The biogeographic relationships of the brachiopod fauna from Marion and Prince Edward Islands

Norton Hiller
Department of Geology, Rhodes University, Grahamstown 6140, South Africa
Present address: Department of Geology, University of Canterbury, Private Bag 4800, Christchurch, New Zealand

The small brachiopod fauna from Marion and Prince Edward Islands comprises at least six species belonging to five genera. Biogeographically this fauna shows closest affinity with that from the other islands in the southern Indian Ocean, but a surprising connection to the southern African region is evident. The components of the fauna are thought to have migrated into the region during the late Pleistocene by way of major ocean current systems.

Introduction

The waters around the subantarctic Marion and Prince Edward Islands are home to a small but significant brachiopod fauna that has been sampled during a number of surveys of the macrobenthos. The earliest account of the brachiopods was given by Davidson (1880) who described the specimens collected by the British *Challenger* expedition. More recent surveys from the French ship *Marion Dufresne* (Cooper 1981) and by the University of Cape Town (Branch *et al* 1991) have also provided data on the brachiopod fauna (Fig 1).

In this paper a total of six species belonging to five genera are confirmed from the vicinity of the islands. As none of the species is new, only brief systematic descriptions are deemed necessary but each is illustrated and the biogeographic affinities of the fauna are discussed.

The fauna

Cooper (1981) described *Xenobrochus anomalus* and *Platidia marionensis* as new species, and *Aerothyris kerguelenensis* (Davidson 1880) from Marion and Prince Edward Islands. Branch *et al* (1991) listed *Liothyrella* sp., *Platidia anomioides* (Scacchi and Philippi 1844) and *Magellania kerguelenensis* from the same area. A recent re-examination by the author of the material collected by the University of Cape Town survey showed that shells identified as *Liothyrella* sp. included specimens of *Xenobrochus anomalus* Cooper, *X. africanus* (Cooper) and *Dyscolia* (?) sp. as well as *Liothyrella*. In addition, *Platidia anomioides* and *Aerothyris kerguelenensis* are confirmed in the fauna.
The following species are recognised within the fauna:

Family Dyscoliidae
- *Dyscolia* (?) sp.
- *Xenobrochus africanus* (Cooper, 1973)
- *Xenobrochus anomalus* (Cooper, 1981)

Family Terebratulidae
- *Liothyrella* cf. *L. moseleyi* (Davidson, 1878)

Family Platidiidae
- *Platidia amonioides* Scacchi & Philippi, 1844

Family Terebratellidae
- *Aerothyris kerguelenensis* (Davidson, 1878)

Systematic description

In the brief descriptions given below, the morphological terms employed are used as they are defined by Williams and Rowell (1965).

Order TEREBRATULIDA Waagen, 1883
Superfamily TEREBRATULOIDEA Gray, 1840
Family DYSCOLIIDAE Fischer & Oehlert, 1891
Genus *Dyscolia* Fischer & Oehlert, 1890
Dyscolia (?) sp.
Fig 3.1 - 3.2

Material: three empty pedicle valves from University of Cape Town station MAD 57.
Description: large subcircular convex valves almost as long as wide; lateral and anterior margins rounded with incurved flange. Anterior commissure gently and broadly uniplicate. Beak short, strongly labiate; foramen rounded, mesothyrid to permesothyrid. Deltidial plates fused to form large concave symphytium. Shell surface smooth except for fine growth lines. Interior of valve with short excavate pedicle collar and small teeth. Large rectangular muscle scar strongly impressed on valve floor.

Dimensions:	length	width
SAM-A37672	39,5 mm	39,1 mm
	49,5	44,3
	—	31,3

Discussion: without accompanying brachial valves with preserved loops it is difficult to be unequivocal about the identification of the specimens described here. They possess the inturned flange around the lateral and anterior margins of the valve which is typical of *Dyscolia* but this feature may occur in large individuals of other terebratulacean genera. In general appearance they are virtually identical to *Dyscolia*(?) *radiata* but they lack

