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Some notes on *Geogarypus harveyi* (Pseudoscorpiones: Geogarypidae) from Iran

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Abstract. Only two species belonging to the genus *Geogarypus* Chamberlin, 1930 are reported from Iran: *G. shulovi* Beier, 1963 from Maku (Eastern Azerbaijan Prov.) by Beier (1971) and *G. harveyi* Nassirkhani, 2014 from Khabr National Park (Kerman Prov.) by Nassirkhani (2014). In this study, a new range in size, a new distribution, a short description, and some morphological differences between the types and the newly collected specimens from southern Iran attributed to *G. harveyi* are presented.

Key words. Morphology, biogeography, distribution, Arachnida, morphometry, Iran, Palearctic Region.

INTRODUCTION

The family Geogarypidae Chamberlin, 1930, which was originally considered as a subfamily of Garypidae Simon, 1879 by Chamberlin (1930), was raised to family level by Harvey (1986). Members of this family are easily separated from all other families of the superfamily by the following combination of characters: anal plates located between tergite XI and sternite XI, rallum with only one blade and a triangular carapace. Also, the width of coxa IV is approximately the same as that of coxa I (Harvey 1992). Only three genera, *Geogarypus* Chamberlin, 1930, *Afrogarypus* Beier, 1931 and *Indogarypus* Beier, 1957 belong to this family. A Key to the genera of the family Geogarypidae is provided by Harvey (1986).

Geogarypus gorskii Henderickx, 2005, *G. macrodactylus* Beier, 1937 and *G. major* Beier, 1937 are only known as fossils from the Eocene (Harvey 2013). The genus consists of 49 species, which occur in various habitats in many different regions of the world, only 10 of which occur in the Middle East and central Asia. The genus *Geogarypus* clearly differs from the other genera in the following combination of characters: pedipalpal chela without sulcus; the fixed chelal finger with accessory teeth (except in *G. mirei* Heurtault, 1970); and arolia slightly longer than claws (Chamberlin 1930, Harvey 1986).

The characters used for identifying individual geogarypid species are not clearly defined. Generally, the following morphometric characters, especially the pedipalpal femur ratio, the chelal ratio, and the length of the movable chelal finger, the shape of the pedipalpal femur, trichobothriotaxy, chaetotaxy, especially the shape and length of the setae on anterior margin of the carapace, and sometimes, the pattern of granulation on the fixed chelal finger, are considered to be helpful. Nonetheless, many species may be incorrectly identified, e.g. numerous species that occur in the Asian and Pacific areas are synonyms of *G. longidigitatus* (Rainbow, 1897) (Harvey 2000).

MATERIALS AND METHODS

The specimens examined during this study were deposited in the Acarology Laboratory, Islamic Azad University of Arak (IAUA). Morphological terminology and measurements follow Chamberlin (1931), Judson (2007) and Harvey (1992). The specimens were collected by sieving litter and studied as temporary slides mounted in Glycerin. An Olympus BH-2 compound microscope was used to examine the specimens. The specimens were measured using an ocular graticule and illustrated using a drawing tube attached to the microscope.

The following abbreviations for trichobothria are used: *eb* = external basal; *esb* = external sub-basal; *est* = external sub-terminal; *et* = external terminal; *ib* = internal basal; *isb* = internal sub-basal; *ist* = internal sub-terminal; *it* = internal terminal; *t* = terminal; *st* = sub-terminal; *b* = basal; *sb* = sub-basal. In addition, the following abbreviations are also used: mm = millimeter; L = length; W = width.

