

A REVIEW OF THE GENUS *SMILASTERIAS*
(ECHINODERMATA, ASTEROIDEA),
WITH DESCRIPTIONS OF TWO NEW SPECIES
FROM SOUTH-EASTERN AUSTRALIA,
ONE A GASTRIC BROODER,
AND A NEW SPECIES FROM MACQUARIE ISLAND

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Abstract

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An emended diagnosis is provided for the genus *Smilasterias* Sladen. Three new species of *Smilasterias* are described. *S. multipara* sp. nov. and *S. tasmaniae* sp. nov. are endemic to south-eastern Australia, and *S. clarkailsa* sp. nov. is from Macquarie Island. The seasonal gastric brooding habit of *S. multipara* sp. nov. is described. Descriptions are given for *S. scalprifera* (Sladen), *S. triremis* (Sladen) and *S. irregularis* H.L. Clark. A key to the species of *Smilasterias* and a distribution map for the three south-eastern Australian species are provided.

Introduction

The type species of the genus *Smilasterias*, *S. scalprifera*, and an additional species *S. triremis*, were described by Sladen (1889) from material collected by H.M.S. "Challenger" in subantarctic waters. H.L. Clark (1928) described a third species *S. irregularis* from a single specimen in poor condition from South Australia.

Subsequently, H.L. Clark (1938) examined a single specimen from San Remo, Victoria (NMV F52993), and 17 specimens in poor condition in the Museum of Comparative Zoology which were collected in Western Port and Port Phillip Bay, Victoria. He concluded that they were all conspecific and close to *S. irregularis*. Because of inadequate comparative material H.L. Clark (1946) expressed his uncertainty about the number of species of *Smilasterias* from southern Australia, and whether the Australian material was congeneric with that collected by H.M.S. "Challenger".

In her report on the BANZARE asteroids, A.M. Clark (1962) detailed a single specimen from Macquarie Island as *Smilasterias* sp. (cf. *irregularis* H.L. Clark), and one from off Princess Elizabeth Land as *Smilasterias* sp. (cf. *triremis* Sladen). The Macquarie Island specimen and description of *S. irregularis* suggested to her the possibility of a fur-

ther genus intermediate between *Smilasterias* and *Allostichaster*, but the lack of comparative material inclined her to leave the identity of these specimens unresolved.

Recent collecting has provided an abundance of material from south-eastern Australia, Macquarie Island, and subantarctic and antarctic waters. There is material conspecific with the San Remo specimen examined by H.L. Clark (1938), and with the Macquarie Island specimen examined by A.M. Clark (1962). *S. scalprifera* (Sladen), *S. triremis* (Sladen), and *S. irregularis* H.L. Clark are all represented. And during museum examinations, material representing a new species of *Smilasterias* from south-eastern Tasmania has been found.

A single specimen (NMV F53029) from off the west coast of Tasmania is discussed as it has characteristics of both *Smilasterias* Sladen and *Allostichaster* Verrill.

Abbreviations and Terminology

AM, Australian Museum, Sydney
BMNH, British Museum (Natural History),
London
NMV, Museum of Victoria, Melbourne
QVM, Queen Victoria Museum, Launceston,
Tasmania

SAM, South Australian Museum, Adelaide
 TM, Tasmanian Museum, Hobart
 WAM, Western Australian Museum, Perth
 R, length of arm from centre of disc
 r, radius of disc to interbrachial apex
 gbr, greatest breadth of arm
 ht, greatest height of arm
 l, length of spinelet
 w, medial width of spinelet
 abactinal plates, plates on the aboral surface
 extending from the superomarginal plates
 dorsolateral plates, skeletal plates between the
 carinal and superomarginal plates
 autotomy, facility for loss of parts of the body
 under adverse stimulation, generally limited to
 single arms or parts of arms (A.M. Clark, 1967)
 fissipary, restricted form of autotomy in which
 division takes place across the disc and results in
 the separation of two approximately equal parts,
 both of which are capable of regenerating to form
 a complete specimen (A.M. Clark, 1967)

Asteriidae Gray, 1840

Asteriinae Verrill, 1914

Smilasterias Sladen, 1889

Asterias (Smilasterias) Sladen, 1889: 562, 578.

Smilasterias.—Fisher, 1923: 250, 602.—1930: 239.—
 1940: 260.—H.L. Clark, 1946: 156.—A.M. Clark, 1962:
 85.

Type species. Asterias scalprifera Sladen, 1889
 (subsequent designation by Fisher, 1923).

Diagnosis (emended). Rays 5, subcylindrical; R up
 to 82 mm; single madreporite, not fissiparous.
 Abactinal skeleton finely reticulate; carinal plates
 small, often irregular, form fine median longitudi-
 nal ridge, linked to superomarginal plates by up
 to 7–16 small dorsolateral plates; dorsolateral area
 broad, plates frequently transversely elongate creat-
 ing transverse ribbing, irregular series of longitu-
 dinal linkages; both series of marginal plates small
 but distinct; no actinal papulae. Inferomarginal
 plates with oblique comb of 2–5 flattened spines;
 adambulacral plates with 2–4 spines. Abactinal
 spinelets numerous, spaced or grouped on plates,
 slightly tapering to clavate, stout to thin. Crossed
 and straight pedicellariae present; pedicellariae not
 clustered around or on spines or spinelets on rays.

Distribution. Antarctica: Palmer Archipelago.
 Subantarctic: off Macquarie, Kerguelen, Heard,
 Marion, Falkland Islands. SE Australia: from
 Nuyts Archipelago (SA) to Shellharbour (NSW),
 Bass Strait Islands, northern and eastern coasts of
 Tasmania. 0–354 m.

Remarks. Sladen (1889) distinguished his new
 subgenus *Asterias (Smilasterias)*, containing the
 species *A. scalprifera* and *A. triremis*, from other
 “*Asterias*” groups by the oblique combs of flattened
 inferomarginal and adambulacral spines, the “su-
 compact” dorsolateral skeleton, and the numerous
 grouped abactinal spinelets. However, on the other
 four species now described, and even on some
 specimens of *S. scalprifera* (Sladen, 1889) and
A. triremis (Sladen, 1889), the spinelets are spaced and
 not noticeably grouped together.

In his final re-diagnosis of the genus Fisher
 (1940) described, amongst other features, the
 inferomarginal plates as being on the ventrolateral
 border of the ray, the presence of a series of small
 actinal plates, the first pair of postoral adambula-
 cral plates as longer than the second pair, and
 straight pedicellariae scattered on all ray surfaces.
 None of these features is consistent across all of
 the species of *Smilasterias*. The inferomarginal
 plates do not always mark a distinct actinolateral
 border, variation occurring within species and in
 the same specimen. Actinal plates may be very
 reduced in number and size, or lacking, as in the
 small species *S. tasmaniae* sp. nov. In most cases
 the first pair of postoral adambulacral plates are
 contiguous, but they are not always longer than the
 second pair. In two of the southern Australian speci-
 es, *S. multipara* sp. nov. and *S. tasmaniae*, there
 may be a few isolated straight pedicellariae on the
 actinal interradial surfaces in the former and on
 the oral spines in the latter, but otherwise straight
 pedicellariae are present only in the furrow in these
 species.

The size and form of the pedicellariae in *S. mul-
 tipara* and *S. tasmaniae* are relatively consistent,
 but there is considerable variation in the size, form
 and distribution of straight pedicellariae in *S. scal-
 prifera*, *S. triremis* and *S. clarkailsa* sp. nov., and
 in the distribution of straight pedicellariae for
 different populations in *S. irregularis* H.L. Clark,
 1928.

To us, the most distinctive diagnostic characteris-
 tic for *Smilasterias* is the form of the abactinal
 skeleton as described. However, in most of the speci-
 es, there is some variation between similar-sized
 specimens in the degree of calcification of the skele-
 ton and in the abactinal plate arrangement. This
 varies from a reticular arrangement, with up to 3
 longitudinal linkages and many irregular or Y-
 shaped dorsolateral plates, to mainly transverse
 series of elongate plates with one or no longitudi-
 nal connections. This was noted by A.M. Clark
 (1962) for *S. triremis*, but it is also true of *S. scal-
 prifera*, *S. clarkailsa* and *S. tasmaniae*. The form

Table 1. Contrasting characteristics of the species of *Smilasterias*.

