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INFAUNA OF MARINE SEDIMENTS AND SEAGRASS BEDS OF UPPER SPENCER GULF NEAR PORT PIRIE, SOUTH AUSTRALIA

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Summary

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The infauna of six intertidal and shallow subtidal habitats were sampled in summer and winter near Port Pirie, Upper Spencer Gulf. The habitats included seagrasses and non-vegetated sediments. Over 12,000 individuals belonging to 372 taxa were collected in the survey. The species composition of this fauna had very little overlap (only 24 species) with that of a more recent survey of Northern Spencer Gulf. The density of the fauna in our study area was least (280 m^{-2}) in the unvegetated intertidal habitat, and highest (2612 m^{-2}) in the intertidal seagrass habitat (*Zostera*), and was dominated by polychaetes, molluscs and crustaceans. The fauna of the *Zostera* and *Posidonia* habitats is compared with other similar habitats sampled in southern Australia, in terms of the number of species, density of individuals and feeding guilds of the fauna. Differences in species diversity and densities between this study and other studies are likely to reflect the intensity of sampling, as well as differences between locations in the density and species of seagrass and in the prevailing hydrological regimes.

KEY WORDS: *Posidonia*, *Zostera*, seagrass beds, unvegetated sediments, infauna.

Introduction

Upper Spencer Gulf near Port Pirie (33°19'S, 138°E), South Australia, is shallow (generally less than 20 m deep) and fringed with large expanses of intertidal mudflats, intertidal seagrasses (*Zostera* spp.), and subtidal beds of the seagrasses *Posidonia australis* and *P. sinuosa*. These shallow expanses of seabed are fished commercially and recreationally for a number of species of fish, including garfish and whiting, and for crustaceans including prawns and crabs (Jones 1979[1]; King 1977[2]). Although these, and many other species, use the seagrass beds and intertidal flats at various stages of their life cycle (Jones 1979[1]), there have been few ecological studies designed to document other species of importance occurring in these habitats of the Gulf.

Upper Spencer Gulf refers to the area of the Gulf between Port Davis Creek (just south of Port Pirie) and Ward Spit, and Northern Spencer Gulf is defined as the portion of Spencer Gulf north of Ward Spit, i.e. north of 33°S (Stefanson 1977). Spencer Gulf, is hypersaline, with salinities gradually increasing from 35 ‰ to more than 60 ‰ near Port Augusta at the head of the Gulf (Bullock 1975). Upper Spencer Gulf has an intermediate salinity regime, varying annually from about 41-47.2 ‰ and water temperatures ranging from 10-26.2°C (Dow 1980[3]). Studies of fish and crustaceans in this area by Ward & Young (1982) have shown that they appear to be unaffected by the constant high salinities.

In this study we examine the mainly invertebrate fauna living in the sediments in shallow-water habitats found in Upper Spencer Gulf near Port Pirie, and its species composition. These results are compared with those obtained from similar habitats elsewhere in southern Australia.

Similar habitats which have been studied in detail elsewhere in southern Australia are those of seagrass beds and intertidal habitats. The infauna of seagrass beds has been examined in several studies in eastern Australia (Collett *et al.* 1984; Hutchings & Recher 1974), and in Western Australia (Hutchings *et al.* 1991; Wells *et al.* 1985) and reviewed by Howard *et al.* (1989). The infauna of intertidal habitats in Northern Spencer Gulf has recently been studied by Ainslie *et al.* (1989).

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[1]JONES, G. I. (1979) Biological Investigations of the Marine Scale Fishery in Spencer Gulf. (Dept Agriculture and Fisheries, South Australia). 72pp.

[2]KING, M. G. (1977) The biology of the Western King Prawn *Penaeus latisulcatus* Kishinouye and aspects of the fishery in South Australia. MSc. thesis, University of Adelaide, unpubl.

[3]DOW (1980) Redcliff Project – Draft Environmental Effects Statement. 178 pp. (Dow Chemical (Australia) Limited, Adelaide S.A.).

Materials and Methods

Samples of sediment were collected at high tide from 18 sites representing six habitats, by divers using PVC corers (220 mm diameter and 160 mm depth) in winter (25.vii.1979 – 17.xiii.1979) and in summer (1.ii.1980 – 1.iii.1980). Each corer had a sharpened leading edge and was capped at the other end by a PVC plate welded in place. A 50 mm hole in the cap covered with 1 mm fibreglass mesh allowed water to escape as the corer was driven into the sediment, and, after coring, was sealed with a rubber bung. No attempt was made to avoid seagrass leaves when they occurred at a sampling site, and the sampling technique resulted in substantial amounts of live and dead seagrass leaf material, rhizomes and roots in the samples. The habitats sampled (Fig. 1) were from about mid-tidal level (on mudflats adjacent to the mangroves) to sediments in 10 m water depth, and are the same habitats in which detailed studies of sediments and epibenthic fauna have been carried out previously (Ward & Young 1981, 1982). The habitats included bare intertidal muds (Sites 1A, 1B, 1C), intertidal seagrass beds of *Zostera mucronata* (Sites 2A, 2B, 2C), subtidal beds of *Posidonia australis* (Sites 3A, 3B, 3C) and *Posidonia sinuosa* (Sites 4A, 4B, 4C) and bare unvegetated

