The Echinodermata of subantarctic Marion and Prince Edward Islands

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The Echinodermata of subantarctic Marion and Prince Edward Islands were sampled over the period 1982-1989 by dredging, SCUBA-diving, intertidal surveys and remote control photography in a University of Cape Town project. This paper comprises illustrated keys to all the species of Echinodermata collected during these and previous surveys. A total of 69 species, including 31 new records of Echinodermata, are now known from Marion Island. These comprise 33 Asteroidea, 22 Ophiuroidea, 10 Holothuroidea, 2 Echinoidea and 2 Crinoidea. Summaries are provided of the depth distribution, abundances and habitats, as well as the geographical distribution of the species. The Asteroidea include more cosmopolitan and warm-water species and have a greater affinity to the Falklands than do the Ophiuroidea and Holothuroidea, which are largely confined to the Antarctic and subantarctic and have a greater affinity to the Kerguelen Islands. Asteroidea from deep, rocky areas have an affinity to the Falklands, while those from shallow, sandy localities are shared with Kerguelen.

Die Echinodermata van subantarktiese Marion- en Prinse Edward-eiland is gedurende die tydperk 1982-1989 gemonster deur middel van baggerwerk, onderwaterduik, tussengetyopnames en afstandkontrolefotografie tydens 'n projek van die Universiteit van Kaapstad. Hierdie artikel bevat geïllustreerde sleutels vir al die spesies van Echinodermata wat versamel is tydens hierdie en vorige opnames. 'n Totaal van 69 spesies, insluitend 31 nuwe inskrywings van Echinodermata, is nou van Marion-eiland bekend. Dit bestaan uit 33 Asteroidea, 22 Ophiuroidea, 10 Holothuroidea, 2 Echinoidea en 2 Crinoidea. Opsommings word voorsien van diepteverspreiding, volopheid en habitat, asook die geografiese verspreiding van die spesies. Die Asteroidea sluit meer kosmopolitiese en warmwaterspesies in en kom meer voor by die Falklande as die Ophiuroidea en Holothuroidea, wat grootliks beperk is tot Antarktika en subantarktika en meer voorkeur gee aan die Kerguelen-eilande. Asteroidea van diep, rotsagtige gebiede gee voorkeur aan die Falklande, terwyl dié van vlak, sanderige gebiede ook voorkom by Kerguelen.

Introduction

Echinoderms have been recorded by a number of offshore scientific expeditions to subantarctic Marion and Prince Edward Islands (MPE) (46°54'S, 37°45'E and 46°38'S, 37°57'E respectively). These included the British *Challenger* Expedition of 1873 (Agassiz 1881, Lyman 1879 & 1882, Théel 1886, Carpenter 1888 & Sladen 1889), the *Discovery* Expedition of 1935 (Mortensen 1936, Fischer 1940 and AM Clark 1962 & 1970) and the French *Marion-Dufresne* voyage in 1976 (Jangoux 1982). South African research began with land-based surveys that reported on the intertidal zonation and shallow water benthos (Fuller 1967, Bernasconi 1968 & 1971, Pawson 1971, Rowe & Clark 1975 and De Villiers 1976). Blankley subsequently investigated the intertidal and shallow subtidal food web at Marion Island (Blankley 1984, Blankley & Branch 1984, Blankley & Grindley 1985).

During the 1980s the University of Cape Town extended this research offshore. Beckley led a quantitative SCUBA-diving survey at 36 sites, with samples at depths of 5, 10 and 15 m at three localities at Marion Island (Beckley & Branch 1992). Repeated dredging and photographic surveys were also carried out from the *SA Agulhas* between 30 and 700 m depth, which provided information on the benthic communities of the shelf and greatly increased the number of species known from the area (GM Branch, Attwood, Gianakouras & ML Branch 1993). Taxonomic notes on the asteroids and holothurians and descriptions of the new species collected during these recent surveys have been published. The asteroids, including one new species *Solaster dianae* are described by Stampanato & Jangoux (in press) and

two new holothurians, *Mesothuria edwardensis* and *Paradota marionensis*, by Massin (1992). Taxonomic notes for the ophiuroids and crinoids are included as footnotes in the illustrated keys and synonyms are given in the systematic list where species from Marion Island have been reported under different names.

The present report analyses the abundance and distribution of all the echinoderms collected during these recent surveys and provides illustrated keys to all species known from the area. It forms part of a series to the major invertebrate groups from MPE. Those published to date have dealt with the Crustacea (Branch, Griffiths, Kensley & Sieg 1991), Mollusca and Brachiopoda (Branch, Arnaud, Cantera & Gianakouras 1991), Pycnogonida (Arnaud & Branch 1991), Cnidaria (Branch & Williams 1993) and Polychaeta (Branch in press).

ML Branch was responsible for the overall compilation of this paper and faunal analyses. M Jangoux and S Stampanato helped with the asteroid identification and key, V Alva with the ophiuroids and C Massin with the holothuroids.

Acknowledgements

This research was carried out under the supervision of Prof GM Branch with funding provided by the South African Steering Committee for Antarctic Research (SASCAR) and the Department of Environment Affairs. The latter department also provided logistical support and thanks are due to the captains of the *SA Agulhas*. D Gianakouras not only led the offshore sampling program but undertook the enormous task of sorting and curating the collection and took the photographs. She has also been of wonderful assistance at all stages of the project and we are delighted that the new species *Solaster dianae* has been named for her. Dr L Beckley led the SCUBA survey and both she and all the members of the University of Cape Town are thanked for their participation in the programme. Dr Ch de Ridder identified *Sterechinus agassizi*. Dr Frank Rowe gave early help with the project. The staff of the marine laboratory and library of the South African Museum are thanked for their cheerful assistance.

Note

The new species of asteroid *Solaster dianae* has been formally described by Stampanato & Jangoux (in press). The present description does not constitute a formal description.

Systematic list of species

* = New records

\# = New species (Described by Massin 1992 and Stampanato & Jangoux 199X)

Synonyms are given only where species have been previously described from MPE under a different name. Page numbers refer to pages in the keys.

Summary of species

Asteroidea: 33 species, 11 new records, 1 new species
Ophiuroidea: 22 species, 13 new records,
Holothuroidea: 10 species, 6 new records, 2 new species
Echinoidea: 2 species, 1 new record
Crinoidea: 2 species

Echinodermata of Marion and Prince Edward Islands

A Asteroidea

Characteristics of the Orders

Order **Paxillosida:**
Asteroids normally with 5 arms; main ossicles form longitudinal series ventrally with a marginal frame consisting of well-developed infero- and superomarginal plates, and a distinct furrow frame which consists of ambulacral and adambulacral plates; the two frames abut distally but are linked proximally by actinal plates; pedicellariae, simple, sessile, spiniform; podia in two rows usually tapering to a point without suckers.

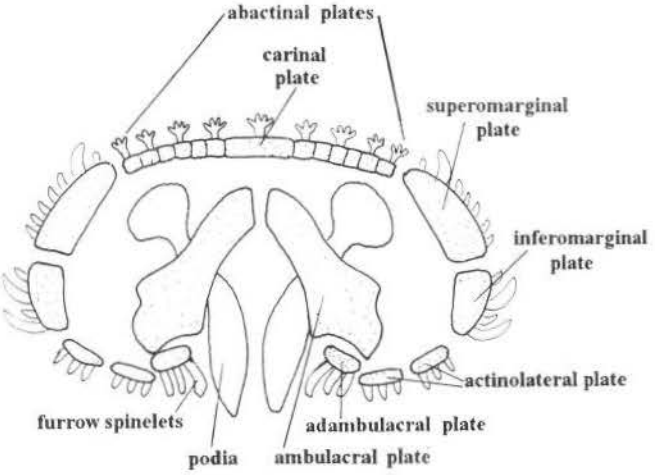
Order **Valvatida:**
Asteroids with 5 or more arms; marginal plates conspicuous or not, abut on the furrow frame along the arms (superambulacral ossicles absent); actinal plates in the interradii; pedicellaria if present vary from elementary to alveolar in which hollows in the underlying plates accomodate the valves when they are open; podia suckered, in two rows.

Order **Forcipulatida:**
Asteroids with 5 or more long arms; abactinal skeleton reticulate and with spaced spines; inferomarginal plates inconspicuous from above, are short and lie ventrolaterally; podia suckered, in two or four rows; pedicellariae complex with two valves and an extra basal piece, either below the valves in straight pedicellaria or between the proximal lobes of the scissor-like crossed pedicellariae.

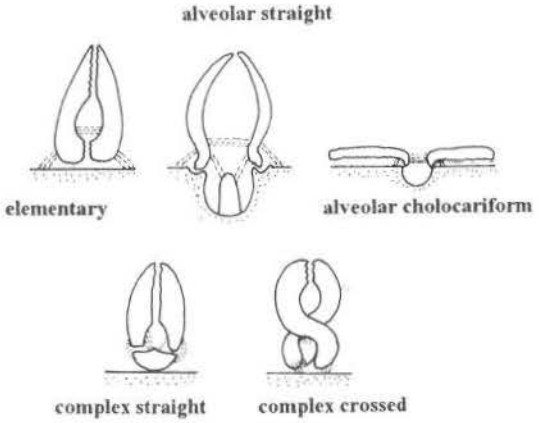
Order **Spinulosida:**
Asteroids with 5 or more arms; main ossicles form longitudinal series ventrally; infero- and superomarginal plates not enlarged and usually inconspicuous; pedicellariae rare; podia suckered, in two rows but in the Pterasteridae they are staggered to form four rows.

(General references, giving the external organisation of asteroids and the vocabulary used in asteroid external anatomy, are Clark & Rowe 1971 and Jangoux 1986. Types and definitions of pedicellariae were taken from Jangoux & Lambert 1988).

Transverse section through Asteroid arm



Types of Pedicellariae



A Asteroidea - Starfish

Key to the species

1 Two rows of podia (tube-feet) per arm; podia suckered (disc-tipped) or pointed (cone-shaped); pedicellariae absent or present. (Four rows of podia may occur occasionally in large cushion stars) 2

Four rows of podia per arm; podia suckered; pedicellariae present (complex - straight and crossed pedicellariae).
Order **Forcipulatida** (part) 30

2 Pedicellariae elementary, alveolar or absent 3

Crossed pedicellariae present.
Order **Forcipulatida** (part) 27

3 Podia pointed (lacking sucker disc); marginal plates very conspicuous, defining the outline of the body.
Order **Paxillosida** 4

Podia suckered; marginal plates conspicuous or not 5

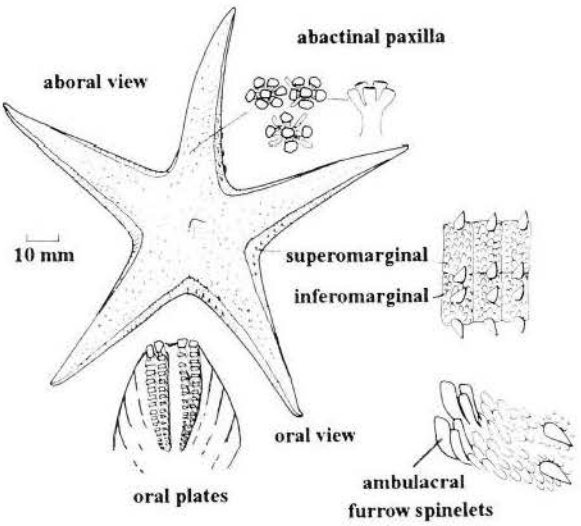
4 Superomarginal and inferomarginal plates equally developed; marginals often bearing enlarged flattened spinelets as well as numerous small spinelets; oral plates separate, each bearing two rows of flat-topped spines; abactinal paxillae (modified plates with a central column crowned with spinelets) crowded, bearing several flat-topped spines and fewer thinner spinelets around the margins.
Bathybiaster loripes Sladen, 1889

Superomarginals distinctly smaller than inferomarginals; marginals bearing uniform small spines; oral plates fused bearing cylindrical spines (older specimens have flattened marginal spines); abactinal paxillae not crowded, bearing numerous slightly thorny spinelets (10-40).
Leptychaster kerguelenensis Smith, 1876

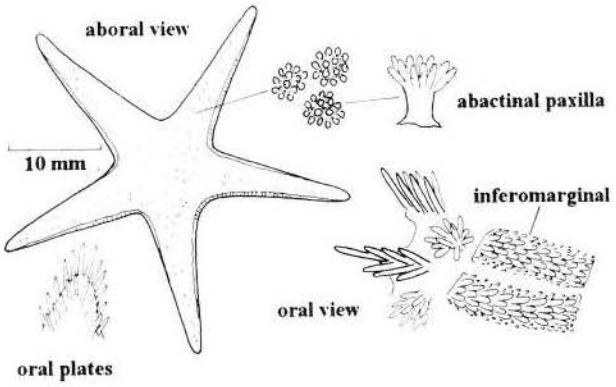
5 Abactinal plates overlapping; enlarged openings in the proximal part of each interradial area, both orally and aborally; body pentagonal and markedly convex; four rows of tube feet proximally.
Tremaster mirabilis Verrill, 1879

Abactinal skeleton reticulate or juxtaposed plates; no interradial openings; body stellate or pentagonal; two rows of tube feet 6

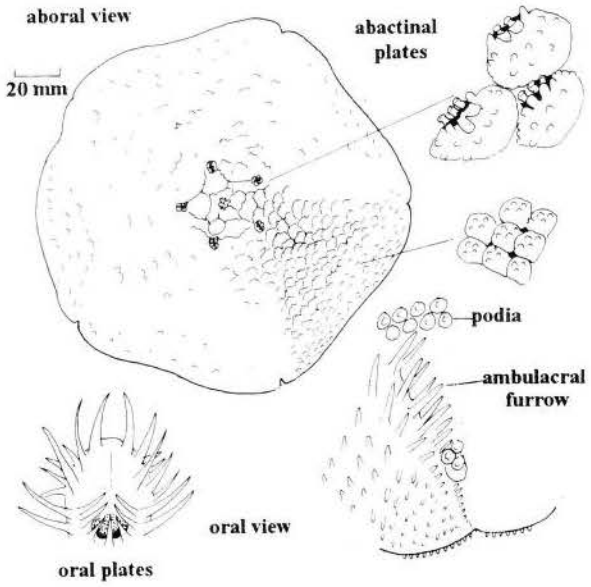
Bathybiaster loripes



Leptychaster kerguelenensis



Tremaster mirabilis



6 Abactinal skeleton made of distinct juxtaposed plates; body flat, disc runs smoothly into the triangular arms; marginal region obvious. 7

Abactinal skeleton reticulate, may be obscured by a thick skin; body and arms usually rounded, disc often small; marginal region indistinct. 14

7 Each jaw (paired oral plates) bears at least one well-developed, glassy-tipped spine; elementary pedicellariae may be present (valves articulate directly with the underlying skeletal plate). Family **Odontasteridae** 8

Jaws without large, glassy-tipped spine; alveolar pedicellariae sometimes present (valves articulate with the underlying skeletal plate and are always associated with a depression or alveole) 11

8 Body stellate; abactinal plates flat or slightly convex, covered with equal-sized flat-topped granules, forming subcircular groups of about 9-12 granules; actinolateral plates covered with granules that increase in size proximally; marginal plates lateral, form a narrow raised margin to the slightly convex arms.
Acodontaster elongatus (Sladen, 1889)

Body pentagonal to stellate; abactinal plates tabulate bearing a group of spinelets (paxilliform); actinolateral plates covered with spines; marginal plates conspicuous or not 9

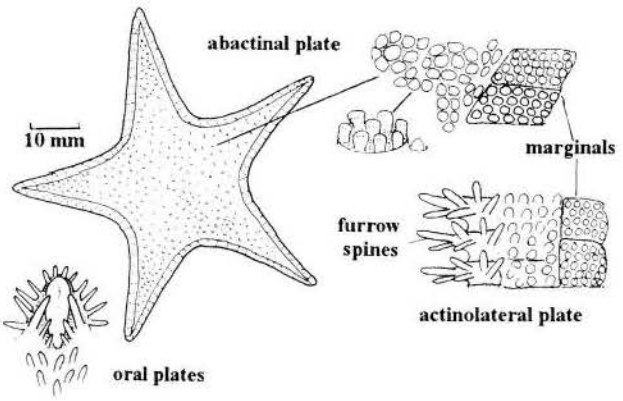
9 Marginal plates large, forming a prominent, raised border when viewed aborally; abactinal surface flat, paxillae with about 12 club-shaped spinelets; (small individuals collected at Marion Island are pentagonal with wide triangular arms). Fisher 1940 discusses the synonymy of this variable species, which shows a wide range of forms from the stellate 'forma *penicillatus*' to the pentagonal 'forma *grayi*'
Odontaster penicillatus (Philippi, 1870)

Marginal plates smaller, not conspicuous in aboral view, with the interradial ones entirely lateral in position 10

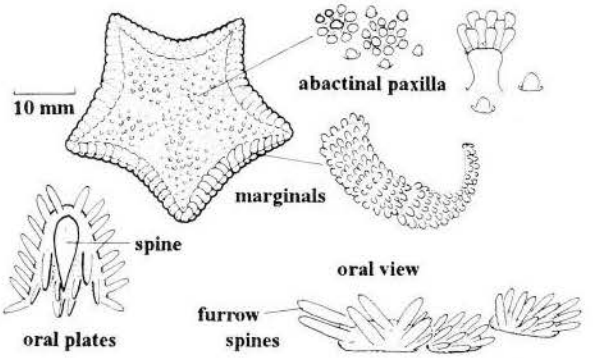
10 Radial paxillae bearing 20-30 spinelets; actinolateral plates large, more or less rectangular with many spinelets, the most central of which are robust.
Odontaster meridionalis (Smith, 1876)

Radial paxillae bearing about a dozen spinelets; actinal plates small and bearing four or five rather short spinelets.
Odontaster validus Koehler, 1906

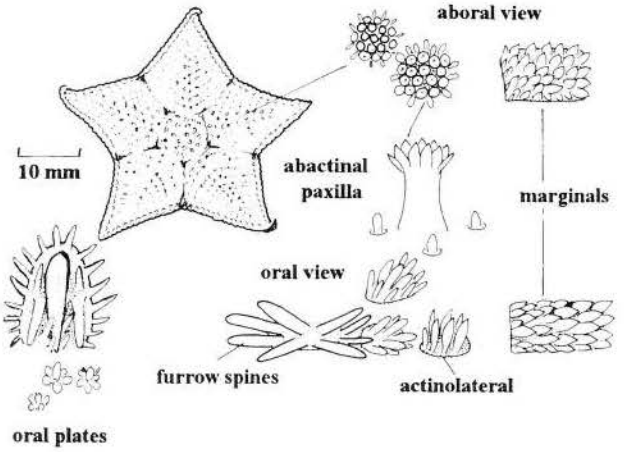
Acodontaster elongatus



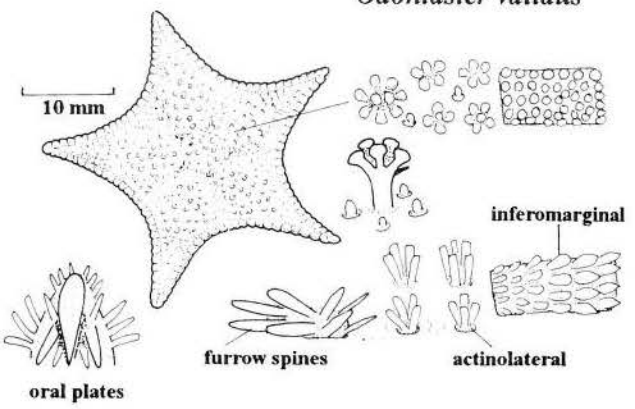
Odontaster penicillatus



Odontaster meridionalis



Odontaster validus



11 Abactinal plates tabulate and covered with equal sized truncated spines or granules; pedicellariae absent 12

Abactinal plates flat or slightly convex, covered with both granules and spines; rectangular bivalve pedicellariae present 13

