Zoosymposia 2: 527–536 (2009)
www.mapress.com/zoosymposia/

ISSN 1178-9905 (print edition)
ZOOSYMPOSIA
ISSN 1178-9913 (online edition)

Sabellaria alveolata (Linnaeus) reefs in the central Tyrrhenian Sea (Italy) and associated polychaete fauna

BARBARA LA PORTA[1] & LUISA NICOLETTI

ISPRA Institute for Environmental Protection and Research, via di Casalotti, 300, 00166 Roma (Italy)
[1]Corresponding author. E-mail: barbara.laporta@isprambiente.it

Abstract

The aim of this research was to analyze the morphological features of *Sabellaria alveolata* reefs and the associated polychaete fauna in three different coastal areas of the Tyrrhenian Sea (Mediterranean Sea, Italy). We assessed the relationship between the physical structure of the reefs and the associated fauna. We also investigated possible connections between polychaete assemblage structure and reef development on spatial and temporal scales. Reefs were morphologically described, and the polychaete assemblages were studied using community indices, as well as multivariate and univariate statistics. Three different reef states were described, linked to their respective phase of development. The structure of the associated polychaete assemblages differed according to the relevant reef's phase of development. Species richness was high in reefs in destruction phase, while it decreased in recovering reefs.

Key words: Sabellariidae, bioconstruction, Mediterranean Sea, Polychaetes, associated fauna

Introduction

Sabellaria alveolata is a gregarious polychaete species that uses sand to build its tube, which is characterized by a "sand crown." These tubes develop communally into biogenic structures that may reach several kilometers in length (Pawlik 1988). These bioconstructions provide a habitat for benthic vertebrates and invertebrates (Bianchi 2001; Done 1995; Gruet 1982). *S. alveolata* reefs are usually found intertidally, and sometimes subtidally (Gruet 1982). Sabellariid reefs have been studied on the coast of South America (Lana & Bremec 1994), Brazil (Lana & Gruet 1989), India (Achary 1969), the coasts of Great Britain and Ireland (Mettam 1992; Bamber & Irving 1997), Portugal (Dias & Paula 2001), and the northern coast of France (Volvelle 1963; Gruet & Bouder 1997; Dubois et al. 2006). *S. alveolata* has been also studied in the Mediterranean Sea on the French coast (Bellan 1964), Spain (Porras et al. 1996), and Italy (Sparla et al. 1992; Gambi et al. 1996; La Porta *et al.* 2006). *S. alveolata* reefs occur in two forms (Dubois et al. 2002). Some reefs are built as structures adhering to rocks, and are very common at the mid-level of the intertidal zone. The second are reefs spread over several acres on sand flats in the low intertidal zone (Gruet 1982). Reefs are ball-shaped and can evolve to form platforms or barrier structures with varying sizes of extensions on the sandy beach (Gruet 1982). According to Gruet (1986), the reef's development can be summarized in four different periods: (1) primary settlement phase, (2) growth phase, (3) stagnation phase, and (4) destruction phase. The morphological features of *S. alveolata* reefs (reef compactness, tube orientation, percentage of tubes with "sand crown," the presence/absence of epibionts and the

Accepted by N. Maciolek: 28 Apr. 2009; published: 31 Aug. 2009

status of the reef surface) change according to the phases (Gruet 1970, 1986). Differences in the reef's structure and morphology are mainly due to both the its current phase and environmental conditions. The phase is the result of a constantly disturbed and precarious balance between biological and physical factors. Hydrodynamic forces, temperature, and local environmental conditions, such as seabed topography and water clarity are the main physical factors that may positively or negatively affect the structural development of the reef (Gruet 1982, 1986; Porras et al. 1995). The main biological factor is the reproduction and recruitment mechanism of the pelagic larvae of *S. alveolata* (Gruet 1982). Human disturbance (e.g., fishing activities and trampling) contributes to changes in reef surface topography (Dauvin 1997; Dubois et al. 2002). In particular, human activity can damage the reef's first few centimeters. This damage contributes to an increase in the development of openings and free microenvironments, normally due to both a decrease in the number of *S. alveolata* individuals and to the surface features of the eroded reef (Dias & Paula 2001).