Species of <i>Smilasterias</i> , distribution, depth range	Maximum R	Dorsolateral plates linking carinals and superomarginals	Inferomarginal spines per plate. Shape of spines	Abactinal spinelet arrangement, shape	Superomarginal beading; spinelets per plate, shape	Actinal series of plates	Straight pedicellariae outside furrow
<i>S. scalprifera</i> Marion, Kerguelen, Heard, Falkland Islands 40(?15)–267 m. (Type species)	82 mm	Up to 16; transverse series with very irregular longitudinal linkages.	Combs of up to 5, mostly 4. Flattened, broad, flared, truncate.	Mostly grouped. Mostly clavate, l/w = 3–4	Not beaded. Up to 10. l/w = 5–6	Up to 3/4 length of a ray; 2 series basally; plates with up to 4, mostly 2–3 spines.	Range of large to small lanceolate and incipient felipedal ones; occur actually, marginally, in arcs. Rare abactinally.
<i>S. triremis</i> Palmer Archipelago. Heard, and between Heard and Kerguelen Islands. 93–354 m.	61 mm	Up to 8; transverse series with very irregular longitudinal linkages	Combs of up to 5, mostly 3. Flattened, broad, flared, truncate to slightly rounded	Mostly grouped. Semi-capitate to slightly tapered. l/w = 3–4	Not beaded. Up to 10. l/w = 4–5	Up to 1/2 length of a ray; plates rarely spiniferous	Small lanceolate ones on all ray surfaces; large felipedal ones may be on some or all ray surfaces
<i>S. clarkailsa</i> sp. nov. Macquarie Island. 69–135 m. (4 specimens only)	35 mm	Up to 7; transverse series with irregular longitudinal linkages.	2 or 3. Flattened, truncate, often flared.	Spaced. Mostly stout and cylindrical. l/w = 2.5	Fine beading. Mostly 2 or 3. l/w = 2.5	Up to 1/2 length of a ray; may be 1–5 plates with spines	Lanceolate, sometimes felipedal; may occur actually, marginally, abactinally
<i>S. irregularis</i> SA, Vic., NSW, northern Tas. 1–30 m. (readily autotomous)	65 mm	Up to 8; transverse series, with mostly 1 irregular series of longitudinal linkages	Up to 3, mostly 2. Flattened, truncate, not flared	Spaced. Cylindrical to clavate. l/w = 3	Prominent beading. Up to 3, mostly with 1 on the proximal lobe. l/w = 4	May be up to 4 thin plates in a series; may be 1–2 plates with spines	Lanceolate ones may occur actually, marginally and abactinally on NSW specimens
<i>S. multipara</i> sp. nov. Vic., northern and eastern Tas. 0–3 m (gastric brooding)	38 mm	Up to 7; transverse series, with mostly 2 irregular series of longitudinal linkages	2. Flattened, truncate, not flared.	Spaced. Semi-capitate to slightly tapered. l/w = 2.5	Fine beading or striations. Mostly 2, aligned transversely. l/w = 3.5	May be up to 6 thin plates in a series; rarely spiniferous.	May be isolated ones on the actinal interradial surfaces, or very rarely some actually.
<i>S. tasmaniae</i> sp. nov. South-eastern Tas. 0–8 m. (3 specimens only)	20 mm	Up to 8; transverse series, with up to 3 very irregular series of longitudinal linkages	2. Flattened, truncate, sometimes with slight waist and swollen end	Spaced. Very stout, sometimes flared or semi-capitate. l/w = 2	Fine striations. Mostly 2 or 3. l/w = 4	None	A few on the oral spines

of the abactinal skeleton is relatively consistent in *S. irregularis* and *S. multipara* and has been figured (fig. 2).

In their keys to the southern genera of Asteroiinae both Fisher (1930) and A.M. Clark (1962) refer to the beading on the supermarginal plates of the related genus, *Allostichaster* Verrill, 1914. A.M. Clark specifically noted the absence of beading for *Smilasterias*. However, the supermarginal plates of *S. irregularis* are prominently beaded. Those of *S. multipara*, *S. clarkailsa* and the *S. sp.* (cf. *triremis*) specimen sometimes have very fine beading. The other species of *Smilasterias* have no beading. Given the consistency of other characteristics, we do not consider beading to be taxonomically significant for *Smilasterias*.

The aboral disc surface is generally a reticulum of small plates, but in two taxonomically uncertain specimens, the BANZARE specimen described by A.M. Clark (1962) as *S. sp.* (cf. *triremis*), and an "Asteroiinae" specimen described herein, there are 10 large radial and interradial plates bordering the disc and giving the disc a distinctly stellar

appearance. These plates are also present in *Allostichaster regularis* H.L. Clark, 1928. More specimens are needed before the taxonomic significance of these plates can be properly assessed.

Unlike some *Allostichaster* species, none of the *Smilasterias* species is fissiparous, but one species, *S. irregularis*, is readily autotomous. Museum specimens of this species, including the holotype, are rarely intact.

In each species small specimens differ from large ones by having a more compact skeleton, fewer dorsolateral transverse plates, restricted papular areas, fewer actinal plates, fewer spinelets per plate, and, in the cases of *S. scalprifera*, *S. triremis* and *S. clarkailsa*, fewer adambulacral and inferomarginal spines. All characters described in this paper refer to larger specimens unless otherwise stated.

Although the greatest depth recorded for the described species is 354 m for *S. triremis*, the *S. sp.* (cf. *triremis*) specimen was collected from 1266 m.

Some of the contrasting characteristics of the species of *Smilasterias* are summarized in Table 1.

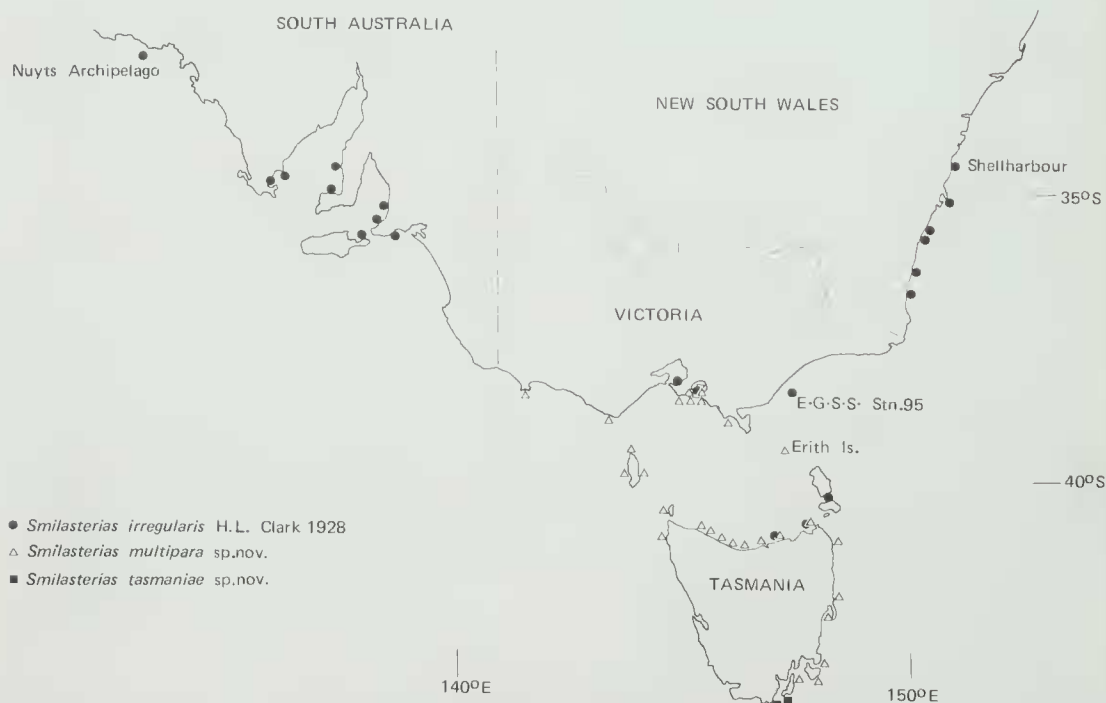


Figure 1. Map showing the recorded occurrence of the Australian species of *Smilasterias*. (EGSS—East Gippsland Scallop Survey).

Key to the species of *Smilasterias* Sladen

- 1 10 distinctly larger radial and interradial plates bordering the disc aborally
 *Smilasterias* sp. (cf. *triremis*) (Sladen, 1889) (A.M. Clark, 1962)
- Aboral disc a reticulum of small plates only 2
- 2 Inferomarginal plates with combs of predominantly 3–4 flared spines; actinal series long, up to half the length of a ray or longer; abactinal spinelets often grouped; up to 2 crossed pedicellariae per spinelet on rays abactinally
 3
- Inferomarginal plates with 2–3 spines, often flared; actinal series long, up to half the length of a ray; abactinal spinelets not grouped; 3–4 crossed pedicellariae per spinelet on rays abactinally *Smilasterias clarkailsa* sp. nov.
- Inferomarginal plates with predominantly 2 spines, not flared; actinal series short or lacking, up to 6 plates; abactinal spinelets not grouped; up to 2 crossed pedicellariae per spinelet on rays abactinally 4
- 3 Inferomarginal plates with predominantly 4 spines; adambulacral plates with predominantly 3 spines; straight pedicellariae rare abactinally; actinal plates spiniferous *Smilasterias scalprifera* (Sladen, 1889)
- Inferomarginal plates with predominantly 3 spines; adambulacral plates with predominantly 2 spines; straight pedicellariae abactinally; actinal plates rarely spiniferous *Smilasterias triremis* (Sladen, 1889)
- 4 Short series of thin actinal plates present on rays; pedicellariae present on upper abactinal surface; oral spines lacking pedicellariae; rays long, with only slight proximal swelling, R/gbr > 4 5
- Series of actinal plates lacking; upper abactinal surface lacking pedicellariae; a few pedicellariae on oral spines; rays short, swollen proximally, R/gbr < 4 *Smilasterias tasmaniae* sp. nov.
- 5 Superomarginal plates contiguous or imbricating longitudinally, with transverse papular areas very rarely continuous between them; superomarginal plates with mostly 3 spinelets, one on a prominent proximal lobe; mostly one irregular series of longitudinal dorsolateral plate linkages along mid-ray; readily autotomous; live colour mostly mottled reddish-brown and cream
 *Smilasterias irregularis* H.L. Clark, 1928
- Superomarginal plates often separated longitudinally, with transverse papular areas continuous between them; superomarginal plates mostly with 2 spinelets, aligned transversely; mostly 2 irregular series of longitudinal dorsolateral plate linkages along mid-ray; not readily autotomous; live colour very dark grey over pale cream *Smilasterias multipara* sp. nov.

