

**THE IMPOVERISHED FAUNA OF THE
DEEP WATER CHANNEL AND MARGINAL
AREAS BETWEEN FLATHOLM ISLAND
AND KING ROAD, SEVERN ESTUARY.**

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SUMMARY

The results of a survey of the benthic fauna of the deep-water channel of the Severn Estuary between Flatholm Island and King Road are presented. Quantitative samples were collected with a grab and the abundance of all animals retained by a 0.5 mm sieve was estimated. Using these data in conjunction with previous studies listed in the text the following conclusions were reached.

- The deep channel of the Severn Estuary has an extraordinarily impoverished fauna and 22 of the 62 grab samples taken held no animals. The sandy substrata were particularly impoverished. The total number of infaunal species at 13 stations with a sand substrate was only 5, which between them only comprised 18 individuals. At any one station with a sand substrate, the maximum number of infaunal species was 2 (**Figure 1**) represented by 4 individuals.
- The worm *Sabellaria alveolata* was the most abundant benthic animal in the survey area. This species was found in 17 grab samples taken from hard bottom areas in and immediately adjacent to the deep channel between the Bristol Deep and the Holm Islands. *Sabellaria* was found in varying abundance, ranging from individual worms in single or multiple tubes encrusting on the surface of pebbles to a maximum of 45 worms within a clump of *Sabellaria* reef. Ten further samples contained encrusting tubes or small fragments of reef, but with no evidence of live worms.
- There are two patches of *Sabellaria* reef in the study area (**Figure 2**). Compared with *Sabellaria* reefs situated further to seaward in the Bristol Channel and in other parts of the British Isles the fauna of these reefs is extremely impoverished. The maximum number of species recorded at a station supporting *Sabellaria* reef in the present study was only 16 (**Figure 1**). Compared with *Sabellaria* reefs situated further to seaward in the Bristol Channel and in other parts of the British Isles the fauna of these reefs is extremely impoverished. For example, littoral reef at Duckpool, North Cornwall, was found to hold 45 species. Published accounts of sub-littoral *Sabellaria* reef in the Wash and Bristol Channel record the presence of 87 and 100 species, respectively.
- The area does not support populations of animals with special adaptations for the conditions in the Severn Estuary. The fauna only comprises widely distributed marine forms that are abundant elsewhere in a variety of habitats. The study area does not hold an estuarine community.

INTRODUCTION

As part of an investigation into the ecology of the subtidal region of the Severn Estuary between King Road and the Island of Flatholm, the Bristol Port Company commissioned a grab survey to be undertaken in May 2001. The primary objective of this survey was to quantify the species richness and abundance of the benthic community within the deep water channel and the adjacent habitat. A particular aim of the study was to acquire further knowledge on the abundance and distribution of *Sabellaria* reef and its associated biota. The survey was planned to include areas covered by previous surveys to both check that the ecology has not greatly changed and to extend our knowledge of the region.

METHODS

Grab sampling was undertaken between the 14th and 16th of May 2001 in the Severn Estuary in the region between King Road and Flatholm Island (**Figure 1**). Sampling transects of 3, 4 or 5 stations were set at 5km intervals along the deep water channel. Further individual sample stations were chosen at 1km intervals between the main transects. In addition to the channel surveys, a small number of samples were collected at stations outside the main channel. Bad weather prevented the collection of these extra samples from the full length of the channel; however, it was possible to sample a number of sites on the Welsh (northwestern) side of the channel. Station position fixing was by GPS. A map of the region showing the position of the sampling stations is shown in **Figure 1** and the co-ordinates of the sampling stations are listed in **Table 1**.

Samples were collected using a 0.1m² Day grab, which takes a semi-cylindrical bite from the seabed with an area of 300 by 330 mm. The penetration, and hence the volume of the sample, varies according to the composition and compactness of the substrate. Two grab samples were collected from each station. On being brought aboard, the grab was checked to ensure that it had deployed correctly; if this was not the case the sample was repeated. In instances where a stone had prevented the jaws of the grab from closing properly, grabbing was repeated until a valid sample was obtained. At certain stations, particularly at the western end of the channel, the grab repeatedly came up completely empty, when this occurred it was assumed that the substrate was bare rock.

Samples were inspected visually, and then emptied in to a plastic tray, a photograph was taken and general features of the composition including the presence of mud, shell debris, organic matter or pieces of *Sabellaria* reef were noted. Any *Sabellaria* present was removed and preserved separately, as were any large stones. The presence of any encrusting organisms was recorded. The remaining sample was then washed through a 0.5mm sieve and the retained material preserved by the addition of 40% formaldehyde solution with 1% Rose Bengal. Generally, the sand fraction of the sample would pass easily through the 0.5mm sieve. However, towards the eastern end of the channel, the grain size was larger. This occasionally resulted in a sample not

being sieved completely before the collection of the next sample was due. In these instances, the entire bulk of the sample was preserved for processing later.

The samples were quantitatively sorted, and all organisms extracted and preserved in formaldehyde. Any *Sabellaria* reef was dabbed dry and weighed, to provide an estimate of the quantity present. The animals in the samples were identified to species and counted. Where possible, actual numbers per sample were obtained, but it is not possible to quantify colonial epifaunal organisms such as hydroids and bryozoans, and so they were recorded as present or absent. It was also found impossible to identify to species the encrusting sponge (only one species found) or the anemones (2 species found) from preserved samples. The number of *Sabellaria* individuals in the samples could not be fully quantified when large chunks of reef were present in the grab samples. However, the relative amount of *Sabellaria* reef present could be inferred from the weight of reef in each sample.