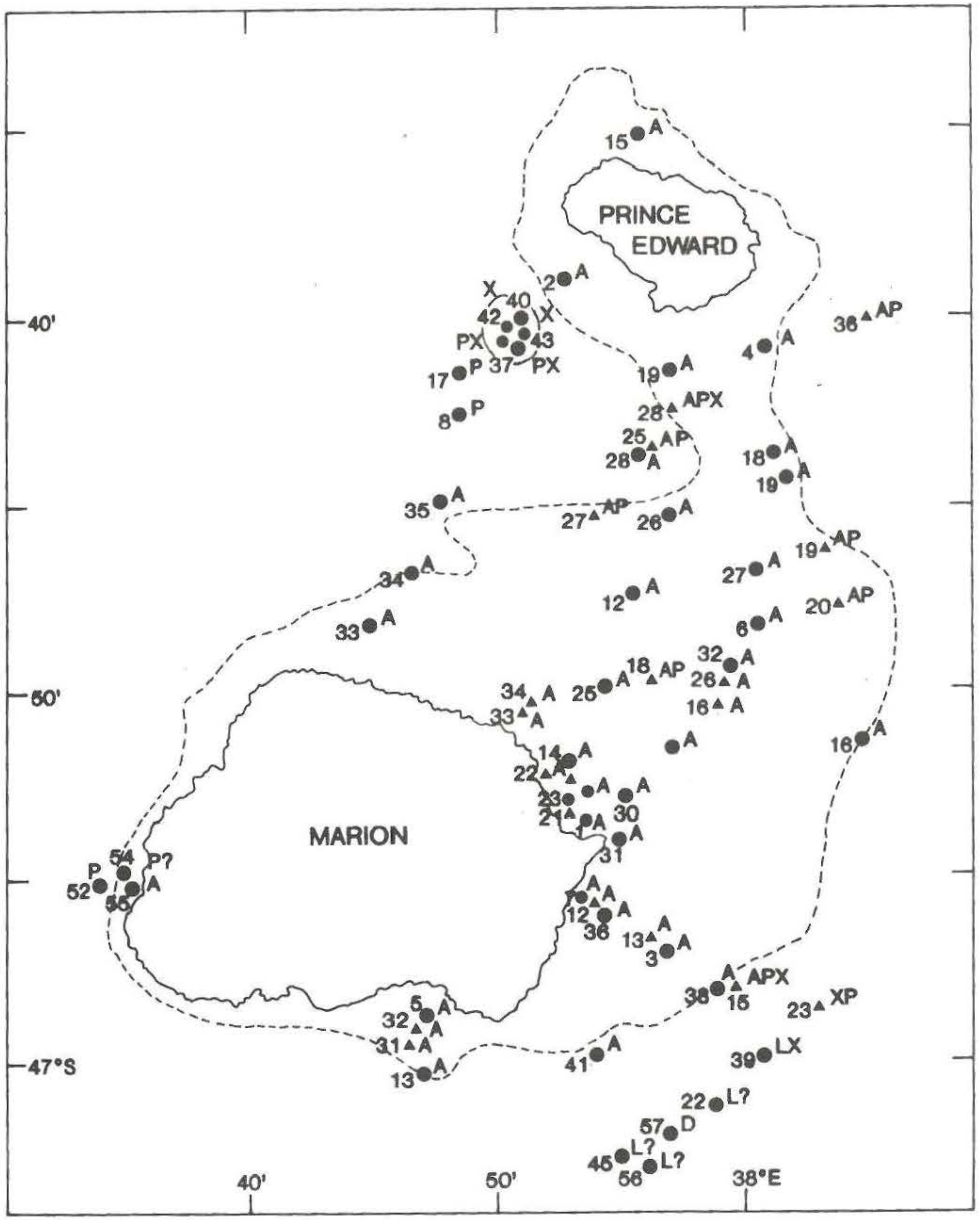


Fig 1. Map of Prince Edward Islands showing positions of sampling stations from which brachiopods were recovered. Black dots represent University of Cape Town survey stations from Branch et al *(1991). Black triangles represent* Marion Dufresne *MD.08 stations from Cooper (1981). Dashed line represents the 200 m bathymetric contour. Letters represent the various brachiopod genera; A =* Aerothyris, *D =* Dyscolia, *L =* Liothyrella, *P =* Platidia, *X =* Xenobrochus. *? denotes an unconfirmed report*

the fine radial ornament of that species and they are somewhat larger than the specimens described by Cooper (1981).

Subfamily AENIGMATHYRIDINAE Cooper, 1983
Genus *Xenobrochus* Cooper, 1981
Xenobrochus africanus (Cooper, 1973)
Fig 3.3

Gryphus africanus Cooper, 1973: 8, pl 4 (Figs 31-38).
Xenobrochus africanus (Cooper) Cooper, 1981: 20, pl 4 (Figs 30-35).

Material: 29 complete shells and several disarticulated valves from four University of Cape Town stations, MAD 39, 40, 43 and 44.

Description: small (maximum length 7,2 mm), biconvex, elongately oval shells about three-quarters as wide as long and about one-half as deep as long (Fig 2). Anterior commissure straight; beak small, suberect; foramen small, mesothyrid; deltidial plates usually conjunct although some specimens are found with disjunct deltidial plates. Shell surface smooth except for faint lines of growth. Interior of valves as described by Cooper (1973) and Hiller (1986).

Dimensions:	length	width	thickness
SAM-A37671	5,5 mm	4,3 mm	3,0 mm
SAM-A37674	6,5	4,5	3,2
	7,2	5,2	4,2
	4,8	3,8	2,2
	5,7	3,9	3,0
SAM-A37679	5,2	3,7	2,4
	6,4	4,9	3,4
	5,9	4,7	2,9
SAM-A37680	5,5	4,3	3,3

Discussion: these little shells are virtually identical in all respects to the specimens described from off the Natal and Eastern Cape coasts of South Africa and must be regarded as being conspecific.