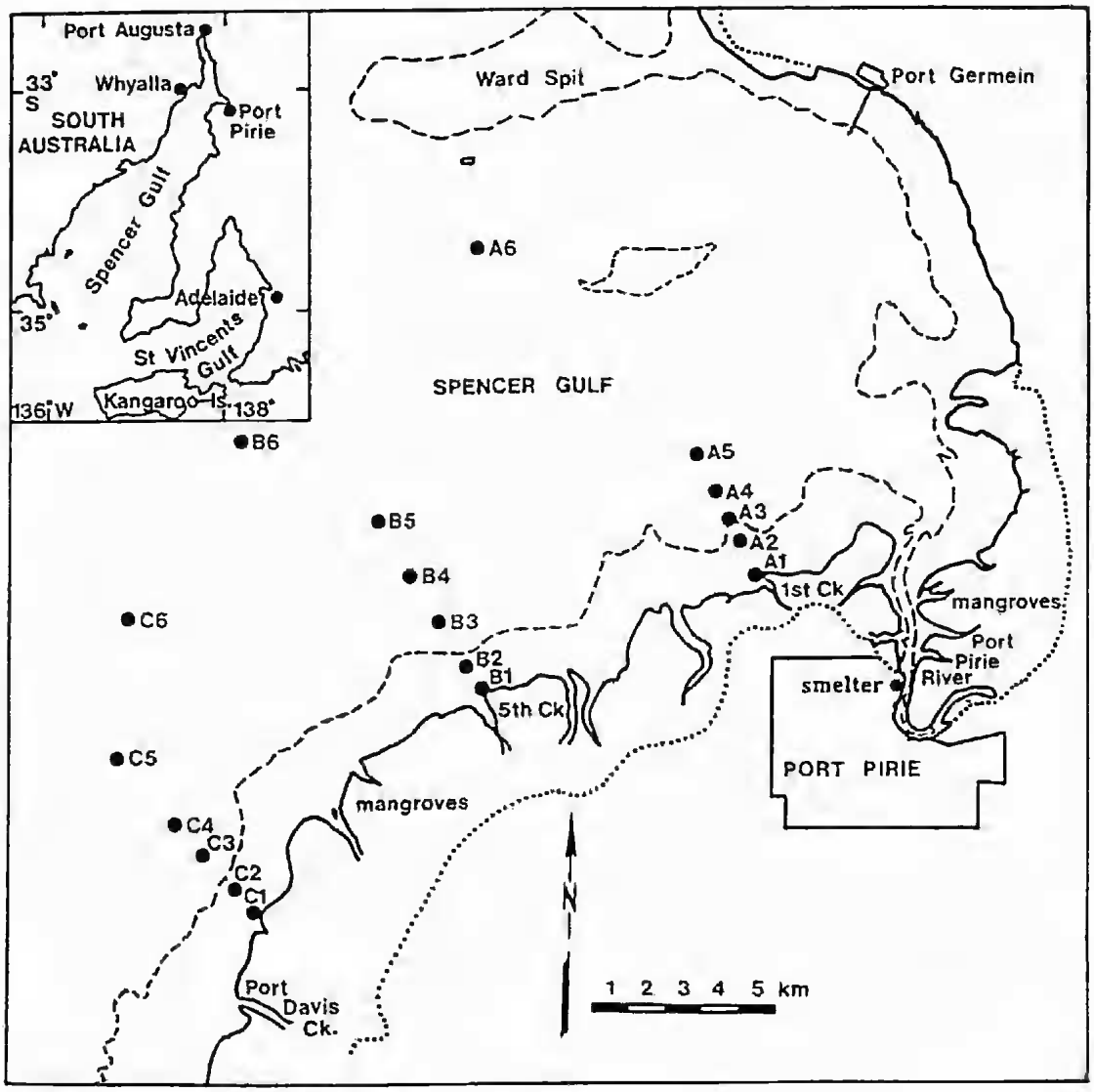

Fig. 1. The Port Pirie study area in Upper Spencer Gulf.

sediments (Sites 5A, 5B, 5C and Sites 6A, 6B, 6C) in deeper water (Fig. 1). At each site three samples were collected haphazardly from each of three plots of about 4 m^2 separated by at least 5 m. This resulted in nine samples from each of the 18 sites, collected in winter and summer, except for summer, when one sample from the *Posidonia australis* habitat was lost.

The samples were sieved in the field through 2 mm mesh and all residues were preserved in 10% formalin. In the laboratory the samples were sorted under water in large flat trays with the aid of low-power magnification. Hermit crabs were discarded because of the difficulty of extracting them from their shells, but all other non-colonial fauna was collected. Colonial organisms such as bryozoans and hydroids attached to the blades of the seagrasses were not sampled in this study. Because of taxonomic difficulties and a lack of funds the collection was stored for six years until resources permitted a detailed evaluation. The collection has been deposited at the Australian Museum, Sydney.

Results and Discussion

Species Composition of the Fauna

The samples contained 12,396 individuals representing 372 taxa. These taxa consisted of 39% polychaetes, 26% molluscs, 22% crustaceans, and 6% echinoderms, with the remaining 7% being distributed among the minor phyla (Table 1). The distribution and abundance of all taxa within the six habitats sampled is shown in Appendix 1. Of the 26 dominant taxa, defined as those represented by 100 or more individuals in the collection, 18 were polychaetes, four were molluscs, three were crustaceans and one was a holothurian (Table 2). The taxa identified as nemerteans and sipunculans may not be monospecific because of difficulties in identifying individuals to the species level. The most abundant species was *Tanais dulongi*, a tanaid crustacean.

The six habitats sampled varied considerably in the number of species present. The four subtidal habitats all had a high numbers of species (173 – 193) compared to the intertidal *Zostera* habitat (116), and

TABLE 1. *Infauna of Upper Spencer Gulf.* Numbers of species (S), density (d, number of individuals m^{-2}), abundance (n, % of total individuals in habitat) and total abundance (N) of the major taxa in each of the six habitat types sampled. All habitats were sampled with 54 cores (total surface area of 2.05 m^{-2}), except *Posidonia australis* which was sampled with 53 (total surface area of 2.01 m^{-2}).

taxa	habitat						
	intertidal	*Zostera*	*P. australis*	*P. sinuosa*	5m bare	10m bare	total
polychaetes							
S	12	57	94	97	91	88	148
d	243	1262	884	630	501	242	626
n(%)	87	48	76	73	76	49	62
crustaceans							
S	5	20	34	44	23	18	81
d	16	907	120	76	28	19	19
n(%)	6	35	10	9	4	4	19
molluscs							
S	6	23	34	32	38	50	95
d	13	330	84	95	92	183	133
n(%)	5	13	7	11	14	37	13
ascidians							
S	0	4	3	5	7	2	10
d	-	11	6	11	16	11	9
n(%)	-	0.5	0.5	1	2	2	1
echinoderms							
S	1	3	10	12	9	10	20
d	0.5	39	37	38	14	32	27
n(%)	0.2	2	3	4	2	7	3
minor taxa*							
S	2	8	6	4	3	4	18
d	8	62	27	11	9	10	21
n(%)	3	2	2	1	1	2	2
all taxa							
S	26	115	181	194	171	172	372
N	574	5362	2329	1764	1350	1017	12396
d	280	2612	1157	860	660	497	1010

* Minor taxa includes fish, insects, sipunculans, poriferans, nemerteans, pycnogonids, enteropneusts and hirudineans.