No comparative data were available from the intertidal *S. alveolata* reefs, and so samples were collected from the 'classic' site at Duckpool on the North Cornish coast (Wilson, 1971) on 24 June 2001 (see **Plate 4**). Fragments of reef were removed from the rock surface at low tide with a hammer and chisel, sufficient to loosely fill four 1-litre containers. The four samples were all taken in the same location, spaced haphazardly about 10m apart. A few large conspicuous animals (e.g. anemones, limpets) were also collected by hand from the same location. The samples were preserved in 10% formalin and subsequently treated in the laboratory in the same way as the subtidal Severn Estuary samples (see above).

RESULTS

From inspection of the grab samples there are 2 main substrates along the deep channel, and the transition between the two occurs around the 'elbow' in the channel roughly north of Weston-Super-Mare (**Figure 1**). To the east of this point, there is a predominantly sand substrate, occasionally overlaid by mud, with shingle, coal particles and shell fragments in places. There appears to be a gradient in the size of sand grains along this section of the channel, with the coarser sand occurring at the eastern end. South-west of the 'elbow' in the channel, the substrate becomes predominantly bedrock, with cobbles and pebbles. **Plates 1-3** show photographs of the contents of selected examples of the contents of the grabs.

The species and the number of individuals recorded from each grab are presented in **Table 2**. The two grab samples at each station are labelled a and b. The two samples from each station showed a high level of consistency in species richness and animal abundance, which demonstrates a high level of sampling precision and suggests that the samples reliably reflected the benthic community of the stations. The maximum of 13 benthic species per 0.1 m² sample was found. The maximum number of individuals was only 51 per 0.1 m². A total of 22 of the 62 samples taken were found to hold no benthic animals large enough to be retained by a 0.5 mm sieve. *Sabellaria alveolata* was the commonest benthic animal and was most prevalent in the western section of the channel (**Figure 2**).

The amount of *Sabellaria* tube in the grab samples varied from lumps of reef (maximum of 2338 g) towards the north-east end of the study area (Stations 9, 32 and 33) to fragments and encrustations on pebbles further south-west towards the islands of Flatholm and Steepholm. *Sabellaria* reef was also encountered at 2 stations (21 and 22) in the eastern section of the channel, but was otherwise absent from that section of the study area. The quantity of *Sabellaria* tubes obtained in each sample is given in **Table 3**. The most animal rich samples were collected from stations 21, 22 and 32, 33, in regions of well-developed *Sabellaria* reef (**Figure 2**).

There is some evidence that *Sabellaria alveolata* tube concretions provide a habitat for other species. The polychaete *Eulalia tripuctata* was found living inside unoccupied *Sabellaria* tubes. The small sipunculan *Nephasoma minutum* (formerly *Golfingia minuta*) was also found buried in the tube matrix. Sponges, hydroids and bryozoans were also found attached to the matrix, as well as on stones.

The animals sampled mostly comprised small juveniles, but there was some evidence of breeding in a few species. The adults of the ascidian *Dendrodoa grossularia* frequently contained tadpole larvae and a female with ripe eggs of the scaleworm *Harmothoe impar* was found at station 9a. Although no specimens of *Sabellaria alveolata* contained eggs or sperm, some grew to a large size (up to 3.1 cm) and relatively large numbers of very small juveniles were found in some samples, suggesting *in situ* reproduction. Single brooding females were observed for the isopod *Eurydice pulchra* (1 specimen in sample 19b) and the amphipod *Haustorius arenarius* (sample 29a).

The intertidal *S. alveolata* reefs at Duckpool on the North Cornish coast were well developed and show the sort of reef that can form given suitable environmental conditions (see **Plate 4**). A total of 45 species was found at this single location and a preliminary species list is presented in **Table 4**. A freshwater stream flows into the sea at this location and the consequent reduced salinity influences the biota: the dominant furoid alga was the typically estuarine *Fucus ceranoides*, and no echinoderms were present in the samples as might have been expected from a fully marine location.

DISCUSSION

The results of this survey confirm earlier observations that:

1. The fauna of the sand and *Sabellaria* reef habitats is extremely impoverished compared with similar habitats further seaward in the Bristol Channel and elsewhere in the British Isles.
2. The species living in these habitats have no special adaptations to the extreme physical conditions of the estuary that might confer conservation interest, but rather they are all common and abundant species with a widespread distribution throughout Britain.

3. The species present in this part of the estuary are fully marine rather than brackish water specialists, so that this region cannot be regarded as estuarine in biological terms.

These three points are discussed in more detail below.

The *Sabellaria* reef habitat

In the Severn Estuary the total number of species found at stations representing the *Sabellaria* reef habitat (6,9,21,22,32,33) was 26. The highest number of species at any one station with *Sabellaria* reef was 16 (station 22). These represent the highest diversity found to date in this habitat in the estuary, because of the very careful analysis of even the smallest specimens retained on a 0.5mm sieve, and the inclusion of sessile epifaunal species such as hydroids and bryozoans attached to the *Sabellaria* tube fragments and to stones. Despite this, the diversity compares very unfavourably both with the intertidal *Sabellaria alveolata* and subtidal *Sabellaria spinulosa* habitats further seaward (George and Warwick, 1985).

