

## Psammophilous halacarids (Halacaridae, Acari) from Dampier, Western Australia. Description of species and faunal comparison of the mesopsammal halacarid fauna of western and eastern Australia

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**Abstract** – Twelve species of halacarid mites were extracted from tidal and subtidal sandy deposits and coral fragments in the tropical Dampier area, Western Australia. The genera and number of species (in parentheses) are: *Actacarus* (2), *Anomalohalacarus* (1), *Arhodeoporus* (1), *Copidognathus* (1), *Scapthognathides* (2), *Scapthognathus* (1), and *Simognathus* (4). All species are diagnosed and four species, new to science, are described, viz. *Actacarus festivus* sp. nov., *Anomalohalacarus dampierensis* sp. nov., *Simognathus salebrosus* sp. nov., and *Simognathus tener* sp. nov. Seven of the twelve species are known from the Indo-Pacific region, from warm-temperate Western Australia, tropical eastern coast of Australia, Hawaiian Islands, and/or off Chile.

**Key words:** Australia, marine mites, psammobionts, new species, faunal comparison

### INTRODUCTION

Sandy deposits with medium and coarse grain fractions provide a system with a large surface, different-sized void volumes and regular interstitial water replenishment but shelter from extreme amplitudes of environmental parameters. These deposits contain a specialized fauna, the interstitial fauna or mesopsammon, terms introduced by Nicholls (1935) and Remane (1940).

The first records of mesopsammic halacarid species from Australia were from Rottneest Island, Western Australia, an island with a variety of sandy deposits. About 30 psammophilous halacarid mites from intertidal and subtidal sandy deposits have been described (Bartsch 1993). Otto (1999a, b, 2000a–e, g, 2001a–c), Otto and Bartsch (1999) and (Bartsch 2000) added more than 50 new records to the list of Australian species extracted from sandy deposits on the northeastern coast of Australia, many of them being psammophilous. Examination of both tidal and subtidal sediments collected near Dampier, tropical Western Australia, resulted in both new records and new halacarid species.

### STUDY AREA, MATERIAL AND METHODS

Dampier, on the Burrup Peninsula, lies in the tropical north of Western Australia, at about 20°S, 117°E. The shoreline is characterized by rocky platforms, rocks and mangroves. Areas with sandy

deposits with medium and coarse sand are rare. Subtidal deposits immediately off Dampier are rich in organic material and typical arenicolous halacarids are generally lacking, but around the outer islands of the Dampier Archipelago there are coarse sediments with a psammophilous meiofauna.

The mites were extracted from the sand by frequently stirring with water and decanting through a sieve with 100 µm mesh diameter. The mites were cleared in lactic acid and mounted in glycerin jelly. Type and voucher specimens are deposited in the Western Australian Museum, Perth (WAM).

Abbreviations used in the descriptions: AD = anterior dorsal plate; AE = anterior epimeral plate; ds-1 to ds-6 = first to sixth dorsal idiosomatic seta(e); GA = genitoanal plate; GO = genital opening; OC = ocular plate(s); P = palp, P-1 to P-4 = first to fourth palpal segment; pas = parambulacral seta(e); PD = posterior dorsal plate; PE = posterior epimeral plate(s); pgs = perigenital setae; sgs = subgenital setae. The legs are numbered I to IV, leg segments 1 to 6 are trochanter, basifemur, telofemur, genu, tibia, and tarsus.

Except one species recently described and figured on the base of specimens from Dampier (Bartsch 2003b), the species are diagnosed and illustrated, in general relying on individuals from the Dampier area. In the bibliography of a given species only the most relevant descriptive papers are cited.

## SYSTEMATICS

## Subfamily Actacarinae Viets, 1939

Genus *Actacarus* Schulz, 1937*Actacarus festivus* sp. nov.

Figure 1A–H

## Material Examined

*Holotype*

Female, sponge garden, West of Rocky Head, 20°32.1'S, 116°26.7'E, Enderby Island, Dampier Archipelago, Western Australia, Australia; 2–13 m, unsorted sandy deposits, 3 August 2000, coll. C. Bryce (WAM T52095).

## Etymology

Specific name from *festivus*, Latin, nice, festive.

## Diagnosis

Idiosomal length 205  $\mu\text{m}$ . Dorsal and ventral plates uniformly porose. Opposing margins of AD and PD and AE and GA truncate. Length of PD less than twice that of AD. Setae ds-2 within striated integument. PE with three setae; one pair of setae within striated integument. Anterolateral margins of GA converging. Ovipositor extending beyond GA. Gnathosoma 0.28 of length of idiosoma. Rostrum extending slightly beyond middle of P-2. Tectum arched. Tibia I with three slender ventral setae, tibiae II to IV each with one faintly bipectinate seta. Claws on tarsi II to IV with long, coarse tines.

## Description

*Female*

*Idiosoma*. Length 205  $\mu\text{m}$ , width 115  $\mu\text{m}$ . Dorsal plates uniformly and minutely porose; with few striae of membraneous integument between opposing margins of AD and PD. AD wider than long (Figure 1A), length 67  $\mu\text{m}$ , width 88  $\mu\text{m}$ ; anterior margin arched, posterior margin almost truncate. Gland pores in lateral margin. OC triangular, length 15  $\mu\text{m}$ , width 7  $\mu\text{m}$ ; with gland pore and pore canaliculus. Length of PD 127  $\mu\text{m}$ , width 90  $\mu\text{m}$ ; its length 1.9 times that of AD. PD with two pairs of gland pores, anterior pair somewhat posterior to level with insertion of leg IV. Dorsal setae small, pair of ds-1 slightly posterior to the level of gland pores. Pair of ds-2 in striated integument; ds-3 to ds-5 on PD, arranged as illustrated. Pair of ds-5 level with gland pores. Pair of ds-6 on anal plate.

Length of AE 91  $\mu\text{m}$ , width 103  $\mu\text{m}$ ; with three pairs of setae; posterior margin of AE truncate (Figure 1B). PE extending beyond insertion of leg IV. One pair of setae within striated integument

between PE. Length of GA 87  $\mu\text{m}$ , width 72  $\mu\text{m}$ ; anterior margin truncate, lateral margin diverging from anterior margin to level with posterior edge of PE. GA with three pairs of pgs. Ovipositor long, extending beyond anterior margin of GA and posterior margin of AE.

*Gnathosoma*. Length 59  $\mu\text{m}$ , width 46  $\mu\text{m}$ , 1.2 times longer than wide. Gnathosoma 0.28 of length of idiosoma. Tectum broadly arched (Figure 1D). Rostrum short, far from reaching end of P-2. P-2 with a dorsal seta. P-3 with spiniform medial process. P-4 with three setae in basal whorl, one spur, one ventral and lateral seta, and a spur-like tip (Figure 1C).

*Legs*. Leg IV longer than leg I. Lateral flanks of legs I and II delicately punctate. Tibia I with slender base, then widened; its length surpassing that of telofemur I. Tibiae and relevant telofemora of following legs similar in length. Telofemur I 1.8 times longer than high. Leg chaetotaxy (solenidia included, pas excluded): leg I, 0, 2, 3, 5, 7, 7 (Figure 1E); leg II, 0, 2, 3, 4, 5, 4 (Figure 1F); legs III and IV, 1, 2, 2, 3, 5, 3 (Figures 1G and H). Genu II with dorsal alveolus but no seta seen. Tibia I with three slender ventral setae, a ventrolateral seta and three dorsal setae. On tibia II ventromedial seta slightly wider than ventral seta. Ventromedial seta on tibia III long and wide, apical seta of tibia III only slightly widened. Ventromedial seta of tibia IV delicately widened, apical seta slender. Tarsi I to IV each with pair of pas.

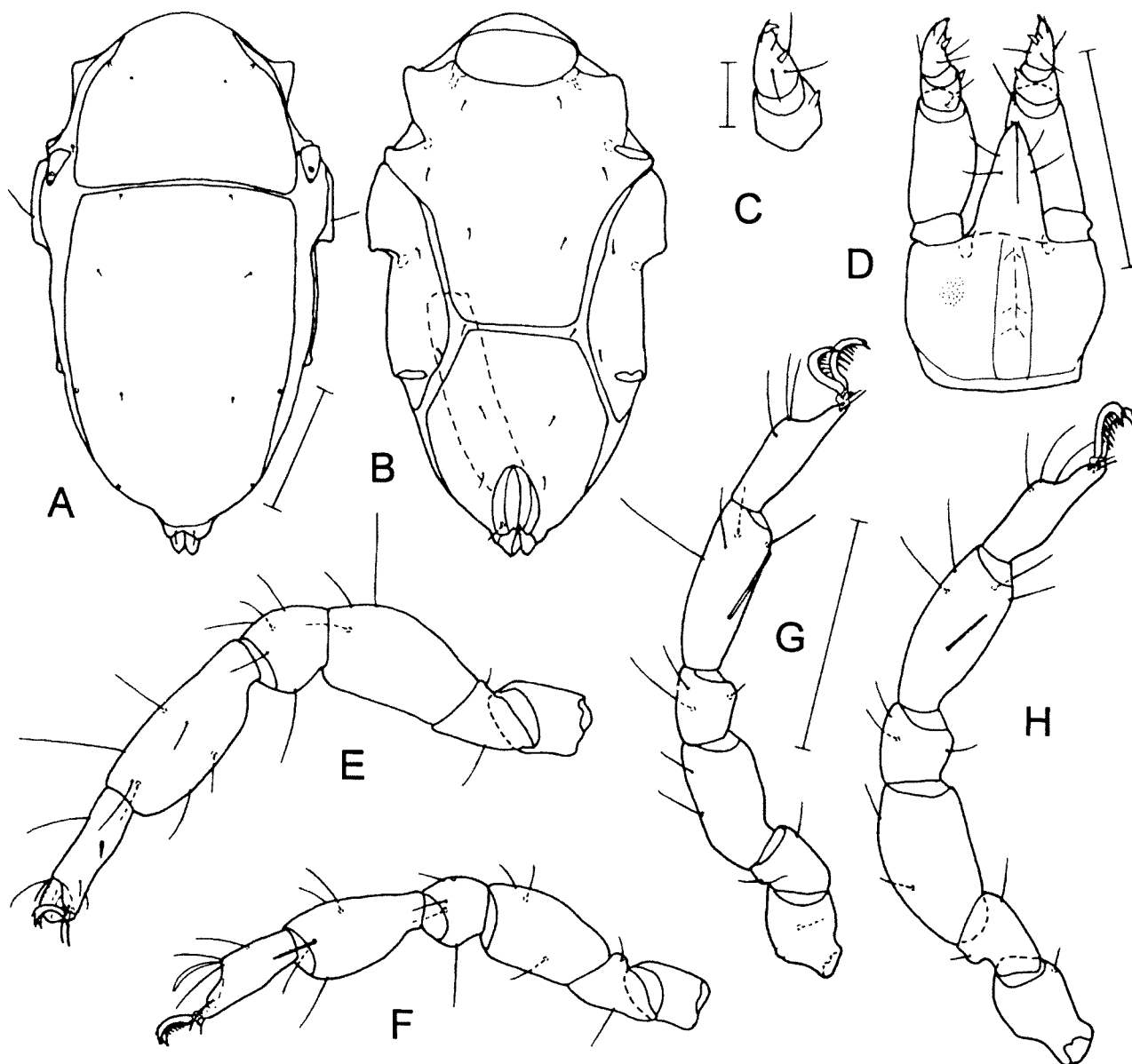
Length of claws increasing from tarsus I to III. Claws on tarsus I with accessory process but no pecten. Pectines of claws II to IV with very coarse tines. Central sclerite with small bidentate process.

## Remarks

*Actacarus festivus* has a short PD relative to the length of the AD, there is one pair of setae within the membraneous ventral integument, and the margins of the female GA are convergent instead of almost parallel-sided. The characters are shared with *A. giganteus* Krantz, 1971, a species recorded from the Caribbean (Krantz, 1971). The Caribbean species is somewhat larger, its idiosoma and the dorsal and ventral plates are more slender than in *A. festivus*, the dorsal plates are coarsely punctate in *A. giganteus* but minutely porose in *A. festivus*.

The arrangement of the dorsal plates resembles that of *A. latus* Newell, 1984. Beside the number of setae on the AE (three in *A. festivus*, four in *A. latus*) there are differences in the size (length of female 205  $\mu\text{m}$  in *A. festivus*, 334–355 in *A. latus*), the ornamentation of the dorsal plates (minutely and uniformly porose in *A. festivus*, pitted in *A. latus*), shape of the female GA and the arrangement of the pgs. *Actacarus latus* is recorded from the Eastern Pacific, from off the coast of Chile (Newell, 1984).

The shape of the female GA of *A. australis* Bartsch,



**Figure 1** A–H. *Actacarus festivus* sp. nov., female. A, Idiosoma, dorsal; B, idiosoma, ventral; C, P-3 and P-4, ventral; D, gnathosoma, ventral; E, leg I, medial; F, leg II, medial; G, leg III, medial; H, leg IV, medial. Scale = 50  $\mu$ m (A,B,D–H); scale = 10  $\mu$ m (C).

1993 is similar to that of *A. festivus*. In contrast to *A. festivus* the PE of *A. australis* bears three ventral setae and the ovipositor is much shorter.

**Distribution**

Indian Ocean, Western Australia, Dampier. From shallow water deposits.

*Actacarus pacificus* Bartsch, 1979  
Figure 2A–D

*Actacarus pacificus* Bartsch, 1979: 231–234, figures 1–14; Bartsch, 1993: 75, 76, figure 1; Abé, 1997: 33–34, figure 2A–C.

*Actacarus orthotectus* Newell, 1984: 245–247, figures 705–707.

*Actacarus marindicus* Otto, 2000c: 116–119, figures 3a–e, 4a–e (new synonymy).

**Material Examined**

**Australia: Western Australia:** 1 female, Dampier, 20°39'S, 116°42'E, sandy beach, coarse, unsorted sand in middle part of tidal slope, 0–3 cm sediment depth, 3 August 2000, coll. I. Bartsch (WAM T52096).

**Diagnosis**

Idiosomal length 263  $\mu$ m. Dorsal and ventral plates with delicate punctation. Opposing margins of AD and PD and AE and GA truncate (Figure 2A). PD more than twice the length of AD. OC with triangular anterior portion extending beyond gland pore. Pair of ds-2 within membraneous integument.

