

# Revision of the crown crabs, genus *Hymenosoma* (Crustacea: Hymenosomatidae), of South Africa

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(with 8 figures and 1 table)

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Recent genetic studies have shown that the South African crown crab, *Hymenosoma orbiculare*, in fact represents five distinct species, three of which are new to science and one of which needs to be resurrected. Three of these species occur in the southwestern Cape, the remaining two being found in estuaries on the South East and East coasts of South Africa. Based on genetic evidence and morphological analyses, *H. geometricum* Stimpson, 1858 is no longer considered a junior synonym of *H. orbiculare*, and is resurrected as a full species. A deeper-water species from False Bay, *H. trilobatum* sp. nov. as well as two East coast species, *H. longicrure* sp. nov. and *H. projectum* sp. nov., are described. The true *H. orbiculare* ranges from Walvis Bay in Namibia to the Gqunube Estuary near East London. *H. geometricum* and *H. trilobatum* sp. nov. are both found in deeper water and are currently known only from False Bay. *H. longicrure* sp. nov. is found from the Qolora Estuary to the Mngazi Estuary in the Eastern Cape and *H. projectum* sp. nov. along the east coast from the Mzimvubu Estuary to Lake Sibaya and Kosi Bay. The size and shape of the rostrum and ornamentation of the carapace are the main features distinguishing species. *H. orbiculare* has a smooth, simple rostrum and only two pairs of plain teeth on the carapace; *H. geometricum* has a very complex, long, trilobate rostrum and three pairs of complex, granulate teeth on the carapace; *H. trilobatum* sp. nov. has a less complex, extended, trilobate rostrum with smooth margins and granulate surface, with only two pairs of teeth on the carapace; *H. longicrure* sp. nov. and *H. projectum* sp. nov. both have a simple rostrum, little ornamentation on the carapace and unusual abdominal projections.

**Key words:** *Hymenosoma*, new species, crown crab, South Africa, taxonomy

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## INTRODUCTION

Members of the family Hymenosomatidae, commonly known as false spider crabs or crown crabs, occur mainly in tropical and subtropical, shallow coastal waters and low-salinity habitats in the Indo-West Pacific (Lucas 1980; Chuang & Ng 1994). Hymenosomatids can occur in high densities and are common in the gut contents of fish, playing a significant role in food webs (Lucas 1980). They are among the smallest members in the infraorder Brachyura, with a maximum carapace width of only 3–26 mm (Lucas 1980). This, combined with their dull and cryptic colouration (Chuang & Ng 1994), makes them inconspicuous (Lucas 1980) and partially explains why they are so poorly known and studied.

Studies of the taxonomy of the family have been published for Australia (Lucas 1980), New Zealand (Melrose 1975), Southeast Asia (Ng & Chuang 1994) and more recently, South Africa (Edkins *et al.* 2007; Teske *et al.* 2009). The recorded number of genera and species is constantly increasing, Lucas (1980) reported 10 genera and 64 species, Edkins *et al.* (2007) 16 genera and 90 species and Ng *et al.* (2008) 17 genera and 109 described species. Until recently, it was considered that only three species of Hymenosomatidae occurred in South Africa – *Hymenosoma orbiculare*, *Neorhynchoplax bovis* (Stimpson 1858) (*cf.* Lucas 1980) and *Elamena mathoei* (Desmarest 1823) (*cf.* Barnard 1950) (see Ng *et al.* 2008, p. 109, note {2}). *H. orbiculare* is distinguishable by the absence of an epistome, well-defined carapace

grooves, slender third maxilliped and smooth dactyls. *N. bovis* has a well-defined epistome and carapace grooves; narrow third maxilliped not completely covering the buccal cavity; denticles (teeth) on the dactyls and a tridentate rostrum. *E. mathoei* is characterized by presence of an epistome; carapace not with defined grooves, smooth; broad third maxilliped covering the buccal cavity; sub-apical denticles (teeth) on the dactyls and a broadly triangular rostrum (Barnard 1950).

On a global basis the genus *Hymenosoma* currently comprises just three species:

- 1) *H. orbiculare*, as currently defined, which has a distribution in southern Africa and Zanzibar and is characterized by absence of an epistome, well-defined grooves on the dorsal carapace and having the infero-external orbital angle bifid.
- 2) *H. depressum*, occurring in New Zealand and distinguishable by presence of antennal spines, epistome and narrow third maxilliped.
- 3) *H. hodgkini*, occurring in eastern Australia and distinguishable by absence of epistome, elongated eyestalks, broad third maxilliped and teeth on dactyls of the walking legs (Lucas 1980).

Melrose (1975) treated *H. depressum* as a separate genus, *Cyclohombroia*. Lucas (1980) agreed that, should these three species be divided into two groups, *H. depressum* would be the outlier but argued that, because these three species are much more closely related to each other than to any other hymenosomatid, they should be retained within one genus.

*Hymenosoma orbiculare* Desmarest, 1825, as currently defined, is found all along the coast of southern Africa (Barnard 1950). Although restricted to calmer areas where fine sands and mud accumulate (Broekhuysen 1955), it is common in fully marine habitats to depths up to 80 m (Barnard 1950), as well as in estuaries, with a small population even occurring in the freshwater (but relictual estuarine) Lake Sibaya (Allanson *et al.* 1966). Although *H. orbiculare* is currently the only species in the genus recognized from South Africa, several authors have noted morphological variants. In 1858 Stimpson described a smaller, more granulose, deeper-water form as *H. geometricum* (*cf.* Stebbing 1905), but this was subsequently treated as a junior synonym of *H. orbiculare* (Stebbing 1914, Barnard 1950). Barnard (1950) and Broekhuysen (1955) both mentioned a variety of differences between deep-water specimens and coastal *H. orbiculare*, but neither found it necessary to consider these as separate species. Barnard (1955), however, suggested that the deep-water species be fully investigated and Lucas (1980) suggested that the large range of morphological and habitat variation of *H. orbiculare* indicated that several species exist under that one name.

Using morphological and genetic methods to compare specimens from all along the South African coast Edkins *et al.* (2007) identified five monophyletic clusters within the species, each with distinct distribution ranges. With the support of morphological data, they proposed that South African *H. orbiculare* in fact represent five distinct species. These are:

- 1) The true *H. orbiculare*, characterized by larger size and absence of characteristic ornamentations of other

morphotypes and found in estuaries, lagoons and shallow, sheltered marine habitats all along the west and south coasts of South Africa.

- 2) Two False Bay deep-water species; the one previously described as *H. geometricum*, and distinguished by a long rostrum, a raised setaceous gastric region on the carapace and post-branchial projections, and the second a new, undescribed species.
- 3) Two new species occurring in estuaries along the south-east and east coasts respectively and distinguished by their small size, relatively large eyes, long walking legs, projections on the abdomen and small anterior spikes on coxae of the legs. Southeastern specimens can be differentiated from east coast specimens primarily by darker colour and longer second walking legs (Edkins *et al.* 2007).

The aims of this paper are thus to formalize the taxonomic status and to illustrate each of these species. *H. geometricum* is officially resurrected and the new False Bay deep-water species and two new east coast estuarine species are named and described.

## METHODS AND MATERIALS

This study is based on the same specimens collected for the genetic study by Edkins *et al.* (2007). Deeper water specimens from False Bay were collected using two methods; by hand while on SCUBA (for samples at 5 m depth), or with a small dredge towed behind a speedboat (for samples at 20 m depth). The remaining estuarine and coastal material was collected by wading into the water and sieving bottom sediments with a D-frame hand-net. Drawings were made using a Wild Camera Lucida (type 300) mounted on a Wild binocular microscope (M5 48418) and whole specimens photographed with a Nikon D50 digital SLR camera fitted with a Nikon 105 mm macro lens. A generalized hymenosomatid male, showing the terms used in descriptions in the text, is illustrated in Appendix 1.

All specimens of *Hymenosoma* in the collections of the South African Iziko Museum were also re-examined, separated into the five newly-recognized species, relabelled and used here to provide additional distributional data.