In the present paper, the morphological features of *Sabellaria alveolata* reefs and the associated polychaete fauna were temporally analyzed in three coastal areas of the Tyrrhenian Sea (Italy) with different environmental conditions, with the aim of: (1) assessing the relationship between the physical structure of the reefs and the associated fauna, and (2) investigating possible connections, on spatial and temporal scales, between the polychaetes, which are usually the dominant taxon (Dubois et al. 2002, 2006) and reef development, in order to define different assemblages.

Materials and methods

Study area. The *Sabellaria alveolata* reefs were located in three different coastal areas of the Tyrrhenian Sea (Mediterranean Sea, Italy): (1) Punta della Quaglia, in the northern part, (2) Tor Caldara in the central portion, and (3) Torre Paola in the southern part, close to the Capo Circeo promontory (Fig. 1). These areas are characterized by different environmental conditions, mainly in terms of water turbidity and hydrodynamic forces. The Tyrrhenian Sea is characterized by a narrow tidal range. The three reefs had different morphologies, but all were situated on sandy bottoms between the intertidal and subtidal zones and were independent from the rock. The reef chosen in the Punta della Quaglia (PQ) area was a platform reef situated inside a crenulated bay, at a depth of 1.5 m. Water turbidity was high, both because of low hydrodynamic force, and because of the presence of surrounding rivers (Fig. 1). The reef of Tor Caldara (TC) was a ball-shaped structure located at a depth of 1 m. The shoreward side of this reef was more exposed to wave action than the PQ reef. The reef of Torre Paola (TP) was also a ball-shaped structure, larger than those found at TC. The reef's depth was 2.5 m. The TP coastal area is the most exposed to wave action among those analyzed in this study.

Field and laboratory procedures. Sampling was carried out in three different periods (Table 1) between February 2000 and May 2001 by scuba diving. Samples were taken from each of the three selected reefs; each block was 20 × 20 × 20 cm (Gruet 1982). Samples were preserved in a 70% alcohol solution. In the laboratory, *S. alveolata* blocks were morphologically described according to the following features: percentage (%) of tubes with a "sand crown," status of the surface (eroded and with openings/crevices), presence/absence of epibionts, block compactness, and tube orientation (Gruet 1970, 1982). A semi-quantitative code was used to describe both eroded portions and portions with openings/crevices, + isolated portions (5–10% of block surface), ++ reduced portions (11–30%), +++ wide portions (31–80%).

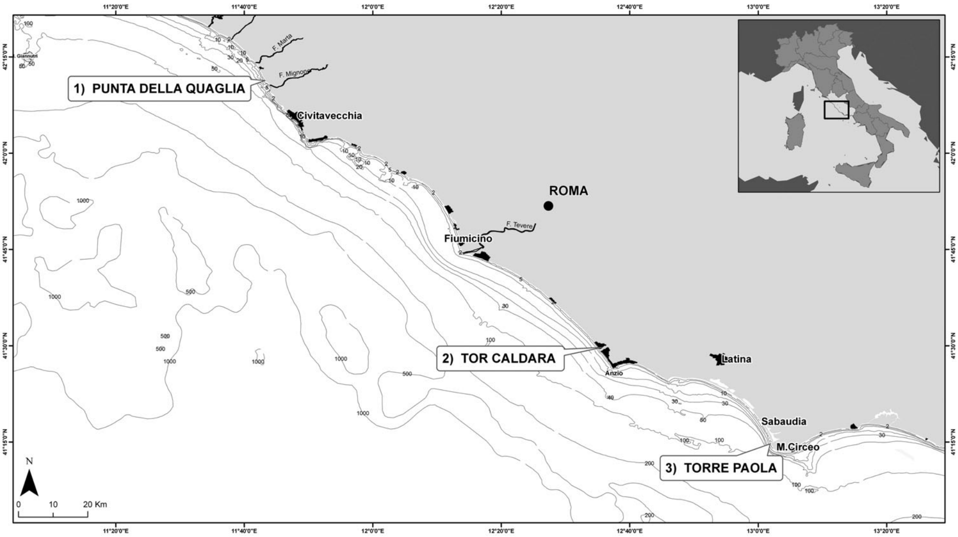

FIGURE 1. Study areas.

TABLE 1. Geographical coordinates, depth, and sampling periods (d/m/y) of each study area.