***Smilasterias multipara* sp. nov.**

Plate 1 a, b, Figures 1, 2, 3

Smilasterias irregularis H.L. Clark, 1928. — H.L. Clark, 1938: 195 (in part).*Smilasterias* sp. — Marine Research Group of Victoria, 1984: 138.**Material examined.** Holotype, Victoria, Flinders, ocean platform, lower intertidal pool, 12 Jan 1986, M. O'Loughlin, NMV F53036 (dry).

Paratypes. Type locality, NMV F53030 (3 specimens), NMV F53033 (8), NMV F53037 (1), AM J20199 (5), BMNH 1986.10.1.1–5 (5); Victoria, Cape Bridgewater, 20 Jan 1979, M. O'Loughlin, NMV F53011 (12); Bushrangers Bay, lower intertidal pools, 25 Jan 1986, M. O'Loughlin, SAM K1760 (5); Flinders, ocean platform, lower inter-

tidal pools, 8 Feb 1986, M. O'Loughlin, WAM 428-86 (5); Tasmania, Stanley, 6 Nov 1979, J.R. Penprase, TM H1546 (2 brooding); Greens Beach, 28 Oct 1978, M. O'Loughlin, NMV F53027 (1 brooding); Lulworth, 22 Nov 1982, M. O'Loughlin, NMV F53035 (1 brooding + 2).

Other material. Victoria, Cape Bridgewater, 20 Jan 1979, NMV F53028 (1), NMV F53034 (10), NMV F53039 (3); Castle Cove, 29 Dec 1986, NMV F53573 (53); Bushrangers Bay, 28 Mar 1981, NMV F53020 (2); 25 Jan 1986, NMV F53031 (7); Flinders, 26 Apr 1935, NMV F52994 (1); 16 Jan 1968, NMV F52996 (1); 6 Jun 1969, NMV F53000 (2); 6 Sep 1969, TM H1594 (10); 17 Dec 1969, NMV F53002 (5); 8 Mar 1976, NMV F53005 (10), AM J9915 (5); 26 Feb 1977, NMV F53007 (8); 14 Jan 1979, NMV F53008 (1), NMV F53010 (8); 10 Mar 1980, NMV F53016 (5); 7 Apr 1980, NMV F53017 (1); 16 Nov 1980, NMV F53018 (3); 22 Jan 1982, NMV F53021 (5); 26 Dec

1983, NMV F53025(1); 12 Dec 1985, NMV F53026(11); 8 Feb 1986, NMV F53032(26); 3 Nov 1986, NMV F53046(15 brooding), NMV F53047(31); 2 Aug 1987, NMV F53574(6); 9 Oct 1987, NMV F53575(41 brooding + 61); Western Port, 10 Jan 1970, NMV F53006(1); Crawfish Rock, 15 Feb 1969, NMV F52999(1); Balnarring, 29 Nov 1969, NMV F53001(2); Phillip Island, Cat Bay, no date, NMV F53004(3); Kitty Miller Bay, 7 Apr 1968, NMV F52997(5); 25 Oct 1987, NMV F53571(1 brooding); San Remo, coll., G. Coghill 28 Jan 1909, identified by H.L. Clark as *S. irregularis* (see Clark, 1938: 195), NMV F52993(1); Cape Liptrap, 7 Mar 1982, NMV F53022(2); Walkerville 7 Mar 1982, NMV F53023(2).

Bass Strait islands. King Island, Narracoopa, 30 Sep 1935, NMV F52995(4); 8 Mar 1980, NMV F53012(3); City of Melbourne Bay, Nov 1969, 2-3 m, TM H1646(2); Cape Wickham, 9 Mar 1980, NMV F53013(2); Currie, 10 Mar 1980, NMV F53014(6); Gulehway, 10 Mar 1980, NMV F53015(7); Erith Island, May 1974, NMV F53003(2), AM J16596(2).

Tasmania. West Point, 9 Dec 1977, AM J11401(2); Marrawah, Green Point, 21 Jan 1975, AM J9018(1); Hunter Island, Jan 1954, AM J6843(7); Circular Head, Highfield Point, 1-14 Jan 1983, TM H1768 (23); Jacobs Boat Harbour, 31 Jan 1969, TM H1592(13); Port Latta, Cowrie Beach, 1 Dec 1968, NMV F52998(1); Western Bay, 29 May 1979, TM H11532(3); Burnie, Somerset, 29

Jan 1972, WAM 670-76(2); Ulverstone, Aug 1934, QVM(1); Devonport, east, 24 Nov 1984, TM H1855(1); Coles Beach, 14 Mar 1977, AM J10556(1); 10-13 Dec 1977, TM H1916(1); 1-12 Dec 1982, TM H1752(1); Greens Beach, 24 Jun 1961, QVM(4); 30 Oct 1965, QVM(12); 16 Apr 1975, QVM(3); 24 Mar 1976, QVM(9); 7 Apr 1976, QVM(4); 8 Apr 1976, QVM (21); 28 Oct 1978, NMV F53009(1), NMV F53040(1); 7 Mar 1981, NMV F53019(6); 3 May 1986, NMV F53572(4); Cape Portland, 2 Mar 1969, TM H1121(8), TM H1416(1); 28 Mar 1971, TM H1645(5); Jan 1980, QVM(1); George Rocks, 19 Nov 1977, QVM(4); Bicheno, 21 Nov 1968, TM H794(4); 21 Nov 1981, NMV F53042(1); 12-13 May 1983, TM H1797(1); Coles Bay, 23 Apr 1972, TM H1644(4); 20 Nov 1982, NMV F53024(1); Eaglehawk Neck, 30 Mar 1970, TM H1140(3); Port Arthur, 28 Feb 1971, TM H1641(1); 23 Mar 1971, TM H1642(2); 3 Jun 1971, TM H1643(4); Safety Cove, 28 Apr 1974, TM E1639(2); Point Puer, opposite Dead Island, 13 Dec 1972, TM H1640(1); Bruny Island, Variety Bay, 30 Jan 1967, TM H1593(5).

Distribution (fig. 1). Victorian coast from Cape Bridgewater (38°23'S, 141°25'E) to Walkerville (38°52'S, 146°0'E); Bass Strait Islands; Tasmanian coast from West Point (40°55'S, 144°37'E) to Variety Bay, Bruny Island (43°12'S, 147°26'E). 0-3 m.

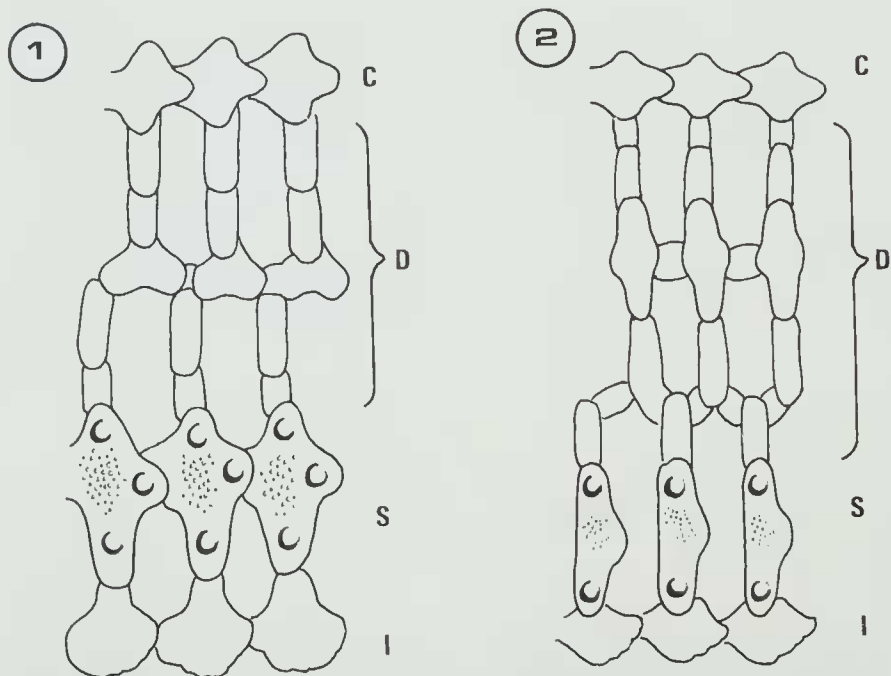


Figure 2. Schematic drawing of the arrangements of the skeletal plates, and the disposition of the spinelets and beading on the superomarginal plates, for proximal sections of the rays of: 1, *Smilasterias irregularis* H.L. Clark (NMV F53048), with 1 series of longitudinal dorsolateral linkages, superomarginals imbricating longitudinally, a spinelet on the proximal lobe of the superomarginal plates, and prominent beading; and 2, *S. multipara* sp. nov. (NMV F53039), with 2 series of linkages, superomarginals not imbricating, spinelets aligned transversely, and fine striations. (C, carinal, D, dorsolateral, S, superomarginal, I, inferomarginal. R.H.S. is adoral.)