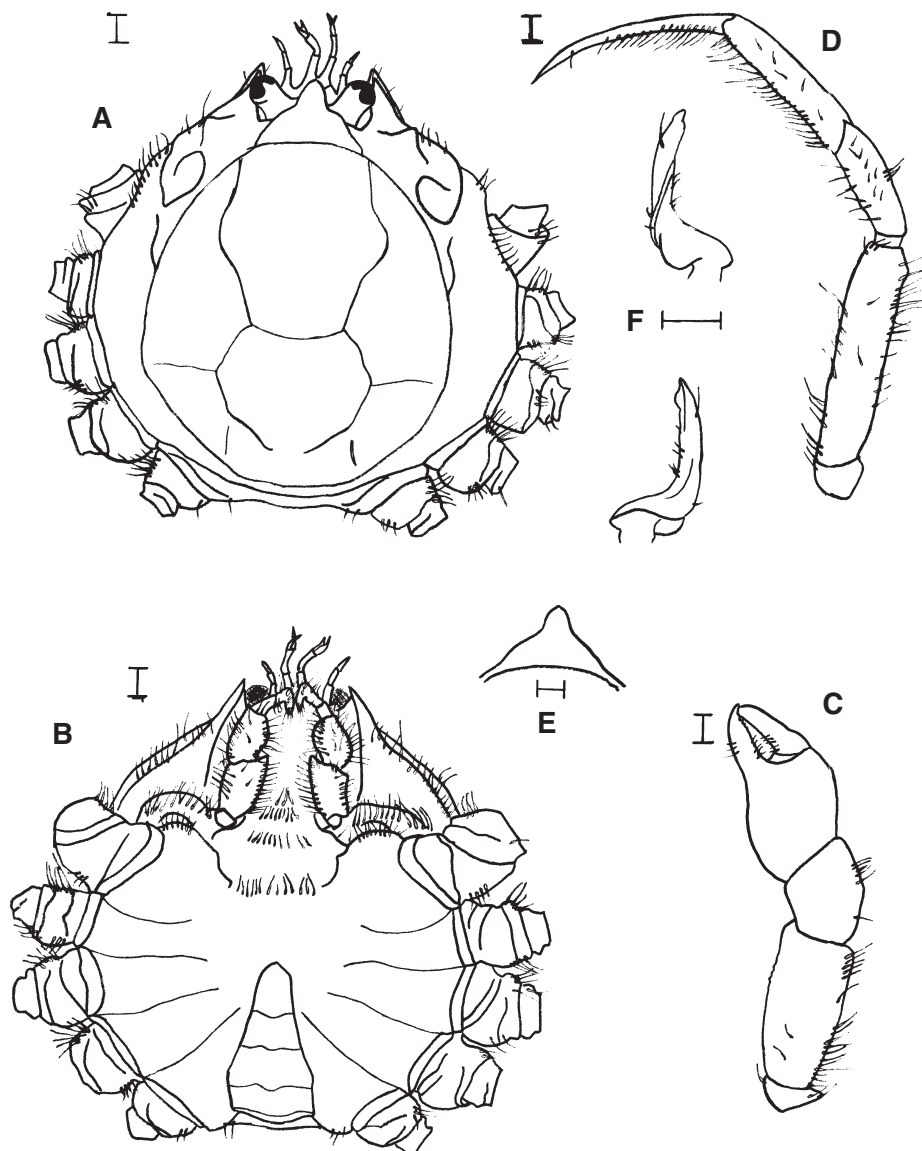
## TAXONOMIC SECTION

### Family HYMENOSOMATIDAE MacLeay, 1838

#### Description

(based on Barnard (1950) and Lucas (1980))

Carapace thin, flat, not heavily calcified, lacking hooked setae; dorsal carapace surface often with well-defined gastro-cardiac groove and neighbouring grooves, usually with horizontal rostrum. No orbits, or very incomplete orbits, eyes exposed and little retractable; antennular sockets shallow and ill-defined; antennae joined to epistome (when present); ischium of third maxillipeds well-developed, palp articulating from antero-lateral corner of merus; chelipeds not long or particularly mobile. Male and female abdomens not more than five segments, excluding telson; male genital openings on last thoracic sternite (hidden beneath abdomen), female genital openings on sternite of second (first walking) legs; female pleopods on abdominal segments 2–5.



**Fig. 1.** *Hymenosoma orbiculare*, male. **A**, Dorsal view of carapace. **B**, Ventral view of carapace. **C**, Pereiopod I – Cheliped. **D**, Pereiopods II–V walking legs. **E**, Rostrum. **F**, Male pleopod. Scale bars = 1 mm.

Genus *Hymenosoma* Desmarest, 1825

Description

(based on Barnard (1950) and Lucas (1980))

Carapace sub-circular or elongate oval, with anterior and posterior lateral angles not evident; carapace flat, with well-defined or fine dorsal grooves, triangular rostrum, usually with groove separating rostrum from dorsal carapace, concave laterally, usually shorter than eyes. Epistome absent or very short and narrow. Plain pterygostomial region. Third maxilliped usually with narrow third and fourth joint and not meeting centrally, underlying appendages partially visible, ischium subequal to or shorter than merus, palp large and conspicuous, epipodites conspicuous. Chelipeds heftier than walking legs, particularly in male specimens, not greatly overstated; walking legs slender or moderately stout, two to three times longer than carapace width, dactyli with row of small teeth, or without spines or denticles on

inner margin, usually with dense long setae. Female abdomen with no fused segments, triangular or trapezoidal plate formed by medial portions of segments 1–3, visible dorsally – segments 1, 2 and part of 3, weak convex laterally making broad, shallow, abdominal cavity (brood cavity); male abdomen with no fused segments, short and narrow and with sutures of all segments distinct.

The following three species are recognized from the Western Cape region of South Africa.

*Hymenosoma orbiculare* Desmarest, 1825 (Crown crab)

Figs 1A–F, 4A

1825 *Hymenosoma orbiculare* Desmarest, *Considerations Generales sur la Classe des Crustaces*, p. 163, pl. 26, fig. 1, 1a–e.

1914 *Hymenosoma orbiculare* (partim), Stebbing, *Transactions of the Royal Society of Edinburgh*, p. 270, pl. 25, fig. A.

- 1950 *Hymenosoma orbiculare* (*partim*), Barnard, *Annals of the South African Museum* **38**, p. 68.
- 1955 *Hymenosoma orbiculare*, Broekhuysen, *Annals of the South African Museum* **41**, p. 313–343. figs 1–13.
- 1955 *Hymenosoma orbiculare* (non), Barnard, *Annals of the South African Museum* **43**, p. 19. fig. 5.
- 1980 *Hymenosoma orbiculare*, Lucas, *Records of the Australian Museum* **33**, pp. 166–169.
- 2007 *Hymenosoma orbiculare* (*partim*), Edkins *et al.*, *Crustaceana* **80**(6), p. 667–683.

#### Material examined

South Africa: SAM A 45731, Kromme River Estuary, July 2005, 7 ♀, 13♂; SAM A 45732, Gonubie River Estuary, 2004, 1 ♀, 9♂; SAM A 45733, Kowie River Estuary, 2004, 2♀, 3♂; SAM A 45734, Milnerton Lagoon, 2005, 2♀, 7♂; SAM A 45735, Knysna Lagoon, March 2008, 1♂; SAM A 45736, Langebaan Lagoon, March 2005, 4♀, 1♂; SAM A1425, Salt River Mouth, 3 ind; SAM A 46795, Walvis Lagoon Namibia, 50 ind; SAM A 45070, Berg River Estuary, 70 ind; SAM A 3137, Port Elizabeth, 2♂; SAM A 42077, St. Helena Bay, 2♂, 1♀; SAM A 13378, Kenton-on-Sea, 1♂; SAM A 44007, Berg River Estuary, 7 ind; SAM A 39589, Lambert's Bay, 1♂, 1♀; SAM A 47808, Berg River Estuary, 30 ind; SAM A 459, East London, 1♂; SAM A 11022, Woodstock Power Station, 1♂; SAM A 6882, Kleinmond Lagoon, 9 ind; SAM A 15361, Port Alfred, 8 ind; SAM A 12142, Luderitz, 1♀; SAM A 12629, Luderitz, 4 ind; SAM A 12771, Luderitz, 2♂; Knysna, 3♂, 1♀; Sandwich Harbour Namibia, 7 ind; Leisure Isle Knysna, 1♂; Sandwich Harbour Namibia, 3♂, 1♀; Sandwich Harbour Namibia, 8 ind (these last samples without museum accession numbers).

