THE MACROBENTHIC FAUNA OF *HALOPHILA* SEAGRASS MEADOWS IN NEW SOUTH WALES

P.J. GIBBS
Division of Fisheries
Department of Agriculture
PO Box K220
Haymarket NSW 2000

G.B. MAGUIRE
Division of Fisheries
Department of Agriculture
Brackish Water Fish Culture Research Station
Salamander Bay NSW 2301

L.C. COLLETT
Division of Fisheries
Department of Agriculture
(now at: Port Phillip Authority
250 Victoria Parade
East Melbourne Victoria 3002)

INTRODUCTION

The fauna of seagrass meadows is a topic which has received considerable worldwide attention in recent years. Australia has been no exception and the extensive literature on Australian seagrass beds is reviewed by Rainer and Fitzhardinge (1981) and Hutchings (1982). These reviews cover floristics, productivity, fauna and importance of the seagrass habitat as a renewable resource. However, most attention has been given to the major seagrass communities of *Zostera capricorni* and *Posidonia australis*.

Thus, although there now exists considerable information concerning the benthic fauna of these communities, data on the fauna of *Halophila* meadows are limited to more general studies where *Halophila* occurred as one habitat type. The paucity of information on the macrobenthos of *Halophila* meadows has lead to this collation of relevant, previously unpublished data which resulted from sampling programmes carried out by the New South Wales Division of Fisheries.

This study describes and compares the macrobenthic fauna of *Halophila* meadows in two similar estuaries; southern Botany Bay and Port Stephens. Comparisons are also made with published Australian literature for macrobenthic fauna of *Halophila* meadows in Moreton Bay, Queensland, a semi-enclosed embayment (Poiner, 1980) and Tuggerah Lakes, New South Wales, a coastal barrier lagoon (Powis and Robinson, 1980).

STUDY AREA

A general description of the geomorphology of estuaries in south-eastern Australia is provided by Bird (1967). Drowned river valleys and coastal lagoons of Pleistocene origin predominate. The coastal entrance environment of these estuaries is characterised by high wave energy and long period swells, with a moderate tidal range (Jennings and Bird, 1967). Recent evolutionary models classify southern Botany Bay (Lat 34°01' S, Long 151°08' E) and Port Stephens (Lat 32°41' S, Long 152°04' E) as drowned river valley estuaries at an early stage of infilling (Roy *et al.*, 1982).

The distribution of seagrass species within the two estuaries has been mapped by West *et al.* (1984). The hydrological characteristics of Botany Bay have been described by the State Pollution Control Commission (SPCC) (1979). The sedimentary environments in which the *Halophila* meadows of southern Botany Bay and Port Stephens are found are medium grade sands with approximately 20% silt (SPCC, 1978 and Maguire *et al.*, 1984).

The meadows of *Halophila* found in the two estuaries are principally of *H. ovalis* Hook though some *H. decipiens* Ostenfeld does occur (Jacobs, pers. comm.).

MATERIALS AND METHODS

Random sampling within a 50 m² area, using a diver operated corer of area 0.0314 m² to a depth of 100 mm in *Halophila* meadows yielded 32 samples at Towra Point in Botany Bay and 65 samples at Fenninghams Island in Port

Stephens. The sampling dates are shown in Table 1.

TABLE 1

Sampling dates and number of *Halophila* macroinvertebrate faunal samples collected

Location	No: of samples	Date
Botany Bay	32	Apr 73
Port Stephens	13	Jan 76
Port Stephens	13	Mar 76
Port Stephens	13	Apr 76
Port Stephens	13	Jul 76
Port Stephens	13	Jan 77

The collected samples were washed through a 1 mm sieve and preserved in 10% formalin. The macrofauna was subsequently sorted from the residual vegetation prior to identification and enumeration.

