.125
Met-III_H	3.42-3.74	3.638	0.127	3.31-3.61	3.503	0.137
Met-IV_L	5.21-5.72	5.490	0.194	5.71-5.94	5.853	0.102
Met-IV_W	3.27-3.52	3.403	0.186	3.49-3.82	3.687	0.142
Met-IV_H	3.19-3.68	3.505	0.188	3.39-3.88	3.687	0.213
Met-V_L	5.83-6.49	6.100	0.251	5.72-6.52	6.183	0.339
Met-V_W	2.51-3.31	2.912	0.291	3.02-3.27	3.177	0.112
Met-V_H	2.57-3.17	2.893	0.231	2.53-2.72	2.620	0.078

x = mean; s = ±Standard deviation.

Diagnosis. The individuals that were identified as *M. m. martensii* corresponded to the type description by QI et al. (2004).

Distribution: The occurrence of *M. m. martensii* in Mongolia has so far only been confirmed for the Dornogovi and Ömnögovi provinces (fig. 5).

Ecology: All Mongolian occurrence records of *M. m. martensii* were limited to desert, semi-desert and mostly dry riverbed habitats. A few individuals were found in self-dug 20 to 40 cm deep burrows under big stone blocks and once in a crevice of a stone wall.

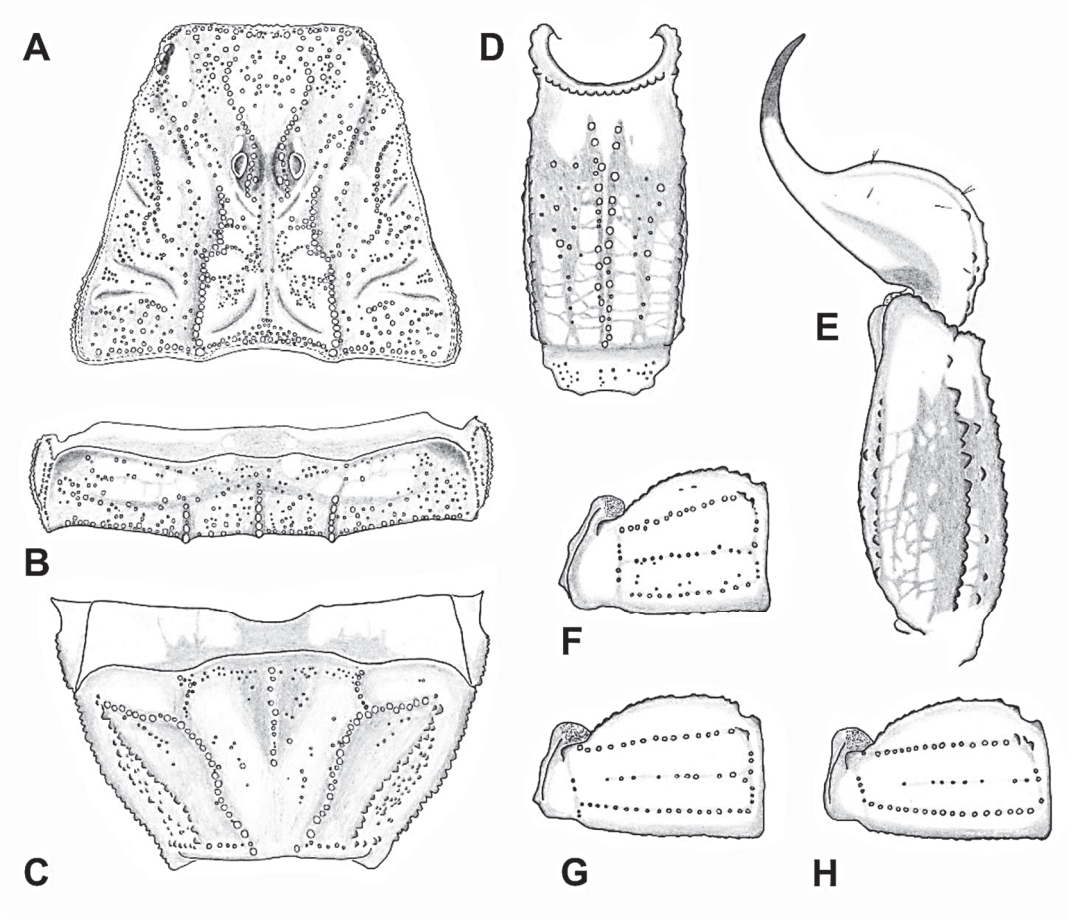

Fig. 6: *Mesobuthus martensii martensii* females from Alxa Zuoqi (38°39'N, 105°48'E) in China (cf. SUN & SUN 2011). A - carapace dorsal; B - segment III of tergite dorsal; C - segment VII of tergite dorsal; D - metasomal segment V ventral; E - metasomal segment V and telson lateral; F - metasomal segment I lateral; G - metasomal segment II lateral; H - metasomal segment III lateral.