While the species diversity in the intertidal *S. alveolata* reefs at Duckpool is much higher than the subtidal Severn Estuary (45 as compared to 25 species). The littoral location and reduced salinity result in a lower diversity than subtidal fully marine locations. George and Warwick (1985), for example, list 100 species from a single *Sabellaria spinulosa* station in the Bristol Channel at a depth of 41m off the North Devon coast. This work lists motile species only and the sessile epifauna was not recorded (as it was in the Severn Estuary), so the contrast is even greater. Such high diversity is not atypical of subtidal *Sabellaria* habitats. Watson *et al.* (1995) for example list 87 species from a single *Sabellaria spinulosa* station at 32m depth in the Wash, although comprehensive species inventories for such habitats are generally lacking.

All species found as adults in association with the *Sabellaria* reef in the Severn Estuary are common with a widespread distribution round the British coast, and so they cannot be regarded as specially adapted to the extreme hydrodynamic regime of the estuary. The species are typically marine and not brackish-water, so that biologically this area should not be regarded as an estuary. The exception is *Gammarus salinus*, which is a brackish species but found in more saline parts of estuaries. The list of species recorded as adults from *Sabellaria* reef in **Table 5** is derived from Mettam *et al.* (1994) plus the present survey of the deep channel. Distributional data are from P.J. Hayward and J.S. Ryland 'The Marine Fauna of the British Isles and North-West Europe (2 volumes) unless otherwise stated.

The subtidal sand habitat

Thirteen of the stations sampled fall loosely into this category (1, 13, 16, 17, 18, 19, 20, 24, 25, 26, 27, 28, 29). Of the 26 samples (2 grabs at each station), 14 contained no fauna at all. In the remaining 12 samples a total of 9 species were recorded, four of which were epifaunal on stones and only five were typically infaunal. Only 18 individuals of the five infaunal species (*Ampharete baltica*, *Capitella capitata*, *Amphilocheus manudens*, *Eurydice pulchra*, and *Haustorius arenarius*) were found in these 12 samples.

The greatest number of species recorded at any one station was two and the maximum number of individual animals recorded was three. The extremely impoverished nature of this fauna is clear from this and previous studies. For example, Mettam *et al.* (1994) also found that a high proportion of sand samples contained no fauna at all. Comparison with other subtidal sandy habitats illustrates the extreme species poverty of this habitat in the Severn Estuary; as an example Warwick *et al.* (1978) list 57 species from a single station further seaward in Carmarthen Bay.

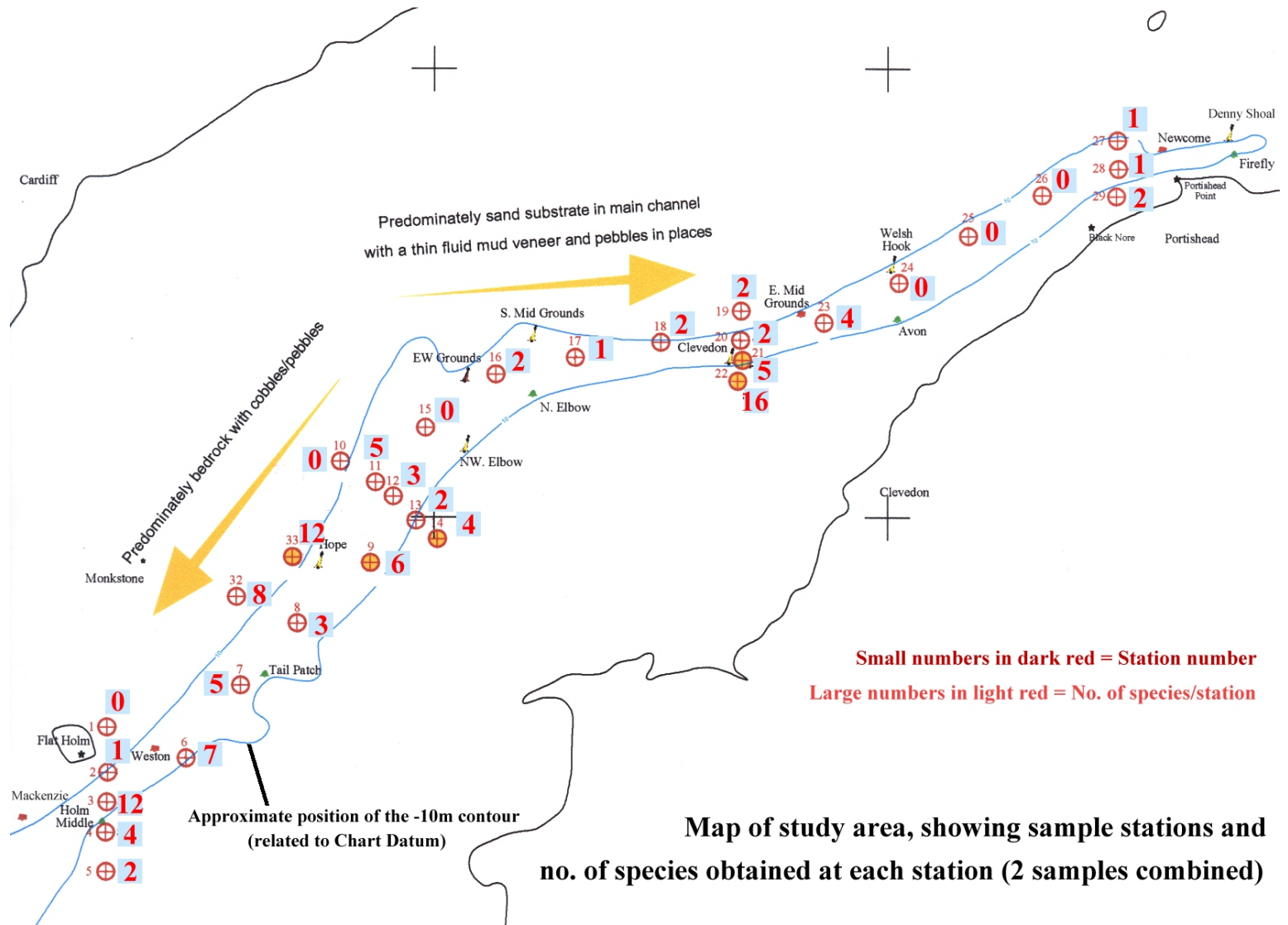
As with the *Sabellaria* reef habitat, all species found as adults associated with the subtidal sand habitat in the Severn Estuary are common with a widespread distribution round the British coast, and so they cannot be regarded as specially adapted to the extreme hydrodynamic regime of the estuary. Likewise, the species are typically marine and not brackish-water, the exception again being *Gammarus salinus*. The list of species recorded as adults and the distributional data derived from the same sources as for the *Sabellaria* reef habitat is given in **Table 6**.