Xenobrochus anomalus Cooper, 1981
Fig 3.4 - 3.6

Xenobrochus anomalus Cooper, 1981: 20, pl 4 (Figs 11-20).

Material: Eight complete shells and a few disarticulated valves from three of the four University of Cape Town stations that yielded *X. africanus*, MAD 39, 40 and 43.

Description: small (maximum length 7,1 mm), strongly biconvex shells with narrow elongately oval outline; width about two thirds of length and thickness slightly more than one half of length (Fig 2). Anterior commissure straight; beak moderately long and narrow, suberect to erect; foramen relatively large, mesothyrid. Deltidial plates conjunct or disjunct, each in about one-half of the specimens. Shell surface smooth apart from faint growth lines. Puncta density about 350/mm².

Pedicle valve interior with well-developed, excavate pedicle collar. Teeth large, narrow, elongate. Muscle scars lightly impressed on valve floor, details obscure.

Brachial valve interior with broad transverse cardinal process that may extend on to proximal ends of socket ridges and cover posterior part of sockets. Socket ridges tall, erect, slender, almost parallel to one another; sockets narrow; fulcral plates quite thick. Narrow outer hinge plates attached to dorsal edge of socket ridges; thin crural

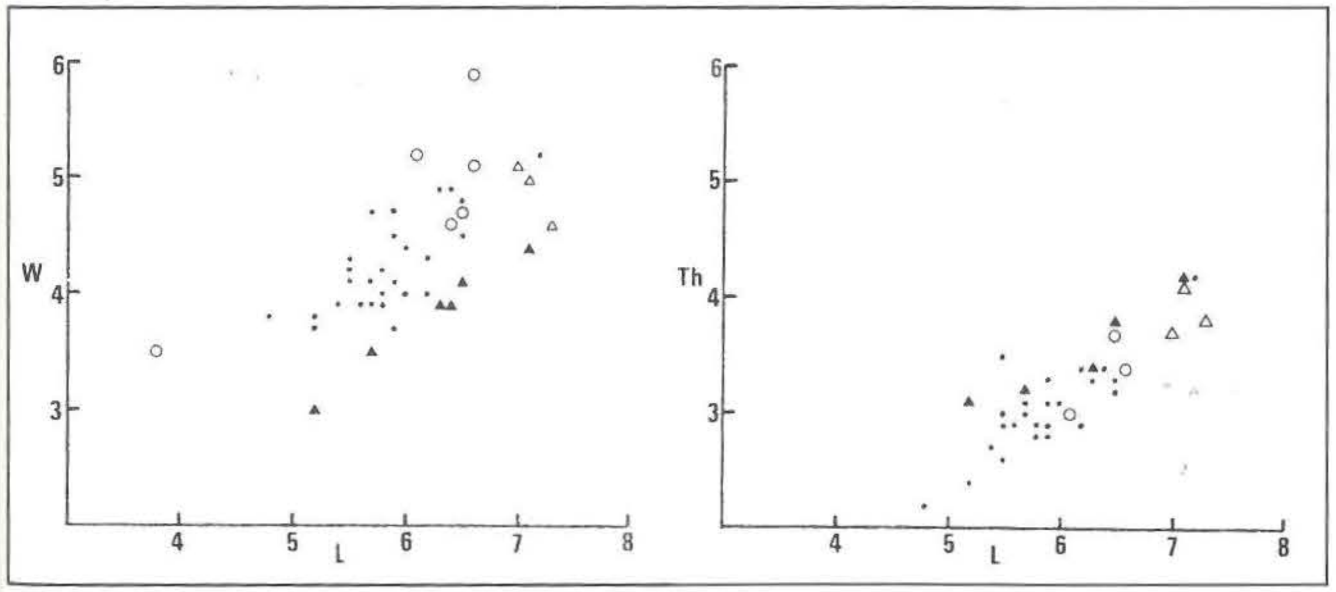


Fig 2. Scattergrams of length vs width and length vs thickness of conjoined valves of Xenobrochus anomalus *and* X. africanus. *Black triangles represent* X. anomalus *specimens recovered during the University of Cape Town survey; open triangles are* X. anomalus *specimens measured by Cooper (1981). Black dots represent* X. africanus *specimens recovered from the Prince Edward Islands during the University of Cape Town survey; open circles are* X. africanus *specimens from South African waters measured by Cooper (1973) and Hiller (1986). Measurements are in mm*

bases barely distinguishable along inner edges of outer hinge plates. Crural processes low, blunt points situated at anterior limit of outer hinge plates. Descending lamellae short; transverse band relatively broad, anteriorly directed, with gentle ventrally-directed median arch.