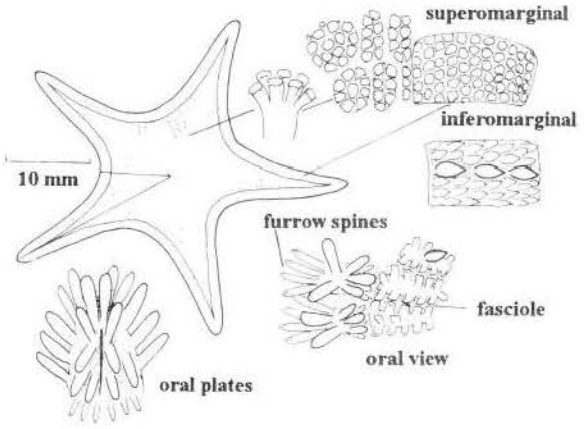
12 Body stellate; some actinolateral and inferomarginal plates with elongated granules; superomarginals largely covered with granules; postadambulacral fascioles present (furrows edged with granules - transverse actinal plates carry four rows of granules, the outer rows curve over the furrows between the plates); oral plates each with two rows of 7-12 papilliform spinelets, increase in size towards the mouth; R=20, r=3 mm (up to R=30, r=12 mm)
Pseudarchaster discus Sladen, 1889

Body pentagonal; marginal plates with central bare patch, otherwise covered with small uniform granules; no postadambulacral fascioles; oral plates with four large, square spines; large R=68, r=43 mm.
Ceramaster patagonicus (Sladen, 1889)

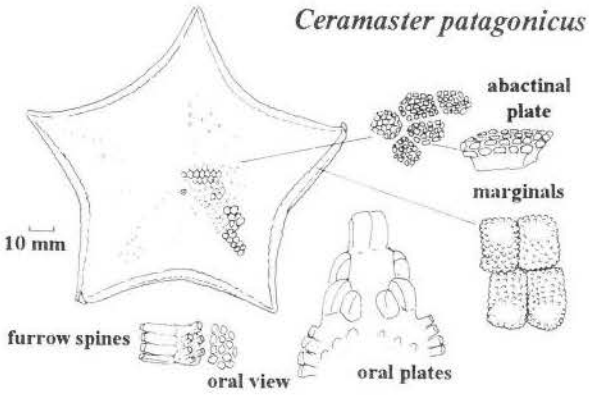
13 Marginal plates outlined by a regular series of small granules and with 1 to 3 large central spines; carinal spines larger than those of adjacent abactinal plates giving a regular arrangement; stiff, flat, regular and beautiful starfish.
Hippasteria hyadesi Perrier, 1891

No regular peripheral series of granules around marginal plates; carinal spines not larger, abactinal surface haphazardly covered with spines of the same size, small granules and large oblong bivalve pedicellariae; thick, convex untidy starfish.
Hippasteria falklandica Fisher, 1940

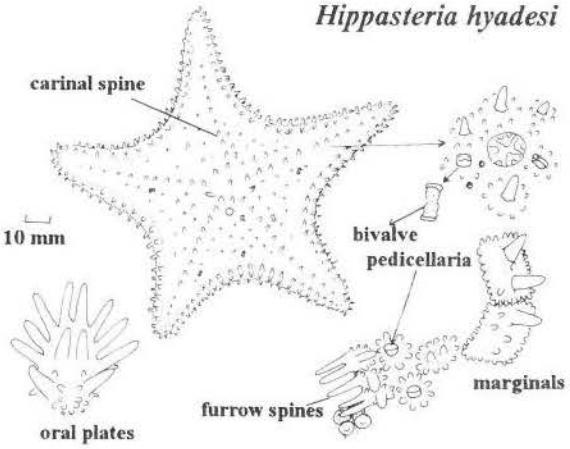
Pseudarchaster discus



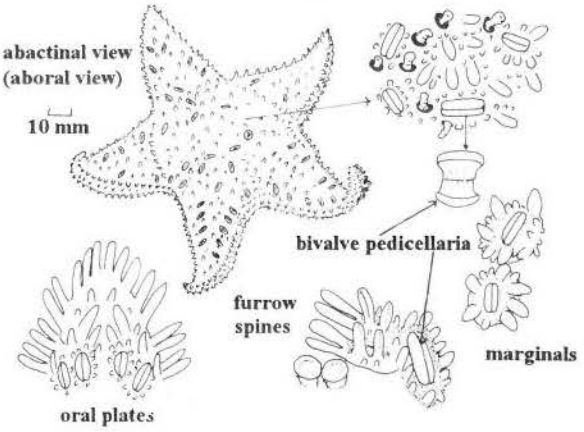
Ceramaster patagonicus



Hippasteria hyadesi



Hippasteria falklandica



14 More than five arms; abactinal plates paxilliform (column crowned with spinelets) 15

Five arms; abactinal plates paxilliform or not 17

15 Paxillae with long needle-like spinelets; abactinal network irregular; usually 9 arms.
Crossaster penicillatus Sladen, 1889

Paxillae with short spinelets having a multifid tip; abactinal network forming regular rows along the sides of the rays; usually not nine-armed. 16

16 Superomarginal paxillae clearly distinct from the adjacent abactinal paxillae; inferomarginal paxillae conspicuous; the most proximal adambulacral plates with two rows of subambulacral spinelets; 7 arms.
Solaster dianae Stampanato & Jangoux, in press

Superomarginal paxillae not distinct from the adjacent abactinal paxillae; inferomarginal paxillae conspicuous; adambulacral plates with only one row of subambulacral spinelets; usually 10 arms.
Solaster regularis Sladen, 1889

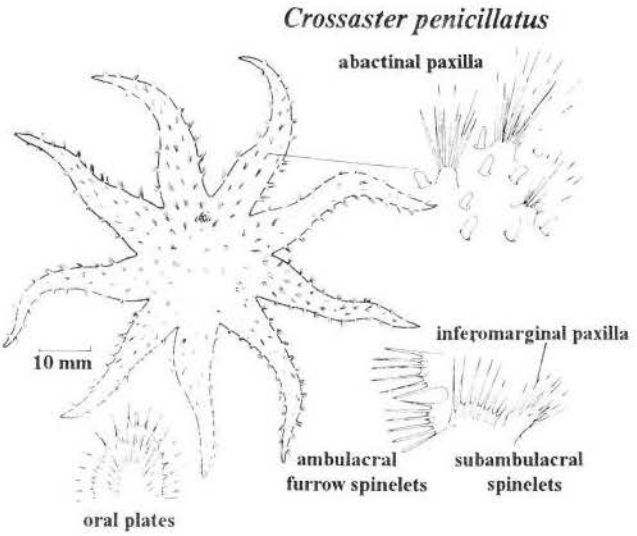
17 Small inner ambulacral spinelets lie between the tube feet, within the ambulacral groove; whole body covered with a thin skin; abactinal plates bearing distinct spinelets 23

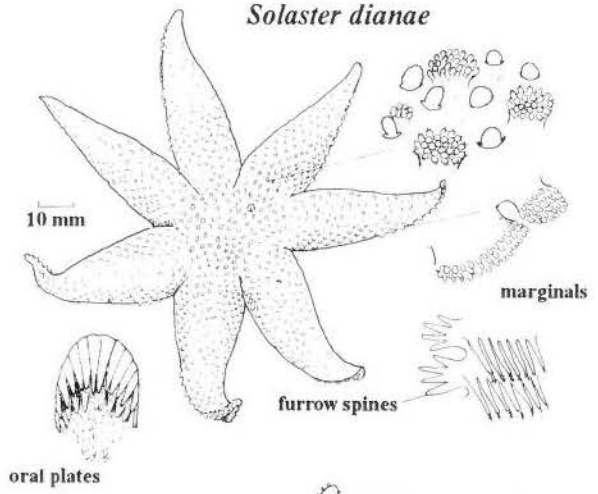
No inner ambulacral spinelets lie between the tube feet; spinelets paxilliform or simple, may be partly obscured by a thick skin or membrane.. 18

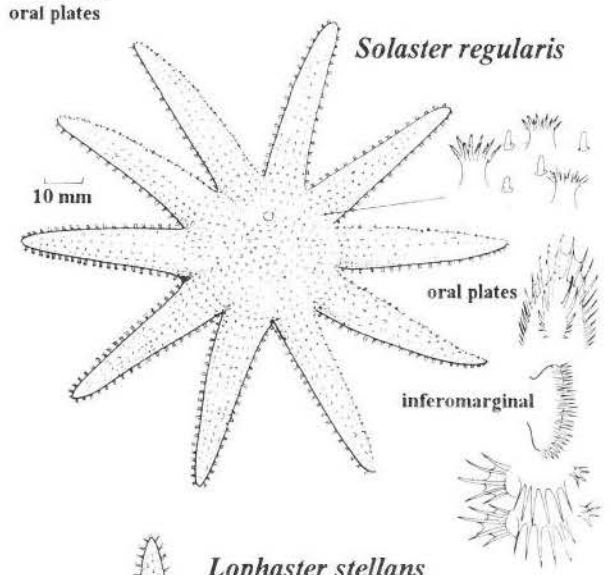
18 Abactinal plates paxilliform with a slender pedicel, may lie beneath a supra-dorsal membrane; adambulacral spinelets partly or wholly webbed. 19

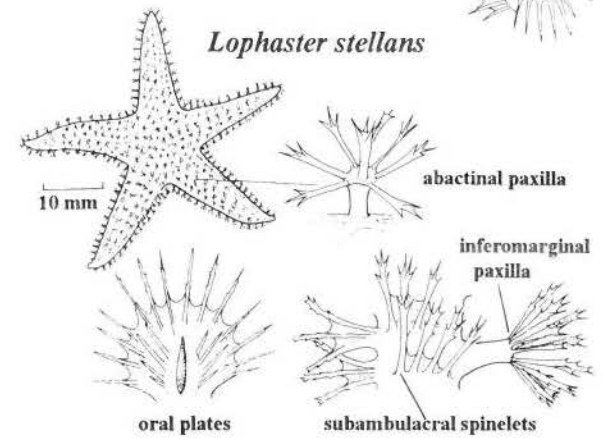
Abactinal plates not paxilliform with a slender pedicel, either spineless, or with single or grouped spinelets; adambulacral spinelets not webbed. 21

19 No supra-dorsal membrane; abactinal plates paxilliform, with long pedicel and beautiful glassy spinelets with trifid tips; marginals distinct, bearing true paxillae with long pedicels; oral and adambulacral spinelets webbed at their bases.
Lophaster stellans Sladen, 1889









Supra-dorsal membrane present; adambulacral and oral spinelets wholly webbed, forming successive fans 20

20 Body pentagonal; large adambulacral fans alternating with small ones, the largest extending over the furrow; usually 6-10 spinelets on a high pedicel beneath the supradorsal membrane; 4-5 spines on the oral plates, webbed together to form a single fan across the jaw; four rows of podia.
Diplopteraster semireticulatus (Sladen, 1882)

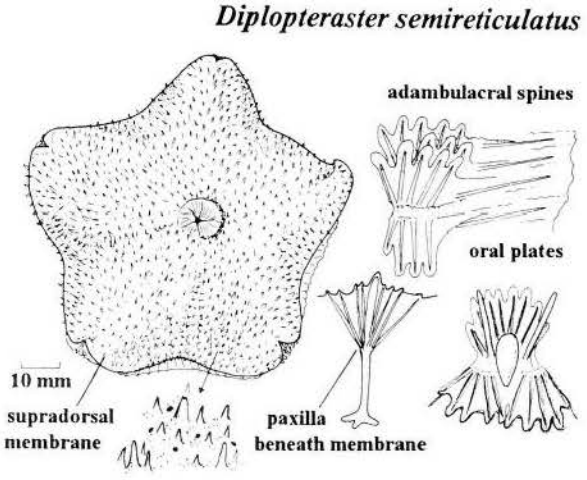
Body substellate; all fans similar; 4-6 spinelets on high pedicels lie beneath the supradorsal membrane; a separate web on the marginal spines of each oral plate 6-8 oral marginal spines; two rows of podia.
Pteraster affinis Smith 1876
(Clark 1962, distinguishes three subspecies -
P. affinis lebruni has slender transparent spinelets and high pedicels, and 5-8 oral spines (Falkland/Magellan and Marion Island)
P. affinis affinis has short thick opaque spinelets (Kerguelen Island)
P. affinis aculeatus has low pedicels and slender transparent spinelets and up to five oral spines [Kemp Land and Ross Sea].)

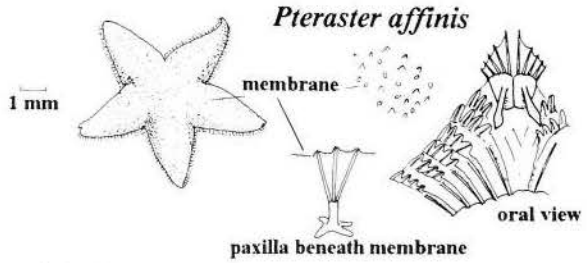
21 Four rows of podia; abactinal surface and superomarginal plates cruciform with 3-5 long spines enveloped in a membranous sheath, single inferomarginal spine; four adambulacral spines also enclosed in membranous sheaths; body stellate with thick round arms.
Peribolaster folliculatus Sladen, 1889

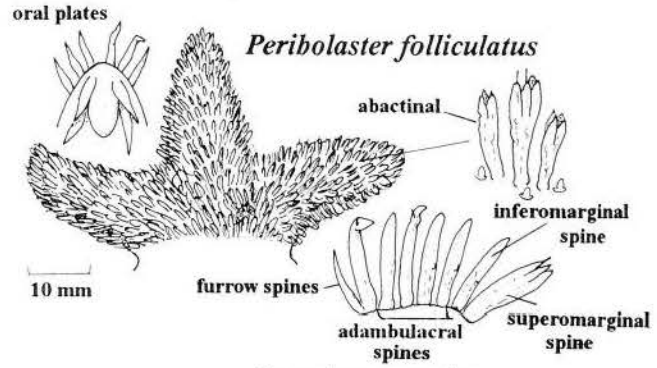
Two rows of podia 22

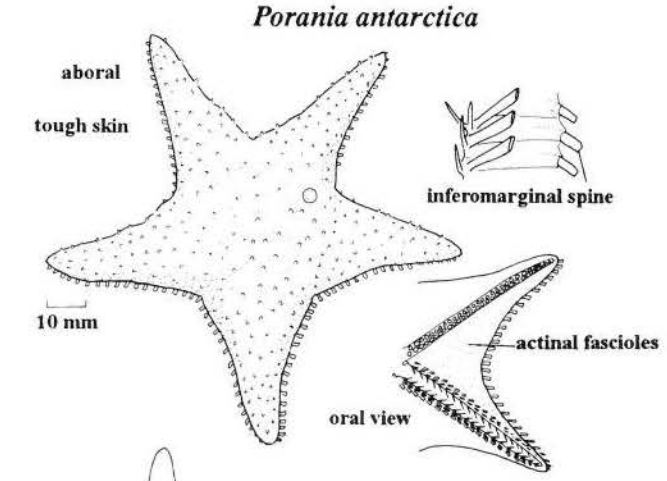
22 Body subpentagonal, covered with a thick, leathery skin and sparse blunt spines; superomarginals unarmed; inferomarginals with one, often conspicuous, flattened spine; actinal fascioles present (furrowed spineless surface); two ambulacral spines not webbed; two promi nent suboral spines; large pink starfish.
Porania antarctica Smith, 1876

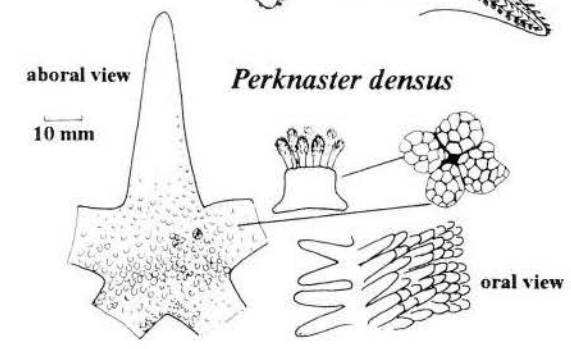
Body stellate, covered with closely packed crowded paxillae, with 1-12 club-shaped spinelets; marginal plates not distinct from abactinals and densely covered with spinelets; no actinal fascioles; suboral spinelets more than two, usually seven or eight.
Perknaster densus Sladen, 1889











23 Four or five subambulacral spines, normally arranged in a single, sometimes irregular, row across the plate 24

Subambulacral spines more numerous, arranged in two rows or in a cluster 25

24 No papulae in the actinolateral area (papulae sometimes occur distally at the limit between the inferomarginal and adambulacral plates); abactinal spines very short and covered by a membrane; small-meshed abactinal skeleton; actinal and inferomarginal plates are very regularly arranged in longitudinal series; inner ambulacral spinelet small and tapering, directed actinally.
Henricia fisheri AM Clark, 1962
(Described by AM Clark from individuals collected at Crozet and Marion and previously identified as *Henricia simplex* by Sladen (1889) & Fisher (1940).)

