

Redescriptions of *Geogarypus bucculentus* Beier and *Geogarypus pustulatus* Beier (Geogarypidae: Pseudoscorpionida)

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Summary

The South American pseudoscorpions *Geogarypus bucculentus* Beier from Juan Fernandez Islands and *G. pustulatus* Beier from Argentina and Chile are redescribed, and compared with *G. connatus* Harvey from Australia. These three species seem to form a monophyletic group that appear to have originated in Gondwanaland. The post-embryonic development of the trichobothria of *G. bucculentus* is discussed.

Introduction

During a recent revision of the Australian Geogarypidae (Harvey, 1986), a description was presented of the first monotarsate member of the family, *Geogarypus connatus* Harvey. This species appeared to be more similar to *G. bucculentus* Beier and *G. pustulatus* Beier from South America, than to any of the other Australian species. I have had the opportunity to examine the type, and other, material of these South American species, and because several important characters were overlooked or not sufficiently emphasised in their original descriptions, redescriptions are provided herein.

Materials and Methods

Specimens were loaned by the following institutions: American Museum of Natural History, New York (AMNH) and Naturhistorisches Museum, Wien (NHMW). Methods follow Harvey (1986, 1987).

Family GEOGARYPIDAE Chamberlin

Genus *Geogarypus* Chamberlin

Remarks

This genus was recently restricted by Harvey (1986) to those species that lack dorsal or lateral sulci on the chelal hand.

Geogarypus bucculentus Beier (Figs. 1-8, 15)

Geogarypus (*G.*) *bucculentus* Beier, 1955: 206-207, figs. 1-2.
Geogarypus bucculentus Beier: Beier, 1957: 454.

Types

Lectotype ♂ (present designation), 1 paralectotype ♀, [Plateau del Yunque], Masatierra, Juan Fernandez Islands, Chile, [200 m], 20 Feb. 1951, [G.] Kuschel (NHMW) (spirit).

Other material examined

CHILE: *Juan Fernandez Islands*: 1 tritonymph, 2

deutonymphs, apparently same data as types, see below (NHMW) (spirit).

Diagnosis

This species differs from *G. pustulatus* in lacking trichobothrium *isb*, and from *G. connatus* in having diplotarsate adults. It further differs from these two species by possessing large lateral flanges on the carapace.

Description

Adults: Colour dark brown. Pedipalps (Fig. 1): trochanter 1.34-1.36 (♂), 1.44 (♀), femur only slightly curved, with a distinct pedicel, 3.87-4.12 (♂), 4.12 (♀), tibia 2.87 (♂), 2.91 (♀), chela with rounded hand, fingers only slightly curved, chela (with pedicel) 3.21-3.28 (♂), 3.53 (♀), chela (without pedicel) 3.06-3.14 (♂), 2.93 (♀) times longer than broad; dorsal portion of femur and lateral margins of femur and tibia with large wart-like swellings, each with a curved seta. Fixed finger with seven trichobothria, moveable finger with four trichobothria (Fig. 4); *isb* absent; fixed finger with four pit-like structures with raised rims (see Harvey, 1986) between and below *eb*, *esb* and *est*; nodus ramosus at level of *est* in fixed finger and at level of *st* in moveable finger. Serrula exterior of chelicera with 18 (♂) lamellae; galea of male simple, of female with 6-7 distal to sub-distal evenly curved rami (Fig. 3). Carapace (Fig. 2) with 13 (♂), 15 (♀) setae on posterior margin; with deep notch on anterior margin and with large lateral flanges; 0.81 (♂), 0.84 (♀) times longer than broad; anterior eye slightly smaller than posterior eye. Lateral margins of tergites swollen and raised, with several setae. Tergal chaetotaxy: ♂, 16:19:18:23:25:30:32:36:33:28:16:2; ♀, 18:20:19:26:30:28:30:30:30:27:14:2. Sternal chaetotaxy: ♂, 0:24:(0)17[9](0):(1)14(1):21:22:20:19:17:11:2:2; ♀, 0:?:(0)?(0):(1)13(?):17:24:22:20:17:12:2:2. Coxal chaetotaxy: ♂, 11:15:23:40; ♀, 11:18:26:?. Tarsi of most legs diplotarsate (Figs. 7-8), but some legs possess fused or partially fused tarsi.