Etymology. From the Latin *multus* (many) and *parere* (to bear), in reference to the brooding habit of bearing many young.

Description. Holotype. 5 rays; R = 30, 29, 28, 26, 24 mm; r = 4 mm; gbr = 6 mm; ht = 6 mm; R/r = 7.5; R/gbr = 5. Rays subcylindrical; fine median longitudinal ridge along rays, transverse ribbing; rays constricted basally, slightly swollen proximally, tapered to rounded tip; interbrachial arcs acutely angular. Abactinal skeleton very finely reticulate; disc an irregular reticulum of small plates aborally; smallest ray with irregular plating; single madreporite at aboral apex of interbrachial arc, surrounded by 9 spinelets. Papular areas extensive; irregular on disc, up to 1.0 mm long; transversely elongate on rays, up to 3.0 mm long, often extending between superomarginals; 1-5 papulae per area; no actinal papulae.

Carinal series of mostly regular quadrilobed plates up to 0.8 mm wide, imbricating proximal over distal lobes; series irregular along 1 ray, basally on 2 rays. Carinals linked to superomarginals by regular transverse series of up to 6 rod-like, cruciform or Y-shaped plates; 1 or 2 irregular series of longitudinal dorsolateral linkages; dorsolateral area up to 5 mm wide transversely. Superomarginals alternate in alignment with carinals; narrowly cruciform, up to 2 mm long transversely; imbricate with dorsolaterals and inferomarginals transversely, often separated longitudinally; finely beaded centrally; 32 superomarginals for R = 30 mm. Inferomarginals correspond in number and alignment with superomarginals; up to 1.2 mm longitudinally, imbricating strongly; up to 1.2 mm transversely, with tapering vertical lobe imbricating under superomarginals; inferomarginals form actinolateral ray margin. Short actinal series of 6

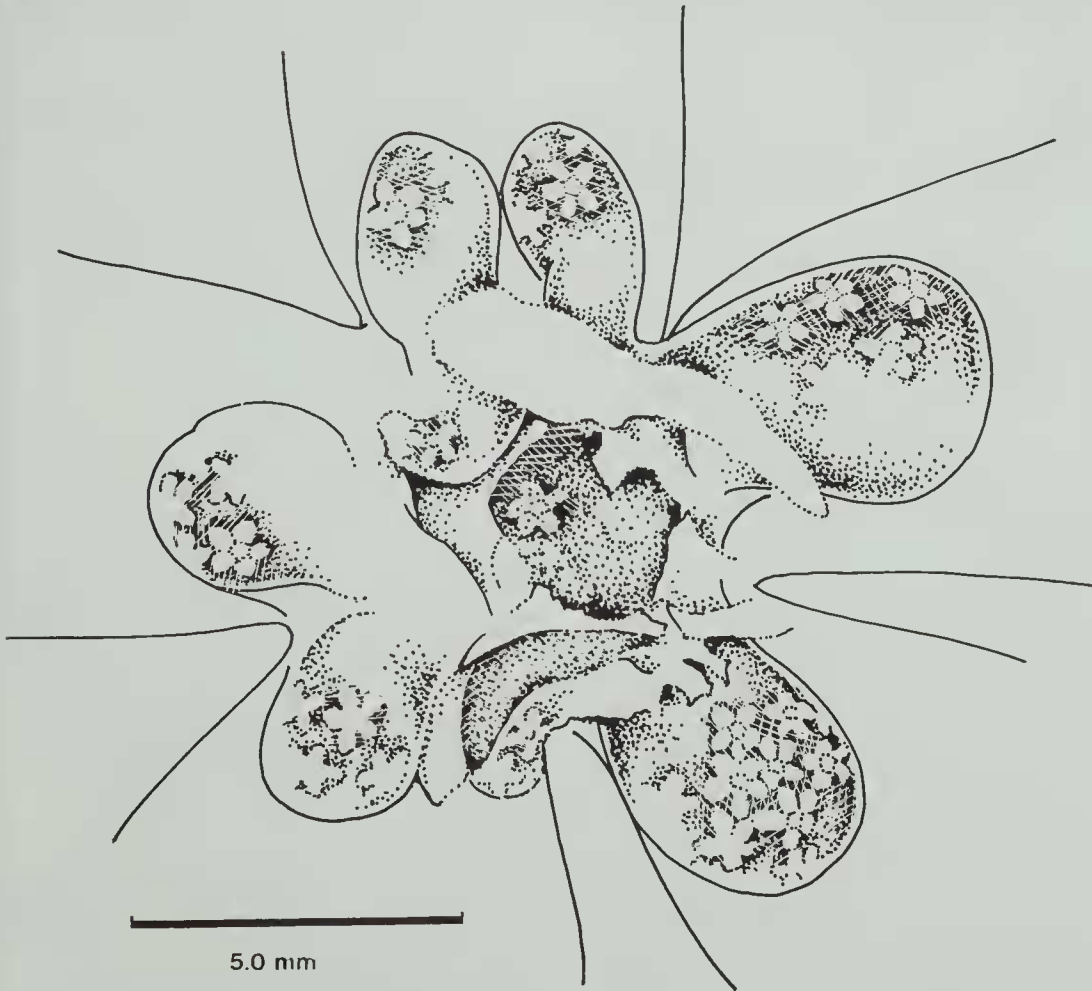


Figure 3. Aboral view of the exposed lobes of the cardiac stomach of *Smilasterias multipara* sp. nov., showing some brood juveniles. (Paratype NMV F53027)

thin plates; correspond with marginals. First pair of adoral adambulacrals contiguous, subequal with adjacent plates; 11 adambulacrals for 5 inferomarginals; terminal plate hemispherical, domed, actinially furrowed, up to 1.6 mm wide.

Abactinal and superomarginal plates with small, spaced, slightly tapering to rarely semi-capitate, often slightly curved, terminally spiniferous spinelets; carinals with 1 or 2 spinelets, $l = 0.2$ mm, $l/w = 2.5$; superomarginals mostly with 2 spinelets aligned transversely, $l = 0.5$ mm, $l/w = 3.5$. Inferomarginals mostly with pairs of slightly flattened, slightly tapered spines, up to 1.3 mm long, aligned obliquely to furrow, more stout than adambulacrals; 1 small actinal spine on each side of 1 ray; most adambulacrals diplacanthid, spines up to 1.3 mm long, spine nearer furrow mostly smaller. Oral plates with 3 or 4 spines; actinal ones similar to adambulacrals; terminal oral ones much shorter, on furrow edge of plate, with swollen base and tapering neck.

Small crossed pedicellariae scattered over abactinal and marginal surfaces; less numerous than spinelets on disc and rays proximally, more numerous distally; up to 0.1 mm high. Some small straight pedicellariae on furrow edge of adambulacrals, 0.1 mm high; single larger straight pedicellaria on 1 actinal interradial surface, 0.2 mm high.

Paratypes. Show no evidence of autotomy; inferomarginal plates do not usually form an actinolateral margin to rays; form of rays is consistent, with $R/gbr > 4$; skeletal form resembles holotype, with up to 7 dorsolateral plates transversely and up to 5 papulae per area in largest specimen ($R = 38$ mm; NMV F53011); mostly 2 very irregular series of longitudinal linkages across the transverse series of dorsolateral plates; superomarginal plates often separated longitudinally, mostly with fine striations rather than beading; mostly 2 superomarginal spinelets, aligned transversely, all at least twice as long as carinal spinelets; inferomarginal spines mostly more flattened and truncate than in holotype; 1 paratype (NMV F53030) with a few proximal inferomarginal plates with 3 spines; straight pedicellariae lacking on abactinal and marginal surfaces, very rare on actinal interradial surfaces; 1 paratype (NMV F53011) with straight pedicellariae actinially; 1 paratype (WAM 428-86) with spiniferous actinal plates.

Colour (live). White to cream actinially and ends of rays, with dark grey mosaic on pale background abactinially; as growth occurs dark grey increases from disc only, to irregular dark bands through rays, to dark rays with irregular pale bands, to mostly dark abactinially; dark grey may be

brownish or greenish; brood juveniles are pink when released; dark grey turns to pinkish red immediately in alcohol.

Reproduction. Specimens of *S. multipara* have been observed to brood young in their cardiac stomachs. Most of the 563 specimens examined have been dissected but only 61, from Stanley, Greens Beach and Lulworth, on the north coast of Tasmania, and from Flinders and Kitty Miller Bay, Victoria, are brooding. All 61 were collected during October and November, although material from all months except July is represented.