The adequacy of the sampling programme was assessed using a computer program to calculate smoothed and averaged species area curves where the average number of species was calculated for all possible combinations (C) of choosing the xth sample from a total of n samples without replacement by

$$C_x^n = \frac{n!}{x!(n-x)!} \quad \text{with } 0! = 1$$

The community site characteristics were determined on the basis of simple numeric indices and for each site species were categorized as dominant (the smallest number of species which when ranked in order of abundance account for greater than 50% of the total number of individuals at the site) and common (present in greater than 50% of the samples at the site) using the methods of Collett *et al.* (1984). Species characteristics are discussed on the basis of feeding categories: 1) herbivores (grazers), 2) suspension (filter) feeders, 3) deposit feeders, 4) carnivores, 5) omnivores and 6) unknown.

RESULTS

The fauna from the *Halophila* meadows at the two sites consisted of 129 species, comprising 47 species of polychaetes (36%), 37 species of crustaceans (29%), 32 species of molluscs (25%) and 13 species from other taxa (10%). There were 26 species which occurred at both sites and 65% of these were polychaetes (Appendix).

Though the 65 samples from Port Stephens were collected over time in conjunction with a study of the macrobenthos of prawn farming ponds, it was demonstrated that no readily discernible seasonal trends were evident in the data (Maguire *et al.* 1984). Therefore, for the purpose of describing and comparing the fauna of *Halophila* meadows, all of the samples were pooled.

TABLE 2

Numerical site characteristics of the macroinvertebrate fauna in two *Halophila* meadows

Location	No: Cores	Number Species	Number Individuals	Mean No: Species per Core	No: Individuals per m²
Botany Bay	32	87	3014	23.5	3014
Port Stephens	65	68	1484	7.0	742

The numerical site characteristics (Table 2) reveal a major contrast in the fauna at the two sites. The sample area standardised characteristics (mean number of species per core and number of individuals per m²) show that Port Stephens was relatively depauperate compared with Botany Bay.

The smoothed and averaged species area curves for the two estuaries are shown in Fig. 1. The most obvious difference between the two localities is that in Botany Bay which has more species and individuals, an adequate sample of the population (greater than 80%) information content is obtained in only 10 cores, whereas 37 cores are required at the Port Stephens site.

The community of animals at each site is best characterised by the dominant and common species (Table 3). The Botany Bay samples contained 5 dominant species which were also common, while the Port Stephens samples contained 3 dominant species of which 2 were also common. The common species in Botany Bay totalled 20 while at Port Stephens there were 4. No species was dominant at both sites, although *Magelona dakini* and *Euchone* sp. were present at both. There was no distinctive faunal species assemblage of *Halophila* meadows.

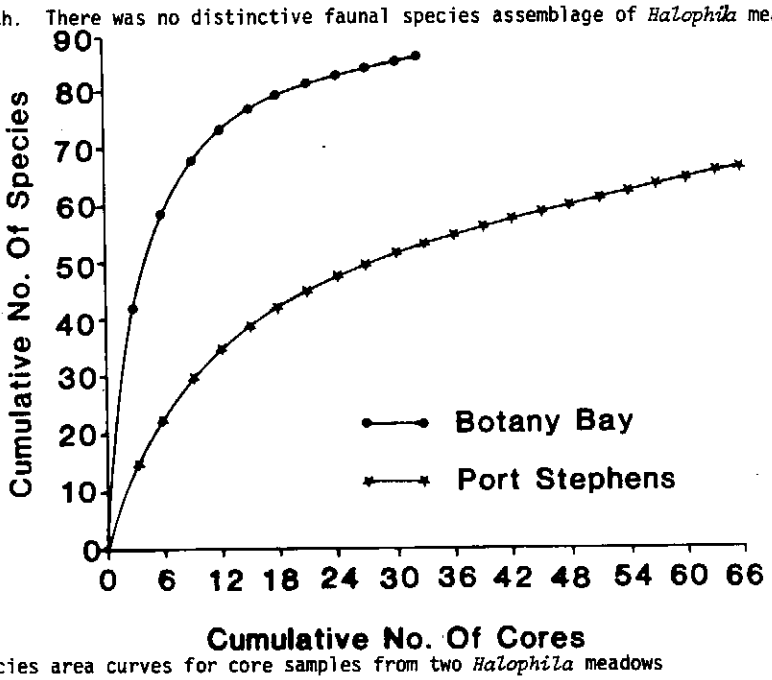


Figure 1 Species area curves for core samples from two *Halophila* meadows

TABLE 3

Total abundance of dominant and common macroinvertebrate species in two *Halophila* meadows: D=dominant, C=common

