SPECIALIST STUDIES – SECTION C

C2.6 A Survey of Epifauna in the Sandpiper-1 (SP-1) Target Phosphate Dredging Area on the Central Namibian Continental Shelf

Prepared for:
Namibian Marine Phosphate (Pty) Ltd.

Prepared by:
T. P. McClurg

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T. P. McClurg
KZN Coastal Impact Consultants. P.O. Box 230, KLOOF, South Africa 3640.
mcclurgs@telkomsa.net

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Email: info@namphos.com
127 Theo-Ben Gurirab Street
Walvis Bay
Namibia

SUMMARY

Trawling at 24 stations across the SP-1 target phosphate dredging area revealed a significant presence of epifaunal organisms with low diversity (14 taxa). The samples were heavily dominated by an ascidian “sea squirt” (*Molgula*) and a pennatulid “sea pen” (family Veretellidae), both of which appear to be capable of enduring periodic hypoxic events. Two crustaceans, notably a swimming crab (*Bathynectes piperitus*) and a mantis shrimp (*Pterygosquilla armata capensis*), were also prominent in the catches. Both of these are active swimmers and considered to be capable of physically avoiding hypoxic conditions. The remaining 10 taxa, which generally follow more sedentary lifestyles, were present in far fewer numbers. Similar surveys performed further south, where hypoxia is not prominent, have yielded far richer epifaunal assemblages, particularly in terms of the less mobile taxa. It appears that the epifauna in the SP-1 area is relatively impoverished and that this is due to the prevalence of episodic hypoxia. The data gathered in this survey may be used as a baseline for future impact monitoring. However, it is important that hypoxic events be concurrently monitored to enable partition of impacts between those putatively caused by dredging and those arising from the natural hypoxic episodes.

contents

figures

tables

1 INTRODUCTION

The proposal to mine phosphate on the continental shelf off central Namibia has raised concern over environmental damage and consequent impact on fisheries. The project, accordingly, has been intensely scrutinised through a rigorous Environmental Impact Assessment (NMP, 2012). This has, *inter alia*, entailed detailed characterisation of the environment, and its resident faunal communities. This information is being used in making risk assessments and in formulating management plans. It will also serve as a baseline against which future impacts may be judged. The benthic environment within SP-1, where dredging is scheduled to commence (Figure 1 and Figure 2), is the particular area of focus. Studies of relevance in SP-1 include two detailed benthic fauna surveys (Steffani 2010, 2013). Project reviewers have expressed concern that these surveys, which were based on traditional grab sampling, were not fully comprehensive, in that the larger organisms inhabiting the sea bed (epifauna) were not adequately sampled. Epifaunal organisms tend to be larger, more mobile and occur in lower densities than their infaunal counterparts and may accordingly be missed in grab-based surveys. Partly in response to this criticism an additional survey, which focussed on epifauna, was performed in June 2014.

This study formed part of a wider trawling survey aimed at further elucidating the biodiversity and fishery potential of the proposed dredging area and environs. This report describes the results of the epifaunal component of the survey.

2 MATERIALS AND METHODS

Three categories of fauna, which are broadly defined by size, are commonly targeted in marine ecological assessments. First, the meiofauna, which includes microscopic organisms which, when sampled, are retained by a fine sieve (usually 0,063 mm). These organisms typically burrow near the sediment/water interface. Second, the macrofauna, which comprises the larger organisms that dwell in close association with the sea-bed and are retained by a coarser sieve (usually 0. 5 or 1 mm). Third, the epifauna (sometimes referred to as megafauna) which is the subject of this study and includes the larger, and typically more mobile, organisms that dwell above the sediment surface.

Special target sampling methods are applied for each category of fauna. Cores and grabs are usually employed for meiofauna and macrofauna, while observations via remotely operated vehicles (ROVs), together with sleds and trawls, are usually more appropriate for the collection and evaluation of epifauna. ROV observations are very expensive and tend to be more suited to qualitative, rather than quantitative, analysis. They also require clear underwater visibility, which seldom prevails in the SP-1 area due to the suspension of particulates in the water column. Additionally, the operation of sleds in deep waters may be confounded by technical problems. It was consequently determined that trawling, using the technical skills of local trawler-men, was the most appropriate route for the collection of the epifauna of this region. This epifauna survey could then be linked logistically to a broader biodiversity and fishery survey which comprises part of the verification programme.