TABLE 2. *Abundances (%) of the dominant species — total abundances of 100 or greater — in each of the six habitat types.*

	intertidal	*Zostera*	*P. australis*	*P. sinuosa*	5m bare	10m bare	total
Tanais dulongii	26 (3)	819 (97)	-	-	-	1 (0.1)	846
Capitella "capitata"	51 (8)	611 (92)	-	-	-	-	662
Nereis bifida	-	31 (5)	577 (89)	29 (5)	7 (1)	1 (0.2)	645
Apseudes australis	-	513 (87)	63 (11)	2 (0.3)	7 (1)	3 (0.5)	588
Leitoscoloplos sp.	31 (5)	414 (71)	121 (21)	13 (2)	1 (0.2)	-	580
Nephtys gravieri	109 (20)	99 (18)	13 (2)	115 (21)	149 (27)	67 (12)	552
Ceratonereis sp. 1	248 (65)	8 (2)	34 (9)	14 (4)	69 (18)	10 (3)	383
Pista violacea	-	340 (91)	6 (2)	12 (3)	3 (0.8)	12 (3)	373
Platynympha longicaudata	2 (0.6)	291 (90)	22 (7)	8 (2)	-	-	323
Barantolla sp.	-	88 (31)	57 (20)	88 (31)	46 (16)	6 (2)	285
Austromytilus penectus	-	5 (2)	2 (0.8)	2 (0.8)	57 (21)	211 (76)	277
Nematonereis unicornis	-	-	103 (41)	118 (47)	25 (10)	7 (3)	253
Augeneria verdis	-	131 (55)	18 (8)	49 (20)	26 (11)	16 (7)	240
Tellina deltoidalis	-	226 (95)	-	8 (3)	5 (2)	-	239
Zeacumantis diemenensis	1 (0.5)	206 (99)	-	-	-	-	207
Eunice sp. 3	-	-	41 (21)	72 (36)	51 (26)	35(18)	199
Notomastus sp. 1		2 (1)	96 (52)	51 (27)	25 (13)	12 (6)	186
Tellina mariae	6 (3)	71 (41)	20 (12)	45 (26)	12 (7)	18 (10)	172
Leptosynapta dolabrifera	-	74 (49)	42 (28)	33 (22)	-	1 (0.7)	150
Asychis sp.	-	-	5 (4)	2 (1)	115 (82)	19 (13)	141
Cirriformia sp. 1	-	43 (34)	43 (34)	28 (22)	4 (3)	9 (7)	127
Caulleriella sp. 4	-	20 (18)	31 (27)	38 (34)	21 (19)	3 (3)	113
Eunice sp. 1	-	-	5 (5)	81 (74)	19 (17)	4 (4)	109
Diplocirrus sp.	-	92 (90)	3 (3)	4 (4)	1 (1)	2 (2)	102
Scoloplos simplex	1 (1)	74 (73)	17 (17)	4 (4)	4 (4)	1 (1)	101
Caulleriella sp. 3	-	7 (7)	35 (35)	43 (43)	14 (14)	1 (1)	100
totals	475 (6)	4165 (52)	1354 (17)	859 (11)	661 (8)	439 (6)	7953
total abundance (all species)	574	5362	2329	1764	1350	1017	12396
% abundance dominant/abundance total	83	78	58	49	49	43	64

the intertidal mud, which was by far the most species-poor habitat with only 27 species recorded (Table 1). The pattern of densities amongst the six habitats was generally similar to that of species richness except for the *Zostera* habitat. This habitat had the highest density of fauna (2612 individuals m^{-2}) with the second lowest species richness (115 spp.).

Overall, polychaetes and molluscs were the two dominant groups in terms of both numbers of species and individuals. The crustaceans were generally similar to the molluscs in species richness and abundance in the two *Posidonia* habitats and the intertidal mud, but were considerably reduced in the two subtidal unvegetated habitats. Echinoderms, ascidians and the

minor taxa were represented by only few species and typically few individuals in all habitats.

Of the 12,396 individuals collected 7,953 (64%) belonged to only 26 (7%) of the 375 species. The remaining 346 species were represented in most cases by only a few individuals (Appendix 1). Ninety-four species were represented by only a single individual in the collection and 155 species were present in only one habitat. Similar patterns have been found in other studies of the infauna of Australian seagrass beds (Collett *et al.* 1984; Hutchings *et al.* 1991).

The 26 dominant species were distributed unevenly between the six habitats (Table 2). The two most dominant species (*Tmais dulongi* and *Capitella "capitata"*) were almost exclusively restricted to the two intertidal habitats, and predominantly in the *Zostera*. Several other species also occurred predominantly in the *Zostera* habitat — *Apseudes australis*, *Leitoscoloplos normalis*, *Pista violacea*, *Platynympha longicaudata*, *Tellina deltoidalis*, *Zeacumantus diemenensis*, *Diplocirrus* sp. and *Scoloplos simplex*. *Nereis bifida* and *Eunice* sp. 1 occurred mainly in the *P. australis* and *P. sinuosa* habitats respectively, while *Asychis* sp. was mainly found in the 5 m subtidal bare habitat. Only four of the dominant species (*Nepthys gravieri*, *Ceratonereis* sp. 1, *Tellina mariae*, and *Scoloplos simplex*) were present in all six habitats. Twenty of the 26 dominants were found in all the subtidal habitats. Thus the dominant species could be separated into two groups: those dominant in the intertidal and those dominant in the subtidal, with few species common to both groups. A detailed analysis of the variability of species composition amongst individual habitats, sites, seasons and sediment characteristics will be presented elsewhere (Ward & Hutchings in prep.).

Comparisons with other areas

Intertidal unvegetated sediments

A recent study by Ainslie *et al.* (1989) of the infauna of intertidal unvegetated mudflats of Northern Spencer Gulf (about 60 km north of our study area) recorded a total of 99 species. These 99 species included 31 species of polychaetes, 31 molluscs, and 22 crustaceans. This is considerably greater than the total of 27 species which were recorded from intertidal unvegetated habitats in this study. The densities of individuals recorded in the Northern Spencer Gulf intertidal habitats (about 550 m^{-2}) was also considerably greater than those recorded in this study (280 m^{-2}). These differences may result from the different scales of sampling in the two studies or to real differences between the locations related to differences in the hydrological conditions between the two Spencer Gulf locations. Similar sampling techniques were used in both studies although Ainslie *et al.* used a 1 mm sized mesh, and 20 replicates were collected at each site in summer and winter from June 1982 to June 1986 inclusive, which is a far greater intensity of sampling than carried out in this study. The Ainslie *et al.* (1989) study sampled a total area of 33 m^2 in Northern Spencer Gulf whereas we sampled about 2 m^2. This difference in total area sampled and the extended temporal scale of the Northern Spencer Gulf study may have contributed to the greater number of species of infauna recorded. Alternatively, the Gulf near Port Pirie may have a depauperate intertidal infauna because of different salinity and temperature regimes.

The species composition of the infauna found by Ainslie *et al.* (1989) in Northern Spencer Gulf is not similar to that found in this study, with very few species being common to both areas. Ainslie *et al.* identified a total of 100 taxa to species level, and in this study we identified 178 taxa to species. Of these only 24 species are common to both Upper and Northern Spencer Gulf. Obviously, some of the taxa identified only to genus may, after further study, be found to occur in both regions. We suggest that this apparent difference in species composition may be related to the different hydrological regimes in these two regions of Spencer Gulf. Northern Spencer Gulf is characterised by high summer salinities, up to 48 ‰ (Nunes & Lennon 1986), and high summer temperatures with wide seasonal fluctuations 11 — 25 °C (Johnson 1981[4]; unpublished data quoted by Ainslie *et al.* 1989). Northern Spencer Gulf is separated from the Upper Gulf by a narrow channel just north of our study area, and this could be responsible for maintaining a different set of hydrological conditions between these two study areas, even though they are close to each other.

