REVISION OF THE PENNATULACEAN GENUS *SARCOPTILUS* (COELENTERATA: OCTOCORALLIA), WITH DESCRIPTIONS OF THREE NEW SPECIES FROM SOUTHERN AUSTRALIA

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WILLIAMS, G. C. 1995. Revision of the pennatulacean genus *Sarcoptilus* (Coelenterata: Octocorallia), with descriptions of three new species from southern Australia. *Records of the South Australian Museum* **28**(1): 13–32.

The pennatulacean genus *Sarcoptilus* Gray, 1848 from southern Australia and New Zealand is revised. Three previously named species assignable to the genus are reassessed and two of these are described from recently collected material. One of these three taxa is here recognized as valid (*S. grandis* Gray, 1848), one is relegated to synonymy (*S. roseum* Broch, 1910), while the validity of the third is questionable at present (*S. bollonsi* Benham, 1906). In addition, three new species are described (*Sarcoptilus nullispiculatus*, *S. rigidus*, and *S. shaneparkeri*), making a total of five species known—four considered valid taxa from southern Australia and one of questionable validity from New Zealand. A dichotomous key to the species is included as well as a complete list of all pennatulacean species presently known to occur in southern Australia.

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During the 1980's and early 1990's, a relatively large collection of pennatulacean coelenterates was collected from southern Australia. From this work as well as the literature, nineteen species of sea pens are here recorded as occurring in southern Australia and New Zealand (see Table 1). Five species of *Sarcoptilus* (family Pteroeididae) are here treated from southern Australia and New Zealand. *Sarcoptilus grandis* Gray, 1848 is a relatively well-known member of the southern Australian fauna. The other two described species assignable to the genus have up until now been poorly known (*Sarcophyllum bollonsi* [Benham, 1906] and *S. roseum* [Broch, 1910]). The latter is here considered synonymous with *S. grandis*, while the former is of questionable validity. In addition, three new species are also described. Southern Australia is here defined as the continental shelf region of southern Western Australia, South Australia, Victoria, Tasmania, and southern New South Wales (i.e. the southern coastal waters extending from Perth to Newcastle). The genus seems to be geographically restricted to between 31° and 48° south latitude in Australia and possibly New Zealand.

Sarcoptilus Gray, 1848 is differentiated from related genera by having siphonozooids restricted to a conspicuous swollen pad at the intersection of the dorsal margin of each polyp leaf with the dorsal edge of the rachis, the absence of spiculiferous rays in the polyp leaves, a well developed axis extending throughout most of the length of the colony, and the presence of mesozooids on the distal/ventral portion of the rachis. *Sarcophyllum* Kölliker, 1869 is considered synonymous with *Sarcoptilus* by Williams (in press).

Gray (1848) and Benham (1906) described new species of sea pens referable to the genus *Sarcoptilus* from Australia and New Zealand, respectively. Broch (1910) and Briggs (1915) identified and described several pennatulacean species from southern Australian coastal waters. Utinomi and Shepherd (1982) briefly reviewed the shallow-water sea pens of southern Australia. Their work represents the only previously published survey of the regional pennatulacean fauna.

To date, material representing the following pennatulacean taxa have been collected from the coastal waters of Western Australia, South Australia, Victoria, Tasmania, New South Wales, and New Zealand, and are housed in the collections of several institutions (see below): *Sarcoptilus*, *Gyrophyllum* and *Pteroeides* (Pteroeididae); *Pennatula* (Pennatulidae); *Sclerobelemnon* (Kophobelemnidae); *Funiculina*

TABLE 1. Pennatulaceans from southern Australia and New Zealand.

Species	Distribution & Depth (m)	References
Anthoptilum grandiflorum	SA/VIC/NSW/TAS (392–1157)	present work
Funiculina quadrangularis	SA/TAS(520–597)	present work
Gyrophyllum sibogae	TAS (520)	present work
Halipteris willemoesi	TAS (520)	present work
Pennatula fimbriata	possibly Australia	von Kölliker, 1872 as *Leioptilus grayi*; Batie, 1972
Pennatula phosphorea	SA/TAS(436–636)	present work
Pteroeides elegans	NSW (40–110)	Briggs, 1915
Pteroeides hymenocaulum	WA (11–12)	Broch, 1910
Pteroeides multiradiatum	SA (40–50)	Utinomi & Shepherd, 1982
Pteroeides sp.	NZ (0–5)	present work
Ptilosarcus sinuosus (probably synonymous with *Pennatula fimbriata*)	possibly Australia	Batie, 1972
Sarcoptilus bollonsi	NZ (73)	Benham, 1906 & 1907
Sarcoptilus grandis	WA/SA/V/NSW (10–146)	Gray, 1860; Briggs, 1915, Utinomi & Shepherd, 1982; present work
Sarcoptilus nullispiculatus	SA/V/NSW (18)	Utinomi & Shepherd, 1982; present work
Sarcoptilus rigidus	WA (depth?)	present work
Sarcoptilus shaneparkeri	WA/SA (6–18)	Utinomi & Shepherd, 1982; present work
Sclerobelemnon schmeltzi	NSW (40–110)	Briggs, 1915
Umbellula sp.	NZ (449–4066)	present work
Virgularia gracillima	NZ (18–20)	von Kölliker, 1880; Dendy, 1896; Benham, 1907.
Virgularia gustaviana	WA/SA (depth?)	Utinomi & Shepherd, 1982; present work
Virgularia mirabilis	SA/VIC(depth?)	Utinomi & Shepherd, 1982

(Funiculinidae); *Anthoptilum* (Anthoptilidae); *Halipteris* and *Virgularia* (Virgulariidae); and *Umbellula* (Umbellulidae). The material, much of it recently collected, originates mainly from Perth, Albany, Great Australian Bight, Spencer Gulf, Gulf St Vincent, several localities off Victoria, New South Wales, and Tasmania, as well as the South Island of New Zealand.

The material (including types) used in this study is deposited at the South Australian Museum, Adelaide (SAM); Western Australian Museum, Perth (WAM); New Zealand Oceanographic Institute (NZOI), Wellington; and the California Academy of Sciences—Department of Invertebrate Zoology and Geology, San Francisco (CASIZG). Terminology used in the present work conforms to that of Bayer, Grasshoff, and Verseveldt (1983).

All figures in the present work are by the author.

Key To The Species Of *Sarcoptilus*

1 — Sclerites absent altogether.....*S. nullispiculatus* sp. nov
— Sclerites present, mostly relatively densely distributed.....2
2 — Basal region of peduncle without robust otolith-like sclerites.....*S. shaneparkeri* sp. nov.
— Basal region of peduncle with numerous robust otolith-like sclerites in the interior, 0.2–1.2 mm long.....4
3 — Colonies stiff and rigid. Polyp leaves thick,

swollen, and turgid, fan-shaped to rectangular or trapezoidal, <6 mm in length. Total colony length <120 mm.....*S. rigidus* sp. nov.

— Colonies flexible to limp. Polyp leaves flattened or thin, not turgid, semi-circular to kidney-shaped, up to 45 mm in length. Total colony length up to 350 mm.....*S. grandis* Gray, 1848

Systematic Account

Family PTEROEIDIDAE Kölliker, 1880

Sarcoptilus Gray, 1848

Sarcoptilus Gray, 1848: 45 (in part). Gray, 1860: 23 (in part).

Sarcophyllum Kölliker, 1869: 224. Leuckart, 1872: 280.

Kükenthal & Broch, 1911: 441. Kükenthal, 1915: 117.

Pteroeides Balss, 1910: 60 (in part).

Diagnosis

Colonies feather-like and stout. Bilateral symmetry throughout length of rachis. Axis extends throughout entire length of colony, and round in cross secton. Polyp leaves present and conspicuous, rounded on margins, mostly kidney-shaped or fan-shaped. Polyp leaves without rays. Autozooids congested on distal margin of polyp leaves. Anthocodiae small, retractile into their basal protuberances. Siphonozooids restricted to swollen pads at base of each polyp leaf where the polyp leaves join rachis. Proximal surfaces of polyp leaves devoid of siphonozooids. Mesozooids usually present on distal ventral portion of rachis in a single longitudinal row or scattered. Sclerites smooth, not three-flanged. Spindles or rods of polyp leaves do not form rays; long needles absent. Rods or flattened rods present in the rachis. Small ovoid or biscuit-shaped plates or rods may occur in peduncle.

A genus of five species: southern Australia (four valid species) and New Zealand (one species of questionable validity).

TABLE 2. Table of comparative characters for the genus *Sarcoptilus*

Species	Colour (In alcohol)	Peduncular Sclerites	Maximum Length (mm)	Polyp Leaf Shape	Polyp Leaves Per Side
S. bollonsi (based on the original description)	pale reddish	large calcareous bodies in the interior	155	sickle or fin-shaped	30
S. grandis	cream-white to pale yellow or rose	ovoid finger-biscuits, rods or spindles, & otolith-like forms	350	semi-circular, kidney-shaped, or crescent-shaped	32–36
S. nulli-spiculatus	apricot to pale orange	absent	74	semi-circular, or fin-shaped	18–30
S. rigidus	cream-white	robust spindles & otolith-like forms	117	fan-shaped, rectangular to trapezoidal	22–26
S. shane-parkeri	blue-grey	stout rods & minute ovals	120–180	triangular or fin-shaped to semi-circular	22–38

Sarcoptilus bollonsi (Benham, 1906) new comb.

Sarcophyllum bollousi Benham, 1906: 66 (misspelling—originally named for Captain Bollons of the Government steamship 'Hinemoa').

Sarcophyllum bollonsi Benham, 1907: 193.

Remarks

I have not been able to locate the type specimen for this species and I do not know of any specimens that can be identified as *Sarcoptilus bollonsi*. The species is known only from the descriptions of Benham (1906, 1907), and apparently has not been collected since. From Benham's descriptions, it is very difficult to distinguish this species from *Sarcoptilus grandis*. In my opinion, the descriptions and figures are not detailed enough to distinguish the species. I therefore have not included it in the key to the species of *Sarcoptilus*.