Area	WGS 84 coordinates		Depth (m)	Sampling periods		
	Longitude	Latitude		1	2	3
Punta della Quaglia	11°43′18.42″	42°11′08.70″	1.5	24/2/2000	27/8/2000	3/4/2001
Tor Caldara	12°35′07.41″	41°29′12.38″	1.0	12/3/2000	21/10/2000	11/5/2001
Torre Paola	13°02′01.08″	41°14′55.58″	2.5	12/3/2000	21/10/2000	5/5/2001

The tubes were then dismantled in water. The polychaetes retained on a 500 μm mesh were sorted, identified by the authors, and counted.

Data analysis. Polychaete assemblages were studied using the following community indices: total number of species (S), total abundance (N), Margalef species richness (d), Shannon-Wiener diversity (H′) and Pielou's evenness (J′) (Clarke & Warwick 1994). These indices were compared by means of a 1-way ANOVA, at a 99% confidence level, which uses stations and sampling periods as factors. Significant factors were further analyzed using Tukey's test set at the 5% significance level. Before calculating the ANOVA, homogeneity of variances was examined. To test the relationship between polychaete abundance and the stations, correspondence analysis (CA) was performed using a matrix of species and stations. Moreover, the contribution to Chi-square (χ^2) and the differences between expected and observed values were analyzed, because the simple distance between row and column factors is not sufficient to justify associations between points. Species represented by only a single individual were excluded from this analysis.

TABLE 2. Morphological description of the sampled blocks.

Sample	**PQ1**	**PQ2**	**PQ3**	**TC1**	**TC2**	**TC3**	**TP1**	**TP2**	**TP3**
Tubes with “sand crown” (%)	0	30	40	70	90	90	50	50	70
Status of block surface:									
Eroded	+	No	No	No	No	No	No	No	No
Openings/crevices	+++	+	No	No	No	No	No	No	No
Epibionts	No	Yes	Yes	Yes	No	No	No	Yes	Yes
Block compactness	*	***	***	****	****	****	**	**	***
Tube orientation	chaotic	parallel	parallel	parallel	parallel	parallel	parallel	parallel	parallel

Block compactness: * very friable, ** fairly friable, *** fairly compact, **** very compact

Status of block surface: + isolated portions (5–10% of block surface) and +++ wide portions (31–80%)

Results

The PQ samples showed an increase over time in the percentage of tubes with a “sand crown” (0–40%), while the blocks’ surface showed a decrease in both the eroded portions and in portions with openings and crevices. Moreover, an improvement of block compactness and a modification of tube orientation (from chaotic to parallel) were observed in PQ2 and PQ3, where epibionts were recorded (e.g., sponges, serpulids, and incrusting algae). All TC samples were characterized by a high percentage of tubes with a “sand crown” (70–90%); the entire surface of the blocks presented no erosion or openings. Samples were very compact, and the tubes showed a consistently parallel orientation. Green algae and serpulids partially covered the surface of the TC1 sample. The TP blocks showed similar conditions over time. Tubes with “sand crown” were 50–70%. The surface did not show any openings and eroded portions, and compactness of the blocks increased over time. Tubes had a parallel orientation. Finally, epibionts were abundant in TP2 and TP3 and consisted of small mussels and tubes of serpulids (Table 2).

A total of 9,462 polychaetes belonging to 64 taxa and 39 species were identified from the nine samples (Table 3). The PQ reef presented the highest number of polychaete species (14–21); TP had 8–12, and TC had the lowest number, with 3–7 species (Fig. 2B). Regardless of the state of the reef, *S. alveolata* (total number 7,510) was the consistently dominant species, with 1,164 specimens collected at PQ, 1,871 at TC and 4,475 at TP (Fig. 2A). The ratio between the individual percentages of *S. alveolata* and the other species revealed both intra- and inter-area diversities, showing different patterns in each area (Fig. 3). The number of species at PQ decreased over time (Fig. 2B) and the polychaete assemblages differed qualitatively in time. The PQ area was characterized by several species, which were preferentially or exclusively sampled on this site. We found species that usually occur on hard or muddy/sandy substrates (such as *Perinereis cultrifera* and *Ceratonereis costae)*, species that have a high tolerance to salinity variations (such as *Hediste diversicolor)*, and others that generally occur in ports and lagoons with low hydrodynamic conditions (such as *Vermiliopsis striaticeps)*. Moreover, the PQ1 sample presented the highest numbers of *Sabellaria spinulosa*, another sabellariid species that lives in sandy tubes and builds up small bioconstructions, and which frequently coexists with *S. alveolata* reefs. The number of species in the TC area decreased over time (Fig. 2B). The most abundant associated polychaetes were *Nereis falsa* and *Eulalia viridis*, both of which usually occur in shallow water and on hard substrates. The family Syllidae, which was generally very abundant in the other areas, was not abundant in the TC area. The number of species collected in the TP area was intermediate when compared with the values for the other areas (Fig. 2B). The composition of TP polychaete assemblages changed in terms of both quality and abundance

