Invertebr. Taxon., 1993, 7, 875–84

Haptolana pholeta, sp. nov., The First Subterranean Flabelliferan Isopod Crustacean (Cirolanidae) from Australia

Niel L. Bruce[A] *and W. F. Humphreys*[B]

[A] Queensland Museum, P.O. Box 3300, South Brisbane, Qld 4101, Australia.
Present address: Zoologisk Museum, University of Copenhagen,
Universitetsparken 15, DK 2100, Copenhagen Ø, Denmark.
[B] Western Australian Museum, Francis Street, Perth, W.A. 6000, Australia.

Abstract

The genus *Haptolana* Bowman, 1966 is rediagnosed, and is characterised by the unique synapomorphy of pereopods 2–7 having an expanded propodus, the palm of which contains a V-shaped series of spines and a haptorial dactylus which folds in between these spines. *Haptolana pholeta,* from anchialine waters on Barrow Island, Western Australia, is described, and is distinguished from the two other species of *Haptolana* in possessing a frontal lamina that is anteriorly rounded, that separates the antennule bases and is visible in dorsal view.

Introduction

That Australia is an arid continent can be regarded as a truism, and the freshwater fauna of the continent is inevitably found to be impoverished when compared with the wetter continents. Cave waters in Australia are correspondingly scarce and have, until the present decade, received little attention from biologists. Recently, several new cave-dwelling crustanceans have been described from Australia, all from tropical western and northern Australia (Holthuis 1986; Bruce 1992; Poore and Humphreys 1992; Wilson and Ponder 1992), indicating that a reasonably rich subterranean aquatic fauna does exist. The discovery of a blind subterranean cirolanid isopod is here added to those recent discoveries; it is both the first cirolanid and the first flabelliferan isopod recorded from subterranean waters in Australia (the ordinal status of Wilson and Ponder's taxon is at present unresolved).

Cave-dwelling isopods have been reviewed by Botosaneanu (1986) and Bănărescu (1990). Cirolanids are arguably the best represented of the subterranean isopod families, with 17 genera and nearly 50 species (Botosaneanu *et al.* 1986, updated here by N.L.B.). Most of these records are from two regions: the Western North Atlantic, comprising the Caribbean and adjacent continental regions of Mexico and the United States of America, and the Mediterranean continental and island regions of Europe, the Middle East and North Africa. Scattered records of *Anopsilana* Paulian & Delamare Deboutteville exist from elsewhere (Paulian and Delamare Deboutteville 1956; Bowman and Iliffe 1987; Bruce and Iliffe 1993), but only the north-eastern corner of Africa (Ethiopia and Somalia) has more than a single record (Messana 1990) of stygial cirolanid isopods. There is only one record of a subterranean cirolanid (*Anopsilana poissoni* Paulian & Delamare Deboutteville from Madagascar) from the Southern Hemisphere. The discovery of a species of *Haptolana* from Western Australia is therefore of some interest.

0818-0164/93/040875$05.00

Methods

All appendages were dissected from the right-hand side with the exception of the mandibles, both of which were dissected.

Specimens are deposited at the Western Australian Museum, Perth (WAM), and Queensland Museum, Brisbane (QM)

Terminology

The word *prehensile* has been used to describe the dactylus of isopods that have hook-like or claw-like pereopods. Kensley and Schotte (1989) define the term simply as 'adapted for holding or clinging', and define *ambulatory* as 'adapted to walking'. Notably, the word prehensile is used to describe the dactylus of cymothoid isopods and is one of the defining characters of that family. Notenboom (1984) discussed the use of the term, misquoting a personal communication from N. L. Bruce in this regard. The opportunity is taken here to present a reassessment of the terms used in describing the pereopods of cirolanids and related flabelliferan families.

Those isopods with a markedly swollen propodus (usually pereopod 1) and a long dactylus have been described as having a subchelate first pereopod (e.g. Serolidae—see Harrison and Poore 1984; Anthuridea—see Poore and Lew Ton 1988). In the Cirolanidae there are a few genera in which the dactylus is elongate (0·5–1·0 times as long as the propodus) and may or may not be reflexed against the propodus. Such a dactylus has been referred to as prehensile or subprehensile. It is clear that such a dactylus is not prehensile in the sense of those of the Cymothoidae, where the dactylus is stout, strongly curved or claw-like and usually extends to the merus.