Dimensions (mm) ♂ (♀): Body length 2.3 (2.5); pedipalps: trochanter 0.37-0.375/0.275 (0.395/0.275), femur 0.87-0.885/0.215-0.225 (0.885/0.215), tibia 0.675/0.235 (0.655/0.225), chela (with pedicel) 1.295-1.30/0.395-0.405 (1.36/0.385), chela (without pedicel) 1.24 (1.295), moveable finger length 0.605-0.61 (0.645); carapace 0.88/1.085 (0.90/1.07), cucullus length 0.235 (0.24), ocular breadth 0.53 (0.535), anterior eye 0.075-0.085 (0.07-0.08), posterior eye 0.08-0.085 (0.075-0.085); chelicera ? (?); leg I: trochanter 0.20/0.15 (?), basifemur 0.34/0.15 (?), telofemur 0.255/0.145 (?), tibia 0.30/0.11 (?), basitarsus 0.205/0.085 (?), telotarsus 0.18/0.07 (?); leg IV: trochanter 0.305/0.19 (?), basifemur 0.245/0.16 (?), telofemur ? (?), tibia 0.465/0.12 (?), basitarsus 0.265/0.095 (?), telotarsus 0.19/0.075 (?).

Tritonymph: Colour slightly paler than adults. Pedipalps: trochanter 1.35-1.39, femur 3.56, tibia 2.61-2.78, chela (with pedicel) 3.38, chela (without pedicel) 3.23 times longer than broad. Fixed finger with seven trichobothria, moveable finger with three trichobothria

(Fig. 5); *isb* and *sb* absent. Serrula exterior of chelicera with 13 lamellae; galea with 6-7 distal to subdistal rami, as in female. Carapace with 12 setae on posterior margin. Tergal chaetotaxy: 12:17:17:20:23:25:24:23:23:20:12:2. Sternal chaetotaxy: 0:3:(1)9(1):(2)8(2):12:15:16:12:13:9:2:2. Coxal chaetotaxy: 7:7:15:21. Monotarsate.

Dimensions (mm): Body length 2.4; pedipalps: trochanter 0.34-0.345/0.245-0.255, femur 0.73/0.195-0.205, tibia 0.535-0.555/0.20-0.205, chela (with pedicel) 1.20/0.35-0.355, chela (without pedicel) 1.145, moveable finger length 0.615; carapace 0.825/0.96.