Organism	Botany Bay	Port Stephens
Mediomastus californiensis	691 D, C	
Euchone sp.	46 C	423 D
Heteromastus filiformis	329 D, C	
Demospongiae Species A		269 D, C
Spio filicornis	239 D, C	
Eunice australis	226 D, C	
Nephtys australiensis		169 D, C
Mysella sp.	146 D, C	
Glycera americana	107 C	
Prionospio sp.	105 C	
Leptanthura sp.	104 C	
Ampeliscaphotis sp.	81 C	
Caprella sp.	76 C	
Birubius sp.	61 C	
Owenia fusiformis	47 C	
Magelona dakini	46 C	41 C
Notomastus torquatus	43 C	
Pista typha		42 C
Cirriformia filigera	41 C	
Amphicteis gunneri	37 C	
Syllis Species 4	35 C	
Photis sp.	34 C	
Solen correctus	23 C	

The fauna at the two sites is dominated by polychaetes, crustaceans and molluscs, and among the taxa the five feeding categories are unequally represented (Table 4). Herbivores are rare (1.5%) while deposit feeders dominate (33.5%), principally polychaetes and crustaceans. The overall representation by the different feeding categories

is similar to that observed in other studies of different seagrass species (Rainer and Fitzhardinge, 1981; Robertson, 1978; Collett *et al.*, 1984).

TABLE 4

Feeding categories of the macroinvertebrate fauna in *Halophila* meadows of Botany Bay (BB) and Port Stephens (PS) (percentages in brackets)

Feeding Category	Polychaetes BB	Polychaetes PS	Crustaceans BB	Crustaceans PS	Molluscs BB	Molluscs PS	Other taxa BB	Other taxa PS	Total*
Herbivores	–	–	–	–	–	2	–	–	2 (1.5)
Filter feeders	5	3	3	2	11	3	–	5	29 (22.5)
Deposit feeders	19	12	12	3	–	5	1	–	43 (33.5)
Carnivores	9	7	5	1	4	7	1	6	31 (24.0)
Omnivores	5	3	10	5	1	–	–	1	20 (15.5)
Unknowns	–	1	1	–	–	2	–	–	4 (3.0)
Total for the taxa*	47(36)		32(29)		37(25)		13(10)		129 (100)

*These values include species occurring at both sites once only.

DISCUSSION

The samples collected at each site in this study are separated by 3 years and the authors recognise that year to year variations could occur in the macrobenthic fauna of a site. However, based on other research (Collett *et al.*, 1984) site differences are considered greater than seasonal and yearly variation.

The data show that the macrobenthic fauna of two *Halophila* meadows in similar estuarine habitats has a very heterogeneous species composition, yet is homogeneous in terms of trophic structure, with deposit feeding polychaetes dominating. Though the total number of species present in the *Halophila* meadows is less, the structural arrangement of the fauna is similar to that in Australian *Posidonia* and *Zostera* meadows (Hutchings, 1982; Collett *et al.*,1984) and does not support the conclusions of Kikuchi and Pérès (1977) that there is a 'characteristic' seagrass-associated macrofauna.

The low species richness in the *Halophila* meadows when compared with *Zostera* and *Posidonia*, is probably a result of the reduced structural complexity of the physical habitat, a characteristic which is important in determining macrofaunal species richness and abundance in seagrass meadows (Heck and Wetstone, 1977 and Lewis and Stoner, 1983). This is consistant with the low structural complexity of *Halophila* and its often transitory nature. The latter because the species undergoes rapid growth and colonises denuded areas (den Hartog, 1970). *Halophila* meadows are often replaced by *Zostera* and later *Posidonia* (den Hartog, 1970).

The large variations in the density of individuals, and to a lesser extent the species richness at the two locations is possibly related to the nature of the *Halophila* meadows. In Port Stephens the meadows have a lower and more variable plant density (pers. obs.) and are located on the deep water edge of medium density *Posidonia australis* meadows. In Botany Bay the area sampled was a dense meadow of plants averaging 900 nodes/m², which was surrounded by encroaching meadows of both *Posidonia australis* and *Zostera capricorni*. These surrounding meadows have replaced much of the original *Halophila* meadow in recent years (personal observation).

