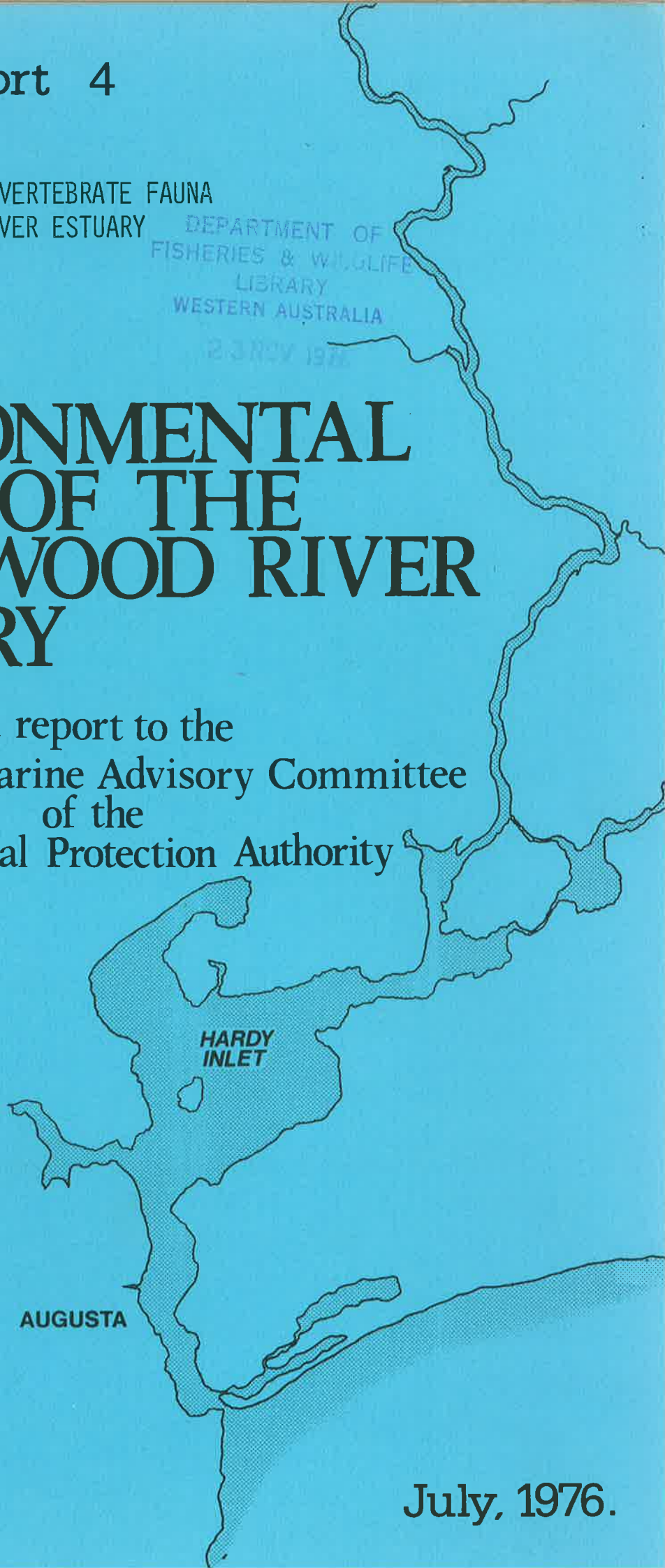
Technical Report 4

THE MACROBENTHIC INVERTEBRATE FAUNA
OF THE BLACKWOOD RIVER ESTUARY

ENVIRONMENTAL STUDY OF THE BLACKWOOD RIVER ESTUARY

a report to the
Estuarine and Marine Advisory Committee
of the
Environmental Protection Authority



July, 1976.

THE MACROBENTHIC INVERTEBRATE FAUNA OF THE BLACKWOOD RIVER ESTUARY

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CONTENTS PAGE

FIGURES

TABLES

The Macrobenthic Invertebrate fauna of the Blackwood River Estuary.

Introduction

The ecology of the macrobenthic invertebrate fauna of the Blackwood River Estuary was investigated as part of a broad study encompassing both physical and biological factors of the estuary. The macrobenthic fauna was defined as "all those invertebrates living in the bottom sediment or amongst the benthic aquatic plants which were retained by a one millimetre mesh sieve."

Students from the University of Western Australia have studied three macrobenthic invertebrate species in the Blackwood River Estuary in great detail. Bray (in prep.) studied the shrimp *Palaemonetes australis*, while Smith (1975) studied the snails *Nassarius pauperata* and *N. burchardi*. Invertebrates in the Swan River Estuary have been more extensively investigated (Serventy, 1955, Blackwell *et al.* 1969).

The study of the invertebrates at the Blackwood River Estuary had three specific objectives; firstly, to determine which species were resident in the estuary; secondly, to show the seasonal distribution of these species in the estuary; and thirdly, to obtain a measure of their relative abundance. It was envisaged that this information would be pooled with information acquired in other segments of the Blackwood Study to provide an understanding of the total ecology of this one estuary. No similar study has been attempted previously in a West Australian estuary. However, larger and more comprehensive studies have been undertaken at Port Phillip Bay (Environmental Study, Port Phillip Bay 1973) and Western Port Bay (Final Report in preparation) on the east coast of Australia.

Methods

Sediment samples were taken to a depth of approximately 18 cm with a cylindrical corer (surface area of 80 sq. cm) in shallow water and with an Ekman grab (gape 400 sq. cm) in deep water. A shovel was also used to sample the large molluscs found on the shallow banks.

There were 19 benthic sampling stations (Figure 1) throughout the estuary, chosen as being representative of the major substratum categories. Each station consisted of a line transect extending from a marker at the waters' edge of the rushes to deep water offshore; a distance which varied between 60 and 220 metres at different stations (Figure 2). Sampling points along the transect were initially selected in each of the habitat types traversed. The same points were relocated in subsequent trips using a marked rope.

Sampling began in May 1974 and was repeated at two-monthly intervals until May 1975. The transect at each of the nineteen stations was sampled once during each field trip.

Samples were emptied into a one millimetre mesh sieve and washed on location by "puddling". The screenings were backwashed into separate bottles using clean estuarine water and taken to the field laboratory for sorting.

While the above methods gave reasonably accurate quantitative data on the infauna of the sediments, they did not give reliable measures of either those animals attached to hard substrates, or those which moved readily in the water. Some information on the 'attached' species was obtained by placing pieces of asbestos in the water and recording the species which settled on these after a period of time. An open ended cylinder 24 cm in diameter was used to sample the mobile species. After positioning it vertically in the sediment, the weed and water trapped inside was removed to a one millimetre sieve and washed.

All samples were sorted at the field station shortly after they were taken. Animals were picked from the residual debris, identified, and counted, before they were fixed in 5% formalin and preserved in 1% phenoxyethanol.

Results

A list of the macrobenthic invertebrate fauna, showing the dominant species together with an indication of the general distribution and usual habitat of each species is given in Appendix 1. Specimens from 55 species were collected including 13 species of polychaetes, 20 of molluscs, 17 of crustaceans, 4 of insects, and one species of nemertean.

Results from stations 02, 13, 61, 85, 90, and 111 illustrate the changes in the distribution and the abundance of the species in the estuarine system. An index of relative abundance for all the species found at each of these six stations was given in Table 1. The distribution and index of relative abundance along the transect for the most abundant species at the same stations was summarised in Figures 3 - 8.

The results showed firstly that species diversity was greatest near the mouth and least at the river end of the system (Table 2).
Secondly, the total number of individuals for all species at a particular station was also greatest near the mouth and least at the river end (Table 3). Also, the index of relative abundance, throughout the estuary, was greater in summer than in winter (Table 3).

Data from Table 1 showed that eight species had a relative abundance in the order of 1 000/m^2. They were the polychaetes *Capitella*, *Ceratonereis*, and *Scoloplos*; the snails *Hydrococcus* and *Potamopyrgus*; the bivalve *Arthritica*; the shrimp *Palaemonetes*; and the larvae of a chironomid. The mussel *Anticorbula* was considered to be similarly abundant but this was not shown because its normal habitat was poorly sampled. The bivalves *Katelysia* and *Sanguinolaria* were not as abundant as the above species but were very much larger and probably represented a significant part of the biomass near the marine end of the estuary. Together these eleven species constituted the bulk of the invertebrate fauna. The relative abundance of each was summarised in Tables 4 - 14.

The summaries of the distribution and relative abundance of the most abundant species at the six stations (Figures 3 - 8) showed that each species was usually found along the length of the transect. The dominant polychaetes were distributed almost uniformly along the transects; while the bivalve *Arthritica* was to some extent restricted to the near shore shallow zone. Abundance of each of the species tended to be lowest in the deeper parts of the transects, particularly the channels. However, this may have been an artefact, resulting from the increasing inefficiency of the sampling device at greater water depths.

The dominant species were grouped into four categories according to their distribution in the estuary.

Group one included those species restricted to the upper part of the estuary (tidal rivers, Molloy basins and the lagoon) and was illustrated with reference to the mussel *Anticorbula amara* (Figure 9). Other species which showed a similar distribution were the snail *Potamopyrgus* sp (estuarine) and the mussel *Xenostrobus securis*.

Group two consisted of species found throughout the estuary as illustrated by the bivalve *Arthritica helmsii* (Figure 10). The polychaetes *Capitella*, *Scoloplos*, and *Ceratonereis*, and the shrimp *Palaemonetes* were also included in this group.

Group three species were restricted to the lower part of the estuary, where they were found in all seasons. The distribution of the snail *Hydrococcus* (Figure 11) was representative of this group.

Group four included those species restricted to a narrow region near the mouth in winter, but which invaded the estuary in summer, as illustrated by the bivalve *Sanguinolaria* (Figure 12). A second bivalve *Katelysia* and a polychaete *Armandia* had similar distributions.

Grouping the species provided a simplified picture of the system. However, none of the species within a group showed exactly the same features. Hence the results for the dominant species in each group are individually reported below (see also Tables 4 - 14). In addition some species, not seen as dominant but nonethe-less important in the system are also discussed. Detail of sampling at each station was given in Table 15.

Group 1.

Anticorbula amara

Total number collected in 773 core samples = 960; observed salinity range <1 - 35 °/oo; observed temperature range 9°C - 28°C; size - up to 15 mm shell length.

Anticorbula was usually found attached to timber, stones, or aquatic plants, but also occurred on the sediment. Its abundance and distribution is shown in Table 4 and Figure 9.

