

A new species of the pseudoscorpion genus *Synsphyronus* (Pseudoscorpiones: Garypidae) from Barrow Island, Western Australia

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ABSTRACT – A new species of *Synsphyronus*, *S. gurdoni*, is described from Barrow Island, Western Australia. The species occurs extensively across the eastern region of the island where it inhabits soil and litter habitats. Molecular data derived from four specimens found divergence levels of up to 0.46% in Cytochrome Oxidase 1.

KEYWORDS: taxonomy, morphology, Arachnida, short-range endemics

INTRODUCTION

Barrow Island is the second largest continental island in Western Australia and lies approximately 56 km from the mainland. The island is characterised by a variety of habitats, ranging from undulating sand dunes to steep valleys, escarpments, claypans and mangroves (Moro and Lagdon 2013). Fluctuating sea levels have played an important role in shaping both the physical aspects and the distinctive biota of Barrow Island. Rising sea levels separated the island from the neighbouring Pilbara and Cape Range bioregions around 8,000 years ago and this isolation is thought to have contributed to the survival of numerous species (particularly mammals), that have reduced mainland populations due to human colonisation (Moro and Lagdon 2013). The island hosts a remarkable 2,800 native species of plants and animals and is noteworthy for harbouring three subterranean vertebrate species, including a fish, an eel and a snake (Moro and Lagdon 2013). While the island is an important refuge for wildlife and has been a Class A nature reserve since 1910, it is not an undisturbed environment as it also supports a longstanding oil industry (since the 1960s) and more recently developed gas industry.

Regular surveys of terrestrial invertebrates on Barrow Island have been conducted since 2005 to provide baseline data prior to the construction of a liquid gas processing plant on the eastern side of the island (Gunawardene et al. 2013). Numerous pseudoscorpions were collected during the surveys including species of the genus *Synsphyronus* Chamberlin, 1930. *Synsphyronus* is endemic to Australasia where there are currently 31 named species (Harvey 1987, 2011, 2012). Most species have been described from Australia, including Tasmania, and two are recorded from New Zealand. Many additional unnamed species are also known from Australia (Harvey, unpublished data), and a new species has been found on the Pacific island of New Caledonia (Harvey 1996). This paper reports the discovery of a previously undescribed species of *Synsphyronus* collected from Barrow Island.

MATERIAL AND METHODS

The material utilised in the present study is lodged in 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 x 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).

Molecular sequence data were obtained from four specimens of *Synsphyronus* collected on Barrow Island to assess divergence levels for Cytochrome Oxidase 1. The techniques used to obtain the sequence are outlined in Harvey et al. (2015).

Family Garypidae Simon, 1879

Genus *Synsphyronus* Chamberlin, 1930

Synsphyronus Chamberlin 1930: 616.

Maorigarypus Chamberlin 1930: 617 (synonymised by Chamberlin 1943: 488).

Idiogarypus Chamberlin 1943: 499 (synonymised by Morris 1948: 37).

TYPE SPECIES

Synsphyronus: *Synsphyronus paradoxus* Chamberlin, 1930, by original designation.

Maorigarypus: *Maorigarypus melanochelatus* Chamberlin, 1930, by original designation.

Idiogarypus: *Garypus hansenii* With, 1908, by original designation.

Synsphyronus gurdoni sp. nov.

<http://zoobank.org/NomenclaturalActs/BC3E240E-9389-4D1D-AD25-9ECD2DBE4302>

Figures 1–13

MATERIAL EXAMINED

Holotype

Australia: Western Australia: ♂, Barrow Island, Gorgon Project footprint plot CC2, 20°49'02"S, 115°26'24"E, 10–15 March 2006, wet pitfall traps, low limestone flats, S. Callan, R. Graham (WAM T123308).