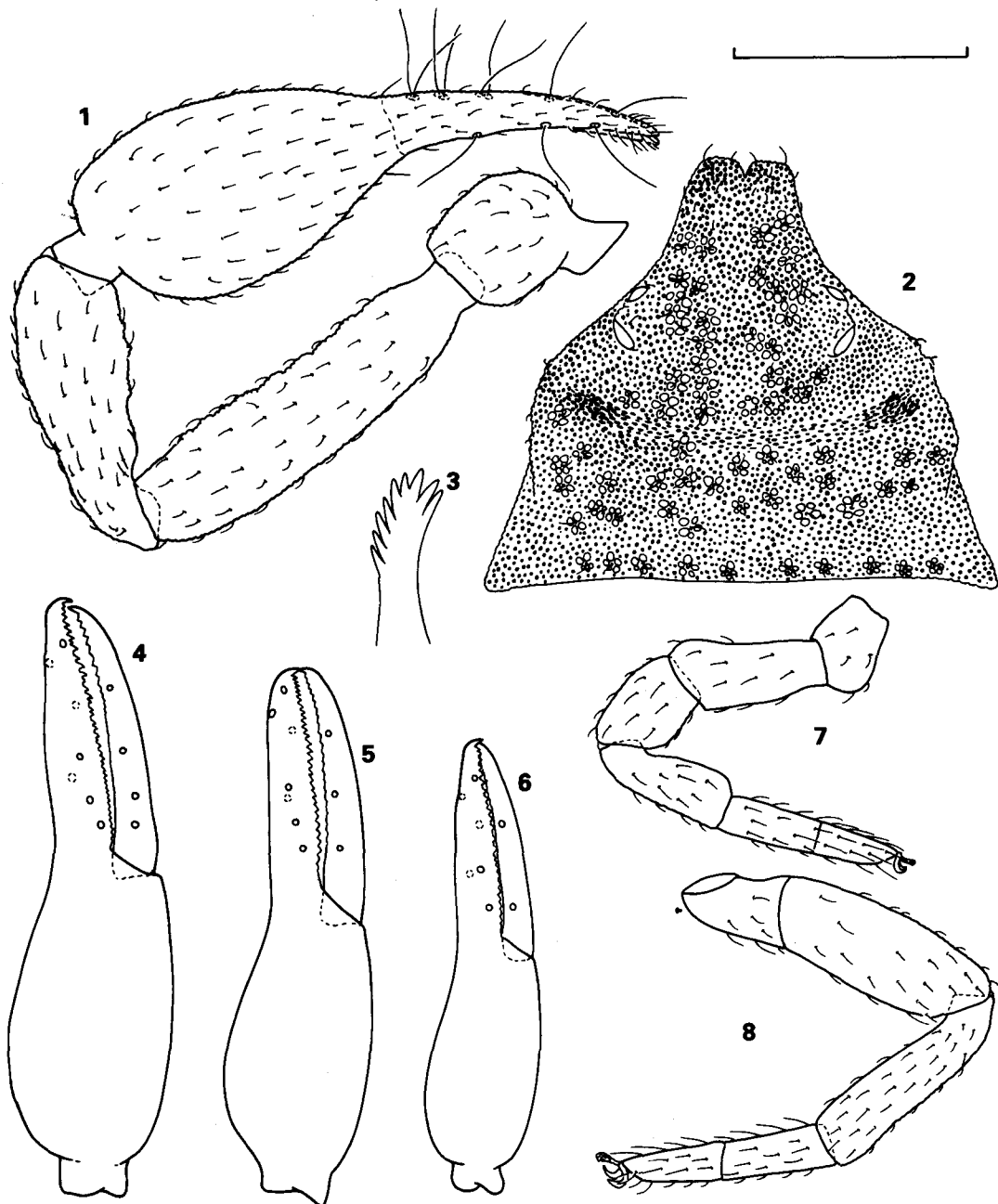
Deutonymphs: Colour much paler than adults. Pedipalps: trochanter 1.41-1.53, femur 3.55-3.61, tibia 2.56-2.63, chela (with pedicel) 3.73-3.85, chela (without pedicel) 3.60-3.71 times longer than broad.

Fixed finger with six trichobothria, moveable finger with two trichobothria (Fig. 6); *esb*, *isb*, *sb* and *st* absent. Serrula exterior of chelicera with 12-13 lamellae; galea as in female. Carapace with 8 setae on posterior margin. Tergal chaetotaxy: 8-9-11-12-11:14-15:13-14:13-15:14-15:13-16:12-9-12:10:2. Sternal chaetotaxy: 0:0:(0)6(?):(1)6(?):6:8:10:8:8:4-6:2-4:2. Coxal chaetotaxy: 2-3:3-4:6-7:7-8. Monotarsate.

Dimensions (mm): Body length 1.7-1.9; pedipalps: trochanter 0.26-0.275/0.17-0.185, femur 0.55-0.635/0.155-0.165, tibia 0.41-0.42/0.16, chela (with pedicel) 0.97-0.98/0.255-0.26 (0.935-0.945), moveable finger length 0.465-0.48; carapace 0.645-0.695/0.70-0.74.