Xenostrobus securis

Total collected = 248; salinity <1 - 35 °/oo; temperature 9° - 28°C; size - up to 30 mm shell length.

Xenostrobus was principally found in masses on solid substrates, but occasionally occurred in the surface sediment (West Bay). It was found upstream from the Inlet Channel and was most abundant in the Molloy Basins and the Lagoon.

Potamopyrgus sp (estuarine)

Total collected = 1 536; salinity <1 - 35 °/oo; spire height = 5 mm (max.)

Potamopyrgus was found on the sediment. It was most abundant in the upper part of the estuary, but unlike *Anticorbula* and *Xenostrobus* a small number of this species were found in the Swan Lakes (Table 5).

Group 2.

Arthritica helmsii

Total collected = 13 586; salinity <1 - 38 °/oo; temperature 9 - 28°C; size - up to 3 mm shell length.

Arthritica lived in the surface sediment layer, burrowing perhaps no deeper than 2 or 3 cm. It was found throughout the estuary (Figure 10) and was most abundant in the Deadwater - Swan Lakes and Lagoon (Table 6). The developing young were retained in the adult's mantle cavity to the bivalved veliger stage (no planktonic dispersal phase). They were present in some adults in July, November, and March, but no dissections were made in September, January or May. The maximum number of juveniles observed in an individual adult was 46; while the maximum size of the juveniles was approximately 400 µ. Many of the adults collected in the lagoon were found to be infected with a trematode cercaria larvae.

Capitella capitata

Total collected = 9 988; salinity <1 - 38 °/oo; slender body with slightly bulbous head, up to 30 mm length.

Capitella burrowed in the sediment to a depth of 10 cm. It was most abundant in the Deadwater - Swan Lakes and Lagoon. Peak abundance was in summer, occurring between January - March near the mouth, and between March and May upstream (Table 7).

Scoloplos simplex

Total collected = 3 240; salinity <1 - 38 °/oo; thick body with bulbous head, up to 50 mm length.

Scoloplos burrowed deeply into the sediment (up to 10 cm) and was most abundant in the lower part of the estuary (Table 8). Gelatinous egg masses about 60 mm in length, known to be made by polychaetes, probably by this species, were found throughout the year attached at their base to the sediment.

Ceratonereis erythraeensis

Total collected = 11 824; salinity <1 - 38 °/oo; dorsoventrally flattened, having large jaws on an eversible pharynx, up to 50 mm length.

Ceratonereis lived in sandy tubes built in the sediment, being most abundant in the Lagoon and Deadwater (Table 9). Most were found near the surface, but some burrowed up to 10 cm in the sediment.

Palaemonetes australis

Collections using the corer were not representative since these shrimp were mobile and avoided capture; salinity <1 - 38 °/oo.

Palaemonetes was most abundant in the Swan Lakes and Deadwater (Table 10) where the sea grass *Ruppia maritima* grew densely. The shrimp breeding season was between October and April (Table 11). The maximum number of eggs carried by an individual was 59, while the usual number was between 25 and 35.

Melita zeylanica kauerti

Total collected = 556; salinity <1 - 35 °/oo; size - up to 10 mm length.

Melita was found throughout the estuary and was most abundant in North Bay, Inlet Channel and Swan Lakes, where it was collected amongst algae and sea grass. Eggs were carried between November and May, but no examinations were made in July or September. The number of eggs per individual was usually from 10 - 15, with a maximum of 43 recorded on a large specimen. The eggs were straw coloured.

Corophium sp.

Total collected = 563; salinity <1 - 35 °/oo; size - up to 4 mm body length.

Corophium built sandy tubes in the sediment forming "colonies". They were present throughout the estuary and were most common in the Lagoon and Swan Lakes. Due to their patchy distribution the sample obtained was probably an underestimate of their abundance in the estuary. Eggs were carried between November and May (no animals were examined in July and September). The maximum number of eggs carried was 17, while between 4 and 5 was more usual.

Paracorophium sp.

Total collected = 445; salinity <1 - 35 °/oo; size - up to 3-4 mm.

Paracorophium was collected throughout the estuary and was most abundant in the Lagoon and Swan Lakes. Eggs were carried between November and May (no examinations in July and September), the maximum being 23, while the more usual was 4 or 5. The eggs were often blue in colour.

Group 3.

Hydrococcus graniformis

Total collected = 10 846; salinity <1 - 38 °/oo; temperature 12 - 24°C; spire height < 3 mm.

Hydrococcus was found only at stations near the mouth of the estuary; and had the same distribution in all seasons (Figure 11). It was most abundant in the Swan Lakes (Table 12) where it was observed moving on the surface sediment or on sea grass. Summer numbers were much larger than winter numbers.

Group 4.

Sanguinolaria biradiata

Salinity range 25 - 35 °/oo; size up to 40 mm shell length.

Sanguinolaria burrowed deeply in the sediment to a depth of 20 cm. The bivalve was most abundant near the mouth where it persisted throughout the year (Table 13). Juveniles were found to invade the estuary to station 73 in March and May. At this station, none survived the following winter.

Katelysia scalarina

Salinity 25 - 35 °/oo; size up to 35 mm shell length.

Katelysia burrowed to a depth of less than 10 cm in the sediment. The shell bore definite growth rings, and each was probably the result of one years growth. 1+ animals were only found in the Deadwater and near the mouth. Settlement in the lagoon during summer (Table 14), resulted in complete mortality by September. The oldest shell found was 5 years, but most were not more than 3 years old.

Rush fauna.

A list of the invertebrate fauna of the intertidal rush zone near the water's edge at the 19 stations was made for each sampling month, and abundance was subjectively assessed. A small snail *Tatea preissi* and a talitrid amphipod *Orchestia sp.* occurred at each station and were the most abundant species. Another snail *Potamopyrgus* sp (fluviatile) was common in the rushes of the lagoonal area. A small crab *Cyclograpsus audouinii* was abundant in the rushes fringing the Inlet Channel, while a much larger crab *Leptograpsodes octodentatus* was numerous both on Thomas Island and in the marsh at the entrance to the Swan Lakes.

Discussion

The limited faunal diversity was probably a consequence of the extreme seasonal changes in the hydrological conditions within the estuary. Perhaps salinity was the major limiting factor, since the salinity range observed at any one point in the estuary - fresh to marine - was beyond the physiological tolerance level for either marine or freshwater animals. The greater diversity of fauna observed near the mouth, where salinity variation was least, supports this idea. However, temperature may have also been a factor which limited the invasion of the estuary, particularly by marine organisms. Within the estuary water temperatures varied greatly, rising to almost 30°C in the extensive shallow areas during summer and falling to 9°C in winter. The temperature variation in the ocean was less and ranged between a maximum of 21°C and a minimum of 14°C.

The importance of each of the various species to the estuarine system was determined according to their relative abundance; those found most frequently were considered dominant. A better method of showing the relative importance of the species would have been to estimate their productivity.

Despite the low invertebrate species diversity the fauna was abundant due to the occurrence of several species in very high numbers. Since so few species constituted the bulk of the group, the removal of any of them might expectedly have a significant influence on higher trophic levels and result in a decrease both in abundance and production of these higher forms.

Summary

1. Species diversity was greatest near the mouth and least at the river end of the estuary.

2. Relative abundance (total number of individuals of all species) was highest near the mouth and lowest in the river, and greater in summer than in winter.

3. Eleven species constituted the bulk of the fauna as determined by abundance and size, and included the polychaetes *Ceratonereis*, *Capitella*, and *Scoloplos*; the snails *Hydrococcus* and *Potamopyrgus*, the bivalves *Arthritica*, *Katelysia*, *Sanguinolaria* and *Anticorbula*; the shrimp *Palaemonetes*, and the chironomid *Pontomyia*.

4. Zonation along the transect was not marked.

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APPENDIX 1

The Macrobenthic Invertebrate Fauna of the Blackwood River Estuary

		Dominant Species	Rushes	Attached to logs, rocks	In mud or sand	Amongst aquatic plants	Free swimming
	ANNELIDA : POLYCHAETA						
Capitellidae	*Capitella capitata* (Fabricius)	*			x		
Orbiniidae	*Scoloplos simplex* (Hutchings)	*			x		
	Haploscoloplos sp. "C"				x		
Ophellidae	*Armandia* sp.				x		
Spionidae	*Prionospio* sp. A				x		
	Prionospio sp. B				x		
Areniocolidae	*Arenicola* sp.				x		
Sabellidae	*Sabellid* sp.				x		
Serpulidae	*Mercierella enigmatica* Fauvel			x			
Nereidae	*Ceratonereis erythraeensis* Fauvel	*			x		
	Nereis (Nereis) sp.				x		
	Nereis (Neanthes) sp.				x		
	Eunereis sp.						
	MOLLUSCA : PELECYPODA						
Mytilidae	*Xenostrobus securis* (Lamarck)			x	x	x	
Laptonidae	#*Arthritica helmsii* Hedley	*			x		
Mactridae	*Spisula (Notospisula) trigonella* (Lamarck)				x		
Tellinidae	*Tellina deltoidalis* Lamarck				x		
	Tellina (Macomona) sp.				x		
Psammobiidae	*Sanguinolaria biradiata* (Wood)	*			x		
Veneridae	*Katelysia scalarina* Lamarck	*			x		
Lyonsiidae	*Anticorbula amara* (Laseron)	*		x	x	x	
	MOLLUSCA : GASTROPODA						
Hydrobiidae	*Hydrococcus graniformis* Thiele	*			x	x	
	Potamopyrgus sp. (estuarine)	*			x	x	
	Potamopyrgus sp. (fluviatile)				x		
	Tatea preissi (Phillippi)			x			
Potamididae	*Batillaria estuarina* Tate				x		
Cerithiidae	*Bittium granarium* Kiener				x		
	Diala lauta (A. Adams)				x		
Nassariidae	*Nassarius burchardi* (Phillippi)				x		
	Nassarius pauperatus (Lamarck)				x		
Bullidae	*Bulla botanica* Hedley				x		
Philinidae	*Philine angasi* Crosse & Fischer				x		
Amphibolidae	*Salinator fragilis* Lamarck				x		

now *Arthritica semen* (Menke)

Appendix 1 (cont.) The Macrobenthic Invertebrate Fauna of the Blackwood River Estuary

