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Polychaete worms associated to six types of substrate in North-Eastern Bermuda

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Abstract: Twenty two species of marine polychaete were collected in six types of substrates incluing rocks, scleractinian corals, demospongean sponges, soft bottoms, brown and red algae and *Thalassia testudinum* in July and August, 1986. Cluster analysis showed little affinity among those substrates, although some species such as *Ehlersia cornuta, Haplosyllis spongicola, Nicolea modesta, Eupolymnia crassicornis* and *Notomastus latericeus* were indentified in several substrates. The greater abundance and species richness of polychaetes was directly related to the heterogeneity and the organic matter contents of sediments. The most abundant species was *Capitella capitata,* wich may be important as an organic pollution indicator.

Polychaetes can be found nearly everywhere in the marine environment (Fauchald 1977). They are mostly benthic and live in the intertidal and subtidal regions (often at dephts greater than 1000 m), on drifting objects (wood, *Sargassum*) and are also planktonic. They may burrow in sand or mud, or into the coral rock, or live in tubes attached to hard substrates (rocks, pollings, *Thalassia*), or burried in sand, mud or under rocks (Sterrer 1986).

Polychaetes are abundant in sediments near mangrove swamps. The mangrove trees have a controlling influence on sedimentation within their boundaries and produce large quantities of organic detritus, which is incorporated to sediments to be a rich source of food for filter or deposit feeders (Thomas 1984).

Due to the variety of substrates in which polychaetes can live, the main objective of this study was to determine the affinity among six substrates, according to the presence/absence of polychaete species in each. An attempt was also made to observe the relationships between the species and grain size and organic matter contents in sediments from soft bottoms, particularly near mangrove swamps.

Bermuda is an interconnected chain of some 100 islands shaped as a finshhook, in the Northwest Atlantic (32° 14' to 32° 23' N, 64° 38' to 64° 53' W). They are located on the volcanic Bermuda Seamount, which is capped by a coral reef platform (Fricke and Meischner 1985).

Although no rivers or lakes exist, a few marshes and brackish ponds can be found. On the other hand, the islands are rich in marine environments such as mangroves, caves, seagrass beds, *Sargassum,* coral reefs, rocky shores with tidal pools, sandy beaches and open waters. This allows the opportunity to study a wide variety of phyla in a relatively complex ecological setting.

The Northeastern portion of Bermuda has reduced wind exposure and is protected by offshore or nearshore reefal structures in shallow waters. Sheltered areas are available in a number of bays, sounds and harbours (Thomas 1985). Samples collected for this study were taken from seven locations in sheltered areas and eight locations in exposed areas (Figure 1).