#### Description

(based on Stebbing (1914), Barnard (1950) and Edkins *et al.* (2007))

Carapace surface sub-circular, dorsal surface flat, well-defined gastro-cardiac groove and neighbouring grooves, with single, broad tooth on anterior sub-hepatic region and low rounded prominence on posterior hepatic region; infero-external orbital angle produced in a bifid tooth, the upper tooth reaching to, or slightly beyond, apex of rostrum (Figs 1A & 4A); rostrum triangular, with groove separating rostrum from dorsal carapace, concave above, with slightly up-turned, rounded apex with point at very tip, shorter than eyes, with lateral sections protruding over eyestalks, no serrations (Fig. 1E). Epistome absent. Plain pterygostomial region. Maxilliped 3 with many setae, not meeting medially, with underlying appendages partially visible, third and fourth joints twice as long as broad, ischium subequal to merus, palp large and conspicuous (Fig. 1B). Elongated eyestalks, very prominent post-ocular lobes. Antennules slightly longer than, or subequal to, antennae. Chelipeds slightly stouter than walking legs in females, almost twice as stout as walking legs in males, with fine teeth on dactyli, no teeth on merus, moderately setose (Fig. 1C); walking legs long and slender, almost twice carapace width, heavily fringed on inner margins of fourth to seventh joints, dactyli longer than propodus, with no teeth (Fig. 1D). Abdomen smooth, with no setae, female abdomen circular to ovate, male abdomen triangular, expands to maximum width mid-

way between segments 3–4 and then narrows to segment 5, segment 5 narrows to base of telson which is semi-ovate (Fig. 1B); no abdominal projections; male first pleopod slightly setose, distinct proximal curve, stout at base, tapering to thin, twisted shaft, slightly curved tip (Fig. 1F). Maximum carapace width 28 mm; carapace dark: reddish, yellowish, brownish or greenish, sometimes carapace mottled and legs banded.

#### Remarks

*Hymenosoma orbiculare* is distinguishable from the other two Western Cape (False Bay) species described here by its larger size and lack of the characteristic ornamentations present in the other species. It has a simple, smooth, rostrum with rounded apex. The rostrum is only slightly trilobate, with the medial lobe reaching the apex of the eyes.

#### Occurrence

The most common *Hymenosoma* species along the entire west and south coasts of South Africa, found in estuaries and lagoons and extending up to 5 m depth in shallow-water marine environments. Range extends from Walvis Bay in Namibia to the Gqunube Estuary, near East London in South Africa (Edkins *et al.* 2007). Also reported from Zanzibar by Barnard (1950), citing Lenz (1905), although in the light of this study it seems highly likely that the Zanzibar material in fact represents either one of the east coast species described here, or yet another as yet undescribed species.

#### *Hymenosoma geometricum* Stimpson, 1858 (reinstated)

Figs 2A–G, 4B

- 1858 *Hymenosoma geometricum* Stimpson, *Proceedings of the Academy of Natural Sciences of Philadelphia* **10**, p. 108.
- 1905 *Hymenosoma geometricum*, Stebbing, *Marine Investigations of South Africa, South African Crustacea Part 3*, p. 50.
- 1914 *Hymenosoma orbiculare* (*partim*). Stebbing, *Transactions of the Royal Society of Edinburgh*, p. 270, pl. 25, fig. A.
- 1950 *Hymenosoma orbiculare*, (*partim*). Barnard, *Annals of the South African Museum* **38**, p. 68.
- 1955 *Hymenosoma orbiculare*, Barnard, *Annals of the South African Museum*, **43**, p. 19. fig. 5.
- 2007 *Hymenosoma orbiculare* (*partim*), Edkins *et al.*, *Crustaceana*, **80**(6), pp. 667–683.

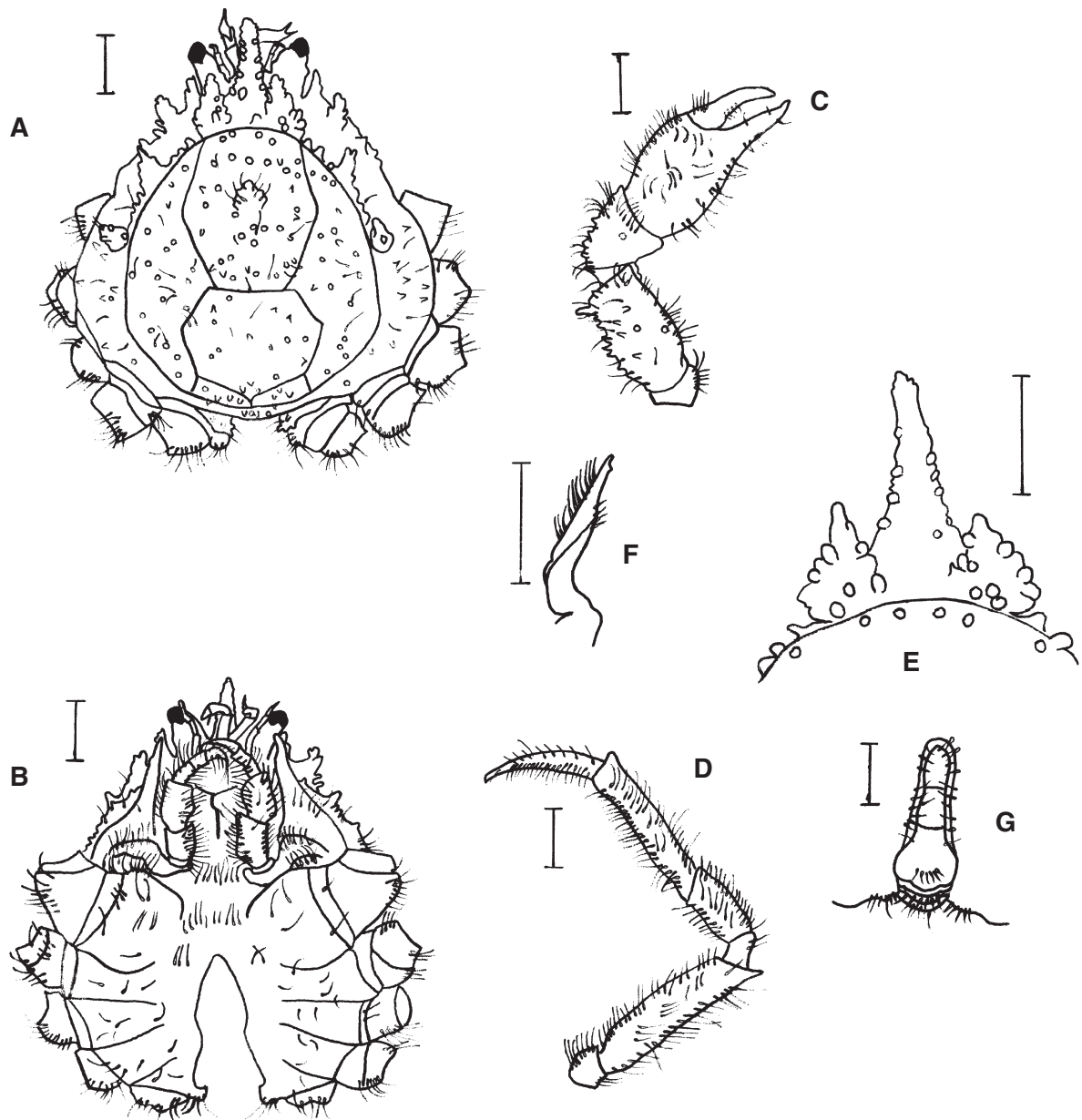
#### Material examined

SAM A 45737, False Bay, South Africa, 2005, 3♀, 2♂, 20 m; SAM A 12399, False Bay, 1♀; SAM A 12400, False Bay, 1♀.