		Dominant Species	Rushes	Attached to logs, rocks	In mud or sand	Amongst aquatic plants	Free swimming
	CRUSTACEA						
Cirripedia	*Balanus* sp.			x			
Mysidacea	*Gastrosaccus* sp.						x
Isopoda	*Sphaeroma quoyana* Milne-Edwards				x	x	x
	Syncassidina aestuaria Baker				x	x	x
	Isopod A				x	x	
Amphipoda	*Corophuim* sp.				x		
	Paracorophium sp.				x		
	Melita zeylanica kauerti Barnard					x	
	Orchestia sp.		x				
Palaemonidae	*Macrobrachium intermedius* (Stimpson)					x	x
	Palaemonetes australis Dakin	*				x	x
	Palaemonetes serenus (Heller)					x	x
Penaeinae	*Metapenaeus dalli* Racek				x		x
	Penaeus latisulcatus Kishinouye				x		x
Grapsidae	*Cyclograpsus audouinii* (Milne-Edwards)		x				
	Leptograpsodes octodentatus (Milne-Edwards)		x				
Hymenosomatidae	*Halicarcinus ovatus* (Stimpson)					x	
	INSECTA						
Chironomidae	*Pontomyia natans* Edwards	*			x	x	
	Chironomus australis Marquart				x	x	
Trichoptera	2 spp.					x	
	NEMERTEA						
	1 sp. unident				x		

FIGURE 1. THE BLACKWOOD RIVER ESTUARY

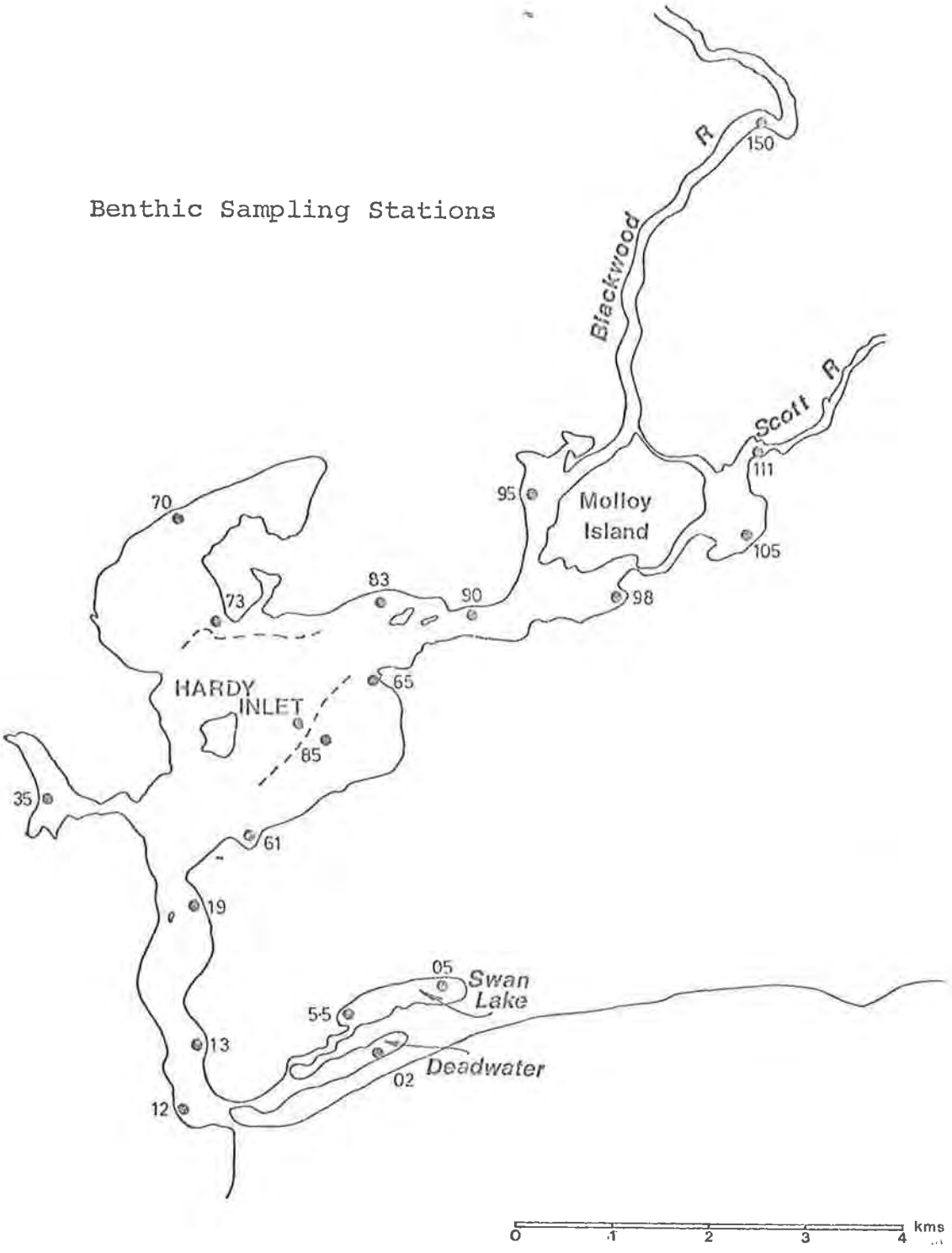


Figure 2. TRANSECT PROFILES

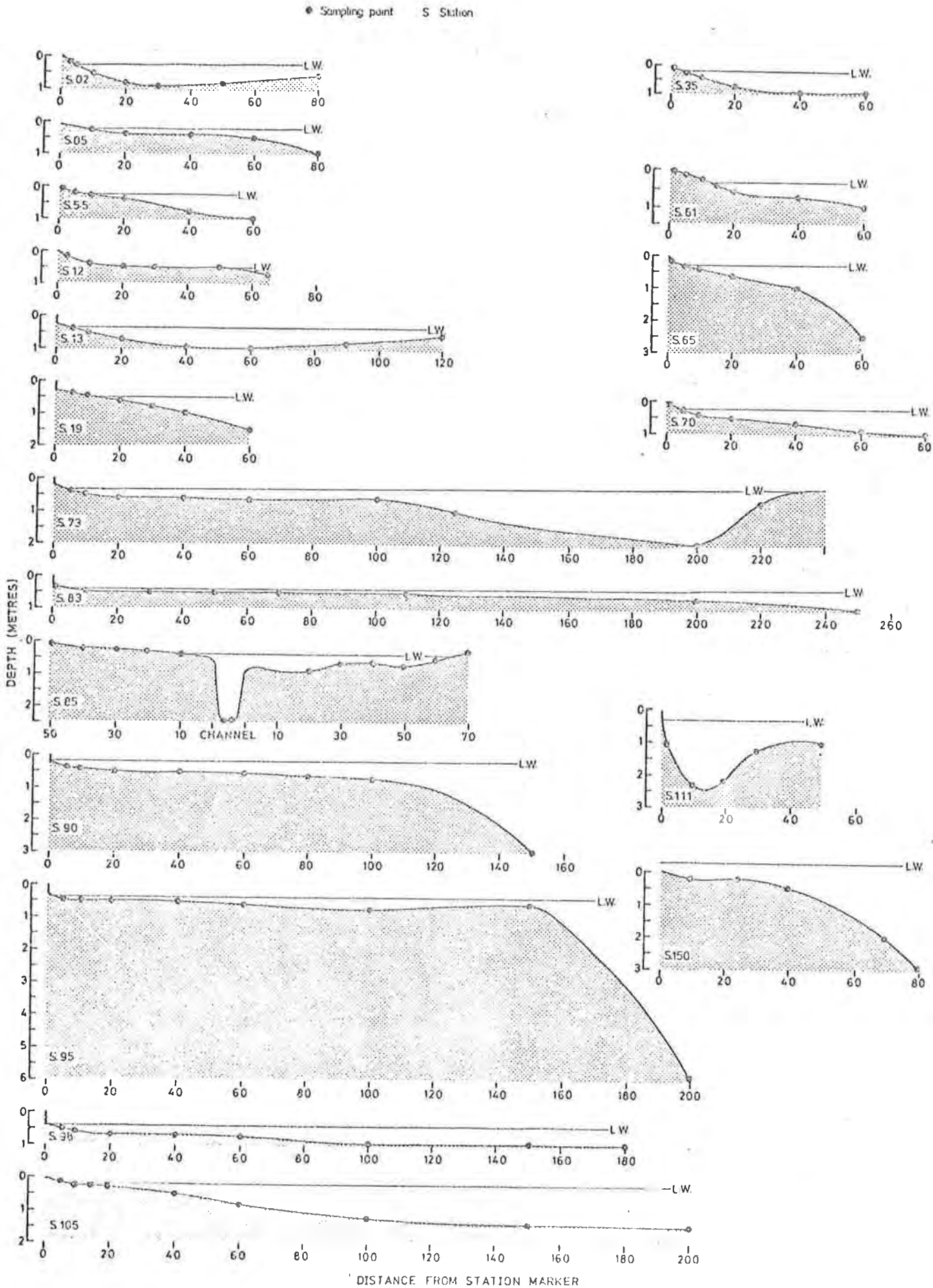
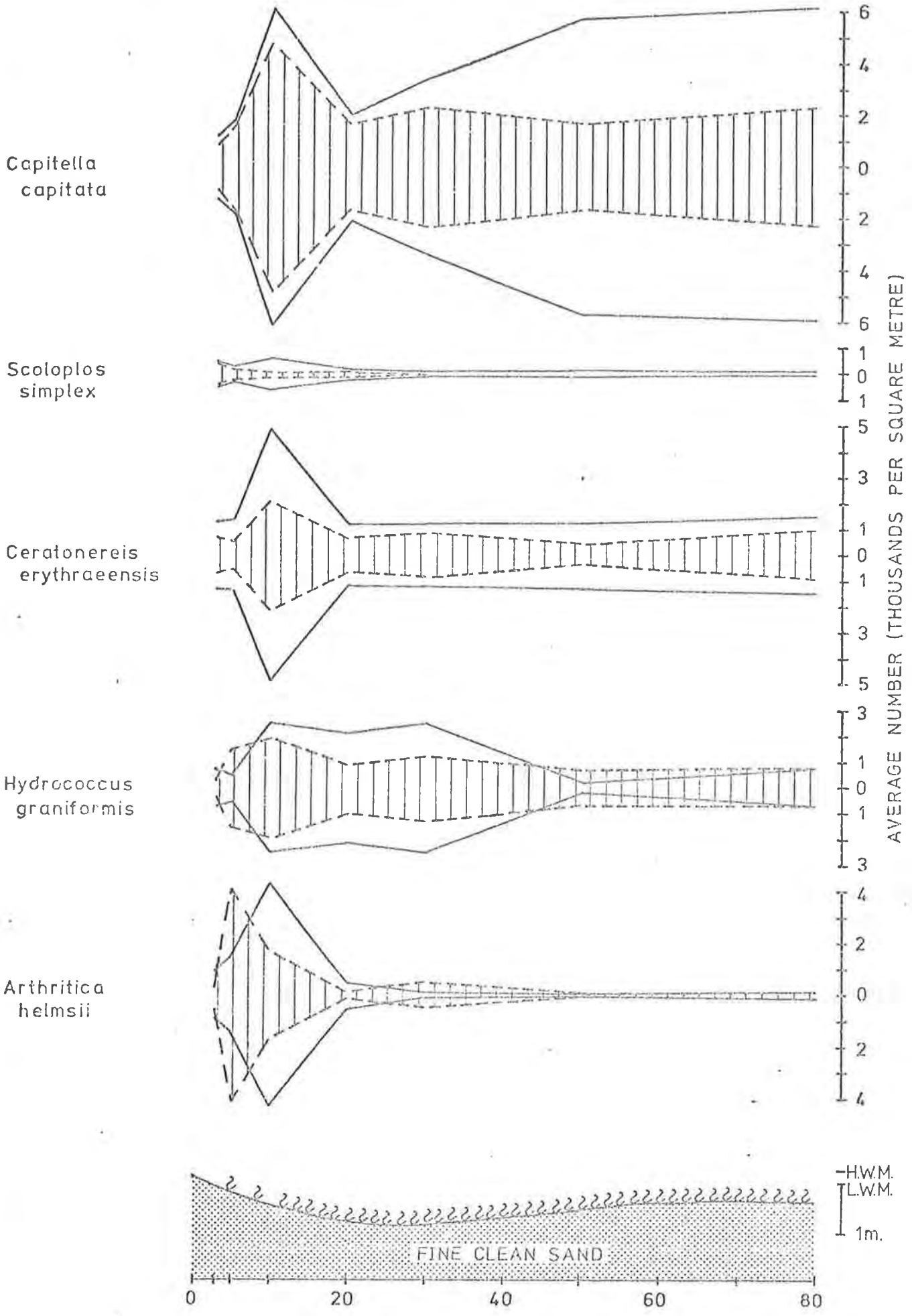