Paratypes

Australia: Western Australia: 1 ♂, Barrow Island, plot N22, old drill workshops, 20°49'55"S, 115°25'13"E, 6 May 2006, S. Callan, R. Graham (WAM T101471); 1 ♀, Barrow Island, trap 1.27, 20°47'21"S, 115°27'18"E, November 2003, sieved from spinifex debris, R. Teale, G. Harold (WAM T60177); 1 ♀, Terminal Tanks, Barrow Island, 20°47'24"S, 115°27'22"E, 23 November 2003, sieved debris, R. Teale, G. Harold (WAM T57749); 3 ♀, Barrow Island, Gorgon Project footprint plot GP5, 20°46'59"S, 115°27'03"E, 15 March 2006, winkler sac, high limestone flats, S. Callan, R. Graham (WAM T123310); 1 ♀, Barrow Island, plot N05b, current airport, 20°51'50"S, 115°24'23"E, 26 April–1 May 2007, wet pitfall traps, S. Callan, K. Edwards (WAM T123321).

Other material examined (not types)

Australia: Western Australia: 1 tritonymph, WSW. of Latitude Point, Barrow Island, 20°46'51"S, 115°26'28"E, 11 August 2002, S. Slack-Smith (WAM T59964); 1 ♀, 1 deutonymph, 1 protonymph, Barrow Island, Gorgon Project footprint plot GP7, 20°47'51"S, 115°26'27"E, 15 March 2006, limestone ridge to drainage line, S. Callan, R. Graham (WAM T123309); 1 ♂, 1 tritonymph, Barrow Island, Gorgon Project footprint plot GPX, 20°47'45"S, 115°27'08"E, 15 March 2006, winkler sac, low limestone ridge, S. Callan, R. Graham (WAM T123311, T135256); 1 deutonymph, Barrow Island, Gorgon Project footprint plot GP8, 20°47'59"S, 115°26'25"E, 25 September 2006, winkler sac, valley flats, S. Callan, R. Graham (WAM T123312); 1 protonymph, Barrow Island, Gorgon Project footprint plot CC2, 20°49'02"S, 115°26'24"E, 25 September 2006, winkler sac, low limestone flats, S. Callan, R. Graham (WAM T123313); 1 deutonymph, 2 protonymphs, Barrow Island, Gorgon Project footprint plot CC2, 20°49'02"S, 115°26'24"E, 15 March 2006, winkler sac, low limestone flats, S. Callan, R. Graham (WAM T123314); 1 protonymph, Barrow Island, Gorgon Project footprint plot GP4, 20°47'03"S, 115°27'33"E, 15 March 2006, winkler sac, low limestone flats, S. Callan, R. Graham (WAM T123315); 1 ♂, 1 ♀, 1 tritonymph, Barrow Island, Gorgon Project footprint plot GP9, 20°47'59"S, 115°27'00"E, 15 March 2006, winkler sac, low limestone ridge, S. Callan, R. Graham (WAM T123316, T135257, T135258); 1 tritonymph, Barrow Island, Gorgon Project footprint plot GP6, 20°47'05"S, 115°26'28"E, 15 March 2006, winkler sac, high limestone flats, S. Callan, R. Graham (WAM T123317); 1 protonymph (pedipalps missing), Barrow Island, plot N20, old air strip, 20°45'00"S, 115°26'51"E, 6 May 2006, winkler sac, S. Callan, R. Graham (WAM T123318); 1 ♂, 1 tritonymph, Barrow Island, plot N05a, current airport, front office, 20°51'58"S, 115°24'22"E, 1 May 2007, winkler sac, S. Callan, K. Edwards (WAM T123319, T135259); 1 ♂, 1 protonymph, Barrow Island, plot N05b, current airport, helicopter hanger, 20°51'50"S, 115°24'23"E, 1 May 2007, winkler sac, S. Callan, K. Edwards (WAM T123320); 1 deutonymph, Barrow Island, site 45, 20°47'18"S, 115°26'31"E, 24 April 2005,

29 April 2005, winkler sac, K. Edward, S. Callan (WAM T123322); 1 ♀, 1 protonymph, Barrow Island, site 22, 20°47'12"S, 115°27'17"E, 17 May 2005, winkler sac, S. Callan et al. (WAM T126235); 1 deutonymph, Barrow Island, site 105, 20°48'08"S, 115°26'48"E, 17 May 2005, winkler sac, S. Callan et al. (WAM T126236).

DIAGNOSIS

Synsphyronus gurdoni differs from all other members of the genus by the highly reduced basal blades of the cheliceral rallum (Figure 11).