Remarks

Beier (1955) did not nominate a holotype from the



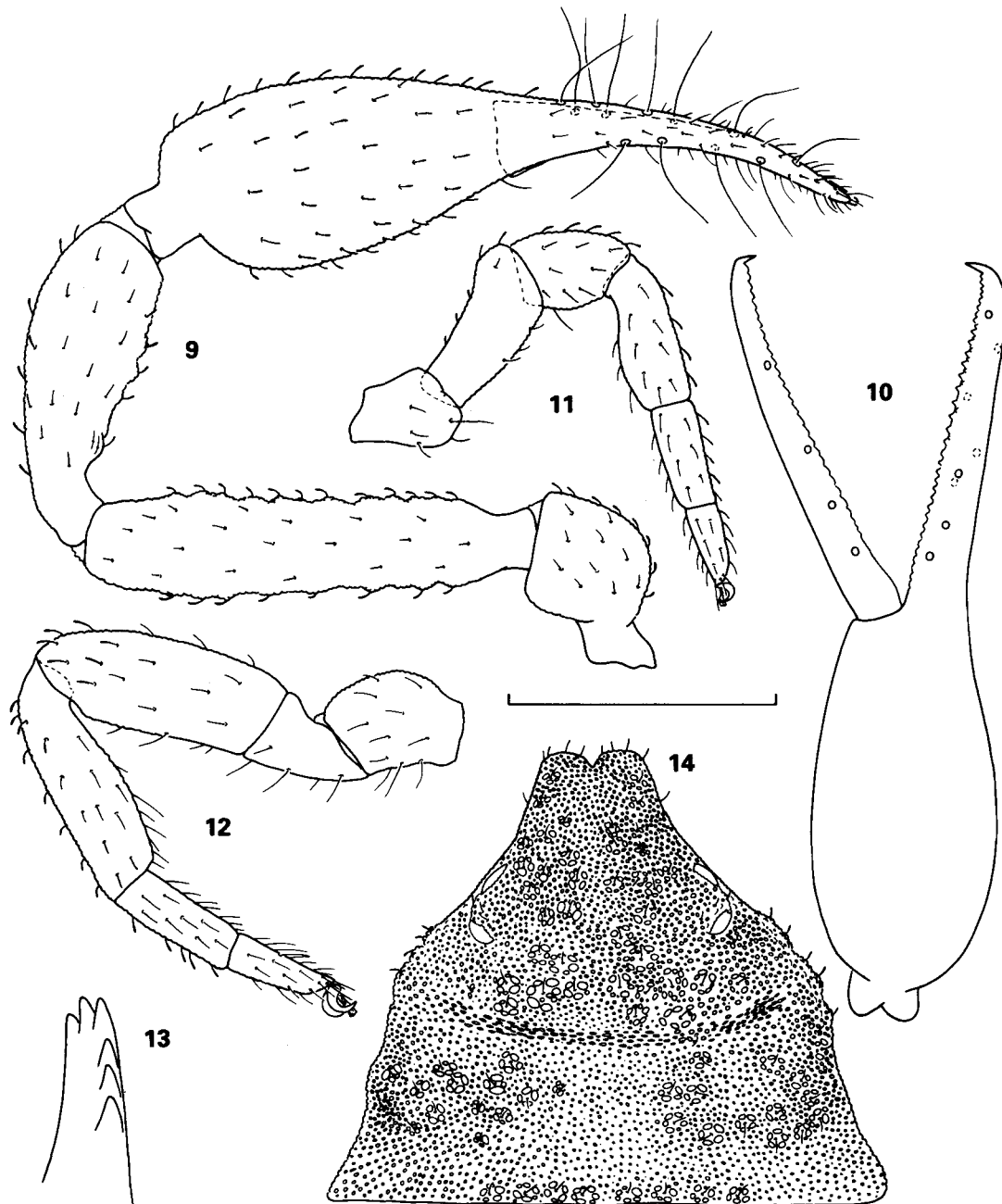
Figs. 1-8: *Geogarypus bucculentus* Beier. 1-2, 4, 7 Male lectotype; 3, 8 Female paralectotype; 5 Tritonymph paralectotype; 6 Deutonymph paralectotype. 1 Left pedipalp, dorsal view; 2 Carapace; 3 Galea; 4-6 Right chela, lateral view; 7 Left leg I, lateral view; 8 Left leg IV, lateral view. Scale line = 0.5 mm (except Fig. 3).