At least two specimens of a species of pteroeidid sea pen closely resembling *Pteroeides dofleini* (Balss, 1909) (see d'Hondt, 1984: 18) have recently been collected from near the type locality of *Sarcoptilus bollonsi* from 0–5 metres depth by the New Zealand Oceanographic Institute (NZOI O840 and NZOI Q97). These specimens superficially resemble members of the genus *Sarcoptilus*. It is possible that the two taxa may be confused.

It is necessary to examine type material of *Sarcoptilus bollonsi* in order to make a sound assessment of its taxonomic status.

Distribution

New Zealand (southwestern coast of the South Island). Recorded only from the type locality at Doubtful Sound in 73 metres of water.

Sarcoptilus grandis Gray, 1848

(Figs 1–5)

Sarcoptilus grandis Gray, 1848: 45. 1860: 23. 1870: 25. Utinomi & Shepherd, 1982: 209.

Sarcophyllum australe Kölliker, 1870: 229. 1872: 186. Hickson, 1890: 140. Thomson & Mackinnon, 1911: 694.

Sarcophyllum grande Kölliker, 1880: 2. Balss, 1910: 60. Kükenthal & Broch, 1911: 441. Briggs, 1915: 93. Kükenthal, 1915: 118.

Sarcophyllum roseum Broch, 1910: 117. Kükenthal, 1915: 118, 120. ***syn. nov.***

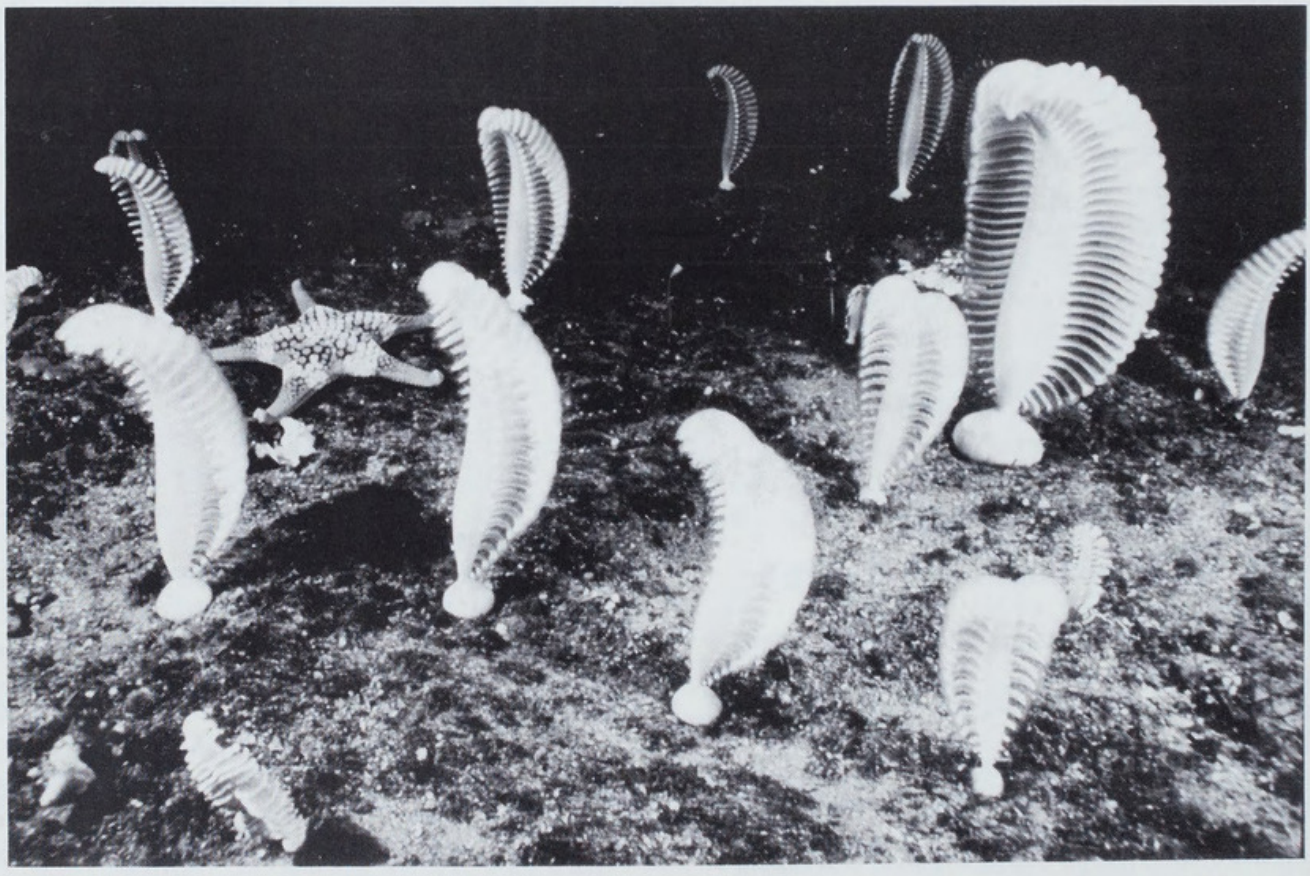

FIGURE 1. *Sarcoptilus grandis*. Underwater photograph of several living sea pens. Photograph: Fred Bavendam.

FIGURE 2. *Sarcoptilus grandis*. Photographs of a single specimen, 170 mm in length (SAM H11919). **A**, Dorsal view; **B**, Ventral view.

Material

South Australia: SAM–10931 (H195), Great Australian Bight, Ceduna District (32°24'S, 133°30'E), 49 metres depth, 23 August 1973, P. Symonds (collector), 2 specimens. SAM–H11919 (H771), Great Australian Bight, near Ceduna (32°24'S, 133°24'E), 26 October 1973, P. Symonds (collector), 1 specimen. SAM–H11920 (H774), Spencer Gulf: 15 km S of Cowell, Stn 10X (34°0'S, 136°56'30"E), 28 September 1981, (N.A. Carrick (collector), 1 specimen. SAM–H11922 (H785), Gulf St Vincent, Adelaide District: Hallett's Cove, 1 specimen. CASIZG–088073, Spencer Gulf, ca 1.5 Nm NW of Point Riley (33°52'S, 137°35'E), 20–25 metres depth, FV Kara George (prawn trawler), 14–15 December 1988, K. L. Gowlett-Holmes and P. Briggs (collectors), 5 specimens. CASIZG–088074, Gulf St Vincent, Adelaide, 4 miles SW of end of Outer Harbour, 12 metres depth, 27 June 1965, P.D. Mitchell (collector), 2 specimens. CASIZG–091432, Gulf St Vincent, Port Noarlunga Beach, 20 January 1964, Mr. Castleton (collector), 1 specimen. **Western Australia:** WAM–65–59, King George Sound, just outside entrance to Oyster Harbour, 4.6 metres depth, 7 January 1959, 1 specimen. WAM–68–59, Albany, Emu Point Channel, 4.6 metres depth, 15 January 1959, 1 specimen. WAM–707–91, Western Australia, Albany, Oyster Harbour ca 6 metres depth, 17 July 1965, E. P. Hodgkin (collector), 1 specimen. WAM–517–88, Esperance, between Sandy Hook Island and Cape LeGrande, 31–35 metres depth, 23–25 June 1986, A. Longbottom on LFBE 'Triumph' (collector), 1 specimen. WAM–67–59, Albany, Emu Point Channel, 4.6 metres depth, 15 January 1959, 1 specimen. WAM–706–91, Albany, Middleton Beach, beached after storm, 5–7 August 1984, V. Milne (collector), 8 specimens. **Tasmania:** SAM–H–13071, Port Davey, Bathurst Channel, S Point of Sarah Channel, 10–12 metres depth, 3 April 1993; W. Zeidler, K. L. Gowlett–Holmes, F. A. Bavendam (collectors), 4 specimens. SAM–H13072, Port Davey, Bathurst Channel, 6–10 metres depth; W. Zeidler, K. L. Gowlett-Holmes, F. A. Bavendam (collectors), 2 specimens.

Description

Specimens examined range in length from 115–350 mm. Additional material in South Australian Museum collection measured by Shane Parker (late Curator of Lower Marine Invertebrates) ranges between 165 and 325 mm in length. Rachis comprises 50–72% of total colony length. Polyp leaves semi-circular or kidney-shaped (usually 25–50 mm in length and up to 30 mm in width), relatively thin (mostly 2–4 mm thick), and number approximately 32–36 per side. Autozooids are small, conical in shape, and congested in several rows (usually 10–15) that form a band along the distal margin of each polyp leaf, extending to approximately 5 mm down each side of a particular leaf. Each autozooid approximately 1.0 mm in length and 0.6 mm in width. Siphonozooids restricted to swollen pad at border between base of each polyp leaf and rachis. Each pad ovoid to elliptical/oblong in shape and approximately 7 mm long by 4 mm wide. Each siphonozooid minute (approximately 0.07 mm in diameter). Siphonozooids highly congested and cover surface of each pad. In addition, mesozooids present on distal/ventral region of rachis. These circular in shape, approximately 0.6 mm in diameter and are either congested in several indistinct longitudinal rows or disposed more sparsely in a single or double longitudinal row. Retracted mesozooids have minute slit-like aperture, 0.12 mm in length. Sclerites of polyp