DESCRIPTION

Adults

Colour (Figures 1–4) of sclerotised portions generally red-brown; tergites II–X with paired darker patches; anterior and lateral regions of carapace dark, median and posterior areas pale yellow-brown. Waxy epicuticle. Setae generally aligned perpendicularly from body, each seta quadricarinate. Most cuticular surfaces roughened, but not granulate.

Chelicera: with 5 setae on hand and 1 subdistal seta on movable finger, all setae acuminate; setae sbs and bs shorter than others; 2 dorsal lyrifissures and 1 ventral lyrifissure; galea of ♂ and ♀ unbranched; rallum of 3 blades, the most distal blade with one spinule on leading edge, other blades much reduced and smooth (Figure 11); serrula exterior with 18 (♂), 16 (♀) blades; lamina exterior present.

Pedipalp (Figure 9): trochanter 1.38 (♂), 1.30 (♀), femur 0.61–0.825 (♂), 0.86–1.00 (♀), patella 0.58–0.61 (♂), 0.75–0.845 (♀), chela (with pedicel) 1.11–1.21 (♂), 1.36–1.50 (♀), chela (without pedicel) 1.06–1.13 (♂), 1.27–1.36 (♀), hand 1.90 (♂), 1.61–1.63 (♀) x longer than broad, hand 1.10 (♂), 1.09 (♀) x longer than movable finger. Fixed chelal finger with 8 trichobothria, movable chelal finger with 3, or occasionally 2, trichobothria (Figure 5): eb, esb and isb situated basally in straight row, est submedially, et subdistally, ib and ist basally in diagonal row, and it subdistally, well posterior to et; st situated midway between sb and t; patch of microsetae present on external margin of fixed chelal finger near et. Venom apparatus present in both chelal fingers, venom ducts long, terminating in nodus ramosus midway near et in fixed finger and close to t in movable finger. Chelal teeth retrorse and acute distally, becoming rounded basally; fixed finger with 37 (♂), 34 (♀) teeth; movable finger with 25 (♂), 27 (♀) teeth; accessory teeth absent.

Carapace (Figures 1, 3): 0.91 (♂), 0.81 (♀) x longer than broad; anterior margin slightly indented medially; subtriangular; with 2 pairs of rounded corneate eyes (Figure 10) situated ca. one-third carapace length from anterior margin; anterior eye broad, not constricted and not covered partially by cuticle; with 2 setae near anterior margin and 4 near posterior margin; with numerous lyrifissures; without furrows.

Coxal region (Figures 2, 4): manducatory process rounded, with 3 apical acuminate setae, plus 4 (♂, ♀

additional setae; medial maxillary lyrifissure situated submedially; chaetotaxy of coxae I–IV: ♂, 1: 2: 2: 3; ♀, 1: 2: 2: 6.