The potential colonisation by fauna from encroaching species-rich seagrass meadows into a meadow of *Halophila* is greater at the Botany Bay site (Towra Point) where 70% of the macrobenthic species are common to the fauna of adjoining *Posidonia* meadows sampled by Collett *et al.* (1984) and 46% with the fauna of adjoining *Zostera* (Gibbs unpub. data). By comparison, the Port Stephens site (Fenninghams Island) had only 26% of the species common to adjoining *Posidonia* meadows (no data on the surrounding bare substrate areas are available). This relationship of the *Halophila* meadow fauna to the fauna in surrounding habitats supports in part the concept that *Halophila* is a pioneering species often replaced by other seagrass species and hence associated fauna (den Hartog, 1970).

Poiner (1980) sampling in Moreton Bay, a semi-enclosed embayment, collected 280 (0.1 m²) samples over time at 20 locations, in bare sand, permanent *Halophila* and transient *Halophila*. A total of 137 species of macroinvertebrates was recorded. While many species occur in *Halophila* meadows, only 35 are considered '*Halophila* specialists'. At the generic level, only the polychaete *Cirriformia* is represented in the list of common species in the present study (Table 3). Based on species collected from all habitats sampled, a comparison of the 'common species' in Moreton Bay *Halophila* meadows (defined as having an abundance greater than 140 from the 280 samples) with those in Table 3, reveals only two similar genera: the polychaetes *Prionospio* and *Nephtys*. The faunal abundance recorded by

Poiner (1980) for the permanent *Halophila* meadows was 1700 indiv/m² and for the transient meadow a range of 200 to 2500 indiv/m². These values are between those recorded from Botany Bay and Port Stephens (Table 2) and again reflect the possible correlation between habitat complexity and species abundance.

Powis and Robinson (1980), sampling in Tuggerah Lakes, a coastal barrier lagoon, collected 116 (0.027 m²) samples at 58 locations in a range of habitats (mud, sand, *Halophila*, *Zostera* and *Ruppia*). They recorded 33 species of macroinvertebrates of which four were common though not unique to the *Halophila* meadows. One of these, *Owenia fusiformis*, is also common in our study (Table 3) while *Cyathura* sp. and *Barantolla lepte*, both common in Tuggerah Lakes *Halophila* meadows, were also recorded in this study (Appendix). Powis and Robinson (1980) further commented on low faunal diversity in *Halophila* compared with associated *Zostera* meadows.

In summary, a comparison of the Botany Bay and Port Stephens data with the other studies confirms the heterogeneous nature of the macrobenthic faunal species composition between different *Halophila* meadows, the association of the *Halophila* meadow fauna with that of surrounding habitats, and the low macrobenthic faunal diversity of *Halophila* meadows compared to that in *Zostera* and *Posidonia* habitats.

REFERENCES

Bird, E.G.F. (1967) Coastal lagoons of south eastern Australia. *In* Landform Studies in Australia and New Guinea. (Eds J.N. Jennings and J.A. Mabbutt). Aust. Acad. Sci., Canberra, pp. 366-395.

Collett, L.C., P.A. Hutchings, P.J. Gibbs and A.J. Collins (1984) A comparative study of the macrobenthic fauna of *Posidonia australis* seagrass meadows in New South Wales, Australia. Aquat. Bot. 18: 111-134.

den Hartog, C. (1970) The Seagrasses of the World. North-Holland, Amsterdam. 275 pp.

Heck, K.L. and G.S. Wetstone (1977) Habitat complexity and invertebrate species richness and abundance in tropical seagrass meadows. J. Biogeog. 4: 135-142.

Hutchings, P. (1982) The fauna of Australian seagrass beds. Proc. Linn. Soc. N.S.W. 106(2): 181-200.

Jennings, J.W. and E.C.F. Bird (1967) Regional geomorphological characteristics of some Australian estuaries. *In* Estuaries (ed G.H. Lauff). Am. Ass. Adv. Sci., pp. 121-128.

