

# Two new species of the pseudoscorpion genus *Geogarypus* (Pseudoscorpiones: Geogarypidae) from northern Australia

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**ABSTRACT** – The pseudoscorpion genus *Geogarypus* is widely distributed around the world, but with only six species recorded from Australia. Two new species are described from northern Australia: *G. facetus* from Northern Territory and *G. plusculus* from Western Australia, and COI barcodes are provided for both species.

**KEYWORDS:** taxonomy, morphology, short-range endemics, BushBlitz, COI barcode

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## INTRODUCTION

The pseudoscorpion genus *Geogarypus* Chamberlin, 1930 is widely distributed around the world, and has been recorded from all major biogeographic zones except for the Nearctic (e.g. Harvey 2013). Members of the genus are most commonly found in tropical and subtropical ecotypes in all continents, but may also extend into temperate zones such as southern South America (e.g. Beier 1955, 1959; Harvey 1987), southern Australia (Harvey 1986), southern Africa (e.g. Beier 1947; Neethling and Haddad 2016), the Mediterranean region (e.g. Beier 1961, 1963a, b; Gardini et al. 2017; Harvey 2011), Central Asia and the Tibetan Plateau (e.g. Beier 1974; Dashdamirov 1993; Redikorzev 1934) and the Middle East (e.g. Beier 1963a; Nassirkhani 2014). There are currently 49 described Holocene species of *Geogarypus*, with a further three species described from Eocene Baltic amber fossils (Beier 1937; Henderickx 2005; Henderickx and Perkovsky 2012). The Australian fauna consists of just six species, with *G. connatus* Harvey, 1986, *G. exochus* Harvey, 1986, *G. pisinnus* Harvey, 1986, *G. taylori* Harvey, 1986 and *G. rhantus* Harvey, 1981 (Harvey 1981, 1986) endemic to Australia, and the widely distributed Indo-Pacific species *G. longidigitatus* (Rainbow, 1897) recorded from northern Australia (Harvey 2000).

This paper reports the discovery of two previously undescribed species of *Geogarypus* collected from northern Australia during BushBlitz expeditions.

## MATERIAL AND METHODS

The material utilised in the present study is lodged in the Museum and Art Gallery of the Northern Territory, Darwin (NTM) and the Western Australian Museum, Perth (WAM). They were examined by preparing temporary slide mounts by immersing the specimen in 75% lactic acid at room temperature for one to several days, and mounting them on microscope slides with 10 or 12 mm coverslips supported by small sections of nylon fishing line. Specimens were examined with a Leica MZ16 dissecting microscope, a Leica DM2500 or Olympus BH–2 compound microscopes, and illustrated with the aid of a drawing tube. Measurements (in mm) were taken at the highest possible magnification using an ocular graticule. After study the specimens were rinsed in water and returned to 75% ethanol with the dissected portions placed in 12 × 3 mm glass genitalia microvials (BioQuip Products, Inc.).

Terminology and mensuration largely follow Chamberlin (1931), with the exception of the nomenclature of the pedipalps, legs and with some minor modifications to the terminology of the trichobothria (Harvey 1992), chelicera (Harvey and Edward 2007; Judson 2007) and faces of the appendages (Harvey et al. 2012). Measurements were taken to the nearest 0.005 mm, and in the Dimensions sections expressed as length/width, except for the leg measurements which are length/depth.

Molecular sequence data were obtained from two *Geogarypus* specimens. The techniques used to obtain the Cytochrome Oxidase 1 sequence data are outlined in Harvey et al. (2015) and Harvey et al. (2020).

### Family Geogarypidae Chamberlin, 1930

#### Genus *Geogarypus* Chamberlin, 1930

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*Geogarypus* Chamberlin 1930: 609.

*Geogarypus (Indogarypus)* Beier 1957: 25.

#### TYPE SPECIES

*Geogarypus: Garypus minor* L. Koch, 1873, by original designation.