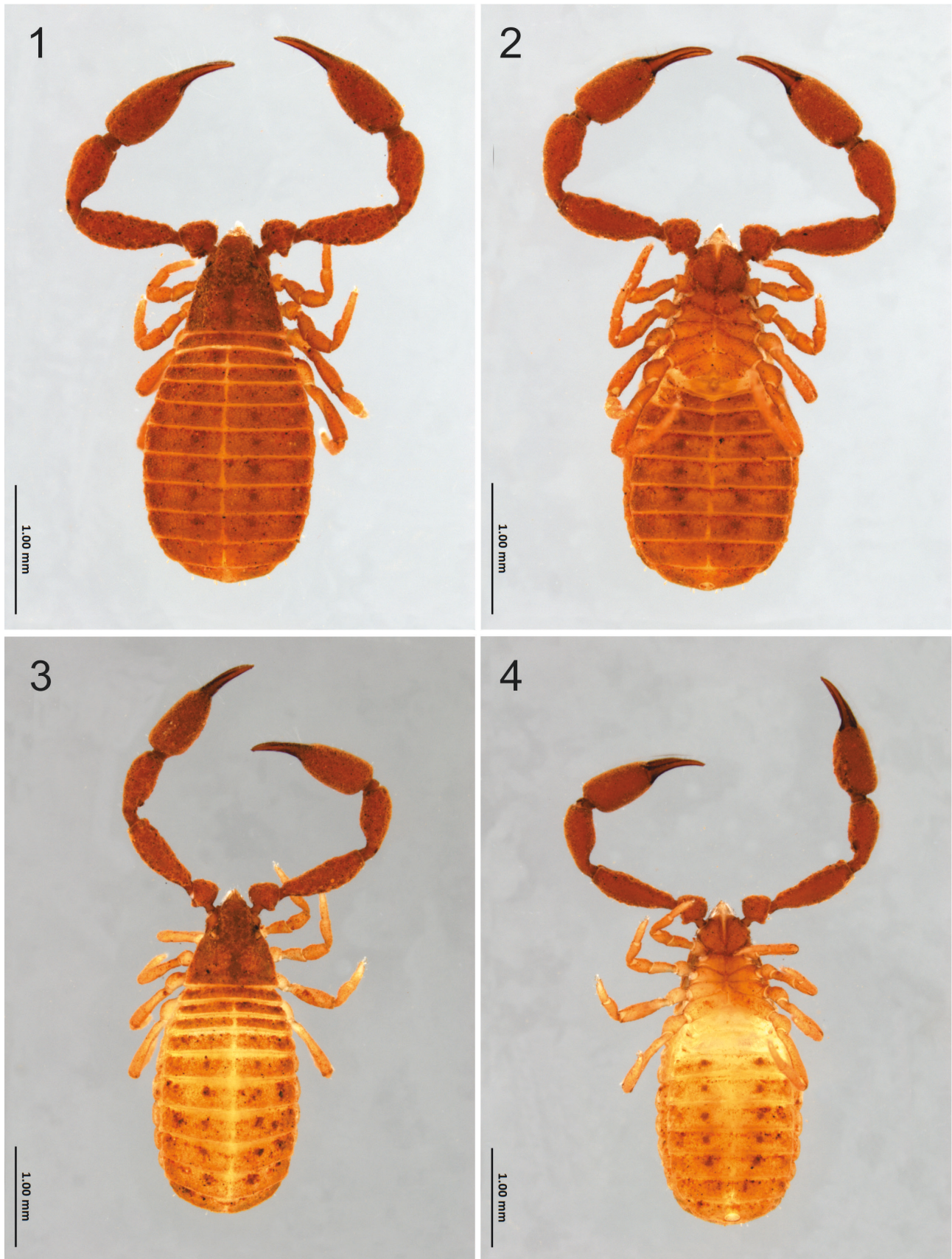
Legs (Figures 12, 13): junction between femora and patellae I and II slightly oblique to long axis; junction between femora and patellae III and IV very angulate; femora III and IV much smaller than patellae III and IV; femur + patella of leg IV 3.56 (♂), 4.14 (♀) x longer than broad; metatarsi and tarsi not fused and without tactile seta; subterminal tarsal setae arcuate and acute; arolium much longer than claws, not divided.

Abdomen: tergites II–X (♂, ♀) and IV–X (♂), V–X (♀) with median suture line (Figures 1–4). Chaetotaxy of tergites I–XII: ♂, 4: 4: 4: 4: 4: 4: 4: 4: 5: 4: 4: 2; ♀, 4: 4: 4: 4: 4: 4: 4: 4: 4: 4: 2; uniseriate; all setae quadricarinate. Chaetotaxy of sternites II–XII: ♂, 10: (0) 5 [4 + 4] (0): (0) 5 (0): 4: 4: 4: 4: 4: 4: 4: 2; ♀, 5: (0) 6 (0): (0) 7 (0): 7: 6: 6: 6: 6: 6: 4: 2; uniseriate; all setae quadricarinate except for setae on sternites II–IV and medial setae on sternites V–VIII, which are acuminate. Spiracles without helix. Anal plates (tergite XII and sternite XII) situated within sternite XI, surrounded by slightly raised rim. Pleural membrane wrinkled-plicate; without any setae.