Sexes are separate and there is no evidence of protandry or hermaphroditism. Female gonads are generally small, 0.07-0.1 times the ray length, and cylindrical, occasionally with small lateral outgrowths. Gonads in female specimens collected in August (NMV F53574), however, are much stouter and longer, 0.3 times the ray length, and filled with large eggs, orange when preserved in alcohol. The gonopores open low down on the lateral side of the rays, between, or just above, the basal and second superomarginal plates. Some female specimens collected in early October are brooding, the gonads retracted to their usual size. In one lot (NMV F53575), of the 94 specimens over $R = 10$ mm, 47 are male, 41 are brooding females and 6 are non-brooding females.

The process of fertilization and ingestion is unknown. One of us (M.O'L., 3 Nov 1986) has observed adults releasing young, and separate broods of recently released juveniles, on the under surface of rocks in shallow pools near low tide mark.

The large cardiac stomach is used for brooding, extending during brooding to up to one third of a ray length (fig. 3). The usually thick and opaque stomach wall is thin and membranous in these extensions. No juveniles have been found in the small, aboral, pyloric stomach. There is no evidence of food in the stomachs of brooding specimens.

Up to 300 juveniles have been found in one individual (TM H1546), approximately 50 in the disc and in each radial extension of the stomach. The smallest brood females, $R = 10-12$ mm (NMV F53575), have only 5-20 juveniles. These are often restricted to the disc and 1-2 rays, the other rays having no stomach extension.

The juveniles are up to $R = 1.0$ mm, $r = 0.6$ mm, when released. There are 5-10 pairs of tube feet along each ray and a few spinelets on the aboral surface, more numerous at the ray tip and longest in the interradial margins.

The brooding habit of *S. multipara* is similar to that described by Fisher (1930: 48-57, fig. 2) for

the arctic asteriian *Leptasterias groenlandica* (Lütken, 1857). However, Fisher found that in the early stages of development the young are attached to the adult by a larval organ. No such organ has been observed in *S. multipara*.

Remarks. This large series of specimens confirms H.L. Clark's (1938) suspicion that the San Remo specimen (NMV F52993), temporarily placed in *S. irregularis*, belongs to another species. This was recognized by the present authors in Marine Research Group of Victoria (1984), where this species is referred to as *Smilasterias* sp.

S. multipara is mostly found on the relatively bare and smooth undersurface of large pebbles and boulders in the lower intertidal and shallow sublittoral zones of exposed ocean platforms, usually basalt. This habitat preference and the brooding habit possibly account for the Victorian distribution, which, despite an extensive survey of the coast, is rather discontinuous (fig. 1). However, where this species is present it is the most abundant asteroid in the zone around the low tide mark.

In addition to this gastric brooding species there are two southern Australian asteroids which are known to be viviparous: *Patiriella vivipara* Dartnall, 1969, from south-eastern Tasmania, and *Patiriella parvivipara* Keough and Dartnall, 1978, from the west coast of the Eyre Peninsula, South Australia.

Smilasterias tasmaniae sp. nov.

Plate 1 c, d, e, Figure 1

Material examined. Holotype. Tasmania, Bruny Is., Lighthouse Bay, on rocks with brown kelp, 8 m, 13 Dec 1977, C. Short, AM J11395 (dry).

Paratypes. Recherche Bay, Catamaran, under stones at low tide, Oct 1929, M. Ward, AM J19659(1 dry); NMV F54579(1 dry).

Distribution. (fig. 1) SE Tasmania in Lighthouse Bay, Bruny Island (43°30'S, 147°10'E), and at Catamaran, Recherche Bay (43°34'S, 146°54'E). 0–8 m.

Etymology. Named in reference to the south-eastern Tasmanian distribution.

Description. Holotype. 5 rays; R = 19 mm, r = 5 mm, gbr = 7 mm, ht = 6 mm, R/r = 4, R/gbr = 3. Rays subcylindrical, constricted basally, swollen proximally, thin distally, rounded tip; interbranchial arcs acutely angular; longitudinal and transverse series on rays very weakly evident abactinally. Abactinal skeleton reticulate, compact; disc an irregular reticulum of small plates aborally; single madreporite at aboral apex of interbranchial arc, surrounded by 13 spinelets. Papular areas

small, rounded to slightly elongate, mostly with 1 papula; no actinal papulae.

Carinal series of quadrilobed plates up to 1.0 mm wide, imbricating proximal over distal lobes; shape and position of plates irregular, especially basally. Carinals linked to superomarginals by irregular transverse series of up to 8 small dorsolateral plates, most transversely elongate; dorsolateral area up to 5 mm wide transversely; up to 3 irregular series of longitudinal linkages across transverse series of dorsolaterals. Superomarginals alternate in transverse alignment with carinals; superomarginal plates irregularly cruciform, sometimes composite, up to 1.5 mm long transversely; imbricate strongly longitudinally, and over dorsolaterals and inferomarginals transversely; plates with fine striations, not beaded; 24 superomarginals for R = 19 mm. Inferomarginals correspond in number and alignment with superomarginals; up to 1.2 mm across, imbricating strongly longitudinally; up to 1.2 mm high with tapering vertical lobe imbricating under superomarginals. Actinal series of plates lacking. First pair of adoral adambulacrals contiguous, subequal with adjacent adambulacrals plates; 10 adambulacrals for each 5 inferomarginals; terminal plate hemispherical, domed, actinally furrowed, surface lumpy not beaded, up to 1.0 mm wide.

Abactinal and superomarginal plates with spaced, short, thick, sometimes flared or semicapitate, often slightly curved, terminally spiniferous spinelets; carinals mostly with 3 spinelets on exposed lobes, l = 0.3 mm, l/w = 2; superomarginals mostly with 2 spinelets, aligned transversely, l = 0.7 mm, l/w = 4. Spines on inferomarginals 2, rarely 3, often 1 basally; up to 1.2 mm long; slightly flattened, narrowed waist, slightly swollen end; aligned obliquely to furrow proximally; spine nearer furrow in pair stouter. Adambulacrals predominantly diplacanthid; proximally spine nearer furrow larger; mostly less thick than inferomarginal spines; up to 1.2 mm long. Oral plates with 2 or 3 spines, distal ones subequal with adjacent adambulacrals spines; proximal oral spines slightly shorter.

Small crossed pedicellariae on lower dorsolateral, superomarginal and inferomarginal plates, 0.2 mm high; upper abactinal surface lacking pedicellariae; some small straight pedicellariae in furrow, some on proximal oral spines, 0.2 mm high; no pedicellariae on actinal surfaces interradially or between inferomarginals and adambulacrals.

Paratypes. Abactinal skeleton of smaller paratype (NMV F54579, R = 17 mm; pl. 1e) finer, more openly reticulate, papular areas more extensive, transverse series of dorsolateral plates more

evident, many superomarginal plates not imbricating longitudinally; abactinal skeleton of larger paratype (AM J19659, R = 20 mm) similar to holotype; carinal plates in both paratypes more regular than in holotype; superomarginal plates in both paratypes with mostly 3 spinelets.

Colour (preserved). Tan or brown.

Remarks. The south-eastern Tasmanian distribution of *S. tasmaniae* does not overlap with the distribution of *S. multipara* in this region. Both species have been found on Bruny Island, *S. tasmaniae* at Lighthouse Bay on the southern coast and *S. multipara* at Variety Bay on the north-east coast. More collecting is necessary to determine if these species are allopatric.

South-eastern Tasmania has a number of endemic littoral echinoderms. Rowe and Vail (1982) listed five species in this category: two asteroids, *Patriella vivipara* Dartnall, 1969 (broods) and *Marginaster littoralis* Dartnall, 1970; an echinoid, *Pachycentrotus bajulus* Dartnall, 1972 (broods); and two holothurians, *Psolidium ravum* Hickman, 1962 and *Neoamphicyclus lividus* Hickman, 1962 (broods). However, there are specimens of *Psolidium ravum*, collected near Devonport, in the Tasmanian Museum, and we have found specimens of *Neoamphicyclus lividus* on both sides of Bass Strait.

Smilasterias clarkailsa sp. nov.

Plate 1 f, g

Smilasterias sp. (cf. *irregularis*).—A.M. Clark, 1962: 87, figs 15a, b.

Material examined. Holotype. Macquarie Island, N of Raine Point, 54°43.5'S, 158°53'E, 100–105 m, T. Cochrane, 6 Dec 1986, NMV F53754(wet).

Paratypes. Type locality, NMV F53755(1); Macquarie Island, off Nuggets Point, 54°33.4'S, 158°56.9'E, 108–135 m, 8 Dec 1986, NMV F53753(1); off Lusitania Bay, 54°42.7'S, 158°54.5'E, 69 m, 5 Dec 1930, BANZARE stn 83, identified by A.M. Clark (1962) as *Smilasterias* sp. (cf. *irregularis*), BMNH 1965.8.5.220(1).

Distribution. Macquarie Island. 69–135 m.

Etymology. Named in recognition of the contribution by Ailsa M. Clark.

Description. Holotype. 5 subcylindrical rays, 1 small regenerating; R = 35 mm, r = 5 mm, gbr = 8 mm, ht = 5 mm, R/r = 7, R/gbr = 4.5. Strong median ridge along rays, weaker longitudinal and transverse dorsolateral ribbing; rays slightly constricted basally, tapering to rounded tip; interbrachial arcs not acutely angular. Abactinal skeleton finely reticulate; disc an irregular reticulum of

small plates aborally; papular areas extensive, transversely elongate on rays, up to 4 papulae per area; no actinal papulae; single madreporite at aboral apex of interbrachial arc, surrounded by 9 spinelets.