*Geogarypus (Indogarypus): Garypus indicus* Beier, 1930, by original designation.

#### REMARKS

The familial and generic classification of this group of pseudoscorpions has altered in recent decades. *Geogarypus* was initially described by Chamberlin (1930) as the sole member of the subfamily Geogarypinae within the Garypidae. Harvey (1986) raised Geogarypidae to full family level, citing significant differences between both families which were confirmed in a later cladistic analysis (Harvey 1992). Recently, using phylogenomic data, Benavides et al. (2019) found Geogarypidae to be sister to Hesperolpiidae + Garypidae within the Garypoidea.

For more than 50 years after its inception, *Geogarypus* was the only genus of the group, but two additional subgenera were recognized, *Geogarypus (Afrogarypus)* Beier, 1931 and *Geogarypus (Indogarypus)* Beier, 1957 based mostly on differences in the shape of the chelal hand. Harvey (1986) treated them as distinct genera but Novák and Harvey (2019) have recently regarded *Indogarypus* as a synonym of *Geogarypus*, due to the lack of noticeable differences between them. This leaves the family with just two

genera, *Geogarypus* which is widespread around the world including many oceanic islands, and *Afrogarypus* which is restricted to the Afrotropical region.

### *Geogarypus facetus* sp. nov.

Figures 1–8

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#### MATERIAL EXAMINED

##### *Holotype*

**Australia: Northern Territory:** ♂, Wongalara, 14°12'20"S, 134°22'14"E, 136 m, 3 June 2012, under rocks, M.S. Harvey, et al. (NTM A005319).

#### DIAGNOSIS

*Geogarypus facetus* most closely resembles *G. exochus* from Queensland and *G. plusculus* from the Northern Territory by the slight expansion of the prolateral margin of the chelal hand (Figure 6). It differs from *G. exochus* by the position of trichobothrium *st* which is midway between *t* and *sb* in *G. facetus* (Figure 12) and noticeably closer to *t* in *G. exochus*. It differs from *G. plusculus* by the colour pattern of the carapace which is mostly brown in *G. facetus* (Figure 3), but contains extensive pale areas in *G. plusculus* (Figure 11). It also differs from *G. exochus* and *G. plusculus* by the low number of setae on the posterior margin of the carapace (4 setae) and tergites I–XI (1: 4: 4: 3: 5: 5: 5: 4: 3: 3: 2), compared with 8–11 (*G. exochus*) or 11 (*G. plusculus*) setae on the carapace margin, and 7–9: 10: 7–11: 9–11: 8–11: 9–12: 9–10: 8–10: 9: 6–8: 6: 2 tergal setae in *G. exochus* and 8: 8: 8: 10: 10: 10: 10: 8: 8: 8: 6: 2 setae in *G. plusculus*.