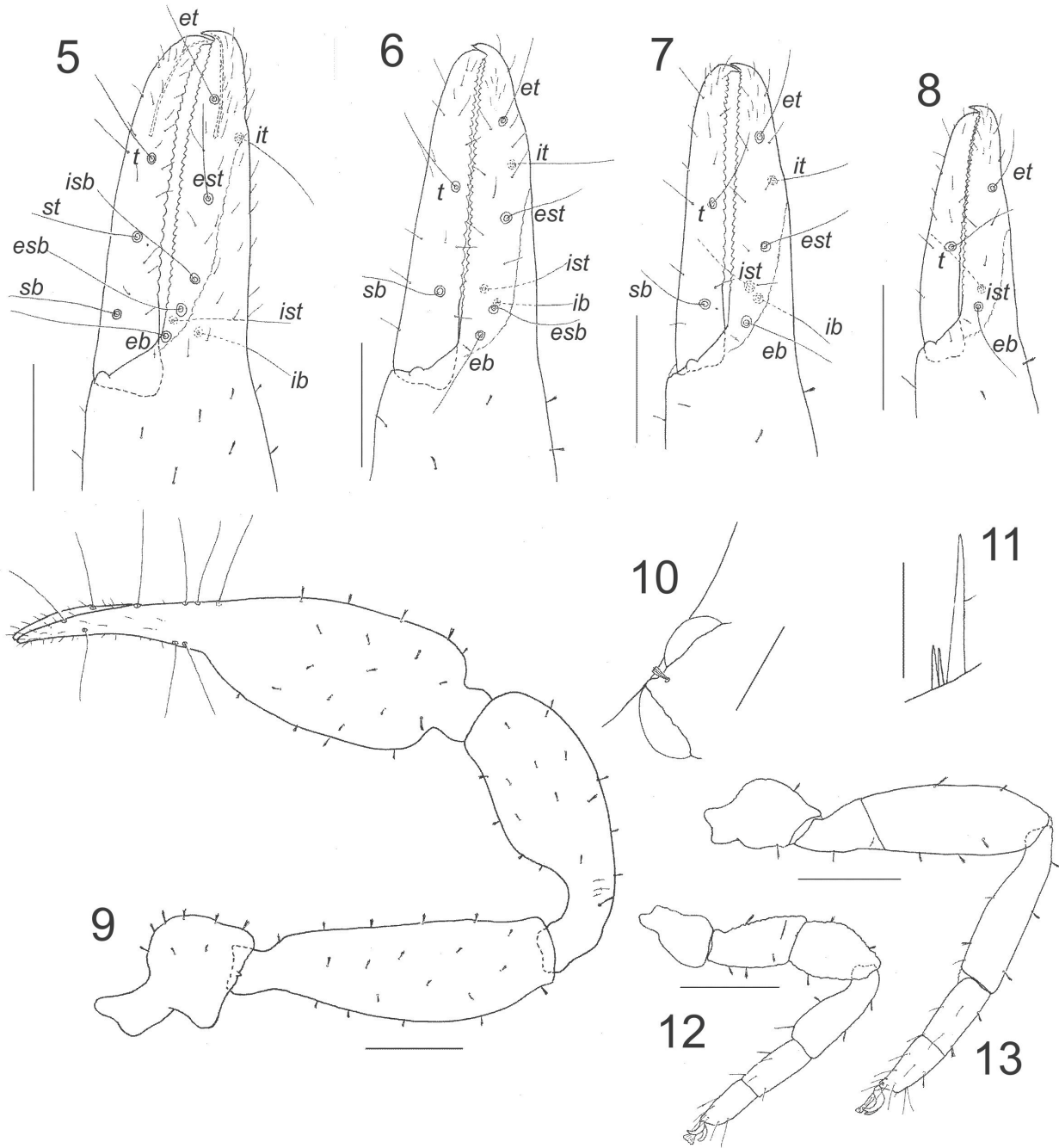
Genitalia: male: lateral apodeme laterally extended and distally broadened; anterior apodeme acute; a pair of acute dorsal apodemes; lateral rod very broad ventrally and with a blunt, anterior projection; ejaculatory canal atrium large and cup-shaped. Female: with one pair of lateral cribriform plates and 2 pairs of median cribriform plates.