The above evidence fully supports the general conclusion of Hiscock and Cartlidge (1980) that “Communities in the Estuary are highly impoverished and this reduces their scientific and conservation interest”.

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Figure 1 Map of the study area showing the position of the sampling stations. The total number of species recorded from each station from the two 0.1 m² grab samples is given as the bold red number in a blue box.



Map of study area, showing sample stations and no. of species obtained at each station (2 samples combined)

Figure 2 Map of the study area showing the position of the stations where evidence of *Sabellaria* reef, fragments of reef and tubes were found.

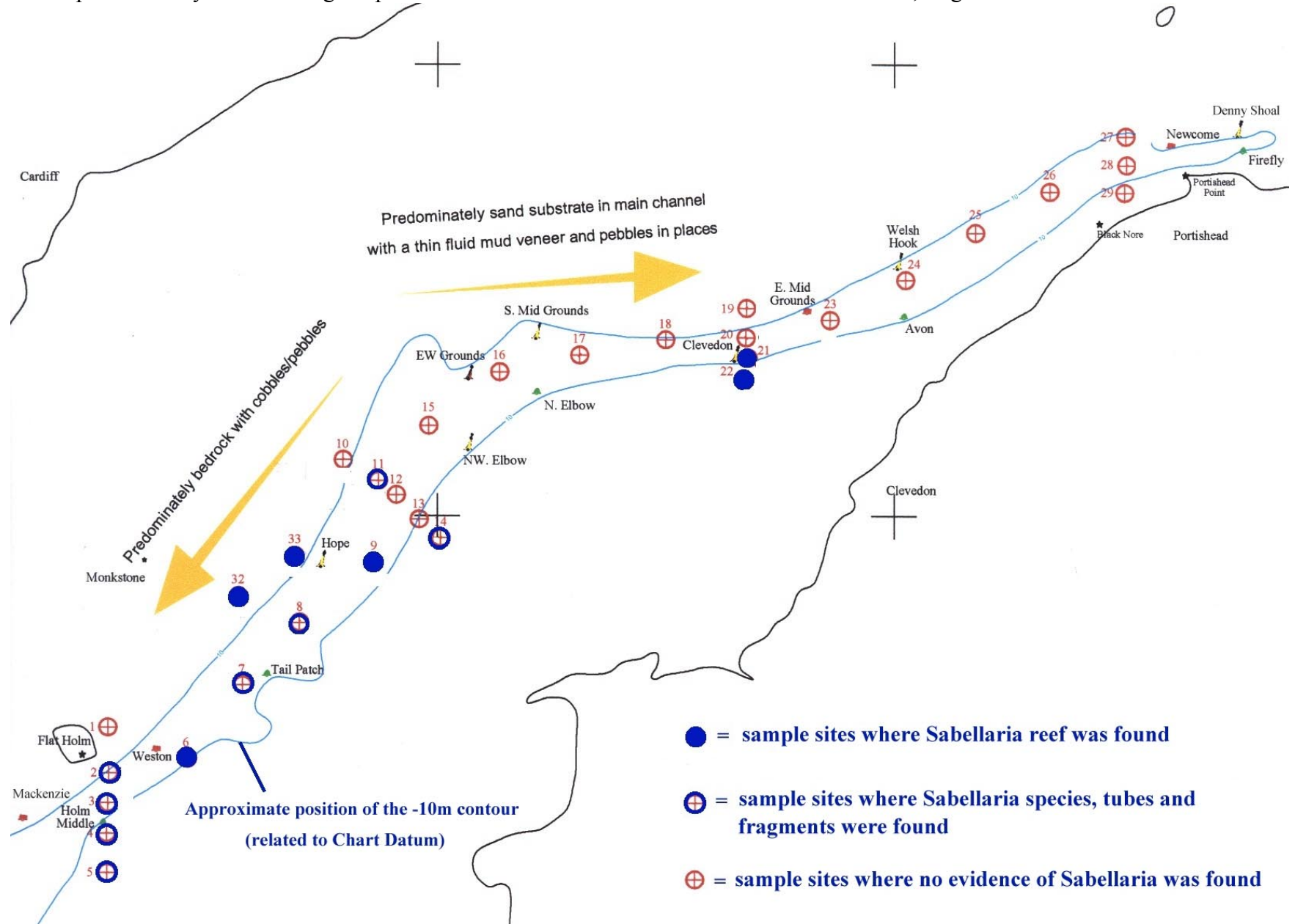


Table 1: Site observations.