Posidonia australis seagrass beds

The low-intertidal seagrass habitat of *Posidonia australis* and *P. sinuosa*, in Northern Spencer Gulf, contained 147 species of infauna with a mean density of about 170 individuals m^{-2} (Ainslie *et al.* 1989). The most similar habitat in our study (*P. australis*) contained 181 species with an average density of 1157 individuals m^{-2}. Ainslie *et al.* do not give any indication of the density of seagrasses in this habitat, but, because *Posidonia* is basically a subtidal seagrass species, we presume that their sample location contained only scattered seagrass on the margins of more substantial subtidal beds of *P. australis*.

P. australis seagrass beds elsewhere in southern Australia have also been studied. In Table 3 the distributions of the major phyla present in *P. australis*

[4]JOHNSON, L. E. (1981) Hydrological data from Upper Spencer Gulf 1975-1978. Fisheries Res. Paper No. 3, 1-30 (Dept Fisheries, Adelaide, SA, unpubl.)

TABLE 3. Posidonia australis: *distribution of the major phyla (S = number of species, d = overall mean density).*

site	Polychaetes	Molluscs	Crustaceans	Echinoderms	Ascidians	Minor	Total
Albany (Hutchings *et al.* 1991)							
S	47	26	15*	11	11	4	113
d**	731	691	656	132	124	-	2327
Spencer Gulf (this study)							
S	94	34	34	10	3	6	181
d**	883	84	119	37	6	27	1156
NSW (Collett *et al.* 1984)							
S	134	51	106	#	#	32	323
d**	1656	285	710			113	2763

* amphipods not identified to species
\# echinoderms and ascidians included in minor phyla
** densities (number of individuals m^{-2}) calculated from total abundances and total area sampled (Albany = 1.2 m^2, Spencer Gulf = 2.014 m^2, NSW = 5.74 m^2).

in Albany, SW West Australia (35°03′27″S 117°03′27″W) (Hutchings *et al.* 1991) and at nine sites along the NSW coast from 32°13′S to 36°54′S (Collett *et al.* 1984) are compared with those occurring in Upper Spencer Gulf. Polychaetes dominated the infauna in these three geographical localities, both in terms of number of individuals and species. The average density of infauna in NSW *Posidonia* beds was twice that of Upper Spencer Gulf, although the NSW data were based on samples totalling 5.74 m^2 in area, collected at nine locations along the NSW coast. Similarly, the *P. australis* sampled in Albany (total area sampled 1.2 m^2) had a mean density of infauna about twice that found in Upper Spencer Gulf in this study.

The species composition of the infauna of *P. australis* in these three geographical areas is different, indicating that although *P. australis* has a wide distribution, occurring from Shark Bay in Western Australia around southern Australia to Wallis Lake on the central coast of NSW (Larkum & den Hartog 1989), the composition and density of its infauna vary according to location. The infauna may also be related to the density of the seagrasses themselves, but at the Upper Spencer Gulf and Albany sites the density and productivity of the *P. australis* beds are similar (Ward 1987; Walker *et al.* 1991). Collett *et al.* (1984) report only a qualitative assessment of the density of seagrass blades which cannot be related to the numeric values determined for the Upper Spencer Gulf and Albany sites. Therefore, because of both different sampling intensities and seagrass densities, it is not possible to directly compare the density or diversity of the infauna found by each of these studies.

In this study we also examined whether the feeding strategies employed by the infauna were similar regardless of geographical location. The fauna was assigned to one of five feeding categories (Table 4) for Upper Spencer Gulf, Albany and the nine locations

TABLE 4. Posidonia australis: *distribution of the fauna amongst feeding categories at Albany, Spencer Gulf and NSW (number of species (%)).*

location	herbivore	suspension	deposit	carnivore	omnivore
Albany (from Hutchings *et al.*, 1991)					
polychaetes	4 (9)	3 (7)	20 (44)	18 (40)	-
molluscs	7 (33)	7 (33)	1 (5)	6 (29)	-
crustaceans	-	-	5 (36)	9 (64)	-
ascidians	-	11 (100)	-	-	-
echinoderms	-	2 (15)	4 (31)	5 (38)	2 (15)
totals	11 (11)	23 (22)	30 (29)	40 (38)	2 (2)
Spencer Gulf (this study)					
polychaetes	11 (12)	12 (13)	40 (43)	30 (32)	1 (1)
molluscs	15 (44)	13 (38)	2 (6)	4 (12)	-
crustaceans	1 (3)	1 (3)	19 (56)	13 (38)	-
ascidians	-	3 (100)	-	-	-
echinoderms	1 (10)	1 (10)	3 (30)	5 (50)	-
totals	27 (16)	30 (17)	64 (37)	52 (30)	1 (1)
NSW (from Collett *et al.*, 1984)					
polychaetes	-	28 (21)	53 (39)	37 (28)	16 (12)
molluscs	10 (19)	24 (47)	7 (14)	4 (8)	1 (2)
crustaceans	3 (3)	4 (4)	28 (26)	20 (19)	44 (41)
totals	13 (5)	56 (19)	88 (30)	61 (21)	61 (21)

along the NSW coast. The designation of feeding categories was determined from the literature (mostly for related species) and from personal observations.

Carnivores, including scavengers, comprised 21 – 38% of the total infauna in a geographical region. The proportion of deposit feeders ranged between 29% (Albany) to 37% (Upper Spencer Gulf). Suspension feeders, which may feed on suspended particulate matter as well as plankton, were between 17 and 22% of the fauna (Table 4). There were major differences in the herbivore and omnivore fauna between locations, with ranges of 5% (NSW) to 16% (Upper Spencer Gulf), and 1% (Upper Spencer Gulf) to 21% (NSW) respectively. These data suggest that the distribution of feeding guilds varies according to geographical location. Perhaps future studies should consider the feeding category of fauna as well as their abundance, productivity and biomass in order to estimate the ecological importance of a species in shallow marine systems. Edgar (1990) used size structure of benthic macrofaunal communities to estimate faunal biomass and secondary productivity but he did not assign the fauna to feeding guilds which may be an additional useful qualitative descriptor for benthic communities.

Posidonia sinuosa seagrass beds

P. sinuosa occurs from Shark Bay to the Great Australian Bight (Larkum & den Hartog 1989). However, the infauna of *Posidonia sinuosa* has only been sampled at one other location in southern Australia – Albany in SW Western Australia (Hutchings *et al.* 1991). The density of the Albany infauna was twice that recorded from Upper Spencer Gulf in this study. This difference between the two faunas was largely the result of higher densities of molluscs, crustaceans and ascidians at Albany (Table 5). Conversely, Upper Spencer Gulf has a considerably increased species richness, the result of an increased number of polychaete species in Upper Spencer Gulf (Table 5). By comparison of the species lists in Hutchings *et al.* (1991) and Appendix 1 of this paper it is clear that there is little similarity in the species composition of the infauna between these two localities. Therefore, as for *P. australis*, the infauna of *P. sinuosa* appears to vary substantially between locations.