Kikuchi, T. and J.M. Pérès (1977) Consumer ecology of seagrass beds. *In* Seagrass Ecosystems: A Scientific Perspective. (Eds C.P. McRoy and C. Helfferich). Marcel Dekker, New York, pp. 147-194.

Lewis, F.G. and A.W. Stoner (1983) Distribution of macrofauna within seagrass beds: An explanation for the patterns of abundance. Bull. Mar. Sci. 33(2): 296-304.

Maguire, G.B., P.J. Gibbs and L.C. Collett (1984) The macro-benthic fauna of brackish water prawn farming ponds at Port Stephens, New South Wales. Aust. Zool. (In press).

Poiner, I.R. (1980) A comparison between species diversity and community flux rates in the macrobenthos of an infaunal sand community and a seagrass community of Moreton Bay, Queensland. Pro. Roy. Soc. Qld. 91: 21-36.

Powis, B.J. and K.I.M. Robinson (1980) Benthic macrofaunal communities in the Tuggerah Lakes, N.S.W. Aust. J. mar. Freshwater Res. 31: 803-815.

Rainer, S.F. and R. Fitzhardinge (1981) Benthic communities in an estuary with periodic deoxygenation. Aust. J. mar. Freshwater Res. 32(2): 227-243.

Robertson, A.I. (1978) Trophic interactions among the macrofauna of an eelgrass community. Doctoral dissertation, University of Melbourne.

Roy, P.S., B.G. Thom and L.D. Wright (1980) Holocene sequences on an embayed high energy coast: an evolutionary model. Sedimentary Geo. 26: 1-19.

Roy, P.S. (1982) Evolution of N.S.W. estuary types. Conference paper, Management of Estuaries conference. WRFA, Sydney, 27 pp.

State Pollution Control Commission (1978) Bottom sediments of Botany Bay. SPCC Report BBS 2. 31 pp.

State Pollution Control Commission (1979) Tidal water movement in Botany Bay. SPCC Report BBS 13. 40 pp.

West, R.J., C.A. Thorogood, T.R. Walford and R.J. Williams (1984) An estuarine inventory for New South Wales. Div. Fish. Tech. Rep. (In prep).

APPENDIX

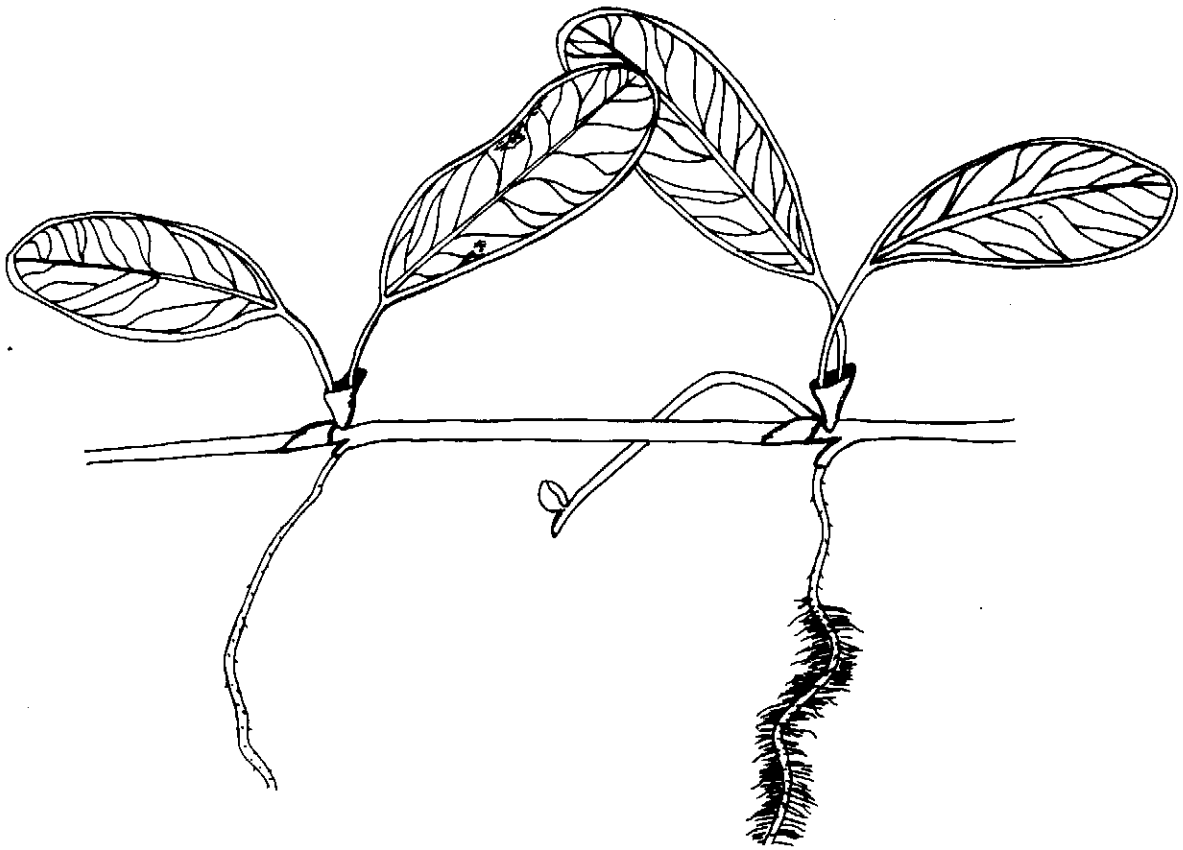
Macroinvertebrate species and their trophic categories in two *Halophila* meadows: 1 herbivores, 2 suspension feeders, 3 deposit feeders, 4 carnivores, 5 omnivores, 6 unknown.