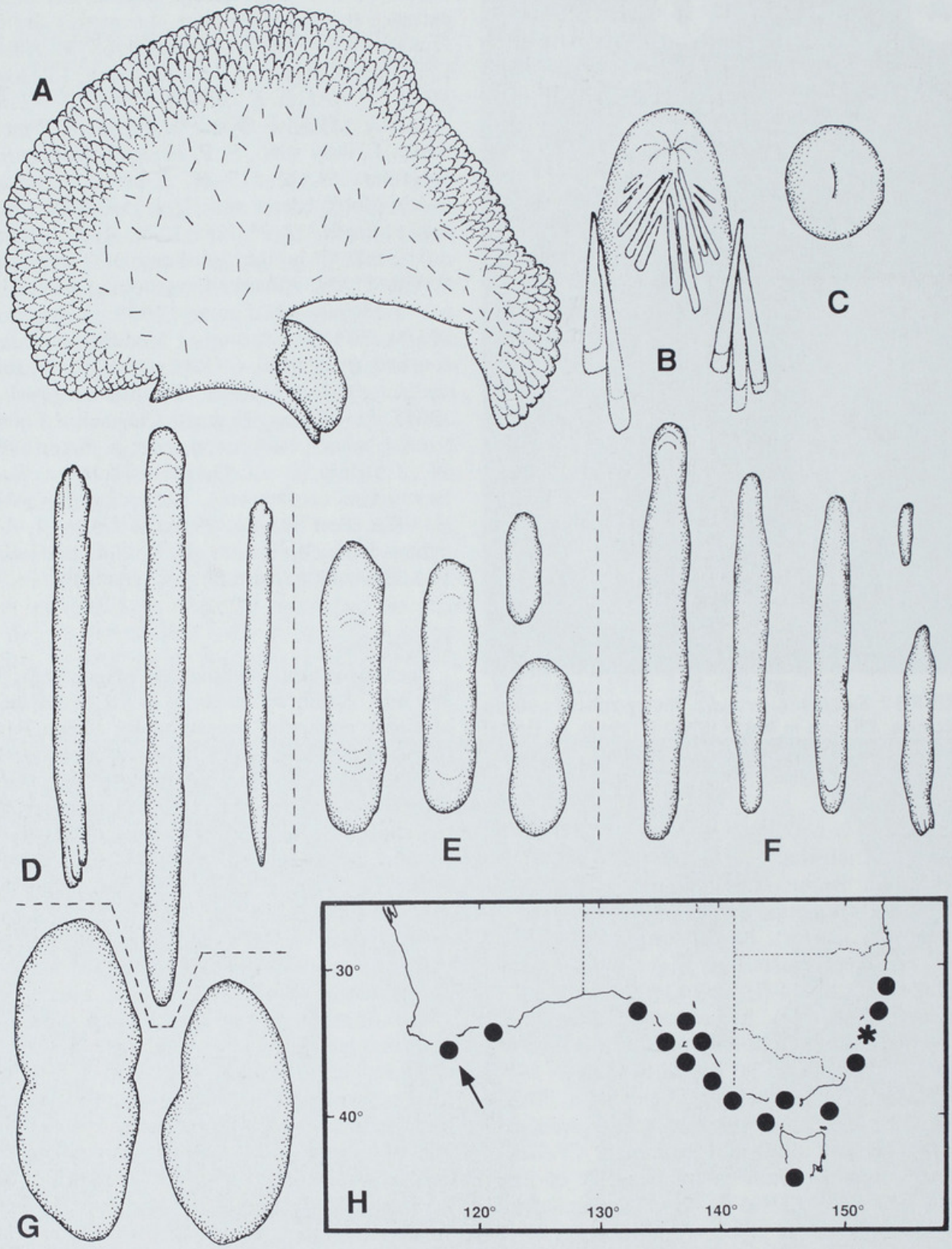

FIGURE 3. *Sarcoptilus grandis*. **A**, Upper surface of a single polyp leaf (39 mm in length), with basal siphonozooid pad; **B**, A single autozooid, maximum width 0.7 mm; **C**, View from above of a single mesozooid, 0.6 mm in diameter; **D**, Polyp leaf sclerites, 1.15 mm. 0.48 mm, 1.25 mm; **E**, Sclerites from the surface of the peduncle, 0.19 mm, 0.17 mm, 0.07 mm, 0.12 mm; **F**, Sclerites from the interior of the upper and middle portions of the peduncle, 0.28 mm, 0.23 mm , 0.21 mm, 0.17 mm, 0.55 mm; **G**, Sclerites of the interior of the lower portion of the peduncle, 1.1 mm, 0.87 mm; **H**, Map showing distribution of the species: ✱ = type locality, ● = other collecting stations; arrow shows type locality of *Sarcophyllum roseum*.

FIGURE 4. *Sarcoptilus grandis*. Scanning electron micrographs of polyp leaf sclerites. **A**, 1.01 mm; **B**, 0.91 mm; **C**, 1.05 mm; **D**, 1.02 mm; **E**, 0.82 mm; **F**, 1.23 mm; **G**, 0.66 mm; **H**, 1.10 mm; **I**, 0.85 mm.

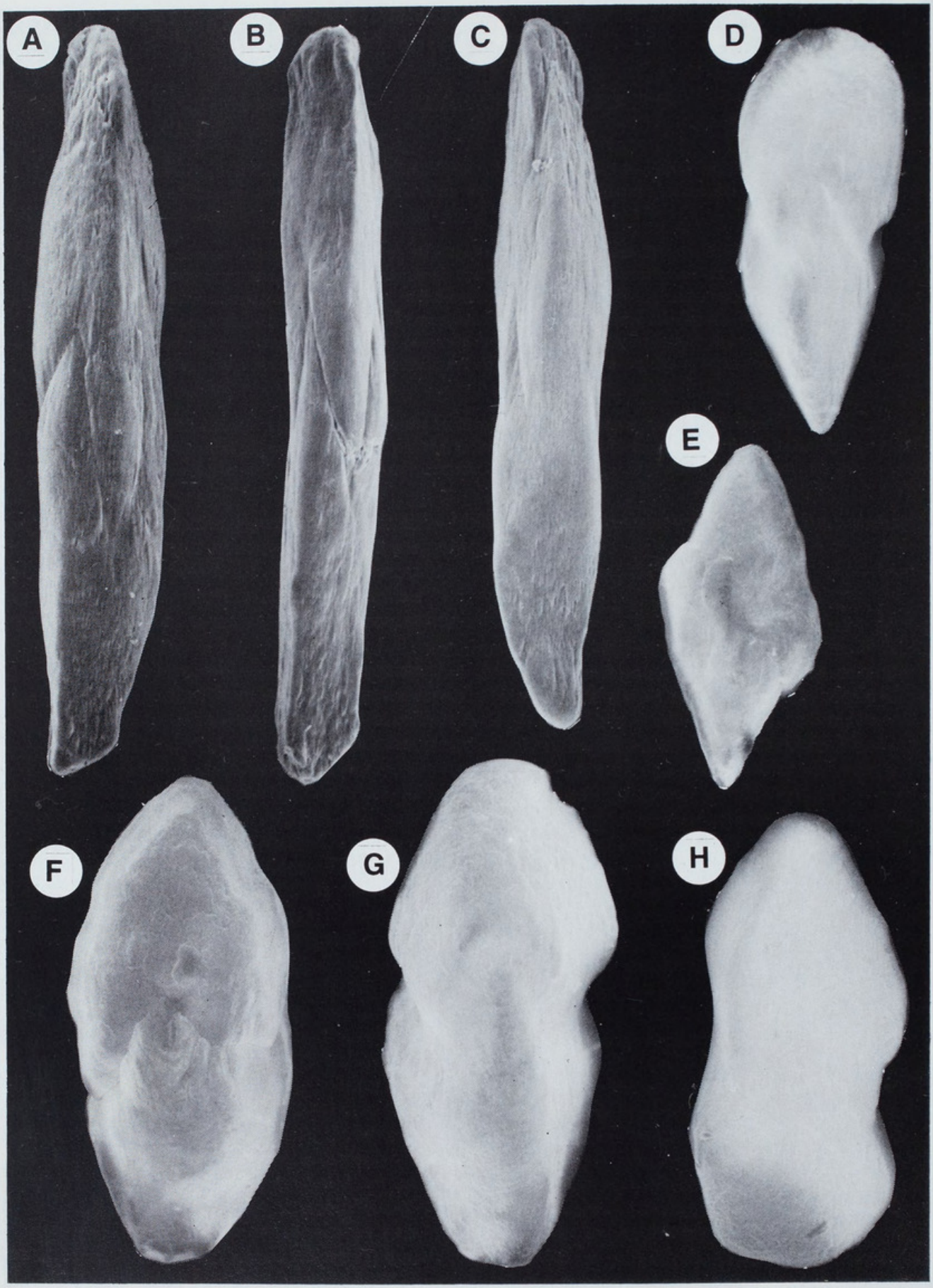

FIGURE 5. *Sarcoptilus grandis*. Scanning electron micrographs of peduncular sclerites. A–C, Sclerites from the interior of the upper and middle portion of the peduncle. **A**, 0.57 mm; **B**, 0.76mm; **C**, 0.53 mm. D–H, Sclerites from the interior of the basal portion of the peduncle; **D**, 0.85 mm; **E**, 0.74 mm; **F**, 1.05 mm; **G**, 0.77 mm; **H**, 0.58 mm.

leaves smooth slender rods or spindles (0.38–1.35 mm in length). Many of these slightly clavate, being enlarged at one end and tapering to a pointed opposite end. Polyp leaf sclerites distributed relatively densely in portion containing autozooids, and very sparse or absent on proximal faces of polyp leaves. Sclerites of surface of polyp leaves often form short lines between groups of autozooids in radiating fashion. Autozooids contain sclerites that either run parallel to longitudinal plain of each autozooid or converge to form inverted 'V' bordering each autozooid. Sclerites of peduncle are of three distinct types—small ovoid fingerbiscuits (0.06–0.19 mm in length) common throughout the surface, stout rods and spindles (0.17–0.76 mm in length) in interior of upper and middle portions of peduncle, and large robust otolith-like forms (0.20–1.1 mm in length) in interior of lower portion near base. Colour in life off-white, orange, or rose; cream or tannish-white preserved in alcohol.