#### Description

(based on SAM A 12398, mature male, False Bay, South Africa, 20 m)

Carapace surface circular, with slight elongation at posterior margin, dorsal carapace surface flat, well-defined gastro-cardiac and neighbouring grooves; gastric region raised into setaceous median boss; carapace surface slightly setose with small, conical granulations; elongate, granular



**Fig. 2.** *Hymenosoma geometricum*, male. **A**, Dorsal view of carapace. **B**, Ventral view of carapace. **C**, Pereiopod I – Cheliped. **D**, Pereiopods II – Walking legs. **E**, Rostrum. **F**, Male pleopod. **G**, abdomen. Scale bars = 1 mm.

tooth protruding from sub-hepatic area, adjacent to orbital angle, conical, granular tooth on hepatic margin and pre-branchial margin of carapace, bifid tooth at outer orbital angle visible ventrally, reaching below apex of eyestalk (Figs 2A & 4B). Rostrum distinctly trilobate, with groove separating rostrum from dorsal carapace, medial lobe narrow with rounded apex, curving slightly upwards and extending significantly beyond end of eyestalks, more than twice length of callosities at the base and serrated along margins, with conical granulations on surface; two basal callosities conical with granulations, extending almost to apex of eyestalks (Fig. 2E). Epistome absent. Pterygostomial region slightly setose. Maxilliped 3 narrow, not meeting medially with underlying appendages partially visible, ischium subequal to merus, highly setose, palp large and

conspicuous (Fig. 2B). Elongated eyestalks, prominent post-ocular lobes. Antennules longer than antennae, extend slightly beyond elongate rostrum. Chelipeds slightly stouter than walking legs in females, almost twice as stout as walking legs in males, no fine teeth on dactyli, single large tooth on outer, distal margin of merus, with several smaller conical teeth along length of cheliped (Fig. 2C); walking legs slender, highly setose, 1.5 times longer than carapace width, dactyli shorter than propodus, with no teeth (Fig. 2D). Abdomen with highly setose margin, female abdomen circular, male abdomen narrow, club-shaped, maximum width at base of segment t4 and then narrows to segment t5 and telson which is semi-ovate (Fig. 2G); no abdominal projections; male first pleopod setose, distinct proximal curve straightening to tip, narrow at base, tapering to thin,

pointed tip, twisted shaft (Fig. 2F). Maximum carapace width small, <10 mm; pale, slightly transparent carapace.

#### Remarks

*Hymenosoma geometricum* has the most elaborate ornamentation of the described species. It has a characteristically very complex rostrum, with serrulate margins and granulate surface. The rostrum is distinctly trilobate, with the medial lobe reaching well beyond the apex of the eyes. The carapace is covered with small conical granulations and is slightly setose, with a raised, setose median boss on the gastric region. Based on both genetic work by Edkins *et al.* (2007) and this morphological analysis, *H. geometricum* of Stimpson 1858 should thus be resurrected as a valid species and no longer treated as a junior synonym of *H. orbiculare*.

#### Occurrence

Presently known only from deeper marine habitats (>20 m) in False Bay, South Africa. Edkins *et al.* (2007) found that *H. geometricum* was either picked off the large ascidian *Pyura stolonifera*, or found in dredges that contained *P. stolonifera*, thus suggesting that *P. stolonifera* may represent a habitat for this species.

#### *Hymenosoma trilobatum* sp. nov.

Figs 3A–F, 4 C

2007 *Hymenosoma* deep water species, C, Edkins *et al.*, *Crustaceana* **80**(6), pp. 667–683.

2009 *Hymenosoma* species 1, Teske *et al.*, *Molecular Phylogenetics and Evolution* **53**, pp. 23–33.

#### Etymology

This species is named for its triple lobed, triangular rostrum.

#### Type specimen

SAM A 45738 mature male, False Bay, South Africa, 20 mm.

#### Material examined

SAM A 45739, False Bay, South Africa, 20 March 2005, 6♀, 20 m; SAM A 45749, False Bay, South Africa, 1♀, 2♂; SAM A 448, False Bay, South Africa, 20♀, 12♂; SAM A 11994 (D430), Saldanha Bay, South Africa, 3♀.

#### Description

(based on the mature male in Fig. 3 and Edkins *et al.* (2007))

Carapace surface sub-circular, dorsal carapace surface flat with well-defined gastro-cardiac groove, but poorly-defined neighbouring grooves; posterior margin slightly concave; strong granulation over entire dorsal carapace surface, with prominent beaded and granulated lateral rim. Carapace, coxopodites and posterior margin all setose. Orbital angle produced in a bifid tooth, each of equal length, sharply pointed apex, protruding slightly beyond eyes; small, granular tooth protruding from sub-hepatic area, adjacent to orbital angle, pustulate or mammilate tooth of hepatic carapace margin (Figs 3A & 4C). Rostrum trilobate, with groove separating rostrum from dorsal carapace, medial lobe triangular with rounded apex and smooth margin, extending to tip of eyestalk, almost twice length of callosities at base. Two basal callosities rounded with circular granulations, extend-

ing only to base of eyestalks (Fig. 3E). Epistome absent. Plain pterygostomial region with setose margin. Maxilliped 3 very narrow, highly setose, not meeting medially, with underlying appendages partially visible, palp reduced, heavily fringed margins of ischium and merus (Fig. 3B). Shortened eyestalks, prominent post-ocular lobes. Antennules almost twice length of antennae, protruding well beyond eyestalks. Chelipeds stouter than walking legs, male chelipeds more robust, covered in circular granulations, very fine teeth on dactyli, merus without tooth, heavily fringed on both fore and hind margins (Fig. 3C); walking legs slender, setose, 1.5 times longer than carapace width, heavily fringed on inner margins, dactyli subequal to propodus, with no teeth (Fig. 3D). Abdomen surface highly setose, female abdomen circular to ovate, male abdomen triangular, expands to maximum width at base of segment 2 and then tapers to segment 5 and telson which is slightly pointed (Fig. 3B); males have two flattened, highly setose, posterior abdominal projections, abdominal projections absent on females; male first pleopod slightly setose, broad at base, tapering to thin, slightly rounded tip, twisted shaft with slight proximal curve (Fig. 3F). Maximum carapace width small, <12 mm; pale, slightly creamy, transparent carapace.

#### Remarks

*Hymenosoma trilobatum* is highly granulate over its entire body surface, but the granulations are more circular than the conical granulations seen on *H. geometricum*. The rostrum is of moderate complexity, with smooth margins but a granulate surface. Like *H. geometricum* the rostrum is distinctly trilobate but the medial lobe is not as long, reaching only slightly past the apex of the eye stalks. Based on both genetic work by Edkins *et al.* (2007) and this morphological analysis, this form needs to be accepted as a separate species.

#### Occurrence

Currently known only from deeper marine habitats (20 m) in False Bay, South Africa.

The following two species are recognized from the Eastern Cape and KwaZulu-Natal regions of South Africa.

#### *Hymenosoma longicrure* sp. nov.

Figs 5A–F, 7A

2007 *Hymenosoma* species D, Edkins *et al.*, *Crustaceana* **80**(6), pp. 667–683.

2009 *Hymenosoma* species 2, Teske *et al.*, *Molecular Phylogenetics and Evolution* **53**, pp. 23–33.

#### Etymology

This species is named for the extended length of its walking legs

#### Type specimen

SAM A 45740, mature male, Mngazi Estuary, Eastern Cape, South Africa, 2005.