FIG 3 TRANSECT AT STATION 02, DEADWATER



ℓ Ruppia maritima

—— Summer (Jan., Mar., May, 1975)

--- Winter (July, Sept., Nov., 1974)

FIG 4 TRANSECT AT STATION 13, INLET CHANNEL

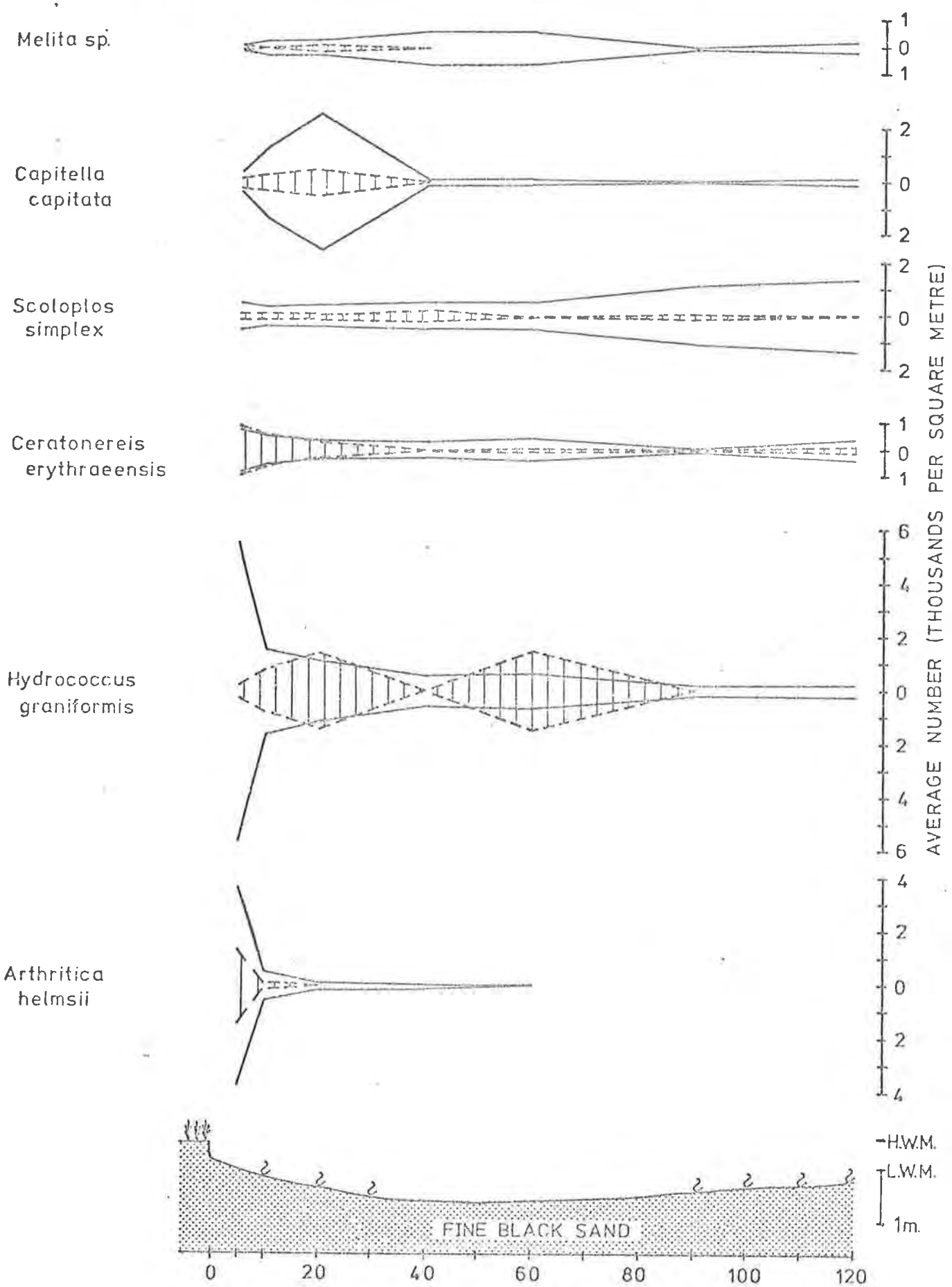


FIG 5 TRANSECT AT STATION 61, LOWER LAGOON

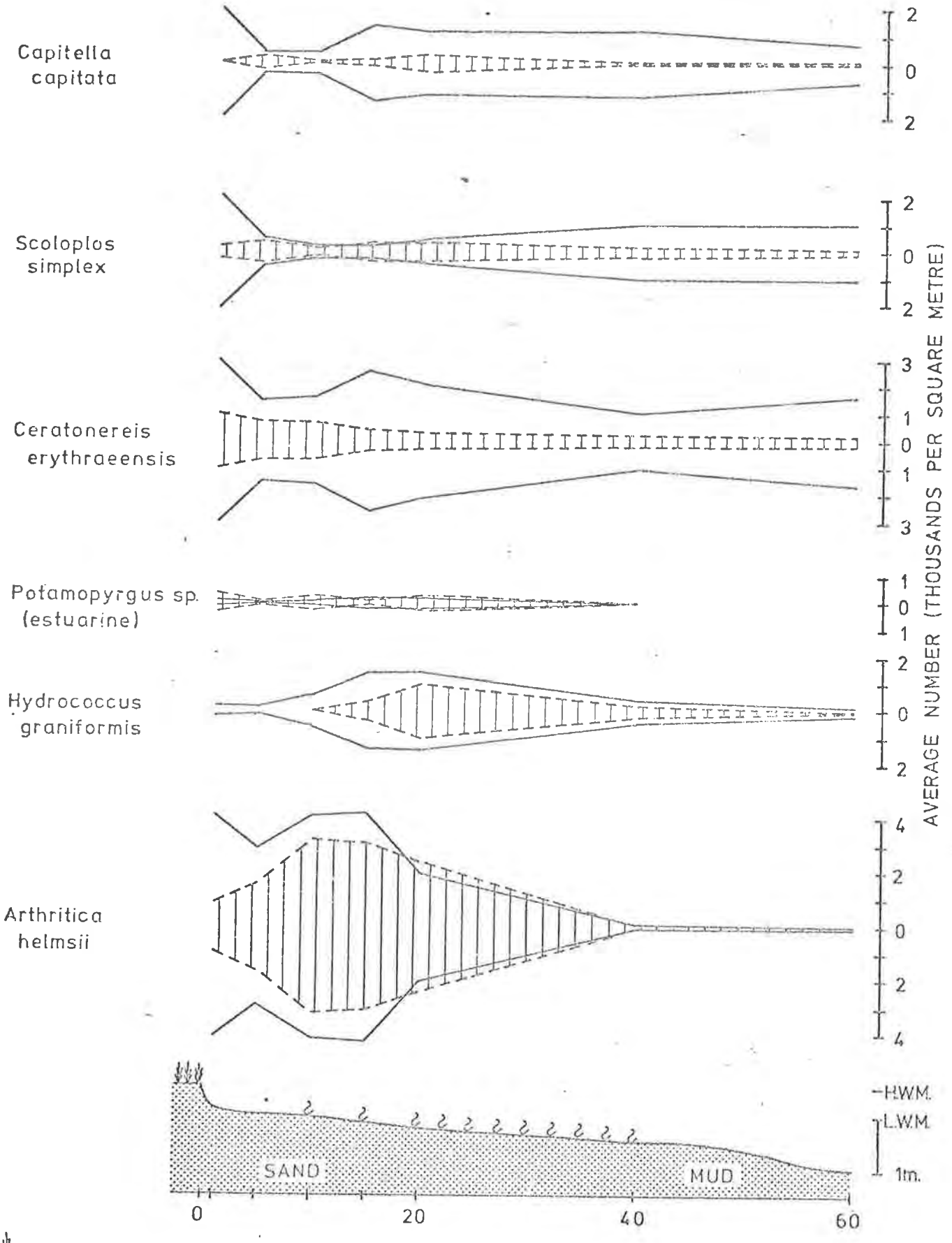
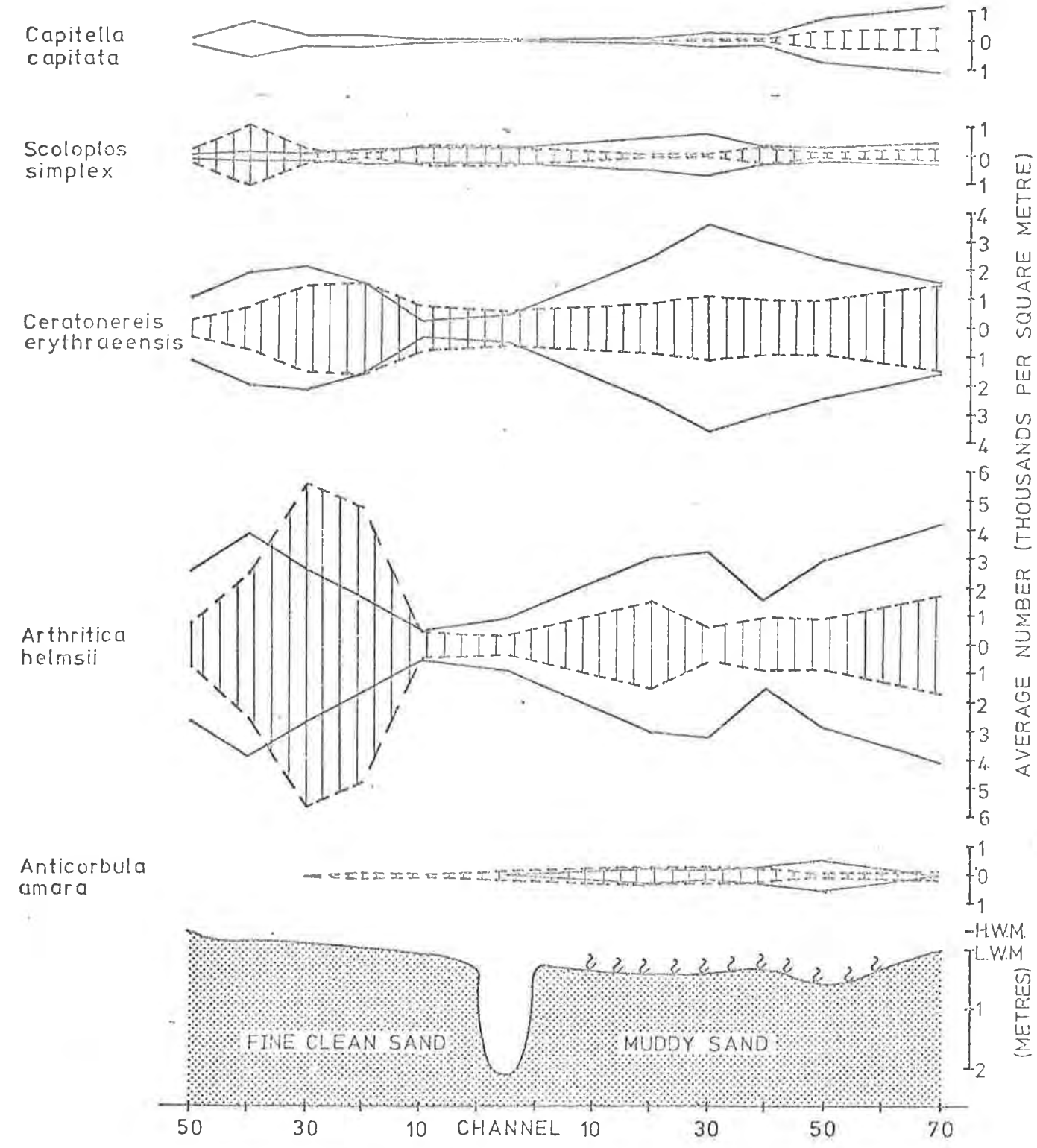