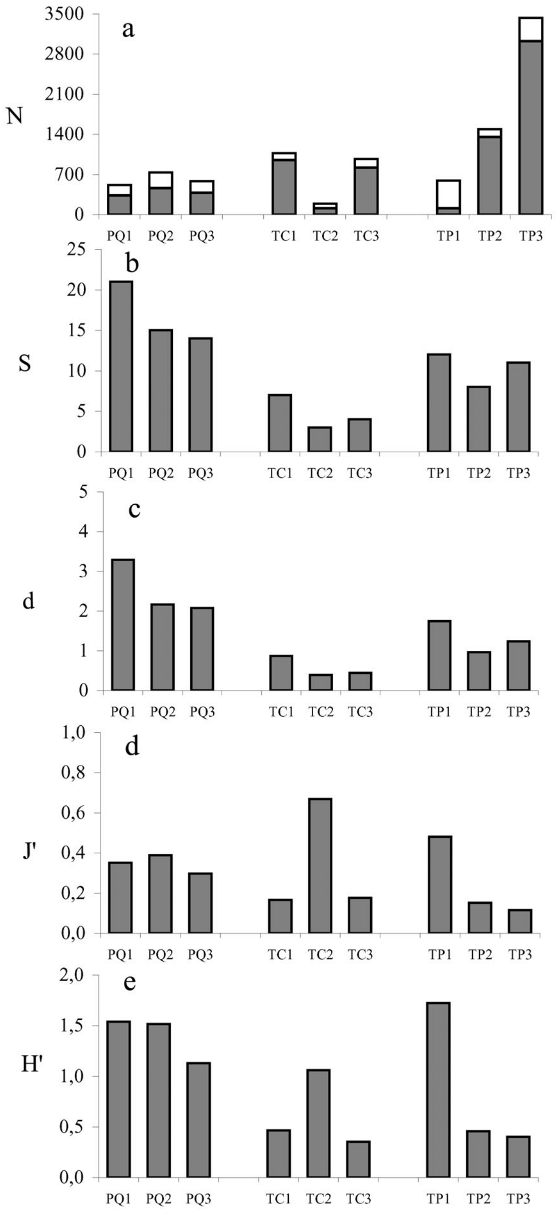

FIGURE 2. A, Total number of individuals (grey = *S. alveolata*, white = polychaetes); B, Species collected in each sample for each of the study areas. Community indices: C, Margalef species richness (d); D, Shannon-Wiener diversity (H′); E, Pielou's evenness (J′) calculated for each area over time.

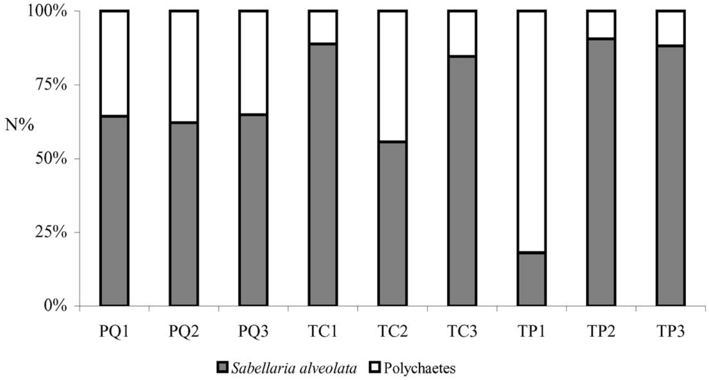

FIGURE 3. Percentage of individuals of *S. alveolata* and other species in each study area.