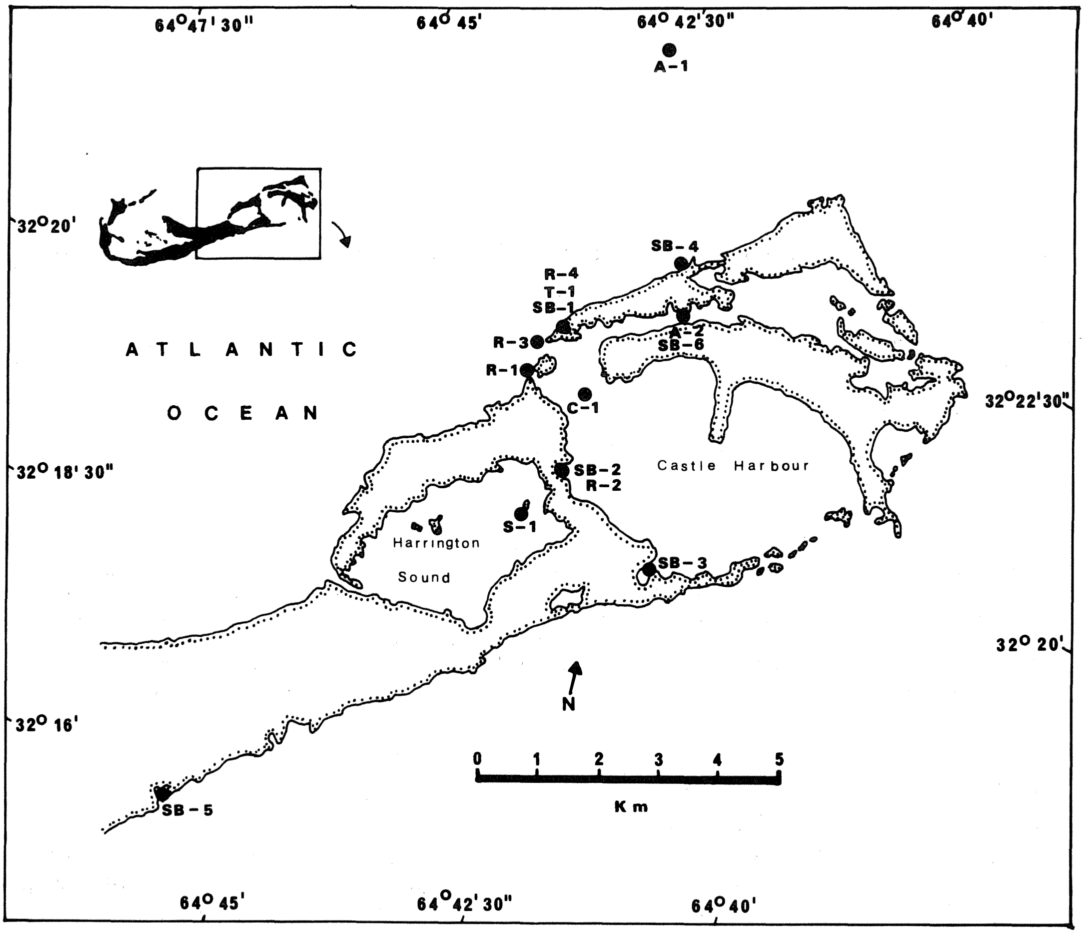

Fig. 1. Study area and sampling locations organized according to substrate type. SPONGES S–1 Hall's Island (Harrington Sound. CORALS C–1 The Causeway (Castle Harbour). ALGAE A–1 North Rock. A–2 Ferry Reach *Thalassia testudinum* T–1 Whalebone Bay. ROCKS R–1 Conney Island. R–2 Walsingham Bay (Castle Harbour) R–3 Ferry Point. R–4 Whalenone Bay. SOFT BOTTOMS SB–1 Whalebone Bay. SB–2 Walsingham Bay (Castle Harbour) (Mangrove) SB–3 Tucker's Town Bay (Mangrove) SB–4 Mullet Bay. SB–5 Hungry Bay SB–6 Ferry Reach.

MATERIAL AND METHODS

Polychaetes were obtained from six types of substrates which included rocks, scleractinian corals (hard substrates), demospongean sponges, soft bottoms, brown and red algae (soft substrates) and *Thalassia testudinum* (seagrass bods).

A qualitative analysis was carried out to obtain the affinity among the six substrates studied, according to the presence and absence of polychaete species in each. Samples of algae, sponges and *Thalassia testudinum* were obtained by hand collection and polychaetes were separated in the laboratory in a finger bowl. Epibenthic polychaetes from scleractinian corals, rocks and soft bottoms (locations SB-5 and SB-6) were collected directly with forceps.

The biological data obtained were subjected to the Sörensen Similarity Index, which only takes into account the presence/abscense of species in each sample (Odum 1971). In this study, each substrate was considered as a single sample although in some cases, there was more than one sample of each type of substrate.

An affinity matrix and a cluster analysis were applied to determine the different groups formed in the substrates studied. The dendrograms were made by hand, according to the

TABLE 1

Polychaete species identified in the survey

FAMILY	SPECIES	SAMPLES
Amphinomidae	*Eurithoe complanata* (Pallas, 1766)	R–1, R–4
Syllidae	*Haplosyllis spongicola* (Grube, 1855)	S–1, A–2
	Typosyllis hyalina (Grube, 1863)	SB–2
	Ehlersia cornuta (Rathke, 1843)	SB–2, T–1, A–1
Nereidae	*Perinercis andersonni* Kinberg, 1866	SB–3
Onuphidae	*Mooreonuphis jonesi* Fauchald, 1982	T–1
Eunicidae	*Eunice vittata* (delle Chiaje, 1828)	R–3
Lumbrineridae	*Lumbrineris inflata* (Moore, 1911)	T–1
Dorvilleidae	*Dorvillea sociabilis* (Webster, 1879)	SB–2
Cirrantulidae	*Cirriformia punctata* (Grube, 1859)	T–1
	Caulleriella sp.	SB–2
Orbiniidae	*Naineris setosa* (Veriill, 1900)	SB–2
Opheliidae	*Polyophthalmus pictus* (Dujardin, 1839)	SB–1
Capitellidae	*Notomastus latericeus* (Sars, 1851)	SB–1, T–1
	Capitella capitata (Fabricius, 1780)	SB–2, SB–3
Maldanidae	Species 1	T–1
	Euclymene coronatus Verril, 1900	SB–5
Sabellariidae	*Lygdamis indicus* Kinberg, 1867	SB–5
Terebellidae	*Nicolea modesta* Verrill, 1900	T–1, A–2
	Eupolymnia crassicornis (Schmarda, 1861)	SB–6, C–1
Sabellidae	*Sabella melanostigma* Schmarda, 1861	R–2
	Species 1	A–2