Despite the different species composition there was a considerable similarity in feeding types between Upper Spencer Gulf and Albany (Table 6). Deposit feeders, carnivores including scavengers, and

TABLE 5. Posidonia sinuosa: *distribution of the major phyla (S = number of species, d = overall mean density).*

site	Polychaetes	Molluscs	Crustaceans	Echinoderms	Ascidians	Minor	Total
Albany (Hutchings *et al.* 1991)							
S	40	24	18*	7	16	1	106
d**	711	259	611	54	140	-	1797
Spencer Gulf (this study)							
S	97	32	44	12	5	4	192
d**	630	95	76	38	11	11	860

* amphipods not identified to species.
** densities (number of individuals m^{-2}) calculated from total abundances and total area sampled (Albany = 1.2 m^2, Spencer Gulf = 2.052 m^2).

TABLE 6. Posidonia sinuosa: *distribution of the fauna amongst feeding categories at Albany and Spencer Gulf (number of species (%)).*

location	herbivore	suspension	deposit	carnivore	omnivore
Albany (from Hutchings *et al.*, 1991)					
polychaetes	3 (7)	6 (13)	18 (39)	19 (41)	-
molluscs	12 (50)	4 (17)	4 (17)	4 (17)	-
crustaceans	-	1 (6)	1 (6)	6 (35)	9 (53)
ascidians	-	14 (100)	-	-	-
echinoderms	-	1 (14)	2 (26)	2 (26)	2 (26)
totals	15 (14)	26 (24)	25 (23)	31 (29)	11 (11)
Spencer Gulf (this study)					
polychaetes	14 (14)	16 (16)	38 (39)	28 (29)	1 (1)
molluscs	9 (28)	12 (38)	3 (9)	8 (25)	-
crustaceans	-	2 (5)	22 (50)	20 (45)	-
ascidians	-	5 (100)	-	-	-
echinoderms	2 (17)	1 (8)	3 (25)	6 (50)	-
totals	25 (13)	36 (19)	66 (35)	62 (33)	1 (1)

suspension feeders were the dominant feeding types in *P. sinuosa* beds in both locations.

Conclusions

While species diversity in the subtidal seagrass beds is higher in Upper Spencer Gulf than in Albany, it is lower than in the seagrass beds of NSW. The density of individuals is far lower in Upper Spencer Gulf than elsewhere, and this may reflect the different temperature and salinity regimes in Upper Spencer Gulf compared to Albany and the nine locations along the NSW coast. Collett *et al.* (1984) concluded that hydrological conditions were important determinants in the composition of the infauna of seagrass beds, and more important than latitudinal effects. This study and the study of Albany (Hutchings *et al.* 1991) indicate that the conclusions of Collett *et al.* (1984) may also hold for the broader geographical region of southern Australia. Hydrological conditions may also be responsible for the difference between the Northern Spencer Gulf intertidal infauna (Ainslie *et al.* 1989) and the intertidal infauna of Upper Spencer Gulf observed in this study.

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Appendix 1 Summary of all data

Species	Family	Habitats						
		intertidal	*Zostera*	*Posidonia australis*	*Posidonia sinuosa*	5m bare	10m bare	sum
Harmothoe sp. 1	Polynoidae			5	7	3	1	16
Harmothoe sp. 2	Polynoidae						1	1
Harmothoe sp. 3	Polynoidae		2		1			3
Paralepidonotus ampulliferus	Polynoidae		1					1
Sigalion sp.	Sigalionidae			1	2	6	3	12
? *Sthenelais* sp.	Sigalionidae						1	1
Chrysopetalum sp.	Chrysopetalidae			1				1
Eumida sp.	Phyllodocidae		21	18	15	5		59
Paranaitis sp.	Phyllodocidae					1	4	5
Pteryosyllis sp. 1	Phyllodocidae						2	2
Phyllodoce sp. A	Phyllodocidae		49	17	4	6		76
*Eteone n.*sp.	Phyllodocidae		9	5	1		1	16
Genetosyllis sp.	Phyllodocidae			1			1	2
Phyllodocid sp. 5	Phyllodocidae		1	4		3		8
Podarke microantennata	Hesionidae			1	2			3
Podarke angustifrons	Hesionidae		11	9				20
Typosyllis sp. 1	Syllidae	1	1	17	3			22
Exogone sp.	Syllidae			2	2			4
Odontosyllis sp. 1	Syllidae				2			2
Odontosyllis sp. 2	Syllidae			2	1			3
Pionosyllis ehlersiaeformis	Syllidae			10	14	2	2	28
Syllinae sp. 2	Syllidae				2		7	9
Typosyllis sp. 2	Syllidae			52	20	1	1	74
Ehlersia sp.	Syllidae			15	22	1	1	39
Syllinae sp. 8	Syllidae			1				1
Ceratonereis mirabilis	Nereididae	1	6	14	3	4	4	32
Neanthes sp. 1	Nereididae		1			1	7	9
Neanthes bassi	Nereididae		10	15	3	2	13	43
Nereis bifida	Nereididae		31	577	29	7	1	645
Neanthes kerguelensis	Nereididae		6	9	56		3	74
Platynereis sp.	Nereididae		65	5	2	1		73
Neanthes sp. 3	Nereididae		1		7			8
Neanthes vaalii	Nereididae	45		1	1	1	1	49
*Ceratocephela n.*sp. 1	Nereididae					1		1
Neanthes sp. 2	Nereididae				1			1
Ceratonereis sp. 1	Nereididae	248	8	34	14	69	11	384
Ceratonereis aequisetis	Nereididae		4					4
Nereid sp. 20	Nereididae			2	1			3
Gymnonereis sp. 1	Nereididae					2		2
Nephtys gravieri	Nephytidae	109	99	13	115	139	67	542
Glycera americana	Glyceridae		3	2	5	5	3	18
Glycinde sp. 1	Glyceridae		31	12	9	4	3	59
Goniada maculata	Goniadidae					1		1
Onuphid sp. 1	Onuphidae		1	13	21	1		36
Nematonereis unicornis	Eunicidae			103	118	25	7	253
Eunicid juv sp. 1	Eunicidae				1			1
Marphysa sp. 1	Eunicidae	1		1	2	3	34	41
Marphysa sp. 2	Eunicidae	2	15	1	2	2		22
Lysidice sp. 1	Eunicidae			1	5			6
Eunice sp. 1	Eunicidae			5	81	19	4	109
Eunice sp. 3	Eunicidae			41	72	51	35	199
Eunice sp. 4	Eunicidae			7		6	2	15
Eunice sp. 6	Eunicidae			1	14	39	8	62
Eunice sp. 9	Eunicidae						3	3
Eunicid sp. 11	Eunicidae				1			1
Eunice sp. 5	Eunicidae			5	2	6		13
Augeneria verdis	Lumbrineridae		131	18	48	26	16	239
Lumbrineris sp. 1	Lumbrineridae		8	1	4	4	2	19
Arabella sp. 1	Arabellidae			9	8	11	3	31
Schistomeringos sp. 1	Dorvilleidae					7	1	8
Schistomeringos loveni	Dorvilleidae		19	16	6	16	7	64
Leitoscoloplos sp. 1	Orbiniidae			5	1	1		7
Phylo sp. 1	Orbiniidae			1	5			6
Naineris grubei australis	Orbiniidae			4	6			10