RESULTS

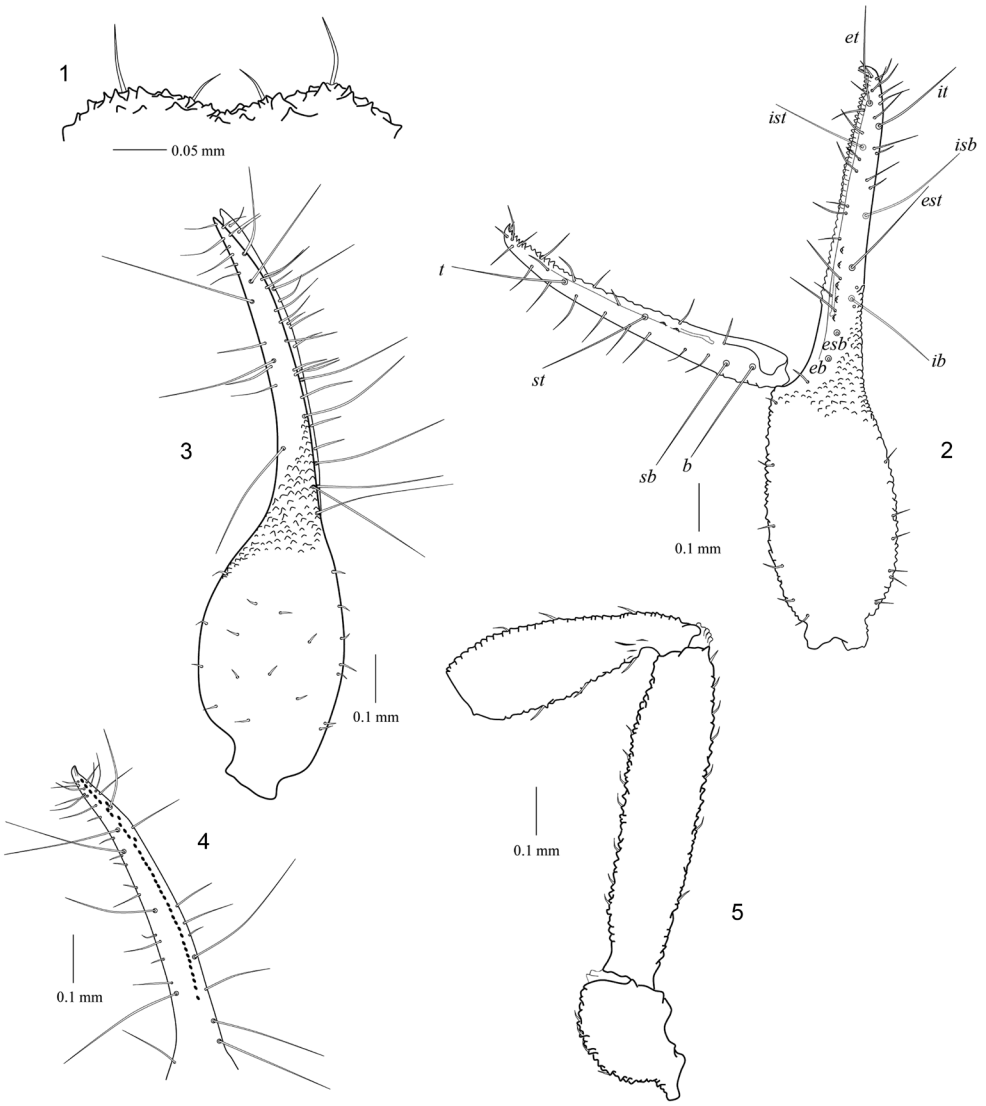
Geogarypus harveyi Nassirkhani, 2014

Geogarypus harveyi Nassirkhani, 2014: 99–103, Figs 1–2.