The dactylus of genera such as *Haptolana* are better described as *haptorial* (clasping), and those in which the dactylus is short (less than 0·5 times the length of the propodus) and not obviously reflexed can be distinguished as *ambulatory* (e.g. *Cirolana, Anopsilana*) or *subhaptorial* (*Metacirolana*). Examples of genera with haptorial dactyli are *Haptolana* (pereopods 2–7), *Arubolana* Botosaneanu & Stock, 1979, *Hansenolana* Stebbing, 1990 (see Bruce 1986), and *Speocirolana* Bolivar (pereopods 1 or 1–3) (see Bowman 1982). *Bahalana* Carpenter, 1981 has pereopods 1–3 with elongate dactyli (about 0·86 times as long as propodus), but these are neither strongly curved nor reflexed and therefore cannot be considered prehensile or haptorial. They are simply long (see Notenboom 1981; Bowman 1987). It should also be borne in mind that intermediate forms of the dactylus may occur.

The abbreviation PMS is used for plumose marginal setae.

Taxonomy

Family **Cirolanidae** Dana

Genus *HAPTOLANA* Bowman

Haptolana Bowman, 1966: 105.—Messana and Chelazzi, 1984: 296; Bruce, 1986: 222; Kensley and Schotte, 1989: 137.

Type species: *Haptolana trichostoma* Bowman, 1966, by monotypy.

Diagnosis

Body smooth, unornamented; without chromatophores or pigment; eyes absent. Pleon with 5 unfused segments; posterolateral margins of pleonite 4 extending posteriorly beyond pleonites 3 and 5; pleotelson not fused to pleonite 5. Ventral surface of frontal lamina flat. Pereopod articles not flattened or expanded, with few setae. Pereopod 1 ambulatory, pereopods 2–7 with moderately expanded propodus, 2·0–3·0× as long as greatest width, posterior margin convex, palm provided with large (10–26% propodal length) spines in 2 divergent rows (forming a V-shape); dactylus of pereopods 2–7 haptorial, 0·6–1·0× length of propodus, folding between palm spines. Pleopods 3–5 endopods without PMS, smaller than exopod. Uropod with peduncle mesial margin produced.

Additional Characters

Articles 1 and 2 of antennule peduncle fused (*H. trichostoma*, *H. pholeta*, sp. nov.); antenna peduncle with 5 articles. Mandible incisor, spine row, molar process and palp entire; maxillule entire; maxilla entire. Maxilliped entire, endite with 1 coupling hook. Penial papillae small, close set in medial position at posterior of sternite 7 (not described for *H. trichostoma*). Both rami of pleopods 1 and 2 with PMS; pleopod 1 peduncle shorter

(0·5–0·8) than wide, rami not operculate; appendix masculina of pleopod 2 arising basally; exopods of pleopods 3–5 with entire or partial suture. Uropods and posterior margin of pleotelson with PMS, amongst which are set 2–17 stout spines.

Remarks

The principal and diagnostic synapomorphy for *Haptolana* is the haptorial morphology of pereopods 2–7. While it is possible that this is a convergent character, the uniformity of the shape and spinal armature of the propodus suggest otherwise. The propodus and dactylus of pereopods 4–7, in particular, differ substantially from those of most other cirolanid genera, which are usually straight-sided, slender, with short spines on the posterior margin, and have a short dactylus (0·3 times the length of propodus in *Cirolana* species, 0·3–0·5 times the length of propodus in *Natatolana* species: Bruce 1986). The endopods of pleopods 3–5 are without plumose marginal setae, but this loss is associated with freshwater habitats (Bruce 1981, 1986; Bowman and Franz 1982) and is not here considered to be of phylogenetic significance. The antennule, antennal, mouthpart, pleopod, uropod and telson morphology is otherwise similar to that of *Cirolana* Leach and, within that genus, most similar to the *Cirolana parva* group of species.

The only significant differences that exist between species of *Haptolana* are in the shape of the frontal lamina, the appendix masculina, and possibly details of the ischium, merus and carpus of pereopods 4–7. In *Haptolana pholeta*, sp. nov. the frontal lamina is flat, broadly rounded anteriorly, and visible in dorsal view; in ventral view it clearly separates the antennule bases. In the other two species the frontal lamina is pentagonal, and does not extend anteriorly between the antennule bases. The appendix masculina of all species arise basally, but that of *H. pholeta* is straight, while those of the other two species arc strongly in a lateral direction. Finally, pereopods 4 and 5 of *H. trichostoma*, as figured by Bowman (1966), appear to have the ischium, carpus and merus somewhat flattened, and with a continuous row of setae along their posterior margins (Bowman did not illustrate pereopods 6 or 7); the pereopods otherwise are similar to those of *H. somala* and *H. pholeta*.