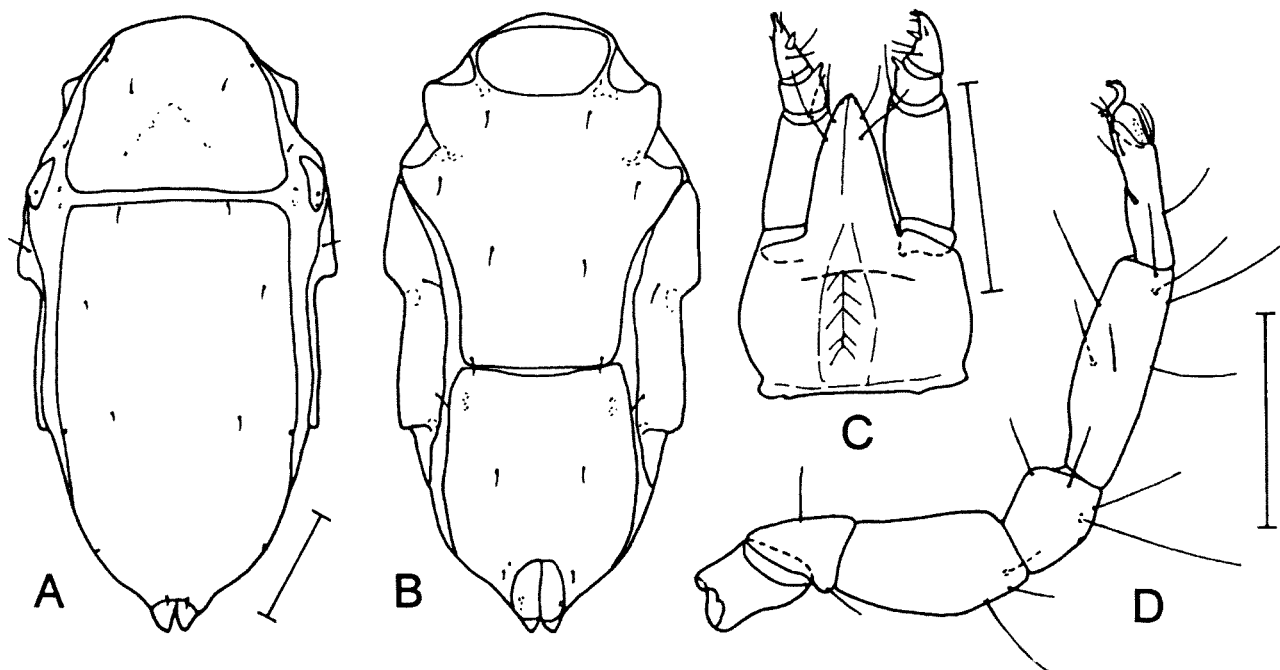


Figure 2 A–D. *Actacarus pacificus* Bartsch, 1979, female. A, Idiosoma, dorsal; B, idiosoma, ventral; C, gnathosoma, ventral; D, leg I, medial. Scale = 50  $\mu$ m.

AE with four pairs of setae. PE with one dorsal and two ventral setae (Figure 2B). Ovipositor in rest extending beyond anterior margin of GA. Gnathosoma 0.27 of idiosomal length. Rostrum about as long as gnathosomal base. Tectum very slightly arched. Rostrum extending almost to end of P-2 (Figure 2C). Both pairs of maxillary setae in distal half of rostrum. Legs less than 0.7 of idiosomal length. Genua shorter than telofemora and tibiae. Leg chaetotaxy: leg I, 0, 2, 3, 5?, 7, 7; leg II, 0, 2, 3, 4, 5, 4; legs III and IV, 1, 2, 2, 3, 5, 3. Tibia I with three slender ventral setae (Figure 2D); tibiae II to IV with two ventral setae, on tibia III these setae faintly bipectinate. Paired claws on tarsus I with accessory process but no pecten, claws II to IV with few large tines.

#### Remarks

According to Bartsch (1993) and Abé (1997), *Actacarus pacificus* is found widely spread in the Indo-Pacific region. In contrast, Otto (2000c) expected specimens from Rottneest Island, Western Australia, collected and identified by Bartsch (1993), not to be identical with *A. pacificus*. Otto described the Australian specimens under the name of *Actacarus marindicus* Otto, 2000. The differences between the individuals from the Hawaiian Islands and Australia were said to be (1) a coarser punctation of the PD in the Hawaiian material and (2) presence of a single bipectinate seta on tibia III of the type specimens, instead of two such setae as present in the Australian individuals. In respect to the first mentioned character, the differences stated by Otto (2000c) cannot be confirmed by the present

author. The dorsal plates of the holo- and paratype female and male of *A. pacificus* are delicately punctate, as the ventral plates are. Unfortunately, Otto (2000c) did not mention if the illustration (Otto, 2000c: figure 8b) was prepared on the base of the holo- or a paratype, a female or male. In the illustration the position of the setae assumedly representing the ds-4 is unusual (and not corresponding to the situation in either the holotype or the paratypes), and the ds-3 are not illustrated. The second character used by Otto (2000c) to distinguish between *A. pacificus* and *A. marindicus* was the shape of a seta on tibia III. The basal one of the two ventral setae on tibia III is longer than the distal one and delicately bipectinate. The distal seta has fuzzy margins and such a tip (Otto, 2000c: 118) due to a very subtle bipectination. These fuzzy margins are not recognizable when viewing the edge of that seta. Presence or absence of fuzzy margins is inadequate for discriminating between species as their perceptibility is influenced by the preservation, storing, clearing and mounting medium.

Bartsch (1993: 76) mentioned the shape of the basal seta on tibia I as a possible diagnostic character to distinguish between the Hawaiian and Western Australian specimens. A re-examination of the holo- and paratypes showed that the relevant seta is somewhat more stout than the other ventral setae but not distinctly pectinate.

Otto (2000c) also discussed the state of *A. orthotectus* Newell, 1984. That species was described from the Juan Fernandez Islands, Chile (Newell, 1984). Bartsch (1993) and Abé (1997) believed it to

be synonymous with *A. pacificus*. Otto (2000c) re-established the Chilean species (*A. orthotectus*) because of its slender P-2 and presented an illustration of the palps of both a Chilean and Western Australian specimen (Otto, 2000c: figure 3e and f). The palps are said to show a lateral aspect. In general, the P-2 of *Actacarus* species are slightly flattened but narrow in dorsal aspect. It is likely that one of the illustrations (Otto, 2000c: figure 3f) represents a dorsolateral aspect of the palps, a notion corroborated by the insertion of the dorsal seta in that figure. In lateral aspect the shape of the palps may be the same in specimens from both the southeastern and northern Pacific.

Nonetheless, several cryptic species may exist in the Indo-Pacific region, each restricted to a small-scale geographical area, and the specimens from Rottneest Island (*A. marindicus*) may prove to be distinct. The presently described morphological characters allow no separation between individuals from the Hawaiian Islands and Western Australia.

The *Actacarus* species recorded from Australia are *A. australis*, *A. chelonis* Otto, 2000, *A. cornutus* Otto, 2000, *A. nanus* Otto, 2000, *A. pacificus*, *A. spinosus* Otto, 2000, and the above described *A. festivus*. The AE of each of *A. pacificus*, *A. nanus* and *A. spinosus* bears four pairs of setae, the PE two ventral setae. *A. spinosus*, the smallest species, has an idiosomal length of 186–194  $\mu\text{m}$ , its P-4 has a conspicuously bent seta (instead of a spur), on tibia I is one of the ventral setae coarsely bipectinate, one faintly pectinate, tibiae III and IV both bear one long bipectinate and one very short and slender ventral seta. *Actacarus nanus* has an idiosomal length of 198–212  $\mu\text{m}$ , the ds-2 are close to the level of the posterior margin of the AD and the OC are rather short, the female GA is short, the distance from the anterior margin of the GO to the GA almost equals half the length of the AE, and none of the ventral setae on tibia I is bipectinate. *Actacarus pacificus* has an idiosomal length of 235–282  $\mu\text{m}$  (Australian specimens), the length of the GA relative to that of the AE is less than in *A. nanus*, the ventral setae on tibia I are apparently smooth.

#### Distribution

Southeastern Pacific (Chile, Robinson Crusoe Island), Northeastern Pacific (Hawaiian Islands), Sea of Japan (Hokkaido), Eastern Indian Ocean (Western Australia, Rottneest Island, Dampier). Intertidal to 10 m.

#### Subfamily Anomalohalacarinae Bartsch, 1985

##### Genus *Anomalohalacarus* Newell, 1949

##### *Anomalohalacarus dampierensis* sp. nov.

Figures 3A–H, 4A–G

#### Material Examined

##### Holotype

Male, Dampier, 20°39'S, 116°42'E, Western Australia, Australia; sandy beach, coarse, unsorted sand in middle part of tidal slope, 0–3 cm sediment depth, 3 August 2000, coll. I. Bartsch (WAM T52097).

##### Paratype

**Australia: Western Australia:** 1 protonymph, same data as for holotype (WAM T52098).

#### Etymology

An adjective referring to the type locality Dampier.

#### Diagnosis

Idiosomal length 300  $\mu\text{m}$ . AD and PD almost equal in length. PD undivided. Setae ds-5 lacking. Setae on epimera IV lacking. Anterior margin of male GA arched. GA with at least four pairs of pgs. P-2 with two setae. Tibia I with two short, bipectinate ventral spurs. Tibia I with eight setae, two of them spur-like. Tibiae II, III and IV each with pair of ventral setae which are slightly pectinate on tibiae III and IV but pectinate and slender on tibia II. One of the two setae on telofemur IV conspicuously stout.

#### Description

##### Male

*Idiosoma*. Length 300  $\mu\text{m}$ ; very slender, much longer than wide. Dorsal and ventral plates delicate. Membraneous integument faintly striated. Length of AD 57  $\mu\text{m}$ , width 39  $\mu\text{m}$ ; with pair of gland pores in lateral margin and pair of ds-1 posterior to gland pores (Figure 3A). PD undivided, its length 57  $\mu\text{m}$ , width 30  $\mu\text{m}$ ; with pair of pores in posterior third of plate and small ds-6 in posterior margin. AD and PD each with pair of gland pores. Setae ds-1 to ds-4 long, slender; ds-1 inserted on AD, ds-2 and ds-3 within striated integument; ds-5 not seen; ds-6 very short, in posterior margin of PD.

AE divided by striated integument into right and left half (Figure 3B). Length of AE 42  $\mu\text{m}$  (to camerostome). Each half with three setae and an epimeral pore. Long apodemes between epimera I and II. PE in posterior fourth of idiosoma. Each plate with one dorsal and two ventral setae; no seta in area representing epimeral plate IV. Anterior margin of GA broadly arched, with at least four pairs of perigenital setae (genital region obscured by legs III and IV and hence setae difficult to discern). Spermatopositor extending far beyond GA. Position of sgs not discernable in the single male available.