Papulae present in the actinolateral area; abactinal spines prominent, sparse and finely spined; small meshed abactinal skeleton; actinal and inferomarginal plates not regularly arranged; inner ambulacral spinelet small, knob-tipped, lying horizontally.
Henricia simplex (Sladen, 1889)

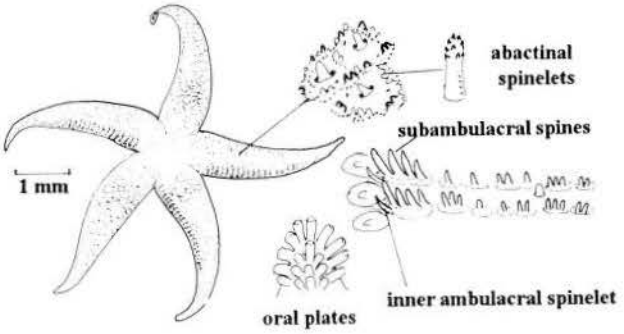
25 Abactinal spinelets with multifid tips; subambulacral spinelets usually in rows; furrow spinelets large and flattened, inner ambulacral spinelets long, slender and lying horizontally; large-meshed abactinal skeleton.
Henricia obesa (Sladen, 1889)

Abactinal spinelets tapering abruptly in distal half; subambulacral spinelets clustered; furrow spinelets slightly larger than adambulacral spinelets, inner ambulacral spinelets short; abactinal skeleton may be fine meshed.
..... 26

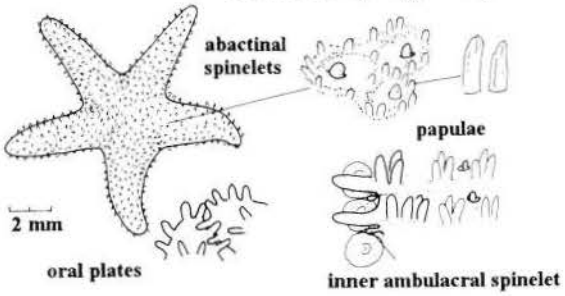
26 Abactinal reticulation subdivided, primary and secondary reticulations distinct when the plates are denuded; actinolateral plates with circular groups of about 6-8 spinelets; inner ambulacral spinelet small, knob-tipped, lying horizontally across the furrow; colour orange.
Henricia praetans (Sladen, 1889)

Abactinal reticulation not subdivided; actinal and inferomarginal plates form bar-like plates, giving the actinal skeleton a regular transverse arrangement; actinolateral plates elongate with about 18 spinelets; inner ambulacral spinelet small, tapering and directed actinally; colour pale.
Henricia studeri (Perrier, 1891)

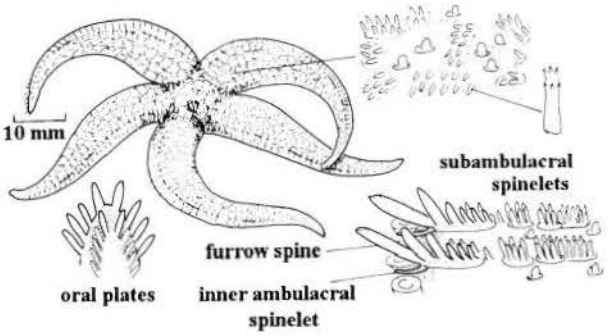
Henricia fisheri



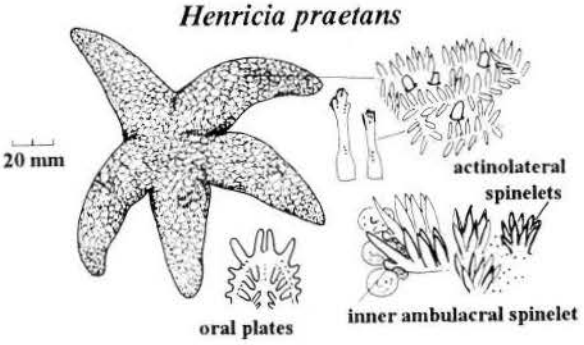
Henricia sp. aff. simplex



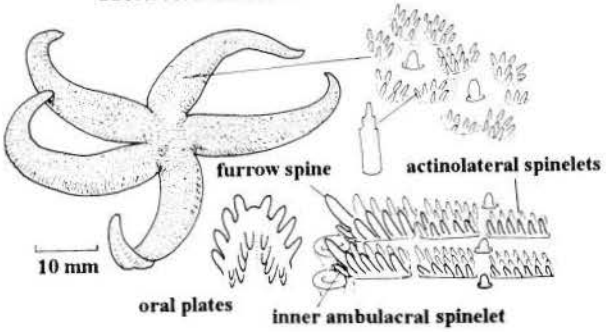
Henricia obesa



Henricia praetans



Henricia studeri



27 Fifteen to fifty arms; circular disc; crossed pedicellariae forming prominent annular bands across the arms; large sun stars.
Labidiaster annulatus Sladen, 1889

Five arms; no annular bands of pedicellariae across the arms 28

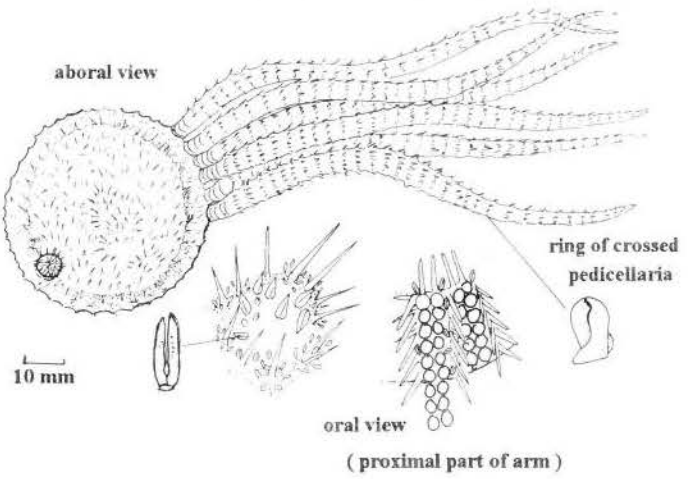
28 Actinal crossed pedicellariae enlarged, with two pairs of enlarged teeth at the distal end of each valve; some abactinal crossed pedicellariae with small terminal teeth; straight pedicellariae in the furrow.
Pedicellaster hypernotius Sladen, 1889

Actinal and abactinal crossed pedicellariae similiar 29

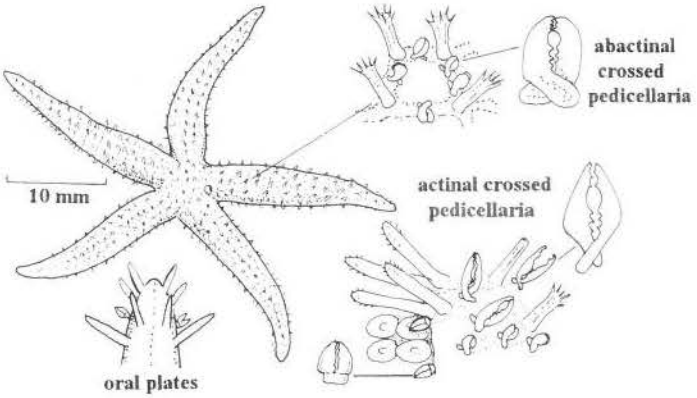
29 Most abactinal spinelets with a bush-shaped multifid tip; abactinal pedicellariae confined to the skeleton and few in number, never obscuring the skeleton.
(Recorded from Kerguelen)
Anteliaster scaber (Smith, 1876)
(The specimen collected by the *Discovery* Expedition from Marion Island (Fisher 1940) was re-examined by AM Clark (1962) and transferred to *Anteliaster australis*. A few small specimens from this UCT collection are tentatively placed in *A. scaber*).

Most abactinal spinelets with a truncated multifid tip; pedicellariae numerous, on the skeleton and on the membrane between the reticulum and thus obscuring the skeletal reticulum. (Recorded from Falkland and S Georgia region, Marion specimens recorded by Fisher 1940 as *A. scaber* are considered to be *A. australis* by AM Clark (1962)
Anteliaster australis Fisher, 1940

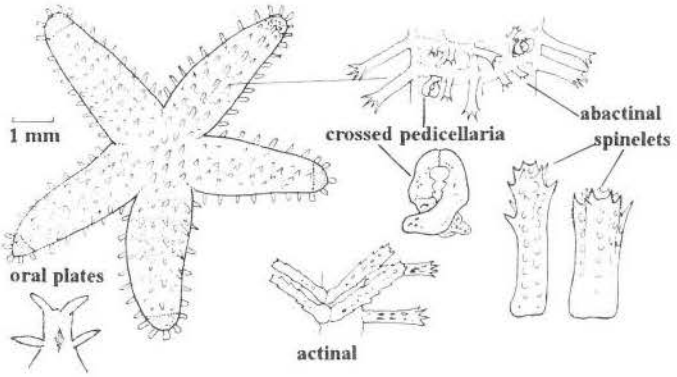
Labidiaster annulatus



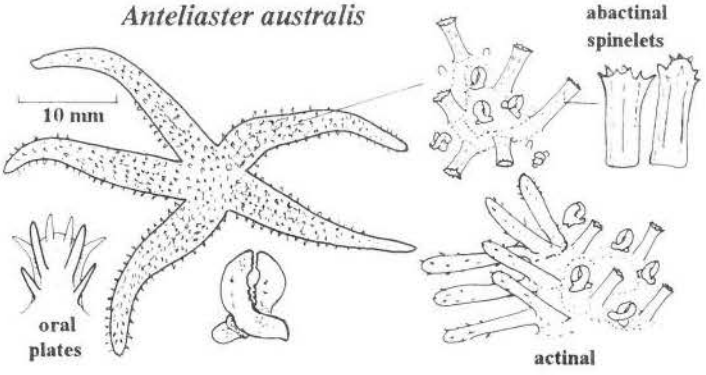
Pedicellaster hypernotius



Anteliaster scaber juvenile



Anteliaster australis



Four rows of podia

30 Adambulacral plates predominantly with one spine (monocanthid plates); large papulae in the interradii of the oral surface and between the oral spines; most common intertidal asteroid; colour green to orange; broods young.
Anasterias rupicola (Verrill, 1876)

Adambulacral plates predominantly with two or more spines (diplacanthid or multicanthid plates) 31

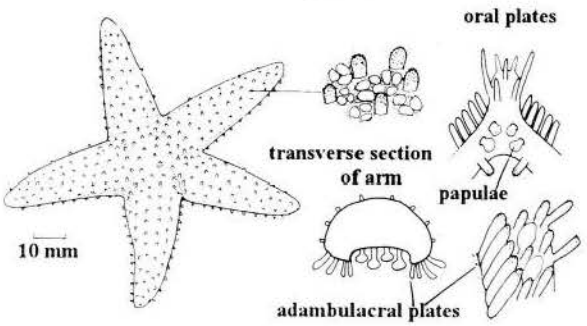
31 Usually six arms; crossed pedicellariae associated with the abactinal and marginal spines, either in groups at their bases or in clusters around them; usually not more than one spine on each abactinal plate; supero- and inferomarginal plates distinct, bearing longer spines; common.
Diplasterias meridionalis (Perrier, 1875)

Five arms; crossed pedicellariae not associated with individual spines, but scattered between the spines or spinelets, which are usually small and may appear granuliform; marginal plates indistinct 2

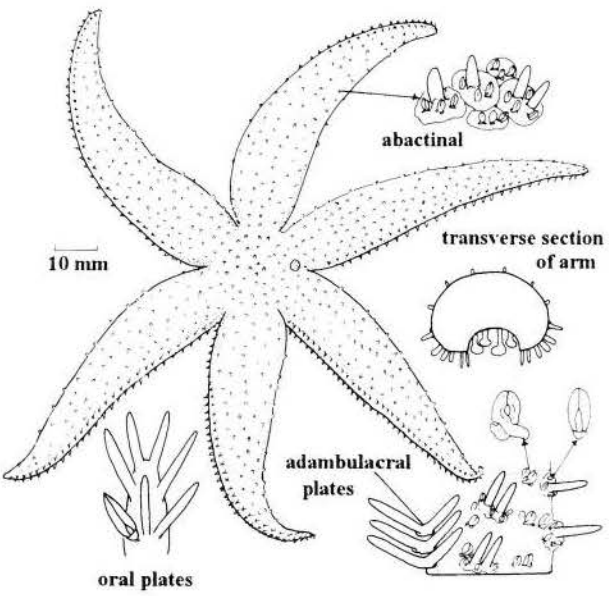
32 Adambulacral plates each with a series of three or four spines, usually four when R>50mm; actinal plates extending for at least half arm length and the proximal ones each with one spine (some times two); abactinal spines numerous and tend to have a regular transverse arrangement on the arms; common.
Smilasterias scalprifera (Sladen, 1889)

Adambulacral plates each with a series of two spines (diplacanthid), rarely three spines on some plates when R>50 mm; actinal plates few, narrow and normally spineless; abactinal spines short and scattered and less numerous than the above species; uncommon.
Smilasterias triremis (Sladen, 1889)

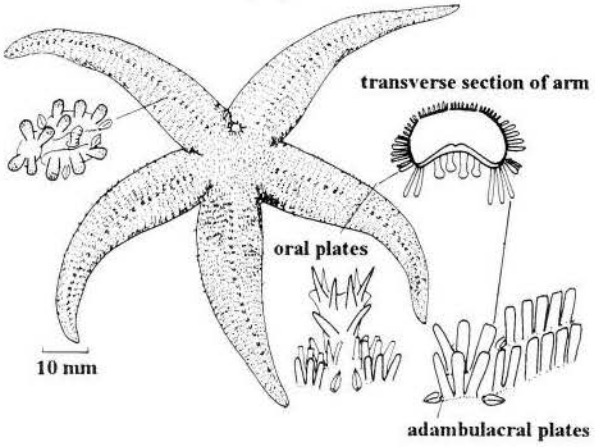
Anasterias rupicola



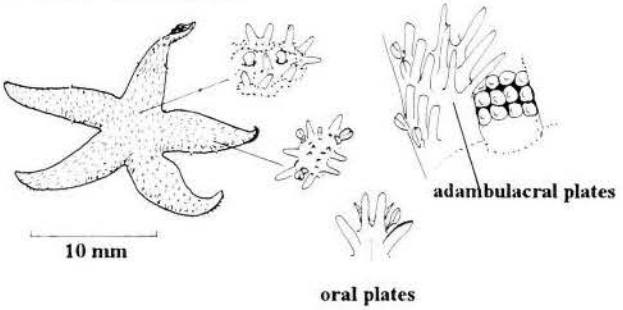
Diplasterias meridionalis



Smilasterias scalprifera



Smilasterias triremis



B Ophiuroidea - Brittle stars

1 Arms branched or not, rolled into vertical coils; disc and arms covered by a thick skin .. 2

Arms always unbranched, not rolled into coils but moving horizontally; disc and arms usually covered by plates 4

2 Arms branched or not, with belts of minute hooks on their aboral surface.
Family **Gorgonocephalidae** 3

Arms unbranched, without belts of hooks on their aboral surface.
Asteronyx loveni Müller & Troschel, 1842

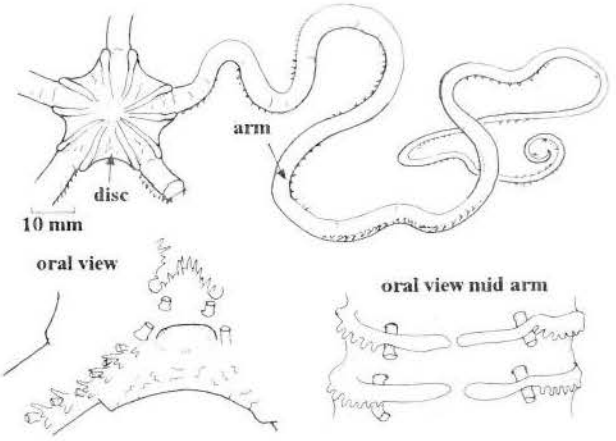
3 Arms unbranched.
Astrotoma agassizi Lyman, 1875

Arms branched.
Gorgonocephalus chilensis (Philippi, 1858).

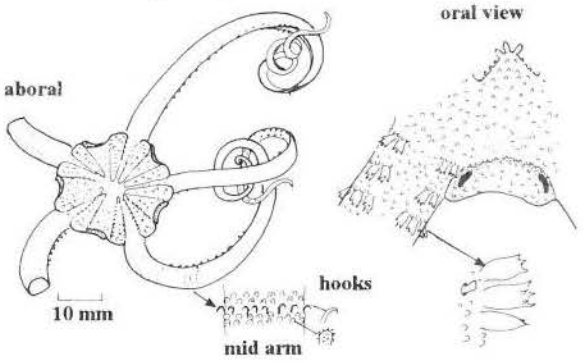
4 Disc and arm plates concealed by a thick skin; aboral arm plates rudimentary and often fragmented.
Ophioscolex (Ophiolycus) nutrix Mortensen, 1936.

Disc and arm plates easily visible, not concealed by skin; aboral arm plates well developed. 5

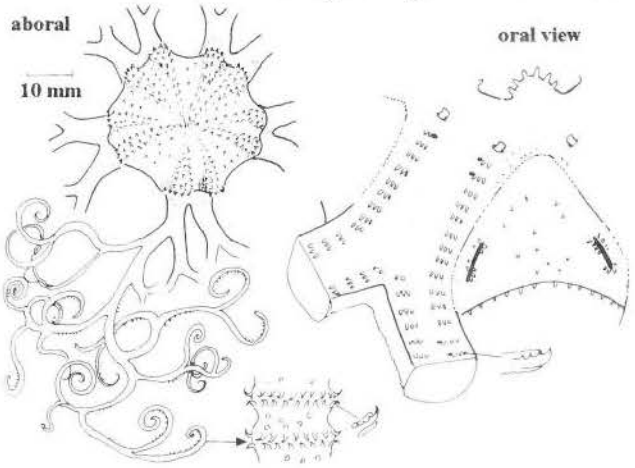
Asteronyx loveni



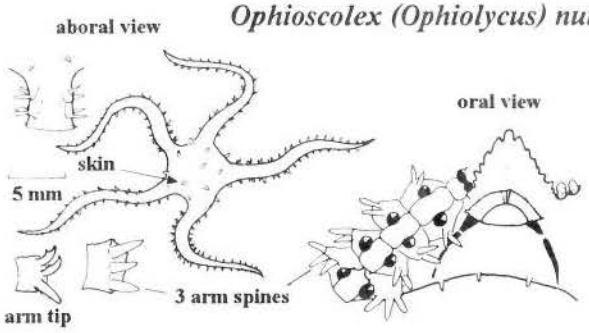
Astrotoma agassizi



Gorgonocephalus chilensis



Ophioscolex (Ophiolycus) nutrix



5 Two paired infradental papillae at the apex of each jaw.
Subfamily **Amphiurinae** 6

A single unpaired infradental papilla at the apex of each jaw 9

6 Tentacle scale present 7

No tentacle scale.
Amphiura tomentosa Lyman, 1879.

7 Only one tentacle scale 8

Two tentacle scales.
Amphiura antarctica Studer, 1876.

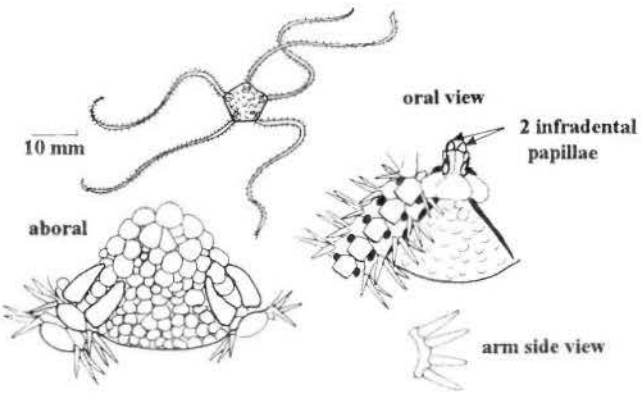
8 Oral surface of disc covered by plates.
Amphiura algida Koehler, 1911.