Material examined. **Iran**: Kerman Prov.: 2 ♂♂, 3 ♀♀, Bidkhan [29° 49’ 57” N, 56° 17’ 33” E, altitude 2600 m], Bardsir, leaf litter, 15 June 2011, leg. M. Nassirkhani (IAUA); – 3 ♂♂, 5 ♀♀, Manujan [29° 34’ 12” N, 57° 18’ 50” E, altitude 1100 m], Jirouft, dry leaf litter, 8 June 2011, leg. M. Nassirkhani (IAUA). – Fars Prov.: 7 ♂♂, 1 ♀♀, Seyyedan [29° N, 53° E, altitude 1610 m], Marvdasht, wood and leaf litter, 8 July 2014, leg. M. Nassirkhani (IAUA); – 3 ♀♀, 2 ♂♂, Saadat-Shahr [30° 06’ 17” N, 53° 13’ 33” E, altitude 1950 m], Pasargad, leaf litter, 9 July 2014, leg. M. Nassirkhani (IAUA). – Khuzestan Prov.: 1 ♂, Pol-e-Ghadim [undetermined], Dezfoul, under stone, leg. A. Bookan (IAUA).

Description. Adults (Figs 1–5). *Carapace*: dark brown, posterior margin lighter in colour than anterior margin (in one male from Dezfoul, posterior margin with a pale butterfly like area!); slightly wider than length or as long as length, L/W 0.87–1.00 (♂♀); front margin with 16–18 setae; anterior margin with four simple setae, two short setae situated medially and 2 long setae situated sub-medially (Fig. 1); posterior margin with 9–12 setae; with eight distinct lyrifissures. *Tergites*: VIII and IX with two slightly longer setae situated sub-medially; X with four slightly longer setae situated sub-medially and laterally; XI with two long tactile setae situated lateromedially; setae simple, acute and narrow. *Sternites*: IX and X with two long tactile setae situated medially. *Pleural membrane*: roughly striate; with more than 22 (♀ 40 setae) simple setae on each side. *Chelicera*: hand with five simple setae; rallum with one simple blade; serrula exterior with 14–15 blades; fixed finger with six teeth; movable finger with one curved and acute apical lobe and two small sub-apical curved teeth. *Pedipalps*: chelal granulation slightly extended to basal third (justified to *est*) of fixed finger (Figs 2–3); trochanter L/W 1.20–1.67 (♀ 1.50–2.00); femur L/W 4.17–4.69 (♀ 3.80–4.94); patella with four lyrifissures (Fig. 5), L/W 3.05–3.44 (♀ 2.10–3.33); chela (with pedicel) L/W 4.15–4.61; chela (without pedicel) L/W 3.93–4.33; hand (with pedicel) L/W 1.92–2.04 (♀ 1.84); movable finger 1.24–1.36 times longer than hand (with pedicel); fixed finger with eight and movable finger with four trichobothria (Fig. 2); fixed finger with 30–43 teeth (19–20 triangular-shaped, 3–4 teeth situated outside of row (Fig. 4), teeth 6, 9 and 13 (or and 17) are duplicated, 2–3 small teeth situated basally and 6–12 accessory teeth present, mostly occurring at fixed intervals); movable finger with 30–32 teeth (10–12 triangular-shaped, 15–16 blunt and a semi-circle of 3–4 weak teeth, 3–4 small teeth situated basally and 1–4 accessory teeth present); nodus ramosus present on both fingers, situated slightly posterior to *ist* on fixed finger and slightly anterior to *st* on movable finger; venom duct elongate on both fingers (in two specimens, nodus ramosus situated close to *est* on fixed and close to *sb* on movable chelal finger). *Legs*: coxal setae arranged: 3–5 : 4–6 : 4–7 : 13–19 (♀ 4–6 : 5–7 : 9 : 33); *leg I*: femur L/W 3.10–3.20 (♀♀ 2.85–3.00); patella L/W 1.80–2.00 (♀♀ 1.91–2.10); tibia L/W 3.28–3.57 (♀♀ 3.25–3.62); metatarsus L/W 3.50–3.60 (♀♀ 3.16–3.33); tarsus L/W 4.00–4.75 (♀♀ 3.80–5.00);

leg IV: femur L/W 1.20–1.55 (♀♀ 1.31–1.70); patella L/W 3.07–3.54 (♀♀ 2.80–4.00); femur + patella L/W 3.06–4.77 (♀♂); tibia L/W 4.22–4.33 (♀♀ 4.27–5.00); metatarsus L/W 2.86–3.50 (♀♀ 3.28–3.83); tarsus L/W 4.20–4.60 (♀♂).