Dimensions: male: holotype (WAM T123308) followed by 5 other males (when measured): Body length 2.65 (2.35–2.64). Pedipalps: trochanter 0.40/0.29, femur 0.855/0.25 (0.61–0.825/0.25–0.27), patella 0.72/0.275 (0.58–0.61/0.25–0.29), chela (with pedicel) 1.26/0.35 (1.11–1.36/0.31–0.36), chela (without pedicel) 1.18 (1.06–1.13), hand length (without pedicel) 0.615 (0.58–0.67), movable finger length 0.58 (0.5–0.58). Chelicera 0.255/0.115, movable finger length 0.16. Carapace 0.74/0.81; eye diameter, anterior 0.07, posterior 0.07. Leg I: femur 0.26/0.165, patella 0.21/0.14, tibia 0.26/0.095, metatarsus 0.16/0.07, tarsus 0.15/0.06. Leg IV: femur + patella 0.64/0.18, tibia 0.43/0.11, metatarsus 0.195/0.08, tarsus 0.18/0.08.

Female: paratype (WAM T123321) followed by 7 other females (when measured): Body length 3.34 (3.125–3.27). Pedipalps: trochanter 0.43/0.33, femur 0.99/0.275 (0.86–1.00/0.29–0.35), patella 0.80/0.29 (0.75–0.85/0.31–0.37), chela (with pedicel) 1.37/0.395 (1.36–1.50/0.38–0.46), chela (without pedicel) 1.29 (1.27–1.36), hand length (without pedicel) 0.685 (0.67–0.75), movable finger length 0.61 (0.61–0.69). Chelicera 0.26/0.13, movable finger length 0.16. Carapace 0.815/1.005; eye diameter, anterior 0.09, posterior 0.075. Leg I: femur 0.295/0.125, patella 0.24/0.145, tibia 0.305/0.105, metatarsus 0.175/0.075, tarsus 0.155/0.065. Leg IV: femur + patella 0.765/0.185, tibia 0.505/0.11, metatarsus 0.211/0.095, tarsus 0.195/0.08.



FIGURES 1–4 *Synsphyronus gurdoni* sp. nov.: 1, male holotype (WAM T123308), dorsal; 2, male holotype (WAM T123308), ventral; 3, female paratype (WAM T123321), dorsal; 4, female (WAM T123321), ventral.



FIGURES 5–13 *Synsphyronus gurdoni* sp. nov., male holotype (WAM T123308), unless stated otherwise: 5, left chela, lateral; 6, left chela, lateral, tritonymph (WAM T123317); 7, left chela, lateral, deutonymph (WAM T126326); 8, left chela, lateral, protonymph (WAM T123313); 9, right pedipalp, dorsal; 10, left ocular region, dorsal; 11, left rallum, lateral; 12, left leg I; 13, left leg IV. Scale lines = 0.25 mm (Figures 9, 12, 13), 0.2 mm (Figures 5–8), 0.1 mm (Figure 10), 0.05 mm (Figure 11).

TABLE 1 Specimens used in the molecular analysis of *Synsphyronus gurdoni* sp. nov., and their pairwise divergence levels (p-distance).

Registration number	Gender	GenBank number, CO1	T123316	T135256	T135257
WAM T123311	Male	KT881494	0.0000	0.0046	0.0000
WAM T123316	Male	KT881495		0.0046	0.0000
WAM T135256	Male	KT881497			0.0046
WAM T135257	Male	KT881496			

Tritonymph

Colour mostly as for adults, but generally paler.

Chelicera: with 5 setae on hand and 1 on movable finger; galea unbranched.

Pedipalp: trochanter 2.73, femur 3.43, patella 2.79, chela (with pedicel) 3.47, chela (without pedicel) 3.24, hand (without pedicel) 1.66 x longer than broad, and movable finger 0.94 x longer than hand (without pedicel). Fixed chelal finger with 7 trichobothria, movable chelal finger with 2 trichobothria (Figure 6): *eb*, *esb*, *ist* and *ib* situated basally; *est* situated medially; *et* distally; *it* subdistally; *b* subbasally; *t* subdistally.

Carapace: 0.90 x longer than broad; with 2 setae near anterior margin and 4 near posterior margin.

Legs: much as in adults except metatarsi and tarsi fused.

Abdomen: tergal chaetotaxy: 4: 4: 4: 4: 4: 4: 4: 4: 4: 2: 2. Sternal chaetotaxy: 0: (0) 2 (0): (0) 2 (0): 4: 4: 4: 6: 6: 4: 4: 2.