Discussion

Only very few geo-reference scorpion finds from Mongolia can be discovered in the literature (BIRULA 1911, 1927; STAHNKE 1967, KOVAŘÍK 1997). Thus far, only three species have been reported to occur in the country, namely *Mesobuthus caucasicus przewalskii* (Birula, 1897), *M. eupeus mongolicus* (Birula, 1911) und *M. martensii martensii* (Karsch, 1879). However, it proved difficult to reconstruct the exact locations of the samples reported by BIRULA (1911, 1927), which were collected in 1907 and 1909 during the Central Asian expedition of Colonel P. K. Kozlov. We compared the location information detailed in Kozlov's expedition report with Birula's description of sample locations. After thorough examination of location names on old maps, it was concluded that none of the sampling sites reported by BIRULA (1911) were within the borders of the present Mongolian territory, but located within the present day Axla Left Banner [= „Alashan Provinz" in BIRULA (1911)], an administrative divison located in the west of Inner Mongolia, an autonomous region of northern China. In other words, the type locality of *M. e. mongolicus* was situated in present-day China (see SUN & SUN 2011), as was the *Buthus martensii* [= *M. m. martensii*]

record by BIRULA (1911). In this context, it is perhaps worth mentioning that HARVEY (2003) already recognised that the type locality given in BIRULA (1911) for *Galeodes caspius kozlovi*, a spider from the order Solifugae that is today known as *Galeodes kozlovi*, was located in China. In contrast, the *M. e. mongolicus* localities reported by BIRULA (1927) could be identified precisely and were situated in the present-day Mongolian province of Ömnögovi. Furthermore, *M. e. mongolicus* has been reported from the Bayankhongor, Dornogovi and Ömnögovi provinces (STAHNKE 1967; KOVAŘÍK 1997). BIRULA (1927) was the first to report the presence of *Buthus caucasicus przewalskii* (Birula, 1897) [= *M. c. prezewalskii*] from Mongolia. The scorpions analysed in this publication were collected again by Colonel P. K. Kozlov between 1925 and 1926. When again comparing the location information detailed in Kozlov's expedition report (KOZLOV 1925) with the sample location of *M. c. prezewalskii* ('Ezsin-gol') provided by BIRULA (1927), it becomes clear that this scorpion species was also collected in the Inner Mongolian autonomous region of northern China. In other words, a critical appraisal of the literature leads us to the conclusion that only *M. e. mongolicus* has been recorded to occur on the present-day territory of Mongolia and that the presence of *M. m. martensii* in Mongolia is confirmed for the first time in the present study.

The reported occurrence patterns of *M. e. mongolicus* significantly increase our knowledge on its distribution, and extend the species' range further north by 150 km and further west by 500 km (fig. 1). The global distribution of *M. e. mongolicus* covers a large area of central Asian China (SHI et al. 2007; ZHANG & ZHU 2009; SUN & SUN 2011) and of southern Mongolia (fig. 7). With the confirmation of the presence of *M. m. martensii* in Mongolia, the range of this species is extended 200 km further north (fig. 8). According to SHI et al (2007), the species appears to be restricted to latitudes south of 43° N in China. Globally, *M. e.martensii* ranges from south-eastern Mongolia, via eastern China to the Korean peninsula (QI et al. 2007; ZHANG & ZHU 2009; SUN & SUN 2011). The species was introduced to Japan (QI et al. 2004).