#### Material examined

SAM A 45741, Mbanzana Estuary, September 2005, 10♂,

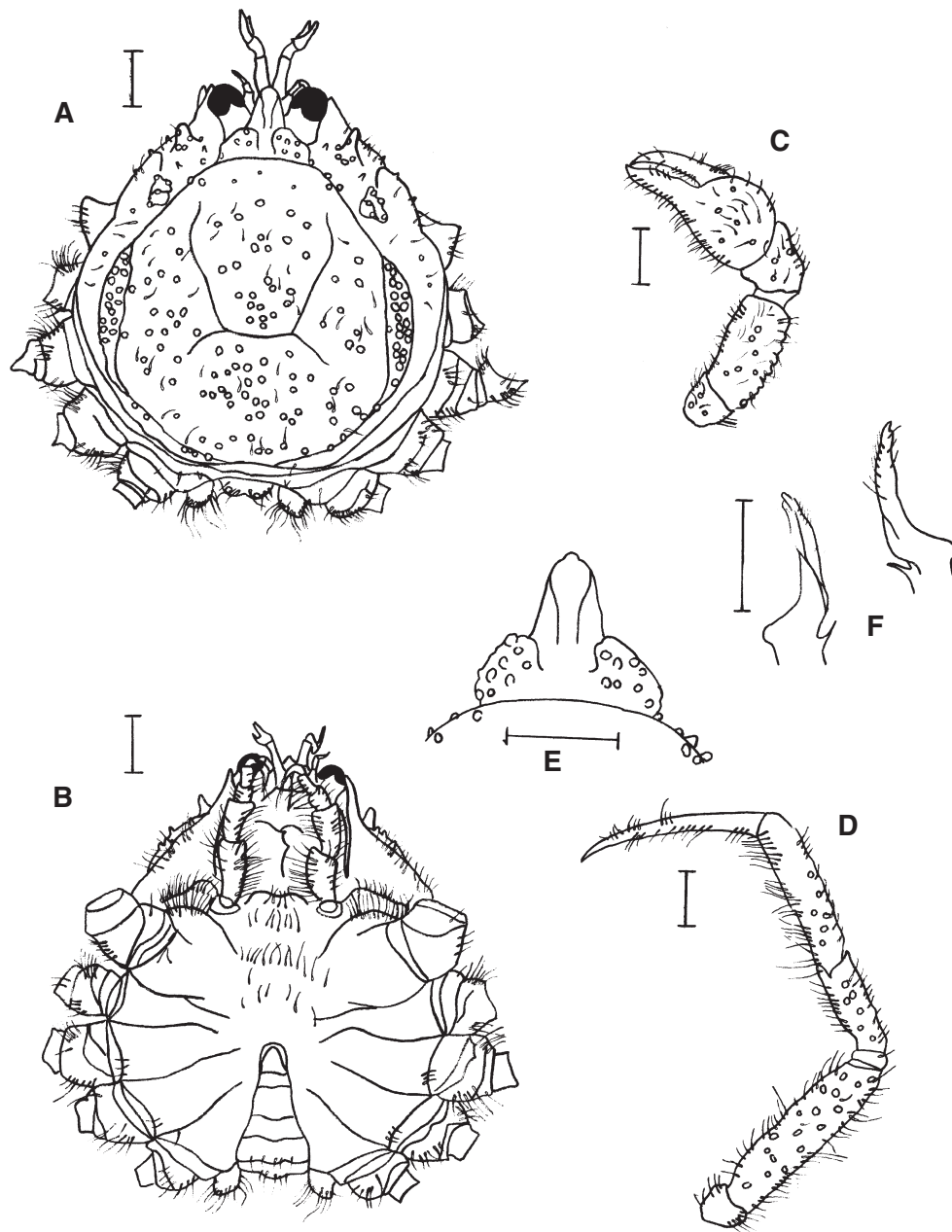


Fig. 3. *Hymenosoma trilobatum* sp. nov., male. **A**, Dorsal view of carapace. **B**, Ventral view of carapace. **C**, Pereiopod I – Cheliped. **D**, Pereiopods II–V walking legs. **E**, Rostrum. **F**, Male pleopod. Scale bars = 1 mm.

5♀; SAM A 45742, Mngazi Estuary, 2005, 8♂, 12♀; SAM A 45368, Nxaxo, 3 April 1993, 1♂, 1♀.

#### Description

(based on the mature male in Fig. 5 and Edkins *et al.* (2007))

Carapace surface sub-circular, dorsal surface flat, well-defined cardiac, gastro-cardiac groove and neighbouring grooves, with single, small bulbous tooth on carapace margin of hepatic region and raised rounded prominence over central hepatic region; external orbital angle produced in a bifid tooth, the upper tooth reaching to or slightly below eye (Figs 5A & 7A); rostrum triangular, with groove separating rostrum from dorsal carapace, indented along central axis – concave surface, with slightly up-turned, rounded apex,

shorter than eyestalks, no serrations (Fig. 5E). Epistome absent. Plain pterygostomial region. Maxilliped 3 narrow with many setae, not meeting medially, with underlying appendages partially visible, with third and fourth joint twice as long as broad, ischium subequal to merus, palp large and conspicuous (Fig. 5B). Eyes large relative to carapace, elongated eyestalks, very prominent post-ocular lobes. Antennules almost twice length of antennae, extending well beyond eyes. Female chelipeds narrower, but no stouter than walking legs, male chelipeds equal or slightly stouter than walking legs with very swollen, bulbous propodus, fine teeth on dactyli and merus, moderately setose. In larger males, small rounded projection found on proximal, inner margin of cheliped dactylus (Fig. 5C); walking legs long and

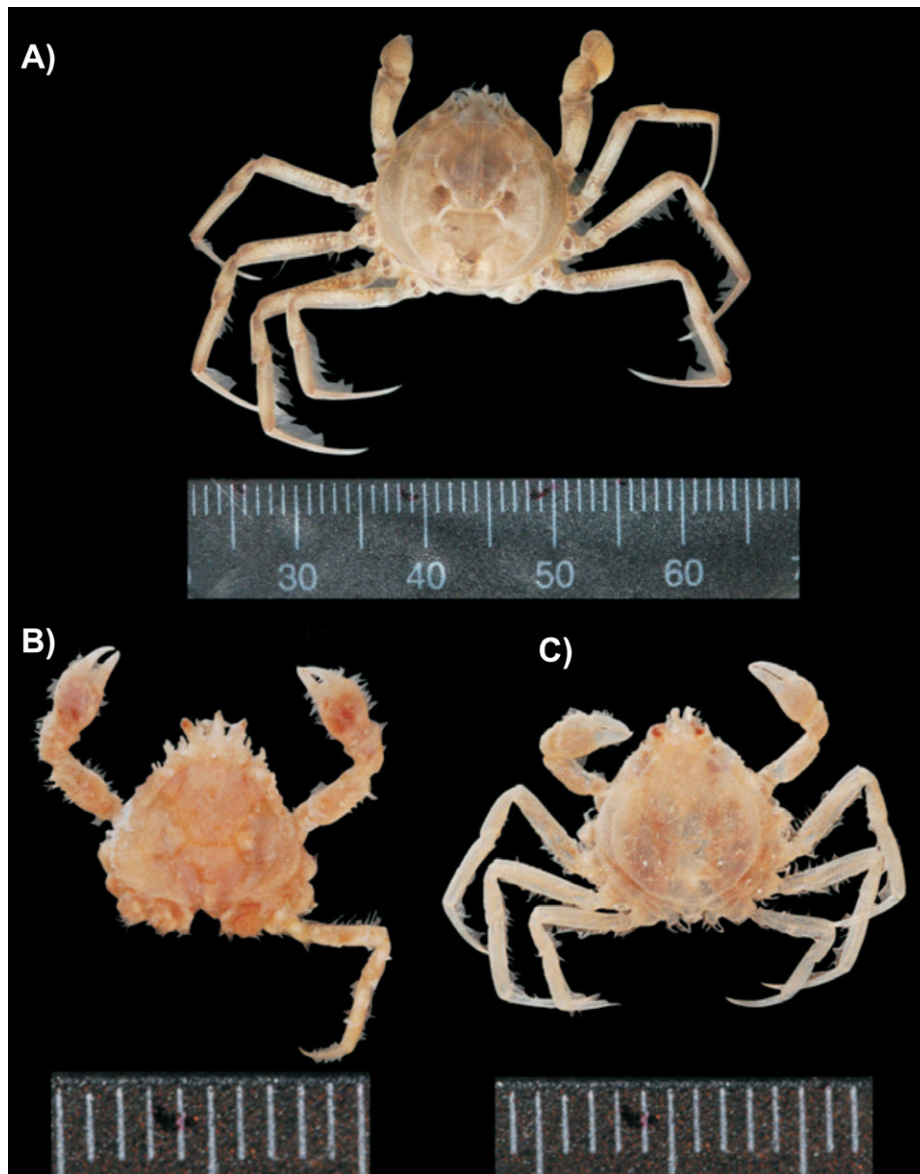


Fig. 4. West coast species. A *Hymenosoma orbiculare*. B *H. geometricum* C *H. trilobatum* sp. nov. Scale in mm.

slender, more than twice carapace width, fringed on inner margins of fourth to seventh joints, dactyli subequal to propodus, small anterior spike on coxae of walking legs (Fig. 5D). Abdomen smooth, with setae, female abdomen circular with fringed margin, male abdomen triangular, expands to maximum width midway between segments 2–3 and then narrows to segment 5, segment 5 narrows to base of small ovate telson (Fig. 5B); abdominal projections present, females with slight point on third abdominal somite, males with two, short, flattened posterior projections, only slightly setose; male first pleopod minimal setae, hooked – broad, but straight at base with strong distal curve to pointed tip, slightly twisted shaft (Fig. 5F). Maximum carapace width small, <10 mm; carapace dark: yellowish, brown sometimes with mottled carapace.