Although the difference in morphology of the frontal lamina is substantial, that and the other differences mentioned are well within the limits of accepted generic boundaries.

Contrary to the doubts expressed by Messana and Chelazzi (1984) and Messana (1990) we would uphold the placement of *H. somala* in *Haptolana*.

Included Species

Haptolana trichostoma Bowman, 1966. Known only from the type locality, a freshwater cave in Cuba.

Haptolana somala Messana & Chelazzi, 1984. Known from springs and wells in several localities in eastern Somalia, up to 150 km from the coast.

Haptolana pholeta, sp. nov. Described here from Western Australia.

Distribution

The three species of *Haptolana* are all from tropical regions (see Fig. 4) that would have been under sea water prior to the sea-level changes of the Miocene, and therefore correspond to the concept of Tethys relicts given by Newman (1991).

Key to the Genus *Haptolana*

1. Pleotelson subtruncate, posterior margin with 17 spines; distal margin of uropod endopod subtruncate .... *H. trichostoma*
   Pleotelson linguiform, posterior margin with 10 or fewer spines; uropod endopod with mesial and lateral margins converging to narrow apex 2
2. Posterior margin of pleotelson with 2 spines; frontal lamina pentagonal, anterior margin acute, not visible in dorsal view .... *H. somala*
   Posterior margin of pleotelson with 8–10 spines; frontal lamina widest anteriorly, anterior margin rounded, visible in dorsal view .... *H. pholeta*

Haptolana pholeta, sp. nov.
(Figs 1–3)

Material Examined

All material is from Barrow I., W.A., coll. W. F. Humphreys and B. Vine.

Holotype. ♂ (6·5 mm), Cave B1, 20°48′S.,115°19′E., 29.vii.1992, in traps (WAM 41/93).

Paratypes. 2♂ (4·5, 4·8 mm), ♀ (non-ovig., 4·6 mm), same data as holotype (WAM 42/93); 2♀ (non-ovig., 5·1, 6·6 mm), Cave B1, 25.vii.1992 (WAM 43/93); manca, Cave B1, 27.iv.1992 (WAM 45/93); ♂ (4·8 mm), 2♀ (non-ovig., 5·8, 6·3 mm), Well B2, 20°43′S.,115°21′E., 25.vii.1992 (QM W18460); ♂ (6·3 mm), Well L16, 20°49′S.,115°23′E., 27.vii.1992, dead on collection (WAM W44/93).