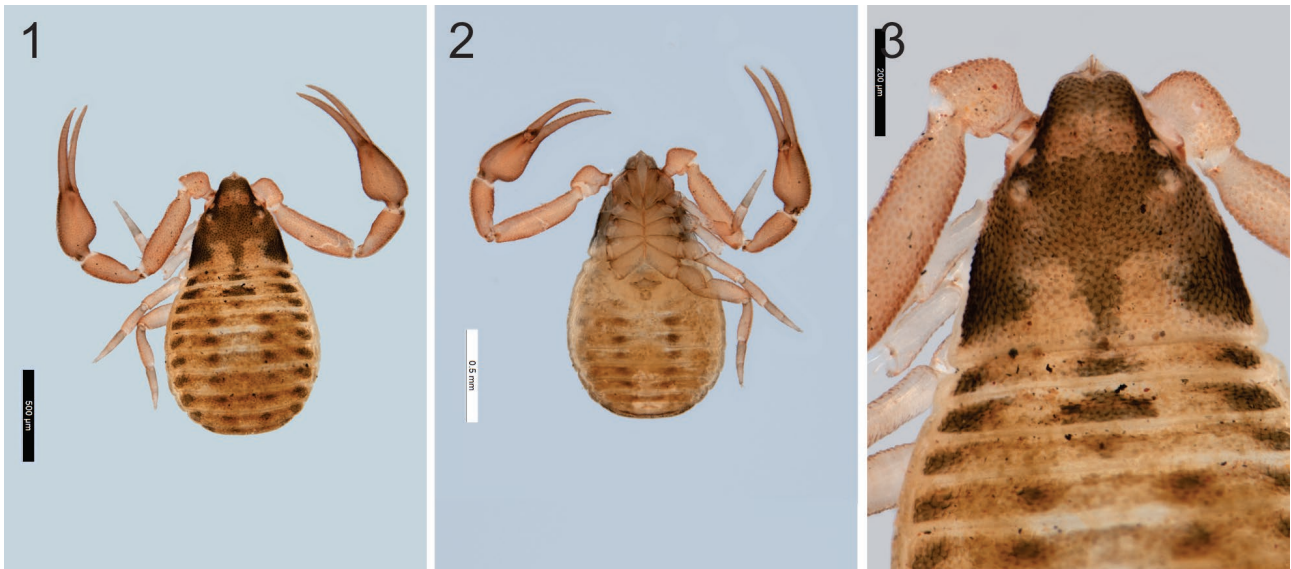
#### DESCRIPTION

##### *Adults*

Male only. Colour (Figures 1–3) of sclerotised portions generally brown, including pedipalpal trochanter; carapace brown with a large pale patch on cucullus and

TABLE 1 Specimens used to generate COI barcodes of two species of *Geogarypus*.

Species	Registration No.	Type status and sex	GenBank No.
<i>Geogarypus facetus</i> sp. nov.	NTM A005319	holotype ♂	OK017072
<i>Geogarypus plusculus</i> sp. nov.	WAM T142009	paratype ♂	OK017073



FIGURES 1–3 *Geogarypus facetus* sp. nov., holotype ♂ (NTM A005319): 1) dorsal; 2) ventral; 3) cephalothorax, dorsal.

paired patches on metazone; tergites generally pale, with darker patches laterally and medially on tergites I–III and sublaterally on tergites IV–X; sternites generally pale with paired darker patches on sternites V–X. Setae small and curved.

*Chelicera*: with 5 setae on hand and 1 subdistal seta on movable finger, all setae acuminate; 2 dorsal lyrifissures and 1 ventral lyrifissure; galea short and triangular, unbranched; rallum of 1 short blade; serrula exterior with 13 blades; lamina exterior present.

*Pedipalp* (Figure 6): trochanter 1.60, femur 4.00, patella 2.81, chela (with pedicel) 3.72, chela (without pedicel) 3.63, hand 1.65 × longer than broad, movable finger 1.34 × longer than hand (without pedicel). Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria (Figure 4): *eb* and *esb* situated basally; *est* subbasally; *et* subdistally; *ib* subbasally, opposite *est*; *isb*, *ist* and *it* subdistally; *b* and *sb* situated subbasally, *st* situated closer to *sb* than *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating near *isb* in fixed finger and near *st* in movable finger. Chelal teeth diastemodontate; fixed finger with 26 teeth in main row, most strongly curved, the basal teeth becoming progressively smaller, plus 5 smaller curved teeth in prolateral accessory row; movable finger with 26 teeth, the 16 or so distalmost teeth retrorse and curved, the 10 or so basalmost teeth rounded, accessory teeth absent. Retrolateral face of fixed finger with several pit-like structures.

*Carapace* (Figure 3): 0.86 × longer than broad; anterior margin slightly indented medially; subtriangular; with 2 pairs of rounded corneate eyes (Figure 8) situated *c.* one-third carapace length from anterior margin; anterior eye broad; with 4 setae near

anterior margin and 4 near posterior margin; with several lyrifissures; without furrows.