Carinal series regular, raised, quadrilobed plates, imbricating proximal over distal lobes, up to 1.5 mm wide; carinals linked to superomarginals by transverse series of up to 7 small, elongate dorsolateral plates; single irregular series of longitudinal dorsolateral linkages; dorsolateral area up to 5 mm wide. Superomarginals cruciform, imbricating longitudinally and with inferomarginals and dorsolaterals transversely; proximal plates slightly beaded; 30–34 plates for R = 35 mm. Inferomarginals correspond in number, alignment, width with superomarginals; imbricate longitudinally; form an actinolateral margin to ray. Actinal series of up to 15 thin plates, up to half ray length. First pair of adoral adambulacral plates contiguous, subequal with adjacent plates, 14 adambulacral to every 5 inferomarginals; terminal plate hemispherical, flattened, actinally furrowed.

Abactinal and superomarginal plates with spaced, stout, cylindrical to slightly clavate spinelets, rounded or flattened ends, up to 0.6 mm high, l/w = 2–2.5, only slightly longer marginally than carinally; carinal plates with 2, sometimes 3, spinelets; series of up to 4 dorsolateral and 2, sometimes 3, superomarginal spinelets transversely. Inferomarginal plates with 3 flattened, rectangular or slightly flared spines, up to 0.9 mm long, aligned obliquely to furrow. First 5 actinal plates with 1–2 spines. Adambulacral plates with 2–3 spines; inner and outer spine subcylindrical, slightly clavate; middle spine larger, flattened, up to 1.0 mm long; adoral spines slightly longer, up to 1.2 mm. Oral plate with 3–4 spines; 2 actinally and 1–2 shorter ones proximally.

Dense covering of crossed pedicellariae on abactinal and marginal surfaces, 3–4 times as numerous as spinelets, up to 0.25 mm high; numerous small lanceolate straight pedicellariae actinally, in furrow, a few on inferomarginal and actinal interradial surfaces, up to 0.2 mm.

Paratypes. Smaller, but similar to holotype, with 2–3 inferomarginal spines per plate; 2, sometimes 3, adambulacral spines; crossed pedicellariae 3–4 times as numerous as spinelets.

Largest paratype (NMV F53755, R = 30 mm, r = 5 mm) with 2 longitudinal dorsolateral linkages proximally; up to 7 actinal plates, some spiniferous; proximal superomarginal plates beaded; some superomarginal spinelets widened, flattened, smaller than, but similar in shape to, inferomarginal spines; inferomarginal spines flat-

tened, flared, wider than on holotype; adoral adambulacral spines only slightly longer than proximal adambulacral spines; some felipedal pedicellariae, up to 0.8 mm long, on actinal, marginal, abactinal surfaces; 1 very large felipedal pedicellaria, 1.0 mm high, on an actinal interradial surface.

Smallest paratype (BMNH 1965.8.5.220, R = 20 mm, r = 5 mm) with compact abactinal skeleton of up to 4 dorsolateral plates transversely; middle 2 plates linked obliquely, slightly raised, form 3 dorsolateral lines; dorsolateral plates next to superomarginals rectangular, not lobed; dorsolateral area up to 2.0 mm wide; dorsolateral plates not transversely elongate; up to 9 actinal plates, not spiniferous; carinals, superomarginals, with mostly 3 spinelets.

Third paratype (NMV F53753, R = 26 mm, r = 4 mm, in poor condition with 2 arms missing) with mostly 3 inferomarginal spines per plate.

Colour (preserved). Tan.

Remarks. A.M. Clark (1962), in detailing the compact abactinal skeleton of one of these paratypes (BMNH 1965.8.5.220), suggested that this specimen and the species *Smilasterias irregularis* were possibly generically distinct from *Smilasterias scalprifera* and *S. triremis* with their more open skeletons. We believe this compact skeleton is a juvenile feature. On larger specimens the dorsolateral region is more openly reticulate, with up to 7 elongate plates transversely and 1 (holotype, R = 35 mm) or 2 (paratypes, R = 26–30 mm) longitudinal series of linkages proximally, surrounding large, transversely elongate papular areas. A.M. Clark was also relying on H.L. Clark's (1928) description of *S. irregularis*, which underestimated the number of dorsolateral plates on the holotype.

S. clarkkailsa is morphologically and geographically intermediate between *S. scalprifera* and *S. triremis* on the one hand and *S. irregularis* and the other Australian species on the other. *S. clarkkailsa* approaches *S. scalprifera* and *S. triremis* in often having more than 2 inferomarginal spines per plate, although they are less flared, and in having a relatively long actinal series, up to half the ray length. It is similar to the Australian species in having relatively few, spaced spinelets on the abactinal surface of the rays and some beading on the superomarginal plates, although the beading is less prominent than on *S. irregularis*. It can be distinguished from all the other *Smilasterias* species in having 3–4 times as many crossed pedicellariae as spinelets on the abactinal surfaces of the rays.

Smilasterias irregularis H.L. Clark

Plate 1 h, Figures 1, 2

Smilasterias irregularis H.L. Clark, 1928: 402, figs 116a, b.—1938: 195 (in part).—Cotton and Godfrey, 1942: 205.—H.L. Clark, 1946: 157.—Shepherd, 1968: 752.—Zeidler and Shepherd, 1982: 417, fig. 10.9a.—Rowe and Vail, 1982: 223.

Material examined. South Australia, Spencer or St Vincent's Gulf, no date, no depth, SAM K171 (holotype); Nuyts Archipelago, St Francis Island, Petrel Bay, 3–5 m, 25 Jan 1982, SAM K1777(1); Franklin Island, 6–8 m, 13 Apr 1983, SAM K1781(1); Port Lincoln, no date, SAM K620(1); 10 m, 31 Dec 1963, AM J7538(1); Sir Joseph Banks Group, Marum Island, 7 m, 13 Jan 1984, SAM K1775(1); Lusby Island, 7–8 m, 11 Jan 1984, SAM K1784(2); 3–5 m, 24 Jan 1986, SAM K1783(1); Reevesby Island, 3 m, 13 Jan 1984, SAM K1774(1); 20 Jan 1986, SAM K1786(1); 27 Jan 1986, SAM K1787(1); Winceby Island, 3–5 m, 26 Jan 1986, SAM K1788(4); Hareby Island, 2–5 m, 28 Jan 1986, SAM K1785(3); Langton Island, 2–4 m, 25 Jan 1976, SAM K1789(1); Partney Shoal, 3–8 m, 22 Jan 1986, SAM K1790(1); Yorke Peninsula, Port Turton, 2–5 m, 25 Nov 1985, SAM K1780(2); Port Noarlunga, 7 m, Nov 1970, AM J7995(2); Port Wilunga, Nov 1966, SAM K1778(1); 12 Oct 1975, SAM K1779(1); Fleurieu Peninsula, Second Valley, 3–4 m, 31 Jul 1985, SAM K1782(3); Rapid Bay, 10 m, 19 Nov 1976, SAM K1776(3); Kangaroo Island, Penneshaw, May 1978, NMV F53048(3); 5 m, 9 Mar 1978, AM J11812(1); Encounter Bay, Victor Harbour, 2–5 m, 8 Mar 1984, SAM K1773(1); 1 m, 29 Mar 1986, NMV F53060(1); Goose Island, 20 Mar 1971, NMV F53055(1).

Victoria, Portsea, no date, NMV F53038(1); Western Port, Crawfish Rock, 29 Feb 1970, NMV F53058(1); Lakes Entrance, 38°42'S, 149°30'E, 26 m, 9 Feb 1971, EGSS stn 95, NMV F53056(1).

Tasmania, Lulworth, 1 m, 22 Nov 1982, NMV F53059(1); NMV F53061(1); Cape Portland, 6 Jan 1971, AM J8973(1); Jan 1980, QVM(3); Flinders Island, Franklin Sound, 27 Nov 1972, NMV F53057(1).

New South Wales, Merimbla, 10 m, 10 Jun 1981, AM J14655(1); Bermagui, 27 m, 29 May 1981, AM J14654(1); Burrewarra Point, 30 m, 15 Mar 1981, AM J14013(1); 27 m, 16 Mar 1981, AM J13983(1); Batemans Bay, 22 m, 10 Mar 1981, AM J14160(1); AM J14158(1); 27 m, 13 Mar 1981, AM J14163(1); Jervis Bay, 17 m, 19 Mar 1981, AM J14186(1); Shellharbour, 1 m, no date, AM J4510(1).

Distribution (fig. 1). Nuyts Archipelago, South Australia (32°31'S, 133°18'E) to Shellharbour, New South Wales (34°34'S, 150°52'E), including north coast of Tasmania. 1–30 m.

Description. R to 65 mm; ht > gbr; R/gbr > 4; rays frequently separated from disc or regenerating; readily autotomous. Rays constricted basally, slightly swollen proximally, tapered to rounded tip; rays with fine median longitudinal ridge, transverse ribbing, mostly a single longitudinal dorsolateral

ridge; disc round, domed; interbrachial arcs acutely angular. Abactinal skeleton finely reticulate; disc an irregular reticulum of small plates aborally; papular areas extensive, transversely elongate on rays, rarely extending transversely between superomarginal plates, up to 6 papulae per area.