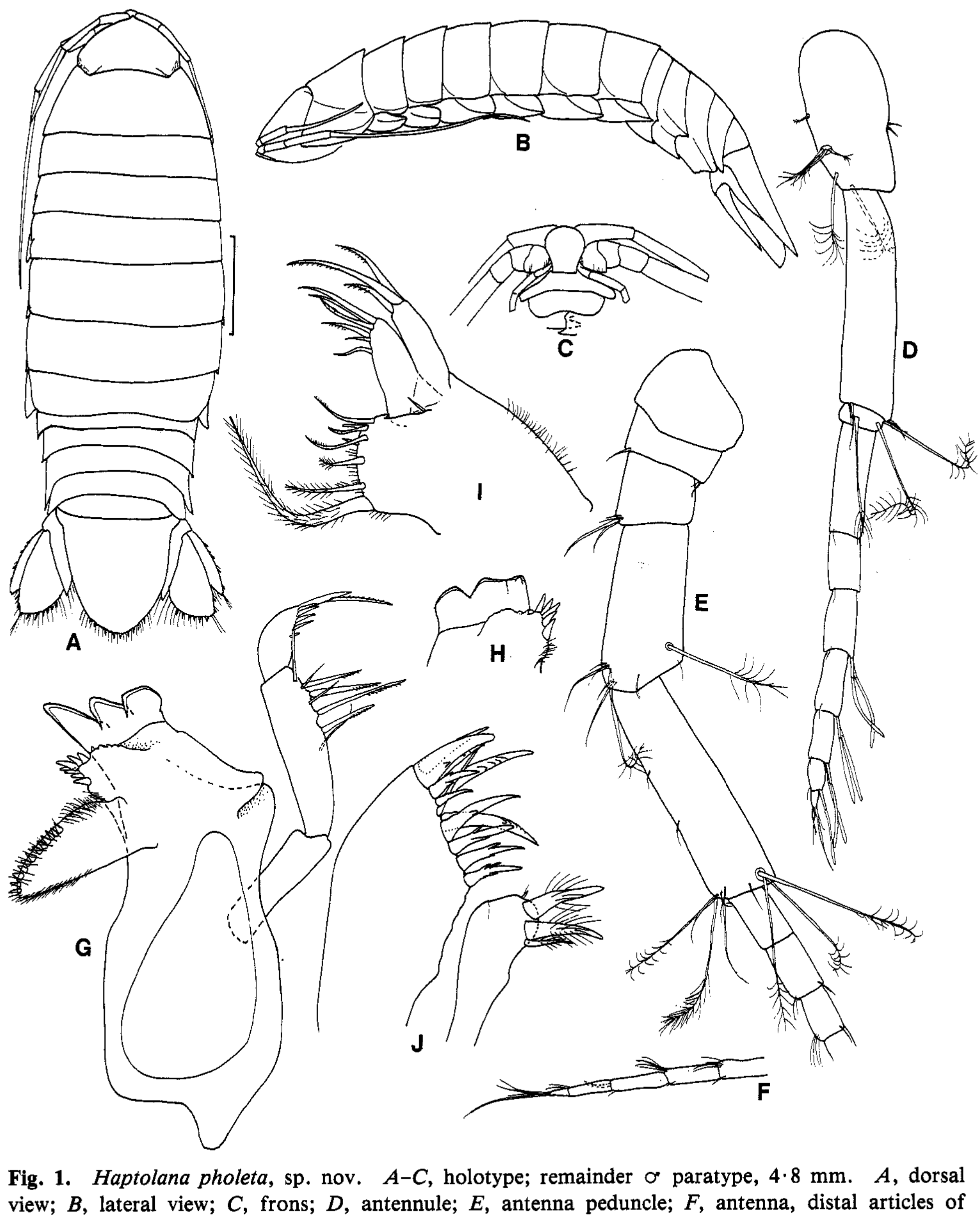

Fig. 1. *Haptolana pholeta*, sp. nov. *A–C*, holotype; remainder ♂ paratype, 4·8 mm. *A*, dorsal view; *B*, lateral view; *C*, frons; *D*, antennule; *E*, antenna peduncle; *F*, antenna, distal articles of flagellum; *G*, right mandible; *H*, left mandible, incisor and spine row; *I*, maxilla; *J*, maxillule. Scale line, 1·0 mm.

Description

Male

Body 3× as long as greatest width, widest at pereonites 5 and 6; pereonite 1 longest, $2<3=4<5=6>7$; coxae 2–7 each with entire diagonal suture; pereonite 1 with 2 fine lateral longitudinal sutures; cephalon with rostral point, without sutures or carinae. Pleotelson linguiform, 0·9× as long as proximal width; posterior margin with small caudomedial point, on either side of which lie 9 spines set amongst PMS.

Antennule peduncle article 3 1·3× as long as coalesced articles 1 and 2; article 4 0·1× as long as article 3; flagellum slightly shorter than peduncle, composed of 7 articles, extending to pereonite 2. Antenna articles 1–3 of peduncle short, article 4 2·8× as long