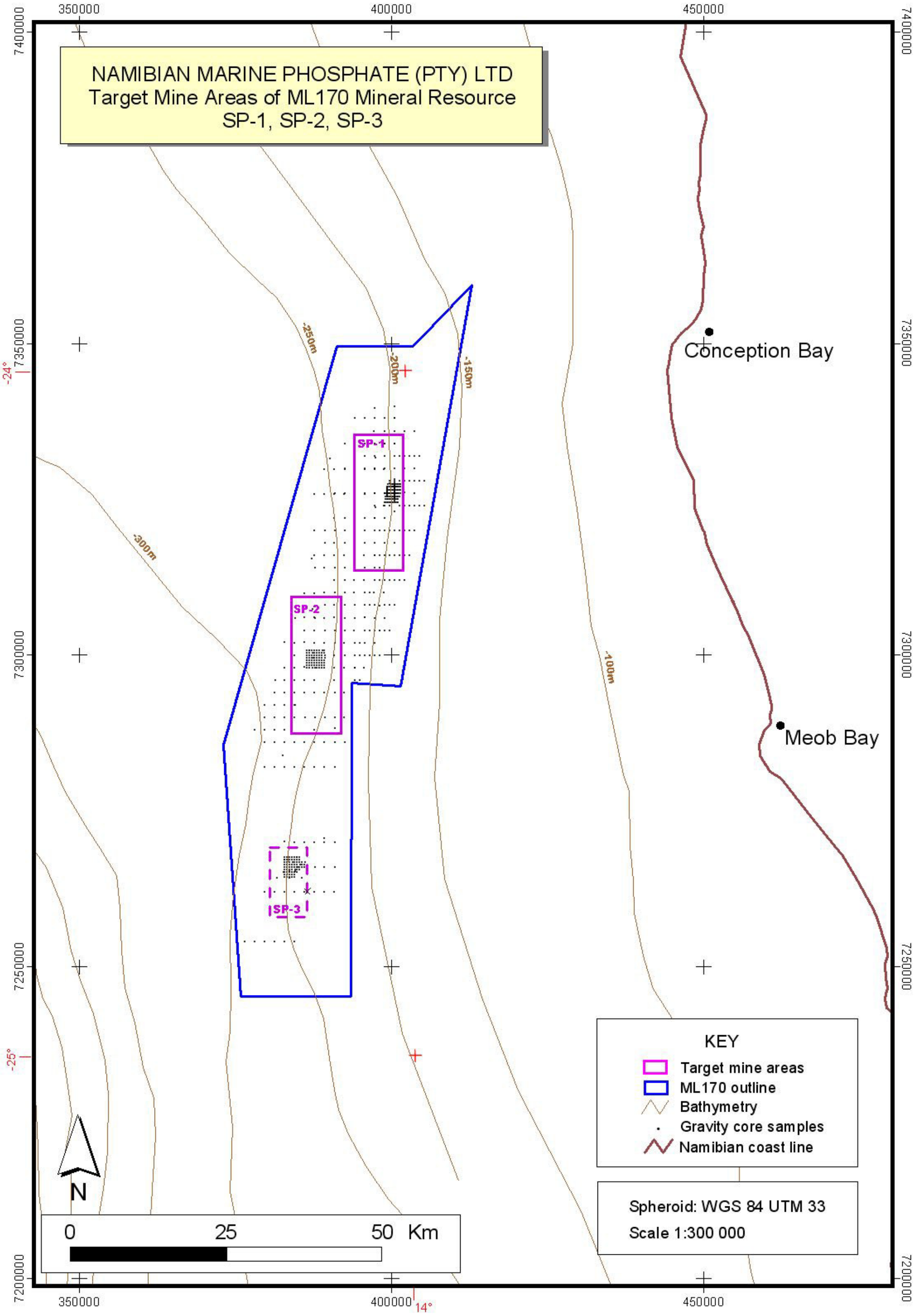


Figure 1: Location of the proposed target dredging sites SP-1, SP-2 and SP-3 within the Sandpiper Phosphate licence area (ML-170).

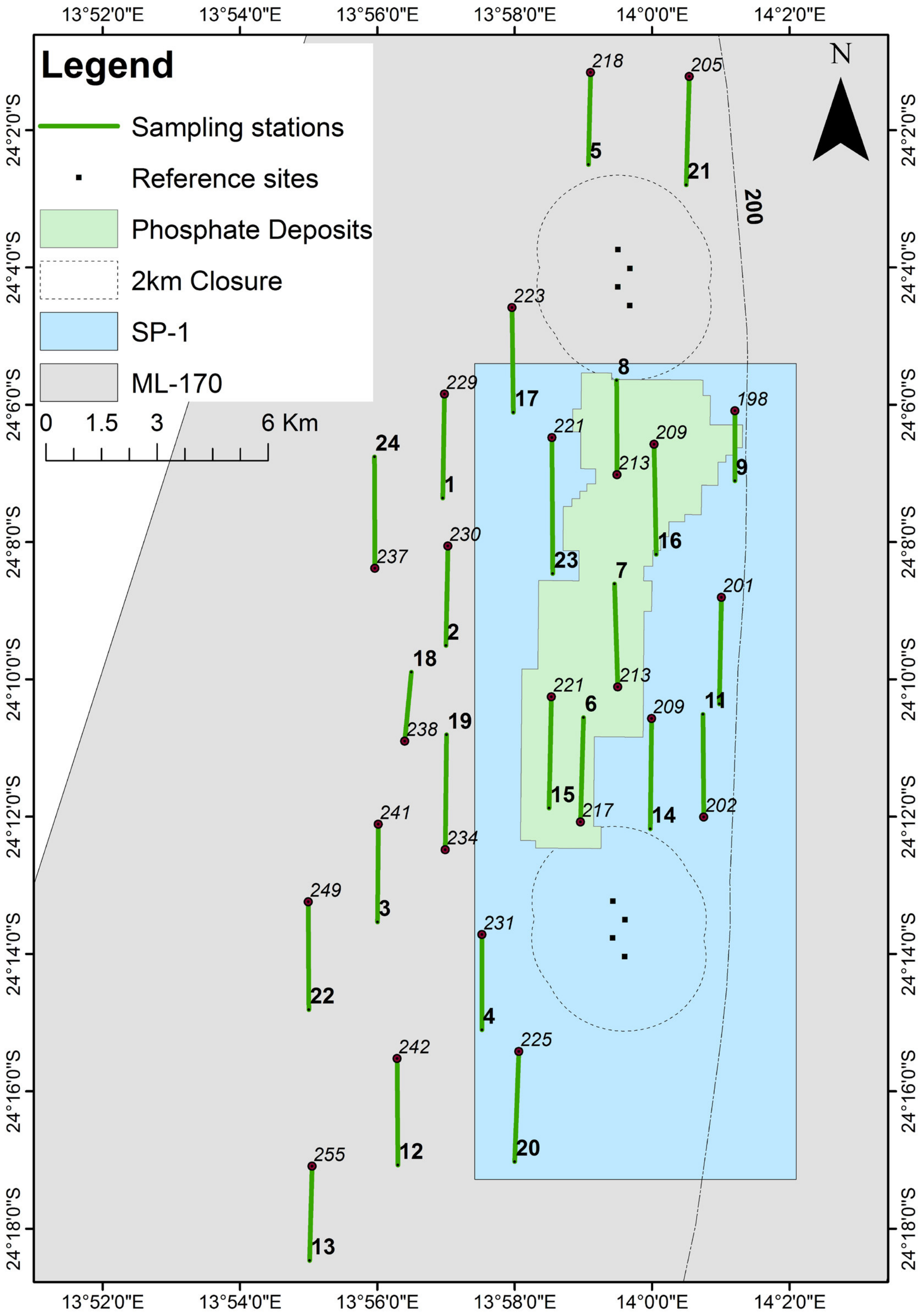


Figure 2: Location of the 24 stations (trawl lanes) where the epifauna was surveyed.