Dimensions:	length	width	thickness
SAM-A37671	6,3 mm	3,9 mm	3,4 mm
SAM-A37674	6,5	4,1	3,8
	5,2	3,0	3,1
	5,7	3,5	3,3
SAM-A37679	7,1	4,4	4,2

Discussion: these little specimens agree with the description given for *X.anomalus* by Cooper (1981) and are accordingly placed in that species. However, the complete loop has now been described and illustrated for the first time and the assignment to *Xenobrochus* confirmed. Although the specimens are of similar dimensions to those of *X. africanus* they differ in being generally narrower and thicker (Fig 2).

Family TEREBRATULIDAE Gray, 1840
Subfamily TEREBRATULINAE Gray, 1840
Genus *Liothyrella* Thomson, 1916
Liothyrella cf. *L. moseleyi* (Davidson, 1878)
Fig 3.7 - 3.9

Terebratula moseleyi Davidson, 1878: 436.
Liothyris moseleyi (Davidson) Davidson, 1886: 11, pl 2 (Figs 1-4).
Liothyrina moseleyi (Davidson) Blochmann, 1908: 618.
Liothyrella moseleyi (Davidson) Hertlein and Grant, 1944: 97, pl 7 (Figs 3-7, 12). Foster, 1974: 69, pl 4 (Figs 23-25).

Material: one complete specimen, one broken pedicle valve and one broken brachial valve all from the same University of Cape Town station, MAD 39.

Description: medium-sized, subcircular to roundly triangular, biconvex shells; pedicle valve deeper than brachial valve; sides and anterior margin rounded. Anterior commissure straight. Beak short, suberect, labiate; foramen relatively small, mesothyrid. Deltidial plates conjunct. Shell surface ornamented with growth lines and faint radial capillae.

Pedicle valve interior with short, excavate pedicle collar; small sturdy teeth; rectangular muscle scar lightly impressed on valve floor.

Brachial valve interior with prominent transversely elongate cardinal process; broad shallow sockets bounded by erect socket ridges; narrow triangular loop about one third as long as valve with broad transverse band; crural processes not well defined. Outer hinge plates quite broad.

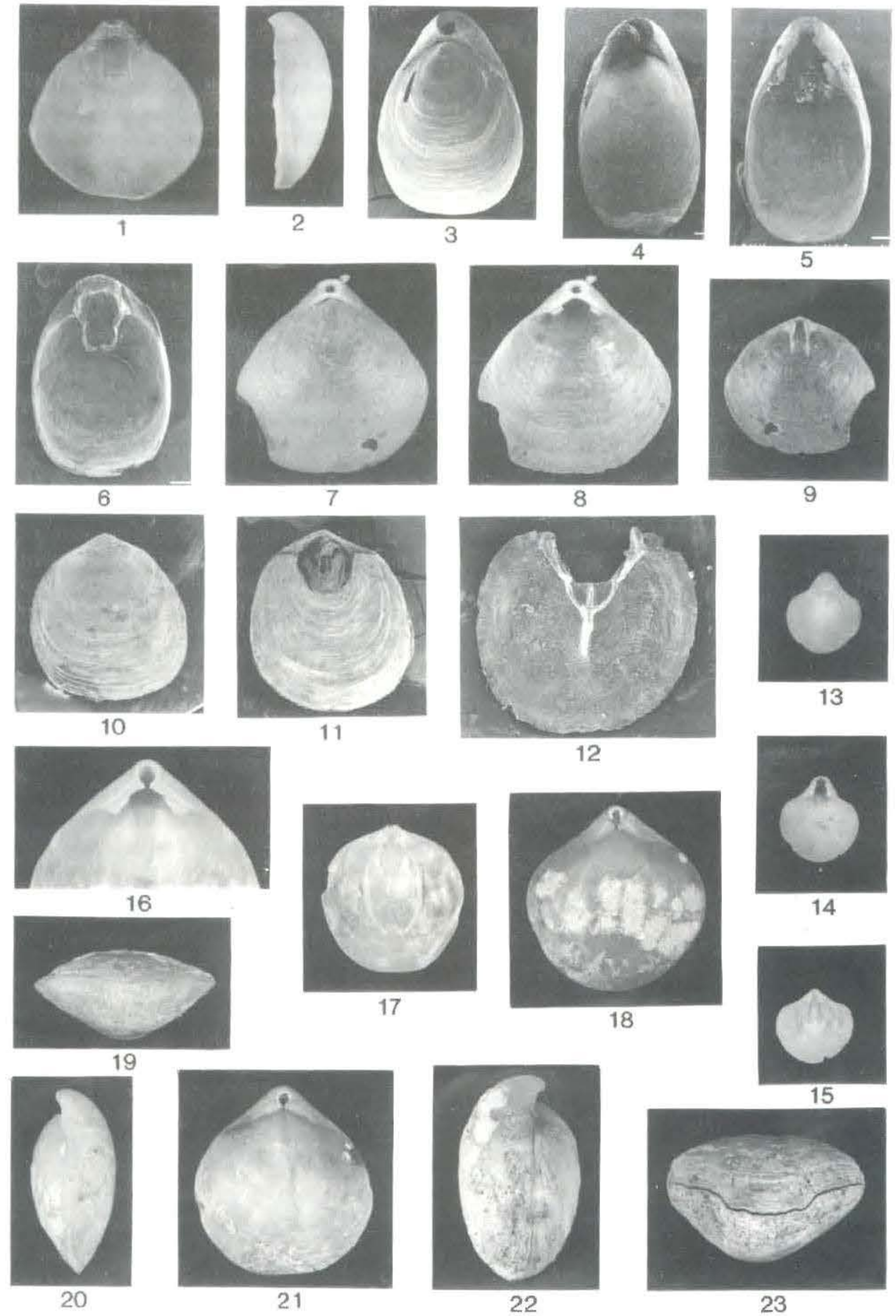
Discussion: in size and shape these specimens closely resemble *L. moseleyi* as described and figured by Foster (1974) and Cooper (1981). Although none of the brachial valves possesses a complete loop, it is clear that it is also very similar to that of *L. moseleyi* especially in having a broad transverse band, a distinguishing characteristic of the species. However, these Marion Island specimens show a faint radial ornament, a feature known from some species of *Liothyrella* but not reported in *L. moseleyi*. Foster (1974) pointed out that the known specimens of this species are few in number so the full range of intraspecific variation is unlikely to have been assessed.