#### Remarks

*Hymenosom longicrure* has the longest legs relative to carapace size of these five species, with the second walking

legs always more than 1.5 times length of the first. Males have a highly differentiated first pleopod when compared to the remaining four species, being broad at the base with a strong distal, not proximal, curve. Males also show a bulbous swelling of the propodus of the cheliped. Based on both genetic work by Edkins *et al.* (2007) and this morphological analysis, this form needs to be accepted as a separate species.

#### Occurrence

Currently known range from Qolora to Mngazi Estuaries on the southeast coast of South Africa.

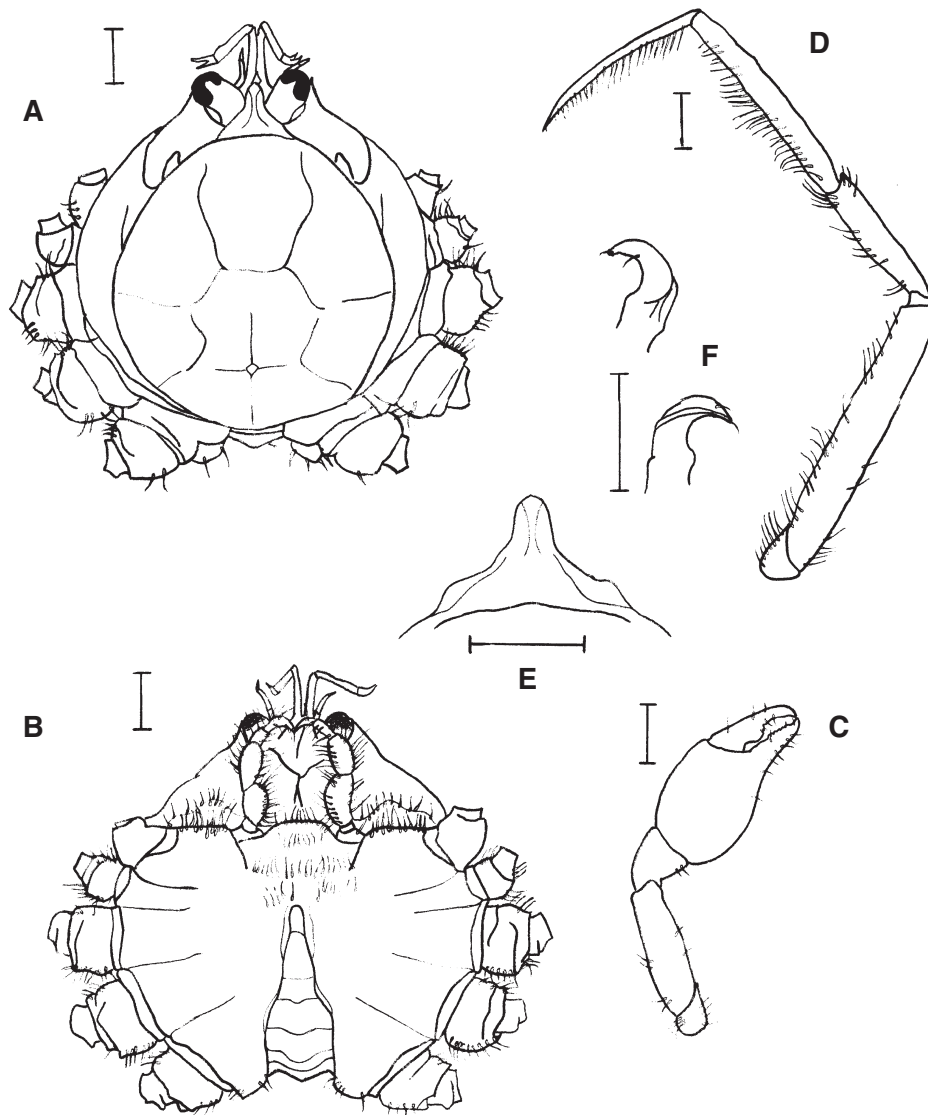
#### *Hymenosoma projectum* sp. nov.

Figs 6A–F, 7B

2007 *Hymenosoma* species E (*partim*), Edkins *et al.*, *Crustaceana* **80**(6), pp. 667–683.

2009 *Hymenosoma* species 3, Teske *et al.*, *Molecular Phylogenetics and Evolution* **53**, pp. 23–33.





**Fig. 5.** *Hymenosoma longicrura* sp. nov., male. **A**, Dorsal view of carapace. **B**, Ventral view of carapace. **C**, Pereiopod I–Cheliped. **D**, Pereiopods II–V walking legs. **E**, Rostrum. **F**, Male pleopod. Scale bars = 1 mm.

#### Etymology

This species is named for the distinct abdominal projections seen on males and immature females.

#### Type specimen

SAM A 45743, mature male, Kosi Bay third Lake, South Africa, August 2005.

#### Material examined

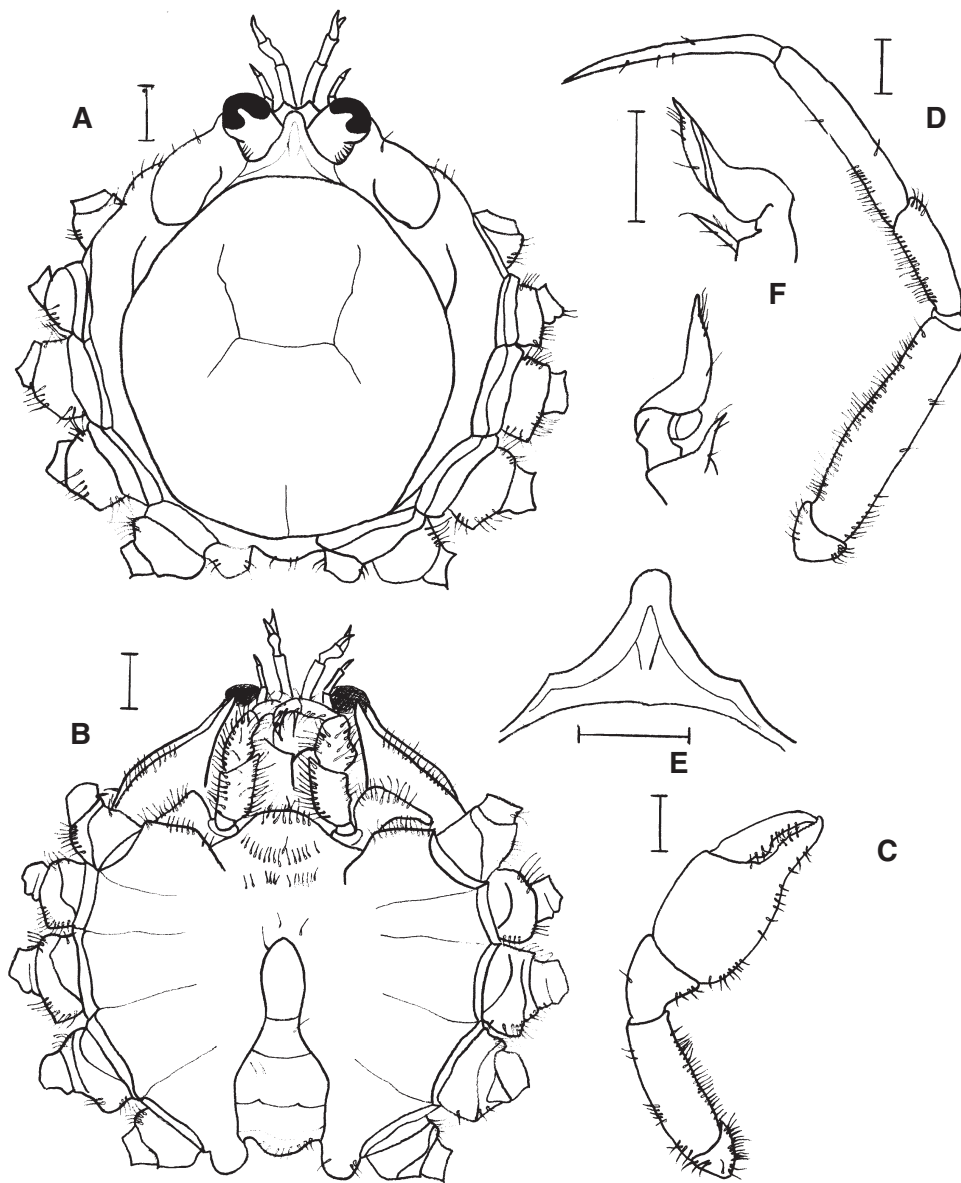
SAM A 45744, Mzingazi Estuary, June 2005, 1♂, 5♀; SAM A 45745, Kosi Bay Lakes, August 2005, 5♂; SAM A 45746, Kosi Bay third Lake, August 2005, 16♂, 7♀; SAM A 45747, Mpenjati Estuary, September 2005, 5♂, 3♀; SAM A 45748, Mbotyi Estuary, October 2005, 1♀.