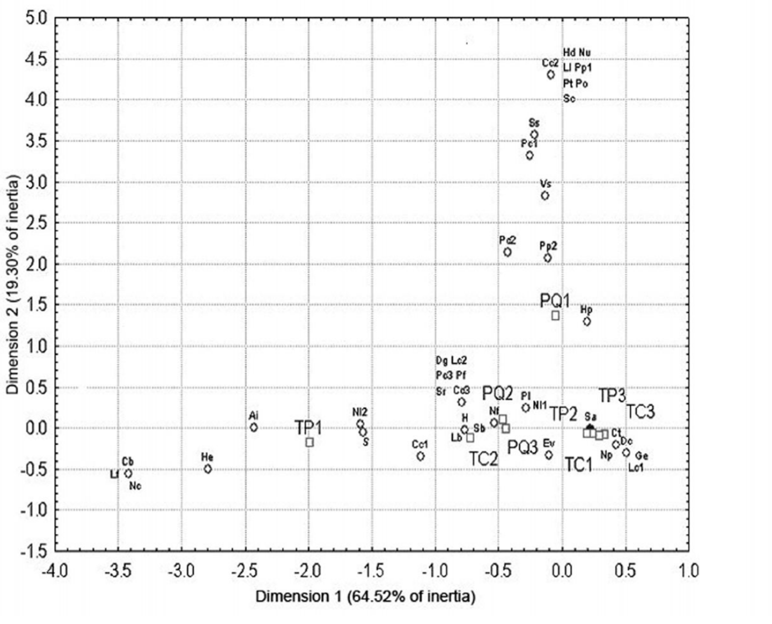

FIGURE 4. Correspondence analysis ordination plot: Dimension 1 is related to abundance of *S. alveolata* (from left to right), Dimension 2 is related to the turbidity tolerance gradient (bottom to top). Species legend: Ai = *Arabella iricolor*, Cb = *Caulleriella bioculata*, Cc1 = *Caulleriella* cf. *alata*, Cc2 = *Ceratonereis costae*, Ct = *Cirriformia tentaculata*, Cc3 = *Clymenura clypeata*, Dc = *Dasybranchus caducus*, Dg = *Dasybranchus gajolae*, Ev = *Eulalia viridis*, Ge = *Goniada emerita*, Hd = *Hediste diversicolor*, He = *Hydroides elegans*, Hp = *Hydroides pseudouncinatus*, Lc1 = *Lanice conchylega*, Lc2 = *Lepidonotus clava*, Lf = *Scoletoma funchalensis*, Lg = *Lumbrineris gracilis*, Ll = *Lumbrineris latreilli*, Nl1 = *Nainereis laevigata*, Nc = *Neanthes caudate*, Nu = *Nematonereis unicornis*, Nf = *Nereis falsa*, Np = *Nereis pelagica*, Nl2 = *Notomastus lineatus*, Pc1 = *Perinereis cultrifera*, Pd = *Platynereis dumerilii*, Pp2 = *Polyophthalmus pictus*, Pl = *Pomatoceros lamarcki*, Pt = *Pomatoceros triqueter*, Pc2 = *Pontogenia chrysocoma*, Pc3 = *Minuspio* cf. *cirrifera*, Po = *Protoaricia oerstedii*, Pf = *Pseudoleiocapitella fauveli*, Sa = *Sabellaria alveolata*, S = *Sabellaria spinulosa*, Sr = *Dorvillea (Schistomeringos) rudolphii*, Sc = *Serpula concharum*, Sb = *Sthenelais boa*, S = Syllidae, Vs = *Vermiliopsis striaticeps*.

TABLE 3. Polychaete species collected.