Distribution

Southern Australia (Vicinity of Albany, Western Australia to at least as far as the Manning River/Cape Hawke region, New South Wales); 4.6–146 metres in depth. Utinomi and Shepherd (1982: 211) state the range as being from the Great Australian Bight to southern Queensland. This is by far the most common and widespread species in the genus. Collecting stations for the species come from Briggs (1915), Gray (1860, 1870), Kölliker (1870, 1872, 1880), Hickson (1890), Thomson and MacKinnon (1911), as well as from a large number of recently acquired lots in the collections of the Western Australian Museum, the South Australian Museum, and the California Academy of Sciences. The maximum depth record is reported by Briggs (1915: 94) from King Island, Bass Strait. The type locality was not recorded in the original description by Gray (1848: 45) but only later by Gray (1860: 23 and 1870: 25) as Sydney, Australia.

Discusssion

I have unfortunately not been successful in locating the type specimen of *Sarcophyllum roseum* Broch, 1910 for comparison. However, after having examined a large number of specimens of *Sarcoptilus* from a wide geographic scope, I here conclude that *Sarcophyllum roseum* should be considered as a junior synonym of *Sarcoptilus grandis*. In my opinion, the minor morphological variance observed in *Sarcophyllum roseum*, which was used by Broch to distinguish his species from Gray's, can certainly be accommodated by the range of variation in *Sarcoptilus grandis*. Included in the specimens examined for the present study are several from Broch's type locality (Albany, Western Australia), which agree well in virtually all respects with his original description.

The four characters used by Broch (1910: 121) to distinguish the species are as follows: (1) rachis polyps—forming a long row or plate in *S. grandis* vs a simple or double row in *S. roseum*; (2) the autozooid region of the polyp leaves—in which this polyp zone is wide with numerous sclerites on both sides of the leaf in *S. grandis* vs narrow with sclerites only on the under surface of the leaf in *S. roseum*; (3) the sterile surface of the polyp leaf—with numerous sclerites in *S. grandis* vs no sclerites in *S. roseum*; and (4) length of sclerites from the surface of the rachis and peduncle—rachis sclerites <0.7 mm long and peduncle sclerites <0.4 mm long in *S. grandis* vs <0.5 mm and <0.2 mm respectively in *S. roseum*. These are all variable characters that show gradations between specimens and hence cannot be used to justify the differentiation of two species. An example that contradicts Broch's distinction is a specimen from King George Sound (WAM – 65–59), which has the rachis mesozooids disposed in a plate as in *S. grandis*, but is without sclerites in the sterile portion of the polyp leaf as in *S. roseum*. I conclude that *Sarcophyllum roseum* and *Sarcoptilus grandis* are morphologically indistinguishable and therefore conspecific.

Apparently a substantial amount of variation is present in the size of the peduncular sclerites. Kükenthal (1915: 119) recorded sclerites from the interior as large as 4.5 mm in length, and those from the surface up to 0.4 mm long.

Sarcoptilus nullispiculatus sp. nov.

(Figs 6, 7A,B)

?*Sarcoptilus* sp. Utinomi & Shepherd, 1982: 211.

Material

Holotype. SAM–H10929A, South Australia: Gulf St Vincent, Adelaide District, Port Stanvac, 18 metres depth, D. Cooper (collector), 1 whole specimen.

Paratype. SAM–H10929B, same data as holotype, 1 whole specimen.

Other material studied. SAM–H10929C, same data as holotype, 1 whole specimen.

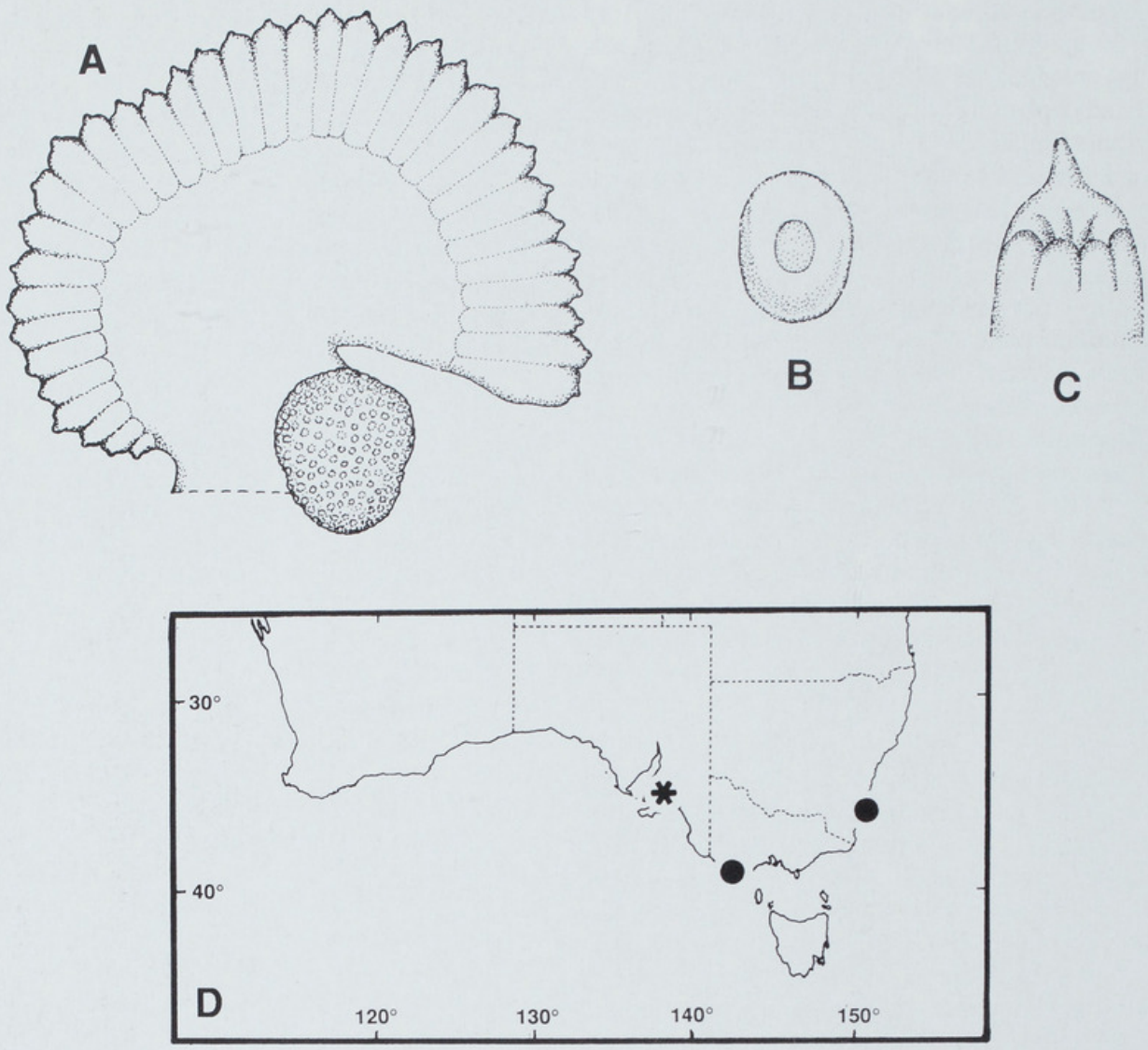

FIGURE 6. *Sarcoptilus nullispiculatus*. **A**, Lower surface of a single polyp leaf (6 mm in length), with siphonozooid pad; **B**, View from above of a single mesozooid, 0.45 mm in length; **C**, Distal portion of a single autozooid, 0.6 mm in width; **D**, Map showing distribution of the species; ✱ = type locality, ● = localities reported by Utinomi and Shepherd (1982) for *Sarcoptilus* sp.

Diagnosis

Colonies under 75 mm in length, slender and limp. Rachis and peduncle roughly equal in length. Polyp leaves 18–30 per side, fin-shaped to semi-circular, <7 mm in length. Autozooids in 1–2 rows, 25–36 per leaf. Siphonozooids restricted to circular pads at dorsal base of each leaf. Single longitudinal row of up to 20 mesozooids present on ventral/distal surface of rachis. Sclerites absent altogether. Colour orange or pale-salmon in alcohol.

Description

The three specimens examined range in length from 58–74 mm. Holotype is 68 mm long while paratype is 74 mm in length. Colonies are slender and flaccid. Rachis comprises 47–58% of total colony length. Dorsal side of rachis has a medial longitudinal groove for its entire length. Polyp leaves number 18–30 per side, fin-shaped to semi-circular, each leaf up to 7 mm in length. Autozooids disposed in one or two rows along distal margin of each leaf, and number approximately 25–36 autozooids per leaf. Each autozooid 0.4–0.6 mm in diameter. Most autozooids have a single non-spiculated, flexible, nipple-like protuberance projecting distally from their apices. Siphonozooids contained on circular to ovoid pads, 1.5 mm in diameter, on the dorsal base of each polyp leaf adjacent to lateral margin of rachis. Each siphonozooid approximately 0.07 mm in diameter. In addition, a single medial row of 10–20 mesozooids present on distal/ventral portion of rachis, each mesozooid 0.20–0.45 mm

FIGURE 7. Photographs of holotypes. A,B. *Sarcoptilus nullispiculatus*. **A**, Ventral view; **B**, Dorsal view. C,D. *Sarcoptilus rigidus*; **C**, Ventral view; **D**, Dorsal view.

in diameter. Sclerites apparently absent altogether from all parts of colonies. Colour throughout apricot-orange to pale orange in alcohol.

Etymology

The specific epithet is derived from the Latin, *nullus* = not any or none, and *spiculum* = a point or dart; in reference to the lack of sclerites in this species.

Distribution

Southern Australia (Gulf St Vincent, South

Australia, and possibly Pt Fairy, Victoria to Jervis Bay, New South Wales—as reported by Utinomi & Shepherd, 1982); 18 metres in depth. Type locality is Gulf St Vincent, South Australia.

Discussion

This species is differentiated from other members of the genus by a complete lack of sclerites. It is likely that *Sarcoptilus* sp. of Utinomi and Shepherd (1982) is conspecific with this species. Even though they do not mention the lack of sclerites in this species, their description agrees in all other aspects with the present material.