Organism	Trophic category	Botany Bay	Port Stephens
PORIFERA			
Demospongiae			
Species A	2		x
Species B	2		x
CNIDARIA			
Hydrozoa			
Species A	2		x
Anthozoa			
Sea pen	2		x
NEMERTINEA			
Species A	4	x	x
ANNELIDA			
Polychaeta			
Amaeana trilobata	3	x	x
Amphicteis gunneri	3	x	x
Australonereis ehlersi	5	x	x
Barantolla lepte	3	x	x
Capitella capitata	3	x	x
Ceratonereis sp.	5	x	
Cirriformia filigera	3	x	
Diopatra sp.	2	x	
Euchone sp.	2	x	x
Eunice australis	5	x	
Gylcera americana	4	x	x
Haploscoloplos sp.	3	x	
Harmothoe praeclara	4	x	
Heteromastus filiformis	3	x	x
Laonome sp.	2		x
Leitoscoloplos sp.	3	x	
Leonnatus stephensoni	5		x
Lumbrineris latreilli	4	x	x
Lysilla pacifica	3	x	
Lysidice sp.	5	x	
Magelona dakini	3	x	x
Maldane sasi	3	x	x
Marphysa sanguinea	5		x
Mediomastus californiensis	3	x	x
Mesochaetopterus sp.	2	x	
Naineris grubei australis	3	x	
Neanthes cricognatha	5	x	
Nephtys australiensis	5	x	
Notomastus torquatus	3	x	x
Odontosyllis sp.	4		x
Owenia fusiformis	2	x	x
Phyllodoce novaehollandiae	4	x	x
Pista typha	3		x
Polyeunoa sp.	4	x	
Prionospio sp.	3	x	
Scalibregma inflatum	4		x
Scolaricia sp.	3	x	