Oral surface of disc naked.
Amphiura angularis angularis Lyman, 1879

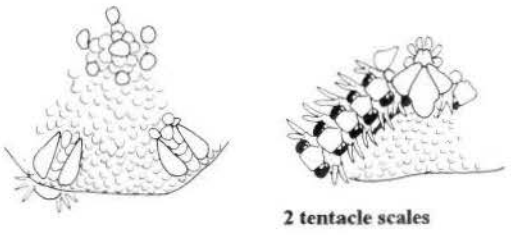
9 Second oral tentacle pore superficial, located out side the oral slit and deprived of a tentacle scale.
Amphilepis gymnopora Hertz, 1927.

Second oral tentacle pore usually inserted into the oral slit; if not, then provided with one or more scales 10

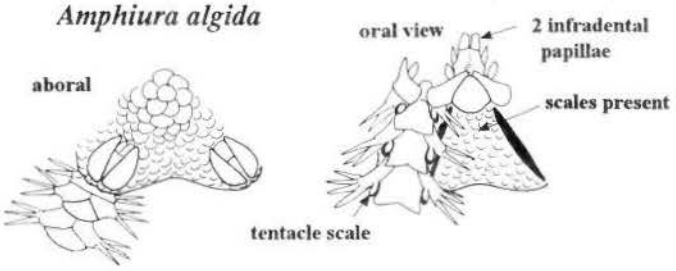
Amphiura tomentosa



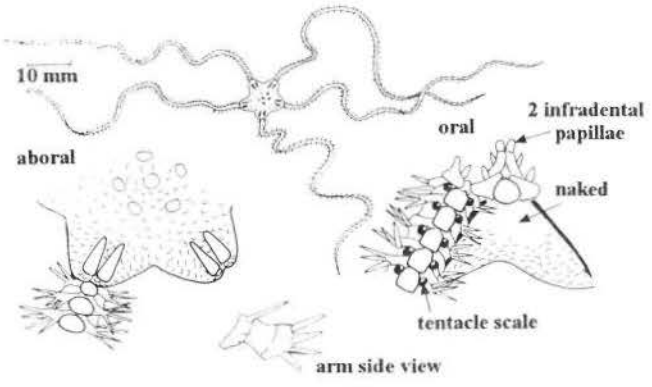
Amphiura antarctica



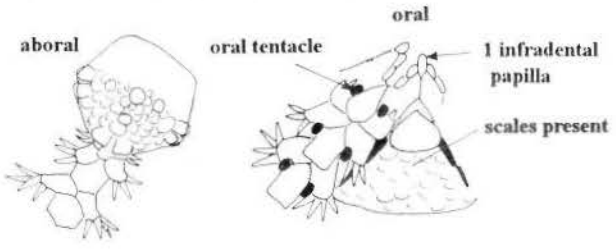
Amphiura algida



Amphiura angularis angularis



Amphilepis sp. aff. A. gymnopora



10 Arms inserted orally below the disc; disc plates with granules or spinelets; arm spines numerous, long and projecting 11

Arms inserted laterally to the disc; disc plates usually naked; arm spines small and adpressed (barely projecting).
Family **Ophiuridae** 16

11 Oral shields covered by granules; arm plates with concentrical ridges.
Toporkovia antarctica (Lyman, 1882).

Oral shields naked; arm plates without ridges.
Family **Ophiacanthidae** 12

12 Disc covered with small thin scales, some of them with granules; no radial shields; tentacle pores large and conspicuous.
Ophiocymbium cavernosum Lyman, 1880.

Disc covered by skin-bearing granules and/or stumps; radial shields long and narrow, separated; tentacle pores not conspicuously large.
..... 13

13 Disc plates covered by a thin skin-bearing granules and stumps; tentacle scale present.
..... 14

Disc and arm plates covered by a thick skin-bearing scattered small granules; tentacle scale absent.
Ophiolebes scorteus Lyman, 1878.

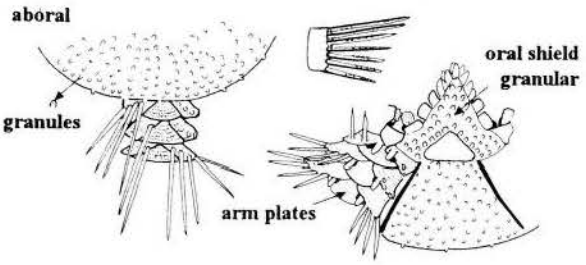
14 Six or seven arms.
Ophiacantha vivipara Ljungman, 1870.

Five arms 15

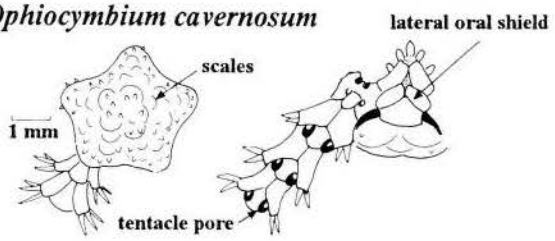
15 Ten to twelve arm spines; one large tentacle scale; oral shield rectangular-shaped.
Ophiacantha rosea Lyman, 1878.

Six arm spines; one small and pointed tentacle scale; oral shield small diamond-shaped.
Ophiacantha imago Lyman 1878.

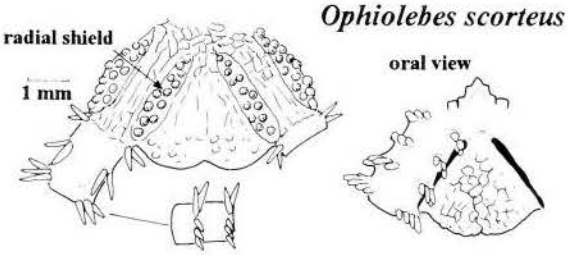
Toporkovia antarctica



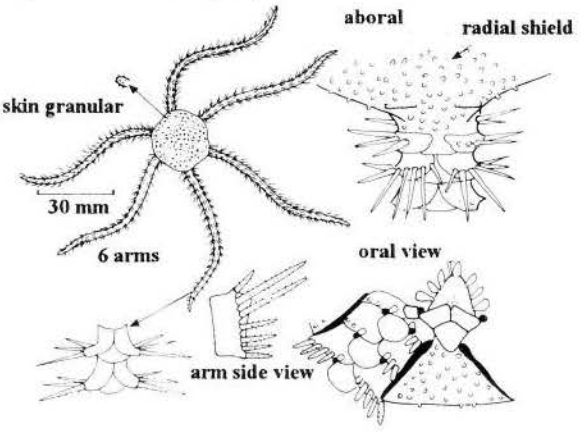
Ophiocymbium cavernosum



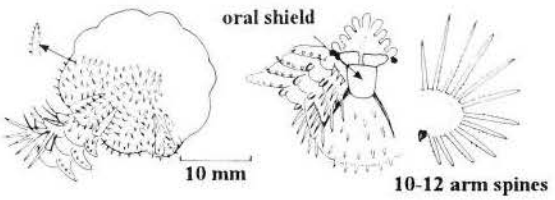
Ophiolebes scorteus



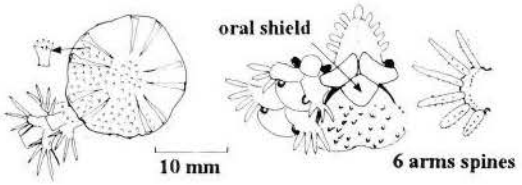
Ophiacantha vivipara



Ophiacantha rosea



Ophiacantha imago



16 Basal lateral arm plates greatly enlarged; no bursal slit.
Ophiophycis mirablis Koehler, 1901

Basal lateral arm plates not enlarged; bursal slit present 17

17 Six arms; aboral arm plates fragmented.
Ophionotus hexactis (Smith, 1876).

Five arms; aboral arm plates not fragmented. 18

18 Tentacle pores restricted to a few basal arm joints.
Ophiurolepis intorta (Lyman, 1878).

Tentacle pores occurring over most of the arm length 19

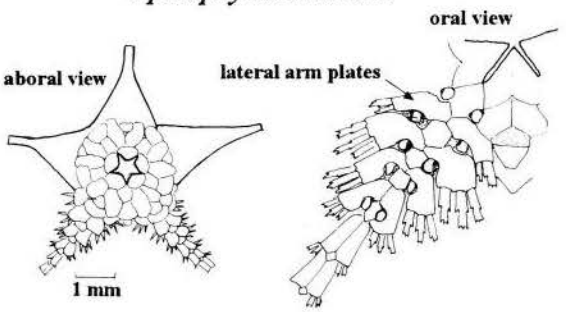
19 Disc high; arms not broader than high .. 20

Disc low and flat; arms broader than high. 21

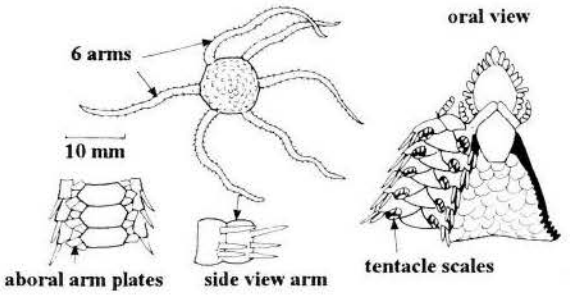
20 Arms higher than broad; dimorphic arm spines; longitudinal swelling on the oral arm plates.
Stegiophiura elevata (Lyman, 1878).

Arms cylindrical; three subequal pointed arm spines; flat oral arm plates.
***Amphiophiura* sp.**

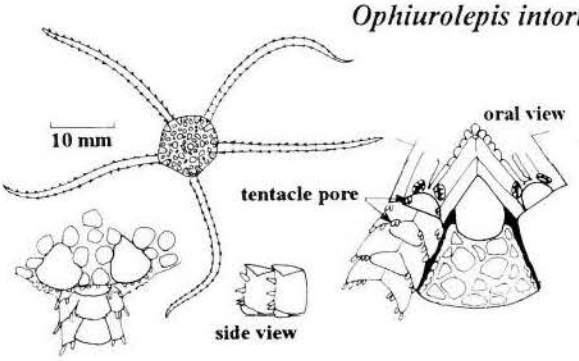
Ophiophycis mirabilis



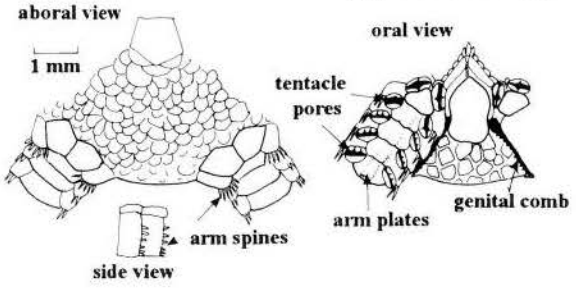
Ophionotus hexactis



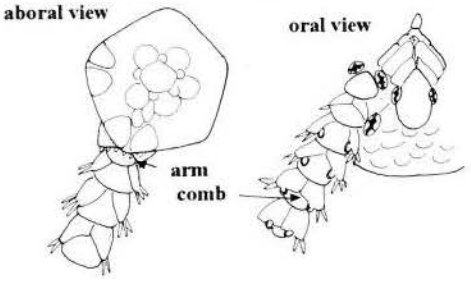
Ophiurolepis intorta



Stegophiura elevata



Amphiophiura sp.

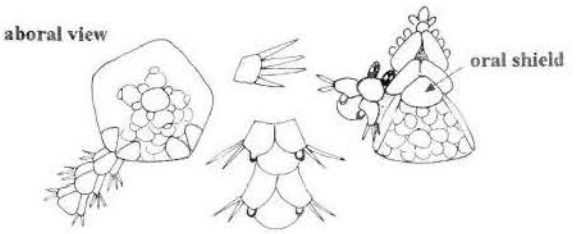


21 Oral shields as long as wide; arm comb not well developed; oral and aboral arm plates not wider than long.
Ophiocten banzarei Madsen, 1964.

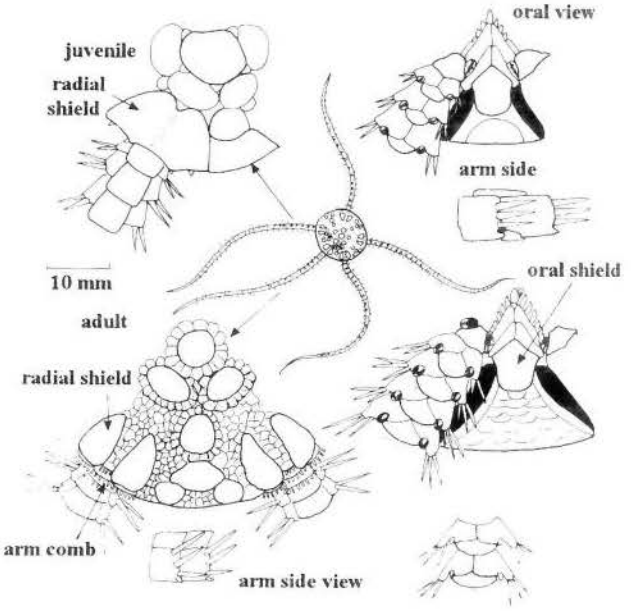
Oral shields longer than wide; arm comb well developed; oral and aboral arm plates much wider than long.
Ophiocten amitinum Lyman, 1878[1].

[1](Guille (1982) places *amitinum* species into *Ophiura* genus.
Records of *Ophiocten sericeum* from MPE are considered to belong to *O. amitinum*. According to Paterson *et al* (1982) *O. sericeum* is a species strictly from the North Atlantic.)

Ophiocten banzarei



Ophiocten amitinum

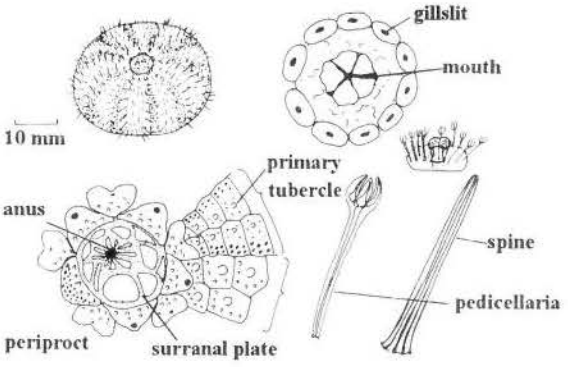


C Echinoidea - Sea urchins

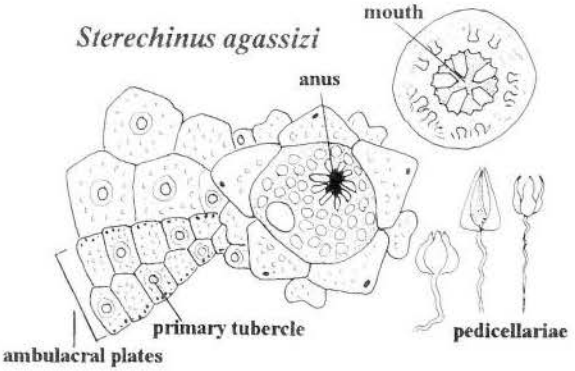
1 Camarodont lantern ; test more or less sculptured (small pits); gill slits are ten shallow notches in the lowest interambulacral plates bordering the peristome. Suborder **Temnopleurina**, family **Temnopleuridae**; one primary tubercle every ambulacral plate; buccal plates well developed (*Pseudechinus*); test greenish, spines whitish and slender; large suranal plate on periproct.
Pseudechinus marionis Mortensen, 1936

Camarodont lantern; test not sculptured. Gill slits not obvious. Suborder **Echinina**, family **Echinidae**; secondary spines forming a dense coat; one primary tubercle every second ambulacral plate (*Sterechinus*); test pink low, subconical; valves of tridentate (three-clawed) pedicellariae not slender.
Sterechinus agassizi Mortensen, 1936

Pseudechinus marionis



Sterechinus agassizi



D Holothuroidea - Sea cucumbers

1 Tube feet present 2

Tube feet absent although papillae may be present.
Order **Apodida** 9

2 Up to 20 tentacles with a bunch of branches at the tip (peltate), no retractor muscles; often large to very large animals.
Order **Aspidochirotida** 3

Ten dendritic (branched) tentacles, retractor muscles present; small to medium-sized animals.
Order **Dendrochirotida** 5

3 Large animal, about 100 mm x 30 mm; tube feet reduced to small knobs; skin covered with a sand layer; no spicules in the skin; 20 tentacles, spicules curved rods with spines; anal slit present.
Pseudostichopus mollis (Théel, 1886)

Tube feet well developed; no sand adhering to the skin; skin spicules present; no anal slit . 4

4 Large, flaccid animal with thin transparent skin, about 170 mm x 20 mm; ventral tube feet long, in 3 rows, spicules are curved rods with short spines and flattened ends with holes; dorsal papillae, spicules are branched rods and pseudotables; skin thin, spicules sparse, four to six-spined cruciform spicules with forked or perforate tips; table-shaped spicules absent.
Synallactes challengeri (Théel, 1886)

Small, pale, less than 50 mm long; ventral side without podia; lateral tube feet longer than the others, no rods in the tube feet; skin and tube feet spicules table-shaped, disc of the table with a large central hole surrounded by six to eight holes, spire of three pillars ending in short spines; 18 orange-brown tentacles.
Mesothuria edwardensis Massin, 1992

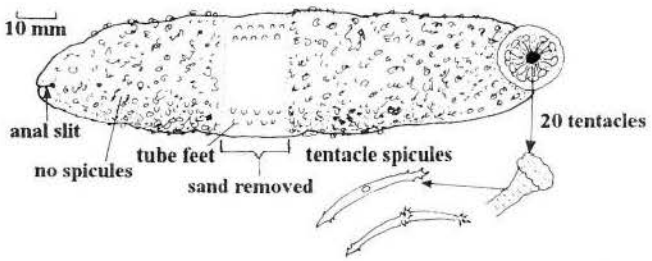
5 Body flattened with well-defined ventral sole; dorsal scales present 6

Body more or less cylindrical, without well-defined ventral sole; dorsal scales absent.
..... 7

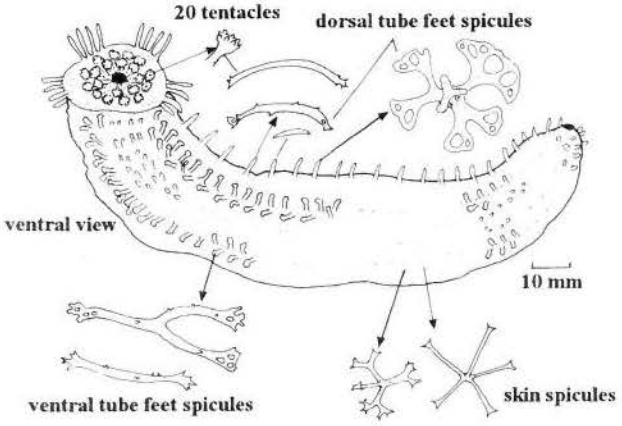
6 Five triangular valves around the mouth; ventral spicules include abundant baskets (cup-shaped, with holes and small knobs on the surface); dorsal scales do not overlap and usually show large holes and small knobs; two rows of similiar sized tube feet around the margin of the sole; common
Psolus paradubiosus Carriol & Feral, 1985[1]