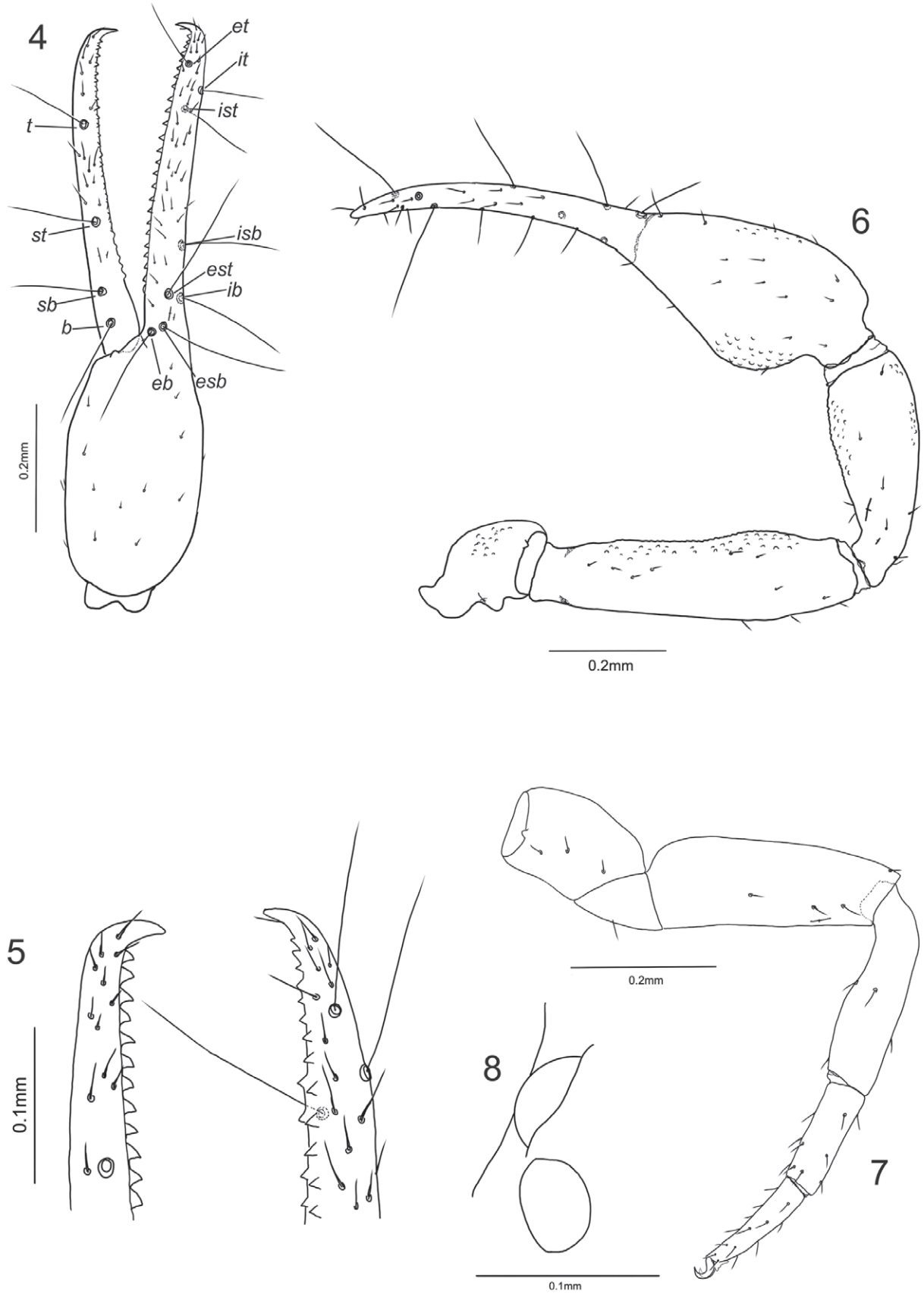
*Coxal region* (Figure 2): manducatory process pointed, with 3 apical acuminate setae, plus 8 additional setae; medial maxillary lyrifissure situated subdistally; chaetotaxy of coxae I–IV: 6: 8: 8: 13.