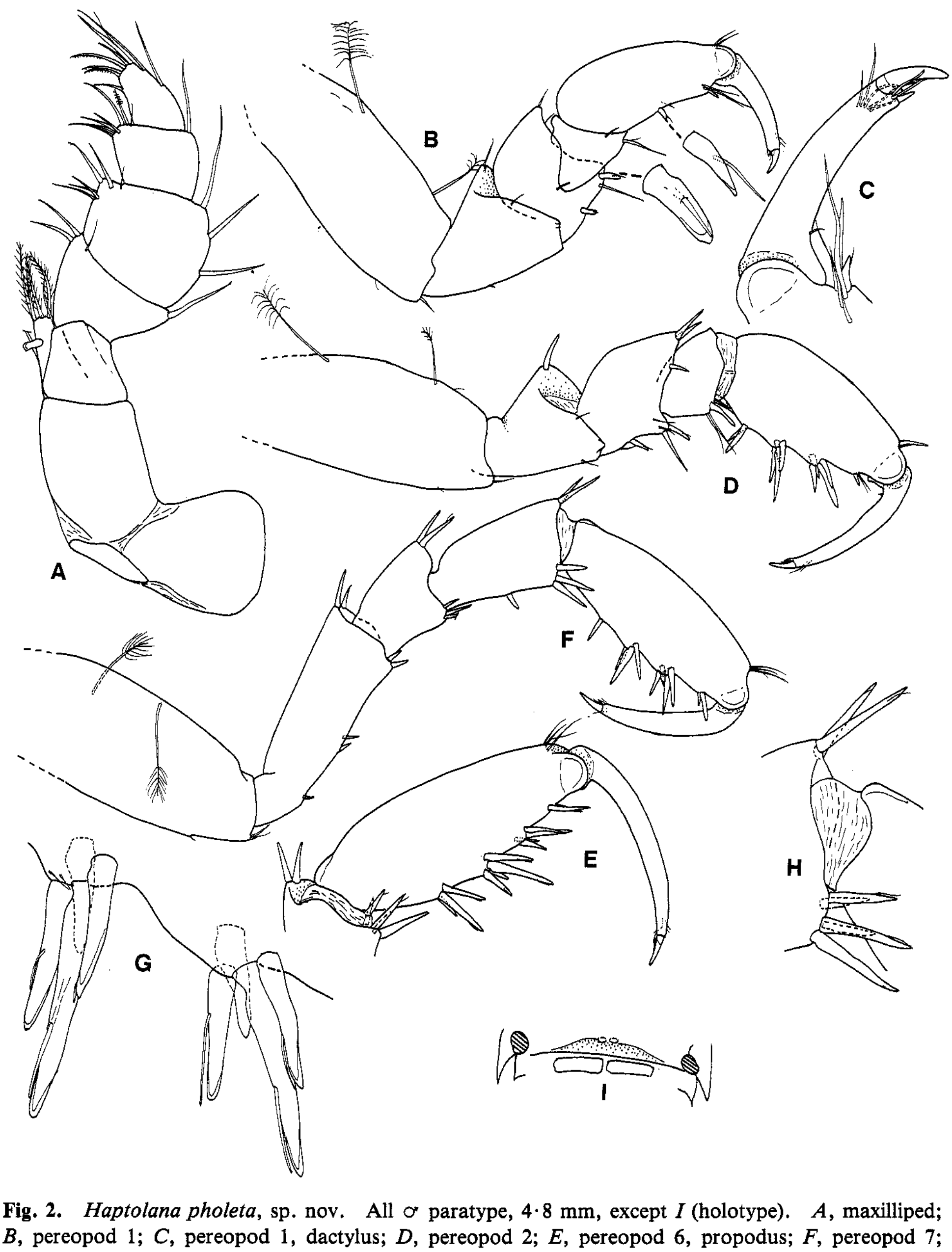

Fig. 2. *Haptolana pholeta*, sp. nov. All ♂ paratype, 4·8 mm, except *I* (holotype). *A*, maxilliped; *B*, pereopod 1; *C*, pereopod 1, dactylus; *D*, pereopod 2; *E*, pereopod 6, propodus; *F*, pereopod 7; *G*, spines, pereopod 2, propodus; *H*, distal margin of carpus, pereopod 7; *I*, penial papillae.

as article 3, article 5 $1{\cdot}3\times$ as long as article 4; distal margin of article 4 with 2 long brush-tipped setae, distal margin of article 5 with 5 long brush-tipped setae; flagellum composed of 16 articles, extending to middle of pereonite 5.

Frontal lamina broadly rounded anteriorly and distolaterally, maximum width $1{\cdot}7\times$ as wide as basal width; anterior margin separating antennule bases, visible in dorsal view.

Mandible spine row with 5 (left mandible) or 7 (right) spines, and 2 blunt lateral tubercles; molar process with setules along mesial and proximal lateral margin; lateral margin with 12 teeth, proximal $\frac{1}{3}$ without teeth; article 2 of palp with 4 serrate and 4 simple setae, article 3 with 7 setae, distal 2 of which are manifestly longest. Maxillule lateral lobe with 12 stout spines and 1 slender spine on gnathal surface; mesial lobe with 3 weakly circumplumose spines, proximal one being reduced in size, less than half as wide and $0{\cdot}66\times$ as long as others. Maxilla lateral lobe with large recurved circumplumose seta at proximal angle, and further 4 plumose seta and 2 simple setae on mesial margin; middle and lateral lobes with 6 and 3 serrate setae respectively. Maxilliped palp articles 2–5 with