*Gnathosoma*. Very slender (Figure 3C), its length

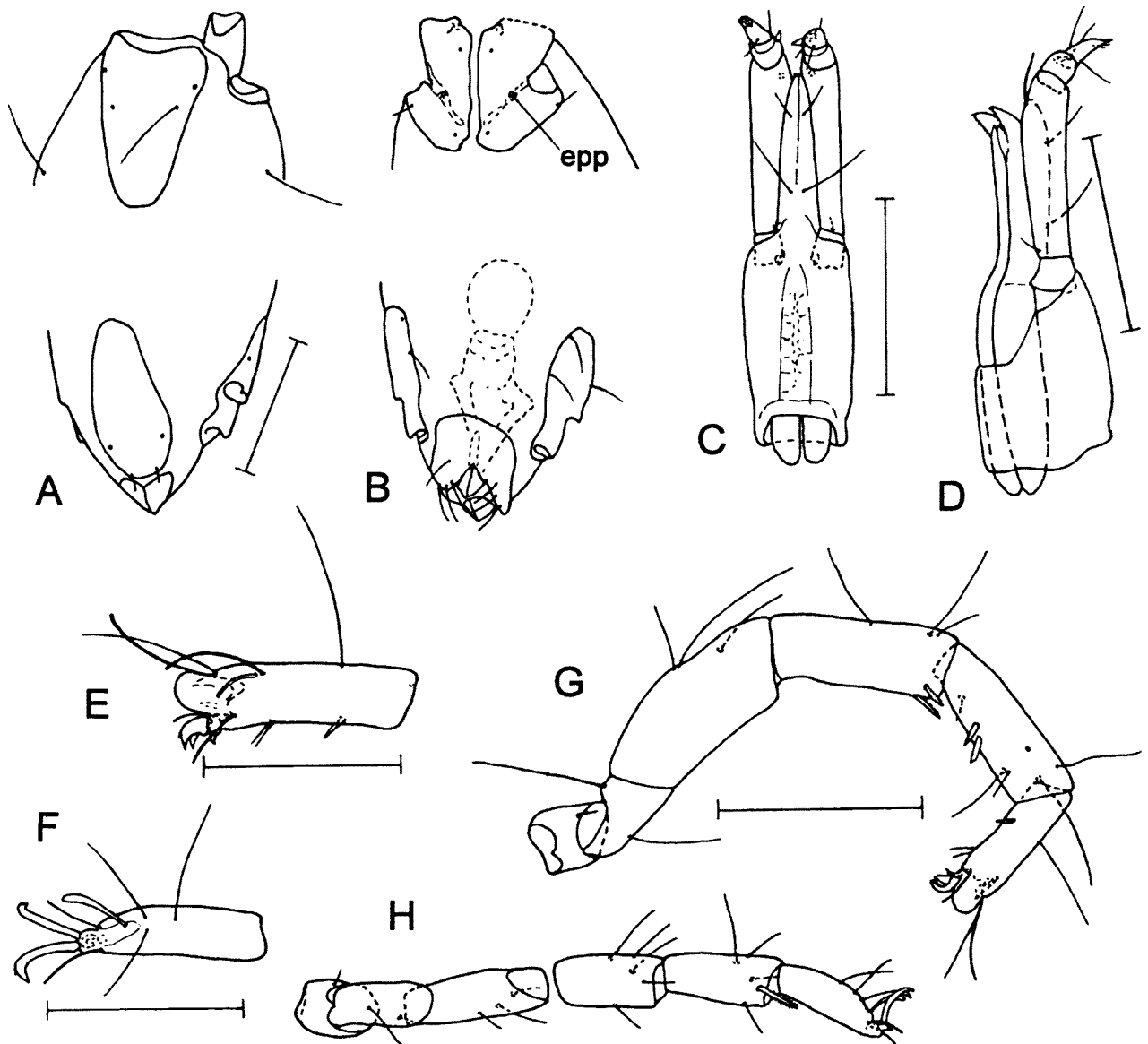


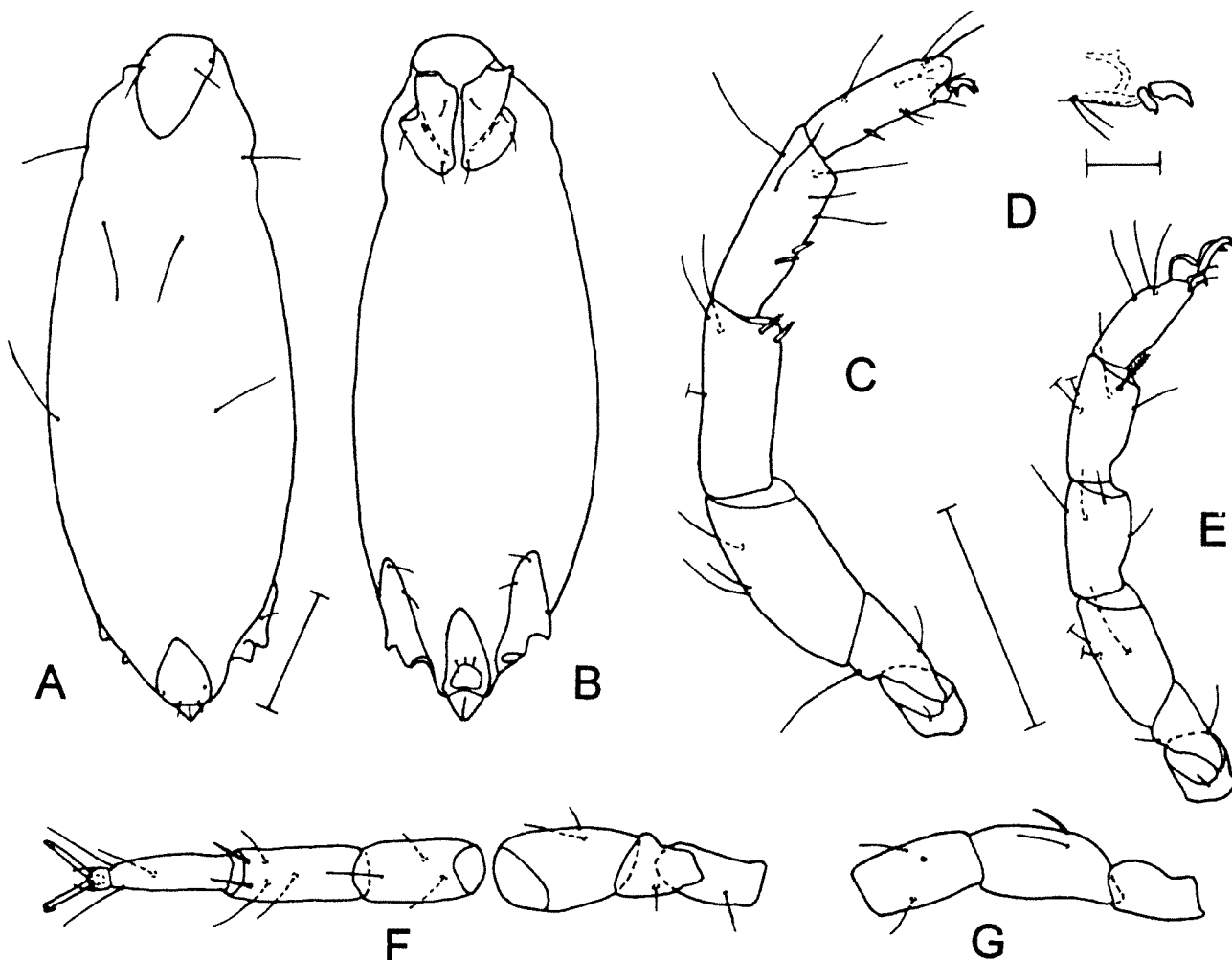
Figure 3 A–H, *Anomalohalacarus dampierensis* sp. nov., male. A, Anterior and posterior part of idiosoma, dorsal; B, AE, PE and GA, ventral; C, gnathosoma, ventral; D, gnathosoma, lateral; E, tarsus I, lateral; F, tarsus II, dorsal; G, leg I, medial; H, leg II, ventral and ventromedial. Scale = 50  $\mu$ m (epp, epimeral pore).

87  $\mu$ m, width 28  $\mu$ m. Rostrum almost as long as gnathosomal base; with two pairs of long maxillary setae; apex with two pairs of minute rostral setae. P-2 with short, slender basal and stout distal seta (Figure 3D). P-3 with large medial spine. P-4 with three setae in basal whorl; apex with minute ventral and lateral seta and flattened dorsal seta.

*Legs.* Leg I longer and wider than the other legs. Genu and tibia I almost equal in length and shorter than telofemur I. Both lateral and medial fossa membrane of tarsus I large. Tarsi II to IV lack prominent membranes. Leg chaetotaxy (solenidia and pas included, famulus excluded): leg I, 1, 2, 3, 5, 8, 9; leg II, 1, 2–3, 3, 5, 5, 6; leg III, 1, 1, 2, 3, 5, 5; leg IV, 0, 0, 2, 3, 5, 5. Dorsal seta of basifemur I conspicuously long and stout (Figure 3G). Genu I with two short, slightly bipectinate spurs, inserted adjacent and ventromedially. Tibia I with two

ventral spurs; most of dorsal setae slender except rather thick distolateral seta. Tarsus I with three ventral setae, one spur-like, two short and slender. Dorsal and dorsomedial fossary seta slender, dorsolateral fossary seta and dorsolateral solenidion conspicuously thick (Figure 3E). Famulus slender, pressed to lateral fossa membrane; its length 8  $\mu$ m. Genua II to IV with slender ventral setae. Tibiae II to IV each with pair of ventral setae; on tibia II one of these setae pectinate and one slender (Figure 3H), on tibiae III and IV both setae equal-sized, with very delicate pectination. Tarsus II with large, claviform solenidion in dorsolateral position (Figure 3F); the three dorsal setae slender. Tarsi I to IV with pair of pas singlets. Telofemora III and IV each with two dorsal setae, on telofemur IV one of these setae stout.

Paired claws of tarsus I short, with basiventral



**Figure 4** A-G, *Anomalohalacarus dampierensis* sp. nov., protonymph. A, Idiosoma, dorsal; B, idiosoma, ventral; C, leg I, medial; D, tip of tarsus I with claw; E, leg II, medial; F, leg III, ventral; G, trochanter, femur, genu IV. Scale = 50  $\mu\text{m}$  (A-C, E-G), scale = 10  $\mu\text{m}$  (D).

process (as in protonymph, Figure 4D). Paired claws of tarsi II to IV with accessory process but without pecten. Central sclerite with minute claw-like process.

#### Protonymph

Idiosomal length 268  $\mu\text{m}$ , width 100  $\mu\text{m}$ . Arrangement of plates and setae as illustrated (Figure 4A and B). AE as in male with three pairs of setae, PE with one dorsal and two ventral setae. Gnathosoma slender, length 80  $\mu\text{m}$ , width 25  $\mu\text{m}$ , number and arrangement of setae same as in adults. Leg chaetotaxy (with solenidia and pas): leg I, 1, 2, 3, 5, 7, 9 (Figure 4C); leg II, 1, 2, 3, 4, 5, 6 (Figure 4E); leg III, 1, 1, 2, 3, 5, 5 (Figure 4F); leg IV, 0, 0+2 (basis + telofemur), 3, 5, 5. Genu I with two spur-like, pectinate setae. Tibia I with two spur-like setae. Tibiae II with one slender and one pectinate seta; tibiae III and IV each with two faintly bipectinate setae. One of dorsal setae on telofemur IV stout (Figure 4G).

#### Remarks

Most species of the genus *Anomalohalacarus* are known from the North Atlantic and the Mediterranean. There is a single species from the western Pacific, from Japan, and three from the Indian Ocean, two from Western Australia and one species of unknown identity from the Bay of Bengal (Abé, 1996; Bartsch, 1976a, b, 1981b, 1985a, 1991a, 1993; Monniot, 1967; Morselli and Mari, 1981, 1982, 1989; Rao, 1970).

The idiosoma and dorsal and ventral plates are similarly shaped in the males of the two Australian species, *A. macellus* Bartsch, 1993, from Rottneest Island, and *A. dampierensis*. The two species differ in the setation of the legs. Tibia I of *A. dampierensis* bears eight setae, two of them are spur-like, in contrast, tibia I of *A. macellus* has 10 setae. The protonymph of *A. dampierensis* has a longer genital plate than that nymph of *A. macellus*.

*Anomalohalacarus biformis* Abé, 1996, from Hokkaido, Japan (Abé, 1996), has 10 setae on tibia I.

The species is easily separated from the two Australian ones by the three ventral bristle-like setae on tibiae II and III.

Fourteen species have been described from the North Atlantic and adjacent basins. Two species, *Anomalohalacarus anomalus* (Trouessart, 1894) and *A. litoralis* Bartsch, 1981, differ from the others in that the idiosomal integument is very prominently striated (cf. Monniot, 1967: figure 1C), the P-2 bears two large setae, one in the basal, one in the distal portion, and tibia I three ventral setae (two spur-like, one seta-like) in the basal half of the segment. In the other North Atlantic species, the striae of the integument are rather delicate, the P-2 bears a single seta which is slender and inserted near the base of that segment, and in the basal portion of tibia I there are one or two setae which are either setiform or seti- and spiniform. Except for *A. marcandrei* Monniot, 1967, the PD of adult North Atlantic species is divided into a right and left half.

The three species from the Indo-Pacific region differ from those of the North Atlantic and its adjacent basins by (1) absence of the ds-5 and (2) absence of the posterior pair of setae on the PE (generally attributed to epimeron IV). The PD is undivided, the idiosomal integument delicately

striated, P-2 bears two setae, the basal seta is short and slender, similar to that of the majority of the North Atlantic species, the posterior seta is stout, resembling that seta of *A. anomalus* and *A. litoralis*. In the basal portion of tibia I there are more than two ventral setae.

#### Distribution

Indian Ocean (Western Australia, Dampier). Intertidal.

#### Subfamily Halacarinae Viets, 1927

#### Genus *Arhodeoporus* Newell, 1947

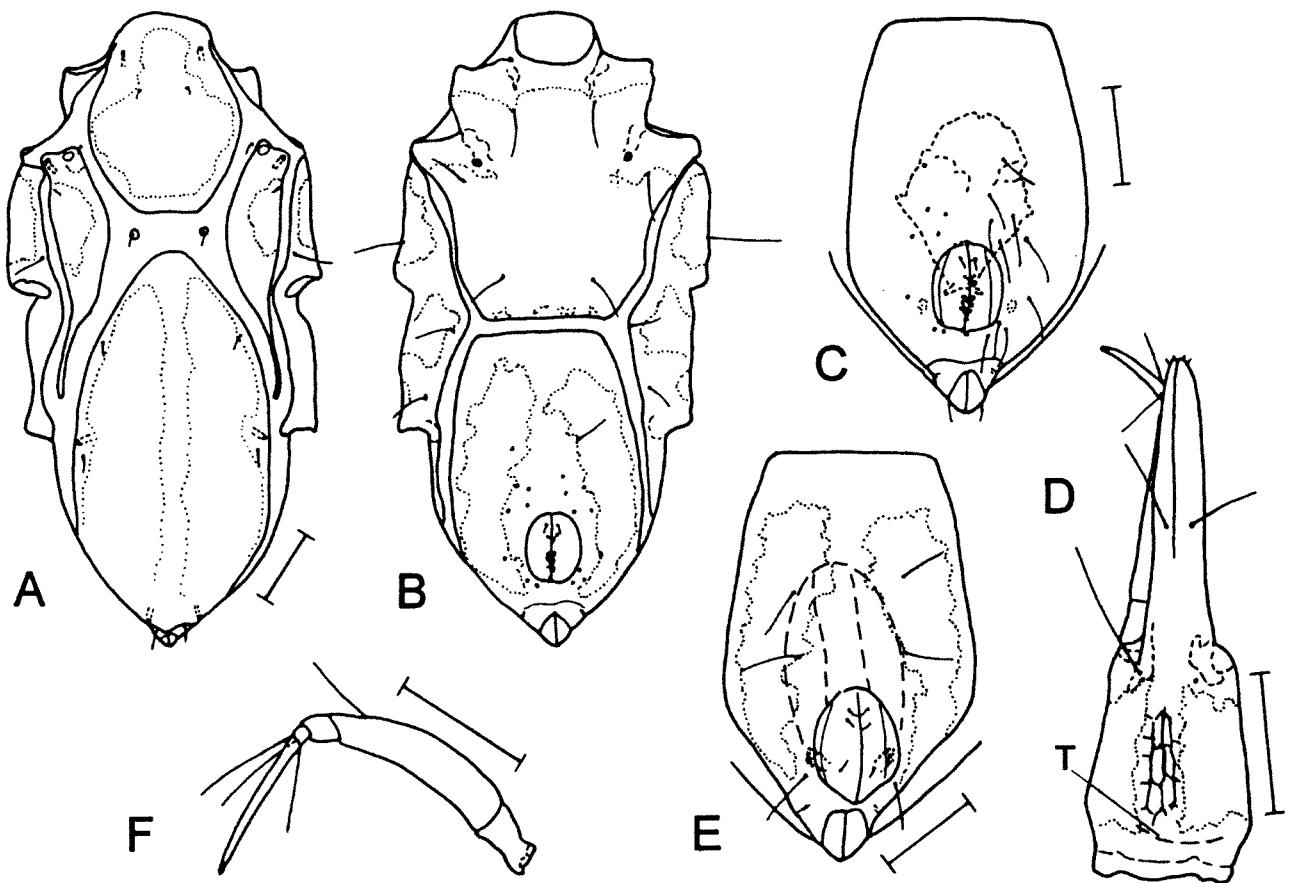
#### *Arhodeoporus corallicolus* Otto, 2000

Figures 5A–F, 6A–F

*Arhodeoporus corallicolus* Otto, 2000g: 5–7, figure 4.

#### Material Examined

**Australia: Western Australia:** 1 female, 1 male, Dampier Archipelago, Enderby Island, West of Rocky Head, 20°32.1'S, 116°26.7'E, sponge garden, 2–13 m, unsorted sandy deposits, 3 August 2000, coll. C. Bryce (WAM T52099 and T52100).