original series, and simply referred to the adults as "Typen"; the male specimen has been selected as the lectotype, and labelled accordingly. Beier also mentioned two nymphs from Plateau del Yunque and Cumberland Bay, but the only other specimens of this species in the NHMW collections are three nymphs preserved in the same vial as the types. Therefore, it is questionable that they all come from the type locality and their provenance must remain uncertain. The label with the type material does not mention "Pl. del Yunque" or the altitude, both of which are taken from Beier's paper. These details have been included in brackets in the "Types" section above. Beier (1957) recorded a male from Cumberland Bay, which I have been unable to examine.

Beier (1955) recorded eight trichobothria on the

fixed chelal finger of this species, but close examination of the types reveals that only seven are present (Fig. 4), allying it to *G. connatus*. These two species are the only geogarypids with a reduced adult trichobothrial complement.

Whereas only adults and deutonymphs of *G. connatus* were described by Harvey (1986), adults, tritonymphs and deutonymphs of *G. bucculentus* have been examined in this study. The following developmental sequence of trichobothria for the latter species can be constructed (even though protonymphs have not been examined, I have no reason to think that they will be any different from any other geogarypids, especially considering that the trichobothriotaxies of the deutonymph and tritonymph are identical to other geogarypids) (abbreviations: N1 = protonymph, N2 =



Figs. 9-14: *Geogarypus pustulatus* Beier. **9, 11-12, 14** Male holotype; **10, 13** Female from El Bolson. **9** Left pedipalp, dorsal view; **10** Left chela, lateral view; **11** Right leg I, lateral view; **12** Right leg IV, lateral view; **13** Galea; **14** Carapace. Scale line = 0.5 mm (except Fig. 13).

deutonymph, N3 = tritonymph, A = adult):

$eb_{N1} esb_{N2} est_{N2} et_{N1} / lib_{N2} isb_{-} ist_{N1} it_{N2} / b_{N2} sb_A st_{N3} t_{N1}$

Comparing this with the pattern given for several geogarypids by Mahnert (1979, 1982) and Harvey (1986), it can be seen that *G. bucculentus* differs from the geogarypids with a full trichobothrial complement only by not acquiring *isb* at the maturation moult. This is quite different from the genus *Synsphyronus*, adults of which possess reduced trichobothrial numbers, in which the last two nymphal stages often possess a modified trichobothriotaxy (Harvey, 1987).

Geogarypus pustulatus Beier (Figs. 9-15)

Geogarypus (*G.*) *pustulatus* Beier, 1959: 200-201, fig. 13.

Geogarypus pustulatus Beier: Beier, 1962: 133; Beier, 1964: 491.

Type

Holotype ♂, Lago Moreno, Bariloche, Rio Negro, Argentina, 24 Nov. 1950, P. Wygodzinsky (NHMW) (spirit).

Other material examined

ARGENTINA: *Rio Negro*: 1 ♀, El Bolson, 350 m, 21 July 1961, G. Topal (NHMW) (spirit). 1 ♀, same data as above except 4 Aug. 1961 (NHMW) (spirit). CHILE: *Malleco*: 2 ♂, 2 km E of Lago Malleco, Parque Nacional Tolhuaca, 925 m, *Nothofagus* forest leaf and log litter, 1 Jan. 1983, A. Newton and M. Thayer (AMNH) (slide and spirit).

Diagnosis

This species differs from *G. connatus* in having diplotarsate adults, and from both *G. connatus* and *G. bucculentus* in retaining trichobothrium *isb*.