Family and Species
Sabellariidae
Sabellaria alveolata Linnaeus, 1767
Sabellaria spinulosa Leuckart, 1849
Serpulidae
Hydroides elegans (Haswell, 1883)
Hydroides pseudouncinatus Zibrowius, 1968
Pomatoceros lamarckii (Quatrefages, 1865)
Pomatoceros triqueter (Linnaeus, 1767)
Serpula concharum Langerhans, 1880
Serpula vermicularis Linnaeus, 1767
Vermiliopsis striaticeps (Grube, 1862)
Cirratulidae
Caulleriella cf. *alata* (Southern, 1914)
Caulleriella bioculata (Keferstein, 1862)
Cirriformia tentaculata (Montagu, 1808)
Terebellidae
Lanice conchylega (Pallas, 1766)
Spionidae
Minuspio cf. *cirrifera* Wirèn, 1883
Polynoidae
Lepidonotus clava (Montagu, 1808)
Aphroditidae
Pontogenia chrysocoma (Baird, 1865)
Goniadidae
Goniada emerita Audouin & Milne-Edwards, 1833
Phyllodocidae
Eulalia viridis (Linnaeus, 1767)
Nereididae
Ceratonereis costae (Grube, 1840)
Nereididae
Hediste diversicolor (O. F. Müller, 1776)
Neanthes caudata (Delle Chiaje, 1828)
Nereis falsa Quatrefages, 1865
Nereis pelagica Linnaeus, 1758
Perinereis cultrifera (Grube, 1840)
Platynereis dumerilii (Audouin & Milne-Edwards, 1833)
Dorvilleidae
Dorvillea (*Schistomeringos*) *rudolphii* (Delle Chiaje, 1828)
Lumbrineridae
Lumbrineris gracilis (Ehlers, 1868)
Lumbrineris latreilli Audouin & Milne-Edwards, 1834
Scoletoma funchalensis (Kinberg, 1865)
Eunicidae
Nematonereis unicornis (Grube, 1840)
Oenonidae
Arabella iricolor (Montagu, 1804)
Capitellidae
Dasybranchus caducus (Grube, 1846)
Dasybranchus gajolae Eisig, 1887
Notomastus lineatus Claparède, 1868
Pseudoleiocapitella fauveli Harmelin, 1964
Maldanidae
Clymenura clypeata (Saint-Joseph, 1894)
Opheliidae
Polyophthalmus pictus (Dujardin, 1839)
Orbiniidae
Nainereis laevigata (Grube, 1855)
Protoaricia oerstedii (Claparède, 1864)

(Fig. 2A) during the sampling period. Among the species recorded, *Hydroides pseudouncinatus* and *H. elegans* (a pioneering and opportunistic species) were found exclusively in this area. Of all areas analyzed, TP1 was characterized by the highest number of syllids, which drastically decreased in the subsequent TP samples. *Eulalia viridis* occurred in all the TP samples and was the dominant species (95 individuals) in TP3.

Community indices are shown in Fig. 2C–E. Only the species richness index (*d*) showed significant differences between stations ($F_{2;6} = 12.62248$, $P < 0.01$) and the Tukey test indicated that the PQ polychaete assemblage differed from that of TC. Within the CA ordination plot, Dimension 1 (64.52% of inertia) is related to the *S. alveolata* abundance gradient, and Dimension 2 (19.39% of inertia) is related to the turbidity tolerance gradient (Fig. 4). In general, the CA analysis confirms the development processes of the three reefs. Concerning Dimension 1, species that usually live in superficial and muddy/sandy substrates and show a high turbidity tolerance such as *S. spinulosa, Polyophthalmus pictus, P. cultrifera, Ceratonereis costae, H. diversicolor,* and *V. striaticeps* are linked to PQ1. Relating to Dimension 2, species such as *Arabella iricolor, H. elegans, Scoletoma funchalensis, Notomastus lineatus*, and the family Syllidae are linked to TP1 and became extremely abundant when the density of *S. alveolata* decreased.

Discussion

The general morphological features, together with the high species richness (the highest in the areas analyzed) and the low abundance of *S. alveolata* recorded in the PQ reef, could be related to the destruction phase of the reef (Gruet 1986). The structure and species composition of polychaete assemblages could be explained by several factors, such as habitat fragmentation associated with changes in surface topography. High tourist pressure characterized this area during the summer period and could partially have damaged the reef. Furthermore, the PQ reef was situated inside a crenulated bay, where the detached breakwaters partially minimize the hydrodynamic effects and increase water turbidity caused by the flow of the surrounding rivers. The high sedimentation rate represents one of the main causes of burial of the *S. alveolata* reef (Gruet 1982; Porras et al. 1995) and in this case it may have contributed to triggering the reef's destruction phase. Results also showed a morphological improvement of the reef's state and a gradual decrease in species richness over time. These conditions could be related to the beginning of a positive development of the reef.