Sample	E	N	Date	Time	Sample contents
1a	322788	165267	15.5	11.30	Sand/mudballs/coal
1b	322786	165280	15.5		Small sample; sand/mudballs/coal
2a	322807	164255	15.5		Small <i>Sabellaria</i> fragments
2b	322813	164287	15.5		Small <i>Sabellaria</i> fragments
3a	322806	163586	15.5		Small <i>Sabellaria</i> fragments, barnacle shells
3b	322791	163631	15.5		Small <i>Sabellaria</i> fragments
4a	322798	162940	15.5		Pebbles with hydroids & <i>Sabellaria</i> tubes
4b	322745	162927	15.5		Empty
5a	322760	162046	15.5		1 stone with encrusted <i>Sabellaria</i>
5b	322788	162079	15.5	12.15	<i>Sabellaria</i> reef fragments
5b	322788	162079	15.5	12.15	<i>Sabellaria</i> fragments
6a	324509	164617	15.5		<i>Sabellaria</i> fragments
6b	324569	164583	15.5		Lumps of <i>Sabellaria</i> reef
7a	325732	166215	16.5	10.20	<i>Sabellaria</i> tube fragments
7b	325835	166360	16.5	10.29	1 cobble with <i>Sabellaria</i> , hydroids & 2 barnacles
8a	327002	167647	16.5	10.48	1 clean stone - nothing found
8b	326933	167595	16.5	10.55	1 cobble with encrusted <i>Sabellaria</i>
9a	328625	168970	16.5	11.52	Small <i>Sabellaria</i> fragments & mud
9b	328602	168993	16.5	11.59	Large <i>Sabellaria</i> lumps & mud
10a	327933	171239	14.5	15.20	Empty
10b	327961	171256	14.5	15.25	Empty
11a	3287?0	170803	16.5	12.28	<i>Sabellaria</i> reef fragments
11b	328733	170775	16.5	12.35	2 large pebbles, 1 with <i>Sabellaria</i> tube & barnacle
12a	329109	170472	16.5	12.13	2 large pebbles
12b	329102	170473	16.5	12.19	1 large pebble
13a	329598	169906	14.5	15.50	Clean sand mud veneer
13b	329609	169941	14.5	15.55	Clean sand mud veneer
14a	330079	169490	14.5	16.05	Small <i>Sabellaria</i> tube fragments
14b	330077	169538	14.5	16.10	Small <i>Sabellaria</i> tube fragments
15a	329820	172049	14.5	16.30	Cobbles/shingle/liquid mud
15b	329812	172012	14.5	16.40	Liquid mud - nothing found
16a	331374	173205	14.5	14.55	Sand, slight mud
16b	331367	173214	14.5	15.00	Muddy sand, mud veneer
17a	333142	173615	14.5		Sand, slight mud
17b	333093	173553	14.5	17.15	Sand, mud veneer
18a	335019	173932	14.5	17.30	Sand, mud veneer
18b	334986	173920	14.5	17.40	Sand, slight mud
19a	336765	174585	14.5	13.00	Clean sand
19b	336786	174657	14.5	13.50	Clean sand
20a	336741	174001	14.5		Sand/mudballs
20b	336783	173949	14.5	18.20	Sand
21a	336796	173537	14.5		<i>Sabellaria</i> reef + sand
21b	336796	173524	14.5	18.00	sand/mud/ <i>Sabellaria</i>
22a	336703	173050	14.5	14.15	Muddy sand + <i>Sabellaria</i> 30% reef
22b	336701	173061	14.5		<i>Sabellaria</i> 90% reef+ muddy sand
23a	336608	174339	14.5		Liquid mud/sand
23b	338600	174373	14.5	18.40	Liquid mud/sand
24a	340244	175263	14.5		Sand, mud veneer
24b	340261	175246	14.5	18.55	Sand, mud veneer
25a	341785	176294	14.5		Coarse sand
25b	341800	176299	14.5	19.30	Sand/mud/1 Cobble
26a	343399	177194	14.5		Sand/mudballs
26b	343433	177221	14.5		Sand/gravel/shell/mudballs
27a	345066	178428	14.5		Sand/gravel
27b	345089	178426	14.5		Sand/gravel/dark grey clay
28a	345083	177792	14.5		Sand
28b	345111	177802	14.5		Sand
29a	345058	177179	14.5		Sand
29b	345052	177202	14.5		Sand
30a	Site not visited				
30b	Site not visited				
31a	Site not visited				
31b	Site not visited				
32a	325650	168237	16.5	11.11	<i>Sabellaria</i> reef fragments, gravel/shell/mud
32b	325655	168175	16.5	11.18	Shingle with <i>Sabellaria</i> & hydroids
33a	326874	169121	16.5	11.27	Large <i>Sabellaria</i> reef lumps
33b	326900	169089	16.5	11.33	Large <i>Sabellaria</i> reef lumps

Table 2: Benthic invertebrates recorded from the 0.1 m² grab samples.