[1] (= partim *Psolus ephippifer* collected by the *Challenger* at Marion Island; Théel 1886) (*Psolus ephippifer* Wyville-Thomson , 1876

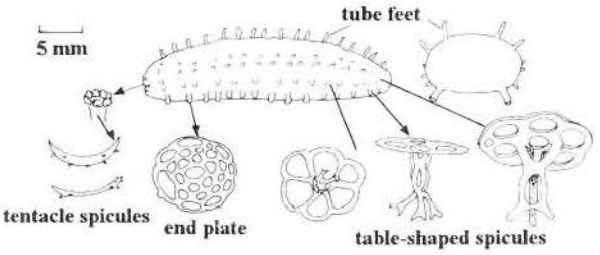
Pseudostichopus mollis



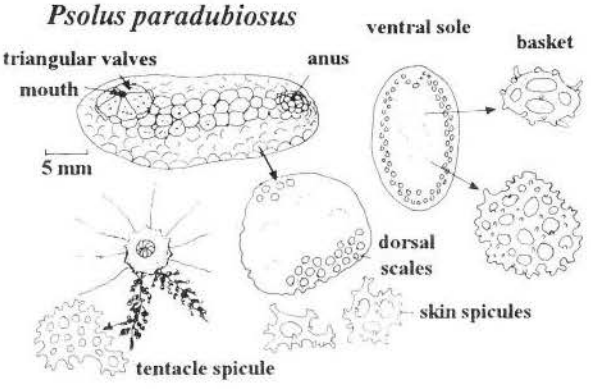
Synallactes challengeri



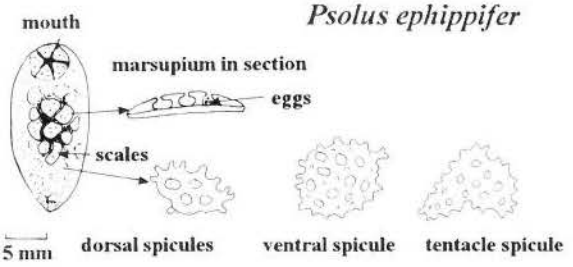
Mesothuria edwardensis



Psolus paradubiosus



Psolus ephippifer



recorded from Heard and Kerguelen Islands has similiar spicules in the dorsal and ventral skin, but the holes in the spicules are smaller and more numerous than in *P. paradubiosus*. The female has a dorsal marsupium where the eggs are incubated, while there is no evidence of a marsupium in *P. paradubiosus*. The anal plates also differ. They are compared by Carriol & Feral, 1985.)

No valves around the mouth; ventral spicules scattered and flat with large holes, usually 4-8 holes, (no baskets); dorsal scales overlap; they have small holes, there are thickened radial ridges towards the centre; two rows of ventral tube feet, large in the inner row and very small near the margin of the sole.
Psolidium incertum (Théel, 1886)

7 Skin spicules, oval knobbled plates; dorsal and ventral tube feet equal-sized 8

Skin spicules, smooth perforated plates; ventral tube feet much larger than the dorsal tube feet.
Cladodactyla crocea croceoides (Vaney, 1908)

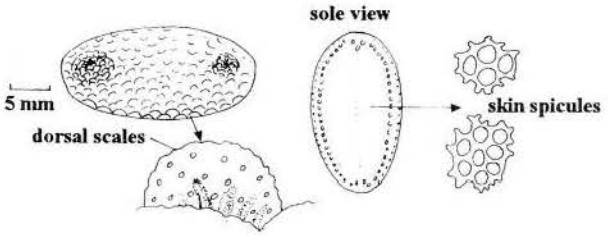
8 Small cylindrical animal (5 to 40 mm), orange or white; skin spicules with oval knobbed plates with holes and bearing a hand-like process at the tip; abundant in shallow water.
Pseudocnus laevigatus (Verrill, 1876)

Large animal (>40 mm), wide anteriorly and tapering posteriorly; skin spicules oval knobbed plates with holes but without hand-like processes; five anal papillae with tooth-like process.
Cucumaria kerguelensis Théel, 1886.

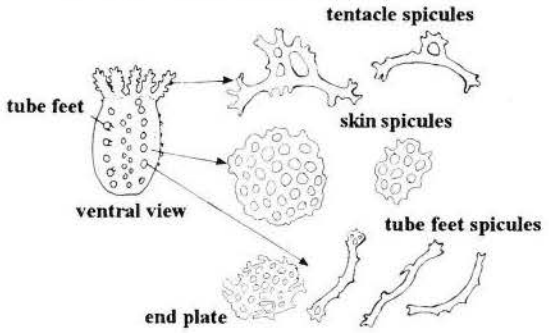
9 Skin deposits sigmoid hooks plus wheel-shaped deposits in the scattered papillae; 12 pinnately branched tentacles carrying rod spicules with branched ends; body 20-30 mm long.
Taeniogyrus contortus (Ludwig, 1874)

Skin without spicules, purplish-white; 12 peltato-digitate tentacles with curved rod spicules some of which are branched; body, small about 17 mm long.
Paradota marionenis Massin, 1992

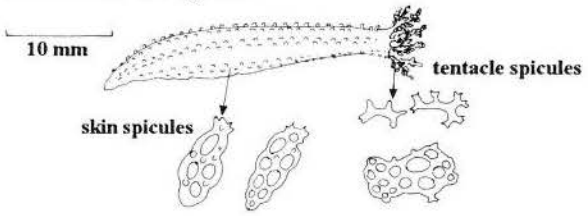
Psolidium incertum



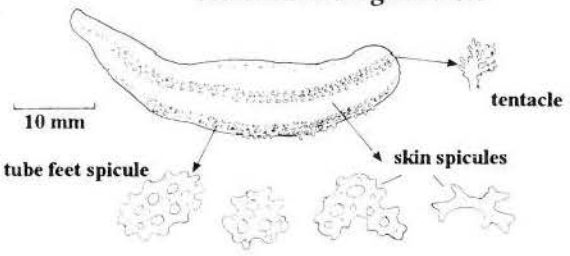
Cladodactyla crocea croceoides



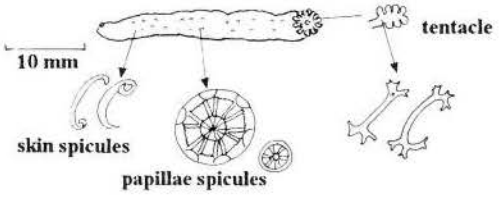
Pseudocnus laevigatus



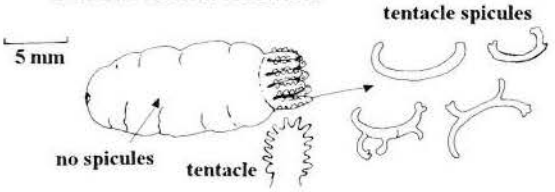
Cucumaria kerguelensis



Taeniogyrus contortus



Paradota marionensis



E Crinoidea - Feather stars

1 Stalk present in the adult.
Family **Bathycrinidae** - (Not recorded at Marion Island.)

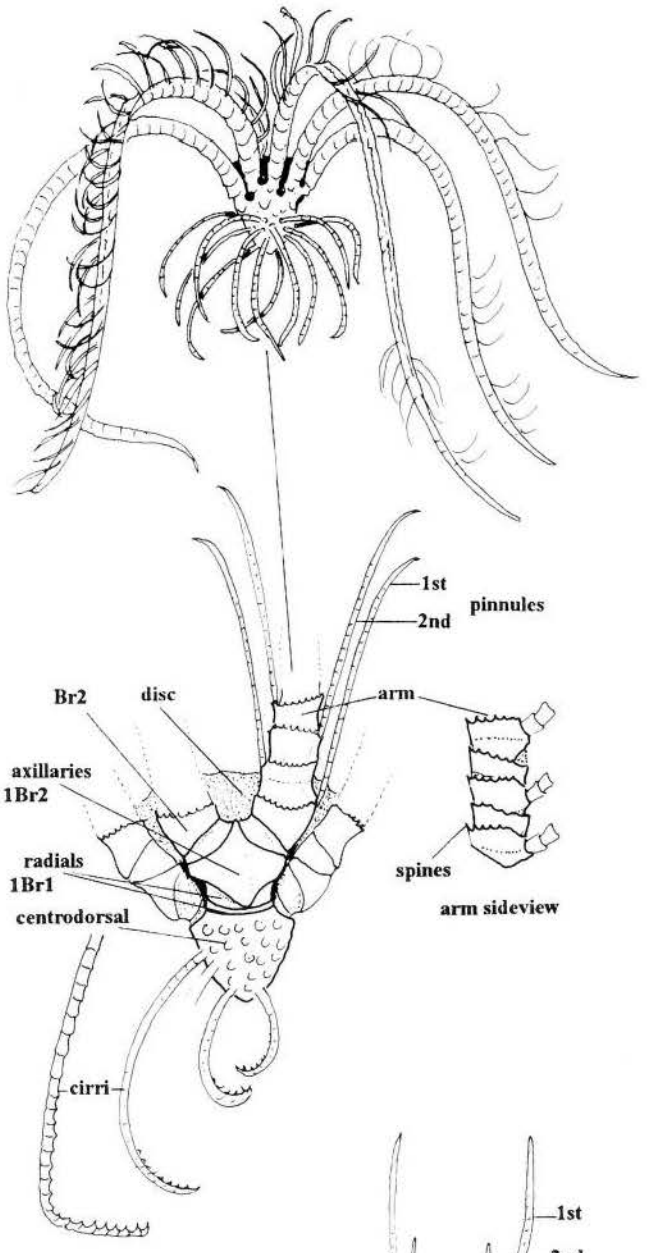
No stalk in adult, attached by a cluster of cirri-borne on the centrodorsal plate; 10 arms; mouth more or less centrally placed on the disc; no conspicuous plates along the amblacral grove of the pinnules on arms 2

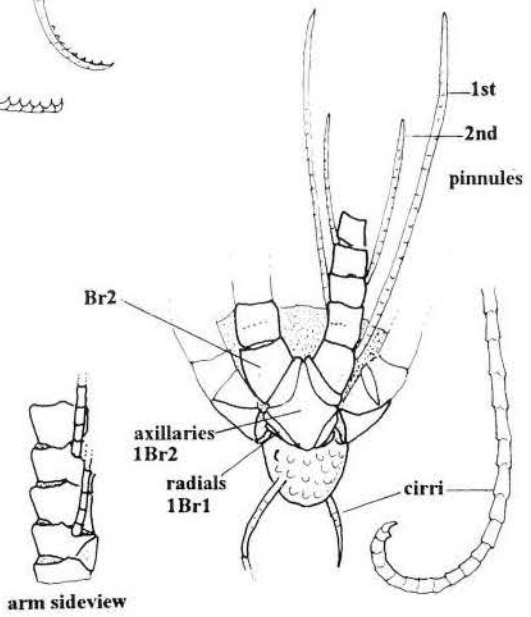
2 Distal edge of each arm joint bears a small fringe of spines; first and second pinnules almost equal; centro-dorsal conical, bears over 35 cirri each with 25 to 30 joints; 3 ossicles of the undivided arm visible, the first (radial) is narrow, the second (1Br1) convex and the third forms a large rhombic axillary (1Br2); the second joint of the arms, after division, is large and triangular (Br2); orange to yellow; up to about 170 mm across (*Challenger* collected one small specimen, spread 70 mm, colour in alcohol white).
Eumorphometra hirsuta (Carpenter, 1888)[1]
= *Antedon hirsuta* Carpenter, 1888

Distal edge of arm joints not spined; first pinnule elongated, 30 or more cylindrical joints, the second pair of pinnules much shorter with stouter joints; centro-dorsal hemispherical, almost covered by some 50 cirri of about 20 joints 3 ossicles of basal arm partly covered, the first (radial) nearly invisible, the second (1Br1) is short and almost concealed in the middle line by the large rhombic axillary (1Br2) which has a sharp clavicular (lateral) process and extends laterally beyond 1Br1; the second joint (Br2) of arms, after division, is large and quadrate; light reddish brown; disc 6 mm, spread about 170 mm.
Phrixometra exigua (Carpenter, 1888)
= *Antedon exigua* Carpenter, 1888

[1]The terminology used for crinoid morphology is taken from Speel and Dearborn, 1983

Eumorphometra hirsuta





Phrixometra exigua

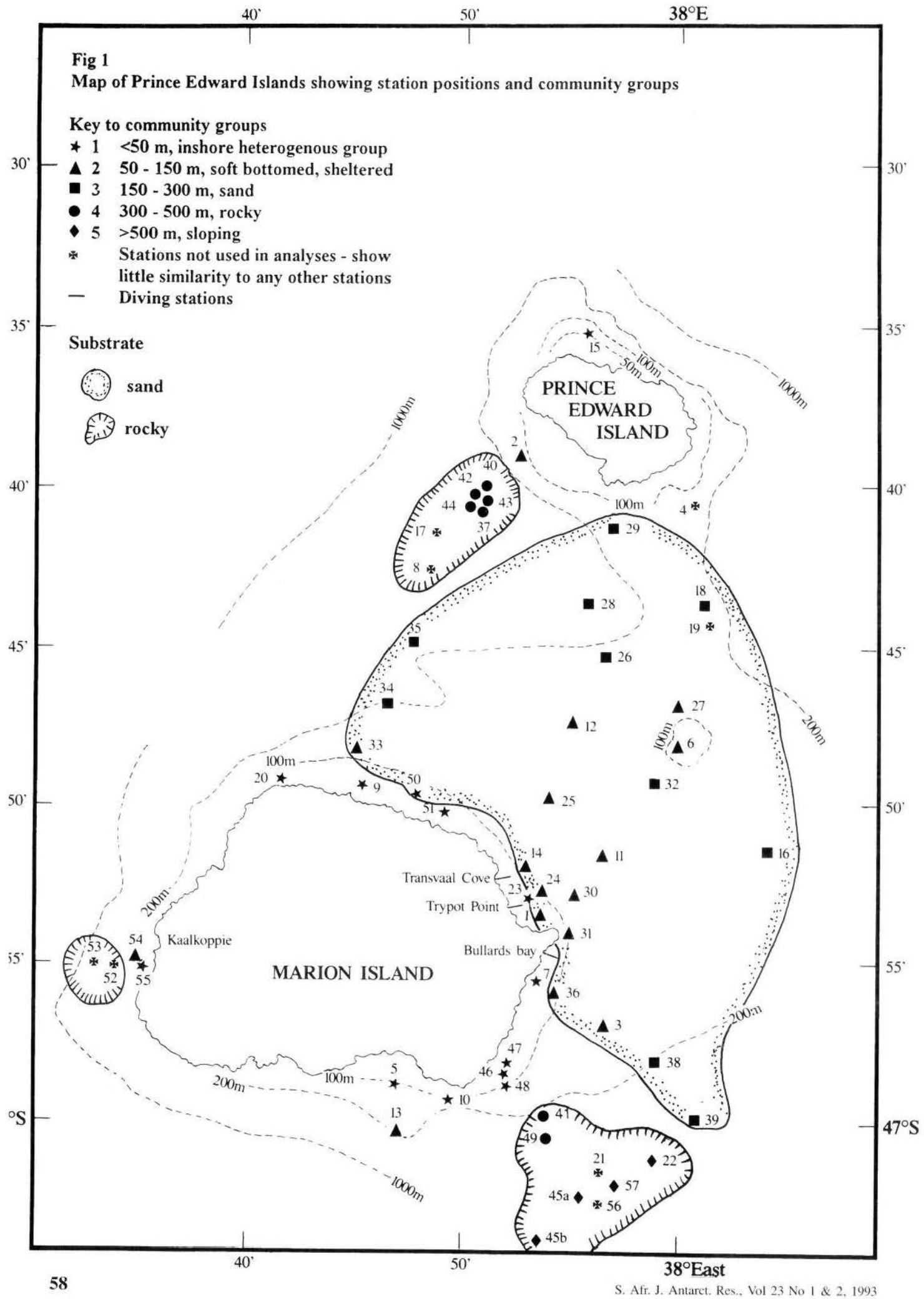


Fig 1
Map of Prince Edward Islands showing station positions and community groups

Discussion

The Echinodermata are an important element in the MPE invertebrate fauna. Although they are not as species-rich (70 species) as the Crustacea (126 species), Polychaeta (91 species), Mollusca (85 species) or Bryozoa (over 100 species), many of them are large in size, and others are numerically abundant.

All the species of Echinodermata recorded from MPE during the 1982-89 surveys by the University of Cape Town are listed in Table 1 and the localities and stations are shown in Fig 1. The results of the 57 dredged collections are given in two ways. The first relates to the substrate types from which the samples were taken, which ranged from volcanic rock, through gravel to black volcanic sand. The second records the abundance of species within community groups which were recognised by a Brey-Curtis similarity analysis of total species composition at each station (GM Branch *et al* 1993). Forty-four SCUBA-diving samples were taken, 36 being part of the quantitative survey at 5, 10, and 15 m depths at Trypot Point, Transvaal Cove and Bullards Bay (Beckley & Branch 1992). Intertidal information was obtained from 8 stations sampled in 1982 and from published intertidal surveys (De Villiers 1976, Pawson 1971, Bernasconi 1971, Rowe & Clark 1975). The numbers of echinoderms were also recorded from remote control photographs taken at the dredge stations (GM Branch *et al* 1993).

The comatulid crinoid, *Eumorphometra hirsuta*, was concentrated in the deep rocky stations to the south-west of Prince Edward Island and to the south-east of Marion Island especially at stations 37, 44 and 52 (over 25 specimens). Large groups of these orange/yellow feather stars were seen in photographs of the seafloor at these sites.

There were only two species of Echinoidea. *Pseudechinus marionis* is abundant subtidally, particularly on soft substrates and occurred at 36 of the 44 dive stations and 45 of the 57 dredged samples. Beckley & Branch (1992) recorded a mean density of 50 m^{-2} at 15 m depth at Trypot Point and over 1 000 were dredged at station 54. The second species, a new record, was the large pink *Sterechinus agassizi*. It was rare and confined to station 45 to the south-east of Marion Island and station 42 south-west of Prince Edward Island.

There were 10 species of Holothuroidea, of which *Pseudocnus laevigatus* was the only intertidal species. Though small, it attained densities of 1 235 m^{-2} with a biomass of 255 gm^{-2} at 15 m and extended to a depth of 240 m. *Psolus paradubiosus* was common between 50 and 300 m on soft substrates.