*Legs* (Figure 7): femora I and II longer than patellae I and II; junction between femora and patellae III and IV very angulate; femora III and IV much smaller than patellae III and IV; femur + patella of leg IV 3.93 × longer than broad; metatarsi and tarsi not fused and without tactile seta; subterminal tarsal setae arcuate and acute; arolium longer than claws, not divided.

*Abdomen*: tergites and sternites without median suture line (Figures 1–4). Tergal chaetotaxy: 1: 4: 4: 3: 5: 5: 5: 4: 3: 3: 2: 2; uniseriate. Sternal chaetotaxy: 6: (0) 6 [2 + 2] (0): (1) 2 (1): 8: 8: 8: 8: 8: 6: 2: 0; uniseriate. Spiracles with helix. Pleural membrane wrinkled-plicate; with several small curved setae.

*Genitalia*: lateral apodeme laterally extended and distally broadened; a pair of acute dorsal apodemes; lateral rod very broad ventrally and with a blunt, anterior projection; ejaculatory canal atrium large and cup-shaped.

*Dimensions*: holotype (WAM T124486): Body length 1.55. Pedipalps: trochanter 0.240/0.150, femur 0.540/0.135, patella 0.380/0.135, chela (with pedicel) 0.855/0.230, chela (without pedicel) 0.835, hand (without pedicel) length 0.380, movable finger length 0.510. Carapace 0.500/0.580; eye diameter, anterior 0.065, posterior 0.050. Leg IV: femur + patella 0.428/0.109, tibia 0.271/0.079, metatarsus 0.150/0.050, tarsus 0.150/0.038.



FIGURES 4-8 *Geogarypus facetus* sp. nov., holotype ♂ (NTM A005319): 4) left chela, retrolateral; 5) left chelal fingers, retrolateral; 6) right pedipalp, dorsal; 7) left leg IV, lateral; 8) left ocular region, dorsal.

## MOLECULAR DATA

The holotype male of this species was successfully sequenced for COI, and accessioned in GenBank under Accession No. OK017072 (Table 1).

## REMARKS

The specimen described here was collected under a rock within Wongalara, a large sanctuary situated in the southern Arnhem Land, Northern Territory.

## ETYMOLOGY

The specific epithet refers to the beauty of this species (*facetus*, Latin, fine, elegant, well made) (Brown 1956).

***Geogarypus plusculus* sp. nov.**

Figures 9–16

urn:lsid:zoobank.org:act:65058989-BA29-4A29-A250-ACA121E5AFAB

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** ♂, Cape Range National Park, Shothole Canyon Road, lookout, 22°03'52.01"S 114°00'38.42"E, 22 June 2019, under rocks, M.S. Harvey (WAM T148079).

*Paratype*

**Australia: Western Australia:** 1 ♂, Cape Range National Park, outside cave C-79, 22°05'31"S, 114°00'13"E, 309 m, 18 August 2016, sifting litter, J.M. Waldoock, W.F. Humphreys, R.D. Brooks (WAM T142009).

## DIAGNOSIS

*Geogarypus plusculus* most closely resembles *G. exochus* from Queensland and *G. facetus* from the Northern Territory by the slight expansion of the prolateral margin of the chelal hand (Figure 14). It differs from *G. exochus* by the position of trichobothrium *st* which is midway between *t* and *sb* in *G. plusculus* (Figure 12) and noticeably closer to *t* in *G. exochus*. It differs from *G. facetus* by the colour pattern of the carapace which contains extensive pale areas (Figure 11) but is mostly brown in *G. facetus* (Figure 3).