		1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b	7a	7b	8a	8b	9a	9b	10a	10b	
Porifera	Encrusting sponge					P	P					P										
Cnidaria	<i>Abietinaria abietina</i>																					
	<i>Anthozoan</i> (large)																2					
	<i>Anthozoan</i> (small)																	4	1			
	<i>Tubulariidae</i> (1 hydranth)																					
	<i>Obelia dichotoma</i>						P															
Sipuncula	<i>Nephasoma minutum</i>						1					2						4				
Annelida	<i>Ampharete baltica</i>																					
	<i>Aphelochaeta marioni</i>					2																
	<i>Autolytus langerhansi</i>						2															
	<i>Capitella capitata</i>					1																
	<i>Eulalia tripunctata</i>												4					4				
	<i>Harmothoe impar</i>					1												1				
	<i>Melinna elisabethae</i>												1									
	<i>Nereis zonata</i>																					
	<i>Proceraea</i> sp.							1														
	<i>Sabellaria alveolata</i>			10								1	16		1		1	10	19			
	<i>Scoloplos armiger</i>																		1			
	<i>Spio martinensis</i>																					
	<i>Syllis armillaris</i>					2																
	<i>Tubificoides benedii</i>																					
Crustacea	<i>Amphilocheus manudens</i>																					
	<i>Cyathura carinata</i>																					
	<i>Dexamine</i> sp.																					
	<i>Elminius modestus</i>					1																
	<i>Eurydice pulchra</i>																					
	<i>Gammarus salinus</i>																					
	<i>Harpinia pectinata</i>																					
	<i>Haustorius arenarius</i>																					
	<i>Janira maculosa</i>																					
	<i>Melita palmata</i>																					
	<i>Semibalanus balanoides</i>														2							
Mollusca	<i>Lutraria</i> sp. (juv)						1			1												
	<i>Mytilus edulis</i> (juv)					1	1											2				
Bryozoa	<i>Cribrilina punctata</i>							P							P							
	<i>Electra pilosa</i>					P	P	P				P	P		P							
Echinodermata	<i>Ophiura</i> sp. (v. small)																					
Tunicata	<i>Dendrodoa grossularia</i>							16		4	1		8		11							
	Total species	0	0	1	0	8	7	4	0	2	1	4	5	0	5	0	3	5	3	0	0	
	Total no. of organisms	0	0	10	0	8+2	5+3	17+2	0	5	1	3+2	29+2	0	14+2	0	5	23	21	0	0	

Table 2 (cont)

		11a	11b	12a/b	13a	13b	14a	14b	15a	15b	16a	16b	17a	17b	18a	18b	19a	19b	20a	20b
Porifera	Encrusting sponge							P												
Cnidaria	<i>Abietinaria abietina</i>																			
	<i>Anthozoan</i> (large)																			
	<i>Anthozoan</i> (small)																			
	<i>Tubulariidae</i> (1 hydranth)		1	1																
	<i>Obelia dichotoma</i>		P	P	P															
Sipuncula	<i>Nephasoma minutum</i>						1													
Annelida	<i>Ampharete baltica</i>										1									
	<i>Aphelochaeta marioni</i>																			
	<i>Autolytus langerhansi</i>																			
	<i>Capitella capitata</i>																			
	<i>Eulalia tripunctata</i>	1																		
	<i>Harmothoe impar</i>																			
	<i>Melinna elisabethae</i>																			
	<i>Nereis zonata</i>																			
	<i>Proceraea</i> sp.																			
	<i>Sabellaria alveolata</i>	3																		1
	<i>Scoloplos armiger</i>																			
	<i>Spio martinensis</i>																			
	<i>Syllis armillaris</i>																			
	<i>Tubificoides benedii</i>																			
Crustacea	<i>Amphilocheus manudens</i>																	1		
	<i>Cyathura carinata</i>																			
	<i>Dexamine</i> sp.																			
	<i>Elminius modestus</i>																			
	<i>Eurydice pulchra</i>														1	1		3		2
	<i>Gammarus salinus</i>																			
	<i>Harpinia pectinata</i>																			
	<i>Haustorius arenarius</i>													1	1					
	<i>Janira maculosa</i>																			
	<i>Melita palmata</i>																			
	<i>Semibalanus balanoides</i>				1															
Mollusca	<i>Lutraria</i> sp. (juv)																			
	<i>Mytilus edulis</i> (juv)																			
Bryozoa	<i>Cribrilina punctata</i>																			
	<i>Electra pilosa</i>		P	P				P			P									
Echinodermata	<i>Ophura</i> sp. (v. small)																			
Tunicata	<i>Dendrodoa grossularia</i>							1												
	Total species	2	3	3	2	0	1	3	0	0	2	0	0	1	2	1	0	2	1	1
	Total no. of organisms	4	1+2	1+2	1+1	0	1	1+2	0	0	1+1	0	0	1	2	1	0	4	1	2

Table 2 (cont)