Superfamily TEREBRATELLOIDEA King, 1850
Family PLATIDIIDAE Thomson, 1927
Genus *Platidia* Costa, 1852
Platidia anomioides Scacchi & Philippi, 1844
Fig 3.10 - 3.12

Orthis anomioides Scacchi and Philippi, 1844: 69, pl 18, Fig 9.
Platidia anomioides (Scacchi & Philippi) Costa, 1852: 48, pl 3, Figs 4, 6.
Platidia anomioides (Scacchi & Philippi) Foster, 1974: 85, pl 7, Figs 17-19.
Platidia marionensis Cooper, 1981: 24, pl 2, Figs. 37-39, pl 5, Figs 15-34.

Discussion: Cooper (1981) separated *P. marionensis* from *P. anomioides* on the basis of its smaller size, more circular outline, and different lophophore. However, Foster (1989) pointed out that the morphology of Cooper's specimens of *P. marionensis* fell within the range of variation displayed by a sample of *P. anomioides* from a single population, and he regarded Cooper's species as a junior synonym of *P. anomioides*. Puncta densities of about 300/mm^2 in specimens collected during the University of Cape Town survey agree well with the figures of Cooper (1981) for *P. marionensis* but, as indicated

Fig 3 1-2. Dyscolia *sp., internal and lateral views of a pedicle valve, SAM-A37672, both X 0.9; 3.* Xenobrochus africanus, *dorsal view of conjoined valves, SAM-A37679, X 7.0; 4-6* X. anomalus, *dorsal view of conjoined valves, and internal views of pedicle and brachial valves, SAM-A37671, all X 7.0; 7-9.* Liothyrella *cf.* L. moseleyi, *dorsal view of conjoined valves, SAM-A37674, X 1.9, and internal views of pedicle and brachial valves, X 1.9 and X 1.2; 10-12.* Platidia anomioides, *external view of pedicle valve, X 9.0, dorsal view of conjoined valves, SAM-A37677, X 9.0, and internal view of brachial valve, X 12.0; 13-23.* Aerothyris kerguelenensis, *13-15 ventral and dorsal views of conjoined valves, and internal view of brachial valve, SAM-A37665, all X 2.1; 16-17 internal views of pedicle and brachial valves of same individual, SAM-A37665, X 2.0 and X 1.1; 18-20 dorsal, anterior, and lateral views of conjoined valves, SAM-A37666, all X 1.3; 21-23 dorsal, lateral, and anterior views of conjoined valves, SAM-A37667, X 0.8, X 0.9, and X 0.9. Numbers 3-6 and 10-12 are SEM photographs.*



by Foster (1989), this figure seems to vary with geographic location in populations of *P. anomioides* and should not be used to distinguish between species.

Family TEREBRATELLIDAE King, 1850
Subfamily TEREBRATELLINAE King, 1850
Genus *Aerothyris* Allan, 1939
Aerothyris kerguelenensis (Davidson, 1878)
Figs 3.13 - 3.23

Waldheimia kerguelenensis Davidson, 1878: 431; 1880: 40, pl 3, Figs 1-9; 1886: 53, pl 10, Figs 7-17.
Terebratella dorsata Davidson, 1880: 44, pl 4, Fig 4.
Magellania kerguelenensis (Davidson) Jackson, 1918: 179.
Magellania kerguelenensis (Davidson) Foster, 1974: 137, pl 20, Figs 2-4; pl 24, Figs 5-7.
Aerothyris kerguelenensis (Davidson) Cooper, 1981: 33, pl 4, Figs 1-3, 7-9; pl 8, Figs 1-10; pls 9-11; pl 12, Figs 5-27; pl 13, Figs 16-23.