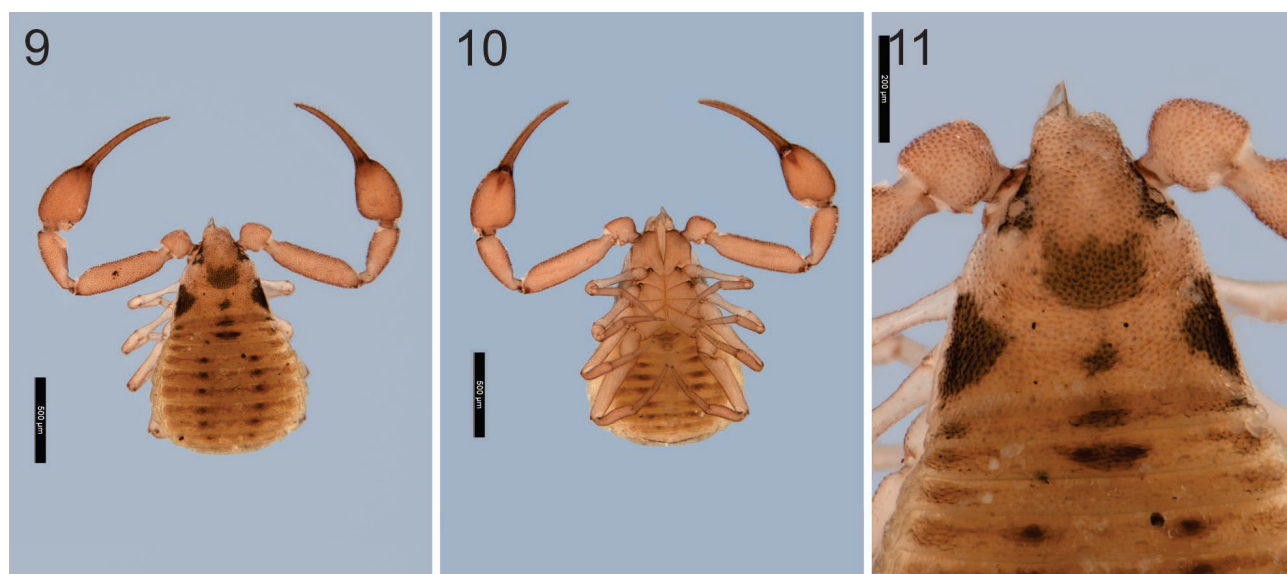
## DESCRIPTION

*Adults*

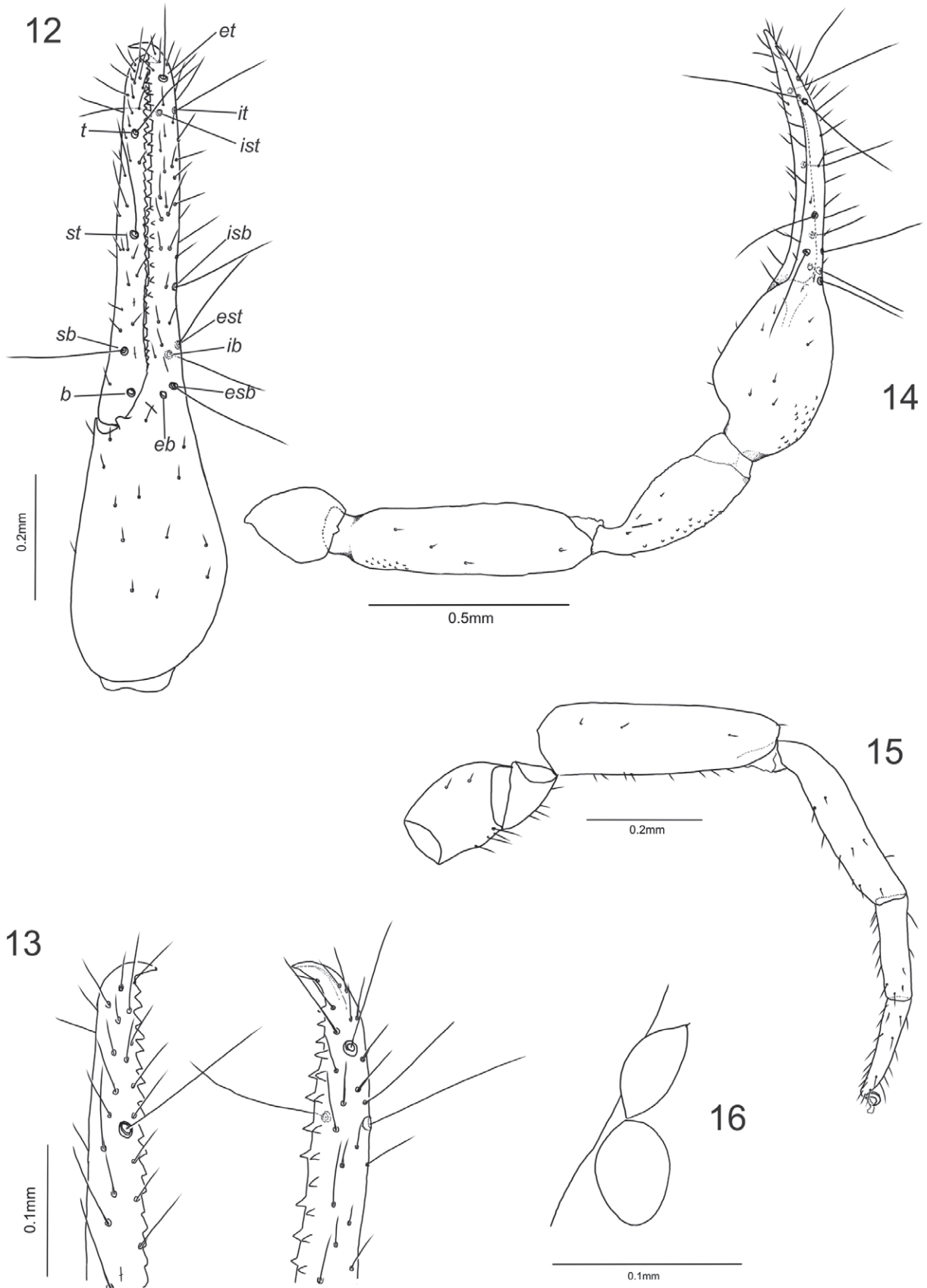
Male only. Colour (Figures 9–11): pedipalps, including trochanter, red-brown; carapace mostly pale with ocular region brown, a large medial brown patch on prozone, paired brown patches laterally on metazone, and a small brown median patch on metazone; tergites generally pale, tergites I–II with darker patches laterally and medially, sublaterally on tergites IV–X; sternites generally pale with paired darker patches on sternites V–X. Setae small and curved.

*Chelicera:* with 5 setae on hand and 1 subdistal seta on movable finger, all setae acuminate; 2 dorsal lyrifissures and 1 ventral lyrifissure; galea small, triangular and unbranched; rallum of 1 small blade; serrula exterior with 15 blades; lamina exterior present.

*Pedipalp* (Figure 14): trochanter 1.47–1.48, femur 3.75–3.77, patella 2.79–2.87, chela (with pedicel) 3.59–3.63, chela (without pedicel) 3.50–3.52, hand 1.31–1.48 × longer than broad, movable finger 1.53–1.69 × longer than hand (without pedicel). Fixed chelal finger with 8 trichobothria, movable chelal finger with



FIGURES 9–11 *Geogarypus plusculus* sp. nov., holotype ♂ (WAM T148079): 9) dorsal; 10) ventral; 11) cephalothorax, dorsal.