Appendix 1 Summary of all data (continued)

Species	Family	Habitats						
		intertidal	*Zostera*	*Posidonia australis*	*Posidonia sinuosa*	5m bare	10m bare	sum
Scoloplos simplex	Orbiniidae	1	74	17	4	4	1	101
Leitoscoloplos normalis	Orbiniidae	31	414	121	13	1		580
Family Orbiniidae	Orbiniidae		17	1			1	19
Aonides oxycephela	Spionidae						1	1
Spio sp. B	Spionidae			2			1	3
Prionospio sp. 2	Spionidae		1	2		1		4
Polydora sp. 1	Spionidae		2					2
Pseudopolydora sp. 1	Spionidae	5		1		4		10
Boccardia sp. 3	Spionidae						1	1
Boccardia sp. 2	Spionidae			1				1
Aquilaspio multipinnulata	Spionidae		7	1	9	1	2	20
Aquilaspio aucklandica	Spionidae		3			2	3	8
Spio pacifica	Spionidae				1			1
Scolelepis sp. 2	Spionidae				5	17	5	27
Pseudopolydora sp. 4	Spionidae					1	5	6
Malacoceros sp. 1	Spionidae			10	28	38	14	90
Scolelepis sp. 1	Spionidae				2	4		6
Spionidae sp. 2	Spionidae				1	1		2
Spionidae sp. 3	Spionidae		1				1	2
Boccardia sp. 1	Spionidae				1			1
Aricidea sp. 2	Pilargiidae		1	1	3	1		6
Magelona sp. 1	Magelonidae			2	5	1	1	9
Tharyx sp. 2	Cirratulidae			1				1
Caulleriella sp. 1	Cirratulidae				4	1		5
Caulleriella sp. 2	Cirratulidae		1	20	14	31	6	72
Caulleriella sp. 3	Cirratulidae		7	35	43	14	1	100
Caulleriella sp. 4	Cirratulidae		20	31	38	21	3	113
Cirriformia sp. 1	Cirratulidae		43	43	28	4	9	127
Cirriformia sp. 2	Cirratulidae		29	43	13	5	2	92
Cirratulid sp. 1	Cirratulidae		3	1	4	1		9
Diplocirrus sp.	Flabelligeridae		92	3	4	1	2	102
Scalibregma inflatum	Scalibregmatidae			5	2	11	2	20
Hyboscolex dichranochaetus	Scalibregmatidae			1				1
Armandia intermedia	Opheliidae		10	51	5	8		74
Heteromastus filiformis	Capitellidae		26	5				31
Capitella "capitata"	Capitellidae	53	608					661
Barantolla sp.	Capitellidae		88	57	88	46	6	285
Mediomastus n. sp.	Capitellidae		19	19	36	7	7	88
?Scyphoproctus sp. 1	Capitellidae		1		1	5	1	8
Scyphoproctus sp. 2	Capitellidae			7	2	7	1	17
Notomastus sp. 1	Capitellidae		2	96	51	25	12	186
Notomastus torquatus	Capitellidae			4	14	29	16	63
Leiochrides sp. 1	Capitellidae					3	1	4
Poecilochaetous serpens	Poecilochaetidae		1			2	8	11
Asychis sp.	Maldanidae			5	2	115	19	141
Petaloproctus sp.	Maldanidae		1	10	2	10	1	24
Praxillella sp.	Maldanidae			1	2	2		5
Maldanid sp. 3	Maldanidae						3	3
Owenia fusiformis	Oweniidae					5	3	8
Pectinaria sp. 1	Pectinaridae				1		3	4
Isolda pulchella	Ampharetidae					1	1	2
Ampharctid sp. 1	Ampharetidae			1	3	38	7	49
Ampharetid sp. 3	Ampharetidae				1			1
Lysilla pacifica	Terebellidae			11	4	4	7	26
Polycirrus sp. 1	Terebellidae			1			1	2
Polycirrus tesselatus	Terebellidae		4	5	26	1	3	39
Polycirrus cf. nephrosus	Terebellidae			1				1
?Decathelepus	Terebellidae						1	1
Thelepus plagiostoma	Terebellidae				1	2		3
Thelepus extensus	Terebellidae						1	1
Streblosoma sp.	Terebellidae					33	24	57
Lanassa exelysis	Terebellidae			6	18		1	25
Lysilla laciniata	Terebellidae			2	1		1	4
Pista australis	Terebellidae		18	16	11	6	12	63
Pista violacea	Terebellidae		440	6	12	3	12	473

Appendix 1 Summary of all data (continued)