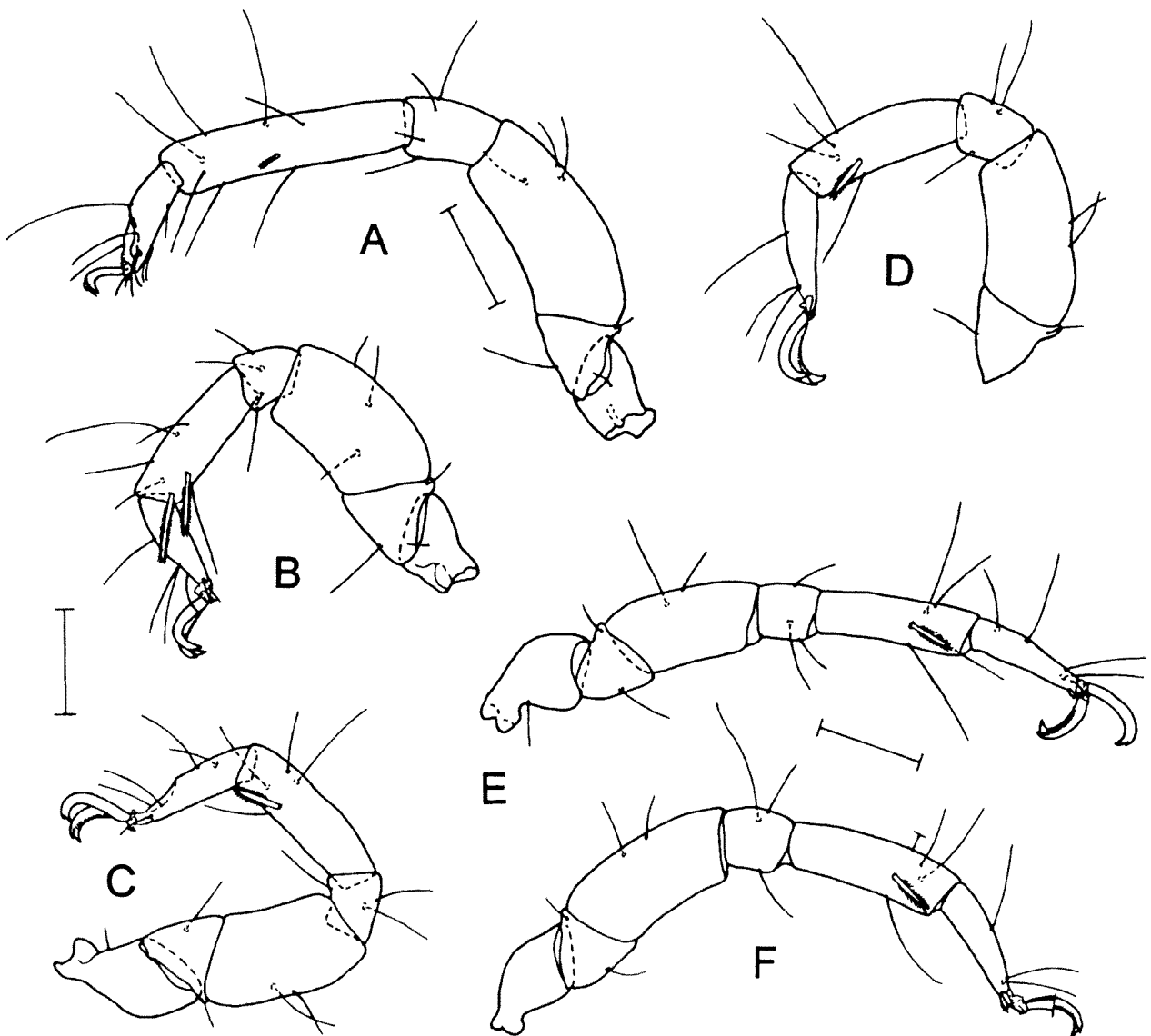


**Figure 5** A–E. *Arhodeoporus corallicolus* Otto, 2000. A, Idiosoma, dorsal, male; B, idiosoma, ventral, male; C, genitoanal plate, male; D, gnathosoma, ventral, male; E, genitoanal plate, female; F, palp, lateral, male. Scale = 50  $\mu$ m (T, tectum).

**Diagnosis**

Idiosomal length 400–411  $\mu\text{m}$ . Surface of plates smooth but integument pierced by numerous canaliculi. Outline of such porose areolae as illustrated (Figure 5A and B). OC with long tail and one small cornea and, beneath, small spots of eye pigment. Anterior margin of PD ovate. Each of the four pairs of gland pores with a small tube. Pair of ds-2 within striated integument; ds-3 on small platelets; ds-5 just posterior to gland pore. Punctuation of AE coarser than that of dorsal plates and GA. Opposing margins of AE and GA truncate. AE with pair of epimeral pores. PE with one dorsal and three ventral setae. Female GA with three pairs of pgs; genital sclerites with three pairs of sgs; two pairs of internal genital acetabula. Ovipositor extending slightly beyond the level of anterior pair of pgs (Figure 5E). Male GA with 17

pgs; genital sclerites with five pairs of sgs and a slightly projecting posterior cone (Figure 5C). Spermatopositor extending well beyond anteriormost pair of pgs. Gnathosoma slender, almost three times longer than wide and 0.44 of idiosomal length. Rostrum distinctly longer than gnathosomal base (Figure 5D). The latter with marginal porose areolae. Rostral trough long; truncate tectum in basal portion of gnathosomal base (Figure 5D). Palps slender (Figure 5F). Basi- and telofemora II to IV flattened; telofemora II to IV about twice as long as high; basifemora dorsally slightly projecting. Tibiae slender, cylindrical. Height of telofemora II to IV 1.8–2.0 times that of relevant tibiae. Tibia I longer than telofemur I, tibiae of following legs as long as or shorter than telofemora. Leg chaetotaxy (solenidia included, pas excluded): leg I, 1, 2, 3, 4, 8, 7 (Figure 6A); leg



**Figure 6** A–F. *Arhodeoporus corallicolus* Otto, 2000, male. A, Leg I, medial; B, leg II, medial; C, leg III, medial; D, basifemur to tarsus IV, medial; E, leg III, medial; F, leg IV, medial. A–D, male from Dampier; E and F, paratype from Great Barrier Reef. Scale = 50  $\mu\text{m}$ .

II, 1, 2, 3, 4, 7, 4 (Figure 6B); leg III, 1, 2, 2, 3, 5, 4 (Figure 6C); leg IV, 0, 2, 2, 3, 5, 3 (Figure 6D). Ventral flank of tibia I with one short, pectinate and three long, smooth setae. Tibiae II to IV with 2, 1, 1 bipectinate and 1, 1, 1 smooth and slender seta. Tarsus I short, less than half length of tibia I. Tarsi I and II with slender pas; tarsus III with slender medial and short, wide lateral pas; tarsus IV with pair of short and wide pas. Claws with accessory process and pecten; tines of pectines very short (seen only at high magnification and oil immersion).

#### Remarks

The specimens from the Dampier Archipelago have conspicuously flattened telofemora II to IV, their height is almost twice that of the tibiae. The height of the telofemora of the Great Barrier Reef specimens (Otto 2000g: figure 4f and present paper: Figure 6E and F) is less striking, 1.5–1.7. The fixative and the contraction of the muscles may influence the shape of the telofemora. The slight difference in the shape of the PD is expected to be within the variability of this character; the anterior portion of the holotype PD is broadly rounded (Otto 2000g: figure 4a), that of the specimen from Dampier more slender (Figure 5A).

Species most similar to *Arhodeoporus corallicolus* are *A. caudatus* Otto, 2000, *A. clypeatus* Otto, 2000, *A. lizardensis* Otto, 2000, and *A. psammophilus* Bartsch, 1993, all from Australia, from the Great Barrier Reef, the Queensland Plateau and from Rottnest Island, off Perth (Otto, 2000g; Bartsch, 1993). Further species are *A. mactanus* Bartsch, 1991, from the Philippine Island Mactan, and *A. longirostris* Bartsch, 1981, from off the Isles Glorieuses, Mozambique Channel (Bartsch, 1981a, 1982, 1991b). *Arhodeoporus corallicolus* can be identified on the base of the combination of: OC with one cornea; AE and GA separated; punctation of AE coarser than that of the other plates; tibia I with short, delicately pectinate seta; basi- and telofemora flattened. An unique character is that the female genital sclerites bear three pairs of sgs, in contrast to two pairs of setae which is the most common state of this character.

*Arhodeoporus corallicolus* has very flattened telofemora. In general, the telofemora of halacarid mites are almost cylindrical, but in many species the legs bear large ventral lamellae, e.g. in species of the *Copidognathus gibbus* group (Bartsch, 1994b; Otto, 2000f). In *A. corallicolus* there are no such lamellae.

#### Distribution

Great Barrier Reef, northeastern Australia, and Dampier, northwestern Australia. Inhabitant of shallow water sandy deposits.

### Subfamily Copidognathinae Bartsch, 1983

#### Genus *Copidognathus* Trouessart, 1888

#### *Copidognathus meridianus* Bartsch, 2003

*Copidognathus meridianus* Bartsch, 2003b: xx–xx, figures 1A–H, 2A–H, 3A–F.

#### Material Examined

**Australia: Western Australia:** 3 females, 1 male, Dampier, 20°39'S, 116°42'E, unsorted sand in mid- and upper tidal shore, 31 July 2000 and 1 August 2000, coll. I. Bartsch (WAM T45195–T45198); 1 female, north of Cape Preston, 40 Mile Beach, coarse unsorted sediment, upper tidal shore, 6 August 2000, coll. I. Bartsch (WAM T45199).

#### Diagnosis

Idiosomal length 360–385 µm. Dorsal plates almost uniformly ornamented with small pits arranged within polygons. AD with three delicately raised areolae. PD without prominent costae. OC with minute cornea. PD with pairs of pores at the level and posterior to ds-5; each pore with large internal gland. Female GA with four pairs of pgs; male GA with 15–16 widely scattered pairs of pgs. Length of gnathosoma almost one third of that of idiosoma. Length:width ratio of gnathosoma 1:0.7; rostrum triangular, about as long as gnathosomal base and extending just beyond P-2. Tectum truncate. Leg chaetotaxy (solenidia and pas included): leg I, 1, 2, 5, 4, 7, 11; leg II, 1, 2, 5, 4, 7, 8; leg III, 1, 2, 2, 3, 5, 5; leg IV, 0, 2, 2, 4, 5, 5. Tibiae II to IV with 2, 1, 1 bipectinate setae. Tarsi I to IV with 4, 4, 3, 3 dorsal setae (solenidia included). Pectines of claws II to IV with delicate tines.

#### Remarks

This rather large-sized psammophilous *Copidognathus* species can be separated from congeners by the unique combination of (1) dorsal plates almost uniformly ornamented and (2) genu IV with four setae.

#### Distribution

Tropical Western Australia, Dampier. Present in sandy deposits, in mixed coarse and fine sand. In the Dampier area, this species dominated the intertidal psammophilous halacarid fauna.

### Subfamily Lohmannellinae Viets, 1927

#### Genus *Scaptognathides* Monniot, 1972

#### *Scaptognathides hawaiiensis* Bartsch, 1988

Figure 7A–E

*Scaptognathides hawaiiensis* Bartsch, 1988: 221, 222, figures 27–30; Bartsch, 1991c: 59, figure 1A–H.

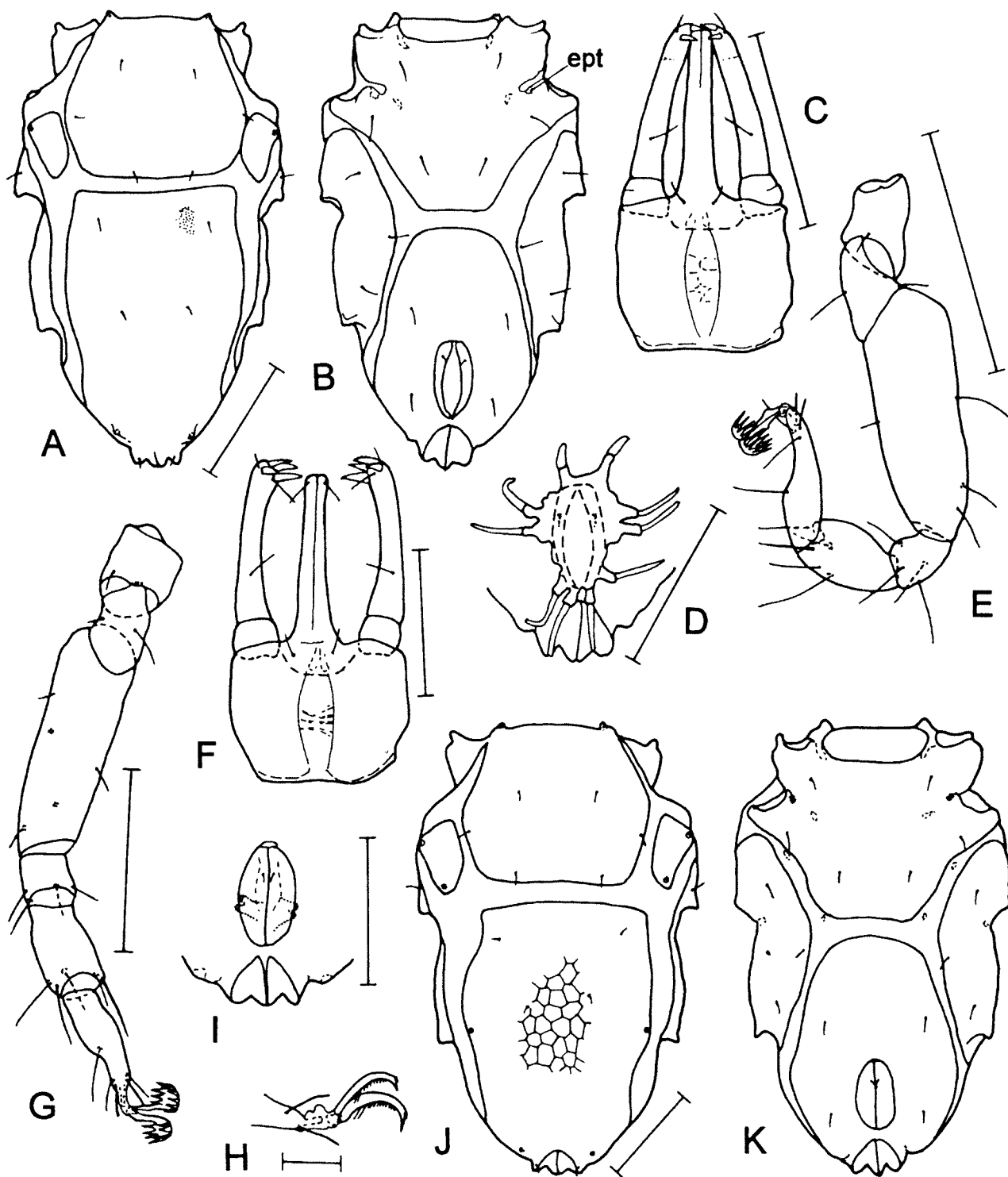


Figure 7 A–D. *Scaptognathides hawaiiensis* Bartsch, 1988, female. A, Idiosoma, dorsal; B, idiosoma, ventral; C, gnathosoma, ventral; D, ovipositor; E, leg I, medial. (ept, epimeral tube). F–K. *Scaptognathides ornatus* Bartsch, 1988, female. F, gnathosoma, ventral; G, leg I, ventral; H, tip of tarsus II, medial; I, genital opening; J, idiosoma, dorsal; K, idiosoma, ventral. Scale = 50 µm (A–G, I–K), scale = 10 µm (H).