The survey took place during the latter half of June, 2014 using the Walvis Bay-based Fishing Vessel *Zeearend*. Trawling was achieved with a standard double belly monk trawl (108 metres) fitted with a tickler chain. The cod ends were lined with a 20 mm mesh net so that the smaller epibenthic organisms would be retained. Twenty four trawls were completed, as illustrated in Figure 2. Twelve were undertaken during daylight hours (07:00 – 18:00) and twelve at night (20:00 – 05:30). The trawl distances were standardised at approximately 1.5 nautical miles. Processing of the catches was achieved through team work by all the scientists and crew. Key components of each trawl (principally fishes and jellyfish) were extracted first and the remaining material was then transferred to a sorting table where it was rigorously screened for epifauna. Counts and weights were recorded for each epifaunal taxon. Appropriate photographic records were made and samples of each taxon were preserved in 96% ethanol for future reference.

3 RESULTS AND DISCUSSION

The identities, counts and weights of all organisms collected in the trawls are listed in Annexure 1. Since the trawls were not all of equal length, it was necessary to standardise the figures so that valid statistical comparisons could be made. The standardised figures are given in Annexure 2.

3.1 OVERALL COMPOSITION

Fourteen epifauna taxa were recovered from the trawls comprising 209 185 specimens with a total mass of 5582 kg., the equivalent standardised results being 198 767 specimens and 5325 kg. Some perspective on the dimensions of the epifauna catch can be gained by making comparisons with the “fish and pelagic” component of the survey (section C 3.1) where the equivalent standardised totals were 37 885 specimens and 23124 kg. This reveals, as might be expected, a biomass dominance in the ”fish and pelagic” component and, perhaps surprisingly, a massive numerical dominance in the epifauna.

3.2 COMPOSITION OF THE EPIFAUNA

The composition of the epifauna , expressed in terms of standardised numbers and weights for each taxon, and their percentage contributions to the overall catch, is summarised in Tables 1and 2 and depicted graphically in pie charts. Figure 3, which draws on the full data set, displays massive dominance by two taxa, namely the sea squirt (*Molgula*) and the sea pen (Veretellidae). *Molgula* contributed 60% of the numbers and 85 % to the biomass, while Veretellidae contributed 37 % to the numbers. Apart from a marginal 7 % weight contribution by the sponge (Porifera) none of the other taxa had any significant presence, the vast majority contributing less than 1%.

Table 1: Composition of the epifauna expressed in terms of numbers for each taxon and their percentage contributions to the overall biomass.

Identity	Common Name	Number	% of Catch	% of Catch (excl. *Molgula* and Veretellidae)
Astropecten	Starfish (long-armed)	5	0.0025	0.089
Bathynectus piperitus	Swimming Crab	2701	1.36	48.373
Callianassa africana	Mud Prawn	1	0.0005	0.018
Fasciolaria lugubris	Whelk (tulip)	206	0.1036	3.69
Funchalia woodwardi	Prawn	6	0.0030	0.107
Molgula	Sea Squirt	116573	58.649	-
Nassarius wolffi	Whelk (dog)	7	0.0035	0.125
Odonaster australis	Starfish (cushion star)	15	0.00754	0.269
Paguridae	Hermit Crab	7	0.0035	0.125
Porifera	Sponge (brown)	1619	0.815	29.00
Pseudocnus thandari	Sea Cucumber	43	0.022	0.770
Pterygosquilla armata	Mantis Shrimp	903	0.454	16.18
Solenocera africana	Prawn	70	0.035	1.254
Veretellidae	Sea Pen	76612	38.54	-
TOTAL		**198767**	**100**	**100**

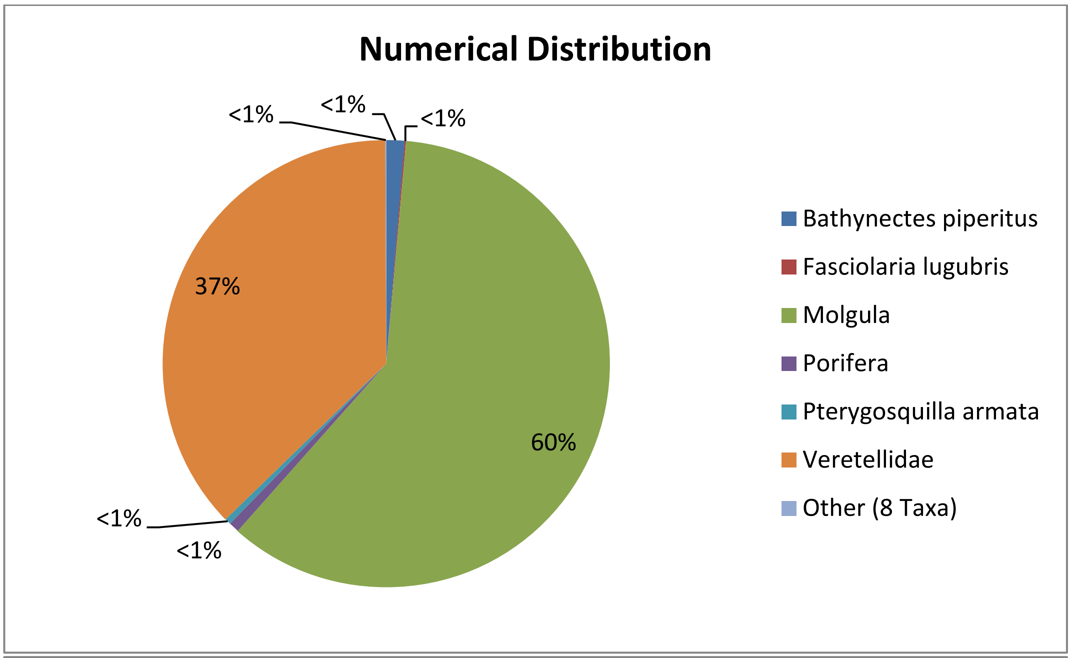
In order to better display the relative contributions of the lesser taxa, the process was repeated after removal of the very high numbers attached to *Molgula* and Veretellidae. The results (Figure 4) show the swimming crab (*Bathynectus pip*eritus) and the sponge (Porifera) to be relatively dominant. However , the remaining taxa were again very poorly represented. The epifauna in the SP-1 area is clearly skewed in favour of a few dominant taxa. A description of each epifaunal taxon (with illustrations) is given below.