Discussion: in this account of the Marion Island brachiopods the author has chosen to follow Cooper (1981) in using the generic name *Aerothyris* rather than *Magellania* as employed by Foster (1974). Cooper (1981) pointed out that species such as *A. kerguelenensis* which retain a smooth shell surface into the adult stages of development, do not conform to the definition of *Magellania* based on the type species, *M. flavescens* (Lamarck, 1819). Typical *Magellania* is smooth-shelled in the early growth stages but strong costae are developed round the margins of mature shells. When Allan (1939) erected the genus *Aerothyris* he regarded its smooth shell as an important characteristic.

Discussion

A. kerguelenensis is the most common of the brachiopods and is the species that extends over the greatest depth range, from waters less than 50 m deep to those in excess of 500 m. It is particularly common in the shallow area between the two islands (Fig 1). It seems capable of living on a variety of substrate types having been recovered from rocks as well as soft sediment, ranging from mud to coarse sand and gravel; the coarser-grained substrate seems to be its preference. Like most brachiopods with a functional pedicle, individuals probably began life by attaching to a hard substrate such as a sand grain or shell fragment. However, once it outgrew this initial anchor, the thickened posterior part of the shell allowed an animal to continue living even on relatively fine-grained sediment.

Platidia anomioides is also quite common but is distributed over a narrower depth range, being found in waters more than 100 m deep. This tiny species prefers a course sand to gravel or rocky substrate but some specimens have been recovered from mud or sandy mud substrates. In these cases the very small individuals are usually attached to shell fragments or other large clasts scattered in the finer sediment.

Both species of *Xenobrochus* are fairly uncommon and show a preference for water more than 200 m deep to the west and south-east of the islands (Fig 1). Although individuals are small, they are known only from coarse-grained or rocky substrates. Many specimens were recovered attached to volcanic clasts of similar dimensions to the shells themselves.

Liothyrella sp. is quite rare, occurring in deep water south-east of Marion Island (Fig 1). Only one specimen was recovered alive, from a depth of between 360 m and 380 m; two dead shells were dredged from the same locality. The live specimen was attached to a pebble, suggesting a preference for coarse-grained or rocky substrates.

Dyscolia (?) sp. is also rare, with only three dead shells having been recovered from a single station south-east of Marion Island (Fig 1) at a depth of 680 m to 715 m. The substrate preference for these shells is unknown.

Davidson (1880) recorded *Terebratulina caput-serpentis* var. *septentrionalis* as being abundant off the Cape of Good Hope and noted its occurrence in association with *Platidia anomioides* and *Waldheimia kerguelenensis* off Marion Island. In a later monograph (Davidson 1886), he appeared to cast some doubt on the authenticity of the Cape locality, but gave the Marion Island longitude and latitude in error for the Cape. Jackson (1952) placed Davidson's *Terebratulina* in synonymy with his new species *T. meridionalis* from off the South African west coast but stated that the species recorded by Davidson from Marion Island required further investigation. However, Cooper (1973 p 3) listed *T. meridionalis* Jackson as occurring off Marion Island, and Foster (1974 p 34) indicated the species as occurring in the same region. Obviously, there is some doubt as to whether a species of *Terebratulina* occurs in the vicinity of Marion Island or not. Certainly, neither Cooper (1981) nor Branch *et al* (1991) recorded the genus.

Biogeographic affinities

Of the brachiopod species confirmed from the Marion Island group, all but one are known from other parts of the southern Indian Ocean, especially the other subantarctic islands. *Xenobrochus anomalus* has only been recorded from Marion and Prince Edward Islands but a closely similar species, *X. naudei* Hiller (1994), is known from the South African east coast. Another species, *X. australis* Cooper (1981), occurs at Heard Island.

The presence of *X. africanus* at Marion Island is a little surprising. It is a form best known from the South African east coast (Hiller 1991) and these new occurrences extend its geographic range considerably to the south.

Aerothyris kerguelenensis is a common brachiopod at other subantarctic Indian Ocean islands, *viz* the Crozet Island group, and Kerguelen and Heard Islands. The closely related *A. macquariensis* (Thomson 1918) is found at subantarctic localities in the New Zealand region (Foster 1989), and Cooper (1981 p 56) regarded the specimens from one station on the north-eastern side of Marion Island as being more akin to this species than to *A. kerguelenensis*.

Platidia anomioides enjoys an almost cosmopolitan distribution (Foster 1989). It is well known from localities in the South Pacific and off the subantarctic islands of the southern Indian Ocean. It also occurs off the south coast of South Africa.