Carinal plates small, quadrilobed, most slightly asymmetrical; most imbricating proximal over distal lobe, some linked by smaller plates; carinal series often irregular, least regular proximally. Carinal plates linked to superomarginals by transverse series of up to 8 small dorsolateral plates; most dorsolateral plates transversely elongate; mostly 1 series of irregular longitudinal linkages across the dorsolateral transverse series. Superomarginal plates asymmetrically cruciform, often with prominent proximal lobe; sometimes a composite of plates proximally; superomarginals alternate in alignment with carinals; superomarginals mostly imbricating or contiguous longitudinally; 34 plates when $R = 46$ mm; superomarginal plates with prominent beading. Inferomarginals correspond in number, alignment, width with superomarginals; imbricate longitudinally, with superomarginals transversely. Short actinal series of up to 4 thin plates; occasionally 2 plates wide basally. 12 adambulacral plates for each 5 inferomarginals; first pair of adoral adambulacrals contiguous, subequal with adjacent ones.

Abactinal and superomarginal plates with spaced, fairly thick spinelets, barely spiniferous terminally; carinals with 1-4 irregularly placed spinelets, truncate to clavate, $l/w = 3$; superomarginals with 1-3 spinelets, truncate to slightly tapering, $l/w = 4$, rarely aligned transversely, very frequently spinelet on prominent proximal lobe of plate, at least twice as tall as carinal spinelets. Inferomarginal plates with predominantly 2, sometimes 3, subequal, flattened, truncate spines; generally taller than adambulacral spines; aligned obliquely to furrow. Often 1-2 actinal plates per series with spines. Adambulacrals diplacanthid; spine nearer furrow generally smaller; adoral adambulacral spines often slightly larger than adjacent adambulacral ones. Oral plates with 3-4 spines; 2 large, flattened, often grooved actinal oral spines; 1-2 shorter basal oral spines, proximal one on furrow edge.

Small crossed pedicellariae on abactinal, marginal surfaces, fewer than 2 per spinelet, most numerous distally; numerous small straight pedicellariae in furrow; single larger straight pedicellariae on some actinal interradial surfaces; straight pedicellariae extremely rare on abactinal, marginal and actinal surfaces of rays except for NSW specimens

where straight pedicellariae may be numerous on some or all of these surfaces.

Colour (live). Predominantly mottled red, reddish-brown, cream; no immediate colour change in alcohol; preserved specimens show residual colour.

Remarks. Re-examination of the holotype ($R = 37-49$ mm) revealed inconsistencies with H.L. Clark's (1928) original description. Clark found two, possibly three, rows of dorsolateral plates, no actinal plates, and did not mention any beading on the superomarginal plates. However, there are up to five transverse dorsolateral plates, at least two actinal plates, and the superomarginals are distinctly beaded. These latter features are typical of *S. irregularis* specimens of this size.

There appears to be a consistent geographical variation in the occurrence of straight pedicellariae within this species. On the holotype, and on other specimens from South Australia, Victoria and northern Tasmania, straight pedicellariae are only very rarely present on the abactinal, marginal and actinal surfaces of the rays. But on material from New South Wales straight pedicellariae are often present and may be numerous on these surfaces. Geographical variation in the form, size and distribution of straight pedicellariae is also found in *S. triremis*.

Most specimens have been collected by divers from subtidal rocky substrates. We have found only three specimens in rocky shallows (Lulworth, Tasmania, NMV F53059, F53061, and Victor Harbour, South Australia, NMV F53060) and these were under boulders about 1 m below low tide mark. Collection by museum divers has been more intensive on the coasts of New South Wales and South Australia, and this is probably reflected in the recorded distribution (fig. 1).

Smilasterias scalprifera (Sladen)

Plate 1 i, j

Asterias (*Smilasterias*) *scalprifera* Sladen, 1889: 578, pl. C, figs 4-6, pl. CIII, figs 1, 2.

Smilasterias scalprifera.—Fisher, 1930: 239.—1940: 261.—A.M. Clark, 1962: 85.—Cherbonnier and Guille, 1975: 620, pl. II, figs h, i.

Material examined. Subantarctic, off Marion Island, 93 m, 28-30 Dec 1873, HMS "Challenger", BMNH 1890.5.7.968 (syntype); Marion Island, Transvaal Cove, ?15 m, Sep 1982, in a *Macrocystis* bed, G. Branch, AM J18138(1); AM J18140(1 juvenile); off Heard Is., 52°55'S, 73°20'E, 177 m, 3 Feb 1967, coll. "Umitaka Maru", NMV F52678(1); 53°07.6'S, 73°49'E, 40-50 m, 3 Oct 1985, M. Norman on "Nella Dan", NMV F52679(1); 53°11.7'S,

73°04.5'E, 200 m, 4 Oct 1985, ?black silt sediment, M. Norman on "Nella Dan", NMV F53576(30).

Distribution. Falkland, Marion, Kerguelen and Heard Islands. 40(?15)–267 m.

Description. On largest specimen (AM J18138), R = 82 mm, r = 10 mm, gbr = 16 mm, ht = 12 mm, R/r = 8, R/gbr = 5. Rays often widened basally, attenuate distally; strong transverse dorsolateral ribbing; 6–7, rarely up to 12, papulae per area. Disc surface a reticulum of small plates aborally; carinal plates small, series irregular; carinals linked to superomarginals by up to 16, generally elongate, dorsolateral plates; usually 1, up to 3, irregular longitudinal series of linkages proximally; superomarginals not beaded; inferomarginal plates not always forming actinolateral border to ray; actinal plates up to three-quarters ray length, sometimes 2 series proximally.

Dense cover of abactinal spinelets, usually grouped on plates; spinelets clavate or tapering, smooth or slightly spiniferous, l/w = 3–6, longest on superomarginals, in arcs, up to 0.8 mm high; some superomarginal spinelets flattened, flared, similar in shape but smaller than inferomarginal spines; carinal plates with 3–5 spinelets, 1–5 on dorsolaterals, 3–6, rarely up to 10, on superomarginals. Inferomarginal plates with oblique combs of 2–5, mostly 4, flattened, flared, truncate spines; 1–3, rarely 4, actinal spines, often confluent with inferomarginal spines; 2–4, mostly 3, adambulacral spines, shorter, thinner, less flared than inferomarginal spines; oral plates with up to 6 spines.

Crossed pedicellariae numerous on abactinal, marginal ray surfaces, on disc, 0.5–1.5 times as numerous as spinelets, smaller than spinelets; small straight pedicellariae in furrow, actinally, marginally, occasionally on abactinal surface, larger than crossed pedicellariae; larger straight pedicellariae, up to 1.2 mm, usually in arc, actinally, usually much smaller than spines, with rounded or acute tips, sometimes slightly hooked, opposing valve tip crossed, sometimes incipiently felipedal, 1 small tooth set back on each side of valve tip.

Smallest specimen (R = 16 mm, NMV F53576) with 5–6 transverse dorsolateral plates proximally; up to 6 actinal plates, extending up to one third ray length; 2–3 inferomarginal, no actinal, 2–3 adambulacral spines per plate.

Remarks. A.M. Clark (1962) found that specimens from the Falkland Islands had some large, incipiently felipedal straight pedicellariae, whereas those on specimens from off Marion, Kerguelen and Heard Islands were solely lanceolate in shape. However, some of the specimens we have examined

(NMV F53576) from off Heard Island also have incipiently felipedal straight pedicellariae.

Smilasterias triremis (Sladen)

Asterias (Smilasterias) triremis Sladen, 1889: 579, pl. CI, figs 5, 6, pl. CII, figs 5, 6.

Smilasterias triremis.—Fisher, 1930: 239.—1940: 262.—A.M. Clark, 1962: 85, fig. 15c.

Material examined. Subantarctic, between Kerguelen and Heard Islands, 52°4'S, 71°22'E, 279 m, 2 Feb 1874, coarse gravel, "Challenger" stn 150, BMNH 1890.5.7.971(2 syntypes); off Heard Island, 53°11.7'S, 73°04.5'E, 200 m, 4 Oct 1985, ?black silt sediment, M. Norman on "Nella Dan", NMV F53756(9).

Antarctic, Palmer Archipelago, Schollaet Channel, 160–335 m, 12 Mar 1927, mud, "Discovery" stn 181, BMNH 1948.3.16.773(1); Neumayr Channel, 259–354 m, 18 Mar 1927, mud, "Discovery" stn 187, BMNH 1948.3.16.774(1); Bismarck Strait, 93–130 m, 24 Mar 1927, stones and mud, "Discovery" stn 190, BMNH 1948.3.16.775(1).

Distribution. Antarctic, Palmer Archipelago. Subantarctic, off Heard and between Kerguelen and Heard Islands. 93–354 m.