Table 2: Composition of the epifauna expressed in terms of weights for each taxon and their percentage contributions to the overall biomass.

Identity	Common Name	Weight (kg)	% of Catch	% of Catch (excl. *Molgula*)
Astropecten	Starfish (long-armed)	0.03	0.00056	0.00505
Bathynectus piperitus	Swimming Crab	118.4	2.223	19.942
Callianassa africana	Mud Prawn	0.01	0.00018	0.00168
Fasciolaria lugubris	Whelk (tulip)	11.12	0.209	1.873
Funchalia woodwardi	Prawn	0.06	0.00112	0.0101
Molgula	Sea Squirt	4731.55	88.85	-
Nassarius wolffi	Whelk (dog)	0.01	0.00018	0.00168
Odonaster australis	Starfish (cushion star)	0.05	0.00093	0.00842
Paguridae	Hermit Crab	5.29	0.0993	0.8909
Porifera	Sponge (brown)	408.52	7.671	68.805
Pseudocnus thandari	Sea Cucumber	0.202	0.00379	0.03402
Pterygosquilla armata	Mantis Shrimp	21.03	0.3949	3.542
Solenocera africana	Prawn	0.21	0.00394	0.0354
Veretellidae	Sea Pen	28.8	0.5408	4.856
TOTAL		**5325.282**	**100**	**100**

Ascidiacea (sea squirts or ascidian tunicates). A single species (*Molgula*) was encountered at 21 of the 24 stations, often in large numbers (Figures 4 and 5). Ascidians are widespread and common, particularly on rocky shores and reefs (Branch *et al*., 2010). They are often overlooked and have not been well described. They have several life forms which include solitary anchored individuals, and compound colonies. The latter may form encrustations or exist as relatively loose aggregations. They can reproduce by budding. *Molgula* are clearly colonial in the sense that they tend to exist in clumps. Individual may survive alone but they would lose the stability associated with mass aggregation. Ascidians are filter feeders and assumed to play an important role in nutrient recycling. There is sparse information on what predates on ascidians. Their tough leathery exterior "tunic" may render them unattractive to many potential predators. Nevertheless there are reports of ascidian predation by fish and echinoderms (particularly starfish). There was, incidentally, no evidence of *Molgula* remains in any of the fish stomach contents that were examined in this survey. It is speculatively suggested that the high abundance of *Molgula* in the SP-1 area may be related to the virtual absence of echinoderms. As would be expected, *Molgula* were also recovered in the macrobenthic survey by Steffani (2010,). Discussions with Mr Malakia Shimhanda (on-board technician from the Namibian Ministry of Fisheries and Marine Resources – NatMIRC) revealed that *Molgula* is widely known in Namibian fishing areas. However, he remarked that, in 25 years at sea, he had never seen them recovered in such large numbers. It is likely that the reduced mesh size (20 mm), that was used to line the cod end in this survey, played a significant role in boosting catches. Bottom trawling and fishing intensity are also very likely to affect their distribution and abundance.

Figure 3/...



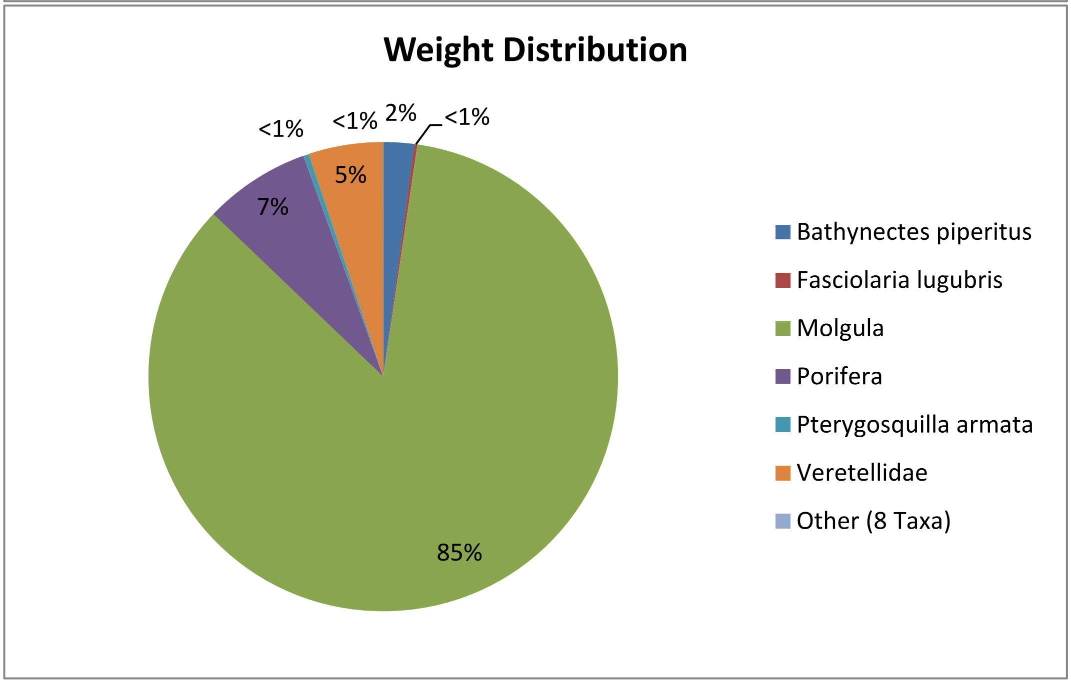


Figure 3: Relative proportions of all epibenthic taxa recorded in the trawling survey according to numbers (top and weights (bottom).