Concerning the TC reef, the good morphological conditions recorded in all samples, the lowest species richness of all areas studied, and the high number of *S. alveolata* specimens classify this reef in the growth phase (Gruet 1971, 1986). *S. alveolata* occupied most of the living space, and the reef structure (without openings, crevices, or eroded portions) allowed the settlement of a small number of species. Moreover, because of its filtering activities, *S. alveolata* could be an important consumer of newly settling larvae (Andrè et al. 1993), which would contribute to the low species richness. The polychaete assemblage, which was significantly different from PQ, reflected the reef phase. In fact, among the few species collected, *Nereis falsa* and *Eulalia viridis* (the most abundant species in the area) and the low number of syllids (the lowest of all areas) are typically found in the reef growth phase (Gruet 1982). A high percentage of *S. alveolata* typically occurs in reefs situated on the most exposed shore, because wave action supplies material for tube construction, food, and removal of excrements (Dias & Paula 2001). The TC area is located along a more exposed shore than PQ, and here the hydrodynamic regime represented the main factor influencing the reef development. Nevertheless, strong wave action could also damage or even destroy the reefs (Gruet 1982; Dias & Paula 2001). In fact, following adverse marine conditions that occurred over the spring–summer period of the year 2000 (La Porta pers. obs.), TC2 presented a drastic decrease in the individual number of *S. alveolata*.

The morphological analysis of TP samples highlighted a positive developmental trend of the reef state over time. The improvement of the reef's condition was also confirmed by the exponential increase in *S. alveolata* abundance, and by the qualitative and quantitative changes in the polychaete assemblage over time. Hydrodynamic force was the main factor influencing reef recovery in this area. The presence and abundance of polychaetes such as *Eulalia viridis*, *Nereis falsa*, and Syllidae were comparable with those recorded in the TC reef, suggesting a similar condition between the two respective assemblages. At the same time, similarities in species composition were observed between PQ and TP assemblages. Since the assemblage structure of TP was equally comparable with the others analyzed, it was possible to classify this reef as in an phase intermediate between the destruction and the growth phases.

Altogether, the results led to the identification of different developmental phases of *Sabellaria alveolata* reefs, and in particular, this study confirms the relationship between the morphological reef state, the structure of the polychaete assemblage associated with the reef, and the local environmental conditions. Moreover, this study highlights the importance of this species as an ecosystem engineer whose reef structures increase the complexity of both the soft-bottom environments and the biodiversity of the associated fauna (Bianchi 2001). This research has also increased the knowledge of these particular bioconstructions, widely distributed in the Mediterranean Sea but very little studied so far.

References

Achary, G.P.K. (1969) Sabellariids as associates of other invertebrates and their role in the formation of benthic animal communities. *Journal of the Marine Biological Association of India*, 11 (1–2), 198–202.

Andrè, C., Jonsson, P.R. & Lindegarth, M. (1993) Predation on settling bivalve larvae by benthic suspension feeders: the role of hydrodynamics and larval behaviour. *Marine Ecology Progress Series*, 97, 183–192.

Bamber, R.N. & Irving, P.W. (1997) The differential growth of *Sabellaria alveolata* (L.) reefs at a power station outfall. *Polychaete Research Newsletter*, 17, 9–14.

Bellan, G. (1964) Contribution à l'etude systematique, bionomique et ecologique des Annèlides Polychetes de la Mediterraneè. *Recueil des travaux de la Station Marine d'Endoume* 33 (49), 1–371.

Bianchi, C.N. (2001) Le biocostruzioni negli ecosistemi marini e la biologia marina italiana. *Biologia Marina Mediterranea,* 8 (1), 112–130.

Clarke, K.R. & Warwick, R.M. (1994) Change in marine communities: an approach to statistical analysis and interpretation. *Natural Environment Research Council*, UK., 144 pp.

Dauvin, J.C. (1997) *Les biocenoses marines et littorales francaises des cotes atlantique, Manche et Mer du Nord. Syntesi, menance et prospective.* Service du Patrimoine Naturel/IEGM/MNHN Paris, 1–376.

Dias, A.S. & Paula, J. (2001) Associated fauna of *Sabellaria alveolata* colonies on the central coast of Portugal. *Journal of the Marine Biological Association of the United Kingdom*, 80, 169–170.

Done, T.J. (1995) Ecological criteria for evaluating coral reefs and their implication for managers and researchers. *Coral Reefs*, 14(4), 183–192.