**Material Examined**

**Australia: Western Australia:** 3 females, Dampier, sandy beach, coarse, unsorted sand, lower part of tidal slope, 2–15 cm sediment depth, 4 August 2000, coll. I. Bartsch (WAM T52101 and T52102).

**Diagnosis**

Idiosomal length 170–180 µm. Dorsal and ventral plates minutely pitted. AD, OC and PD each with one pair of gland pores (Figure 7A). Pairs of ds-1, ds-2 and ds-3 on AD, ds-4 and ds-5 on PD, adanal setae on anal valves. AE with three pairs of setae

and pair of small epimeral tubes (Figure 7B). GA with two pairs of pgs, genital sclerites with one pair of sgs. Gnathosomal length 0.44–0.47 times of that of idiosoma. Margin of tectum truncate. Rostrum slightly longer than gnathosomal base (Figure 7C). Two of the four apical palpal spines pectinate. Leg I somewhat longer and considerably more stout than following legs. Length of legs I and IV about 0.75 of that of idiosoma. Leg chaetotaxy (very short solenidia excluded, pas included): legs I and II, 1, 2, 4, 4, 5, 5; legs III and IV, 1, 2, 2, 3, 5, 5. Length:height ratio of telofemora II to IV about 2.2–2.3. Paired claws of tarsus I with large, umbrella-like arranged tines (Figure 7E). Pectines of claws of tarsi II to IV seen only at higher magnification; basalmost tine twice the length of the other very delicate tines.

#### Supplementary notes

Ovipositor with 10 pairs of delicately sclerotized, lamellar genital spines (Figure 7D).

#### Remarks

The PD of *Scaptognathides hawaiiensis* bears a single pair of gland pores situated near the posterior margin of the plate. In the other Australian species, the PD has two pairs of gland pores, one pair about the level of insertion of leg IV, the other pair near the posterior margin, similar to *S. hawaiiensis*.

Records of *S. hawaiiensis* are from the Hawaiian Archipelago, Hong Kong and northwestern Australia. There are small differences in the shape of the female GA, with the anterior margin oviform in the individuals from the Hawaiian Archipelago (Bartsch 1988: figure 28) but almost truncate in those from the Dampier area. Considering the delicateness of the plates, which easily can be deformed, the differences mentioned are thought to be negligible.

#### Distribution

Northeastern Pacific (Hawaiian Islands), South China Sea (Hong Kong), Eastern Indian Ocean (Western Australia, Dampier). Intertidal sandy deposits.

#### *Scaptognathides ornatus* Bartsch, 1988

Figure 7F–K

*Scaptognathides ornatus* Bartsch, 1988: 222–224, figures 31–39.

#### Material Examined

**Australia: Western Australia:** 1 female, Dampier, 20°39'S, 116°42'E, sandy beach, coarse, unsorted sand in lower part of tidal slope, 2–15 cm sediment depth, 4 August 2000, coll. I. Bartsch (WAM T52103).

#### Diagnosis

Idiosomal length 217  $\mu$ m. Dorsal plates reticulated (Figure 7J). AD with one pair of pores, OC and PD each with two pairs of gland pores. Pair of ds-1, ds-2 and ds-3 on AD, ds-4 near anterolateral corners of PD, ds-5 situated in middle of plate anterior to the level of pair of glp-4. Marginal areas of ventral plates faintly reticulated, ventral portions punctate. GA with two pairs of pgs (Figure 7K) and two pairs of internal genital acetabula (Figure 7I), its genital sclerites with one pair of sgs. Length of gnathosoma 0.48 times that of idiosoma. Tectum concave, median margin truncate. Rostrum somewhat longer than gnathosomal base (Figure 7F). Two of apical palpal spines pectinate. Legs I and IV almost 0.75 of idiosomal length. Length of genu I about 0.6 and 0.2 times that of tibia and telofemur I, respectively. Telofemora II to IV slender, almost three times longer than high. Leg chaetotaxy (very short solenidia excluded): legs I and II, 1, 2, 5, 4, 5, 5; legs III and IV, 1, 2, 2, 3, 5, 5. Paired claws of tarsus I with long, umbrella-like arranged tines (Figure 7G); claws of tarsi II to IV with minute accessory process, pecten with tines, two basalmost tines enlarged (Figure 7H).

#### Remarks

The two species, *Scaptognathides ornatus* and *S. hawaiiensis*, present in Dampier in the same beach, are easily separated even at low magnification; *S. ornatus* is larger, has reticulate dorsal plates and slender telofemora II to IV.

From Australian shores, six species of *Scaptognathides* are recorded, *S. australis* Bartsch, 1993, *S. hawaiiensis*, *S. heraldensis* Otto, 2000, *S. ornatus*, *S. tomkinsae* Otto, 2000, and *S. undulatus* Otto, 2000. Characters to identify adults (and assumedly nymphs as well are):

*Scaptognathides australis*: OC slender, at least four times longer than wide, and with a single gland pore; PD with two pairs of gland pores.

*Scaptognathides hawaiiensis*: the only species with a single pair of gland pores on OC and PD.

*Scaptognathides heraldensis*: OC with one gland pore, PD with two pairs of pores; in contrast to *S. australis*, the OC are rhomboid, about twice as long as wide.

*Scaptognathides ornatus*: both OC and PD with two pairs of gland pores. Telofemora II to IV slender; tarsus III with three dorsal setae.

*Scaptognathides tomkinsae*: PD with two pairs of gland pores; OC with a single pore, its posterior edge with a minute seta instead of a gland pore.

*Scaptognathides undulatus*: both OC and PD with two pairs of gland pores; tarsus III with four dorsal setae, instead of three as present in the other species.

**Distribution**

Northeastern Pacific (Hawaiian Islands), Eastern Indian Ocean (Western Australia, Dampier). Intertidal.

**Genus *Scaptognathus* Trouessart, 1889*****Scaptognathus exquisitus* Otto, 2000**

Figure 8A–E

*Scaptognathus exquisitus* Otto, 2000b: 539–543, figure 4.

**Material Examined**

**Australia: Western Australia:** 1 female, Enderby Island, West of Rocky Head, 20°32.1'S, 116°26.7'E, sponge garden, 2–13 m, unsorted sandy deposits, 3 August 2000, coll. C. Bryce (WAM T52104).

**Diagnosis**

Idiosomal length 210 µm. Dorsal and ventral plates pitted, AD with the pits arranged within polygons (Figure 8A). AD very wide, posterior margin arched. OC small, rounded. Anterior margin of PD truncate. AE wider than long, with large epimeral pores and circular markings. PE with funnel-like structures anterior to insertion of legs III and IV (Figure 8A and D). Female GA bipartite;

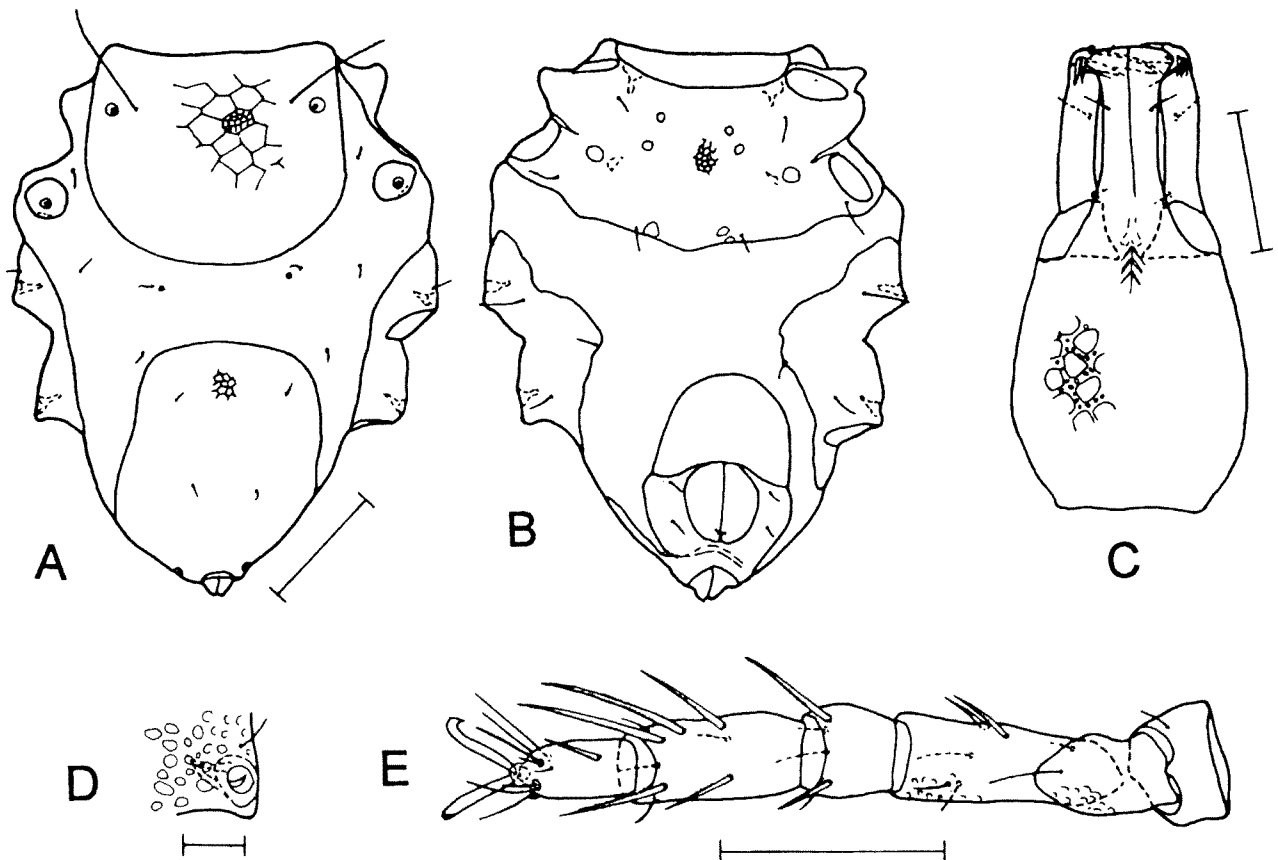
posterior portion with two pairs of pgs (Figure 8B); genital sclerites with single pair of sgs. Gnathosoma almost twice as long as wide; its length 0.79 of that of idiosoma. Spatula-shaped rostrum shorter than gnathosomal base (Figure 8C). Legs slender; leg I 0.7 of idiosomal length. Lateral flanks of basi- and telofemora with small, deep foveae. Leg chaetotaxy (solenidia, famuli and pas excluded; bipectinate setae in roman numerals): leg I, 1, 1, 4+II, 3+II, 4+V, 4+I (Figure 8E); leg II, 1, 1, 5, 3+I, 3+II, 3+I; leg III, 1, 1, 2, 3, 3+III, 3; leg IV, 1, 1, 2, 3, 3+III, 3. Tarsus I with 'hollow' claviform solenidion and solid, digitiform famulus. On either side of tarsi I and II one setiform and one distinctly shorter pas. Tarsus III with pair of setiform pas, medial pas with adjacent short seta. Tarsus IV with pair of small, setiform pas. Claws with small accessory process, else smooth. Central sclerite without dent-like process.

**Supplementary notes**

PE with funnels anterior to insertion of legs III and IV (Figure 8D).

**Remarks**

The individual in Otto (2000b: figure 4A, B) shows much wider areas between the dorsal and ventral plates than are present in the specimen from the



**Figure 8** A–E. *Scaptognathus exquisitus* Otto, 2000, female. A, Idiosoma, dorsal; B, idiosoma, ventral; C, gnathosoma, ventral; D, epimeral plate III anterior to insertion of leg III, with funnel-shaped structure; E, leg I, ventral. Scale = 50 µm (A–C, E), scale = 10 µm (D).

Dampier Archipelago. Such a difference is common within ovigerous halacarid females, depending on the number and size of eggs. The difference in the length:width ratio of the gnathosoma (0.66 in the specimen from the Great Barrier Reef vs 0.79 in the one from Dampier) most likely is due to compression of the holotype.

Marginal cavities on the PE, anterior to the insertions of legs III and IV, have not been described before. They are also present in two paratype females (Zoological Museum in Hamburg A57/00) from the Great Barrier Reef.

#### Distribution

*Scaptognathus exquisitus* seems to be widespread along the coast of tropical Australia; records are from eastern Australia, from 19 to 14°S, and western Australia, at 20°S, from sandy deposits at a depth range of 0.5 to 10 m.

#### Subfamily Simognathinae Viets, 1927

#### Genus *Simognathus* Trouessart, 1889

#### *Simognathus platyaspis* Otto, 2000

Figure 9A–E

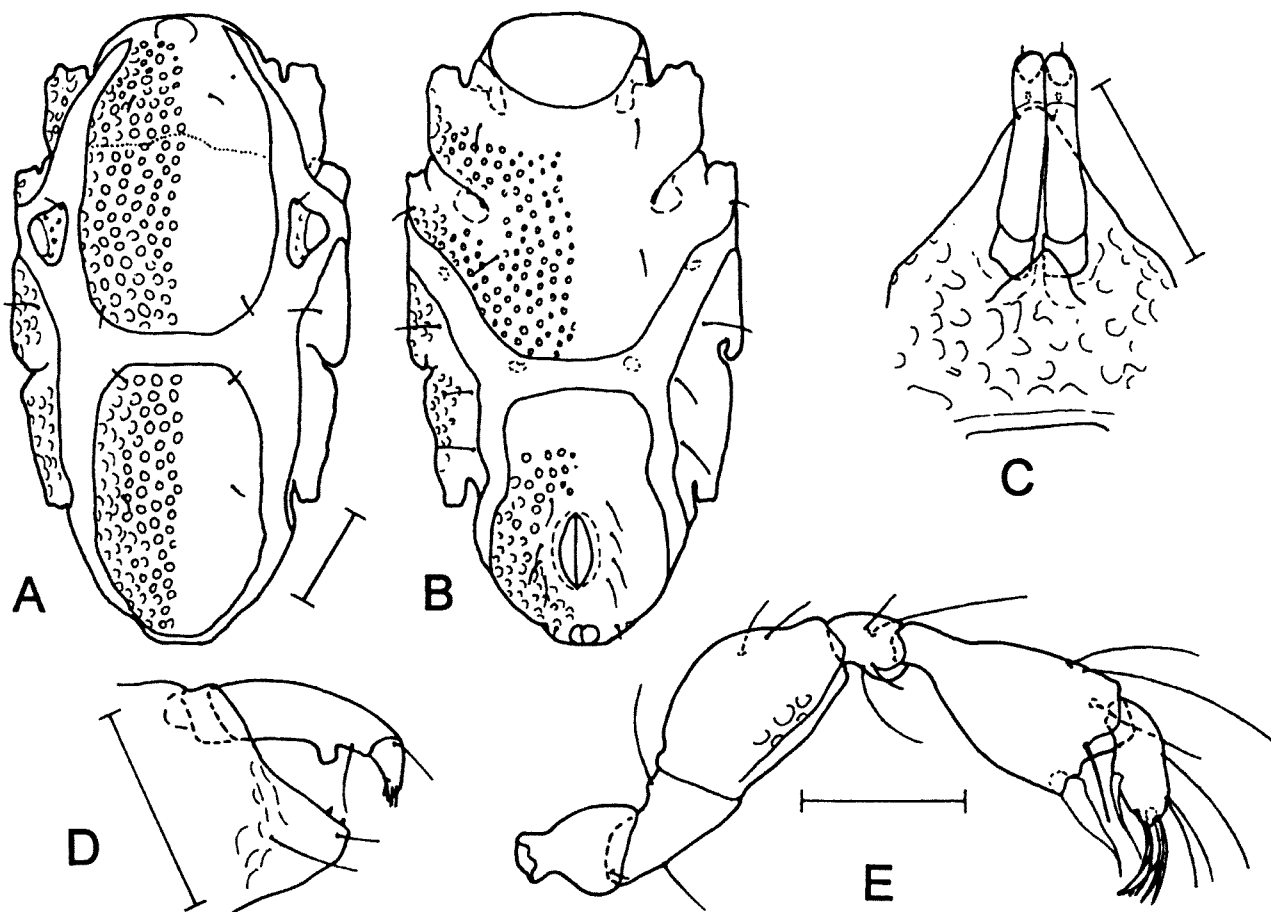
*Simognathus platyaspis* Otto, 2000a: 519–521, figures 14A–D, 15A–D.