Sarcoptilus rigidus sp. nov.

(Figs 7C,D, 8, 9)

Material

Holotype. WAM–363–31, Western Australia: vicinity of Perth: Cottesloe Beach, 1 whole specimen.

Paratype. WAM–364–31, same data as holotype.

Other material studied. WAM–714–91, Western Australia: Albany: Middleton Beach, beach drift, 10 August 1991, S. Bolton (collector), 1 specimen.

Diagnosis

Colonies stiff and rigid, dart-shaped. Polyp leaves thick and turgid, fan-shaped to rectangular or trapezoidal; <6 mm in length; 22–26 leaves per side of rachis. Autozooids in single row of 25–30 per polyp leaf. Several mesozooids scattered on ventral distal extremity of rachis. Siphonozooid pad conspicuous and kidney-shaped. Peduncular sclerites: robust spindles in upper part (0.25–0.42 mm long) and robust, ovoid, otolith-like bodies (0.3–1.2 mm long) in lower part. Colour in alcohol uniformly cream-white or bicoloured with rachis grey and peduncle cream-white.

Description

Specimens examined dart-shaped, markedly stiff and rigid, 65–117 mm in length. Holotype is 80 mm long and paratype 65 mm in length. Peduncle makes up approximately 38–43% of total length. Axis extends throughout entire length of each specimen. Polyp leaves thick and turgid, fan-shaped to rectangular or trapezoidal with rounded corners, 3–6 mm in length. 22–26 polyp leaves per side. Autozooids completely retractile and disposed in single row at distal margin of each polyp leaf, generally 25–30 per polyp leaf. Each retracted autozooid has slit-like aperture, perpendicular to plane of polyp leaf. This aperture surrounded by slightly ovoid ring-like basal swelling without teeth. Siphonozooids contained on swollen, more-or-less elliptical to kidney-shaped pads at dorsal base of each polyp leaf, adjacent to lateral margin of rachis. Each siphonozooid pad approximately 1.5–3.0 mm in length, while an individual siphonozooid is approximately 0.1 mm in diameter. In addition, several mesozooids scattered on distal ventral extremity of rachis, each approximately 0.3–0.5 mm in diameter. Upper and lower surfaces of polyp leaves densely or sparsely ornamented with sclerites that are mostly longitudinally disposed in parallel. Sclerites of polyp leaves slender elongate rods and spindles, 0.3–1.3 mm in length. Many of these faintly longitudinally grooved, some rounded on ends while others angled and obliquely truncate at ends. Sclerites of rachis similar to those of polyp leaves, sparsely distributed. Sclerites of upper portion of peduncle smooth robust spindles, 0.25–0.42 mm in length. These tapered to rounded on ends and often slightly constricted in middle. Lower part of peduncle contains ovoid otolith-like bodies, 0.3–1.2 mm in length. Most of these robust with rounded ends, and many somewhat constricted in middle. Colonies vary in colour in alcohol from bicoloured—rachis grey with peduncle cream-white, to monochromatic—entirely cream-white.

Etymology

The specific epithet is derived from the Latin *rigidus* = stiff or rigid; in reference to the rigid and turgid nature of the colonies of this species.

Distribution

Western Australia (Perth and Albany); shallow sublittoral (depth range unknown). This species is known from only three specimens collected at two localities. The type locality is Perth, Western Australia.

Discussion

This species differs markedly from other members of the genus by its remarkably rigid form and conspicuously turgid polyp leaves. The only other species containing similar otolith-like sclerites in the peduncle is *Sarcoptilus grandis*.

The density of spiculation on the polyp leaves varies greatly from very dense (and covering the entirety of both surfaces) in the holotype and paratype, to very sparse in the specimen from

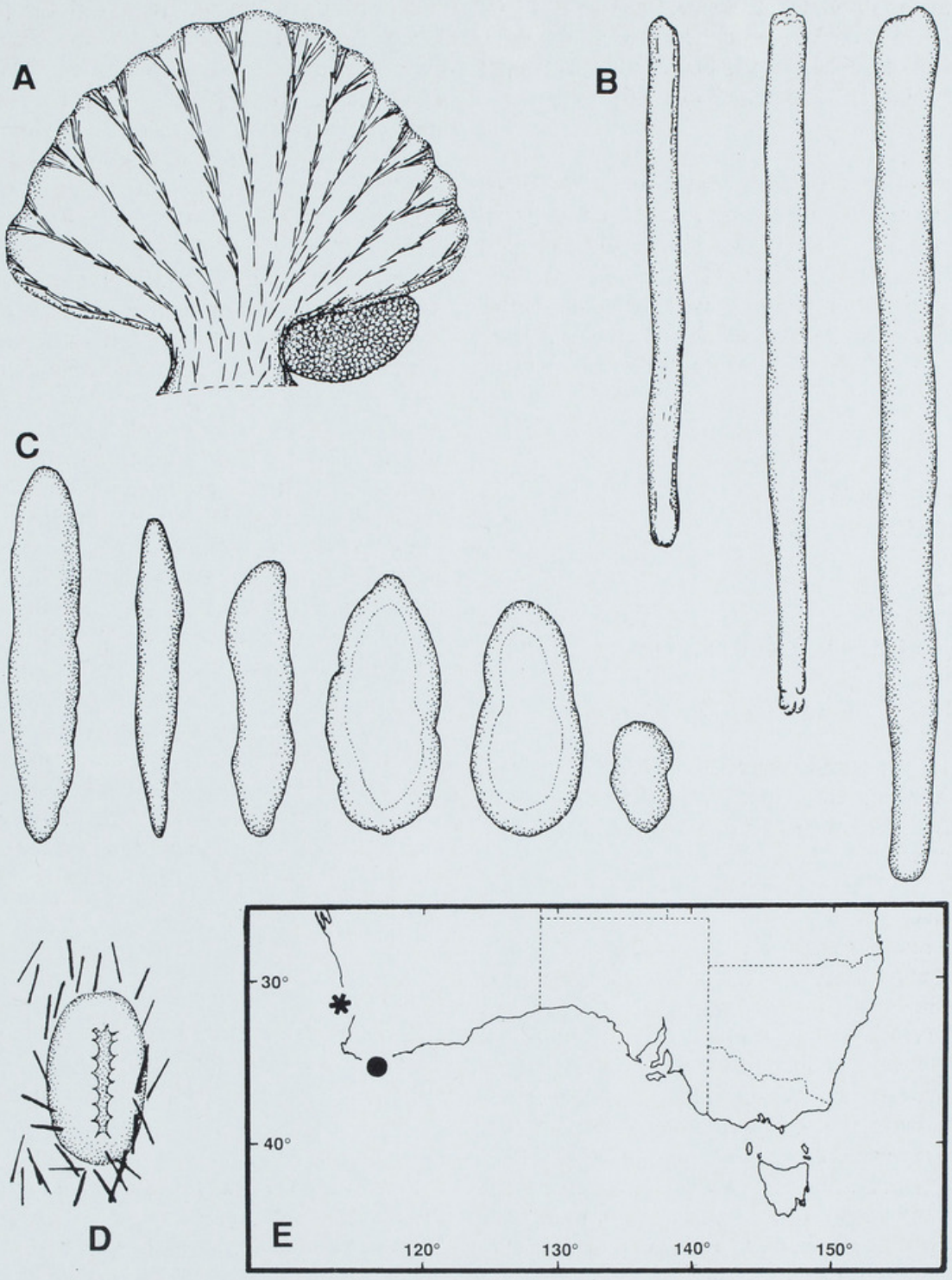

FIGURE 8. *Sarcoptilus rigidus*. **A**, Ventral view of a single polyp leaf (4 mm in length), with siphonozooid pad; **B**, Polyp leaf sclerites, 0.95 mm, 1.30 mm, and 0.40 mm in length; **C**, Peduncular sclerites, 0.27 mm, 0.42 mm, 0.35 mm, 1.2 mm, 1.0 mm, and 0.5 mm in length; **D**, View from above of a single autozooid, 0.27 mm in length; **E**, Map showing distribution of the species: ✱ = type locality; ● = other locality.

Albany, in which only a few sclerites are scattered in the distal margin of each leaf just below the autozooids.

Sarcoptilus shaneparkeri sp. nov.

(Figs 10–13)

Scytalium sp. Utinomi & Shepherd 1982: 209.

Material

Holotype. SAM–H10923A, South Australia: upper Spencer Gulf: 1.6 km E of Douglas Point, 17 metres depth, May 1988, N. Holmes (collector), 1 whole specimen.