FIG 6 TRANSECT AT STATION 85, CENTRAL LAGOON

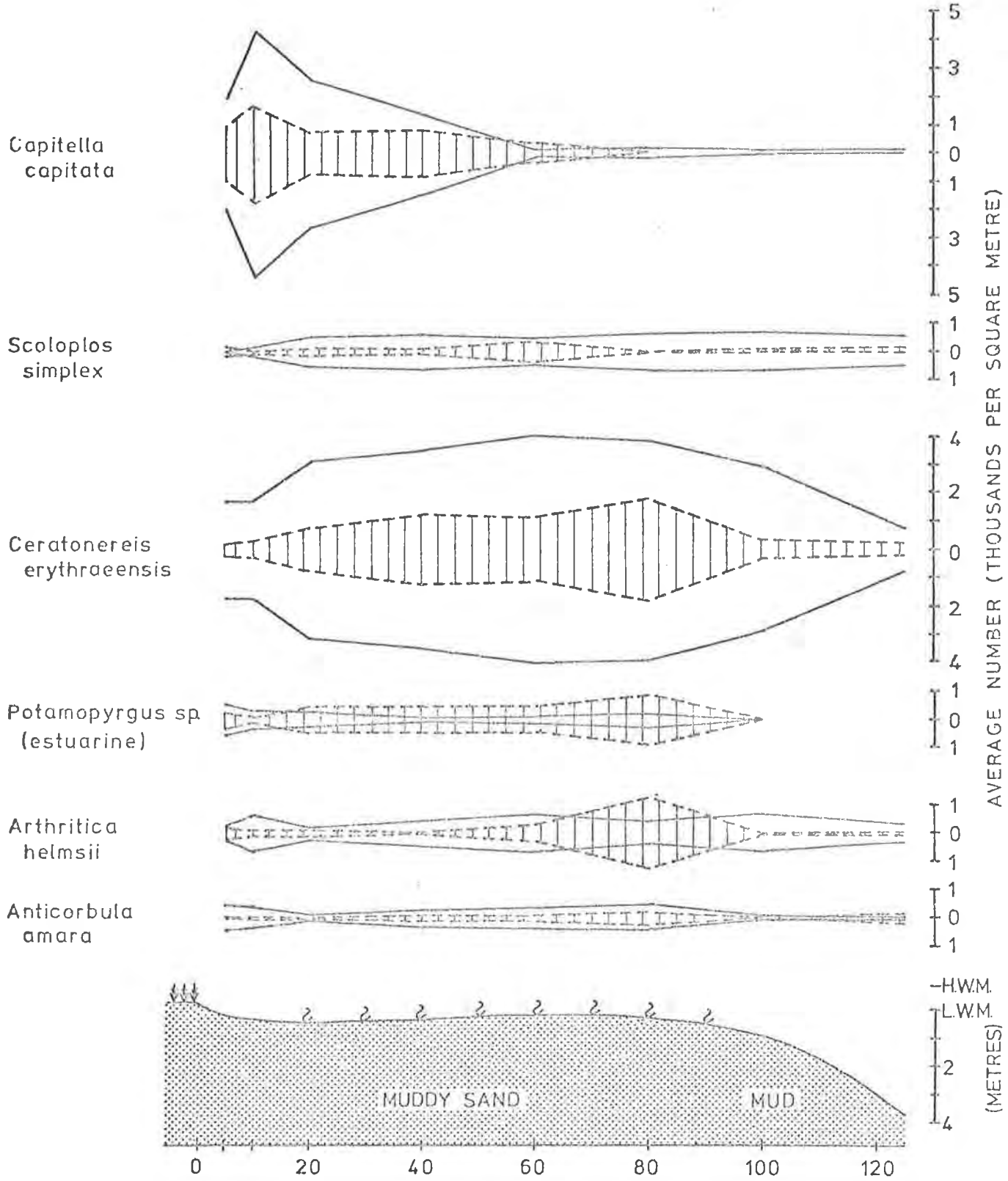


ƨ Ruppia maritima

— Summer (Jan., Mar., May, 1975)

--- Winter (July, Sept., Nov., 1974)

FIG 7 TRANSECT AT STATION 90, UPPER LAGOON



Juncus maritimus

Ruppia maritima

— Summer (Jan., Mar., May, 1975)

--- Winter (July, Sept., Nov., 1974)