Liothyrella is a widespread genus in the Southern Hemisphere, especially in Antarctic and subantarctic waters where it is represented by a number of species and subspecies (Foster 1974; 1989). The specimens recovered during the University of Cape Town surveys appear closest to *L. moseleyi* (Davidson 1878) which occurs in the Crozet Islands.

Dyscolia is another widespread genus, occurring in the Atlantic, Indian, and South Pacific Oceans, but it is poorly known in Antarctic waters. The specimens in the University of Cape Town survey collections are very similar to *Dyscolia* (?) *radiata* Cooper 1981, which is known from the Crozet Islands and a locality on Walters Bank, south of Madagascar.

Not surprisingly, therefore, the brachiopod fauna from Marion and Prince Edward Islands bears closest resemblance to that of the other subantarctic islands in the southern Indian Ocean, i e the Crozet Islands, and Kerguelen and Heard Islands, where all five of the genera are represented by the same, or closely related, species. There is also a close similarity, at the generic level, with other Antarctic and subantarctic localities.

The presence of *Xenobrochus africanus* in the Marion Island group suggests a link with the South African region, an area where *Platidia anomioides* also occurs. If *Terebratulina meridionalis* can indeed be confirmed from Marion Island, then the link with South Africa will be strengthened.

Given the similarities with the brachiopod faunas from other southern Indian Ocean islands, it is perhaps surprising that the Marion and Prince Edward Islands fauna bears very little similarity to that from Amsterdam and St Paul Islands. Here the fauna is dominated by rhynchonellide and kraussinid brachiopods instead of the terebratulides found elsewhere and *Liothyrella* is the only genus common to both areas.

Origin of the fauna

The volcanic Marion and Prince Edward Islands probably became emergent in the middle to late Pleistocene (c 450 000 y BP), about the time the earliest of the lava sequences was being laid down (Verwoerd and Chevallier 1987). The islands, and the plateau from which they rise, would then have provided settlement areas for brachiopod larvae brought from similar shallow water sites upstream in the Antarctic Circumpolar Current. The most likely source for the brachiopods is the area of the Antarctic Peninsula and the southern tip of South America where genera such as *Aerothyris* and *Liothyrella* are common. From this area the animals may have spread via the relatively shallow regions of the sea bed associated with the Scotia Arc and the South-West Indian Ridge. However, *Xenobrochus* could not have arrived by this route and must have been derived from the Indian Ocean, possibly during the last interglacial when sea surface temperatures may have been a little higher than at present. In such circumstances the Agulhas Current may have penetrated further south than it does today and introduced *Xenobrochus* larvae.

References

ALLAN RS 1939. Studies of the Recent and Tertiary Brachiopoda of Australia and New Zealand. *Rec. Canterbury Mus.* 4: 231-248

BRANCH ML, ARNAUD PM, CANTERA J & GIANAKOURAS D 1991. The benthic Mollusca and Brachiopoda of subantarctic Marion and Prince Edward Islands: 1) Illustrated keys to the species 2) Records of the 1982-1989 University of Cape Town Surveys. *S. Afr. J. Antarct. Res.* 21: 45-64

COOPER GA 1973. New Brachiopoda from the Indian Ocean. *Smithson. Contrib. Paleobiol.* 16: 1-43

COOPER GA 1981. Brachiopoda from the southern Indian Ocean (Recent). *Smithson. Contrib. Paleobiol.* 43: 1-93

DAVIDSON T 1880. Report on the Brachiopoda dredged by HMS *Challenger* during the years 1873-1876. *Rep. sci. Res. Voy. Challenger (Zool.).* 1: 1-67

DAVIDSON T 1886-1888. A Monograph of Recent Brachiopoda. *Trans. Linn. Soc. Lond.* ser.2 (Zoology) 4: 1-248

FOSTER MA 1974. Recent Antarctic and Subantarctic brachiopods. *Antarct. Res. Series* 21: 189 p. American Geophysical Union, Washington, DC

FOSTER MA 1989. Brachiopods from the extreme south Pacific and adjacent waters. *J. Paleont.* 63: 268-301

HILLER N 1986. The South African Museum's *Meiring Naude* cruises, Part 16. Brachiopoda from the 1975-1979 cruises. *Ann. S. Afr. Mus.* 97: 97-140

HILLER N 1991. The southern African Recent brachiopod fauna. In: *Brachiopods through Time*, eds DI MacKinnon, DE Lee & JD Campbell. AA Balkema, Rotterdam. pp 439-445

HILLER N 1994. The environment, biogeography and origin of the southern African Recent brachiopod fauna. *J. Paleont.* 68: 776-786

JACKSON JW 1952. A revision of some South African Brachiopoda; with descriptions of new species. *Ann. S. Afr. Mus.* 41: 1-40

WILLIAMS A & ROWELL AJ 1965 Morphological terms applied to brachiopods. In: *Treatise on Invertebrate Palaeontology. Part H: Brachiopoda*, ed RC Moore. Geol. Soc. Am. & Univ. of Kansas Press. 139-155.