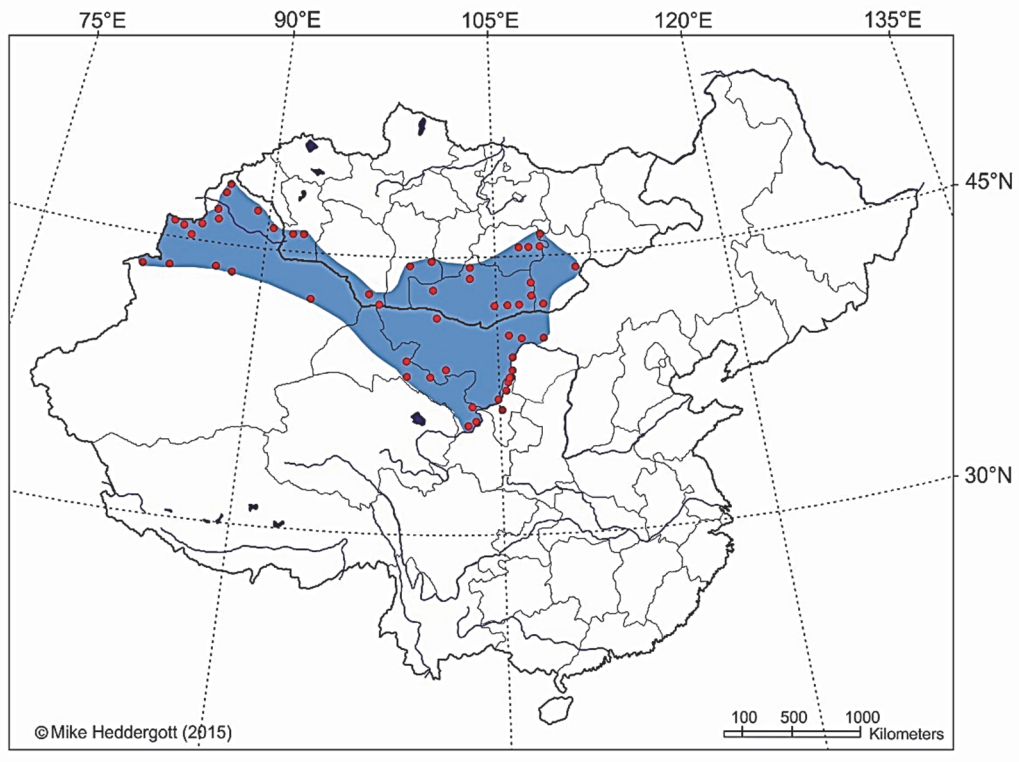

Fig. 7: Global range map of *Mesobuthus eupeus mongolicus*.

Scorpions are characterized by a large phenotypic variability within their geographic distribution areas (cf. ABDEL-NABI et al. 2004; ZHANG & ZHU 2009; OLIVERO et al. 2012), probably as a result of differing climate and physiographical factors within their ranges (POLIS & McCORMICK 1986). We only observed phenotypic variability (morphology and pigmentation) between different sampling locations in the case of *M. e. mongolicus*. The most pronounced morphometric differences were observed in the measures of total length (Tot_L). Both males and females from the province Khovd were generally smaller than scorpions from other areas (table 2, 3). Comparable morphological studies from China are only available for *M. m. martensii*. ZHANG & ZHU (2009) found that the morphological variation of the species in China was not large, but that individuals from the province of Qinghai were morphologically least similar to animals from other provinces.