Several species of Ophiuroidea were abundant. *Ophiurolepis intorta* occurred from 1-750 m reaching a mean density of 232 m^{-2} at 10 m depth at Transvaal Cove (listed as *O. martensi* in Beckley & Branch 1992). Photographic records showed communities between the islands dominated by small ophiuroids.

Anasterias rupicola was the only asteroid found intertidally, where it is a dominant shallow subtidal predator (Blankley 1984). Blankley and Branch (1984) examined its ecology and showed that it feeds on the polychaete *Platynereis australis*, isopods *Dynamenella eatoni* (called *D. huttoni* in earlier papers) and *Exosphaeroma gigas*, chitons, bivalves and amphipods, but the major food source was the limpet *Nacella delesserti*. *Anasterias rupicola*'s habit of brooding the young for 6-9 months coupled with a slow growth rate and longevity, as well as the ability of even small starfish to feed on large limpets by cooperatively attacking them, have all contributed to the maintenance of high densities of *A. rupicola*. Blankley (1984) recorded a mean density of 57 m^{-2} but as they were strongly aggregated they were locally even more dense.

The composition of species within the community groups (1-5 in Table 1), recognised from the dredge survey (GM Branch *et al* 1993) and shown on Fig 1, are characterised as follows:

Group 1. A heterogenous inshore community was identified around the Islands, in <50 m depth, in which the echinoid *Pseudechinus marionis* and the asteroid *Smilasterias scalprifera* were abundant and the ophiuroid Ophiurolepis intorta was common. There was a difference between the exposed and sheltered sides of the islands; *Ophionotus hexactis* and *Ophiacantha vivipara* occurred on the exposed, rocky western shelf of the islands, along with the asteroids *Diplasterias meridionalis* and *Henricia praetans*, while on the sheltered eastern, sandy shelf asteroids *Diplopteraster semireticulatus* and *Porania antarctica* were found.

Group 2. A very uniform, shallow (50-150 m) community favouring soft sediment was prevalent in the lee of Marion Island and extending to Natal Bank. The most common of the 16 species of asteroids in this community were *Diplopteraster semireticulatus, Odontaster meridionalis* and *Porania antarctica*. Nine species of ophiuroids were found in this community, with *Amphiura angularis angularis, Ophiacantha vivipara, Ophiocten amitinum, Ophionotus hexactis, Ophiurolepis intorta* and *Toporkovia antarctica* being common to abundant. The photographic survey showed an average density of brittle stars of 15 m^{-2} reaching a maximum of 192 m^{-2}. *Pseudocnus laevigatus* and *Psolus paradubiosus* (63 dredged at station 12) were the most common holothuroids with a further 5 species being rare. The recently described *Mesothuria edwardensis* (Massin 1992) was collected from station 27. *Pseudechinus marionis* was abundant and the majority of dredge stations recorded 50-300 while over 400 of these urchins were dredged from Natal Bank (station 6).

Table 1
Summary of Echinodermata recorded from Marion and Prince Edward Islands during the 1971-89 University of Cape Town surveys

The number of stations at which each species was recorded is given for intertidal (Int), SCUBA-diving (Dv) and dredging (Dr) surveys. For these three survey methods respectively 11, 44 and 57 stations were sampled. Maximum and minimum depths are given. The modal abundance of each species is shown in relation to substratum where the modal abundance is expressed as follows: 0 = absent, 1 = 1-5, 2 = 6-15, 3 = 16-30, 4 = 31-50, 5 = 51-100 individuals per sample. Substrate types are: A = >60% rock, B = 10-60% rock, C = >50% gravel, D = sand with 5-50% gravel, E = sand with >5% mud, F = 100% sand. Abundance is also summarised in relation to five community groups recognised by similarity analyses of the offshore dredged material (community groups 1-5, in Fig 1) or for intertidal (Int group 6 <5 m depth) and shallow-water SCUBA-samples (Dv group 7, 5-15 m). Abundance was ranked as - = absent, r = rare, p = present, c = common, a = abundant. Ranking was assigned on the basis of the product of the modal abundance and the percentage of stations within a community group at which the species was collected.

Cnidaria	No of records			Depth (m)		Modal abundance in substrates						Abundance in Communities						
						Rock			Sand			Offshore Shallow			Deep		Int	Dv
	Int	Dv	Dr	Min	Max	A	B	C	D	E	F	1	2	3	4	5	6	7
Asteroidea																		
Acodontaster elongatus			4	52	151	0	0	0	0	1	1	r	r	p	-	-		
Anasterias rupicola	6	13	1	1	45	1	0	0	0	0	0	r	-	-	-	-	c	p
Anteliaster australis			5	147	474	0	1	0	1	1	1	-	r	r	r	-		
Anteliaster scaber		14	2	5	350	1	0	0	0	0	0	-	-	-	-	-	-	c
Bathybiaster loripes			6	140	368	1	0	0	0	1	1	-	r	c	-	-		
Ceramaster patagonicus			1	527	527	1	0	0	0	0	0	-	-	-	r	-		
Crossaster penicillatus			4	165	370	1	1	0	0	1	1	-	-	c	r	-		
Diplasterias meridionalis		2	17	10	228	1	0	4	1	1	2	p	c	r	-	-	-	c
Diplopteraster semireticulatus			3	139	350	1	0	0	0	1	1	-	r	r	-	-		
Henricia fisheri			4	45	527	1	1	0	0	0	1	r	-	r	p	-		
Henricia sp. aff. H. obesa			1	527	527	1	0	0	0	0	0	-	-	-	r	-		
Henricia praetans		7	7	5	527	1	0	0	1	2	1	r	p	r	-	-	-	c
Henricia sp. aff. H. simplex			3	52	474	1	0	0	0	0	1	-	r	r	-	-		
Henricia sp. aff. H. studeri			2	474	527	1	1	0	0	0	0	-	-	-	r	-		
Hippasteria hyadesi			3	474	527	1	1	0	0	0	0	-	-	-	p	-		
Hippasteria falklandica			3	204	527	1	1	0	0	0	1	-	-	r	c	-		
Labidiaster annulatus			4	255	475	1	1	0	1	0	0	-	-	r	p	-		
Leptychaster kerguelenensis		1	5	10	475	1	1	0	1	0	1	-	-	p	p	-	-	r
Lophaster stellans			6	135	475	2	0	0	0	2	0	-	p	r	r	-		
Odontaster meridionalis			18	49	240	1	1	0	1	2	1	r	c	c	-	-		
Odontaster penicillatus			1	527	527	1	0	0	0	0	0	-	-	-	r	-		
Odontaster validus			4	135	527	1	1	0	1	1	0	-	r	-	r	-		
Pedicellaster hypernotius			2	102	475	1	0	1	0	0	0	-	r	-	-	r		
Perknaster densus																		
Peribolaster folliculatus			1	139	139	0	0	0	0	1	0	-	r	-	-	-		
Porania antarctica		3	18	10	179	1	1	0	0	1	1	r	c	c	-	-	-	r
Pseudarchaster discus			1	368	368	1	0	0	0	0	0	-	-	r	-	-		
Pteraster affinis		5	6	10	475	1	1	0	1	1	1	-	r	p	c	-	-	c
Smilasterias scalprifera		4	9	10	527	1	0	0	3	1	3	a	r	-	p	-	-	r
Smilasterias triremis		4	3	5	165	2	0	0	0	1	1	r	-	r	-	-	-	r
Solaster dianae			2	355	475	1	0	0	0	0	0	-	-	-	r	-		
Solaster regularis		5	3	10	527	2	0	0	0	0	1	r	r	-	r	-	-	c
Tremaster mirabilis			2	474	527	1	1	0	0	0	0	-	-	-	r	-		

Table 1 (continued)

Cnidaria	No of records			Depth		Modal abundance in substrates						Abundance in Communities						
						Rock			Sand			Offshore Shallow			Deep		Int	Dv
	Int	Dv	Dr	Min	Max	A	B	C	D	E	F	1	2	3	4	5	6	7
Ophiuroidea																		
Amphilepis gymnopora			2	210	355	1	0	0	0	0	0	-	-	r	-	-		
Amphiophura sp.			1	697	697	1	0	0	0	0	0	-	-	-	-	r		
Amphiura algida			2	125	165	1	0	0	0	1	0	-	r	r	-	-		
Amphiura angularis angularis			25	49	527	1	1	0	1	1	2	r	c	c	r	-		
Amphiura antarctica																		
Amphiura tomentosa	2	3	10	0.5	355	1	0	0	1	1	2	r	r	p	-	-	p	r
Asteronyx loveni			1	290	290	0	2	0	0	0	0	-	-	-	p	-		
Astrotoma agassizi			3	474	510	2	2	0	0	0	0	-	-	-	a	-		
Gorgonocephalus chilensis			3	474	527	3	2	0	0	0	0	-	-	-	a	-		
Ophiacantha imago			3	475	527	3	0	0	0	0	0	-	-	-	a	-		
Ophiacantha rosea			3	475	527	1	0	0	0	0	0	-	-	-	c	-		
Ophiacantha vivipara	1	9	27	2	510	1	3	0	5	1	1	c	a	c	a	-	r	c
Ophiocten amitinum			26	106	475	2	1	0	0	5	3	-	c	a	a	r		
Ophiocten banzarei			1	680	715	1	0	0	0	0	0	-	-	-	-	r		
Ophiocymbium cavernosum			1	697	697	1	0	0	0	0	0	-	-	-	-	r		
Ophiolebes scorteus																		
Ophionotus hexactis			21	31	368	1	0	0	1	2	3	r	a	c	-	-		
Ophiophycis mirabilis			1	527	527	1	0	0	0	0	0	-	-	-	r	-		
Ophioscolex nutrix			6	132	527	1	0	0	0	1	1	-	r	p	c	-		
Ophiurolepis intorta	1	23	36	1	750	1	1	1	3	3	3	c	a	a	p	-	p	a
Stegophiura elevata			1	697	697	1	0	0	0	0	0	-	-	-	-	r		
Toporkovia antarctica			17	132	475	1	5	0	1	1	4	-	c	a	a	-		
Holothuroidea																		
Cladodactyla crocea croceoides			1	420	420	0	0	0	0	0	1	-	-	-	p	-		
Cucumaria kerguelensis			2	52	350	1	0	0	0	0	1	r	-	-	-	-		
Mesothuria edwardensis			2	113	255	0	0	0	1	0	1	-	r	-	-	-		
Paradota marionensis			1	240	240	0	0	0	0	0	1	-	-	r	-	-		
Pseudocnus laevigatus	4	36	16	0.5	240	1	1	0	2	1	1	r	c	c	-	-	c	a
Pseudostichopus mollis			7	140	474	1	1	0	0	1	1	-	r	p	c	r		
Psolidium incertum			5	140	475	1	1	0	1	2	0	-	r	r	c	-		
Psolus paradubiosus			17	90	355	0	1	1	1	3	1	-	c	c	-	-		
Synallactes challengeri			7	140	475	3	2	0	1	1	1	-	r	p	a	-		
Taeniogyrus contortus			2	125	132	1	0	0	0	1	0	-	r	-	-	-		
Echinoidea																		
Pseudechinus marionis		36	45	5	527	1	2	1	4	5	5	a	a	a	a	-	-	a
Sterechinus agassizi			2	480	510	1	0	0	0	0	0	-	-	-	r	r		
Crinoidea																		
Eumorphometra hirsuta			9	98	750	3	3	0	0	0	1	r	-	-	a	r		
Phixometra exigua																		

Group 3. The deeper water (150-300 m), soft-sediment community between and to the east of MPE showed a similiar echinoderm species composition to group 2, with the addition of deep-water asteroids *Bathybiaster loripes, Crossaster penicillatus, Hippasteria falklandica, Labidiaster annulatus* and *Leptychaster kerguelenensis. Pseudarchaster discus* from station 39 was a new record for these islands. The large holothuroids *Pseudostichopus mollis* and *Synallactes challengeri* were present and the recently described *Paradota marionensis* (see Massin 1992) was found at station 28. The ophiuroids comprised several small species already listed for group 2 but they were less common and averaged 9 m^{-2} in the photographic survey.

Group 4. These deep, rocky bottomed stations which are rich in octocorals and hydrozoans yielded most of the new records for the MPE region. Crinoids were found commonly in this community. Of the holothuroids the large flaccid *Synallactes challengeri* was abundant, *Pseudostichopus mollis* and *Psolidium incertum* were common, while the only record of *Cladodactyla crocea croceoides* came from station 40. The small ophiuroids of the previous groups were still present or abundant in this community group and three large euryalines were also collected: *Gorgonocephalus chilensis* and *Astrotoma agassizi* were common south-east of Prince Edward Island, while *Astronyx loveni* was found at station 49. Two large Ophiacanthids, the abundant *Ophiacantha imago* and the common *Ophiacantha rosea* came from stations 42-44. Eighteen asteroids were recorded from this community group of which *Pteraster affinis* was the only common one. There were several new records for the islands: *Hippasteria hyadesi*, (cover photograph) *Hippasteria falklandica, Odontaster penicillatus, Odontaster validus, Ceramaster patagonicus, Anteliaster australis, Henricia obesa* and *Henricia studeri. Solaster regularis* is also a new record but it was much more common in the diving survey at 10-15 m. The new species *Solaster dianae* (Stampanato & Jangoux in press), came from stations 43 and 17.

Group 5. The fifth community group recognised by GM Branch *et al* (1992) occurred at stations south-east of Marion Island, where the shelf was sloping and over 500 m in depth. Echinodermata were very poorly represented in this community with a few crinoids (*Eumorphometra hirsuta*), one record of the urchin *Sterechinus agassizi*, the ophiuroids *Ophiocten amitinum* and *Stegophiura elevata* and the holothuroid *Pseudostichopus mollis*. Asteroids were absent.

Group 6. This intertidal community had remarkably few species of echinoderms. *Anasterias rupicola* occurred on the sublittoral fringe on exposed rock and sheltered rocky gulleys, where its main food source - the limpet *Nacella delesserti*, was found. Three species of small ophiuroids, *Amphiura tomentosa, Ophiurolepis intorta* and *Ophiacantha vivipara* lived among algae in the sheltered sublittoral fringe and extended into deeper zones. The small holothuroid *Pseudocnus laevigatus* was found sheltering under boulders and was fairly common at the sublittoral fringe.

Group 7. These samples from the diving survey in 5-15 m depths were collected from dense algal beds. *Durvillea antarctica* formed a narrow fringe in the infralittoral between 3-6 m depths, while the kelp *Macrocystis laevis* occurred in depths >5 m. The zoobenthic biomass as a whole and the echinoderm biomass in particular increased with depth at the three sites surveyed (Transvaal Cove, Trypot Point and Bullards Bay). The most important echinoderms were the holothuroid *Pseudocnus laevigatus* (up to 1 235 m^{-2}), the echinoid *Pseudechinus marionis* (50 m^{-2}) and the ophiuroid *Ophiurolepis intorta* (up to 232 m^{-2}). Of the ten asteroids recorded only *Anteliaster scaber, Henricia praetans, Pteraster affinis, Solaster regularis* and *Diplasterias meridionalis* were common, but they did not contribute significantly to the overall echinoderm biomass (Beckley & Branch 1992). All the specimens of *Anteliaster scaber* were small (R<10 mm), as were the *Pteraster affinis* (R=average 20 mm), but the beautiful 10-armed *Solaster regularis* was often large (R> 60 mm).

Very few clear patterns emerge when the modal abundance of species is examined with respect to different substrata (see Table 1). This is understandable because of the general mobility of echinoderms. The clearest patterns emerged in the deep rocky stations. Crinoids, the ophiuroids *Asteronyx loveni, Astrotoma agassizi* and *Gorgonocephalus chilensis*, as well as *Ophiacantha imago* and *O. rosea*, the two species of *Hippasteria* and *Tremaster mirabilis* were all confined to this area. This is probably due to the combination of substrate, depth and a more exposed locality. The first four species are filter feeders.

The sheltered sandy area between the islands (groups 2 and 3) supports a community of filter feeding bivalves, tubiculous polychaetes, brachiopods and bryozoans. The echinoderms in this region were all detritus feeders, comprising 10 small species of ophiuroids, *Pseudechinus marionis*, and the flat soled holothuroid *Psolus paradubiosus* and two large holothuroids as well as 20 asteroids.

Geographical distribution

The geographical distribution of the Marion Island echinoderms is summarised in Table 2. Distribution is shown for the four quadrants of the Antarctic and Subantarctic regions: namely Weddell, Enderby, Victoria and Ross Quadrants, Fig 2.

Figure 2
Antarctic showing the Antarctic Covergence in relation to the various islands and southern continents. (After Clark 1962 and Knox & Lowry 1977)

The position of the four quadrants Weddell, Enderby, Victoria and Ross is shown. The surface currents and the dispersal routes of marine fauna between the Antarctic and Marion Island and other subantarctic islands is shown.

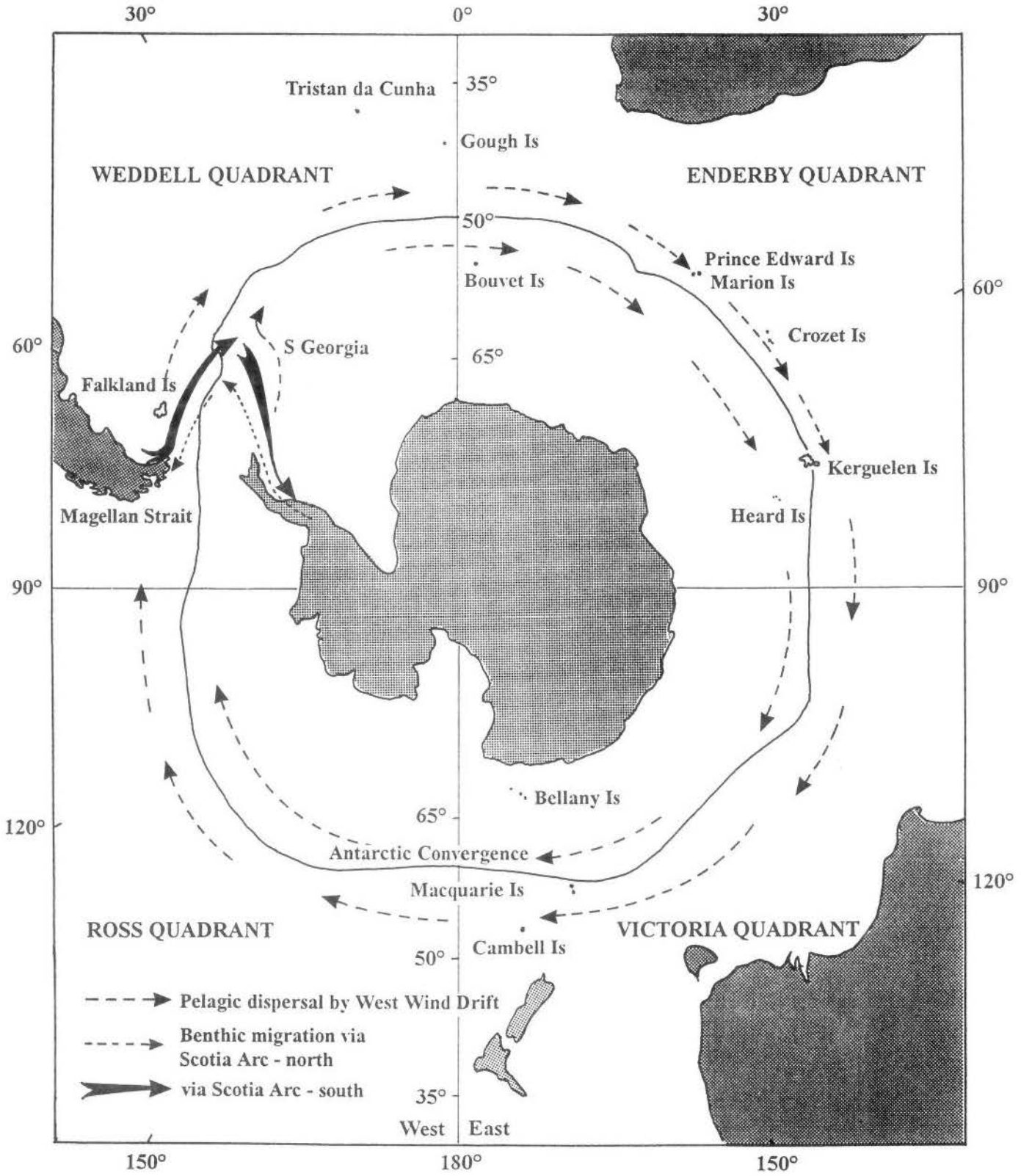


Table 2
Geographical distribution of Marion and Prince Edward Island Echinodermata

The Antarctic and subantarctic have been divided into four quadrants: Weddell (W) Enderby (E), Victoria (V) and Ross (R). The Arctic Convergence forms a circle around the Antarctic and marks the boundary between the Antarctic and subantarctic waters. It lies at approximately 50 °S in the Weddell and Enderby Quadrants and 60 °S in the Victoria and Ross Quadrants. (See Fig 2). Distribution is given as x = present and - = absent for each zone except in the Weddell subantarctic where presence at the Falklands = f, and in the Enderby Quadrant where the presence at Crozet = cr, at Kerguelen = k and at Marion = m.