VERWOERD WJ & CHEVALLIER L 1987. Contrasting types of surtseyan tuff cones on Marion and Prince Edward Islands, southwest Indian Ocean. *Bull. Volcanol.* 49: 399-417

The diving behaviour of adult southern elephant seal, *Mirounga leonina*, cows from Marion Island

F C Jonker & M N Bester

Mammal Research Institute, University of Pretoria, Pretoria 0002, South Africa

Present address: Department of Zoology & Entomology, University of Pretoria, Pretoria 0002, South Africa

The diving patterns of eight adult southern elephant seal, Mirounga leonina, *cows (seven post-breeding and one post-moulting) from subantarctic Marion Island were recorded during the pelagic phase of their annual cycle, using geolocating time-depth recorders attached to the seals. A total of 28 948 dives have been categorised into seven distinct types representing transit, exploratory and foraging dives. No benthic foraging dives were recorded and all but one cow showed a marked diel variation in dive depth, dives being deeper during the day (by 30 to 300 m) than during the night. Mean (± SE) dive depth ranged from 406 ± 157 m to 585 ± 226 m and mean dive duration from 19,08 ± 5,77 min to 33,41 ± 14,62 min, the deepest and longest dives being 1 444 m and 113 min respectively. Dive depth and duration were positively correlated and unimodal in their frequency distribution, and two cows had secondary modes at 800 to 900 m and 40 to 44 min respectively. Post-dive surface intervals ranged from 2,03 ± 1,64 min to 4,99 ± 53,34 min between individuals and were unrelated to dive depths and durations of previous dives, as were extended surface intervals (>10 min) which were more frequent at night than during the day. Extended surface intervals were also more common during long journeys at sea and were probably associated with successful foraging. The frequency of occurrence and the bottom times of foraging dives varied with the season, the highest frequency of occurrence and longest bottom times being recorded during the post-moulting (winter) period. It is postulated that the seasonal and individual variation in the diving behaviour of the southern elephant seal cows are related to their geographic locations and the abundance and behaviour of their prey.*

Die duikgedrag van agt volwasse (sewe ná teling en een ná verharing) suidelike olifantrobkoeie, Mirounga leonina, *van subantarktiese Marion-eiland is gedurende die pelagiese fase van hul jaarlikse siklus opgeneem deur die gebruik van geolokasie-tyddieptemeters wat aan die robbe vasgeheg is. 'n Totaal van 28 948 duike is in sewe duiktipes onderverdeel, wat deurtog-, verkennings- en voedingsduike verteenwoordig. Geen bodemvoedingsduike is aangeteken nie en al die koeie, met die uitsondering van een, het 'n beduidende verskeidenheid in duikdiepte oor 24-uur tydperke vertoon, met die duike dieper gedurende die dag (tussen 30 tot 300 m) en vlakker gedurende die nag. Die gemiddelde (± SF) duikdiepte strek van 406 ± 157 m tot 585 ± 226 m en duur gemiddeld 19.08 ± 5,77 min tot 33,41 ± 14,62 min. Die diepste en langste duike was onderskeidelik 1 444 m en 113 min. Daar was 'n positiewe verband tussen duikdiepte en duurte en die frekwensieverdelings was enkel-modus, terwyl twee koeie sekondêre modusse by onderskeidelik 800 tot 900 m en 40 tot 44 min gehad het. Na-duikse verposings aan die oppervlakte het van 2,03 ± 1,64 tot 4,99 ± 53,34 min tussen individue gewissel en het nie verband gehou met duikdieptes en duurtes van voorafgaande duike nie, soos ook in die geval van lang verposings (>10 min) aan die oppervlakte wat meer in die nag as in die dag voorgekom het. Verlengde verposings aan die oppervlakte het ook meer gedurende lang seereise voorgekom en kan met suksesvolle voeding verband hou. Die frekwensie van voorkoms en die bodemtye van voedingsduike het met die seisoene verander. Die hoogste frekwensie van voorkoms en langste bodemtye is gedurende die na-verharingstydperk (winter) aangeteken. Daar word bespiegel dat die seisoenale en individuele veranderlikheid in die duikgedrag van die suidelike olifantrobkoeie verband hou met hul geografiese verspreiding en die volopheid en gedrag van hul prooi.*

Introduction

Southern elephant seals breed and moult on Marion Island during the austral spring and summer (Condy 1978). Breeding elephant seals are ashore from August to November and after a few months at sea (the post-breeding period), they return for the moult haulout that peaks in January and February for cows and bulls respectively. In individuals the period of moult lasts approximately 30 days. From May to August elephant seals are presumably feeding at sea (the post-moulting period) because few occur on the island (Condy 1979).

The population of southern elephant seals at Marion