#### Material Examined

**Australia: Western Australia:** 1 female, Burrup Peninsula, Watering Cove, 20°35'S, 116°58'E, coral block, low water edge, 1 August, 2000, coll. I. Bartsch (WAM T52105).

#### Diagnosis

Idiosomal length 315 µm, width 170 µm. Dorsal plates uniformly foveate, integument delicately punctate. Posterior two-third of AD with brown pigmentation. AD longer than PD (Figure 9A). OC triangular. AD with hyaline lens, OC with cornea. Ventral plates almost uniformly foveate except for (1) a portion immediately posterior to camerostome, (2) anterior portion of GA and (3) around GO (Figure 9B). GA with four pairs of pgs. Adanal setae in ventral position. Ventral flank of gnathosoma foveate. Triangular lamella forming a tectum (Figure 9C). Second palpal segment with ventral protuberance and one long seta (Figure 9D). Tibiae club-shaped. Leg chaetotaxy (solenidia omitted, pas included): leg I, 1, 2, 2, 4, 5, 6; leg II, 1, 2, 3, 4, 5, 6; legs III and IV, 1, 1, 2, 3, 5, 5. Ventral seta of tibia I basally wide, with apophysis, then tapering (Figure



**Figure 9** A–F. *Simognathus platyaspis* Otto, 2000, female. A, Idiosoma, dorsal (stippled line along margin of brown pigmentation); B, idiosoma, ventral; C, part of gnathosoma, dorsal; D, part of gnathosoma, lateral; E, leg I, medial. Scale = 50 µm.

9E). Pair of ventral spines of tibiae II coarsely pectinate, that pair of spines on tibiae III and IV only slightly pectinate. Tarsi I and II each with three dorsal setae, one ventral seta and pair of single eupathid pas. Tarsi III and IV each with three dorsal setae, one ventral seta and medial pas. Tarsus I with large median claw and slender paired claws. Paired claws of tarsi II to IV with accessory process, else smooth; central sclerite with small process.

### Remarks

Similarly shaped and pigmented plates and the same outline of palps and tibiae are present in *S. maculatus* Bartsch, 1994, *S. specialis* Otto, 2000, *S. versicolor* Otto, 2000, and *S. xandarus* Otto, 2000, all from Australia, in *S. glareus* Bartsch, 1985 from New Zealand, in *S. latitarsus* Proches, 2002 from South Africa, in *S. obtusus* Newell, 1971 and *S. subobtusus* Newell, 1984 from off Chile, and in *S. fuscus* Viets, 1936, recorded from the Caribbean (Viets, 1936; Newell, 1971, 1984; Bartsch, 1985b, 1994a; Otto, 2000a; Proches 2002).

In the just mentioned Australian species, as also in *S. latitarsus*, the foveate ornamentation of the AE is restricted to the lateral margins, ventrally the plate is uniformly punctate. In contrast, in *S. platyaspis* the AE is almost uniformly foveate. Females of the three southern Pacific species, *S. glareus*, *S. obtusus* and *S. subobtusus*, have a small PD and the ds-4 are situated within the membranous integument, whereas in *S. platyaspis* that pair of setae is on the PD. Moreover, in *S. glareus* and *S. subobtusus* the paired claws on tarsus I are much more stout than in *S. platyaspis*, and female *S. obtusus* have a shorter GA relative to the size of GO.

*Simognathus fuscus*, a species from Bonaire (Viets, 1936), resembles *S. platyaspis* in shape and ornamentation. Otto (2000a) used the length:width ratio of the AD for discrimination, a quotient that can be influenced by the mounting procedure. The paratype of *S. platyaspis*, housed in the Zoological Museum in Hamburg, Germany (ZMH A3/01), is squeezed and the holotype (not seen by the author) is suspected to be deformed, too. The length:width ratio of the AD in the present specimen of *S. platyaspis* is 1.65, that of the holotype of *S. fuscus* 1.69, hence almost the same. The rostrum of *S. fuscus* is very short, about one fifth of the length of the gnathosoma, but one fourth in *S. platyaspis*.

### Distribution

Tropical Australia, Great Barrier Reef, 1–6 m, coarse sand and coral rubble (Otto, 2000a) and Dampier area (present record). Not bound to sandy deposits.

### *Simognathus salebrosus* sp. nov.

Figures 10A–J, 11A–F

### Material Examined

#### Holotype

Male, Burrup Peninsula, east coast, King Bay, 20°38'S, 116°45'E, sandy tidal bank in a small river emptying into King Bay, Western Australia, Australia; 25 July 2000, coll. I. Bartsch (WAM T52106).

#### Other Material Examined

**Australia: Western Australia:** 1 female, Dampier, 20°39'S, 116°42'E, sandy flat, lower part of tidal slope, 1 August 2000, coll. I. Bartsch (WAM T52107).

### Etymology

Derived from Latin *salebrosus*, rough, uneven, because of the rough surface of the plates.

### Diagnosis

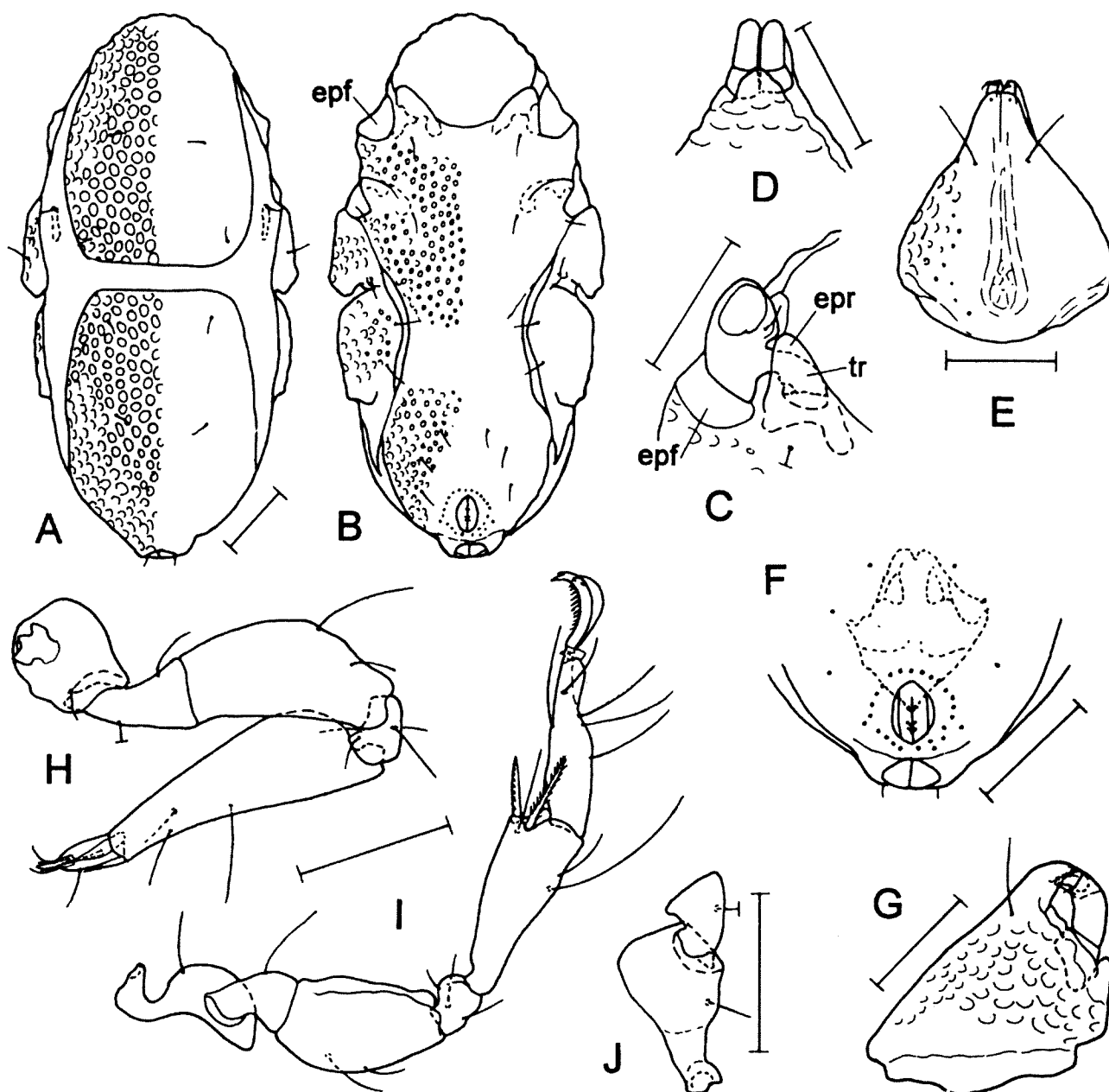
Idiosomal length 364–398 µm. AD and PD with delicate punctation, their surface uniformly foveate. AD longer than PD. OC elongate, covered by membranous integument. AE and GA fused. Plates foveate apart from area representing anterior part of GA. AE with large marginal epimeral fossae. Area of epimera II and PE contiguous; lateral GA and posterior part of PE almost articulating. Female GA with four pairs of pgs. Male GA with three pairs of outlying pgs and 26 pgs arranged in a ring close around GO. Gnathosomal base dorsally and marginally foveate; with triangular lamelliform tectum. Palps short. Trochanter I large, with small cylindrical base. Tibia I widest in basal third, then evenly tapering. Posterior part of tibia I rotated relative to axis of the leg. Tarsus I short, 0.17 of length of tibia. Tarsi I to IV with 1, 1, 1, 1 ventral setae and 2, 2, 1, 1 pas, respectively. Pectines of claws of tarsi II to IV with numerous short tines.

### Description

#### Male

*Idiosoma.* Male. Length 364 µm, width 189 µm. AD and PD with intense punctation and superficial foveae. Length of AD 167 µm, width 130 µm; anterior margin undulate due to foveae (Figure 10A), posterior margin truncate. AD with ds-1 and ds-3 as illustrated. OC reduced to short, elongate sclerite which is covered by striae of membranous integument; its length 22 µm, width 7 µm. PD slightly longer than AD, its length 175 µm, width 130 µm; anterior margin truncate. Pairs of ds-4 and ds-5 slightly posterior to the level of insertions of legs III and IV, respectively. Pair of ds-6 in marginal position.

Ventral plates evenly punctate and foveate; foveae absent posterior to camerostome, in an area representing anterior part of GA and around GO



**Figure 10** A–F. *Simognathus salebrosus* sp. nov. A, Idiosoma, dorsal, male; B, idiosoma, ventral, male; C, epimeral plate with fossa and trochanter I, female; D, tectum, male; E, gnathosoma, ventral, male; F, genital area, male; G, gnathosoma, lateral, female; H, leg I, medial and ventral, male; I, leg III, medial (trochanter in ventral aspect), male; J, trochanter and basifemur III, medial, female. Scale = 50  $\mu\text{m}$  (epf, epimeral fossa; epr, epimeral process; tr, trochanter).

(Figure 10B). AE and GA fused to a ventral shield; its length 289  $\mu\text{m}$ , width 164  $\mu\text{m}$ . Epimera II and PE as well as posterior part of PE and lateral GA contiguous. Epimeral processes I to IV forming large lamellae. Anterior epimera with large marginal fossae lateral to insertions of legs I (Figure 10C) and II. AE with three pairs of setae and rather small epimeral vesicles. PE extending posteriad beyond insertion of leg IV. GO small, length 45  $\mu\text{m}$ , width 27  $\mu\text{m}$ , situated close to posterior margin of idiosoma. GA with three pairs of outlying pgs and 26 pgs arranged in a ring close around GO. Genital sclerites with three pairs of sgs (Figure 10F).

*Gnathosoma*. Length 115  $\mu\text{m}$ , width 99  $\mu\text{m}$ . Gnathosomal base dorsally and marginally foveate (Figure 10G), median part of ventral flank almost smooth (Figure 10E). Dorsum with lamellar, triangular tectum (Figure 10D). Basal pair of maxillary setae long, distal pair short, slender. Palps short, three-segmented. Second segment with ventral seta but without protuberance; delicate incision may represent fusion between P-2 and P-3.

*Legs* I to IV rather similar in length. Base of trochanters I and II cylindrical, bent in an almost right angle to longitudinal axis of the legs (Figure 10C). Trochanters III and IV elongate, almost as

long as telofemora. Telofemora III and IV longer than tibiae. Tibia I with cylindrical base, abruptly expanding at 0.28 (relative to length of tibia), then evenly tapering (Figure 10H). Posterior portion rotated so that the ventral seta is in a medial position. Tibiae II to IV claviform (Figures 10I, 11B and C). Tarsus I very short, hardly longer than high, its median claw turned inward (Figure 11D and E). Tarsi II to IV at least three times longer than high. Leg chaetotaxy (solenidia omitted, pas included): leg I, 1, 2, 2, 4, 5, 6; leg II, 1, 2, 3, 4, 5, 6; legs III and IV, 1, 1, 2, 3, 5, 5. Ventral spine of tibia I stout, bluntly ending, without basal apophysis (Figure 11D); medial seta slender, flagelliform. Tibiae II to IV with pair of wide, roughly bipectinate ventral setae. Tarsi I to IV with three dorsal fossary setae; on tarsus I dorsomedial fossary seta shorter than dorsolateral one; on tarsi II to IV paired fossary setae delicately serrate. Tarsi I to IV each with long ventral seta, that seta on tarsus I basally wide, then tapering, on tarsi II to IV ventral seta delicately serrate. Tarsi I and II each with pair of pas, tarsi III and IV with medial pas. Solenidion of tarsus I setiform, famulus lamellar. Solenidion of tarsus II setiform, situated on inside of medial fossa membrane (Figure 11F).