Organism	Trophic Category	Botany Bay	Port Stephens
Cumacea			
Anchicolurus sp.	2	x	
Colurostylis sp.	2	x	
Tanaidacea			
Species A	5	x	x
Isopoda			
Cirolana woodjonesi	4	x	
Cyathura sp.	4	x	
Cymadoce c.f. aculeata	4	x	
Leptanthura sp.	4	x	x
Neasticilla deducta	5	x	
f. Sphaeromidae sp. 1	4	x	
Amphipoda			
Amaryllis sp.	3	x	
Ampelisca sp.	3	x	
Ampelisciphotis sp.	3	x	
Aora sp.	2	x	
Birubius sp.	3	x	
Caprella sp.	5	x	
Cerapus sp.	3	x	
Corophium sp.	3		x
Ericthonius sp.	3	x	
Gammaropsis sp.	3	x	
Hippomedon sp.	3	x	
Hyale rubra	3		x
Leucothoella gracilis	5	x	
Liljeborgia sp.	5	x	x
Megamphopus sp.	3	x	
Metaprotella haswelliana	5	x	
Monoculoides sp.	3		x
Paraoroides sp.	2		x
Parawaldeckia sp.	3	x	
Photis sp.	3	x	
Siphonocetes sp.	3	x	
Unknown sp.	6	x	
Decapoda			
Alpheus sp.	5	x	x
Callianassa arenosa	5	x	x
Dromidia sp.	5		x
Hippolyte tenuirostris	5	x	
Thalamita intermedia	5	x	
SIPUNCULIDA			
Species A	4		x
PHORONIDA			
Species A	4		x
ECHINODERMATA			
Holothuroidea			
Species A	3	x	
Ophiuroidea			
Species A	4		x
Species B	4		x
Species C	4		x

Organism	Trophic Category	Botany Bay	Port Stephens
Scoloplos simplex	3	x	
Serpulid sp. 1	2	x	
Spio filicornis	3	x	
Spio pacifica	3	x	
Sthenelais sp.	4	x	x
Streblosoma acymatum	3		x
Syllis sp. 4	4	x	
Terebellides stroemii	3		x
Trypanosyllis sp.	4	x	
Unknown sp.	6		x
MOLLUSCA			
Gastropoda			
Adamnestia sp.	3		x
Agnewia sp.	4		x
Aplysia sp.	1		x
Bedeva hanleyi	4	x	
Bittium lucertinus	4	x	
f. Columbellidae sp. 1	5	x	
Conuber sordidum	4	x	x
Cylichna sp.	3		x
Nassarius burchardi	4	x	x
Nassarius sp.	4		x
Onchidella patelloides	1		x
Tanea sagittata	4		x
f. Turridae sp. 1	4		x
f. Turridae sp. 2	4		x
Unknown sp.	6		x
BIVALVIA			
Anadara trapezia	2	x	
Dosina sp.	2	x	
Epicodakia tatei	2	x	
Ennuncula sp.	2		x
Irus crenatus	2	x	
Laternula creccina	2		x
Musculus sp.	2	x	
Mysella sp.	2	x	
Notospisula trigonella	2	x	x
Paphia undulata	2	x	
Placamen sp.	2		x
Sanguinolaria donacoides	3		x
Solen correctus	2	x	
Tellina deltoidalis	3		x
Wallucina assimilis	2	x	
Xenostrobus securis	2	x	
Unknown sp.	6		x
ARTHROPODA			
Pycnogonida			
Species A	5		x
Crustacea			
Mysidacea			
Australomysis sp.	2		x

Organism	Trophic Category	Botany Bay	Port Stephens
CHORDATA			
Ascidiacea			
Pyura sp.	2		x



Halophila ovalis

COAST AND WETLANDS SOCIETY

In June 1981 the Australian Littoral Society (NSW Division) changed its name to the Coast and Wetlands Society.

The aims and objectives of the Society are:

- to promote the appreciation and conservation of all aspects of coast and wetland ecosystems;
- to promote the application of ecological principles in the conservation, development and utilisation of coastal and wetland ecosystems;
- to advise governmental and other agencies, where the Society may be of assistance;
- to conduct research into aspects of coastal wetland ecology;
- to publish results of scientific investigations and other material designed to encourage conservation and appreciation of coastal and wetland ecosystems;
- to increase public knowledge and awareness of aspects of coastal and wetland ecology and conservation.

Members of the Society receive a regular Newsletter and its annual journal 'Wetlands'. Membership affords the opportunity to be actively involved in conservation of our coastal and wetland resources, through our research and educational programmes.

Paul Adam,
President.

APPLICATION FOR MEMBERSHIP:

Please write, with appropriate remittance to:

The Secretary,
Coast and Wetlands Society,
Box A225, P.O.,
SYDNEY SOUTH,
N.S.W. 2000.

Annual Subscription:

	$
Student	7.00
Ordinary	10.00
Family	15.00
Institution	15.00
Library	15.00

The financial year of the Society is from January to January.