methods for the Complete Linkage Clustering (also called Furthest Neighbour Clustering) and the Single Linkage Clustering (also known as Nearest Neighbour Clustering) (Espinosa and López 1986).

To determine the relationships between fauna and sediments in soft bottoms a quantitative analysis was done of locations SB-1 to SB-4. Samples of sediment were taken with a five liter container at about 15 cm depth into the substrate, and this volume of sediment was later filtered through a 1 mm sieve to obtain the organisms. Once separated from the sediment, they were fixed in formaldehide (10%), preserved in ethanol (70%), and identified, in most cases to species, according to Sterrer's (1986) and Fauchald's (1977) keys.

Additional samples of sediments from these locations were analysed for organic matter contents and grain size analysis. Organic matter contents in percentages was obtained by loss of ignition (Dean 1974). Gravel, sand and mud (the latter considered as the mixture of silt and clay) percentages were determinated according to Folk (1968).

The polychaete species recognized in samples SB-1 to SB-4 were alto taken into account in the qualitative analysis.

RESULTS AND DISCUSSION

A total of 22 species of polychaetes, distributed in 15 damilies was identified (Table 1). The species richness for each substrate was as follows: soft bottoms, 12 species: *Thalassia testudinum*, 7 species; algae, 4 species; rocks, 3 species; corals and sponges, 1 species. The highest species richness found from soft bottoms may be due to the fact that a greater volume of sediment was collected from these substrates.

Substrate associations.

Cluster analysis by the Complete and Single methods (Fig. 2) showed that the largest associations were between sponges and algae. This may be due to the small number of polychaete species represented in each of these substrates (sponges – 1 species and algae – 4 species). The presence of *Haplosyllis spongicola* in sample A-2 (Ferry Reach) was attributed to the presence of a considerable number of sponges which live near algae, and probably the sample contained polychaetes from both substrates.

A second independent group corresponding to the association between *Thalassia testidium*

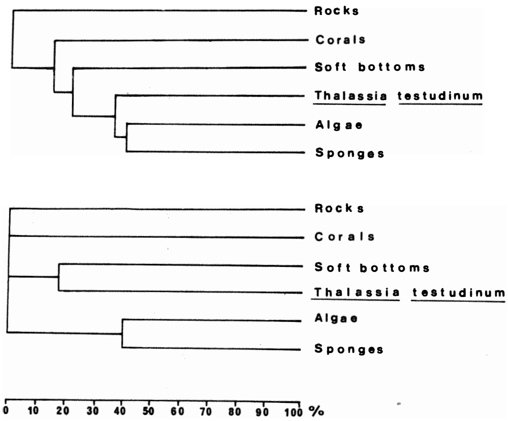

Fig. 2. Dendrograms generated from Sörensen Similarity Index values. Above: Single Linkage Clustering, below: Complete Linkage Clustering.

and soft bottoms was found by the Complete method of cluster analysis, while by the Single method, both *Thalassia testudinum* and soft bottoms were found associated with algae/ sponges. The similarity of polychaete species from algae and *Thalassia testudinum* may be explained because both substrates are adequate sites of attachment, protection and, in some instance, food, due to the similar structure of these plants. The similarity between soft bottoms and algae/*Thalassia testudinum* is due to the fact that both plants live attached to this type of sediment. The syllid *Ehlersia cornuta* (Table 1) was encountered in the three substrates, while the capitellid *Notomastus latericeus* was found only in soft bottoms and on *Thalassia testudinum*. These organisms are free living and it is not unusual to find them close to these plants, in or on the sediment.