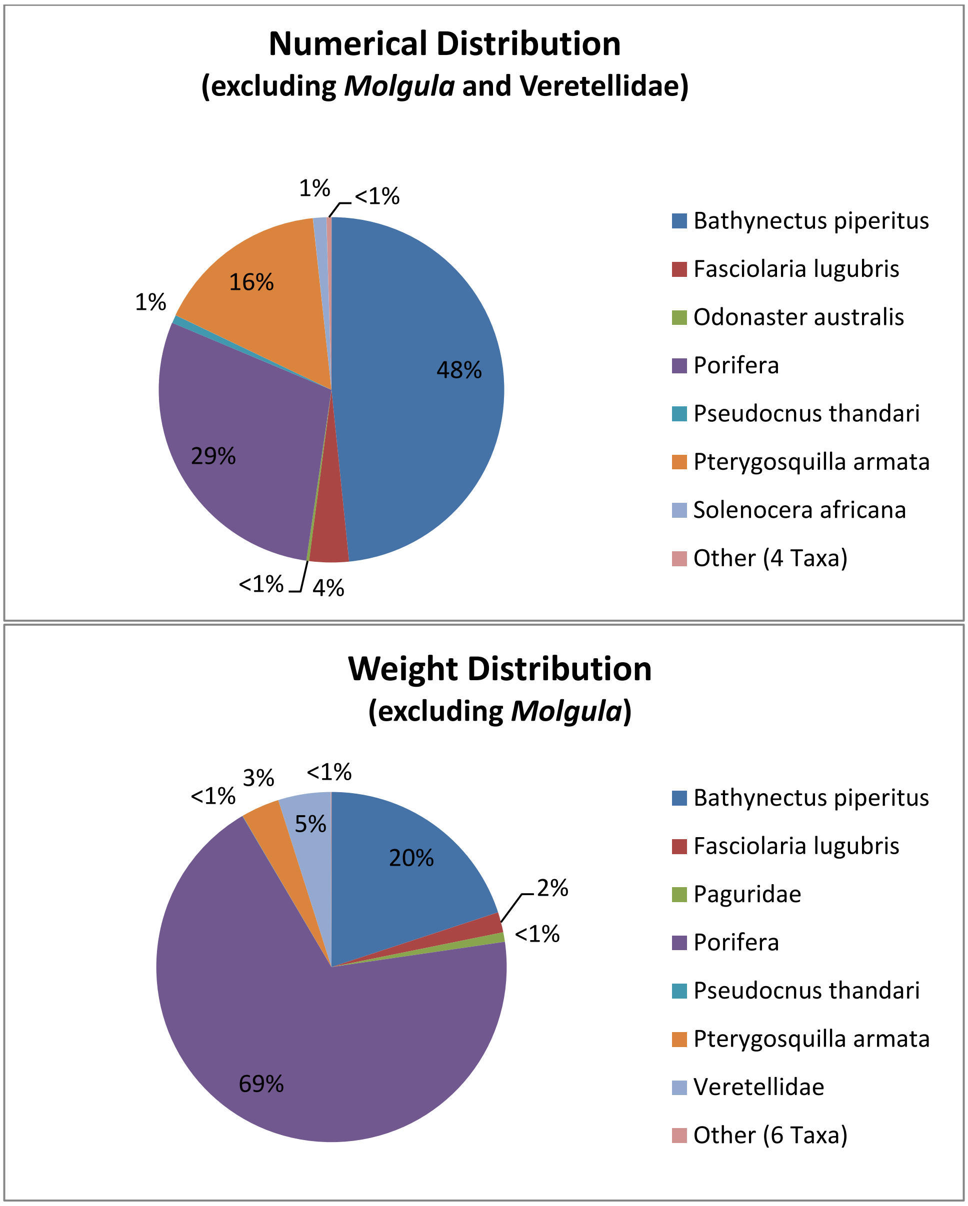


Figure 4: Relative proportions of epibenthic fauna recorded in the trawling survey after removal of selected super-abundant or heavy taxa (*Molgula* and/or Veretellidae).

Figure 5: Trawl contents at station 20 showing high abundance of spherical *Molgula* .

Figure 6: Close-up view of *Molgula* displaying aggregation.

The widespread presence of *Molgula* in the SP-1 area provides potential for efficient monitoring of contamination, and consequent bio-accumulation that may arise when dredging commences. Ascidians have many of the characteristics of an ideal “sentinel” organism (sedentary, filter feeding, long-lived, proven ability to accumulate contaminants non-lethally). Assessment of spatial contamination in the dredging area could be achieved by making use of existing populations or through the strategic placement of trans-located specimens.

Pennatulacea (sea pens, Family Veretellidae, Phylum Cnidaria). The Cnidaria (which includes jellyfish, anemones and hydroids) comprises a diverse, abundant and widely distributed group of marine organisms (Branch *et al.,* 2010). Only one member of this group was encountered in the epifauna survey, namely a sea-pen which was assigned to the family Veretellidae (Figure 7). Sea pens have a fleshy body covered with polyps and a soft unbranched peduncle that anchors the colony in mud or sand. The specimens recovered in this survey were generally small (2 to 3 cm) so would not be expected to be readily caught in the trawl.

Figure 7: Sea Pens (*Veretellidae*).

Interestingly, none was encountered in the cod-ends while relatively high numbers were consistently retained in the net wings. It was not possible to make direct counts of material in the net wings so a rough estimate was made, per running metre of the net, and this was extrapolated. Numbers appeared to be consistent for all trawls so a single extrapolated value was applied across the board. This is clearly an extremely rough estimate and should be treated with caution. Nevertheless it serves to indicate that high numbers of sea pens were present. It is likely that numbers were, in fact, much higher since the net wings constitute a very inefficient trap. Veretellidae were also recorded in the benthic faunal surveys (Steffani, 2010, 2014) and those studies would provide a firmer foundation for estimating abundance. They are clearly an important inhabitant of the SP-1 benthic environment.