#### Description

(based on the mature male in Fig. 6 and Edkins *et al.* (2007))

Carapace surface sub-circular/ovate, dorsal carapace surface flat with well-defined gastro-cardiac groove, but

poorly-defined neighbouring grooves; raised rounded prominence over central hepatic region; external orbital angle produced in a bifid tooth, upper tooth reaching slightly beyond eye (Figs 6A & 7B); rostrum triangular, with groove separating rostrum from dorsal carapace, slightly indented along central axis – concave surface, with slightly up-turned, rounded apex, shorter than eyes, no serrations (Fig. 6E). Epistome absent. Plain pterygostomial region with fringed margin. Maxilliped 3 with many setae, not meeting medially, with underlying appendages partially visible, third and fourth joints twice as long as broad, ischium subequal to merus, palp large and conspicuous (Fig. 6B). Large eyes relative to carapace size, eyestalks elongated, prominent post-ocular lobes. Antennules longer than antennae. Female chelipeds, narrower, or no stouter, than walking legs, male chelipeds equal or slightly stouter than walking legs, with swollen, bulbous propodus, moderately setose. In larger males, small rounded projection found on proximal, inner margin of cheliped dactylus (Fig. 6C); walking



**Fig. 6.** *Hymenosoma projectum* sp. nov. male. **A**, Dorsal view of carapace. **B**, Ventral view of carapace. **C**, Pereiopod I – Cheliped. **D**, Pereiopods II–V walking legs. **E**, Rostrum. **F**, Male pleopod. Scale bars = 1 mm.

legs long and slender, fringed on inner margins of fourth to sixth joints, dactyli subequal to propodus, small anterior spike on coxae of walking legs (Fig. 6D). Abdomen smooth, slightly setose, female abdomen circular, male abdomen triangular, expands to maximum width midway between segments 3–4 and then narrows to segment 5, segment 5 narrows to base of small semi-ovate telson (Fig. 6B); abdominal projections present, females with slight point on third abdominal somite, males with two, extended, flattened posterior projections, only slightly setose; male first pleopod moderately setose, broad at base, slight proximal curve to pointed tip, slightly twisted shaft (Fig. 6F). Maximum carapace width small, <10 mm; carapace light: yellowing orange, to clear and translucent.

#### Remarks

*Hymenosoma projectum* is distinguishable by its very

light, translucent colour and the presence of abdominal projections. Males show long posterior, flattened abdominal projections also present in immature females.

#### Occurrence

Currently known to inhabit South African east coast north of Mzimvubu Estuary to Lake Sibaya and Kosi Bay. Edkins *et al.* (2007) suggest the range probably extends further north, possibly even to Zanzibar (Barnard, 1950) and Madagascar (Ng & Chuang, 1996). Small individuals noted at Inhaca Island, Mozambique (Macnae & Kalk, 1958; Dornelas *et al.*, 2003), probably also belong to this species.

#### DISCUSSION

Edkins *et al.* (2007) used genetic and morphological data to show that the South African crown crab, *Hymenosoma orbiculare*, in fact represents five distinct species. Three of

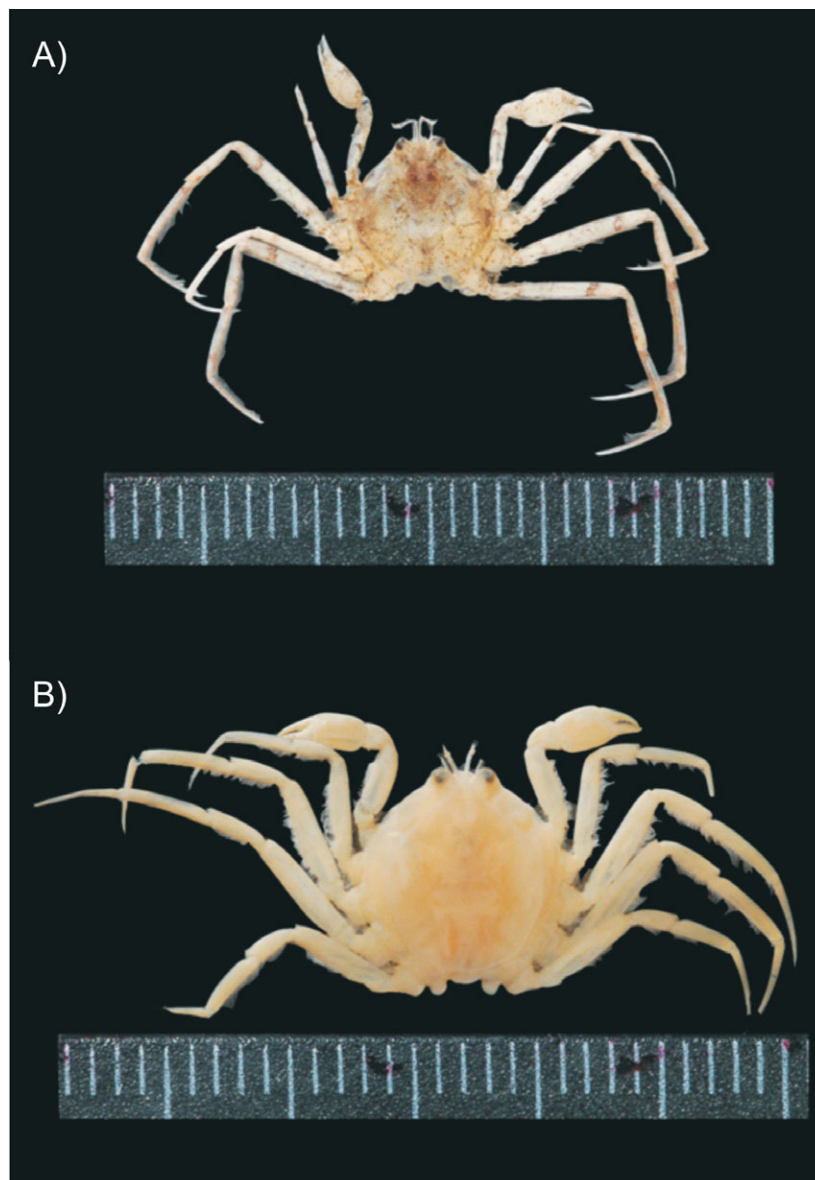


Fig. 7. East coast species. **A**, *Hymenosoma longicrure* sp. nov. **B**, *H. projectum* sp. nov. Scale in mm.

these can be found in the Western Cape Province (one extending into Namibia) and the remaining two along the east coast of South Africa.

Aside from the DNA evidence (Edkins *et al.* 2007) the separation of the rostrum from the carapace by a groove and/or a ridge, and the absence of an epistome, clearly identify all these species as belonging to the genus *Hymenosoma*.