Description. On largest specimen (BMNH 1948.3.16.773), R = 61 mm, r = 7 mm, gbr = 8 mm, ht = 7 mm, R/r = 9, R/gbr = 7.5. Rays tapering; median longitudinal ridge; transverse ribbing usually evident; 2, sometimes 3, papulae per area. Aboral disc a reticulum of small plates; carinal series irregular or regular; carinals linked to superomarginals by up to 8 generally elongate dorsolateral plates; 1–2 irregular longitudinal linkages; superomarginals not beaded; up to 24 thin, narrow, actinal plates, up to half ray length.

Dense cover of spinelets abactinally, usually grouped on plates; spinelets tapering to slightly clavate; l/w = 2.5–5, longest on superomarginals, in arcs; superomarginal spinelets sometimes flattened, flared, similar in shape but smaller than inferomarginal spines; carinals with 4–6, dorsolaterals with 3–5, superomarginals with 4–6, rarely up to 10, spinelets. Inferomarginal plates with oblique combs of 2–5, mostly 3, flattened, widely flared, truncate spines; actinal plates, sometimes with 1, usually no spines; 2–3, usually 2, adambulacral spines, shorter, less flared than inferomarginal spines.

Crossed pedicellariae on abactinal, marginal ray surfaces, on disc; 0.5–1.0 times as numerous as spinelets; smaller than spinelets. Small, lanceolate or incipiently felipedal, straight pedicellariae in furrow, actinally, marginally, abactinally; subequal with crossed pedicellariae. Larger, felipedal pedicellariae sometimes present, up to 1.2 mm, slightly smaller than spines, usually with 3–5 teeth on

widened valve tip; often in arcs, actinally, sometimes also in furrow, marginally, abactinally.

Small specimen (R = 25 mm, NMV F53756) with up to 5 transverse dorsolateral plates proximally; 2-3 flared inferomarginal spines; up to 7 actinal plates, extending up to one fifth ray length; large felipedal straight pedicellariae actinally, in arcs, abactinally.

Remarks. In his description of the Palmer Archipelago "Discovery" material, Fisher (1940) noted about 10 actinal plates in a series, the series extending up to one-fifth the length of the ray. To our observation there are 24 plates in a series on one cleared ray of the largest of these specimens, the series extending approximately half the length of the ray.

The specimens from off Heard and Kerguelen Islands differ from the Palmer Archipelago material in having large felipedal pedicellariae scattered on most ray surfaces, but particularly actinally and in the arcs. Some Palmer Archipelago specimens have larger incipiently felipedal pedicellariae in the arcs but otherwise they are all of the small type. Some of the specimens from off Heard Island (NMV F53756) also differ in having a spine on nearly all of the actinal plates. Usually these spines, when present, are restricted to a few proximal plates.

The Heard Island specimens were found at the same location as 30 specimens of *S. scalprifera* (NMV F53576). Examination of this new material confirms Fisher's (1940) and A.M. Clark's (1962) distinction between the two species. On *S. triremis* the inferomarginal and adambulacral spines are longer, wider but less numerous; the actinal series is less extensive and often lacks spines. The smaller straight pedicellariae are larger on *S. scalprifera* and are also usually larger than the crossed pedicellariae. On *S. triremis* the two forms are subequal. The larger felipedal straight pedicellariae, almost as long as the adambulacral spines, found on the syntypes and the Heard Island specimens, are never found on *S. scalprifera*. Larger straight pedicellariae, when present on *S. scalprifera*, are lanceolate or incipiently felipedal, with one central and two rudimentary teeth, and are much smaller than the spines.

Smilasterias sp. cf. *triremis* (Sladen)

Smilasterias sp. (cf. *triremis* (Sladen)).—A.M. Clark, 1962: 85, figs 15 d-f.

Material examined. Antarctica, off Princess Elizabeth Land, 66°28'S, 72°41'E, 1266 m, 22 Dec 1929, BANZARE stn 29, BMNH 1965.8.5.219(1).

Remarks. This specimen has been detailed and discussed by A.M. Clark (1962). It is small, R = 21 mm, and in a poor condition and so is not fully described here.

A further observation which supports a unique identity for this specimen is the presence of 10 large plates which border the disc aborally. These plates are up to 2.0 mm wide transversely, with 5 situated radially and 5 interradially, and give the aboral disc surface a stellar appearance. *Allostichaster regularis* H.L. Clark, 1928 has the same characteristic, but in all of the described species of *Smilasterias* the whole aboral disc plating is an irregular reticulum of small plates.

A.M. Clark (1962) noted the presence of small incipient felipedal pedicellariae actinally, up to 0.25 mm in length. We have observed straight pedicellariae abactinally, in the interbrachial arcs, where they are up to 0.4 mm long and have a felipedal form similar to that in the *S. triremis* syntypes.

A.M. Clark (1962) also noted the presence of the tubercles on the abactinal plates of this specimen, and contrasted this characteristic with the relatively smooth abactinal plates of *S. scalprifera* and *S. triremis*. However, specimens of *S. scalprifera* examined here (AM J18138, NMV F53576) do have prominent tubercles and ridges on the abactinal plates. This is another characteristic which is subject to marked variation within a *Smilasterias* species.

The BANZARE specimen has beading on the superomarginal plates. The inferomarginal plates form a distinct actinolateral margin to the rays, but the actinal surface is slightly narrower than the greatest breadth of the rays. The interbrachial arcs are acutely angular, and the rays are slightly swollen proximally. There are up to 7 dorsolateral plates linking the carinal and superomarginal plates, and 4, occasionally 5, tall, thin, tapered, very slightly flattened inferomarginal spines per plate.

Given the aboral disc plating and the tapered inferomarginal spines, this specimen may be better placed in another genus.

Asteriinae sp. cf. *Allostichaster* Verrill and *Smilasterias* Sladen

Material examined. Tasmania, 160 km off the west coast, 570 m, P. Wilson on "Margaret Philippa", 9 Sep 1982, NMV F53029(1).

Description. 5 rays; R = 17 mm, r = 3 mm, gbr = 4 mm, ht = 2 mm; rays not swollen proximally, long thin taper distally; interbrachial arcs not acutely angular; single madreporite; terminal plate flattened; inferomarginal plates tend to form an

actinolateral margin to rays. Abactinal skeleton compact, solidly reticulate; papular areas very reduced; 5 radial and 5 interradial large plates bordering disc aborally; carinal plates subequal with dorsolateral plates, quadrilobed, up to 1.2 mm wide; dorsolateral area narrow, 1 longitudinal series of plates between carinals and superomarginals, plates not transversely elongate; superomarginal plates cruciform, prominently beaded, 1.8 mm long transversely, imbricating or contiguous longitudinally; actinal series of plates extending more than half length of ray; adoral adambulacral plates subequal with adjacent adambulacrals.

Abactinal and superomarginal plates with spaced, semi-capitate, close to granuliform spinelets, $l = 0.2-0.3$ mm, $l/w = 1.5-2$; carinal and superomarginal spinelets subequal, carinal plates with up to 6 centrally and irregularly placed spinelets; superomarginal plates with up to 6 spinelets along proximal margin of plate. Inferomarginal plates with predominantly 3 rounded, slightly flattened spines, up to 1.0 mm long; actinal plates spiniferous; adambulacral plates with 2 or 3 rounded, slightly tapered spines, slightly smaller than inferomarginals; oral plates with 4 thin, rounded, slightly flattened spines, 2 actinally, 2 on side of plate proximally.

Numerous small crossed pedicellariae on abactinal and marginal plates; small lanceolate and large felipedal straight pedicellariae present actinally, a few abactinally in interbrachial arcs; series of large felipedal pedicellariae in furrow on adambulacral and oral plates, up to 1.0 mm long.

Remarks. This specimen is small and in poor condition. The subcylindrical rays, lack of evidence of fissipary, up to 3 inferomarginal and adambulacral spines, and numerous large felipedal straight pedicellariae suggest an affinity with *Smilasterias* Sladen. The narrow dorsolateral area with its single longitudinal series of plates, relatively long and spiniferous series of actinal plates at this small size, and close to granuliform spinelets suggest an affinity with *Allostichaster* Verrill.

In having 10 large plates bordering the disc aborally it is similar to both *Smilasterias* sp. (cf. *triremis*) (Sladen) (A.M. Clark, 1962) and *Allostichaster regularis* H.L. Clark, 1928.

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Explanation of Plate

Plate I

- Figures a, b. *Smilasterias multipara* sp. nov. Holotype, NMV F53036, R = 30 mm. a, abactinal view, R.H. ray cleared. b, actinal view.
- Figures c, d. *Smilasterias tasmaniae* sp. nov. Holotype, AM J11395, R = 19 mm. c, abactinal view, top ray cleared. d, actinal view.
- Figure e. *S. tasmaniae* Paratype, NMV F54579, R = 17 mm, abactinal view.
- Figures f, g. *Smilasterias clarkkailsa* sp. nov. Holotype, NMV F53754, R = 35 mm. f, abactinal view. g, actinal view.
- Figure h. *Smilasterias irregularis* H. L. Clark NMV F53038, R = 40 mm, lateral view of cleared ray.
- Figures i, j. *Smilasterias scalprifera* (Sladen) AM J18138, R = 82 mm. i, abactinal view, R.H. rays partly cleared. j, abactinal view of part of disc and bases of cleared rays.