FIGURES 12–16 *Geogarypus plusculus* sp. nov., holotype ♂ (WAM T148079): 12) left chela, retrolateral; 13) left chelal fingers, retrolateral; 14) right pedipalp, dorsal; 15) left leg IV, lateral; 16) left ocular region, dorsal.

4 trichobothria (Figure 12): *eb* and *esb* situated basally; *est* subbasally; *et* subdistally; *ib* subbasally, opposite *est*; *isb*, *ist* and *it* subdistally; *b* and *sb* situated subbasally, *st* midway between *sb* and *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating near *isb* in fixed finger and near *st* in movable finger. Chelal teeth diastemodontate; fixed finger with 32 teeth in main row, most strongly curved, the basal teeth becoming progressively smaller, plus 11 curved teeth in prolateral accessory row; movable finger with 33 broad teeth, gap between teeth smaller than breadth of tooth, the distal teeth retrorse and slightly curved, the basal teeth rounded, accessory teeth absent. Retrolateral face of fixed finger with several pit-like structures.

*Carapace* (Figure 11): 0.87–0.92 × longer than broad; anterior margin slightly indented medially; subtriangular; with 2 pairs of rounded corneate eyes (Figure 16) situated *c.* one-third carapace length from anterior margin; with 4 setae near anterior margin and 11 near posterior margin; with several lyrifissures; with median furrows.

*Coxal region* (Figure 10): manducatory process pointed, with 3 apical acuminate setae, plus 8 additional setae; medial maxillary lyrifissure situated subdistally; chaetotaxy of coxae I–IV: 6: 6: 7: 13.

*Legs* (Figure 15): femora I and II longer than patellae I and II; junction between femora and patellae III and IV very angulate; femora III and IV much smaller than patellae III and IV; femur + patella of leg IV 3.65 × longer than broad; metatarsi and tarsi not fused and without tactile seta; subterminal tarsal setae arcuate and acute; arolium longer than claws, not divided.

*Abdomen*: tergites and sternites without median suture line (Figures 9, 10). Tergal chaetotaxy: 8: 8: 8: 10: 10: 10: 8: 8: 8: 6: 2; uniseriate. Sternal chaetotaxy: 6: (0) 9 [2 + 2] (0): (1) 4 (1): 10: 12: 13: 11: 10: 6: 4: 0. Spiracles with helix. Pleural membrane wrinkled-plicate; with several small curved setae.

*Genitalia*: lateral apodeme laterally extended and distally broadened; a pair of acute dorsal apodemes; lateral rod very broad ventrally and with a blunt, anterior projection; ejaculatory canal atrium large and cup-shaped.

*Dimensions*: holotype (WAM T148079), followed by paratype in parentheses: Body length 1.65 (1.46). Pedipalps: trochanter 0.250/0.170 (0.245/0.165), femur 0.620/0.165 (0.585/0.155), patella 0.430/0.150 (0.405/0.145), chela (with pedicel) 0.970/0.270 (0.945/0.260), chela (without pedicel) 0.950 (0.910), hand (without pedicel) length 0.400 (0.340), movable finger length 0.610 (0.575). Carapace 0.575/0.625 (0.530/0.610); eye diameter, anterior 0.054, posterior 0.053. Leg IV: femur + patella 0.485/0.133, tibia 0.325/0.085, metatarsus 0.180/0.055, tarsus 0.177/0.038.

## MOLECULAR DATA

The paratype male of this species was successfully sequenced for COI and accessioned in GenBank under Accession No. OK017073 (Table 1).

## REMARKS

*Geogarypus plusculus* has been collected at two locations in Cape Range National Park, Western Australia. Both specimens were collected under rocks.

## ETYMOLOGY

The specific epithet refers to yet another species of the genus *Geogarypus* (*plusculus*, Latin, a little more) (Brown 1956).

## ACKNOWLEDGEMENTS

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