Species	Family	Habitats						
		intertidal	*Zostera*	*Posidonia australis*	*Posidonia sinuosa*	5m bare	10m bare	sum
Neoleprea sp.	Terebellidae			4	8	3		15
Loimia ingens	Terebellidae					2		2
Lanassa ocellata	Terebellidae			7	2			9
Eupolymnia koorangi	Terebellidae		24	26	3	1	2	56
Nicolea amnis	Terebellidae		2		7		1	10
Lanicides fascia	Terebellidae						1	1
Amphitritinae sp. 3	Terebellidae			1		1		2
Amphitritinae sp. 4	Terebellidae					2		2
Terebellides stroemii	Trichobranchidae			7	6	5	1	19
Trichobranchus sp.	Trichobranchidae	1		4	4	1		10
Sabellid sp. 1	Sabellidae		87		1	3		91
Euchone variabilis	Sabellidae			2	5	2	4	13
Laonome sp. 1	Sabellidae						2	2
Sabellid sp. 3	Sabellidae				2	6	10	18
Sabellid sp. 4	Sabellidae						1	1
Galeolaria sp.	Serpulidae				3			3
Serpula sp. 2	Serpulidae			1				1
Serpula sp. 1	Serpulidae						1	1
Hydroides sp. 1	Serpulidae		10	4	7	4	1	26
total	**polychaetes**	498	2590	1779	1292	1029	497	7685
Haliotis sp.	Haliotidae				1			1
Amblychilepas nigrita	*Fissurellidae*		*16*	*1*				*17*
Amblychilepas cf. oblonga	Fissurellidae		1					1
Amblychilepas sp.	Fissurellidae		1					1
Emarginula sp.	Fissurellidae			1				1
Collisella sp.	Lotiidae		1					1
Naccula parva	Lotiidae			5	10			15
Isoclanculus dunkeri	Trochidae		2	3	4			9
Phasianotrochus cf. apicinus	Trochidae			3	1			4
Thaliotia sp.	Trochidae			1				1
Gena sp.	Trochidae					1		1
Micrastrea rutidoloma	Turbinidae		1	4	4			9
Phasianella australis	Turbinidae			1		1		2
Bembicium vittatum	Littorinidae		1					1
Triphorid sp. 1	Triphoridae					1	1	2
Zeacumantus diemenensis	Potamididae	1	206					207
Bittium sp. 1	Cerithiidae			2	1			3
Bittium sp. 2	Cerithiidae					4	1	5
Diala sp.	Dialidae			1	3	1		5
Gazameda iredalei	Turritellidae				2		1	3
Sabia conica	Hipponicidae		1			1		2
Zeacrypta immensa	Calyptraeidae						7	7
Sigapatella calyptraeformis	Calyptraeidae						3	3
Eunaticina umbilicata	Naticidae		2		2			4
Ectosinum zonale	Naticidae						1	1
Cominella eburnea	Buccinidae		2	1	2	2		7
Cominella sp.	Buccinidae				1			1
Nassarius pauperus	Nassariidae				1			1
Fusinus australis	Fasciolariidae					1	1	2
Dentimitrella cf. lincolnensis	Columbellidae			2	1			3
Splendrilla harpularia	Turridae				2			2
Conus anemone	Conidae			1	1			2
Scaeoleda verconis	Nuculidae						3	3
Solemya cf. australis	Solemyidae				1	16		17
Barbatia pistachia	Arcidae						2	2
Glycymeris flammea	Glycymeridae						1	1
Glycymeris radians	Glycymeridae				8			8
Limopsis cf. tenisoni	Limopsidae					1	5	6
Limopsis sp.	Limopsidae						5	5
Mytilus sp.	Mytilidae					3		3
Austromytilus penetectus	Mytilidae		5	2	2	57	211	277
Trichomya hirsuta	Mytilidae						3	3
Musculus cf. ulmus	Mytilidae		2	2	1	4	6	15
Musculus cf. paulucciae	Mytilidae			3	2	2	10	17
Modiolus albicostatus	Mytilidae						1	1

Appendix 1 Summary of all data (continued)

Species	Family	Habitats						
		intertidal	*Zostera*	*Posidonia australis*	*Posidonia sinuosa*	5m bare	10m bare	sum
Brachydontes erosus	Mytilidae		8	3		1		12
Atrina tasmanica	Pinnidae					1		1
Atrina sp.	Pinnidae						2	2
Pinna bicolor	Pinnidae					5	1	6
Electroma georgiana	Pteriidae		11	5	2	3	3	24
Electroma sp.	Pteriidae						2	2
Malleus meridianus	Malleidae					3	1	4
Vulsella vulsella	Malleidae			7				7
Equichlamys bifrons	Pectinidae					1	2	3
Lima nimbifer	Limidae						1	1
Monia ione	Anomiidae			1		18		19
Monia zelandica	Anomiidae						4	4
Anomia descripta	Anomiidae					2	2	4
Saccostrea "australis"	Ostreidae			1	3	3	19	26
Wallucina assimilis	Lucinidae	4	60	2	5	4		75
Cavitidens perplexa	Lucinidae		4	29	14	1	1	49
Myrtea bractea	Lucinidae				1			1
Venericardia sp.	Carditidae					1	1	2
Fulvia tenuicostata	Cardiidae					1		1
Chama ruderalis	Chamiidae						1	1
Dosinia histrio	Veneridae						1	1
Circe rivularis	Veneridae			1		1	3	5
Katelysia rhytiphora	Veneridae		2	11		15		28
Katelysia sp.	Veneridae	1	5				1	7
Placamen flindersi	Veneridae						13	13
Timoclea sp.	Veneridae			1	1	3	1	6
Mactra sp.	Mactridae			1			2	3
Tellina mariae	Tellinidae	6	71	20	45	12	18	172
Tellina deltoidalis	Tellinidae		226		8	5		239
Tellina sp. 1	Tellinidae						1	1
Tellina sp. 2	Tellinidae						7	7
Semele monilis	Semelidae						2	2
Laternula creccina	Laternulidae	11	48			2	6	67
Myadora complexa	Myochamidae				1	2	4	7
Frenamya patula	Pandoridae						1	1
Teredo	Teredinidae			2				2
Bivalve 2							1	1
Bivalve 4							2	2
Chiton sp. 1	Ischnochitonidae					1	2	3
Stenochiton longicymba	Ischnochitonidae			38	46			84
Stenochiton cf. pilsbryanus	Ischnochitonidae			10	17	2	1	30
Chiton sp. 2	Ischnochitonidae						1	1
Chiton sp. 3	Ischnochitonidae					2	4	6
Dorid sp. 1	Doridiidae			2				2
Dorid sp. 2	Doridiidae			1				1
Dorid sp. 3	Doridiidae		1					1
Philinopsis lineolata	Aglajidae						1	1
Philine sp.	Philinidae				1	1		2
Atys sp.	Haminoeidae			1				1
Salinator sp.	Amphibolidae	2						2
total	**molluscs**	25	677	169	194	185	374	1624
Nebaliidae sp. 1	Leptostracan			19	6			25
Paguroidea sp. 1				3	1		1	5
Grapsidae sp. 2	Grapsidae				1			1
Hemigrapsus spinosus	Grapsidae	1	31	2	2		1	37
Halicarcinus rostratus	Hymenosomatidae					1	3	4
Halicarcinus ovatus	Hymenosomatidae			2				2
Portunus pelagicus	Portunidae		1					1
Ebalia intermedia	Leucosiidae					3	3	6
Ebalia sp. A	Leucosiidae		2					2
Macrobrachium intermedium	Palaemonidae		9		2		2	13
Alpheus bidens	Alpheidae			4				4
Alpheus euphrosyne richardsoni	Alpheidae		2					2
Alpheus novaezealandiae	Alpheidae			2				2

Appendix 1 Summary of all data (continued)