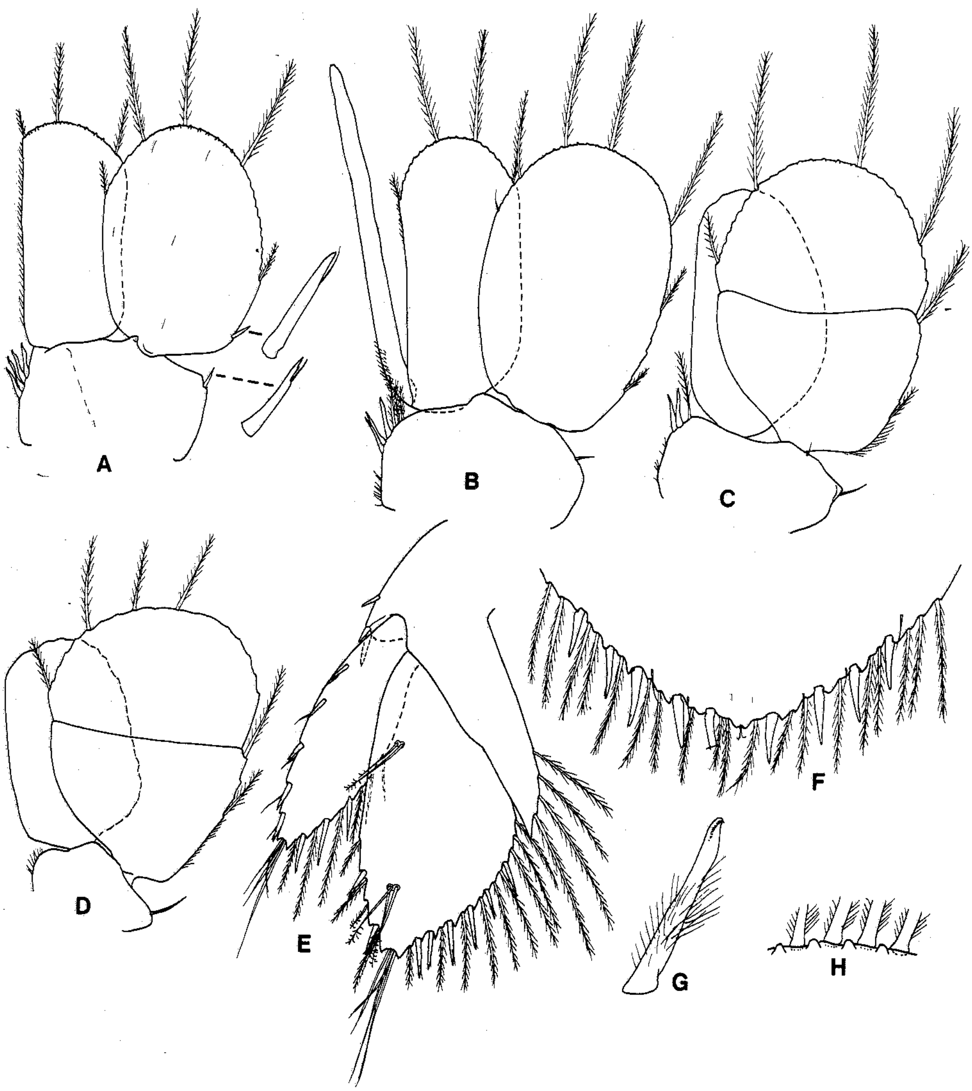

Fig. 3. *Haptolana pholeta*, sp. nov. All ♂ paratype, $4{\cdot}8$ mm, except *B* (holotype). *A–D*, pleopods 1–3, 5 respectively; *E*, uropod; *F*, pleotelson, posterior margin; *G*, coupling hook, pleopod 1; *H*, distal margin of endopod, pleopod 1.

1, 3, 1 and 2 simple setae respectively on lateral margin; mesial margins with 2, 4, 6 and 7 setae respectively at distomesial angle; endite with 5 circumplumose setae.

Pereopod 1 merus posterior margin with 2 spines and single seta; propodus with single acute spine on palm, second spine opposite base of dactylus; dactylus 0·7× length of propodus. Pereopod 2 ischium with single spine at anterodistal angle; merus with 2 spines at anterodistal angle, 1 spine on posterior margin, 1 at posterodistal angle and 1 at lateral margin; carpus short, 0·3× length of propodus, posterodistal angle with 2 spines; propodus with 3 clusters of 2, 4 and 4 spines on palm, 1 spine opposite base of dactylus; dactylus about 0·8× length of propodus. Pereopod 6 similar to 7, palm of propodus with 4 clusters of 3, 4, 4 and 2 spines; dactylus 0·8× length of propodus. Pereopod 7 ischium with 2 spines on posterior margin, 2 spines each at posterodistal and anterodistal angles; merus with 2 spines at anterodistal angle, 3 at posterodistal angle; carpus 0·6× length of propodus, with 1 spine on posterior margin, 2 at anterodistal angle and 5 at posterodistal angle; propodus with clusters of 1, 4, 4 and 2 spines on palm; dactylus 0·7× length of propodus.