Description

Adults: Colour dark brown, with a darker median, longitudinal stripe on carapace. Pedipalps (Fig. 9): trochanter 1.30-1.75 (♂), 1.29-1.64 (♀), femur only slightly curved, 4.35-4.63 (♂), 4.32-4.49 (♀), tibia 2.68-2.80 (♂), 2.85-2.90 (♀), chela slender, chela (with pedicel) 3.81-3.86 (♂), 3.69-4.05 (♀), chela (without pedicel) 3.63-3.73 (♂), 3.56-3.89 (♀) times longer than broad. Femur and tibia with large wart-like swellings, each with a curved, slightly clavate seta. Fixed finger with eight trichobothria, moveable finger with four trichobothria (Fig. 10); fixed finger with four pit-like structures with raised rims (see Harvey, 1986) below *esb*. Serrula exterior of chelicera with 14-15 (♂), 16 (♀) lamellae; galea of male simple, of female with 10 distal rami (Fig. 13). Carapace (Fig. 14) with 14-17 (♂), 17 (♀) setae on posterior margin; without prominent lateral flanges; 0.85-0.90 (♂), 0.77-0.81 (♀) times longer than broad; anterior eye approximately same size as posterior eye. Lateral margins of tergites slightly swollen, with several setae. Tergal chaetotaxy: ♂, 16-18:17-23:20-24:22-30:24-30:25-31:29-33:31-37:28-32:23-32:15-18:2; ♀, 16-18:21-23:20-21:28:28-29:26-30:28-33:29-40:32-34:26-27:17:2. Sternal chaetotaxy:

♂, 0:20-23:(0-1)19-21[12-16](1):(2)11-15(1):19:19-21:17-19:14-18:15:12:2:2; ♀, 0:18-19:(0-1)11-12(1):(1-2)12-13(2):16-22:18-19:17-18:15-17:13:11:2:2. Coxal chaetotaxy: ♂, 8-10:12-13:21-22:47; ♀, 9-10:11-12:21-27:44-45. Diplotarsate (Figs. 11-12).

Dimensions (mm) ♂ (♀): Body length 2.4-2.5 (2.9-3.1); pedipalps: trochanter 0.37-0.41/0.24-0.29 (0.40-0.435/0.265-0.31), femur 0.915-0.97/0.205-0.215 (1.01-1.055/0.225-0.235), tibia 0.63-0.67/0.23-0.24 (0.685-0.73/0.24), chela (with pedicel) 1.37-1.45/0.36-0.38 (1.55-1.62/0.395-0.42), chela (without pedicel) 1.305-1.40 (1.495-1.56), moveable finger length 0.64-0.695 (0.765-0.775); carapace 0.935/1.04-1.10 (0.94-0.95/1.16-1.235), cucullus length 0.22-0.225 (0.245-0.25), ocular breadth 0.515-0.53 (0.565-0.575), anterior eye 0.06-0.075 (0.06-0.075), posterior eye 0.06-0.085 (0.07-0.075); chelicera 0.215-0.22/0.11-0.12 (?), moveable finger length 0.145-0.16 (?); leg I: coxa width 0.355 (?), trochanter 0.195-0.235/0.155-0.17 (0.22/0.17), basifemur 0.32-0.34/0.165-0.17 (0.36/0.155), telofemur 0.24-0.245/0.165 (0.255/0.155), tibia 0.30-0.32/0.125-0.13 (0.25/?), basitarsus 0.215-0.24/0.09 (0.225/?), telotarsus 0.155-0.175/0.07 (0.16/0.065); leg IV: coxa width 0.395-0.41 (?), trochanter 0.255-0.32/0.195-0.20 (?), basifemur 0.23-0.275/0.16-0.175 (?), telofemur 0.48-0.515/0.205-0.215 (?), tibia 0.475-0.505/0.135-0.145 (?), basitarsus 0.24-0.265/0.095-0.10 (?), telotarsus 0.19-0.20/0.075-0.08 (?).

Remarks

This species has also been recorded from Nahuel-Huapi, Neuquén Province, and El Turbio, Chubut Province, Argentina (Beier, 1962, 1964). The latter locality could not be located and is not included on the map.



Fig. 15: Map of southern South America showing known distributions of *Geogarypus bucculentus* Beier (circle) and *Geogarypus pustulatus* Beier (squares).