FIG 8 TRANSECT AT STATION 111, SCOTT RIVER

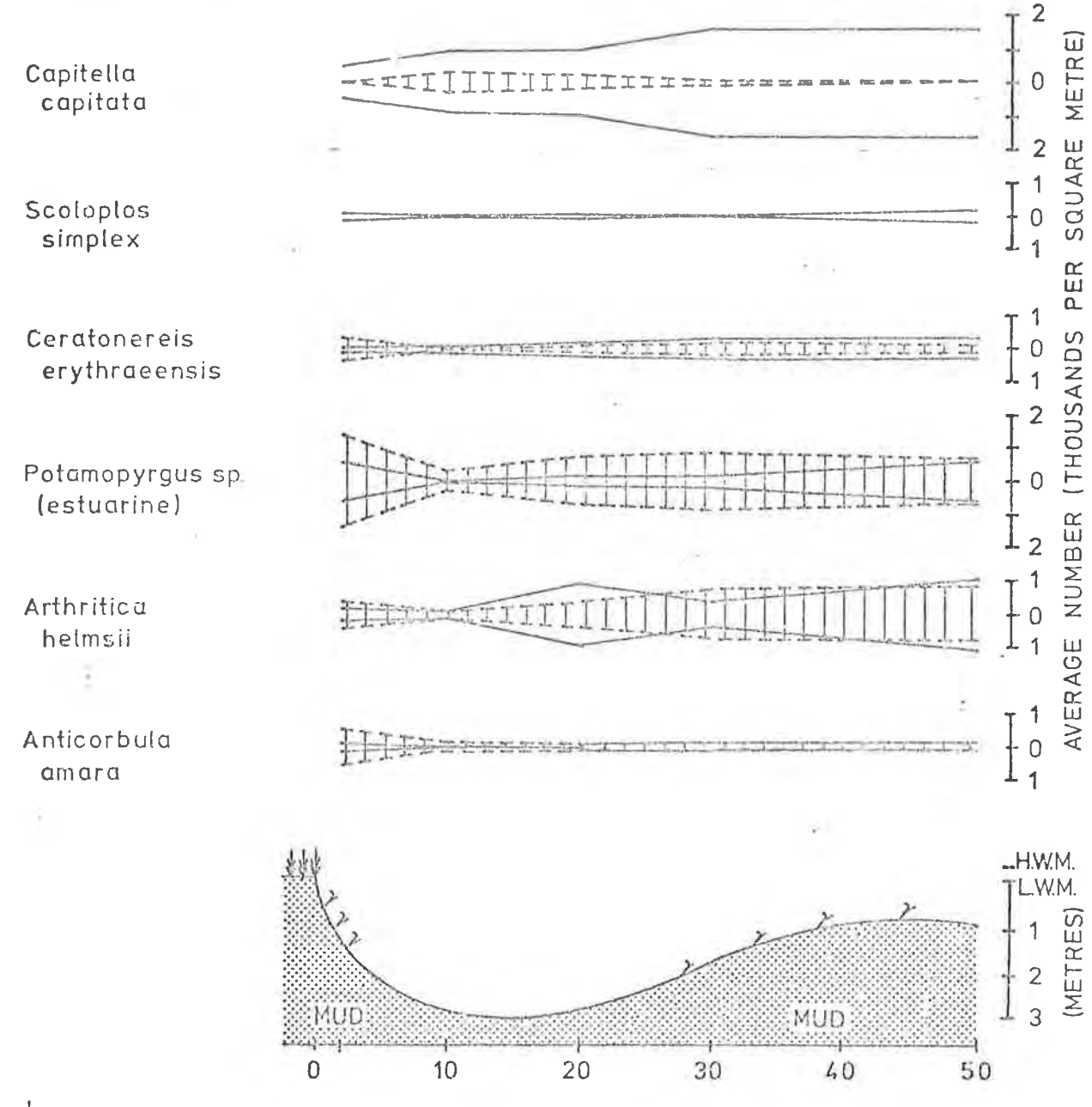


FIG 9 DISTRIBUTION OF *Anticorbula amara* ALONG THE BLACKWOOD RIVER ESTUARY

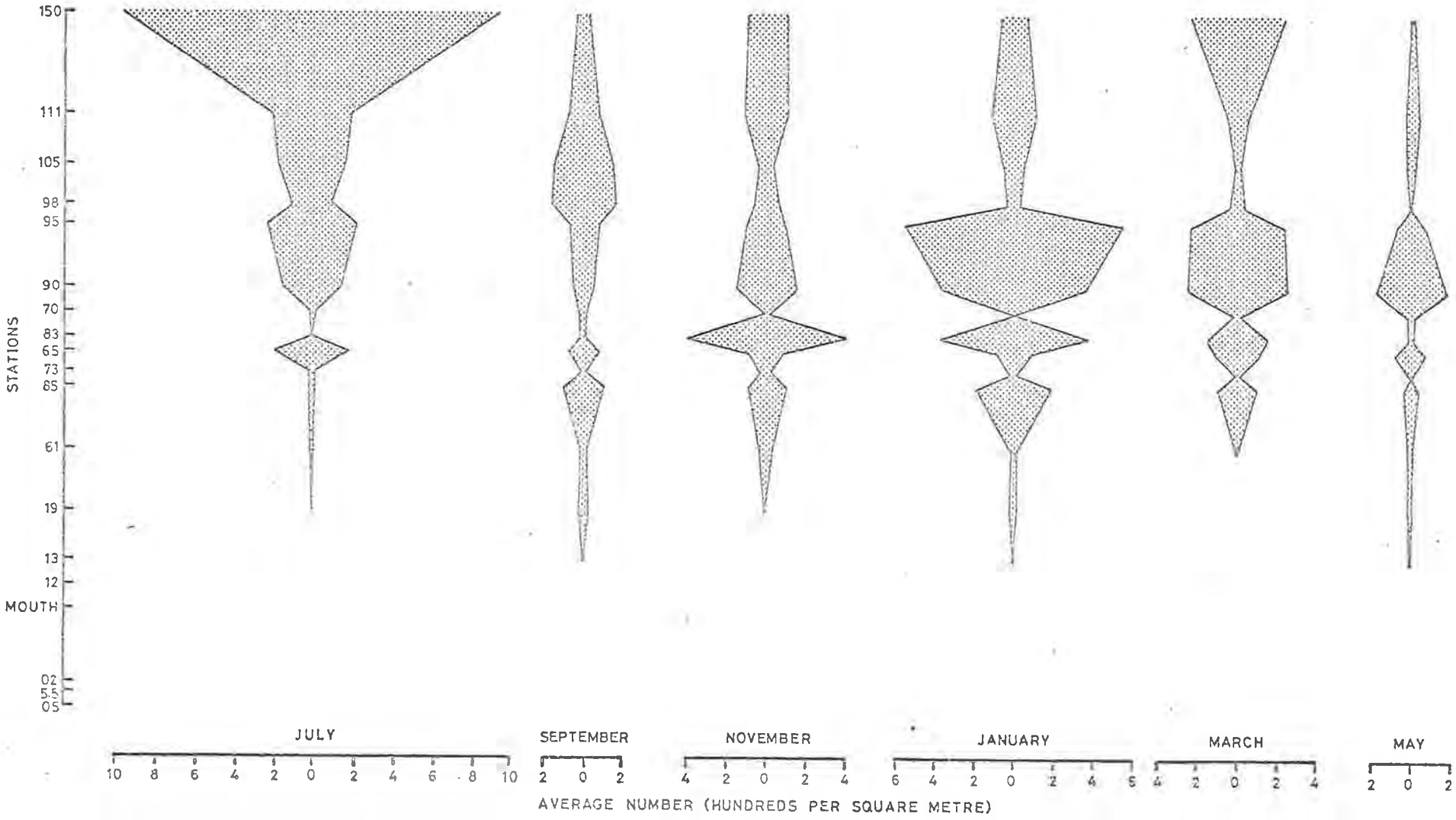


FIG 10 DISTRIBUTION OF Arthritica helmsii ALONG THE BLACKWOOD RIVER ESTUARY

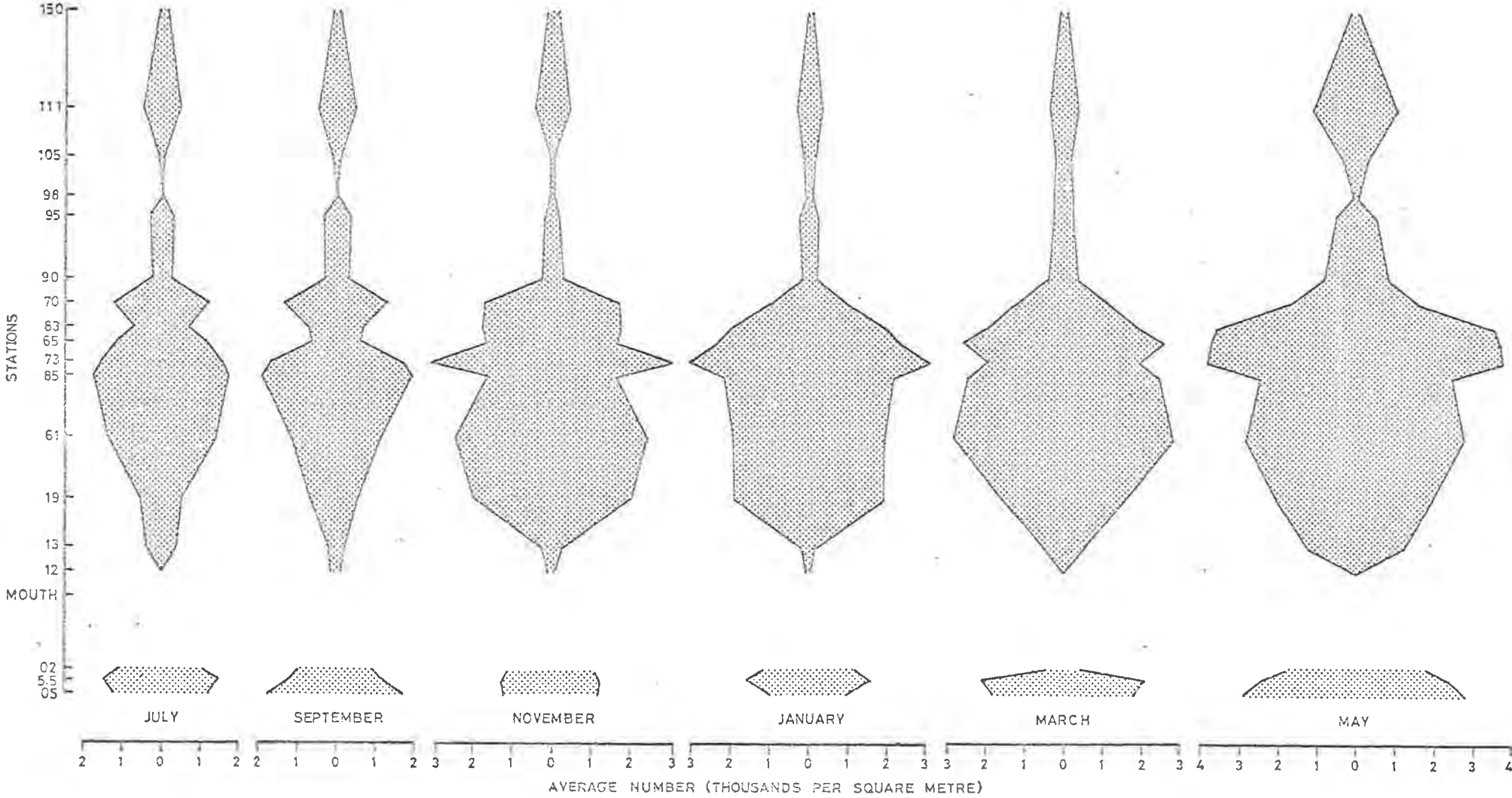


FIG 11 DISTRIBUTION OF *Hydrococcus graniformis* ALONG THE BLACKWOOD RIVER ESTUARY