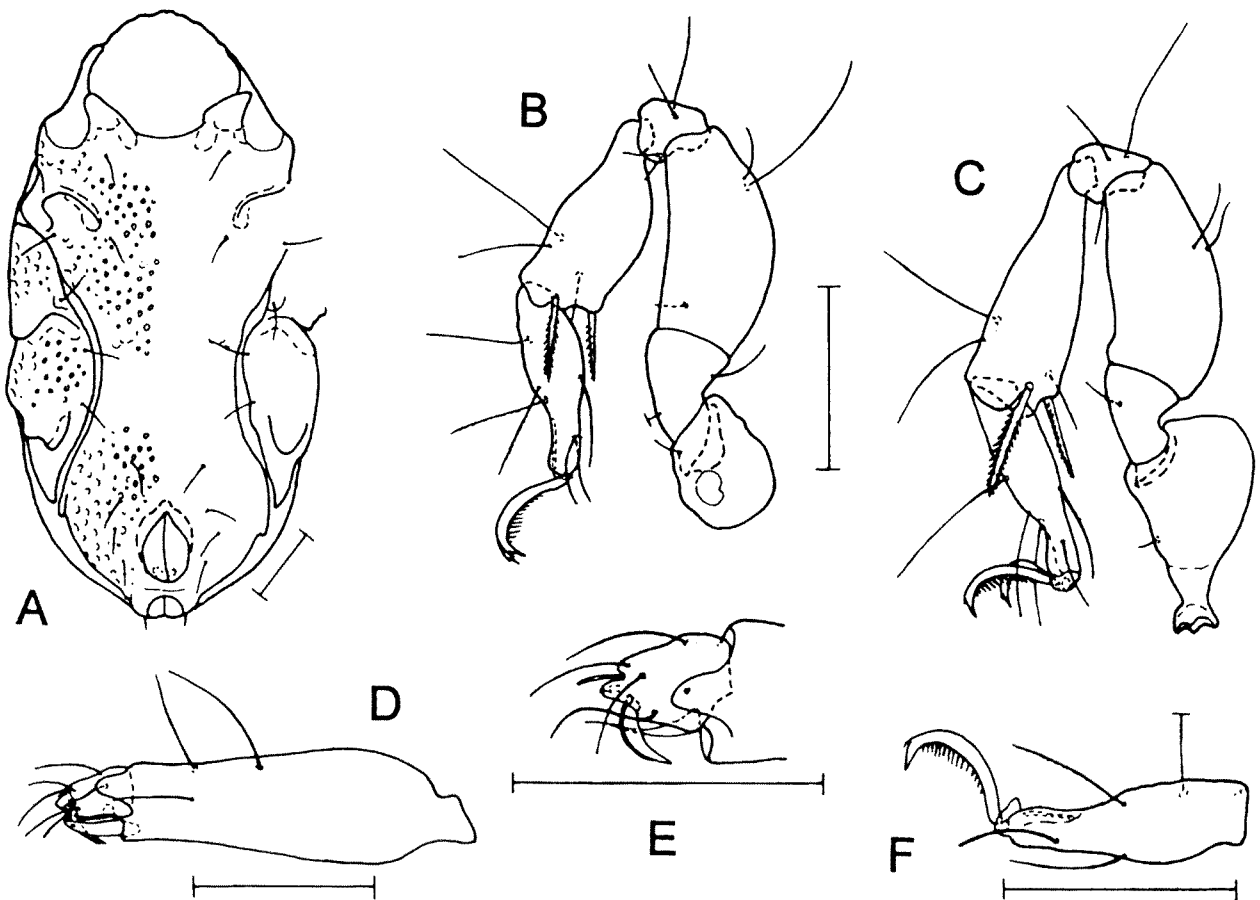
Tarsus I with median claw and very slender paired claws, these claws smooth. Paired claws of tarsi II to IV large, with accessory process and pectines; central sclerite minute, without distinct claw-like process.

#### Female

Dorsal aspect resembling that of male. AE and GA fused. GA with four pairs of pgs (Figure 11A).

#### Remarks

*Simognathus salebrosus* is strikingly similar to *S. abnormalus* Otto, 2000 and *S. scutatus* Bartsch, 1993, species recorded from the Great Barrier Reef, Queensland and Rottnest Island, Western Australia, respectively (Otto, 2000a; Bartsch, 1993), the three species have a ventral shield, short tarsus I and a short palp which lacks a protuberance. *S. scutatus* is easily distinguished from the others because all ventral plates are fused, both in the female and male, and its tibia I is almost equal in height for most of its length. In contrast to males of *S. abnormalus*, which bear two pairs of outlying setae, the single male of *S. salebrosus* has three pairs of such setae. The female GA and PE of *S. salebrosus*



**Figure 11** A–F. *Simognathus salebrosus* sp. nov. A, Idiosoma, ventral, female; B, leg II, medial, female; C, leg IV, medial, female; D, tibia and tarsus I, medial, female; E, posterior part of tibia and tarsus I, medial, female (ventromedial seta and ventral spine of tibia omitted, lateral pas and claw omitted); F, tarsus II, medial, female (lateral pas and claw omitted). Scale = 50  $\mu$ m.

are almost contiguous but not fused. In *S. abnormalus* variants are known with the GA and PE either fused or separated (Otto, 2000a). *Simognathus salebrosus* and *S. abnormalus* differ in that in the former species the AD is foveate throughout, in *S. abnormalus* the anterolateral portions are non-foveate.

With the shape of leg I, the tibia being highest in the basal third, then tapering towards the rotated distal portion, and a very short tarsus, this *Simognathus* resembles *Acaromantis* species. The three-segmented palps and the presence of paired claws associated with the median claw are characters of the genus *Simognathus*.

Conspicuous of *S. salebrosus*, and also of *S. abnormalus*, is that epimera I and II form large marginal fossae. The distal part of trochanters I and

II are within these epimeral fossae while the articulation of the trochanters is protected by the epimeral processes.

#### Distribution

Indian Ocean, Western Australia, Dampier. From a tidal beach area.

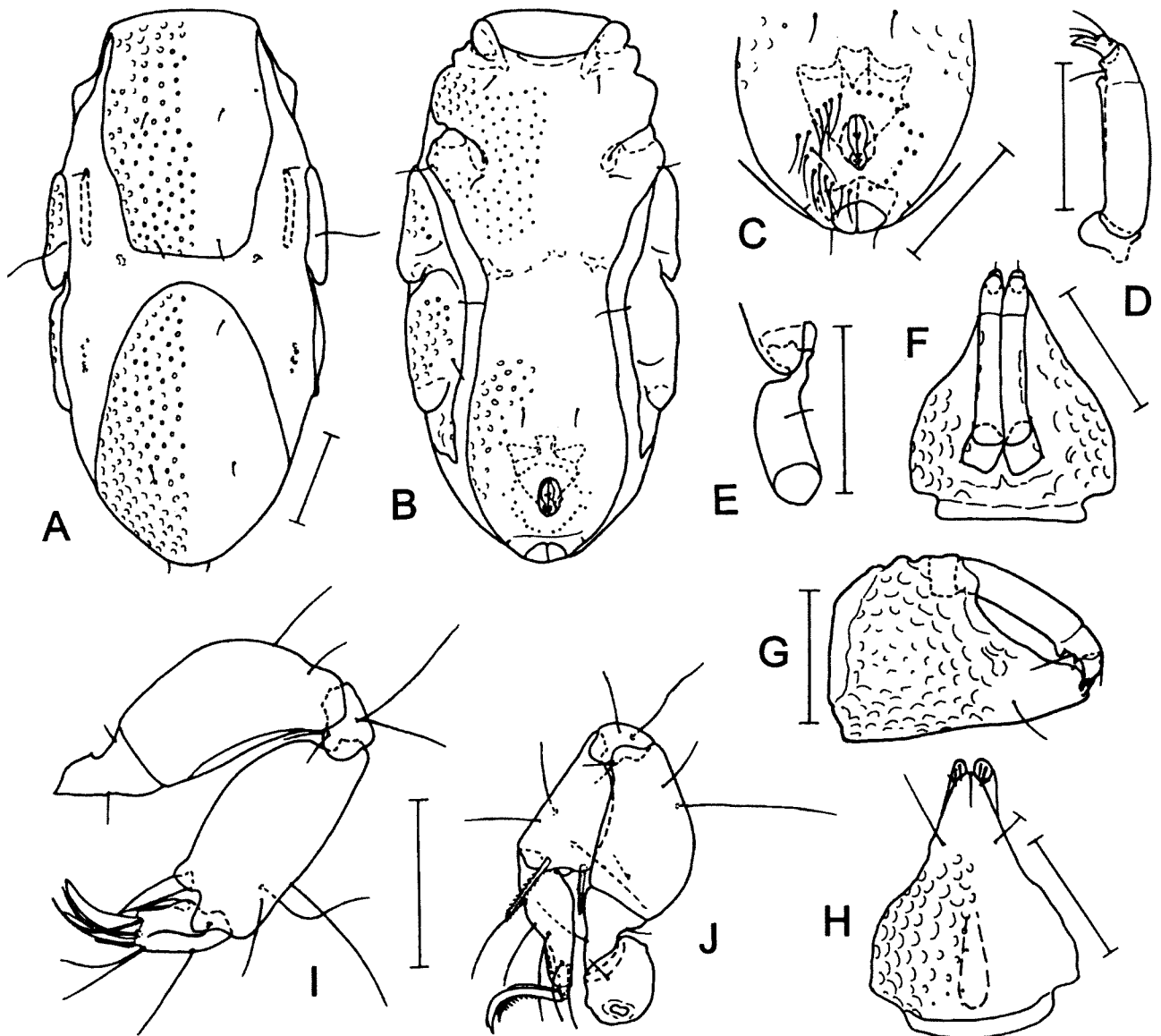
#### *Simognathus tener* sp. nov.

Figures 12A–J, 13A–D

#### Material Examined

##### Holotype

Male, Dampier, 20°39'S, 116°42'E, Western Australia, Australia; beach in recreation area, coarse



**Figure 12** A–J. *Simognathus tener* sp. nov. A, Idiosoma, dorsal, male; B, idiosoma, ventral, male; C, genital area, male; D, palp, medial, female; E, insertion of trochanter IV, ventral, male; F, gnathosoma, dorsal, male; G, gnathosoma, lateral, female; H, gnathosoma, ventral, male; I, basifemur to tarsus I, medial, male; J, leg II, medial, male. Scale = 50  $\mu$ m.

sand, mid-tide, 0–3 cm sediment depth, 3 August 2000, coll. I. Bartsch (WAM T52108).

#### Paratype

**Australia: Western Australia:** 1 female, collecting data same as above (WAM T52109).

#### Etymology

Specific name derived from *tener*, Latin, delicate, referring to the delicate ornamentation of the plates.

#### Diagnosis

Idiosomal length 290–320  $\mu\text{m}$ . Dorsal plates punctate, surface with small, faint foveae. AD shorter than PD. OC elongate, covered by membraneous integument. Anterior margin of PD ovate. AE and GA fused to elongate ventral shield; its surface covered by very delicate foveae. Foveae absent in area representing anterior portion of GA. Gnathosomal base foveate. Dorsum with raised cuticular markings, but without a dorsal lamella extending beyond base of palps. Palps long, more than half of idiosomal length. Second palpal segment elongate, with ventral protuberance, seta and an apical triangular lamella. Length of tibia I twice its height. Ventral spine on tibia I long, evenly tapering. Tarsi II to IV with six setae each, parambulacral setae included (solenidia omitted).

#### Description

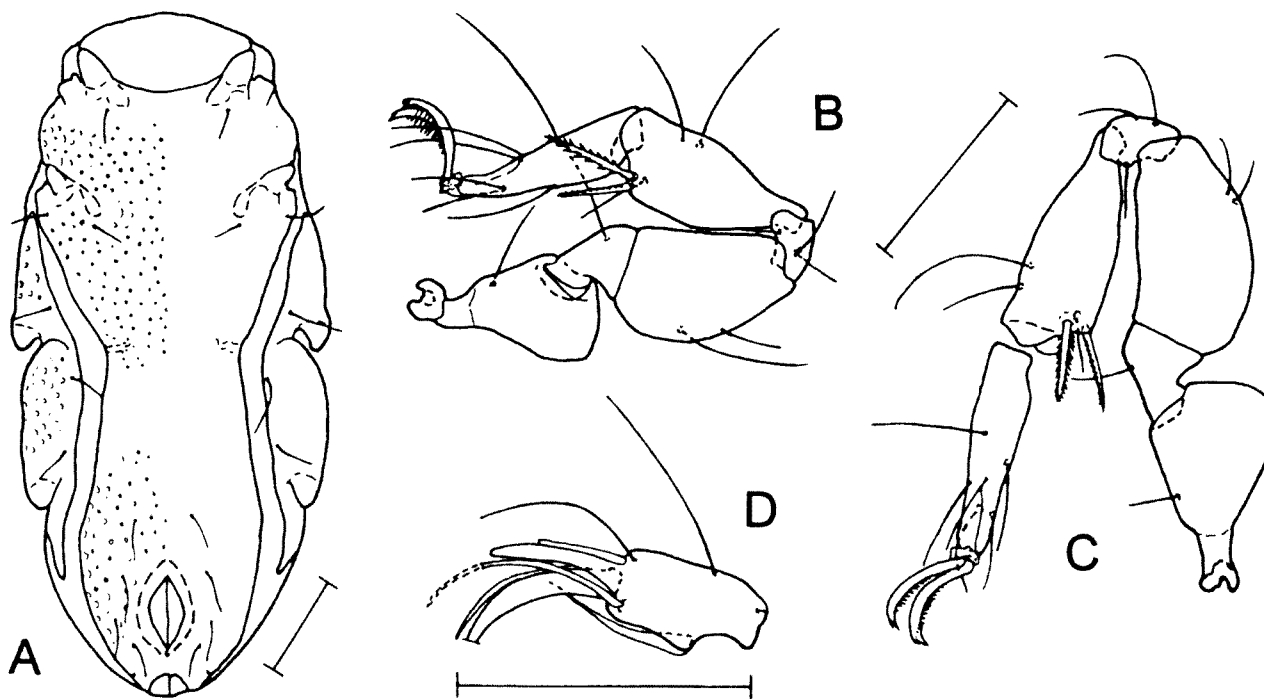
##### Male

*Idiosoma*. Male. Length 290  $\mu\text{m}$ , width 150  $\mu\text{m}$ ;

length:width ratio 1.9. Dorsal plates evenly punctate, surface with delicate foveae (Figure 12A). Length of AD 130  $\mu\text{m}$ , width 92  $\mu\text{m}$ ; posterior margin truncate. Gland pores tiny, near lateral margin. AD with ds-1 and ds-3, the latter removed from lateral margin of plate. Pair of ds-2 on OC which is hidden beneath striae of membraneous integument. Length of PD 147  $\mu\text{m}$ , width 102  $\mu\text{m}$ ; anterior margin ovate. PD with ds-4 and ds-5 (in holotype one of ds-4 lacking). Setae ds-6 in marginal position.