Discussion

Geogarypus connatus, *G. bucculentus* and *G. pustulatus* appear to form a monophyletic group, defined by the monotarsate nymphs (at least in *G. connatus* and *G. bucculentus*) or adults (*G. connatus*) and the large setose pustules on the carapace and pedipalps. This group can be further subdivided with *G. pustulatus* being the plesiomorphic sister group of the remaining two species (based on the synapomorphic loss of *isb* in adults of *G. connatus* and *G. bucculentus*). These three species are allopatric, with *G. connatus* being found in eastern Australia (Harvey, 1986: fig. 5), *G. pustulatus* in Chile and Argentina and *G. bucculentus* on Juan Fernandez Islands (Fig. 15). This certainly implies a Gondwanaland origin for this group.

The volcanic islands of Juan Fernandez are only recent in origin, and Masatierra is approximately four million years old (Steussey *et al.*, 1984). Given the close proximity of Juan Fernandez Islands to South America and that the fauna and flora of the islands appear to be largely derived from the mainland (Kuschel, 1963), the sister group relationship of *G. bucculentus* and *G. connatus* is of some interest. It is unlikely that there has been recent dispersal of pseudoscorpions between Australia and Juan Fernandez Islands, and presumably *G. bucculentus* or its ancestor dispersed, either by rafting or phoresy, to Juan Fernandez Islands from mainland South America during the last four million years. *Geogarypus bucculentus* and the nine other pseudoscorpion species described from Juan Fernandez Islands (Beier, 1955, 1957) have not been recorded from South America, despite extensive collecting, and it appears that the islands provide the last refuge for these relict taxa.

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References

- BEIER, M. 1955: Pseudoscorpione von den Juan-Fernandez-Inseln (Arachnida Pseudoscorpionida). *Revta chil. Ent.* **4**: 205-220.
- BEIER, M. 1957: Die Pseudoscorpioniden-Fauna der Juan-Fernandez-Inseln (Arachnida Pseudoscorpionida). *Revta chil. Ent.* **5**: 451-464.
- BEIER, M. 1959: Zur Kenntnis der Pseudoscorpioniden-Fauna des Andengebietes. *Beitr. neotrop. Fauna* **1**: 185-228.
- BEIER, M. 1962: Pseudoscorpionidea. In *Biologie de l'Amerique australe* **1**: 131-137.
- BEIER, M. 1964: The zoological results of Gy. Topal's collectings in South Argentina. 15. Pseudoscorpionida. *Annls hist.-nat. Mus. natn. hung.* **56**: 487-500.
- HARVEY, M. S., 1986: The Australian Geogarypidae, new status, with a review of the generic classification (Arachnida: Pseudoscorpionida). *Aust. J. Zool.* **34**: 753-778.
- HARVEY, M. S. 1987: A revision of the genus *Synsphyronus* Chamberlin (Garypidae: Pseudoscorpionida: Arachnida). *Aust. J. Zool.*, (Suppl. Ser.) no. 126.
- KUSCHEL, G. 1963: Composition and relationship of the terrestrial faunas of Easter, Juan Fernandez, Desventuradas, and Galapagos islands. *Occ. Pap. Calif. Acad. Sci.* **44**: 79-95.
- MAHNERT, V. 1979: Pseudoscorpione (Arachnida) aus dem Amazonas-Gebiet (Brasilien). *Revue suisse Zool.* **86**: 719-810.
- MAHNERT, V. 1982: Die Pseudoscorpione (Arachnida) Kenyas, IV. Garypidae. *Annls hist.-nat. Mus. natn. hung.* **74**: 307-329.
- STEUSSEY, T. F., SANDERS, R. W. & SIVA, M. 1984: Phytogeography and evolution of the flora of the Juan Fernandez Islands: a progress report. In F. J. Rodovsky, P. H. Raven & S. H. Sohmer, *Biogeography of the Tropical Pacific. Proceedings of a symposium*. Spec. Publ. Bishop Museum No. 72: 55-69.