Pleopod 1 peduncle 0·65× as long as wide, with 4 coupling hooks on mesial margin, single short acute spine on lateral margin; distal margin of exopod rounded, with about 30 PMS; single acute spine at proximolateral angle; endopod with 12 setae on distal margin only, mesial margin straight, lateral margin weakly concave; distal margin of both rami with small cuticular nodules between setae. Pleopod 2 generally similar to 1, exopod with about 40 PMS, endopod with 20 PMS; appendix masculina 1·3× as long as endopod. Exopods of pleopods 3–5 each with complete transverse suture, with 34, 32 and 22 PMS respectively; pleopod 5 endopod without distinct proximomesial lobe.

Uropod rami not extending beyond posterior margin of pleotelson. Exopod about 0·86× as long as endopod, apex bifid, mesial process slightly longer than lateral; lateral margin with 5 acute spines each with adjacent simple setae, mesial margin with 3 acute spines and 6 PMS. Lateral margin of endopod with 2 acute spines, 3 simple setae and single sensory seta set between the two spines; mesial margin with 6 acute spines and 9 PMS, apex subequally bifid; peduncle with single short acute spine on lateral margin, 2 spines at ventrolateral angle; distomesial margin with 3 PMS.

Female

Similar to male; ovigerous females not present.

Size

Males 4·5–6·5 mm, females 4·6–6·6 mm.

Variation

The appendix masculina of the largest male (the holotype) is significantly longer than that of the 4·8-mm male dissected, being 1·30 times as long as the endopod in the larger specimen compared with 1·08 in the smaller; the larger male also has more PMS on the rami of pleopod 2 (exopod 40, endopod 20) than the smaller male (exopod 30, endopod 13).

Spine counts for the pleotelson were 8 (43%, $n = 7$), 9 (28·5%) and 10 (28·5%). The lateral margin of the uropod exopod had 5 (35%, $n = 14$) or 6 spines (64%), the mesial margin most commonly had 3 spines (93%, $n = 14$); the lateral margin of the endopod had 2 (42%, $n = 14$) or 3 spines (50%), the mesial margin most commonly had 5 (57%, $n = 14$) or 6 spines (28%), one specimen each being observed with one ramus with 4 spines and one with 7 spines.

Remarks

The flat and widely rounded frontal lamina, visible in dorsal view, the straight appendix masculina and the linguiform pleotelson with 8–10 spines immediately separate *Haptolana pholeta* from its congeners.

Etymology

The epithet is derived from the Greek *pholeter*—one who lives in a hole.