Ventral plates evenly punctate; surface largely covered by small, delicate foveae; these foveae absent in an area representing anterior part of GA and around GO (Figure 12B). AE and GA fused to a ventral shield; its length 263  $\mu\text{m}$ , width 122  $\mu\text{m}$ . Epimeral processes I to IV forming large lamellae (Figures 12B and E). PE extending posteriad beyond insertion of leg IV. AE with three pairs of setae; the two posterior ones at almost the same level. GO small, length 20  $\mu\text{m}$ , width 12  $\mu\text{m}$ . GA with one pair of outlying setae and 31 slender setae around GO. Spermatopositor extending beyond ring of pgs (Figure 12C).

*Gnathosoma*. Coarsely foveate (Figures 12F–H); its length 97  $\mu\text{m}$ , width 75  $\mu\text{m}$ . Dorsum of gnathosomal base roughly textured, without lamelliform tectum (Figure 12F); pair of lateral lamella enclosing P-1 (Figure 12G). Palps slender; second palpal segment long, about 0.6 of gnathosomal length; segment with ventromedial lamella and protuberance (Figure 12D), strong ventral seta, and triangular, distolateral lamella. The latter discernible in dorsolateral aspect.



**Figure 13** A–D. *Simognathus tener* sp. nov. A, Idiosoma, ventral, female; B, leg III, medial, female; C, leg IV, medial, female; D, tarsus I, lateral (medial setae and claw omitted, lateral pas in holotype broken), male. Scale = 50  $\mu\text{m}$ .

*Legs.* Telofemur and tibia I almost equal in length. Tibia II shorter than telofemur II. Base of tibia I cylindrical, then abruptly widened and almost equal in height in posterior half of segment (Figure 12I). Tibiae II to IV clavate (Figures 12J, 13B and C). Leg chaetotaxy (pas included, solenidion excluded): leg I, 1, 2, 2, 4, 5, 6; leg II, 1, 2, 3, 4, 5, 6; legs III and IV, 1, 1, 2, 3, 5, 6. Ventral spine of tibia I without basal apophysis but evenly tapering; medial seta flagellate. Tibiae II to IV each with two coarsely bipectinate setae. Each of tarsi I to IV with three dorsal setae, one ventral seta and a pair of pas. That ventral seta on tarsus I basally stout, then tapering. Solenidion of tarsus I setiform, famulus lamelliform (Figure 13D).

Median claw on tarsus I large, smooth, paired claws similar in length but slender, resembling parambulacral setae. Paired claws of tarsi II to IV with pectines, each with numerous tines.

#### Female

Length 320  $\mu\text{m}$ . Dorsal aspect resembling that of male. Ventral plates AE and GA fused (Figure 13A). GA with four pairs of pgs.

#### Remarks

*Simognathus tener* and *S. aspidiotus* Otto, 2000 share numerous characters, the AE and GA form a ventral shield; the males have a single pair of outlying setae, the palps are long and slender, the second segment is provided with a protuberance and distal lamella; tarsi II to IV each bear one ventral seta and a pair of pas. *Simognathus tener* has more slender dorsal plates and more delicate foveae than *S. aspidiotus*.

Species with a ventral shield are *S. abnormalus*, *S. aspidiotus* Otto, 2000, *S. clypeatus* Otto, 2000, *S. gibberosus* Bartsch, 1994, *S. salebrosus*, *S. scutatus* Bartsch, 1993, *S. tener*, *S. tropicalis* Chatterjee & de Troch, 2000, and *S. uniscutatus* Bartsch, 1994 (Bartsch 1993, 1994a; Chatterjee & de Troch, 2000; Otto, 2000a).

In contrast to the other above species, the AD of *S. gibberosus* bears a hyaline lens. *S. abnormalus* and *S. salebrosus* have an *Acaromantis*-like tibia I, elongate and rotated. In *S. scutatus* all ventral plates are fused, there are no striae of membraneous integument between AE and PE. Tarsi III and IV of *S. uniscutatus* have a ventral seta and a single pas, the medial but no lateral pas. In contrast, tarsi III and IV of *S. aspidiotus*, *S. clypeatus* and *S. tener* each bear a ventral seta and both a medial and lateral pas; in *S. clypeatus* one of the pas is doubled. The three species can be separated on the base of the ornamentation of the dorsal and ventral plates; the ventral plates are almost smooth in *S. clypeatus*, delicately foveate in *S. tener* and coarsely foveate in *S. aspidiotus*. The description of *S. tropicalis*, by Chatterjee & de Troch (2000), presents no

information on the arrangement and number of the pas.

According to Otto (2000a), the male of *S. gibberosus* (housed in the WAM) has the AE and GA separated. A re-examination of that male showed that the AE and GA are fused to a ventral shield but there is a rupture. Most likely, the slide had been pressed seriously, a pressure and distortion which caused a split in the integument of the mite which was soaked and hardened by the mounting medium (glycerin jelly). The rupture largely follows the borders of the relevant plates. Hence, according to present knowledge, males of *S. gibberosus* have a ventral shield.

#### Distribution

Indian Ocean, Western Australia, Dampier. From a tidal beach.

#### *Simognathus uniscutatus* Bartsch, 1994

Figure 14A–D

*Simognathus uniscutatus* Bartsch, 1994a: 145, figures 45–52.

#### Material Examined

**Australia: Western Australia:** 1 female, Enderby Island, West of Rocky Head, 20°32.1'S, 116°26.7'E, sponge garden, 2–13 m, unsorted sandy deposits, 3 August 2000, coll. C. Bryce (WAM T52110).

#### Diagnosis

Idiosomal length 390  $\mu\text{m}$ . Dorsal plates densely punctate and distinctly foveate. AD shorter than PD (Figure 14A). Anterior margin of PD truncate. OC reduced to oblong sclerite beneath striae of integument. Pair of ds-2 in anterior edge of that platelet. AE and GA fused (Figure 14B). This ventral shield with small foveae except for a smooth median portion representing anterior part of GA. AE with large epimeral processes. Female GA with four pairs of sgs. Gnathosomal base foveate; dorsally with raised cuticular ornamentation but without tectum-like lamella (Figure 14C). Second palpal segment elongate, with ventral protuberance, a seta and a triangular lamella. Leg chaetotaxy (solenidia omitted, pas included): leg I, 1, 2, 2, 4, 5, 6; leg II, 1, 2, 3, 4, 5, 6; legs III and IV, 1, 1, 2, 3, 5, 5. Tibia I short, with cylindrical base, then conspicuously widened (Figure 14D); its ventral spine evenly tapering, without apophysis. Pair of ventral spines on tibiae II to IV distinctly bipectinate. Tarsi I and II each with a wide ventral seta and a pair of eupathid pas; tarsi III and IV with a ventral seta and a single medial pas. On tarsus IV ventral seta and pas situated almost adjacent. Tarsus I with large median and slender paired claws. Paired claws of the following legs with coarsely dentate pectines. Central sclerite with small process.

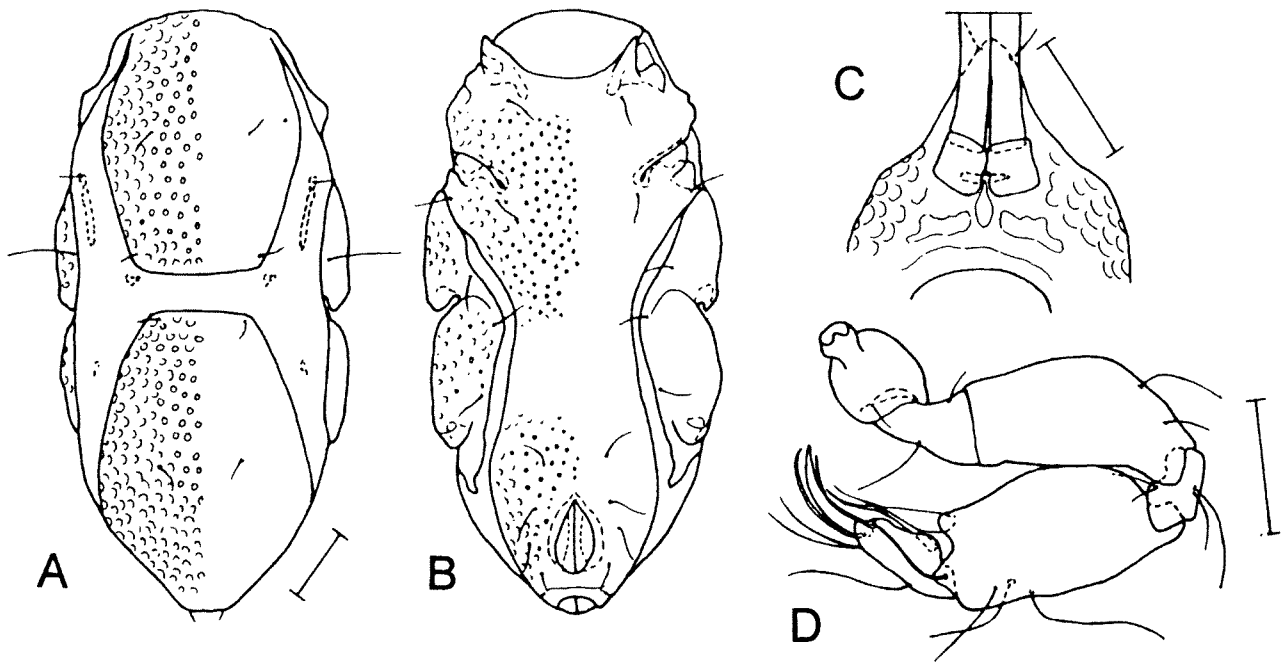


Figure 14 A–F. *Simognathus uniscutatus* Bartsch, 1994, female. A, Idiosoma, dorsal; B, idiosoma, ventral; C, part of gnathosoma, dorsal; D, leg I, medial. Scale = 50 µm.

#### Remarks

The present female is larger than the holotype female from Rottnest Island, Western Australia (390 µm vs 322 µm) and basifemur I bears two instead of three setae, as present in the holotype of *Simognathus uniscutatus*. Two setae on basifemur I is the usual number in the majority of *Simognathus* species and the presence of three setae is expected to be an anomaly and of no taxonomic relevance.

#### Distribution

Western Australia, Rottnest Island and Dampier.

#### FAUNAL COMPARISON

From Australia, information on psammophilous halacarid species is available from Rottnest Island and Dampier, Western Australia, and the Great Barrier Reef Marine Park and Coral Sea, Queensland. Though the data sets are far from complete, a preliminary comparison of the faunas can be made.

Rottnest Island, at a latitude of about 32°S, is characterized by numerous sandy beaches separated by limestone platforms. The beaches, with different exposure to waves and currents, demonstrate a variety of grain size composition. Rottnest Island lies in a transition zone between the warm-temperate and tropical zone (Wells and Walker, 1993).

Dampier is in the tropical arid zone, at about 20°S. The coastline is dominated by muddy and silty flats or mud-covered rocky platforms in the mid- and lower tidal zone, rocks, boulders and mangroves in

the higher tidal area. Sandy deposits with coarse and medium-sized grains are rare. The subtidal sediment immediately off Dampier is rich in organic material but around the outer islands of the Dampier Archipelago there are coarse sediments.

The tropical Great Barrier Reef Marine Park and adjacent Coral Sea cover a latitudinal area from about 14° to 21°S. There is a variety of different substrata, amongst others areas with fine to coarse sand and coral rubble.

The number and extent of collections performed in the three areas Rottnest Island, Dampier and Great Barrier Reef vary from sampling just once, during a short stay of about two and a half weeks (Rottnest Island, Dampier) to numerous collections taken in a period of about two years (Great Barrier Reef). Additional species (Table 1) are expected to be found in all three areas.

Table 1 Halacarid genera and number of psammophilous species recorded from the Dampier area, Rottnest Island, the Great Barrier Reef and Coral Sea.

	Dampier	Rottnest Island	Great Barrier Reef, Coral Sea
<i>Actacarus</i>	2	2	4
<i>Anomalohalacarus</i>	1	1	0
<i>Arhodeoporus</i>	1	2	7
<i>Copidognathus</i>	1	7	14
<i>Scaptognathides</i>	2	1	3
<i>Scaptognathus</i>	1	2	8
<i>Simognathus</i>	4	7	12

**Table 2** Psammophilous halacarid species from Dampier area and notes on records from other areas. +, record; -, no record

Dampier	Other areas
<i>Actacarus pacificus</i>	+ (Rottneist I., Hokkaido, Hawaiian Is, Robinson Crusoe I.)
<i>Actacarus festivus</i>	-
<i>Anomalohalacarus dampierensis</i>	-
<i>Arhodeoporus corallicolus</i>	+ (Great Barrier Reef)
<i>Copidognathus meridianus</i>	-
<i>Scaptognathides hawaiiensis</i>	+ (southern China, Hawaiian Is)
<i>Scaptognathides ornatus</i>	+ (Hawaiian Is)
<i>Scaptognathus exquisitus</i>	+ (Great Barrier Reef)
<i>Simognathus salebrosus</i>	-
<i>Simognathus platyaspis</i>	+ (Great Barrier Reef)
<i>Simognathus tener</i>	-
<i>Simognathus uniscutatus</i>	+ (Rottneist I.)

In the Dampier area, the collection from sandy deposits and coral fragments contained 12 species, seven of them have been recorded previously from other areas, two species from the Indian and six from the Pacific Ocean and adjacent basins, three from the Great Barrier Reef and three from the Hawaiian Islands (Table 2). The data on the psammobiont halacarid fauna corroborates an assumption of the presence of a rather uniform tropical coastal fauna from North West Cape across the northern Australian coastline to Queensland and also to the Hawaiian Islands. Yet, because of the small size of psammobiont halacarids and hence difficulties in recognizing details, the presence of cryptic species cannot be excluded. Studies on the tidal rhombognathine halacarids from Dampier also demonstrated close similarities with the fauna of the northeastern Australia (Bartsch, 2003a).

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