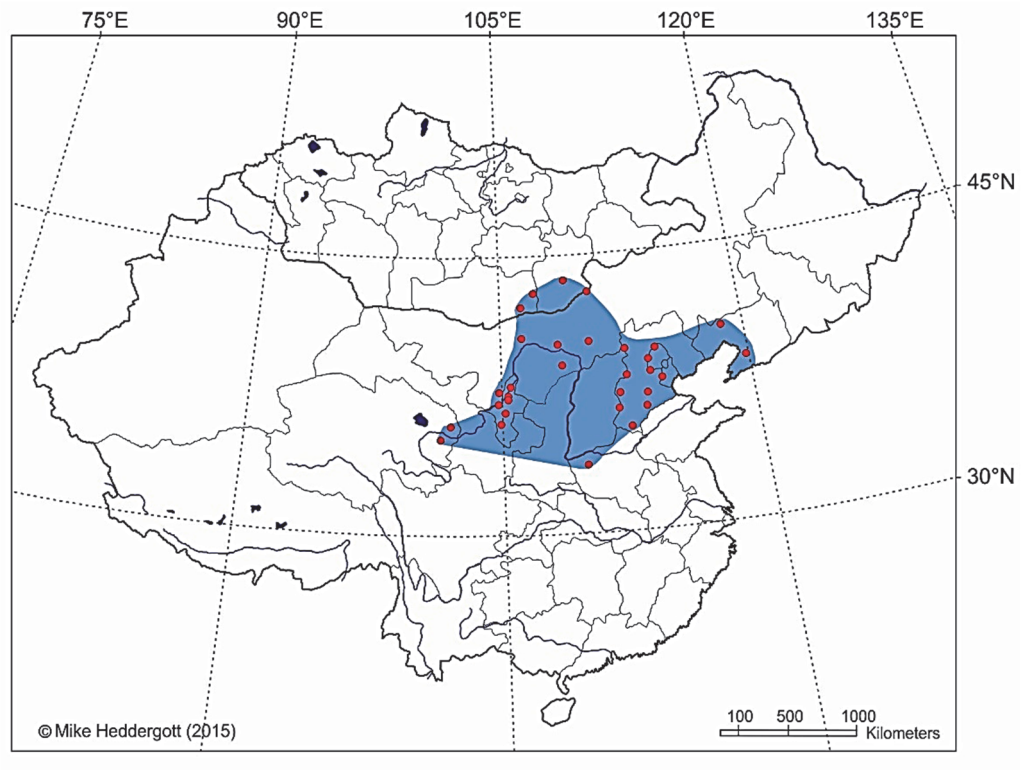

Fig. 8: Global range map of *Mesobuthus martensii martensii* in Mongolia and China. The presence on the Korean peninsula and Japan is not considered.

In the case of *M. e. mongolicus*, we observed differences in the pigmentation on the ventral plates of the metasoma segments I-IV. While individuals from the eastern Gobi desert (provinces: Dundgovi, Dornogovi, Govisümber und Omnögovi) did not have any pigmentation on these ventral plates, some individuals from the Trans-Altai Gobi were characterized by a light-brown pigmentation and all individuals from Khovd by a light-brown or dark pigmentation. Similarly, SUN & SUN (2011) also observed differences in the pigmentation of the ventral plates of the metasoma segments I-IV depending on the province of origin of their Chinese *M. e. mongolicus* specimens. Scorpions living in dry habitats have been shown to be less pigmented than species in wetter environments (cf. LOURENCO & CLOUDSLEY-THOMPSON 1996; MATTONI 2002; OLIVERO et al. 2012). Our results do not contradict this find, since the mean annual precipitation in the eastern Gobi desert (123 mm; Mongolia: Dalanzadgad www.wetterkontor.de) is lower than in

the Khovd province (236 mm; measurement taken at Ürümqi, approximately 100 km further south in China, www.wetterkontor.de).

There are to date no published accounts on the ecology of *M. e. mongolicus* und *M. m. martensii* in Mongolia (STAHNKE 1967; KOVAŘÍK 1997). All sampling locations of *M. e. mongolicus* in Mongolia were situated in a desert, semi-desert, or habitat adjacent to steppes. In China *M. e. mongolicus* is described as desert and semi-desert dwelling species (SUN & SUN 2011). The description of the ecology, with particular reference to the variety of daytime hideouts, for the species in China is consistent with our observations (cf. SUN & SUN 2011). However, our findings from Dundgovi also revealed novel daytime hideouts for *M. e. mongolicus*; in particular, individuals were found hiding in excavated burrows as well as under the bark of trees close to the ground.

Of particular interest is the confirmed occurrence of *M. m. martensii* in the provinces Dornogovi and Ömnögovi, which are located both in the eastern Gobi desert. All sampling locations for this species were limited to desert and semi-desert habitats, which were characterized by a dry or semi-dry continental climate. In contrast, habitats of *M. m. martensii* in China were characterized by a temperate and subtropical climate SUN & SUN (2011). According to SONG (1982), excessive humidity exacerbates the species' susceptibility to diseases and fungal infections. Locations on sunny hillsides covered in small shrubs and herbs are therefore likely to be more beneficial for this species. Our observations of daytime hideouts of *M. m. martensii* in Mongolia are consistent with findings by SUN & SUN (2011), who reported that the species hides in crevices and 30 to 50 cm deep burrows during daytime and for hibernation.

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