		21a	21b	22a	22b	23a	23b	24a	24b	25a	25b	26a	26b	27a	27b	28a	28b	29a	29b	32a	32b	33a	33b
Porifera	Encrusting sponge																						
Cnidaria	<i>Abietinaria abietina</i>																				P	P	
	<i>Anthozoan</i> (large)	1																					
	<i>Anthozoan</i> (small)	2			2																		1
	<i>Tubulariidae</i> (1 hydranth)			1																			
	<i>Obelia dichotoma</i>				P		P													P	P	P	
Sipuncula	<i>Nephasoma minutum</i>																						
Annelida	<i>Ampharete baltica</i>			2	1															1			
	<i>Aphelochaeta marioni</i>																						
	<i>Autolytus langerhansi</i>				1																		
	<i>Capitella capitata</i>					4	2							1	2			2					
	<i>Eulalia tripunctata</i>	2			2															4			1
	<i>Harmothoe impar</i>			1	2																		1
	<i>Melinna elisabethae</i>																						
	<i>Nereis zonata</i>				3																	1	
	<i>Proceraea</i> sp.																						
	<i>Sabellaria alveolata</i>	45	24	11	15															13	6	6	7
	<i>Scoloplos armiger</i>	1	5																				
	<i>Spio martinensis</i>			1	2																		
	<i>Syllis armillaris</i>																						1
	<i>Tubificoides benedii</i>			3	10															2		2	1
Crustacea	<i>Amphilocheus manudens</i>				2																		
	<i>Cyathura carinata</i>			1																			
	<i>Dexamine</i> sp.						1																
	<i>Elminius modestus</i>																						
	<i>Eurydice pulchra</i>															1							
	<i>Gammarus salinus</i>				1															2			
	<i>Harpinia pectinata</i>																						1
	<i>Haustorius arenarius</i>																	1					
	<i>Janira maculosa</i>																						1
	<i>Melita palmata</i>			1																			
	<i>Semibalanus balanoides</i>																						
Mollusca	<i>Lutraria</i> sp. (juv)																						
	<i>Mytilus edulis</i> (juv)																						
Bryozoa	<i>Cribrilina punctata</i>																						
	<i>Electra pilosa</i>				P																P	P	P
Echinodermata	<i>Ophiura</i> sp. (v. small)						1																
Tunicata	<i>Dendrodoa grossularia</i>																						
	Total species	5	2	8	13	1	4	0	0	0	0	0	0	1	1	1	0	2	0	6	4	6	9
	Total no. of organisms	51	29	21	41+2	4	4+1	0	0	0	0	0	0	1	2	1	0	3	0	22+1	6+3	9+3	14+1

**Table 3: Weight of *Sabellaria* reef recorded in the grab samples.
Samples not included in this table held zero or negligible quantities of tube.**

Sample	E	N	Date	Time	Sample contents	Weight of <i>Sabellaria</i> tube g
2a			15.5		<i>Sabellaria</i> fragments	15
5b			15.5	12.15	<i>Sabellaria</i> fragments	11
7b	325835	166360	16.5	10.29	1 cobble with <i>Sabellaria</i> , hydroids & 2 barnacles	10
8b	326933	167595	16.5	10.55	1 cobble with <i>Sabellaria</i>	98
9a	328625	168970	16.5	11.52	<i>Sabellaria</i> reef fragments & mud	465
9b	328602	168993	16.5	11.59	Large <i>Sabellaria</i> lumps & mud	2720
14a	330079	169490	14.5	16.05	<i>Sabellaria</i> reef fragments	20
14b	330077	169538	14.5	16.10	<i>Sabellaria</i> reef fragments	22
21a	336796	173537	14.5		<i>Sabellaria</i> reef + sand	2890
21b	336796	173524	14.5	18.00	sand/mud/ <i>Sabellaria</i> reef	744
22a	336703	173050	14.5	14.15	Muddy sand + 30% <i>Sabellaria</i> reef	930
22b	336701	173061	14.5		90% <i>Sabellaria</i> reef+ muddy sand	2649
32a	325650	168237	16.5	11.11	<i>Sabellaria</i> fragments, gravel/shell/mud	660
33a	326874	169121	16.5	11.27	Large <i>Sabellaria</i> reef lumps	958
33b	326900	169089	16.5	11.33	Large <i>Sabellaria</i> reef lumps	2338

Table 4 Species list for the intertidal *S. alveolata* reefs at Duckpool on the North Cornish coast.

Group	Species
Algae	<i>Ceramium rubrum</i>
	<i>Chaetomorpha</i> sp.
	<i>Cladophora</i> sp.
	<i>Corallina officinalis</i>
	<i>Enteromorpha</i> sp.
	<i>Ulva lactuca</i>
	<i>Fucus ceranoides</i>
Cnidaria	<i>Actinia equina</i>
	<i>Obelia dischotoma</i>
	<i>Actinia fragacea</i>
Nemertea	Nemertea indet.
Nematoda	<i>Thoracostoma coronatum</i>
Annelida	<i>Aonides oxycephala</i>
	Aphroditidae indet.
	<i>Eulalia viridis</i>
	<i>Eumida</i> sp.
	<i>Fabricia sabella</i>
	<i>Malacoceros fuliginosus</i>
	Oligochaeta indet.
	<i>Pomatoceros triqueter</i>
	<i>Sabellaria alveolata</i>
	<i>Sabellaria spinulosa</i>
<i>Typosyllis armillaris</i>	
Chelicerata	<i>Achelia</i> sp.
	<i>Nymphon gracile</i>
	Pycnogonida indet.
Crustacea	<i>Chthamalus montagui</i>
	<i>Dynamene bidentata</i>
	<i>Hyale</i> sp.
	<i>Idotea granulosa</i>
	<i>Idotea pelagica</i> ,
	<i>Jaera albifrons</i>
	<i>Jassa falcata</i> ,
	<i>Jassa oci</i>
	<i>Liocarcinus pusillus</i>
	<i>Tigriopus brevicornis</i>
Insecta	Chironomid larva
Mollusca	<i>Acanthochitona crinitus</i>
	<i>Gibbula umbilicalis</i>
	<i>Modiolus modiolus</i>
	<i>Mytilus edulis</i>
	<i>Nucella lapillus</i>
	<i>Patella depressa</i>
<i>Patella vulgata</i>	
Bryozoa	<i>Callophora lineata</i>

Table 5 A list of adult species found in association with *Sabellaria* reefs in the Severn Estuary.