(Information from Baker 1901, Cherbonnier & Guille 1974, 1975, AM Clark 1962, HES Clark 1963, 1970, AM Clark & Courtman-Stock 1976, Ekman 1927, Fell 1961, Guille 1982, Gutt 1991, Hertz 1927, Koehler 1901, 1917, 1920, Paterson 1985, Paterson *et al* 1982, Pawson 1964, Smith 1876, 1878, Vaney 1908).

	ANTARCTIC				SUBANTARCTIC						NORTH OF SUBANTARCTIC
	W	E	V	R	W		E		V	R	
					Falk	M	Cr	Kg			
Asteroidea											
Acodontaster elongatus	x	x	x	x	f	m	-	k	-	-	Buenos Aires, Urugauy
Anasterias rupicola	-	-	-	-	f	m	cr	k	-	-	-
Anteliaster australis	x	-	-	-	f	m	-	-	-	-	-
Anteliaster scaber	-	-	-	-	f	m	-	k	-	-	-
Bathybiaster loripes	x	x	x	x	f	m	-	k	-	-	S Chile; Brazil
Ceramaster patagonicus	-	-	-	-	f	m	-	-	-	-	S Brazil, S Africa, Northern hemisphere
Crossaster penicillatus	-	-	-	-	f	m	-	k	-	-	S Africa
Diplasterias meridionalis	x	-	-	-	f	m	-	k	-	-	-
Diplopteraster semireticulatus	-	-	-	-	-	m	-	k	-	-	-
Henricia fisheri	-	-	-	-	-	m	cr	-	-	-	-
Henricia sp. aff. H. obesa	-	-	-	-	f	m	-	-	x	-	-
Henricia praetans	-	-	-	-	-	m	cr	k	-	-	-
Henricia sp. aff. H. simplex	x	-	-	-	f	m	-	-	-	-	Tristan
Henricia sp. aff. H. studeri	-	-	-	-	f	m	-	-	-	-	-
Hippasteria hyadesi	-	-	-	-	f	m	-	-	-	-	-
Hippasteria falklandica	-	-	-	-	f	m	-	-	-	-	Buenos Aires
Labidiaster annulatus	x	x	x	-	-	m	-	k	-	-	-
Leptychaster kerguelenensis	-	-	-	-	f	m	-	k	-	-	-
Lophaster stellans	x	-	x	-	f	m	-	-	x	-	Santa Crux Province, S Argentina
Odontaster meridionalis	x	x	x	x	-	m	-	k	-	-	-
Odontaster penicillatus	-	-	-	-	f	m	-	-	-	-	Buenos Aires, Uruguay
Odontaster validus	x	x	x	x	-	m	-	-	-	-	Buenos Aires, Uruguay
Pedicellaster hypernotius	x	x	x	x	-	m	-	k	-	-	-
Perknaster densus	-	x	-	x	-	m	-	k	-	-	Santa Crux Province, S Argentina
Peribolaster folliculatus	-	-	-	-	f	m	-	-	-	-	S Chile
Porania antarctica	x	x	x	x	f	m	-	k	x	-	Uruguay
Pseudarchaster discus	-	-	-	-	f	m	-	-	-	-	Buenos Aires Province
Pteraster affinis	x	x	x	-	f	m	-	k	-	-	S Africa
Smilasterias scalprifera	-	x	-	-	f	m	-	k	-	-	-
Smilasterias triremis	x	x	-	-	-	m	-	k	-	-	-
Solaster dianae	-	-	-	-	-	m	-	-	-	-	-
Solaster regularis	x	x	x	x	f	m	-	k	-	-	Rio de la plata (N Argentina)
Tremaster mirabilis	-	-	-	-	-	m	-	k	-	-	N Atlantic Ocean

Table 2 (continued)

	ANTARCTIC				SUBANTARCTIC						NORTH OF SUBANTARCTIC
	W	E	V	R	W		E		V	R	
					Falk	M	Cr	Kg			
OPHIUROIDEA											
Amphilepis gymnopora	x	-	-	-	-	m	-	-	-	-	-
Amphiophura sp.	-	-	-	-	-	m	-	-	-	-	-
Amphiura algida	-	-	-	x	-	m	-	-	-	-	-
Amphiura angularis angularis	-	-	-	-	-	m	-	k	-	-	-
Amphiura antarctica	-	x	-	-	-	m	-	k	-	-	-
Amphiura tomentosa	x	-	-	-	-	m	-	k	-	-	-
Asteronyx loveni	-	-	-	-	-	m	-	-	-	-	S Africa, Northern hemisphere
Astrotoma agassizi	x	-	x	x	f	m	-	k	-	-	Patagonia
Gorgonocephalus chilensis	x	-	-	-	f	m	-	k	-	-	Chile, Argentina, New Zealand
Ophiacantha imago	-	x	-	x	-	m	-	k	-	-	-
Ophiacantha rosea	-	-	x	-	f	m	-	-	-	-	-
Ophiacantha vivipara	x	x	-	x	f	m	-	k	-	-	Patagonia, Argentina
Ophiocten amitinum	x	x	-	-	f	m	cr	k	-	-	S Africa
Ophiocten banzarei	-	-	-	-	-	m	-	-	-	-	-
Ophiocymbium cavernosum	-	x	-	-	-	m	-	-	-	-	-
Ophiolebes scorteus	-	-	-	-	-	m	cr	-	-	-	-
Ophionotus hexactis	x	-	-	-	-	m	-	k	-	-	-
Ophiophycis mirabilis	-	-	-	-	-	m	-	-	-	-	-
Ophioscolex nutrix	x	-	-	-	f	m	-	-	-	-	North Atlantic
Ophiurolepis intorta	x	-	-	-	f	m	-	k	-	-	-
Stegophiura elevata	-	-	-	-	-	m	-	-	-	-	-
Toporkovia antarctica	-	x	-	x	-	m	-	k	-	-	-
HOLOTHUROIDEA											
Cladodactyla crocea croceoides	x	x	-	-	f	m	-	k	-	-	Southern S America
Cucumaria kerguelensis	-	-	-	-	-	m	-	k	-	-	-
Mesothuria edwardensis	-	-	-	-	-	m	-	-	-	-	-
Paradota marionensis	-	-	-	-	-	m	-	-	-	-	-
Pseudocnus laevigatus	-	-	-	-	-	m	-	k	x	-	-
Pseudostichopus mollis	-	-	-	-	-	m	-	-	-	-	-
Psolidium incertum	x	x	-	-	-	m	-	k	-	-	-
Psolus paradubiosus	-	x	-	-	-	m	cr	k	-	-	-
Synallactes challengeri	-	-	-	-	-	m	cr	-	-	-	-
Taeniogyrus contortus	x	-	-	-	f	m	-	k	-	-	-
ECHINOIDEA											
Pseudechinus marionis	-	-	-	-	-	m	-	-	-	-	-
Sterechinus agassizi	x	-	-	-	f	m	-	-	-	-	Atlantic S of S America
CRINOIDEA											
Phixometra exigua	-	-	-	-	-	m	-	-	-	x	-
Eumorphometra hirsuta	x	-	-	x	-	m	-	-	-	x	Chile

At its northernmost limit the dense, cold Antarctic surface-water sinks beneath the less dense, south-flowing subantarctic water forming the Antarctic Convergence. This convergence forms a boundary zone around the Antarctic continent and lies at about 50°S in the Atlantic and Indian Ocean section and about 60°S in the Pacific section. There are steep temperature and salinity gradients at the surface in the region of the convergence. The northern boundary of the Subantarctic cold temperate water is marked by the Subtropical Convergence where it meets southward moving subtropical water. Antarctic waters range from -2 to 8°C, and Subantarctic waters from 3 to 14.5°C (Knox 1960). Marion and Prince Edward Islands, the Falkland Islands to the west and Crozet Islands to the east are true subantarctic islands while Kerguelen lies at the Subantarctic Convergence. In Table 2 the distribution of Marion Island species (m) in the Enderby Quadrant is therefore further subdivided to show whether they have also been collected at Crozet (cr) or Kerguelen (k). Those that have been collected at the Falklands (f) in the Weddell Quadrant are also shown.

The geographical distribution of Marion Island species were analysed with respect to temperature and latitude and are summarised in the pie graphs Fig 3. Cosmopolitan species (occuring in Antarctic, the subantarctic and north of the subantarctic) comprised 8 species of asteroid, 4 ophiuroids, and 1 holothuroid. Subantarctic forms comprised 10 asteroid species, 5 ophiuroids and 6 holothuroids. Species that were also found in the Antarctic numbered 8 asteroids, 11 ophiuroids and 3 holothuroids. No MPE holothuroids, 2 ophiuroid and 7 asteroids were also recorded from the southern continents (mainly South America). Only three asteroids and andtwo ophiroids were also recorded from southern Africa (*Ceremaster patagonicus, Crossaster penicillatus, Pteraster affinis, Asteronyx loveni* and *Ophiocten amitinum*) (Clark & Courtman-Stock 1976). Thus the MPE asteroids have a wider distribution with a higher percentage of cosmopolitan species and more warm water/low latitude species, than do the ophiuroids and the holothuroids, which are largely confined to the subantarctic and the Antarctic. Exceptions are *Cladodactyla crocea croceoides* and the large basket star *Gorgonocephalus chilensis* which extend into warmer waters, *Ophiophycus mirabilis* which is found in the bathyal North Atlantic, and *Asteronyx loveni*, *Ophiacantha vivipara* and *Ophiocten amitinum* which are cosmopolitan ophiuroids.

The distribution was further analysed to test groupings between the subantarctic islands. The numbers of species shared with the Falklands, Kerguelen or both, and those endemic to Marion Island are shown in Fig 4. The species list for Crozet was small and probably incomplete and the single species from each class which occurred at Marion and Crozet Islands only were ignored. Cosmopolitan species (Fig 3) were also excluded from this analysis. The results show that a higher proportion of asteroids were shared only with the Falklands (10) than only with Kerguelen (6) but the ophiuroids and holothuroids had a greater affinity with Kerguelen (6 and 4 species respectively) than the Falklands (2 and 0 species respectively). Clark (1962) made the zoogeographic observation with respect to asteroids that 'the bottom fauna of Marion Island may prove to be more closely related to that of the similarly subantarctic Falkland-Magellan area than to the fauna of Kerguelen, which though much closer to Marion Island, is separated from it by the Antarctic Convergence'. The present results support this MPE /Falkland link for the asteroids. The distribution of the ophiuroids and holothuroids, however, support the grouping proposed by Knox and Lowry (1977) that MPE, Kerguelen and Crozet form the Kerguelen Province - which is only loosely linked to other subantarctic islands, as has also been demonstrated for the Crustacea. (ML Branch *et al* 1991b). At Marion there was also a higher proportion of endemism in the Ophiuroidea (3 species) and Holothuroidea (3 species) than in the Asteroidea (1 species). About 50% of the Antarctic and subantarctic ophiuroids are brooding, which may explain the high degree of endemism (14%) at MPE, although the mode of reproduction is not known for many of the species.

The asteroids from the deep rocky stations to the south-west of Prince Edward Island and south-east of Marion Island showed a greater affinity with the Falklands, while those occurring in sheltered, sandy areas between, and to the lee of the islands had a greater affinity with Kerguelen (Fig 1). The results from Tables 1 and 2 are summarised graphically in Fig 5 to show these differences in habitat and distribution: the asteroids were considered with respect to substrate and depth, which were closely related to exposure and their community groups discussed above. Seven of the ten MPE/ Falkland species occur in the deep rocky stations south-west of Prince Edward Island and south-east of Marion (r); (*Pseudarchaster discus, Odontaster penicillatus, Hippasteria hyadesi, Henricia studeri, Henricia obesa, Ceremaster patagonicus, Anteliaster australis*), two occurred in both rocky and sandy localities (r+s) (*Hippasteria falklandica* and *Henricia simplex*), and only one, (*Peribolaster folliculatus*) occurred on sand (s). In sharp contrast only one of the seven MPE/ Kerguelen species (*Tremaster mirabilis*) occurred in the deep rocky stations. The other six species occurred at least partly in sandy sheltered areas: three occurred in the sheltered sandy stations between Marion and Prince Edward Islands (s)(*Diplopteraster semireticulatus, Odontaster meridionalis* and *Smilasterias triremis*) and three occurred in both sand and intertidal or rocky sites (s+i, s+r, or s+r+i) (*Henricia praetans, Labidiaster annulatus* and *Pedicellaster hypernotius*). Of the six

Figure 3
Geographical distribution of MPE Echinoderms with respect to temperature and latitude

The Asteroidea (33 species), Ophiuroidea (22 species) and Holothuroidea (10 species) from MPE are separated into four groups: (1) Subantarctic - those that are confined to the subantarctic, (2) Antarctic - species occurring in the Antarctic and subantarctic (3) S. Continents - species occurring in the subantarctic and the southern continents and further north, and (4) Cosmopolitan - species occurring in the subantarctic, Antarctic and at the southern continents or futher north.

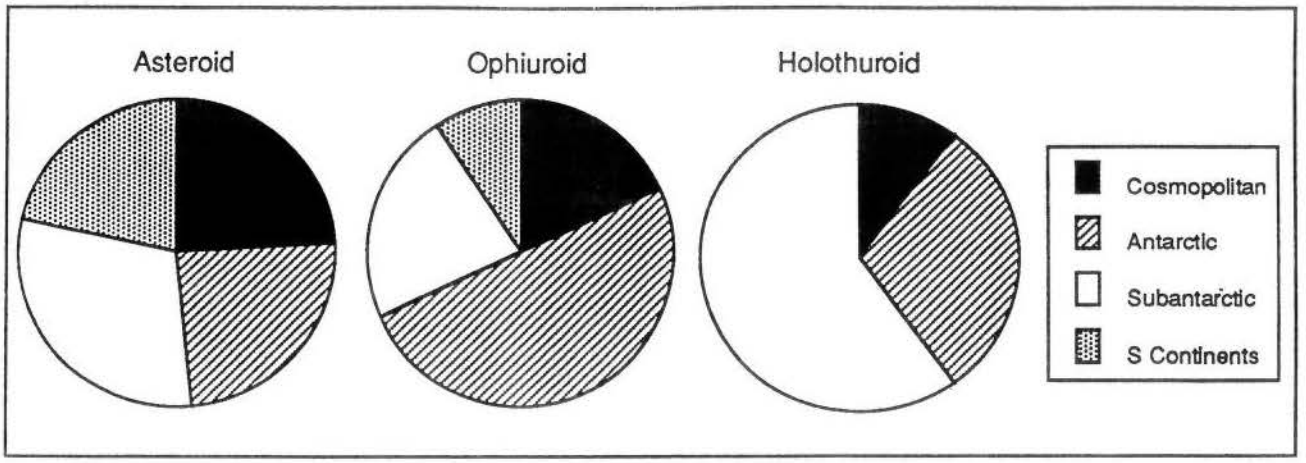
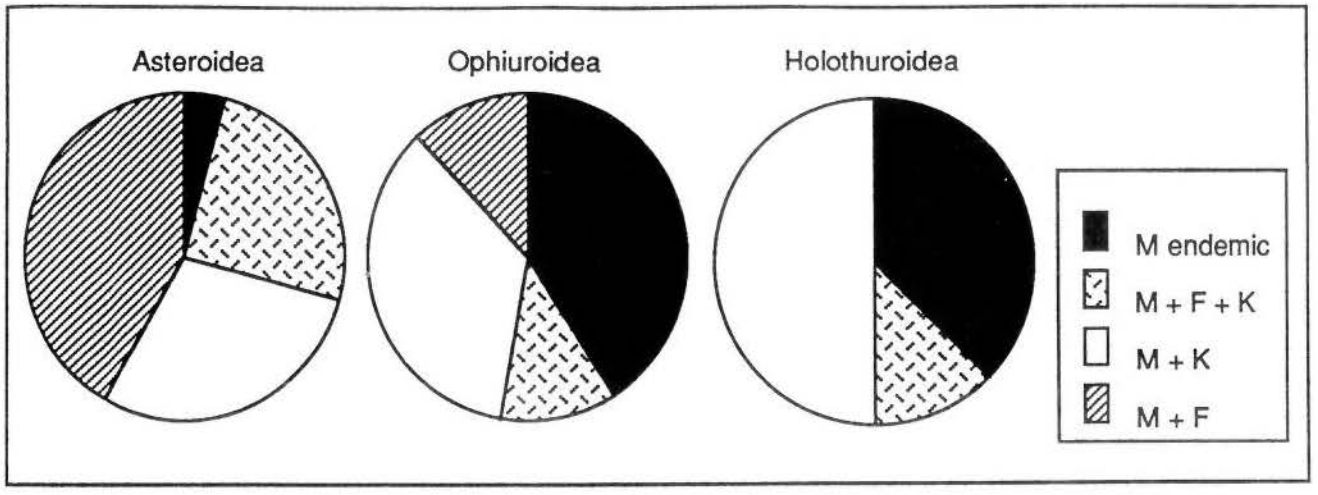


Figure 4
Geographical distribution of MPE Echinoderms between the Subantarctic Islands of Falkland, Marion and Kerguelen

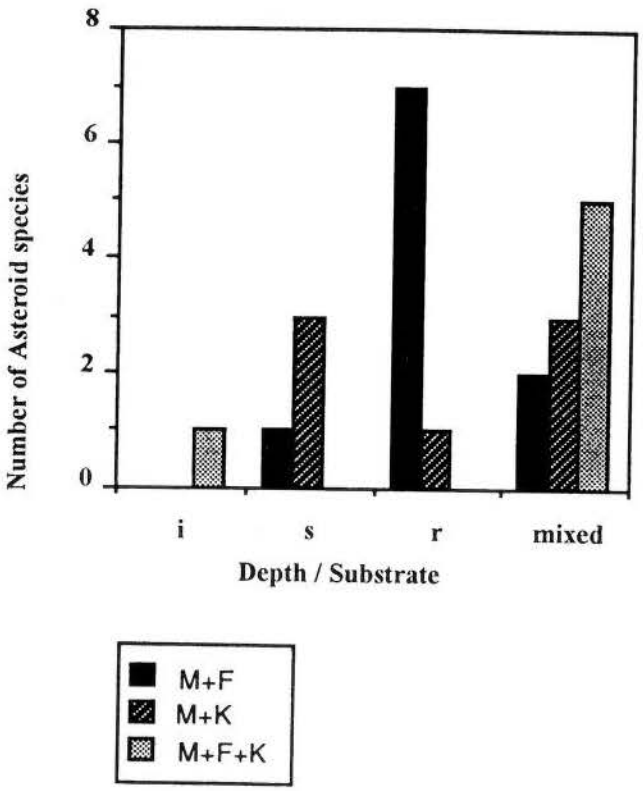
Ignoring the cosmoplitan species, the Asteroidea (24 species), Ophiuroidea (17 species) and Holothuroidea (8 species) are separated into four groups: (1) M + F - species occurring at Marion and Falklands, (2) M + K - species occurring at Marion and Kerguelen, (3) M + F + K - species occurring at Marion, Falklands and Kerguelen and (4) M - species occurring at Marion but not at Kerguelen and Falklands. The majority of these are endemic to Marion.



species occurring at all three island groups (Marion, Falklands & Kerguelen) one (*Anasterias rupicola*) was intertidal, and the other five were wide-spread but predominantly in shallow and sandy areas.