Porifera (sponges). Sponges are simple, primitive, and somewhat characterless organisms. As a result, they have been very poorly described. One unidentifiable species (Figure 8) was recovered at 20 of the 24 stations in numbers ranging between 1 and 285. It has been labelled “sponge (brown)”. The brown coloration appears to have arisen from mud staining.

Figure 8: Porifera (sponge).

Gastropoda (whelks). Whelks are commonly recovered in bottom trawls. They are active predators or scavengers. Eight specimens of *Nassarius wolffi* (dog whelk) were recovered at station 13. This species is widely spread along the Atlantic coast of West Africa and has been recorded as far south as Angola and northern Namibia. Somewhat more common was the "tulip whelk" (*Fasciolaria lugubris*) which was found at 16 of the 24 stations, in numbers ranging between 1 and 98 (Figure 9).

Figure 9 : The two gastropod whelks encountered in the survey. 1 – *Fasciolaria lugubris* (dorsal); 2 - Fasciolaria lugbris (ventral); 3 - Nassarius wolffi (dorsal); 4 – Nassarius wolffi (ventral).

Crustacea. Crustacea are usually common in bottom trawls. Some species are exploited commercially while others are usually discarded. This survey yielded six species, of which four are illustrated in Figure 10. Only two of these were found to be widespread and relatively abundant. A swimming crab (*Bathynectes piperitus*) was present at all stations in numbers ranging between 31 and 212. This species is a frequent by-catch in the trawl industry (Bianchi *et al*., 1999) and, in common with all portunid crabs, their fifth legs are flattened to enable swimming. They are active predators and scavengers. A mantis shrimp (*Pterygosquilla armata capensis*) was absent only from station 11 and was recorded in numbers ranging between 2 and 124. This is a highly specialised predator with massive raptorial claws (Branch *et al*., 2010). They may swarm in surface waters. The remaining four crustacean species were present in relatively small numbers and at only a few stations. Two specimens of mud prawn (*Callianassa australis*) were recovered at station 8. This species is reported by Kensley (1981) to occur between Saldanha Bay and Lüderitz at depths between 10 and 180 metres. It was also recorded in the SP-1 area by Steffani (2010). Eight specimens of unidentified hermit crabs (Paguridae) were recovered at station 13, while three specimens of the prawn *Funchalia woodwardi* were present at station 12. Finally, the prawn *Solenocera africana* had a slightly higher presence with recoveries at four stations in numbers ranging between 3 and 32. It is evident that, apart from the swimming crabs and mantis shrimps, crustacean numbers in the study area were exceedingly sparse.

Figure 10: Crustacea. 1 –Bathynectes piperitus; 2 – Solenocera africana;
3 – *Pterygosquilla armata capensis* ; 4 – *Callianassa australis.*

Echinodermata. Echinoderms are usually well represented in bottom trawls, globally, with urchins and starfish being particularly prominent. In the SP-1 study area they were virtually non-existent. The total recovery for 24 trawls was 20 starfish (Asteroidea) and 43 sea cucumbers (Holothuroidea) (Figure 11). The starfish were divided between two taxa, namely an unidentified species of *Astropecten* and *Odontaster australis*. The latter has been previously recorded in deep waters off Cape Town, Lamberts Bay and Lüderitz (Clarke and Courtman-Stock, 1976). The sea cucumber was identified as *Pseudocnus thandari* (Moodley, 2008; Thandar *et al*., 2010). It has been recorded between St Helena Bay and northern Namibia at depths between 18 and 117 metres.

Figure 11: Echinoderms. 1 – *Odontaster australis;* 2 – *Astropecten* (aboral view); 3 – *Astropecten* (oral view); 4 - *Pseudoncnus thandari.*

3.3 COMPARISONS WITH OTHER TRAWLING SURVEYS

Drawing direct and valid comparisons between epifaunal catches in disparate bottom trawling surveys is fraught with difficulties. Trawling is not a precise sampling method and is influenced by numerous confounding factors which are likely to determine the numbers and types of organisms that are retrieved. These include the nature of the trawling gear, the skill of the operators, the prevailing hydrographic conditions, the nature of the sea-bed, the season, the time of day, the water depth etc. These in turn are overlain by a plethora of biotic influences which might relate to issues such as breeding cycles, seasonal migration and feeding patterns. Nevertheless the need remains to evaluate these results within a broader framework. There have been no similar surveys on the central Namibian continental shelf. However, in recent years there has been renewed interest in the benthic ecology of the southern Benguela Current region, driven by a need to evaluate the impacts of trawling (Atkinson, 2009; Atkinson *et al*., 2011). These studies have focussed on the deeper waters (roughly 350 to 450 metres) between Cape Point and southern Namibia. While there are significant differences in location and depth between the two studies, a broad comparison would appear to be justified. Both studies were based on 24 trawls so may be directly compared.

Atkinson *et al.* (2011) recorded a total of 81 epifaunal taxa in their study, which is far in excess of the 14 recorded here. Echinoderms and crustaceans were particularly well represented in their samples, whereas they are very poorly represented here. The epifauna in the SP-1 area would thus appear to be highly impoverished, particularly in terms of crustaceans and echinoderms.