By the Single method of cluster analysis, corals were associated with all the above mentioned groups, even though the affinity was small; by the Complete method, there was no affinity. The presence of *Eupolymnia crassicornis* is soft bottoms and corals may explain 15% affinity found in these substrates, since this organism can live attached to a solid surface or in sand-gravel built tubes (Sterrer 1986).

Since there was no affinity between rocks and the other groups (Figure 2), it can be considered that the species *Eurithoe complanata, Eunice vittata* and *Sabella melanostigma* only can live in this substrate in the study area (Table 1).

These results suggest that the majority of species were confined to a particular substrate. Nevertheless, cluster analysis showed that some polychaete species like *E. cornuta, N. latericeus, N. modesta, H. spongicola* and *E. crassicornis* may be present in more than one of the substrates studied.

Soft bottoms. Relationships between fauna and sediments.

The quantitative analysis for samples SB-1 to SB-4 are shown in Tables 2 and 3. Sample SB-4 was not taken into account because only a fragment of the eunicid *Marphysa sanguinea* (Montagu 1815) was encountered. The dominance of sand is evident in the three samples, especially in SB-1 and SB-3. The presence of organic matter contents are greater in samples SB-2 and SB-3.

The highest values of abundance and species richness corresponded to samples collected near the mangrove roots (*Rhizophora mangle*), which provide detritus to the sediment, making it rich in organic matter. The organic material is a source of food for animals inhabiting this kind of bottom (Thomas 1984).. The largest abundance of individuals corresponded to samples SB-3 (Table 3), where the content of organic matter was relatively high (16.67%) (Table 2).

TABLE 2

Grain size analysis of sandy sediments from quantitative samples

Sample	%Gravel	%Sand	%Mud	%Organic matter
SB–1	2.12	97.14	0.74	1.00
SB–2	21.88	66.67	11.45	13.70
SB–3	3.16	94.04	2.80	16.67

The polychaetes *N. setosa* and *C. capitata* were found in the locations with the highest values of organic matter in the sediment (Tables 2 and 3). This suggests that these species live in bottoms with great ammounts of organic material.

At SB-3 the abundance of the capitellid *Capitella capitata* may be important since

TABLE 3

Abundance and species richness of annelid polychaetes in the soft bottom's quantitative samples

Samples	Species Richness	Species	Number of Individuals
SB–1	2	*Polyophthalmus pictus*	2
		Notomastus latericeus	1
SB–2	6	*Naineris setosa*	1
		Dorvillea sociabilis	1
		Caulleriella sp.	1
		Capitella capitata	5
		Typosyllis hyalina	1
		Ehlersia cornuta	2
SB–3	3	*Naineris setosa*	1
		Capitella capitata	70
		Perinereis andersonni	1

Reish (1959), Bellan (1967) and Lizárraga-Partida (1974) have found this species in California (U.S.A.), Marseille (France) and Ensenada (Mexico), respectively, and related it to organic pollution.

The highest species richness was found in samples SB-2 (Table 3) where the proportion of sand was lower (Table 2). Probably, the polychaetes *D. sociabilis, Caulleriella* sp. and *T. hyalina* from this location prefer soft heterogeneous sediments. The existence of a wider range of grain diameters increases the species distribution, since detritivorous animals have more opportunities of feeding, and animals that burrow into the sediment can manipulate grains of similar size more easily.

In sample SB-1 both abundance and species richness were low (Table 3), possibly because the scarcity of organic matter in the sandy bottom did not provide a suitable feeding ground.

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RESUMEN

Veintidós especies de poliquetos marinos fueron colectadas en seis tipos de sustratos que incluyen rocas, corales escleractinios, esponjas demospogiarias, fondos blandos, algas pardas y rojas y *Thalassia testudinum.*, durante julio y agosto de 1986. Aunque el análisis de agrupamiento mostró poca afinidad entre sustratos, especies como *Ehlersia cornuta, Haplosyllis spongicola, Nocilea modesta, Eupolymnia crassicornis* y *Notomastus latericeus* aparecieron en varios fondos blandos, la mayor abundancia y riqueza de especies de poliquetos se relacionó, de manera directa, con la heterogeneidad y contenido de materia orgánica en el sedimento. La especie más abundante fue *Capitella capitata,* que puede ser importante como indicadora de contaminación orgánica.

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