Figure 5
Distribution of Asteroidea from MPE, Falklands and Kerguelen with respect to depth and substratum

The number of Asteroidea species that occurred at Marion and Falklands (M + F), Marion and Kerguelen (M + K) and all three (M + F + K) were compared with respect to substratum and depth, which were closely related to exposure and their community groups 1-7 (see Fig 1). The depth and substratum types considered were: (r) Rocky substrate, >300 m depths, in exposed sites occupied by community group 4, (s) Soft substrate, 50-300 m depths, sheltered sites, community groups 2 + 3 (i) Intertidal to <50 m, community groups 1, 6 & 7 and mixed) those that occurred in more than one locality type.



The ophiuroids that were shared with Kerguelen were also more common in the shallow sandy areas.

Holothuroidea from MPE area share 5 of the ten species with the Antarctic and only two of these with the Falkland Islands, while 6 are shared with Kerguelen and 2 with Crozet. Three species are endemic.

Of the echinoids the rare *Sterechinus agassizi* occurs in both Antarctic and subantarctic sections of the Weddell Quadrant. This is the first record in the Enderby Quadrant. *Pseudechinus marionis* appears to be endemic to the MPE area. It differs from *Notechinus magellanicus*, the closely related species from Kerguelen and Falkland Islands, in the periproct structure, colour and the smaller number of inter-ambulacral plates.

The comatulid crinoid distribution in the Southern Ocean is summarised by Speel and Dearborn (1983), who recorded four species for MPE, but two of these, *Thalassometra bispinosa* and *Thaumatocrincus renovatus*, were collected at abyssal depths of over 2 000 m between Marion and Crozet Islands and are not considered to be MPE fauna. Of the remaining two species, *Eumorphometra hirsuta* is wide-spread in the Weddell and Ross Quadrants of both the Antarctic and subantarctic as well as Chile. *Phrixometra exigua* has been collected only at MPE and in the Ross Sea south of new Zealand.

Knox and Lowry's Fig 10 (1977) summarised the origin and dispersal of the Antarctic marine fauna: "Presumably, when the Antarctic continent became isolated from the adjacent land masses after the breakup of Gondwanaland, a nucleus of species became isolated around the shelf of the region. Many of the 'old' Antarctic species would have their origin by this means". The consensus of opinion is that the Scotia Arc then became the major route of movement of species in and out of the Antarctic. The Macquarie Ridge is a possible route for echinoderms between Macquarie and Bellany Island to the south and New Zealand to the north. The other submarine ridges (including the ridge to Kerguelen and Heard) radiating from Antarctica appear to be of minor significance. In the subantarctic the West Wind Drift is considered to be the most important agent of dispersal, where the source of colonisation appears to be the nearest neighbour to the west. Fell (1962) proposed this mechanism for the dispersal of echinoderms between the southern continents. Species with pelagic larvae, provided the larval stage is long enough, could easily disperse in this way. Adults may be transported on drift algae. Echinoderms, particularly the asteroids, are mobile and they could migrate along the ocean floor provided they can cope with the depth and temperature gradients. Most of the cosmopolitan asteroids from the area were large and tough.

There is a strong case for colonisation of MPE via the West Wind Drift. They are summits of geologically recent volcanoes (250 000 years old, McDougall 1971) and are extremely isolated, with their nearest continental land mass being Africa, 2 300 km to the north-west, and their nearest island neighbour Crozet to the west. MPE is also separated from the Antarctic and the southern continents by the physical barriers of the Antarctic and Subtropical Convergences. There are also no benthic ridges linking them to any other land mass. Colonisa-

along the Scotia Arc and either originated in the Antarctic and moved north, or migrated in from the north. From the Scotia Arc these species could then have been carried to MPE in the West Wind Drift. Twenty-eight of the 32 species of echinoderm shared with the Antarctic occur in the Weddell Quadrant of the subantarctic or Antarctic and could have used this route. There are only three species of ophiuroids and one holothuroid shared between MPE and the Enderby Quadrant of the Antarctic without the known link through the Scotia Arc, (*Amphiura antarctica, Ophiocymbium cavernosum, Ophiacantha imago* and *Psolus paradubiosus*).

In conclusion the asteroids share a higher percentage of species with the Falklands than with Kerguelen while ophiuroids and and holothuroids share a higher percentage with Kerguelen. In all three groups the species common in the deeper community to the west of the MPE tend to occur in the Falklands, while those in the shallow communities between and to the east of MPE are closer to the Kerguelen group. This distribution may be because Falkland has a deeper, rocky, more exposed shelf, while Kerguelen has large, shallow sheltered bays with soft substrata. Or it may be a reflection of the areas actually sampled to date at the various localities, for example much of the work at Kerguelen has been done in shallow sandy areas such as the Bay of Morbihan (Cherbonnier & Guille 1975) and Royal Sound (Smith 1876).

References

AGASSIZ A 1881. Echinoidea. *Rep. Scient. Res. Voy. Challenger* 1873-76, London. 3: 1-321

ARNAUD F & BRANCH ML 1992. The Pycnogonida of subantarctic Marion and Prince Edward Islands; Illustrated keys to the species. *S. Afr. J. Antarct. Res.* 21(1): 65-71

BAKER AN 1980. Euryalinid Ophiuroidea (Echinodermata) from Australia, New Zealand, and the south-west Pacific Ocean. *N. Zeal. J. Zool.* 7: 11-83

BECKLEY L & BRANCH GM 1992. A quantitative SCUBA diving survey of the sublittoral macrobenthos at sub-antarctic Marion Island. *Polar Biol.* 11: 553-563

BERNASCONI I 1968. Equinodermos de las Islas Marion y Principe Eduardo con descripcion de una nueva especie de Ophiuroideo. *Physis.* 28(76): 55-58

BERNASCONI I 1971. Echinodermata. In: *Marion and Prince Edward Islands*, eds EM van Zinderen Bakker, JM Winterbottom & RA Dyer. AA Balkema, Cape Town. pp 284-287

BLANKLEY WO 1984. Ecology of the starfish *Anasterias rupicola* at Marion Island (Southern Ocean). *Mar. Ecol. Prog. Ser.* 18: 131-137

BLANKLEY WO & BRANCH GM 1984. Co-operative prey capture and unusual brooding habits of *Anasterias rupicola* (Verrill) (Asteroidea) at sub-Antarctic Marion Island. *Mar. Ecol. Prog. Ser.* 20: 171-176

BLANKLEY WO & GRINDLEY JR 1985. The intertidal end shallow subtidal food web at Marion Island. In: *Antarctic nutrient cycles and food webs*, eds WR Siegfried, PR Condy & RM Laws, Springer, New York. pp 630-636

BRANCH GM, ATTWOOD GG, GIANAKOURAS D & BRANCH ML 1993. Patterns in the benthic communities on the shelf of the subantarctic Prince Edward Islands. *Polar Biol.* 13: 23-34

BRANCH ML 199X. The Polychaeta of subantarctic Marion and Prince Edward Islands. *S. Afr. J. Antarct. Res.* (in press)

BRANCH ML, ARNAUD PM, CANTERA J & GIANAKOURAS D 1991a. The benthic Mollusca and Brachiopoda of subantarctic Marion and Prince Edward Islands. *S. Afr. J. Antarct. Res.* 21: 45-64

BRANCH ML, GRIFFITHS CL, KENSLEY B & SIEG J 1991b. The benthic Crustacea of subantarctic Marion and Prince Edward Islands. *S. Afr. J. Antarct. Res.* 21: 3-44

BRANCH ML & WILIAMS GC 1993. The Hydrozoa, Octocorallia and Scleractinia of subantarctic Marion and Prince Edward Islands. *S. Afr. J. Antarct. Res.* 23: 3-24

CARPENTER PH 1888. Crinoidea. Part 2 Comatulae. *Rep. Scient. Res. Voy. Challenger* 1873-76, London. 26: 1-399

CARRIOL RP & FéRAL JP 1985. Réexamen de quelques Psolidae (Holothurioides, Echinodermata) antarctiques et subantarctiques. Description de deux nouvelles especes du genre *Psolus. Bull. Mus. natn. Hist. nat., Paris,* 4eme ser. A 7(1): 49-60

CHERBONNIER G & GUILLE A 1974. Echinodermes. Invertébrés de l'infralittoral rocheux dans l'archipel de Kerguelen. Vol 3. *CNFRA* (*National Committee for Antarctic Research*) Paris. 35: 25-44

CHERBONNIER G & GUILLE A 1975. Echinodermes récoltés aux îles Kerguelen. *Bull. Mus. natln. Hist. nat., Paris, Zool.* 210: 603-629

CLARK AM 1962. Asteroidea. *B.A.N.Z. Ant. Res. Exp.* 1929-31. *Rep. Ser.* B9: 1-104

CLARK AM 1970. Notes on the family Amphiuridae (Ophiuroidea). *Bull. Br. Mus. nat. Hist. (Zool.)* 19: 1-81

CLARK AM & COURTMAN-STOCK J 1976. *The Echinoderms of Southern Africa.* Trustees British Museum (Natural History) London. pp 1-277

CLARK AM & ROWE FWE 1971. *Monograph of shallow-water Indo-west Pacific echinoderms.* Trustees British Museum (Natural History), London. pp 1-238

CLARK HES 1963. The fauna of the Ross Sea 3. Asteroidea. *Bull. NZ. Dept. scient. ind. Res.* 151: 1-84

DE VILLIERS AF 1976. Littoral ecology of Marion and Prince Edward Islands (Southern Ocean). *S. Afr. J. Antarct. Res. Suppl.* 1: 1-40

EKMAN S 1927. Holothurien der Deutschen Südpolar-Expedition 1901-1903 aus der Ostantarktis und von den Kerguelen. *Deutsche Südpolar Exped.* 1901-1903, 19, *Zool.* 11: 359-419

FELL HB 1961. The fauna of the Ross sea. Part I. Ophiuroidea. *Mem. N. Zeal. oceanog. Inst.* 18: 9-79

FELL HB 1962. West-wind-drift dispersal of echinoderms in the Southern Hemisphere. *Nature* 193: 759-761

FULLER NR 1967. A preliminary report on the littoral ecology of Marion and Prince Edward Islands. *S. Afr. J. Sci.* 63: 248-252

FISHER WK 1940. Asteroidea. *Discovery Rep.* 20: 69-306, t. 1-16

GUILLE A 1982. A new genus and species of ophiacanthid

brittle-star (Echinodermata, Ophiuroidea) from the Kerguelen Islands, Indian Ocean with new taxonomic, biogeographic and quantitative data on the echinoderm fauna. *Austral. Mus. Memoir* 16: 67-87
GUTT J 1991. On the distribution and ecology of holothurians in the Weddell Sea (Antarctica). *Polar Biol.* 11: 145-155
HERTZ M 1927. Die Ophiuriden der Deutschen Südpolar-Expedition, 1901-1903, *Deut. Südpolar. Exp.* 1901-1903 19, *Zool.* 11: 1-56
JANGOUX M 1982. On *Tremaster* Verrill, 1879, an odd genus of recent starfish (Echinodermata: Asteroidea). In: *Echinoderms: Proceedings of the International Conference, Tampa Bay*, ed JM Lawrence. Balkema, Rotterdam. pp 155-163
JANGOUX M 1986. Astérides. In: *Guide des Etioles de Mer, Oursins et autres Echinodermes du Lagon de Nouvelle-Calédonie*, eds A Guille, P Laboute & JL Menou. ORSTROM, Paris. pp 110-153
JANGOUX M & LAMBERT A 1988. Comparative anatomy and classification of asteroid pedicellariae. In: *Proc. 6th intern. Echinoderm Conference, Victoria*, eds RD Burke, PV Mladenov, P Lambert & RL Parsley. Balkema, Rotterdam. pp 719-723
KNOX GA 1960. Littoral ecology and biogeography of the southern Oceans. *Proc. Roy. Soc. London*, B 152: 577-624
KNOX GA & LOWRY JK 1977. A comparison between the benthos of the Southern Ocean and the North Polar Ocean with special reference to the Amphipoda and Polychaeta. In: *Polar Ocean*, ed MJ Dunbar. Proc. Polar Oceans Conference, Montreal, May 1974. Arctic Institute of North America. pp 423-462
KOEHLER R 1901. Note préliminaire sur quelques ophiures nouvelles provenant des campagnes de la *Princesse Alice*. *Bull. Soc. Zool. France* 26: 222-231
KOEHLER R 1911. Asteries, Ophiures et Echinides. *Sci. Rep. Brit. Ant. Exp.* (1907-9). 2, Biol., 4: 25-66
KOEHLER R 1917. Echinodermes (Astéries, Ophiures et Echinides) recueillis par M Rallier du Baty aux Iles de Kerguelen en 1913-14 *Ann. Inst. Ocean. Monaco*, 7(8): 1-87
KOEHLER R 1920. Echinodermata Asteroidea. *Sci. Rep. Aust. Antarctic. Exp.* Sér. C, 8(1): 1-308
LYMAN T 1879. Ophiuroidae & Astrophytidae of the *Challenger* Expedition. Part 2. *Bull. Mus. comp. Zool. Harv.* 6(2): 17-83
LYMAN T 1882. Report on Ophiuroidea. *Rep. Scient. Res. Voy. Challenger 1873-76, Zool.* 5: 1-386
MCDOUGAL I 1971. Geochronology. In: *Marion and Prince Edward Islands*, eds EM van Zinderen Bakker, JM Winterbottom & RA Dyer. AA Balkema, Cape Town. pp 72-77
MASSIN C 1992. Holothurians (Echinodermata) from Marion and Prince Edward Islands: new and rare species. *Zool. Scr.* 21: 311-324
MORTENSEN T 1936. Echinoidea and Ophiuroidea. *Discovery Rep.* 12: 199-348
PATERSON GJL 1985. The deep-sea Ophiuroidea of the North Atlantic Ocean. *Bull. Br. Mus. (nat. Hist.) Zool.* 49(1): 1-162
PATERSON GJL, TYLER PA & GAGE JD 1982. The taxonomy and zoogeography of the genus *Ophiocten* (Echinodermata: Ophiuroidea) in the North Atlantic *Ocean. Bull. Br. Mus. (nat. Hist.) Zool.* 43(3): 109-128
PAWSON DL 1964. The Holothuroidea collected by the Royal Society Expedition of Southern Chile, 1958-1959. *Pacif. Sci.* 18(4): 453-470
PAWSON DL 1971. Holothuroidea. In: *Marion and Prince Edward Islands*, eds EM van Zinderen Bakker, JM Winterbottom & RA Dyer. Balkema, Cape Town. pp 288-290
PERRIER E 1875. Révision de la collection de Stellérides du Muséum d'Histoire Naturelle de Paris. *Arch. Zool. Exp. gén.* 4: 263-449
PERRIER E 1891. Echinodermes. I. Stellérides. *Missionn. Scient. Cap. Horn 1882-83*, Paris, 6, *Zool.* 3: K, 3-K: 1-198
ROWE FWE & CLARK AM 1975. Notes on some echinoderms from Marion Island. *Bull. Br. Mus. nat. Hist. (Zool.)* 28(5): 187-190
SLADEN WP 1889. Asteroidea, *Rep. Scient. Res. Voy. Challenger* 1873-76, London. 30: 1-935
SMITH EA 1876. Descriptions of species of Asteriidae and Ophiuridae from Kerguelen's Island. *Ann. Mag. nat. Hist. (ser. 4)* 17, 98: 105-113
SMITH EA 1879. Echinodermata of Kerguelen Island. *Phil. Trans. roy. Soc. London.* 168: 270-281
SPEEL JA & DEARBORN JH 1983. Comatulid crinoids from R/V *Eltanin* Cruises in the Southern Ocean. *Biology of the Antarctic Seas XIII Antarctic Res Series* 38: 1-60
STAMPANATO S & JANGOUX M 199X. A new Species of asteroid (*Solaster dianae*) and taxonomic notes on the asteroid fauna (Echinodermata) of subantarctic Marion and Prince Edward Islands. *Ann. S. Afr. Mus.* (in press)
THéEL H 1886. Report on the Holothurioidea. Part 2. *Rep. Scient. Res. Voy. Challenger 1873-76, Zoology*, London. 14(39): 1-290
VANEY C 1908. Les holothuries recuellies par l'Expédition Antarctique écossaise. *Zool. Anz.* 33(10): 290-299
VERRILL AE 1876. Contributions to the natural history of Kerguelen Island. Echinodermata. *Bull. U.S. nat. Mus.* 3: 68-75