3.4 ENVIRONMENTAL DRIVERS

Apart from station 11, where a massive catch of jellyfish was made, and counts of other organisms were suppressed, there was notable uniformity in the epifauna across the study area. This is in line with a geophysical survey (Ludick, 2014) which confirmed that sediment type and sedimentary conditions were also uniform. Other factors which might be considered to influence the epifauna include water depth, salinity and oxygen concentration. The depth range was 198 to 255 metres, which would seem to be sufficiently narrow to be of little consequence. Salinities and oxygen concentrations were continuously monitored during trawling through a CTD that was attached to the tow line. The detailed results are presented in an accompanying report (Lwandle, 2014). Deployment of the CTD in this manner posed a number of technical challenges. Nevertheless the data have allowed broad conclusions to be drawn with regard to oceanographic conditions. The salinity and temperature readings were within expected ranges and indicated the presence of South Atlantic Central Water (SACW) in the study area for most of the survey. However, dissolved oxygen concentrations were, in many instances, significantly depressed towards the sea-bed. The natural periodic development of hypoxic conditions is well-documented in Namibian coastal waters and this is a clear a manifestation of that phenomenon. The link between impoverished crustacean and echinoderm communities amongst the epifauna and oxygen depletion seems obvious and draws support from the work of Steffani (2010, 2014) which revealed that the macrobenthic community structure in the SP-1 area was also reflective of a low oxygen environment. Periodic hypoxia may not be problematic for mobile organisms that are capable of avoiding low oxygen conditions. However it may impose severe limitations on those that lack this ability or are not physiologically pre-adapted to a low oxygen environment. Under conditions of periodic hypoxia one would expect the less mobile and more sensitive species to be chronically suppressed and, conversely, for the more mobile taxa to show increased abundance when oxygen levels rise. The presence of high numbers of sea squirts (*Molgula sp.*) and sea pens (Veretellidae) suggests that they are able to tolerate occasional hypoxia and maintain significant populations. On the other hand, portunid crabs (*Bathynectes piperitus*) and mantis shrimps (*Pterygosquilla armata capensis*), which were the only other taxa present in significant numbers, are strong swimmers and presumably capable of avoiding hypoxic conditions. Most of the remaining taxa, notably the gastropods, echinoderms, the sponge, the mud prawn and the hermit crab, have relatively limited mobility and would thus be vulnerable to the negative effects of oxygen depletion. The situation is not clear for the two prawn species (*Funchalia woodwardi* and *Solenocera africana*), both of which were found in low numbers but appear to be adept swimmers.

While the frequency and extent of hypoxic episodes in the SP-1 area are currently unknown it is important to factor their existence into the bio-monitoring programme. Whether a low oxygen environment may be considered the norm, and higher oxygen levels the exception, (or *vice-verse*) is debatable. The programme should aim to monitor hypoxic events to enable partition of impacts between those putatively caused by dredging and those arising from the natural hypoxic episodes.

4 CONCLUSION

While there was a significant presence of epifaunal organisms in the SP-1 area, there was low diversity. This may be ascribed to the chronic effects of periodic hypoxia on the less mobile and more vulnerable taxa. The fauna was numerically dominated by ascidians (sea squirts) and pennatulids (sea pens), which are presumably capable of tolerating periodic hypoxia. Relatively high numbers of portunid crabs and mantis shrimps were also observed. These are strong swimmers and thus capable of circumventing periodic hypoxic events. The information gained in this survey may serve as a baseline for future impact monitoring. However the confounding effects of periodic hypoxia must be taken into account. Of particular interest, in this survey, was the widespread abundance of ascidians (*Molgula.*). It is suggested that these might serve as “sentinel organisms” for assessing possible contamination once dredging starts.

5 ACKNOWLEDGEMENTS

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Annexure 1: Epifauna Counts and Weights

Station Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sampling Time (Day/Night)		N	D	D	D	D	D	D	D	D	D	D	D	N	N	N	N	D	N	N	N	N	N	N	N
Water Depth at start (m)		229	230	241	231	218	217	213	213	198	201	202	242	255	209	221	209	223	223	238	234	205	249	221	237
COUNTS																									
Astropecten	Starfish (long-armed)													5											
Bathynectus piperitus	Swimming Crab	92	88	41	129	143	197	94	145	73	107	31	87	119	172	175	156	98	59	73	176	212	68	126	79
Callianassa africana	Mud Prawn								2																
Fasciolaria lugubris	Whelk (tulip)	9	3	5	11			16						98	1	15	12	9	5	5	3	1	8	16	10
Funchalia woodwardi	Prawn												3					3							
Molgula	Sea Squirt	3226	8259	1275	44408	9207	5254	16044	4001	89	242		884		209	4622	2638	2308	2083	1873	15728		109	3014	328
Nassarius wolffi	Whelk (dog)													8											
Odontaster australis	Starfish (cushion star)									10	5														
Paguridae	Hermit Crab													8											
Porifera	Sponge (brown)	219	285	46		97	21	16	7	1	1			94	5	41	23	51		164	165	17	151	91	95
Pseudocnus thandari	Sea Cucumber					6	10	2								10	12				3				
Pterygosquilla armata capensis	Mantis Shrimp	54	50	39	26	34	25	27	19	2	4		39	53	12	20	40	80	40	67	36	3	124	101	18
Solenocera africana	Prawn													3					28	32					4
Veretellidae	Sea Pen	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240
Total Counts		**6840**	**11925**	**4646**	**47814**	**12727**	**8747**	**19439**	**7414**	**3415**	**3599**	**3271**	**4253**	**3628**	**3639**	**8123**	**6121**	**5789**	**5455**	**5454**	**19351**	**3473**	**3700**	**6588**	**3774**
Numbers of Taxa		**6**	**6**	**6**	**5**	**6**	**6**	**7**	**6**	**6**	**6**	**2**	**5**	**9**	**6**	**7**	**7**	**7**	**6**	**7**	**7**	**5**	**6**	**6**	**7**
WEIGHTS (kg)																									
Astropecten	Starfish (long-armed)													0.03											
Bathynectus piperitus	Swimming crab	3.37	3.37	1.63	5.15	12.27	8.65	3.92	5.14	3	4.68	1.39	3.18	5.28	7.65	6.97	6.38	3.84	1.98	3.41	8.87	7.69	2.78	5.02	2.79
Callianassa africana	Mud Prawn								0.01																
Fasciolaria lugubris	Whelk (tulip)	0.02	0.06	0.11	0.11			3.02						5.92	0.02	0.32	0.15	0.39	0.19	0.16	0.06	0.01	0.25	0.33	0.47
Funchalia woodwardi	Prawn												0.03					0.03							
Molgula	Sea squirt	69.36	60.28	316.97	346.94	644.46	367.75	175.14	280.08	6.26	16.97		61.91		100.25	323.55	184.67	161.59	145.83	131.11	1100.93		7.61	210.96	22.95
Nassarius wolffi	Whelk (dog)													0.01											