Figs 1–5. *Geogarypus harveyi* Nassirkhani, 2014; ♂. 1 – anterior margin of carapace (showing chaetotaxy), dorsal view. 2 – left chela, lateral view. 3 – right chela, dorsal view. 4 – fixed chelal finger (showing that the teeth are not in a row), ventral view. 5 – basal segments of pedipalp, dorsal view.

Table 1. Morphometrical comparison of *Geogarypus harveyi* Nassirkhani (type), *G. harveyi* (new collected specimens) and *G. azerbaidzhanicus* Dashdamirov [mm = millimetres; (+) = with pedicel]

dimensions (in mm) and ratios		femur L	femur W	femur L/W	chela (+) L	chela W	chela(+)L/W
G. harveyi (type)	♂♂	0.62–0.68	0.14–0.16	4.33–4.64	0.95–1.02	0.22–0.24	4.32–4.54
	♀♀	0.69–0.70	0.16–0.17	4.17–4.37	1.07–1.10	0.25–0.27	4.07–4.28
G. harveyi (new specimens)	♂♂	0.73–0.76	0.16–0.17	4.47–4.69	1.12–1.22	0.26–0.27	4.15–4.61
	♀♀	0.83–0.84	0.17–0.18	4.61–4.94	1.30–1.32	0.31	
G. azerbaidzhanicus	♂	0.69	0.16	4.32	1.14	0.29	3.93

Dimensions (mm). ♂♂ *carapace*: 0.65–0.67/0.64–0.77. *Pedipalp*: trochanter 0.25–0.30/0.17–0.19; femur 0.70–0.79/0.16–0.17; patella 0.52–0.57/0.16–0.18; chela (with pedicel) 1.12–1.22/0.26–0.28; chela (without pedicel) L 1.07–1.17; hand (with pedicel) L 0.50–0.54; movable finger L 0.63–0.68. *Leg I*: trochanter 0.14–0.16/0.12; femur 0.31–0.32/0.10–0.12; patella 0.17–0.20/0.09–0.11; tibia 0.23–0.27/0.07; metatarsus 0.17–0.18/0.05–0.06; tarsus 0.16–0.19/0.04. *Leg IV*: trochanter 0.18–0.22/0.13-0.14; femur 0.12–0.17/0.09–0.10; patella 0.43–0.48/0.13–0.16; femur + patella 0.53–0.57/0.13–0.16; tibia 0.38–0.41/0.09; metatarsus 0.20–0.22/0.06–0.07; tarsus 0.21–0.22/0.05. ♀♀ *carapace*: 0.73–0.77/0.70–0.76. *Pedipalp*: trochanter 0.31–0.34/0.17–0.20; femur 0.76–0.84/0.17–0.20; patella 0.53–0.61/0.18–0.21; chela (with pedicel) 1.27–1.32/0.29–0.31; chela (without pedicel) L 1.22–1.25; hand (with pedicel) L 0.56–0.58; movable finger L 0.73–0.76. *Leg I*: trochanter 0.16–0.19/0.13–0.16; femur 0.33–0.37/0.11–0.13; patella 0.20–0.21/0.10–0.11; tibia 0.26–0.29/0.08; metatarsus 0.19–0.21/0.05–0.06; tarsus 0.19–0.20/0.04–0.05. *Leg IV*: trochanter 0.27–0.30/0.14–0.19; femur 0.14–0.17/0.10–0.13; patella 0.51–0.56/0.13–0.20; femur + patella 0.62–0.68/0.13–0.20; tibia 0.43–0.47/0.09–0.11; metatarsus 0.23–0.25/0.06–0.07; tarsus 0.21–0.24/0.05.