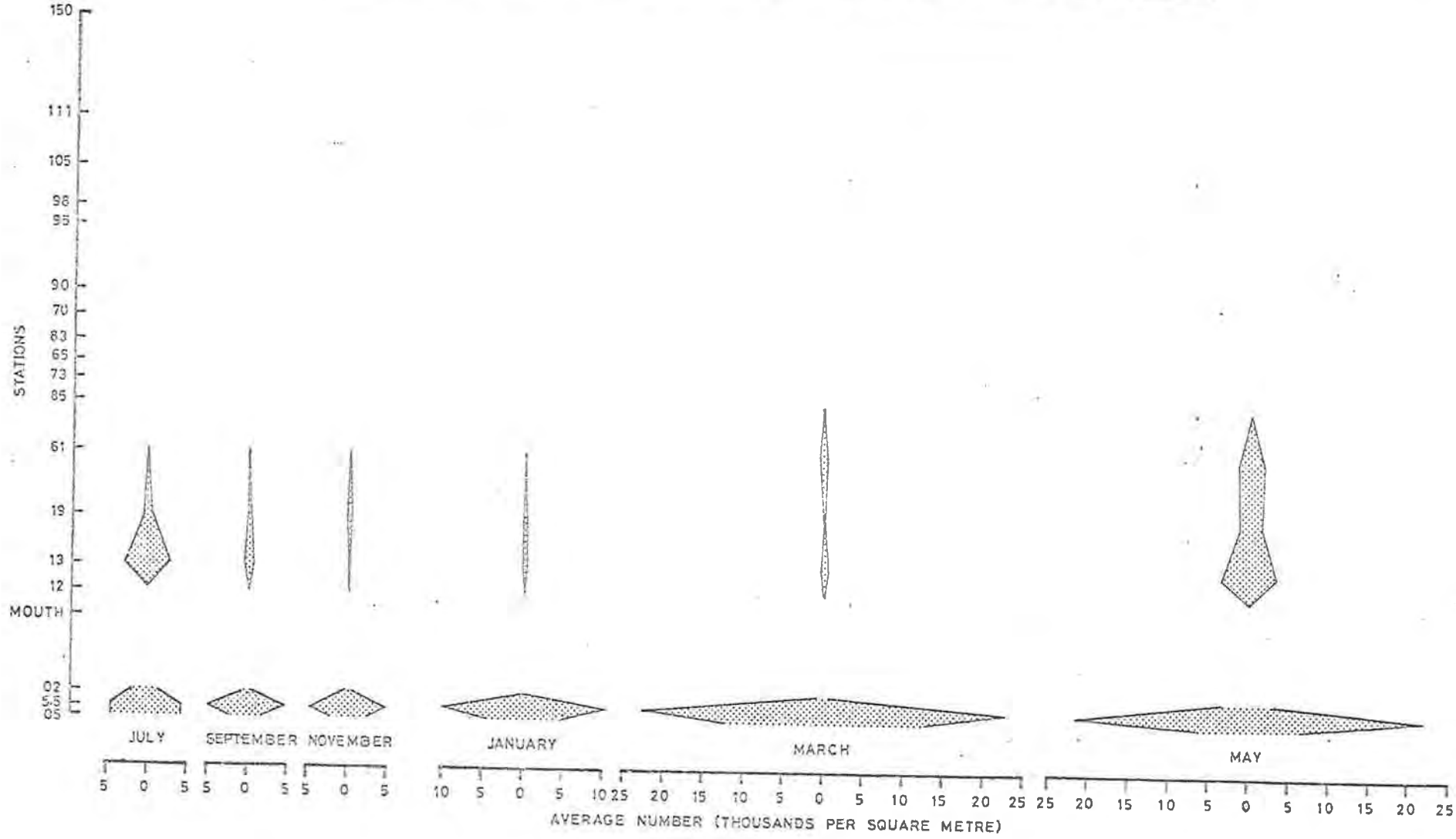


FIG. 12 DISTRIBUTION OF Sanguinolaria biradiata ALONG THE BLACKWOOD RIVER ESTUARY

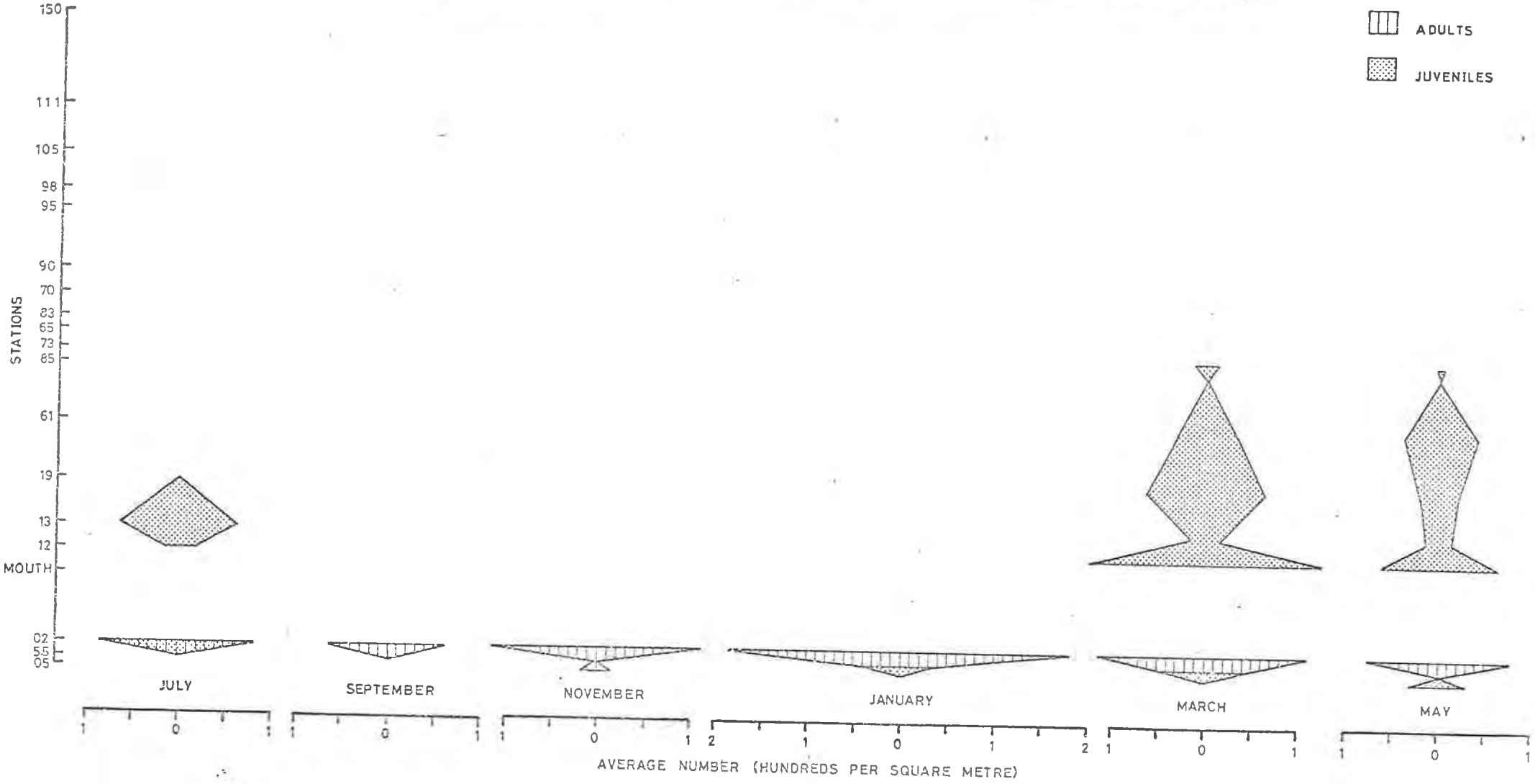


Table 1 Relative Abundance (as numbers per square metre) of all the species found at six stations

STATION	02		13		61		85		90		111	
Season	S	W	S	W	S	W	S	W	S	W	S	W
No. of Core Samples	21	20	21	21	21	21	36	33	23	22	15	18
POLYCHAETES												
Capitella capitata	7595	4619	1262	351	2113	196	576	114	2782	1227	2325	188
Scoloplos simplex	560	300	1357	214	1595	560	566	511	886	261	125	83
Armandia sp.	508	0	309	0	351	0	200	0	47	0	2	0
Prionospio sp B	68	31	24	0	7	0	0	0	43	0	75	0
Arenicola sp	21	0	6	0	0	0	0	0	0	0	0	0
Prionospio sp A	0	0	12	0	19	0	648	0	232	1	3	0
Sabellid sp.	42	58	0	0	0	1	0	0	0	0	0	0
Ceratonereis erythraeensis	3613	1719	839	625	3750	970	3531	1867	5304	1324	583	278
Nereis spp.	2	0	0	0	0	0	0	0	0	0	0	0
Eunereis sp.	0	6	0	0	0	0	0	0	0	0	0	0
MOLLUSCA: POLECYPODA												
Xenostrobus securis	0	0	0	0	7	48	0	24	11	157	0	22
Anticorbula amara	0	0	0	0	12	42	212	146	527	222	125	271
Arthritica helmsii	2293	2106	1262	554	4905	3274	4667	3515	891	534	1150	958
Katelysia scalarina	26	42	104	21	3	0	12	0	0	0	0	0
Sanquinolaria biradiata	247	172	21	25	49	0	0	0	0	0	0	0
Tellina spp.	0	9	0	30	0	30	0	6	1	16	0	3
Tellina deltoidalis	15	20	60	6	61	37	0	1	1	0	0	3
: GASTROPODA												
Batillaria estuarina	0	0	208	71	0	0	0	0	0	0	0	0
Bittium granarium	0	6	0	6	0	0	0	0	0	0	0	0
Diala lauta	60	112	6	12	0	2	0	0	0	0	0	0
Parcanassa pauperata	0	0	6	18	0	0	3??	0	0	0	0	0
Potamopyrgus sp. (est.)	0	83	0	0	155	280	219	197	418	580	608	1465
Hydrococcus granii-formis	2672	2244	2863	2446	1268	428	0	0	0	0	0	0
Tatea preissi	0	0	0	65	7	54	0	0	0	0	0	0
CRUSTACEA												
Mysid sp.	6	8	83	0	65	1	13	0	6	0	2	0
Sphaeroma quoyana	18	27	6	6	0	28	10	29	201	11	3	0
Syncassidina aestuaria	0	0	0	0	0	0	0	0	5	0	3	1
Corophium sp.	0	9	65	0	6	2	59	4	16	4	0	0
Paracorophium sp.	57	6	577	36	65	13	74	0	49	6	12	35
Melita zeylanica	187	8	589	30	12	1	7	0	43	6	2	24
Palaemonetes australis	875	645	N.S.	115	30	100	200	N.S.	N.S.	N.S.	N.S.	N.S.
Metapenaeus dalli	6		*		*		*		*			
Halicarcinus ovatus	0	0	18	0	1	0	3	0	0	0	0	0
INSECTA												
Chironomid larvae	2400	470	393	738	171	60	65	26	0	102	18	108
Trichopteran 1	0	0	0	0	0	0	0	0	5	0	0	10
Trichopteran 2	0	0	0	0	0	0	0	0	0	0	0	14
Total No. Individuals	21271	12708	10070	5369	14652	6074	10065	6439	11468	4451	5052	3457

N.S. No sample

* Present but not represented in samples.