Group	Species	Distribution
Cnidaria	<i>Abietinaria abietina</i>	On shells and stones: 10 m to offshore, often found on strandline; all coasts, common; arctic to Mediterranean.
	<i>Obelia dichotoma</i>	On animal, plant and inert substrata; intertidal to about 100 m; throughout British Isles; near cosmopolitan.
Sipuncula	<i>Nephasoma minutum</i>	Very common in rocky crevices from mid-shore to 50 m depth; Shetland, Sweden, Britain, Brittany.
	<i>Golfingia vulgari</i>	In muddy sand or gravel from LW to 2000 m depth, widespread round Britain and from northern Norway to West Africa and Mediterranean.
Annelida	<i>Ampharete baltica</i> (as <i>acutifrons</i>)	At low water, in muddy sand amongst sea-grasses, and sublittorally. Circum-Arctic, European coasts to Mediterranean, including the Baltic Sea.
	<i>Eulalia tripuctata</i>	Not listed in Hayward and Ryland.
	<i>Eumida sanguinea</i>	At low water, under stones or in kelp holdfasts; offshore amongst old shells. All around Britain and north-west Europe, Mediterranean: Arabian Gulf, Australasia.
	<i>Harmothoe impar</i>	At low water under stones, amongst shells or in kelp holdfasts; offshore to some depth. Northwestern European coasts, Mediterranean.
	<i>Mediomastus fragilis</i>	Not listed in Hayward and Ryland, but listed as 'very common' in 'The species Directory of the Marine Fauna and Flora of the British Isles and Surrounding Seas' (eds C.M. Howson & B.E. Picton).
	<i>Melinna elisabethi</i> (as <i>cristata</i>)	On the shore and sublittorally on muddy bottoms, often amongst sea-grasses. Most north-west European coasts, Arctic; north Pacific, sub-Antarctic.
	<i>Sabellaria alveolata</i>	On lower shore and shallow sublittoral rocks adjacent to a sand table; southern species; both sides of Britain as far as Firth of Clyde and Berwick; western Ireland; locally abundant.
	<i>Scoloplos armiger</i>	At low water or in shallow sublittoral, in fine muddy sand, often amongst sea-grasses. West and north of Britain, Arctic, north-west Europe; Indian Ocean, Pacific, Antarctic.
	<i>Typosyllis armillaris</i>	On the lower shore and sublittorally, under stones or in kelp holdfasts. Around most of the British coast: cosmopolitan.
	<i>Tubificoides benedii</i>	Commonly found with <i>Clitellio arenarius</i> ; on the lower shore and sublittorally in sediments, from estuaries to some distance offshore. Europe (recorded from major estuaries all around Britain), north-east America.
Crustacea	<i>Harpinia pectinata</i>	On muddy sand from 5 m downwards. All coasts.
	<i>Janira maculosa</i>	Amongst sponges, ascidians, hydroids, bryozoans and <i>Laminaria</i> holdfasts: LWST and below; most coasts, not uncommon. Distributed from Norway to Atlantic coast of France.
	<i>Melita palmata</i>	Marine and brackish water; intertidal and shallow sublittoral, among silty, stony habitats. All coasts.
Mollusca	<i>Sphenia binghami</i>	Attaches by a byssus, in holes and crevices or algal holdfasts, in shallow sublittoral waters. Off most British coasts; distributed southwards to the Mediterranean and north-west Africa.
	<i>Tricolia pullus</i>	On rocky shores near LWST and sublittorally to 35 m; intertidally most abundant on tufted red algae such as <i>Lomentaria</i> , <i>Laurencia</i> , and <i>Chondrus</i> . A southern species extending from the Mediterranean to the west and south-west coasts of Britain and Ireland; rare in the North.
Bryozoa	<i>Electra pilosa</i>	Marine; various substrata, particularly <i>Fucus serratus</i> and other algae; lower shore and shallow water; all coasts; very common.
Tunicata	<i>Dendrodoa grossularia</i>	On rock, stones, shells etc. from the lower shore into deep water; all coasts, in aggregations; particularly in the south and west; locally common; North America, Arctic south to Isles of Scilly and Brittany peninsula (Glenan archipelago).

Table 6 A list of adult species found in subtidal sand habitat in the Severn Estuary.

Group	Species	Distribution
Annelida	<i>Capitella capitata:</i>	At low water and offshore, in muddy sand or rich mud and under stones; often indicates polluted conditions. European coasts from Arctic to the Mediterranean, widespread elsewhere around Atlantic and Pacific coasts.
	<i>Nephtys cirrosa:</i>	Intertidal and at low water. All around Britain, Atlantic coast of Europe.
Crustacea	<i>Eurydice pulchra:</i>	Up to HWN in intertidal sand, swimming freely with the rising tide; all British coasts; common. Distributed from Norway to Morocco; absent from the Mediterranean.
	<i>Gammarus salinus:</i>	Brackish waters, usually in more saline conditions than <i>G. zaddachi</i> . All coasts.
	<i>Haustorius arenarius</i>	In clean, medium to coarse sands. Intertidal, generally close to the highest point of emergence of water table. All coasts, including sandy estuaries. Common.

Plate 1 – Sample substrates



Site 24b – clean sand



Site 19a – Clean sand



Site 26b – Sand, shell & mud

Plate 2 – Sample substrates



Site 27b – Sand, mud & stone



Site 21b – Sand & mud



Site 15a – Stone & mud

Plate 3 – Sample substrates



Site 4a - Stone



Site 21a – *Sabellaria* & muddy sand



Site 33b - *Sabellaria*

Plate 4 – *Sabellaria alveolata*, Duckpool, North Cornwall