Remarks. The newly collected specimens of *Geogarypus harveyi* from southern Iran and the types differ slightly in a number of morphological characters, e.g. the numbers of accessory teeth (four on the fixed and three on the movable chelal finger in most of the newly collected specimens), colour pattern on the carapace (uniformly dark brown in the types, and posterior margin lighter in

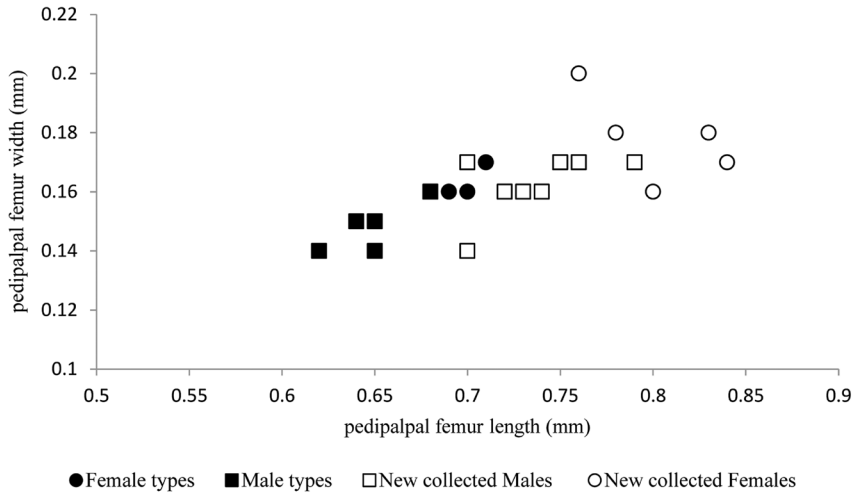


Fig. 6. *Geogarypus harveyi* Nassirkhani, 2014: graph depicting pedipalpal femur ratio of the type and the newly collected specimens from Iran.

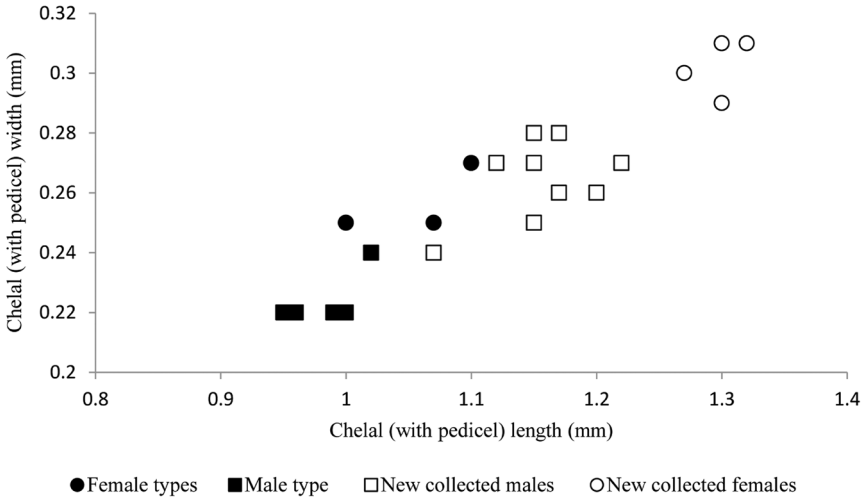


Fig. 7. *Geogarypus harveyi* Nassirkhani, 2014: graph depicting chelal (with pedicel) ratio of the type and the newly collected specimens from Iran.