Odontaster australis	Starfish (cushion star)									0.03	0.02														
Paguridae	Hermit crab													0.53											
Porifera	Sponge (brown)	26.27	27.57	21.88		12.27	10.24	1.85	3.24	0.38	0.69		19.98	44.98	0.69	19.68	3.19	24.69		26.19	31.77	2.52	72.59	12.03	45.82
Pseudocnus thandari	Sea Cucumber					0.06	0.03	0.002								0.05	0.03				0.03				
Pterygosquilla armata capensis	Mantis shrimp	0.8	1.07	0.86	0.56	0.72	0.51	0.71	0.53	0.06	0.07		1.04	1.5	0.5	0.57	0.72	1.22	0.67	2.66	1.06	0.07	3.02	1.68	0.43
Solenocera africana	Prawn													0.01					0.09	0.09					0.02
Veretellidae	Sea Pen	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
Total Biomass (kg)		**111.72**	**104.25**	**353.35**	**364.66**	**681.68**	**399.08**	**196.542**	**300.9**	**21.63**	**34.33**	**13.29**	**98.04**	**70.16**	**121.01**	**363.04**	**207.04**	**203.66**	**160.66**	**175.52**	**1154.62**	**22.19**	**98.15**	**241.92**	**84.38**

Station Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sampling Time (Day/Night)		N	D	D	D	D	D	D	D	D	D	D	D	N	N	N	N	D	N	N	N	N	N	N	N
Water Depth at start (m)		229	230	241	231	218	217	213	213	198	201	202	242	255	209	221	209	223	223	238	234	205	249	221	237
STANDARDISED COUNTS																									
Astropecten	Starfish (long-armed)													4.55											
Bathynectus piperitus	Swimming Crab	92	88	41	117.3	143	203.8	64.09	145	73	107	31	87	108	172	175	156	98	65.6	73	176	212	68	126	79
Callianassa africana	Mud Prawn								1																
Fasciolaria lugubris	Whelk (tulip)	9	3	5	10			13.64						89.1	1	15	12		5.56	5	3	1	8	16	10
Funchalia woodwardi	Prawn												3					3							
Molgula	Sea Squirt	3226	7760	1275	40371	9207	5435	10939	4001	89	242		884		209	4622	2638	2308	2314	1873	15728		109	3014	328
Nassarius wolffi	Whelk (dog)													7.27											
Odontaster australis	Starfish (cushion star)									10	5														
Paguridae	Hermit Crab													7.27											
Porifera	Sponge (brown)	219	285	46		97	21.72	10.91	7	1	1		42	85.5	5	41	23	51		164	165	17	151	91	95
Pseudocnus thandari	Sea Cucumber					6	10.34	1.364								10	12				3				
Pterygosquilla armata capensis	Mantis Shrimp	54	50	39	23.64	34	25.86	18.41	19	2	4		39	48.2	12	20	40	80	44.4	67	36	3	124	101	18
Solenocera africana	Prawn													2.73					31.1	32					4
Veretellidae	Sea Pen	3240	3240	3240	2945	3240	3352	2209	3240	3240	3240	3240	3240	2945	3240	3240	3240	3240	3600	3240	3240	3240	3240	3240	3240

Total Counts		**6840**	**11426**	**4646**	**43467**	**12727**	**9049**	**13257**	**7413**	**3415**	**3599**	**3271**	**4295**	**3298**	**3639**	**8123**	**6121**	**5780**	**6061**	**5454**	**19351**	**3473**	**3700**	**6588**	**3774**
Numbers of Taxa		**6**	**6**	**6**	**5**	**6**	**6**	**7**	**6**	**6**	**6**	**2**	**6**	**9**	**6**	**7**	**7**	**6**	**6**	**7**	**7**	**5**	**6**	**6**	**7**
STANDARDISED WEIGHTS (kg)																									
Astropecten	Starfish (long-armed)													0.03											
Bathynectus piperitus	Swimming Crab	3.37	3.36	1.63	5.15	12.27	8.65	3.92	5.14	3	4.68	1.39	3.18	5.28	7.65	6.97	6.38	3.84	1.98	3.41	8.87	7.69	2.78	5.02	2.79
Callianassa africana	Mud Prawn								0.01																
Fasciolaria lugubris	Whelk (tulip)	0.02	0.06	0.11	0.11			3.02						5.92	0.02	0.32	0.15	0.39	0.19	0.16	0.06	0.01	0.25	0.33	
Funchalia woodwardi	Prawn												0.03					0.03							
Molgula	Sea Squirt	69.4	56.26	317	346.9	644.5	367.8	175.1	280	6.26	17		61.9		100	323.6	185	162	146	131	1101		7.61	211	23
Nassarius wolffi	Whelk (dog)													0.01											
Odontaster australis	Starfish (cushion star)									0.03	0.02														
Paguridae	Hermit Crab													5.29											
Porifera	Sponge (brown)	26.3	27.57	21.9		12.27	10.24	1.85	3.24	0.38	0.69		20	45	0.69	19.68	3.19	24.7		26.2	31.77	2.52	72.6	12	45.8
Pseudocnus thandari	Sea Cucumber					0.06	0.03	0.002								0.05	0.03				0.03				
Pterygosquilla armata capensis	Mantis Shrimp	0.8	1.07	0.86	0.56	0.72	0.51	0.71	0.53	0.06	0.07		1.04	1.5	0.5	0.57	0.72	1.22	0.67	2.66	1.06	0.07	3.02	1.68	0.43
Solenocera africana	Prawn													0.01					0.09	0.09					0.02
Veretellidae	Sea Pen	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total Biomass (kg)		**101**	**89.52**	**343**	**354**	**671**	**388.4**	**185.8**	**290**	**10.9**	**23.6**	**2.59**	**87.3**	**64.2**	**110**	**352.3**	**196**	**193**	**150**	**165**	**1144**	**11.5**	**87.5**	**231**	**73.2**