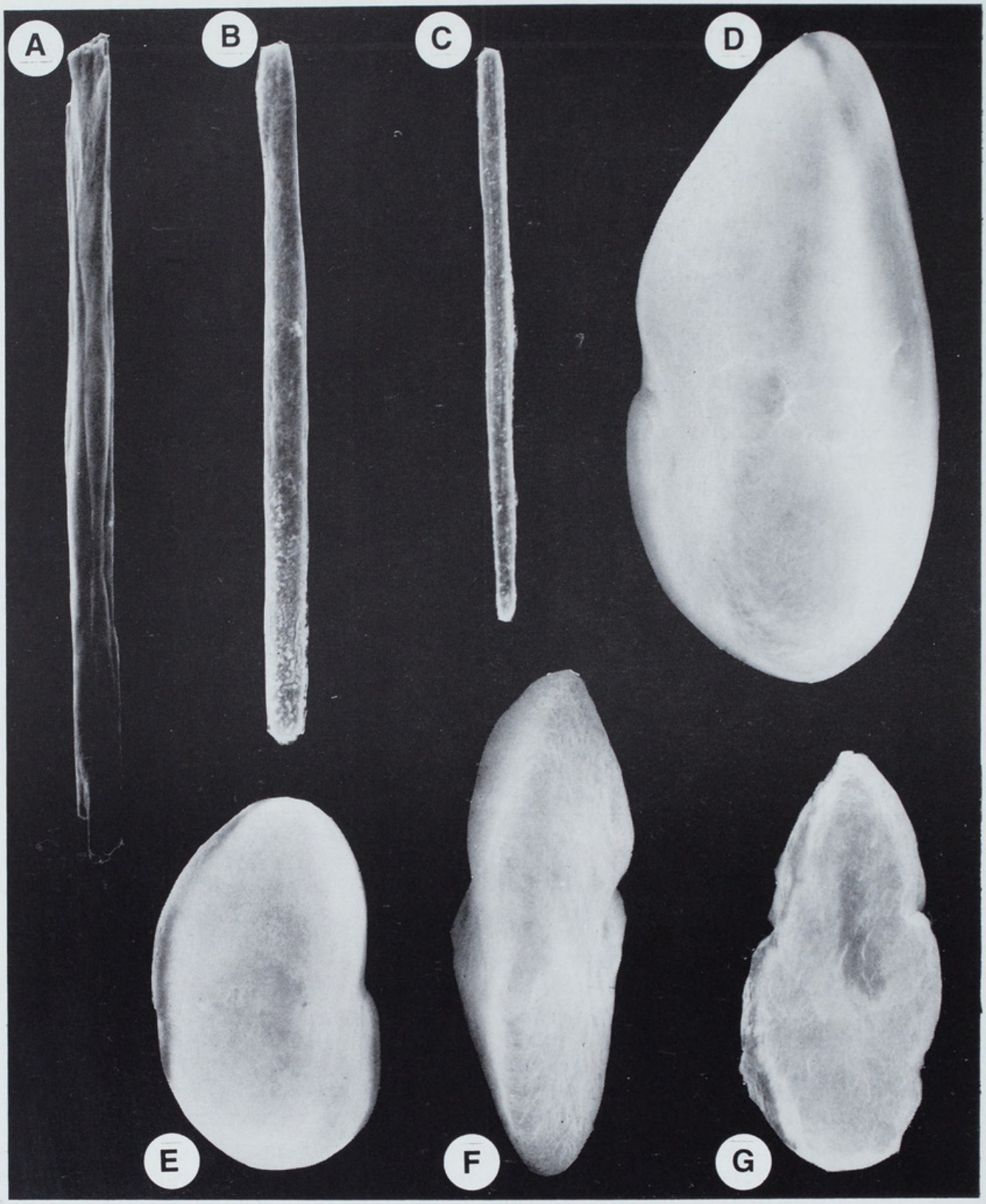

FIGURE 9. *Sarcoptilus rigidus*. Scanning electron micrographs. A–C, Sclerites of the polyp leaves. **A**, 0.99 mm; **B**, 0.33 mm; **C**, 0.41 mm. D–G; Sclerites of the peduncle. **D**, 0.77 mm; **E**, 0.54 mm; **F**, 0.73 mm; **G**, 0.86 mm.

Paratype. SAM–H10923B, same data as holotype, 1 whole specimen.

Other material studied. **South Australia:** SAM–H10922, upper Spencer Gulf, 1.6 km E of Douglas Point (Kinhill Survey Station 3A), 17 metres depth, May 1988, N. Holmes (collector), 11 specimens. SAM–H10924, upper Spencer Gulf: 1.6 km E of Douglas Point (Kinhill Survey Station 3A), 17 metres depth, May 1988, N. Holmes (collector), 1 specimen. SAM–H10926,

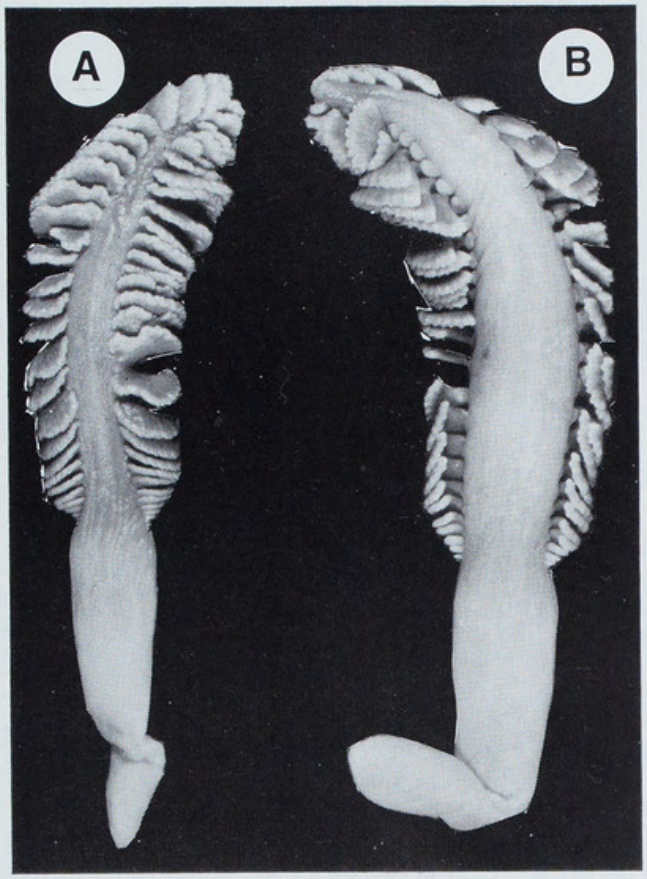

FIGURE 10. *Sarcoptilus shaneparkeri*. Photographs of holotype. **A**, Ventral view; **B**, Dorsal view.

upper Spencer Gulf: 1600 m E of Douglas Point; 27 June 1988, N. Holmes (collector), 3 specimens. SAM–H11842, Spencer Gulf, 22 km S of Port Augusta, 10 metres depth, 3 February 1983, R. Henderson (collector), 1 specimen. SAM–H10918, Spencer Gulf between Douglas Point and Mambray Creek, 15–18 metres in depth, June 1987, N. Holmes (collector), 1 specimen. SAM–H10920, Spencer Gulf between Douglas Point and Mambray Creek, 15–18 metres depth, June 1987, N. Holmes, 2 specimens. SAM–H10921, upper Spencer Gulf, 1.6 km E of Douglas Point, 15 metres depth, 5 May 1988, N. Holmes, 1 specimen. SAM–H10917, upper Spencer Gulf, S of Redcliff Point, 15 metres depth, 9–11 April 1980, 2 specimens. SAM–H10916, upper Spencer Gulf, Port Germein Bay, 6 metres depth, February 1980, N. Holmes (collector), 1 specimen. SAM–H10919, upper Spencer Gulf near Redcliff, 15 metres depth, 17 November 1980, S.A. Shepherd (collector), 1 specimen. SAM–H 10927, Gulf St Vincent, Adelaide District, Seacliff, 15 metres depth, 12 May 1990, N. Holmes (collector), 4 specimens. SAM–H10925, upper Spencer Gulf, 1.6 km E of Douglas Point (Kinhill Survey Station 3A), 17 metres depth, May 1988, N. Holmers (collector), 1 specimen. SAM–H10928, Kangaroo Island, Penneshaw, 14 metres depth, 3 August 1971, J. Kroezen (collector), 2 specimens. **Western Australia:** WAM–709–91, North Mole, Fremantle Harbour, 25 November 1983, S. Slack Smith/L. Marsh/J. Watson/C. Bryce (collectors), 5 specimens. WAM–707–91B, Albany, Oyster Harbour, ca 6 metres depth, 17 July 1965, E.P. Hodgkin (collector), 1 specimen.

Diagnosis

Maximum length 180 mm. Polyp leaves thin, triangular or semi-circular to kidney-shaped, 22–38 pairs of polyp leaves. Polyp zone of each leaf with autozooids in 1 or 2 rows, at least autozooids 20 per row. Retracted autozooids with single basal tooth composed of converging sclerites. Several mesozooids scattered or in a single longitudinal row on ventral distal extremity of rachis. Peduncular sclerites mostly elongate biscuit-shaped rods, 0.11–0.17 mm long. Colour mostly bicoloured: rachis dark blue-grey or brownish-grey with peduncle cream to orange. Monochromatic orange form less common.

Description

Specimens examined range in length from 60–180 mm. Holotype 108 mm in length while paratype 100 mm long. Length of peduncle constitutes 45–55% of total length of single specimen. Rachis may contain deep longitudinal medial groove along entire length of its dorsal side. 22–38 pairs of polyp leaves, which are thin and variable in shape: from deltoid/fin-shaped to semicircular or kidney-shaped, mostly 8–13 mm in length. Retractile autozooids arranged usually in one or two rows along distal margin of each polyp leaf, with 20–35 autozooids per row. Distal tip of each autozooid has single tooth, which is small, blunt to pointed, and triangular in shape. This polyp tooth projects over top of each retracted autozooid. Siphonozooids densely-crowded on small roughly circular pad, situated on dorsal base of each polyp leaf, adjacent to rachis. Each pad ca 1.7 mm in diameter, and single siphonozooid ca 0.1–0.2 mm in diameter. In addition, 10–28 mesozooids present on distal ventral portion of rachis, usually in single longitudinal row or sometimes randomly scattered. These vary from 0.23–0.50 mm in diameter. All three forms of polyps contain scattered sclerites in polyp walls. Sclerites of polyp leaves and surface of rachis are mostly slender rods and spindles, 0.22–0.93 mm in length. Those of polyp leaves sparsely to densely-set in longitudinal rows between the