Dubois, S., Retiere, C. & Olivier, F. (2002) Biodiversity associated with *Sabellaria alveolata* (L.) (Polychaeta: Sabellariidae) reefs. Effects of the human disturbance. *Journal of the Marine Biological Association of the United Kingdom*, 51, 817–826.

Dubois, S., Committo, J.K., Olivier, F. & Retiere, C. (2006) Effects of epibionts on *Sabellaria alveolata* (L.) biogenic reefs and their associated fauna in the bay of Mont Saint-Michelle. *Estuarine, Coastal and Shelf Science*, 68, 635–646.

Gambi, M.C., Giangrande, A. & Fraschetti, S. (1996) Policheti dei fondi mobili del golfo di Policastro (Mar Tirreno meridionale): distribuzione e ruolo di alcune specie. *Proceedings of Società Italiana di Ecologia*, 17, 349–353.

Gruet, Y. (1970) Faunè associèe des recefs edifiès par l'annelide *Sabellaria alveolata* (Linnè) en baie du Mont Saint Michel: banc de Hermelles. *Memoires de la Société des Sciences de Cherbourg*, 54, 21pp.

Gruet, Y. (1971) Morphologie, croissance et faune associè dès rècifs de *Sabellaria alveolata* (Linnè) de la barnerie-en-retz (Loir atlantique). *Tèthys*, 3(2), 321–380.

Gruet, Y. (1982) *Recherches sur l'ecologie des "recifs" d'hermelles edifies par l'annelidae polychete* Sabellaria alveolata *(Linné).* Thése doctorat d'etat, Universite de Nantes. 1–234.

Gruet, Y. (1986) Spatio-temporal changes of *Sabellaria* reef built by the sedentary polychaete *Sabellaria alveolata* (Linnè). *Marine Ecology*, 7(4), 303–319.

Gruet, Y. & Bodeur, Y. (1997) Les recifs d'Hermelles. *In*: Dauvin, J.C. (Ed.), *Les bioceneses marines et littorales* *francaises des cotes atlantique, manche et mer du nord, synthèse, menaces et prospective*. Paris Service du Patrimoine Naturel/IEGB/MNHN Paris, 168–176.

La Porta, B., La Valle, P. & Chimenz, Gusso (2006) *Sabellaria alveolata* (Linnaeus, 1776): la selezione dei granuli di sedimento per la costruzione dei tubi. *Biologia Marina Mediterranea*, 13 (1), 593–596.

Lana, P. & Bremec, C.S. (1994) Sabellariidae (Annelida, Polychaeta) from South America. In: Dauvin L.C., Laubier L., Reish D.J. (Eds), Actes de la 4ème Conférence Internationale del Polychètes. *Mémoires du Muséum d'Histoire Naturelle*, 162, 211–222.

Lana, P. & Gruet, Y. (1989) *Sabellaria wilsoni* sp. n. (Polychaeta, Sabellariidae) from the southeast coast of Brazil. *Zoologica Scripta*, 18, 239–244.

Mettam, C. (1992) The influence of *Sabellaria* reefs on sublittoral community structure. *Polychaete research newsletter*, 14, 1–3.

Pawlik, J.R. (1988) Larval settlement and metamorphosis of sabellariid polychaetes, with special reference to *Phragmatopoma lapidosa*, a reef-building species, and *Sabellaria floridensis*, a non-gregarious species. *Bulletin of Marine Science*, 43, 41–60.

Porras, R., Bataller, J.V., Murgui E., Torregosa M.T., October 24–27 (1995) Reef building worms in Iberian Mediterranean coast. *In*: Ozhan, E. (Ed), *Proceedings of the Second International Conference on the Mediterranean Coastal Environment*, 87–94.

Porras, R., Bataller, J.V., Murgui, E. & Torregosa, M.T. (1996) Trophic structure and community composition of polychaetes inhabiting some *Sabellaria alveolata* (L.) reefs along the Valentia Gulf coast, western Mediterranean. *Marine Ecology*, 17(4), 583–602.

Sparla, M.P., D'Anna, G. & Riggio, S. (1992) Notes on the development of *Sabellaria alveolata* reefs in N/W Sicily. *Rapports et Procès Verbaux des Réunions*, 33, 53.

Volvelle, J. (1963) Données granulomètriques sur le tube de quelques annelides polychète de la plage de Saint-Efflam. *Cahiers de Biologie Marine*, 4, 315–319.