Dimensions (mm): WAM T123317: Body length 2.54. Pedipalps: trochanter 0.355/0.285, femur 0.79/0.23, patella 0.67/0.24, chela (with pedicel) 1.18/0.34, chela (without pedicel) 1.10, hand length (without pedicel) 0.565, movable finger length 0.53. Carapace 0.74/0.82.

Deutonymph

Colour mostly as for adults, but generally paler.

Chelicera: with 5 setae on hand and 1 on movable finger; galea unbranched.

Pedipalp: trochanter 1.44, femur 3.26, patella 2.44, chela (with pedicel) 3.57, chela (without pedicel) 3.35, hand (without pedicel) 1.63 x longer than broad, and movable finger 1.03 x longer than hand (without pedicel). Fixed chelal finger with 6 trichobothria, movable chelal finger with 2 trichobothria (Figure 7): *eb*, *ist* and *ib* situated basally; *est* situated medially; *et* distally; *it* subdistally; *sb* subbasally; *t* subdistally.

Carapace: 0.84 x longer than broad; with 2 setae near anterior margin and 4 near posterior margin.

Legs: metatarsi and tarsi fused.

Abdomen: tergal chaetotaxy: 4: 4: 4: 4: 4: 4: 4: 6: 6: 4: 2: 2. Sternal chaetotaxy: 0: (0) 2 (0): (0) 2 (0): 2: 2: 4: 4: 6: 4: 4: 2.

Dimensions (mm): WAM T126236: Body length 2.05. Pedipalps: trochanter 0.295/0.205, femur 0.62/0.19, patella 0.50/0.205, chela (with pedicel) 0.965/0.27, chela (without pedicel) 0.905, hand length (without pedicel) 0.44, movable finger length 0.455. Carapace 0.595/0.71.

Protonymph

Colour mostly as for adults, but generally paler.

Chelicera: with 4 setae on hand and 0 on movable finger; galea unbranched.

Pedipalp: trochanter 1.58, femur 3.14, patella 2.19, chela (with pedicel) 3.48, chela (without pedicel) 3.27, hand (without pedicel) 1.57 x longer than broad, and movable finger 1.09 x longer than hand (without pedicel). Fixed chelal finger with 3 trichobothria, movable chelal finger with 1 trichobothria (Figure 8): *eb* and *ist* situated basally; *et* situated distally.

Carapace: 0.90 x longer than broad.

Legs: metatarsi and tarsi fused.

Abdomen: tergal chaetotaxy: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2. Sternal chaetotaxy: 0: (0) 2 (0): (0) 2 (0): 2: 2: 2: 2: 2: 2: 2: 2.

Dimensions (mm): WAM T123313: Body length 1.51. Pedipalps: trochanter 0.245/0.155, femur 0.455/0.145, patella 0.355/0.16, chela (with pedicel) 0.765/0.22, chela (without pedicel) 0.72, hand length (without pedicel) 0.345, movable finger length 0.375. Carapace 0.51/0.565.

REMARKS

Synsphyronus gurdoni is a small species that has been found at many localities on the eastern side of Barrow Island. It has not yet been located on the adjacent Australian mainland, although numerous other new species of the genus are known from the Pilbara region of Western Australia (unpublished data). Also, despite rigorous sampling for terrestrial invertebrates on Barrow Island (Gunawardene et al. 2013), *S. gurdoni* is the only species of the genus to be found on the island thus far. The restricted island distribution of *S. gurdoni* seems to

indicate that this species should be regarded as a short-range endemic species (Harvey 2002; Harvey et al. 2011).

The two basal blades of the rallum are noticeably shorter than the anterior blade (Figure 11), which serves to distinguish this species from all others. In all other species of *Synsphyronus*, the basal blades are about half as long as anterior blade, (With 1908, figure 2; Chamberlin 1943, figure 10; Morris 1948, figure 5a; Harvey 1987, figure 8).

Four male specimens of *S. gurdoni* were sequenced for COI, revealing two haplotypes, with three variable sites. The divergence among specimens was up to 0.46% (Table 1), confirming the existence of only a single species on the island.

ETYMOLOGY

This species is named for Nobel Laureate Sir John Gurdon in recognition of his contributions to developmental biology.

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