S Summer

W Winter

Table 2 Changes in Diversity of Invertebrate Species along the Blackwood River Estuary.

Stations	02		13		61		85		90		111	
	S	F	S	F	S	F	S	F	S	F	S	F
No. of spp:-												
Polychaeta	9	6	7	3	6	3	5	3	6	4	6	3
Crustacea	6	6	8	4	7	6	8	3	8	5	6	4
Mollusca: Pelecypoda	4	5	4	5	6	5	3	5	5	4	2	3
Gastropoda	2	4	4	6	3	4	2	1	1	1	1	1
Insecta	1	1	1	1	1	1	1	1	1	1	1	3
Total : S	22		24		23		19		21		16	
F		22		19		19		13		15		14

S = Saline phase (Jan, Mar, May)

F = Fresh phase (Jul, Sept, Nov)

Table 3 Index of Relative Abundance (total number of individuals per square metre).

	Stations					
	02	13	61	85	90	111
Winter	12 708	5 369	6 074	6 439	4 451	3 457
Summer	21 271	10 070	14 652	10 065	11 468	5 052
Average	16 990	7 720	10 363	8 252	7 960	4 254

Winter = July, September, November (1974)
Summer = January, March, May (1975).

Table 4 Abundance of *Anticorbula amara* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	-	-	-	-	-	-
5.5	-	-	-	-	-	-
02	-	-	-	-	-	-
Mouth						
12	-	-	-	-	-	-
13	-	-	-	-	-	-
19	-	41	-	41	-	21
35	-	18	18	41	0	50
61	18	35	64	18	0	18
85	28	210	188	368	198	72
73	25	38	55	34	14	0
65	375	141	178	178	216	145
83	0	25	785	732	285	8
70	21	35	18	0	41	41
90	291	94	302	718	494	338
95	458	158	196	1086	484	140
98	200	321	128	78	78	0
105	338	296	78	98	25	38
111	408	158	205	225	110	60
150	1920	60	195	115	468	5

Table 5 Abundance of *Potamopyrgus* sp (Estuarine) along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	212	75	25	100	950	300
5.5	-	38	25	25	25	-
02	138	100	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
19	-	188	725	162	-	1475
35	62	38	-	125	-	-
61	50	212	575	100	50	300
85	38	375	188	188	150	325
73	100	200	175	112	38	150
65	75	125	62	100	25	100
83	-	-	350	50	75	212
70	38	50	38	8	100	338
90	288	688	688	625	500	88
95	425	1112	762	988	100	225
98	-	500	550	62	225	38
105	212	675	262	838	288	1175
111	1225	1538	1700	775	375	675
150	75	0	150	125	550	0

Table 6 Abundance of *Arthritica helmsii* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	2462	3475	2400	1925	3600	5575
5.5	2912	2312	2475	3100	4212	4775
02	2150	1925	2250	2462	850	3550
Mouth						
12	25	250	125	88	62	38
13	762	375	512	300	1000	2475
19	1025	1288	4000	3838	3212	4000
35	562	638	875	1038	1125	1700
61	2750	2250	4825	3825	5575	5160
85	3475	3862	3275	4362	4800	4838
73	3138	3488	6188	6125	3862	7528
65	2300	1250	3288	4625	5100	7425
83	1425	1350	3538	4000	3825	7100
70	2412	2688	3412	1975	2375	3250
90	500	575	512	350	750	1675
95	600	688	350	412	500	1000
98	0	35	140	188	500	100
105	100	200	50	275	388	638
111	975	938	950	600	750	2100
150	225	125	250	75	94	225

Table 7 Abundance of *Capitella capitata* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	712	1100	562	1150	1300	500
5.5	150	1900	1288	5062	6112	4100
02	4912	4912	4075	6138	9275	7375
Mouth						
12	600	62	125	1625	4288	500
13	225	125	700	1175	1962	638
19	125	38	62	212	662	1238
35	150	25	0	50	88	525
61	288	138	162	0	2762	3575
85	325	12	12	75	612	1038
73	1850	300	225	150	1100	3162
65	1800	62	175	162	950	2325
83	6125	1575	4512	3575	7712	10162
70	525	625	250	462	2562	3875
90	2900	750	450	425	3525	4638
95	1012	50	175	0	250	1550
98	500	475	575	438	5688	3900
105	350	850	2562	938	3912	4925
111	0	38	625	512	3325	3125
150	12	162	50	12	525	400

Table 8 Abundance of *Scoloplos simplex* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	838	325	625	1025	525	400
5.5	25	62	350	250	125	-
02	225	212	450	900	638	150
Mouth						
12	900	338	562	2938	1625	588
13	175	162	300	1288	1638	1138
19	700	100	162	1562	1350	750
35	200	25	12	425	1038	550
61	588	412	500	2888	1238	662
85	975	300	275	588	500	612
73	462	300	400	800	950	738
65	900	500	225	1562	962	538
83	50	200	250	762	1325	300
70	400	188	212	812	762	588
90	662	125	100	1188	950	462
95	488	138	25	538	1162	1150
98	175	50	62	25	100	38
105	-	-	-	25	150	112
111	188	12	25	12	150	200
150	188	38	25	300	150	250

Table 9 Abundance of *Ceratonereis erythraeensis* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month	July	Sept.	Nov.	Jan.	Mar.	May
Station						
05	575	2025	1350	2025	1275	1275
5.5	188	20	728	3200	2458	2125
02	1500	800	2825	5462	3750	1625
Mouth						
12	75	100	200	4325	1475	75
13	662	550	662	1438	838	338
19	650	1438	1875	3025	1662	975
35	2788	1962	2012	4450	6062	5400
61	750	912	1250	3825	4512	2900
85	1462	1975	2100	3162	3900	3525
73	2075	2988	3062	3350	3500	3675
65	1875	1325	1875	1575	4200	4275
83	1325	600	1462	1850	2912	1416
70	1100	1588	1762	2375	2250	2000
90	1838	1000	1250	3638	6425	5925
95	1912	1000	750	944	2475	4475
98	700	638	700	500	1500	925
105	270	202	78	218	481	696
111	450	207	125	775	475	500
150	850	85	175	675	218	1400

Table 10 Abundance of *Palaemonetes australis* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
5.5	716*	1166*	370	466	815	1044
02	NS	NS	330	600	740	1288
Mouth						
13	166*	183*	33*	NS	NS	NS
19	90*	146*	33*	66*	26*	NS
61	123*	200*	60*	38*	30*	NS
85	NS	NS	NS	NS	126	273
70	NS	NS	120	88	NS	NS
95	NS	NS	66	NS	200	NS

NS = No Sample

* Estimate of Mr. D. Bray.

Table 11 Abundance of *Palaemonetes australis* in the Deadwater (02) and the Swan Lakes (5.5), showing the breeding population and its fecundity.

STATION 02	July	September	November	January	March	May
Number/square metre	NE (716)	NE (1166)	330 (266)	600 (330)	740 (660)	1288 (NE)
% with eggs	-	-	40.0	43.2	1.0	0
Av. no. eggs/individual	-	-	25.4	33.7	36.0	0

STATION 5.5						
Number/square metre	NE	NE	370	466	815	1044
% with eggs	?	?	34.0	2.4	1.8	0
Av. no. eggs/individual	-	-	21.5	33.0	30.0	0

Estimates in brackets supplied by D. Bray.

Table 12 Abundance of *Hydrococcus graniformis* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
02	3038	2212	1588	950	1175	5900
05	8975	3825	4325	8325	25225	12900
5.5	9062	9712	9588	19900	45412	43425
Mouth						
12	82	225	0	225	188	0
13	5838	1375	125	925	600	7050
19	1000	288	475	975	82	2862
35	-	-	-	-	-	-
61	675	338	262	200	646	2962
85	-	-	-	-	-	-
73	-					
65	-					
83	-					
70	-					
90	-					
95	-					
98	-					
105	-					
111	-					
150	-					

Table 13 Abundance of *Sanguinolaria biradiata* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	-	-	31	-		62
5.5	-	-	-	82	82	-
02	166	125	225	366	225	150
Mouth						
12	31	-	-	-	250	125
13	125	-	-	-	31	31
19	-	-	-	-	125	38
35	-	-	-	-	-	-
61	-	-	-	-	62	82
85	-	-	-	-	-	-
73	-	-	-	-	25	2
65	-	-	-	-		
83	-	-	-	-		
70	-	-	-	-		
90	-	-	-	-		
95	-	-		-		
98	-	-	-			
105	-	-	-	-	-	-
111	-	-	-	-	-	-
150	-	-	-	-	-	-

Table 14 Abundance of *Katelysia scalarina* along the Blackwood River Estuary as numbers/sq. metre.

	1974			1975		
Month / Station	Jul.	Sept.	Nov.	Jan.	Mar.	May
05	0	0	0	-	31	31
5.5	82	31	0	82	-	-
02	82	0	41	8	54	16
Mouth						
12	102	0	25	56	156	112
13	62	0	0	-	218	94
19	-	-		-	94	31
35	-	-			-	
61	-	-			-	10
85	-	-			-	25
73	-	-			75	58
65	-					
83	-	-				
70	-	-				
90	-	-				
95	-	-				
98	-	-				
105	-	-				
111	-	-				
150	-	-				

Table 15 Number of samples taken at each station in each month (core = 80 sq cm x 180 mm)

	1974		1975			
Month / Station	July	Sept.	Nov.	Jan.	Mar.	May
05	6	5	6	5	5	5
5.5	6	6	6	5	6	5
02	6	7	7	7	7	7
Mouth						
12	6	6	6	6	6	6
13	7	7	7	7	7	7
19	6	6	6	6	6	6
35	6	7	7	6	6	5
61	7	7	7	7	7	7
85	10	10	13	12	12	12
73	8	8	9	9	9	9
65	5	6	6	6	6	5
83	5	5	7	7	7	6
70	6	6	6	6	6	6
90	6	8	8	8	8	7
95	7	8	8	9	8	8
98	5	7	8	8	8	7
105	7	8	8	9	7	7
111	7	6	5	5	5	5
150	5	5	5	5	4	5