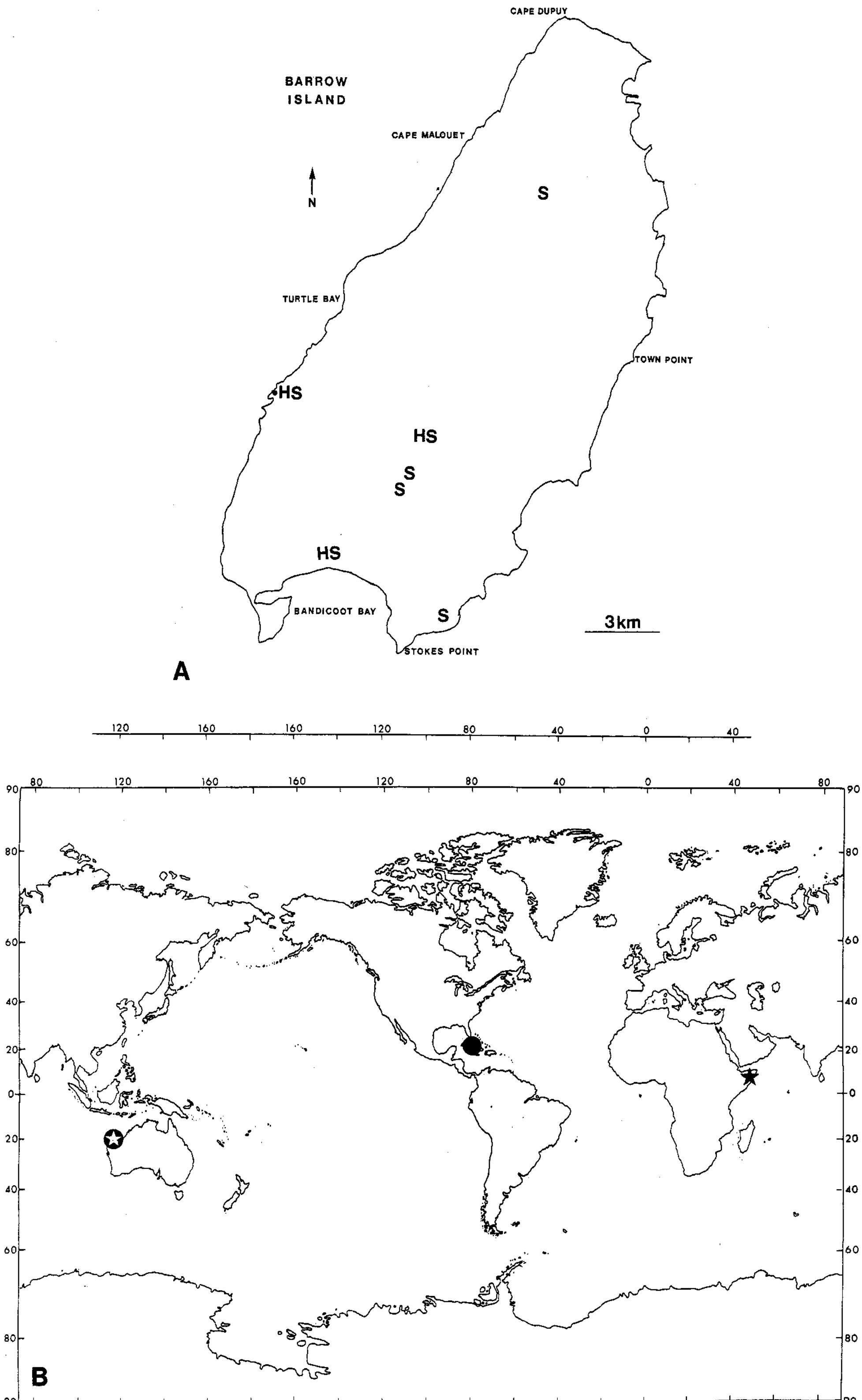

Fig. 4. *A*, distribution of *Haptolana pholeta*, sp. nov. (H) and *Stygiocaris stylifera* (S) on Barrow I. *B*, world distribution of *Haptolana*: ✪, *Haptolana pholeta*; ●, *Haptolana trichostoma*; ★, *Haptolana somala*.

Habitat of Haptolana pholeta

The north-west of Western Australia is currently arid to semiarid and experiences highly unpredictable rainfall (Humphreys *et al.* 1989). A rich stygofauna inhabits the low-lying areas of the North West Cape peninsula (Humphreys and Adams 1991; Poore and Humphreys 1992) and Barrow Island, 160 km to the north-east. Both are part of the same geological structure, the Cape Range Formation, which is an anticline capped with Lower Miocene marine limestones, some of which are highly cavernous (Humphreys *et al.* 1989).

Haptolana pholeta was, together with *Stygiocaris stylifera* Holthuis (Decapoda: Atyidae), collected at three locations on Barrow Island (Fig. 4): in surface waters of an anchialine cave (Cave B1) opening 40 m from the sea cliffs, in an old water bore 0·7 km from the sea shore (Well B2), and in a newly drilled anode bore (Well L16) in the centre of the island, 5·15 km from the nearest sea shore.

Cave B1 is markedly tidal and this is reflected in both the pH and salinity values (Table 1). The location furthest from the sea (Well L16) is the least saline, as would be expected from hydrodynamic considerations. The acidity of the two wells (Table 1) is probably due to the natural emissions of hydrogen sulphide gas found in parts of Barrow Island.

Table 1. Location and characteristics of collection sites for *Haptolana pholeta* sp. nov. on Barrow Island

Field No.	Location	Coordinates	Type	pH	Salinity (p.p.t.)	Means of capture
505	Cave B1	20°48′S.,115°19′E.	Anchialine cave, 16 m deep to water	7·5	24	Hand net
520	Well B2	20°52′S.,115°21′E.	Old water bore *c.* 8 m deep to water	6·6	25	Trap
540	Well L16	20°49′S.,115°23′E.	New anode bore *c.* 45 m deep to water[A]	6·6	5	In water sample, dead on capture

[A] Strong smell of H_2S in water sample, probably due to disturbance of sediment and hence the dead specimen.

Acknowledgments

We thank Brian Vine, Honorary Associate of the Western Australian Museum, for his essential support in the field, and Dr L. B. Holthuis and M. Adams for examining the shrimp specimens. Field work on Barrow Island was conducted with the permission of the Department of Conservation and Land Management and was funded fully by West Australian Petroleum Pty Ltd. This study was completed while in receipt of an Australian Biological Resources Study grant to N.L.B.

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Manuscript received 12 November 1992; accepted February 1993