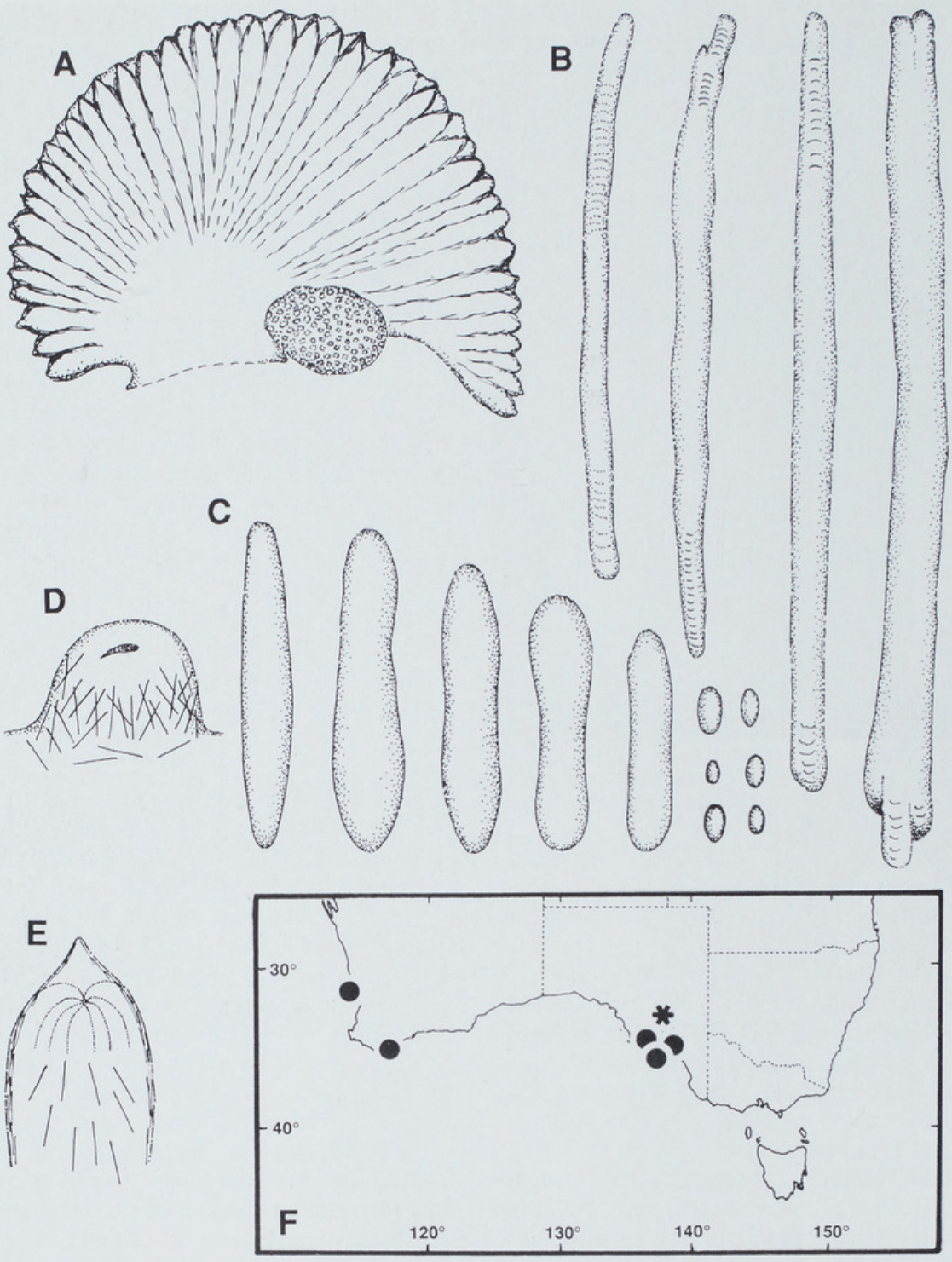

FIGURE 11. *Sarcoptilus shaneparkeri*. **A**, Ventral view of a single polyp leaf (13 mm in length), with siphonozooid pad; **B**, Sclerites of the polyp leaves and rachis, 0.33 mm, 0.48 mm, 0.58 mm, and 0.64 mm in length; **C**, Sclerites of the peduncle, elongate forms are 0.19 mm, 0.18 mm, 0.17 mm, 0.15 mm, and 0.13 mm in length, minute ovals are 0.01–0.02 mm in length; **D**, Lateral view of a single mesozooid, 0.43 mm in length; **E**, Distal portion of a single autozooid, 0.45 mm in width; **F**, Map showing distribution of the species: ✱ = type locality, ● = other localities.

autozooids, as well as being sparsely-scattered obliquely over face of each autozooid just below peristome. Longitudinal rows extend over most of surfaces of both sides of each polyp leaf and radiate outward toward distal margin from base of each leaf. Two adjacent longitudinal rows converge at distal apex of each autozooid to form single inverted V-shaped polyp tooth. Some of sclerites forming tooth blunt and somewhat flattened at distal end. Sclerites from surface of rachis and peduncle arranged mostly longitudinally and in parallel, with a few obliquely

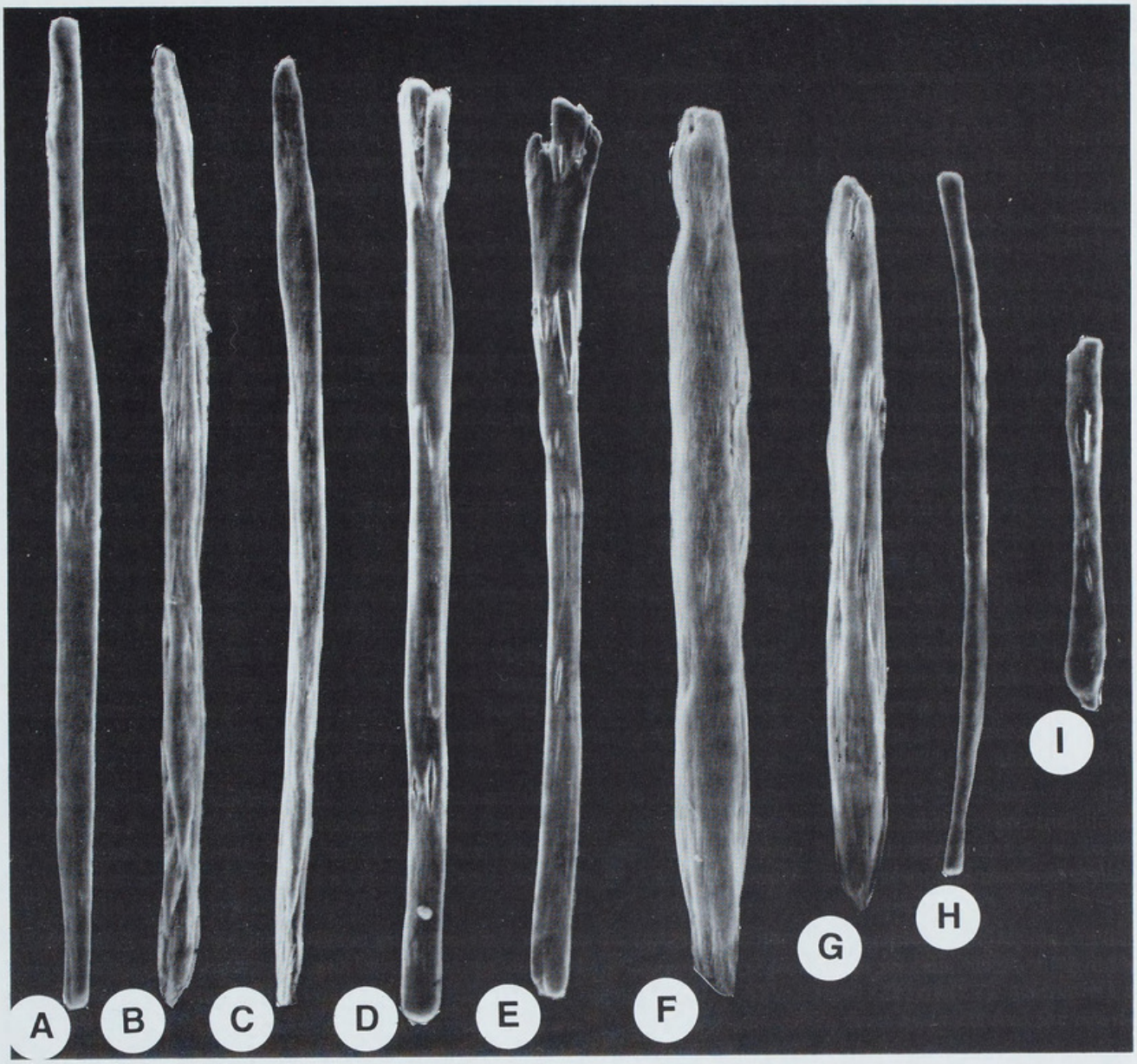

FIGURE 12. *Sarcoptilus shaneparkeri*. Scanning electron micrographs of polyp leaf sclerites. **A**, 0.62 mm; **B**, 0.60 mm; **C**, 0.59 mm; **D**, 0.39 mm; **E**, 0.93 mm; **F**, 0.27 mm; **G**, 0.30 mm; **H**, 0.44 mm; **I**, 0.23 mm.

disposed. Sclerites of surface of peduncle of two distinct kinds—stout smooth rods, sometimes slightly constricted in middle, with rounded ends (0.11–0.17 mm in length and 0.02–0.03 mm in width), and numerous minute ovals (0.01–0.02 mm on length). Sclerites of interior of rachis and peduncle very sparse or apparently lacking. Colour in alcohol of rachis and polyp leaves varies from dark bluish-grey to brownish-grey or violet-grey (rarely orange), contrasting with peduncle which is yellowish-white or pale-orange. Sclerites are colourless.

Etymology

This species is named for Shane A. Parker, late Curator of Lower Invertebrates at the South Australian Museum. Shane originally suggested that the southern Australian pennatulacean fauna be studied. In addition, he supplied on loan much of the essential material for study. Without his interest, enthusiasm, and good humour, this project would not have been possible.

Distribution

Southern Australia (Fremantle Harbour and Albany, Western Australia; Spencer Gulf, Gulf St Vincent, and Kangaroo Island, South Australia); 6–18 metres in depth. This species is apparently locally common in shallow-water of protected embayments, on silty bottom or in hollows of coarse sand between seagrass beds. The type locality is the upper Spencer Gulf, South Australia.