Species	Family	Habitats						
		intertidal	*Zostera*	*Pasidonia australis*	*Posidania sinuosa*	5m bare	10m bare	sum
Alpheus sp.	Alpheidae		1					1
Metapenaeapsis navaeguineae	Penaeidae					1		1
Apseudes australis	Apseudidae		513	63	2	7	3	588
Apseudes sp. 1	Apseudidae		5		3	4	2	14
Apseudes sp. 2	Apseudidae		72	8	3			83
Kalliapseudes sp.	Apseudidae						1	1
Tanais dulangi	Tanaidae	26	819				1	846
Leptochelia ignota	Tanaidae		1	1			2	4
Cymadusa sp.	Amphithoidae	2	5	24	13			44
Ampithoidae sp. 1	Ampithoidae				2			2
Ampelisca toora	Ampeliscidae				2	1	1	4
Byblis cf. bega	Ampeliscidae					1		1
Pratolembos drummondae	Aoridae			17	22	3		42
Xenocheira fasciata	Aoridae					2		2
Bemlas strigilis	Aoridae			1				1
Ceradacus ramsayi	Melitidae				1		1	2
Maera mastersi	Melitidae			6	1	2		9
Maera sp.	Melitidae		1		2			3
Ceradocus dooliba	Melitidae				6			6
Ceradocus rubramaculatus	Melitidae					2		2
Ceradacus serratus	Melitidae			1		2		3
Cotteslae berringar	Melitidae			6	1			7
?Parelasmapus sp.	Melitidae			12	1			13
Melitidae sp. 1	Melitidae			1				1
Melitidae sp. 2	Melitidae			1				1
Melitidae sp. 4	Melitidae			3				3
Leucathoe ?commensalis	Leucothidae				1			1
Leucathae assimilis	Leucothoidae				1			1
Leucathae sp. 2	Leucothoidae						1	1
Leucothoe sp. 1	Leucothoidae						2	2
Waldeckia sp. 1	Lysianassidae					1		1
Waldeckia sp. 2	Lysianassidae					1		1
Waldeckia sp. 3	Lysianassidae			1				1
Parawaldeckia sp.	Lysianassidae				1			1
Tryphosella sp.	Lysianassidae				1			1
Ischyroceridae sp. 1	Ischyroceridae			3	5			8
Phoxocephalidae spp.	Phoxocephalidae			1	23	5	4	33
Atylus sp.	Dexaminidae				4			4
Paradexamine lanacoura	Dexaminidae				1	1		2
Paradexamine ?linga	Dexaminidae			1	2			3
Paradexamine moorehousei	Dexaminidae			1				1
Oedicerotid sp. 1	Oedicerotidae				1	1		2
Eusirid sp. 1	Eusiridae				1			1
Eusirid sp. 2	Eurisidae			2				2
Eusirid sp. 3	Eusiridae				1			1
Eusirid sp. 4	Eusiridae			1	3			4
Hyale sp.	Hyalidae		43					43
Tomituka doowi	Platyischnopidae				1			1
Natatalana wowine	Cirolanidae				6	12	3	21
Platynympha longicaudata	Sphaeromatidae	2	291	22	8			323
Cymodoce sp. 1	Sphaeromatidae					1		1
Cymodace sp. 2	Sphaeromatidae	2	49	18	9			78
Cymodoce bidentata	Sphaeromatidae				1			1
Limnaria sp. nov.	Limnoridae			1	5			6
Euidotea peronii	Idoteidae		4					4
Crabyzas langicaudatus	Idoteidae				1			1
Euidotea bakeri	Idoteidae		7					7
Leptanthura diemenensis	Paranthuridae					1		1
Accalathura bassi	Paranthuridae			2	1			3
Mesanthura stypandra	Anthuridae			1				1
Amakusanthura alearia	Anthuridae		3		1			4
Apanthura cf. *isotama*	Anthuridae				1			1
Haliaphasma sp. 1	Anthuridae		3	3	3	1		10
Callianassa sp.	Callianassidae					1	6	7
Gomeza bicornis	Corystidae				2	4		6

Appendix 1 Summary of all data (continued)

Species	Family	Habitats						
		intertidal	*Zostera*	*Posidonia australis*	*Posidonia sinuosa*	5m bare	10m bare	sum
Ceratoplax punctata	Goneplacidae			4				4
Litocheira bispinosa	Goneplacidae			3	1			4
Actumnus setifer	Pilumnidae						1	1
total	**crustaceans**	33	1862	240	156	58	38	2387
Ascidiidae sp. 1	Ascidiidae		18			2		20
Ascidiidae sp. 2	Ascidiidae		3	1				4
Ascidiidae sp. 3	Ascidiidae				1	1	16	18
Ascidiidae sp. 4	Ascidiidae				5	1		6
Ascidiidae sp. 5	Ascidiidae				1			1
Ascidiidae sp. 6	Ascidiidae					2		2
Microcosmus sp. 1	Pyuridae		3	10	11	2		26
Didemnid sp. 1	Didemnidae		1					1
Pyura stolonifera	Pyuridae			1	4	20	6	31
Polycarpa ?pedunculata	Ascidiacea					4		4
total	**ascidians**	0	25	12	22	32	22	113
Pentacta ignava	Cucumariidae				1			1
Cucumella mutans	Phyllophoridae				1			1
Thyone sp.	Phyllophoridae						1	1
Scoliorhapis sp. ?nov.	Chiridotidae			1	5	5	1	12
Trochodota shepherdi	Chiridotidae			1			3	4
Leptosynapta dolabrifera	Synaptidae		74	42	33		1	150
Order Synaptid	Synaptidae			3				3
Thymio sycia	Holothuriidae			1				1
Goniocidaris tubaria	Cidaridae						1	1
Temnopleurus michaelseni	Temnopleuridae				1	3	14	18
Tosia australis	Goniasteridae			1	3			4
Patiriella exigua	Asterinidae		1					1
Amphipholis squamata	Amphiuridae		5	2		3	1	11
Amphiura elandiformis	Amphiuridae				1	1	23	25
Amphiura parviscutata	Amphiuridae			10	4	12	20	46
Amphiura (Fellaria) sp.	Amphiuridae				2	1		3
Amphiura trisacantha	Amphiuridae			3	9		1	13
Amphiura sp.	Amphiuridae	1		10	15	1		27
Ophiocentrus pilosus	Amphiuridae				3	1		4
Ophioconis opacum	Ophiodermatidae					1		1
total	**echinoderms**	1	80	74	78	28	66	327
Syngnathus phillipi	Syngnathidae		3					3
Favonigobius lateralis	Gobiidae		4					4
Pseudogobius olorum	Gobiidae		2					2
Callogobius mucosus	Gobiidae			5				5
Heteroclinus sp.					1			1
Ophiclinops varius					1			1
Gymnapistes marmoratus	Scorpaenidae		4					4
Platycephalidae				1				1
Vanacampus sp.			1					1
Nemertean	Nemertean		6	5	1	3	2	17
Enteropneust							5	5
Pycnogonid				2				2
Hirudinea				1				1
Sipunculan		1	10	41	19	14	11	96
insects		16						16
Porifera sp. 1							2	2
Porifera sp. 2			98					98
Porifera sp. 3						1		1
total	**minor taxa**	17	128	55	22	18	20	260
Total		574	5362	2329	1764	1350	1017	12396