colour than anterior margin in the newly collected specimens) and the intensity of granulation on the fixed chelal finger (slightly more in most of the newly collected specimens) (Figs 2–3). These small differences are considered to be within the intraspecific variation of this species. In addition, the size of the pedipalp is noticeably different in the recently collected specimens and the types (Figs 6–7). The proportions of the new specimens from Iran are intermediate between those of *G. azerbaidzhanicus* Dashdamirov, 1993 and the types of *G. harveyi* (Table 1), e.g. the chelal (with pedicel) size of *G. harveyi* is 0.95–1.02/0.22–0.24 mm (♀♀ 1.07–1.10/0.25–0.27 mm), of *G. azerbaidzhanicus* is 1.14/0.29 mm (♂) (Dashdamirov 1993) and of the newly collected specimens from Iran is 1.12–1.22/0.26–0.28 mm (♀♀ 1.30–1.32/0.29–0.31 mm). This variation in size is within the range recorded for this species.

Geogarypus azerbaidzhanicus can be easily differentiated from *G. harveyi* on the basis of the shape and size of the setae on the front of the carapace (in *G. azerbaidzhanicus* six setae of equal length), the presence of accessory teeth on the movable chelal finger (loss of accessory tooth in *G. azerbaidzhanicus*) and the number of accessory teeth on the fixed chelal finger (in *G. azerbaidzhanicus* only one accessory tooth).

Geogarypus longidigitatus (Rainbow, 1897) has been synonymized with *G. formosanus* Beier, 1931, *G. javanus* (Tullgren, 1905), *G. audyi* Beier, 1952, *G. micronensiensis* Morikawa, 1952 and *G. marquesianus* Chamberlin, 1939 (see Harvey 2013), so the range in pedipalpal size is very wide. For example, the recorded range in pedipalpal femur size is 0.56–0.80/0.15–0.19 mm, the chelal hand (without pedicel) is 0.44–0.56/0.23–0.32 mm and the movable chelal finger length is 0.48–0.69 mm (♀♂) (e.g. in Chamberlin 1932, Beier 1931, 1932, 1952, Harvey 1988). In addition, the pedipalpal femur size is 0.72/0.19 mm, the chela (with pedicel) is 1.16/0.31 mm, and the movable chelal finger length is 0.68 mm (♂) for *G.* aff. *longidigitatus* from Pakistan (Dashdamirov 2005). Due to the morphological characters, the intensity of granulation on the fixed chelal finger and the chaetotaxy on the anterior margin of carapace (the paramedian setae on the anterior margin of carapace are slightly shorter than lateral setae in *G.* aff. *longidigitatus*

from Pakistan) *G. harveyi* resembles *G. longidigitatus* (Rainbow, 1897), the lack of accessory teeth on the movable chelal fingers of *G. longidigitatus* (Chamberlin 1939, Harvey 1988), while there are 1–4 accessory teeth on those of the Iranian material. The coloration of the carapace is the other difference between these taxa, e.g. in *G. harveyi*, the carapace is unicoloured or the posterior half of carapace is uniformly lighter in colour than the anterior half. The posterior pale

Fig. 8. Geographical distribution of *Geogarypus harveyi* Nassirkhani, 2014 in southern Iran.

half of the carapace in *G. longidigitatus* is very similar to a butterfly with open wings (judging from Dashdamirov 2005: Fig. 45). It is noteworthy that the colour of the carapace of one male collected from Dezfoul-west southern Iran is similar to that of *G. longidigitatus*!

Geogarypus continentalis (Redikorzev, 1934) can be distinguished from *G. harveyi* by the pedipalpal size e.g. the femur ratio is 0.65/0.15, chelal hand 0.45/0.30 mm and movable chelal finger length is 0.65 mm, the presence of four denticulate setae on the anterior margin of the carapace and the existence of granules distal to/at the same level as *est* on the fixed chelal finger (judging from Dashdamirov 2005: Figs 42, 44, 47).

Geogarypus harveyi is widely distributed in southern parts of Iran from Kerman Province to Khouzestan Province (Fig. 8). It is usually found in litter containing the leaves of *Platanus* sp., *Punica* sp., *Malus* sp. and *Prunus* sp., and thin pieces of wood and leaves of Citrus trees, and rarely under stones.

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