Barnard (1950) reported that specimens of *H. orbiculare* ranged not only around the entire coastline of southern Africa, but from the sublittoral down to 80 m, into estuaries, and in one case into a coastal freshwater lake (Allenson *et al.* 1966). Lucas (1980) called this 'a surprising distribution for a euryhaline species.' Thus it is not unexpected to discover that this distribution is not that of a single species, but rather of five different *Hymenosoma* species. The true coastal *H. orbiculare* is found in estuaries and lagoons along the west and south coasts; *H. geometricum* Stimpson, 1858, resurrected in this paper, and *H. trilobatum* sp. nov. occur in

deeper-water in False Bay; while estuaries on the south-east and east coasts harbour *H. longicrure* sp. nov. and *H. projectum*, respectively.

In this paper we describe and illustrate all five of the South African *Hymenosoma* species. The species fall into two groups, based on geographical range, thus in the account below we will concentrate on variations between species with overlapping or adjacent distribution ranges.

Although at first glance the three west and south coast species may appear similar, each has distinct characteristics that differentiate it from the others. Summarizing the data from Table 1, *H. orbiculare* and *H. geometricum* differ in 10 features, *H. orbiculare* and *H. trilobatum* in eight features and *H. geometricum* and *H. trilobatum* in ten features. *H. trilobatum* appears to be an intermediate between the other two species, it shares traits with each and a number of its features are not as extreme as *H. geometricum*, or as simple as those of *H. orbiculare*.

**Table 1.** Morphological features distinguishing the species of *Hymenosoma*: '+' presence, '-' absence, '++' strongly present.

	<i>H. orbiculare</i>	<i>H. geometricum</i>	<i>H. trilobatum</i>	<i>H. longicrure</i>	<i>H. projectum</i>
Sub-circular dorsal carapace	+	-	+	+	+
Distinct gastro cardiac grooves on dorsal carapace	+	+	+	+	+
Strong neighbouring grooves on dorsal carapace	+	+	-	+	-
Granulations on carapace, rostrum, appendages	-	+	+	-	-
Rostrum reaching corneas of eyes	+	+	+	-	-
Rostrum extending over eyestalks	-	+	+	-	-
Rostrum distinctly trilobate	-	+	+	-	-
Rostrum serrulate	-	+	-	-	-
Epistome	-	-	-	-	-
Teeth at base of ocular lobes bifid	+	+	+	+	+
Teeth on hepatic region	1 pair	2 pairs	2 pairs	1 pair	0
Teeth on pre-branchial region	-	+	-	-	-
Teeth on cheliped merus	-	+	-	-	-
Teeth on coxae	-	-	-	+	+
Raised, setaceous gastric region	-	+	-	-	-
Narrow third maxillipeds	+	+	+	+	+
Very prominent mouth-frame angles	+	+	+	+	+
Prominent post-ocular lobes	+	+	+	+	+
Elongated eyestalks	+	++	-	+	+
Large eyes	-	-	-	+	+
Long slender walking legs	+	+	+	++	+
Small anterior spike on coxae of walking legs	-	-	-	+	+
Antennules elongated	-	-	+	+	-
Female with slight point on third abdominal somite	-	-	-	+	+
Male with abdominal projections	-	-	+	+	+
Male abdomen shape	Triangular	Clubbed	Triangular	Clubbed	Clubbed
Distally curved male first pleopod	++	++	+	-	+

The simplest feature distinguishing the three southwestern species is the rostrum. *H. orbiculare* has a simple rostrum, with smooth margin and a flat surface, not extending past the apex of the eyestalk; *H. geometricum* has a complex, triangular, trilobate rostrum, the medial lobe, with serrulate margins, extending well beyond the eyestalks, and the two basal lobes and rostrum surface covered with conical granulations. *H. trilobatum* has a less complex, trilobate rostrum, with smooth margins, the medial lobe extends just beyond the apex of the eyestalks and the rostrum surface is covered in circular granulations.

The ornamentation on the carapace can also be used to distinguish these species. *H. orbiculare* has an obtuse tooth and low, rounded prominence on the hepatic regions; *H. geometricum* has a complex, elongate, granular tooth protruding from sub-hepatic area; a conical, granular tooth on the hepatic and pre-branchial regions; the former with a much smaller, inferior anterior tooth. Also unique to this species is the raised, setose, median boss protruding from the centre of the gastric region and the presence of one large and several smaller teeth on the merus of the cheliped. *H. trilobatum* has a small granular, tooth of the sub-hepatic region and a pustulate or mammilate tooth on the pre-branchial region and a continuation of the carapace granulations onto the cheliped. Uniquely, in terms of west and south coast species, *H. trilobatum* has two highly setose, flattened projections on the abdominal region of the male carapace.

The deeper-water species, *H. geometricum* and *H. trilo-*

*batum* also mature at a smaller size (Broekhuysen 1955, Lucas 1980), are more setose and more granulose, and are generally paler in colour than *H. orbiculare*.

The two east coast species, *H. longicrure* sp. nov. and *H. projectum* sp. nov., are very similar to one another and most similar to *H. orbiculare* amongst the west and south coast species. The geographical boundary between the southeast *H. longicrure* and southern *H. orbiculare* corresponds to the zoogeographic boundary separating the subtropical East Coast and the Warm Temperate South Coast provinces (Emanuel *et al.* 1992; Edkins *et al.* 2007).

Summarizing the data from Table 1 *H. orbiculare* differs from both *H. longicrure* and *H. projectum* in nine separate features, while *H. longicrure* and *H. projectum* only differ in four features. The east coast species are smaller, <10 mm carapace width, and paler in colour than *H. orbiculare*, have relatively larger eyes and are less setose than any of the west and south coast species. Although simple and similar in shape to *H. orbiculare* the lateral sections of the rostrum of *H. longicrure* and *H. projectum* do not protrude over the eyestalks and the apex never reaches past the eyes. East coast species have small anterior spikes on the coxae of the walking legs, and abdominal projections are present, females have a slight point on the third abdominal somite, males having two, slightly setose, flattened posterior projections, a trait only the males of *H. trilobatum* share.

*Hymenosoma longicrure* and *H. projectum* are not easily distinguishable, the simplest distinguishing feature being colour. *H. longicrure* is darker and often a mottled brown

colour, while *H. projectum* is much paler and a light orange to translucent colour. Anatomically *H. longicrure* has longer walking legs, with the second walking leg always more than 1.5 times as long as the first (Edkins *et al.* 2007), more defined carapace grooves, with a small tooth on the hepatic carapace margin and longer antennules; *H. projectum* has poorly defined carapace grooves but more prominent, longer abdominal projections, distinctly visible in both dorsal and ventral view of carapace.

The greatest distinction between the east coast species is only seen in the males; *H. longicrure* has a uniquely shaped first pleopod, easily distinguishable from the other four species, it is hook-shaped with a broad base and a strong distal curve that is only slightly twisted. *H. projectum* has a broad base with a proximal curve that never fully straightens. The first pleopods of east coast species are similar in shape, only differing in the degree of distal curve and basal width, these species have a twisted shaft, distally curved, straightening and tapering to a pointed tip.

Teske *et al.* (2009) showed that in southern Africa *Hymenosoma* range expansion occurred from the Tropical Western Indian Ocean southwards, with species moving south during warmer climate periods, then adapting once cooler climatic conditions returned, resulting in speciation. Given the presence of three distinct species of *Hymenosoma* in the South Western Cape of South Africa and two others along the eastern coast, it is highly unlikely that the specimens reported from Zanzibar (2500 km further north) by Barnard (1950), based on an original record by Lenz (1905), represent any of these species, certainly not the temperate *H. orbiculare*. We have been unable to locate these original specimens, but collection and examination of new material from Zanzibar should be carried out to determine the true identity of that population.

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**Appendix 1.** Generalized hymenosomatid male, showing the terms used in descriptions. **A**, Dorsal view of carapace and leg bases. **B**, Posterior view of left cheliped. **C**, Posterior view of third walking leg. **D**, Ventral view of carapace and leg bases. (From Lucas (1980, fig. 1), originally from Melrose (1975, fig. 1).)