FIGURE 13. *Sarcoptilus shaneparkeri*. Scanning electron micrographs of peduncular sclerites. **A**, 0.15 mm; **B**, 0.15 mm; **C**, 0.10 mm; **D**, 0.14 mm; **E**, 0.13 mm; **F**, 0.14 mm; **G**, 0.12 mm; **H**, 0.12 mm.

Discussion

Utinomi and Shepherd (1982: 208–209) incorrectly identified this species as an undetermined species of *Scytalium*. Members of the genus *Scytalium* have sclerites that are exclusively oval-shaped plates and the siphonozooids are arranged only on the rachis between the polyp leaves. In *Sarcoptilus*, the sclerites are spindles or rods and the siphonozooids are mostly situated on circular pads at the dorsal base of each polyp leaf.

There is a considerable amount of variability observed in this species. Members of the South Australian populations do not exceed 120 mm in length, while those from Western Australia are markedly larger—up to 180 mm in length. The arrangement and amount of spiculation on the polyp leaves varies considerably—from very sparse to very dense. In some specimens, the proximal portion of each polyp leaf is devoid of sclerites. The amount of development of the terminal polyp tooth is also variable—being conspicuous in most members of the South Australian populations, and less strongly developed in others, particularly the specimens from Western Australia. The amount of spiculation present in the surface of the rachis and peduncle is variable—relatively sparse in some to dense in others.

Observations

This species is preyed upon by arminacean nudibranch molluscs (presumably *Armina* sp.) (S. A. Parker, pers. comm.). Many of the specimens observed have the ventral margins of the polyp leaves devoid of polyps—showing signs of being partially eaten.

The following notes on colour, written by S.A. Parker, were found with five specimen lots: (SAM–H10922)—'Colours shortly after collection: stalks bright orange to pale orange, rachis brownish olive to light orange-brown; leaves dark olive-grey-brown; autozooids pale orange to brownish-cream, siphonozooids pale orange'; (SAM–H10923A Holotype and 10923B Paratype)—'Colours shortly after collection: stalk pale apricot-buff, rachis & leaves dull leaden grey with slight brownish tinge; autozooids very pale greyish white to off-white. Siphonozooid pads pale greyish white'; (SAM–H10927)—'Lobes violet-grey, stem creamy-orange'; (SAM–H10928)—'Colour in life: orange'; (SAM–H10925)—'Colours shortly after collection: stalk bright orange, rachis leaves & siphonozooids paler; autozooids whitish orange'. The bicoloured grey/cream form is apparently the most common form and is present throughout the range of the species. The less common monochromatic orange form has only been encountered in upper Spencer Gulf and Kangaroo Island (South Australia) and Albany (Western Australia).

Conclusions

Three species were previously assignable to the pennatulacean genus *Sarcoptilus*: *S. grandis* as the type species, with *Sarcophyllum bollonsi* and *Sarcophyllum roseum* transferable to the genus. This revision adds three new species (*S. nullispiculatus*, *S. rigidus*, and *S. shaneparkeri*), one synonymy (*Sarcophyllum roseum* as a junior synonym of *Sarcoptilus grandis*), and one new combination (*Sarcoptilus bollonsi*), establishing a total of five species for the genus (four valid species in southern Australia and one species of questionable validity in New Zealand (*S. bollonsi*)).

Acknowledgments

I am grateful to Shane Parker, late Curator of Lower Marine Invertebrates at the South Australian Museum in Adelaide, for originally suggesting the study of the southern Australian pennatulacean fauna and for kindly lending the material used in this study.

I thank Loisette Marsh, Curator of Aquatic Invertebrates, Western Australian Museum in Perth, and Dennis Gordon and Paul Anderson of the New Zealand Oceanographic Institute in Wellington for the loan of material from their collections. I also thank Karen Gowlett-Holmes, Wolfgang Zeidler, and Eric Matthews (South Australian Museum) for their cooperation. I am grateful to Darrell Ubick (CAS Scanning Electron Microscope Unit), and Charlotte Fiorito and Caroline Kopp (CAS Photography Department) for their assistance in the production of the plates.

I am indebted to Fred Bavendam, professional freelance photographer, for use of his underwater photograph in Figure 1.

I sincerely thank Marie-José d'Hondt (National Museum of Natural History, Paris) for her helpful ideas concerning the manuscript.

References

BALSS, H. 1910. Japanische Pennatuliden. *In:* Doflein, F. (ed.) *Beiträge zur Naturgeschichte Ostasiens. Abhandlungen der Mathematisch-Physischen Classe der Königlich Sächsischen Gesellschaft der Wissenschaften* **1** (10, suppl.): 1–106.

BATIE, R. E. 1972. Investigations concerning the taxonomic status of the sea pen *Ptilosarcus gurneyi* (Cnidaria, Pennatulacea). *Northwest Science* **46** (4): 290–300.

BAYER, F. M., GRASSHOFF, M., & VERSEVELDT, J. 1983. 'Illustrated trilingual glossary of morphological and anatomical terms applied to Octocoralllia'. E. J. Brill: Leiden.

BENHAM, W. B. 1906. On a new species of *Sarcophyllum* from New Zealand. *Zoologischer Anzeiger* **31** (2/3): 66–67.

BENHAM, W. B. 1907. On a new species of pennatulid (*Sarcophyllum bollonsi*). *Transactions of the New Zealand Institute* **39**: 193–195.

BRIGGS, E. A. 1915. Report on the alcyonarians obtained by the F.I.S. 'Endeavour' on the eastern and southern coasts of Australia, Part 1. *Biological Results of the Fishing Experiments carried on by the F.I.S. 'Endeavour' 1909–1914* **3** (2): 59–94.

BROCH, H. 1910. Pennatulida. *In* Michaelsen, W. and R. Hartmeyer (eds.), *Die Fauna Sudwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905*, **3** (2): 109–122. Verlag von Gustav Fischer: Jena.

DENDY, A. 1896. On *Virgularia gracillima* in Lyttelton Harbour. *Transactions and Proceedings of the New Zealand Institute*, **29**: 256–257.

GRAY, J. E. 1848. Description of *Sarcoptilus*, a new genus of Pennatulidae. *Proceedings of the Zoological Society of London* **1848**: 45.

GRAY, J. E. 1860. Revision of the family Pennatulidae, with descriptions of some new species in the British Museum. *Annals and Magazine of Natural History* (3) **5**: 20–25.

GRAY, J. E. 1870. 'Catalogue of the sea-pens or Pennatulariidae in the collection of the British Museum'. British Museum: London.

HERKLOTS, J. A. 1858. Notices pour servir à l'étude des polypiers nageurs ou pennatulides. *Bijdragen tot de Dierkunde* **7**: 1–31.

HICKSON, S. J. 1890. Preliminary report on a collection of Alcyonaria from Port Phillip. *Proceedings of the Royal Society of Victoria, Melbourne*, (new series) **2** (2): 136–140.

HICKSON, S. J. 1916. The Pennatulacea of the Siboga Expedition, with a general survey of the order. *Siboga Expeditie* Monograph 14 (Livr. 77): 1–265.

HONDT, M.-J. d'. 1984. *Pteroeides* (Octocorallia, Pennatulacea) de Nouvelle-Calédonie. *Bulletin du Muséum national d'histoire naturelle* (4) **6** (A, 1): 3–29.

KÖLLIKER, R. A., von. 1869–72. Anatomisch-Systematische Beschreibung der Alcyonarien. I. Die Pennatuliden. *Abhandlungen von der Senckenbergischen naturforschenden Gesellschaft* **7**: 111–255 (1869); 487–602 (1870); **8**: 85–275 (1872).

KÖLLIKER, R. A., von. 1880. Report on the Pennatulida dredged by H.M.S. Challenger during the years 1873–1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873–76.* Zoology **1** (2): 1–41.KÜKENTHAL, W. 1915. Pennatularia. *Das Tierreich* **43**: 1–132. Verlag von R. Friedländer: Berlin.

KÜKENTHAL, W. & BROCH, H. 1911. Pennatulacea. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia' 1898–1899* **13** (1) Lieferung **2**: 113–576.

MARION, A. F. 1906. Étude des coelentérés atlantiques recueillis par la Commission de dragages de l'aviso le 'Travailleur' durant les campagnes 1880–1881. Oeuvres posthumes de A.-F. Marion. Réunies par Paul Gourret. IV. Les Alcyonaires de la première expédition du Travailleur. *Expédition scientifique Travailleur et Talisman*: 103–151. Masson: Paris.

ROULE, L. 1905. Notice préliminaire sur les pennatulides recueillis par le Travailleur et le Talisman, dans l'Océan Atlantique, au large du Maroc. *Bulletin du Muséum d'histoire naturelle* **11**: 454–458.

STUDER, T. 1891. Note préliminaire sur les alcyonaires provenant des campagnes du yacht 'l'Hirondelle' 1886, 1887, 1888. Part 2. Alcyonacea and Pennatulacea. *Mémoires de la Société zoologique de France* **4**: 86–95.

THOMSON, J. A. & HENDERSON, W. D. 1906. 'An account of the alcyonarians collected by the Royal Indian Marine Survey Ship Investigator in the Indian Ocean. Part I. The alcyonarians of the deep sea'. Indian Museum: Calcutta.

THOMSON, J. A. & MACKINNON, D. L. 1911. The alcyonarians of the 'Thetis' Expedition. *Australian Museum Memoirs* **4**: 661–695.

TIXIER-DURIVAULT, A. & d'HONDT, M.-J. 1973(1974). Nouvelles récoltes d'Octocoralliaires à Madagascar. *Téthys* **5** (2–3): 251–266.

UTINOMI, H. & SHEPHERD, S. A. 1982. Seapens (Order Pennatulacea). *In* Shepherd, S. A. & Thomas, I. M. (eds), *Marine invertebrates of southern Australia, Part I.* Handbooks Committee, South Australian Government.

WILLIAMS, G. C. In Press. Living genera of sea pens – illustrated key and synopses (Coelenterata: Octocorallia; Pennatulacea). Zoological Journal of the Linnean Society.