

POLYCHAETES ASSOCIATED WITH DIFFERENT FACIES OF THE PHOTOPHILIC ALGAL COMMUNITY IN THE CHAFARINAS ARCHIPELAGO (SW MEDITERRANEAN)

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ABSTRACT

To study the polychaetes associated with different facies of the photophilic algal community in the Chafarinas Islands, 18 samples measuring 625 cm² were scraped by SCUBA dives (0–6 m). Five algal facies were sampled: (1) *Stypocaulum scoparium* - *Cladostephus hirsutus*, (2) *Padina pavonica*, (3) *Cystoseira tamariscifolia*, (4) *Corallina elongata* and (5) crustose calcareous rhodophytes (Corallinaceae) with sea urchins. Polychaetes collected belonged to 21 families and 105 species. Syllidae, Nereididae and Sabellidae were the dominant families. *Odontosyllis ctenostoma*, *Sphaerosyllis hystrix*, *Syllis prolifera*, *Perinereis cultrifera*, *Platynereis dumerilii*, and *Amphiglena mediterranea* were found throughout the community. The Bray-Curtis similarity analysis, took into account feeding guilds and life styles, showed rather high similarity of this five facies. Two main clusters were identified according to the increasing of high of algal cover and the spatial heterogeneity. The first group is formed by the facies with *Padina pavonica* and the facies with *Corallina elongata*, the second group contains the facies of *Stypocaulum scoparium* - *Cladostephus hirsutus* and *Cystoseira tamariscifolia*. The facies of crustose calcareous rhodophytes with sea urchins, was clearly separated from the rest.

The Mediterranean photophilic algal community extends over more or less illuminated rocky surfaces and is characterized by several species of macroalgae. Among the algal populations it is possible to discern different facies, whose composition varies as a function of the environmental conditions (e.g., wave exposure, water quality, irradiance, etc.) and biogeography. This particular vegetal covering provides a multitude of different microenvironments, offering a high degree of structural complexity which at the same time support a large diversity, among the richest of the Mediterranean benthos (Pérès and Picard, 1964; Pérès, 1967, 1982; Bellan-Santini, 1985).

This microenvironmental diversity is used by several macrofaunal groups, including the polychaetes. This group constitutes, together with mollusks and crustaceans, an important faunistic component of the photophilic algal community from a qualitative as well as a quantitative standpoint. Many faunistic studies that dealt with this community in the Mediterranean included the polychaetes. The aims of these studies were varied: from general macrobenthic studies of the superior horizons (Bellan-Santini, 1962, 1969), the ecology of several groups of motile fauna (Ledoyer, 1966), to industrial pollution effects (Bellan-Santini and Desrosiers, 1976-1977; Bitar, 1982, 1987; Desrosiers et al., 1982, 1986), and biogeographical affinities (Menioui, 1988; Bitar, 1987). The sampling methodology and the biological units studied varied from one study to another. Papers treating the polychaetes that inhabit this community are numerous although the majority include them in broader studies that also deal with other biocoenoses (Pérès, 1954; Bellan, 1964; Camp, 1976; Sardá, 1984; Alós, 1988; López, 1995; Tena, 1996). Among the studies dealing with this community are a few which, besides presenting a faunistic catalog, discuss the occurrence and ecological preferences of polychaetes in this environment:

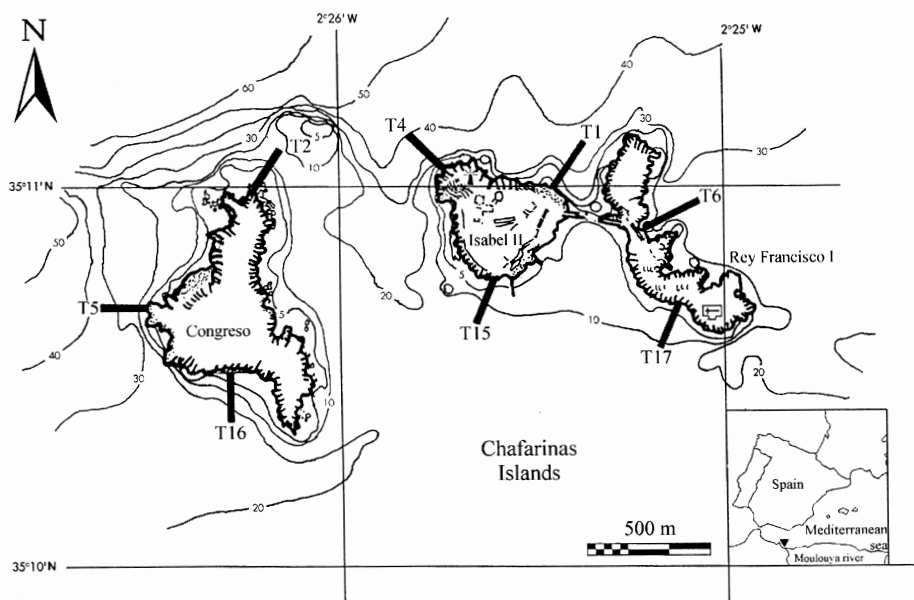


Figure 1. Map of Chafarinas Islands showing sampling transects (to location and description of samples see Table 1).

Bellan (1969) in the region of Provence; San Martín and Vieitez (1979) and Sardá (1991) in the Balearic Sea, and Fresi et al. (1983, 1984), Abbiati et al. (1987, 1991) and Giangrande (1988) in the Tyrrhenian Sea.

This study is the first of a series that attempts to characterize the different hard bottom communities in the Chafarinas Archipelago (SW Mediterranean) on the basis of polychaete fauna. For this purpose, the contribution of the different species in each of the photophilic algal community facies is analyzed from a perspective availability and exploitation of microenvironments (life styles) and trophic guilds.

MATERIAL AND METHODS

The Chafarinas Islands form an archipelago of three volcanic islands (Congreso, Isabel II, and Rey Francisco I) in the Alboran Basin of the western Mediterranean close to the Moroccan coast (Fig. 1). The northern side of the archipelago presents an abrupt topography with vertical cliffs. The southern side has gentle slopes and cliffs of low height and pebble beaches.

Sea-water temperature and salinity were recorded with a Beckman RS-Induction Salinometer. Temperatures in the study area ranged from 16 to 28°C with a summer thermocline at 10–15 m. All the facies studied were located above this thermocline. Salinity varied from 37 to 35.95‰. Turbidity of water column is high and the depth of dissipation of a Secchi disc ranged from 12 to 16 m. Thus, the values of irradiance measured by a Biospherics underwater irradiator revealed that at a depth of 40 m, irradiance was below 0.01 $\mu\text{E cm}^{-2} \text{s}^{-1}$ and all the facies sampled are exposed to an irradiance always above 0.04 $\mu\text{E cm}^{-2} \text{s}^{-1}$ (Fig. 2) (Tena, 1996).

The midlittoral belt in the Chafarinas Archipelago is wide compared with other places in the Mediterranean with similar hydrodynamic conditions due to a tide fluctuation of 1–1.10 m. Around the perimeter of the islands, in those places most exposed to wave action, two superficial character-

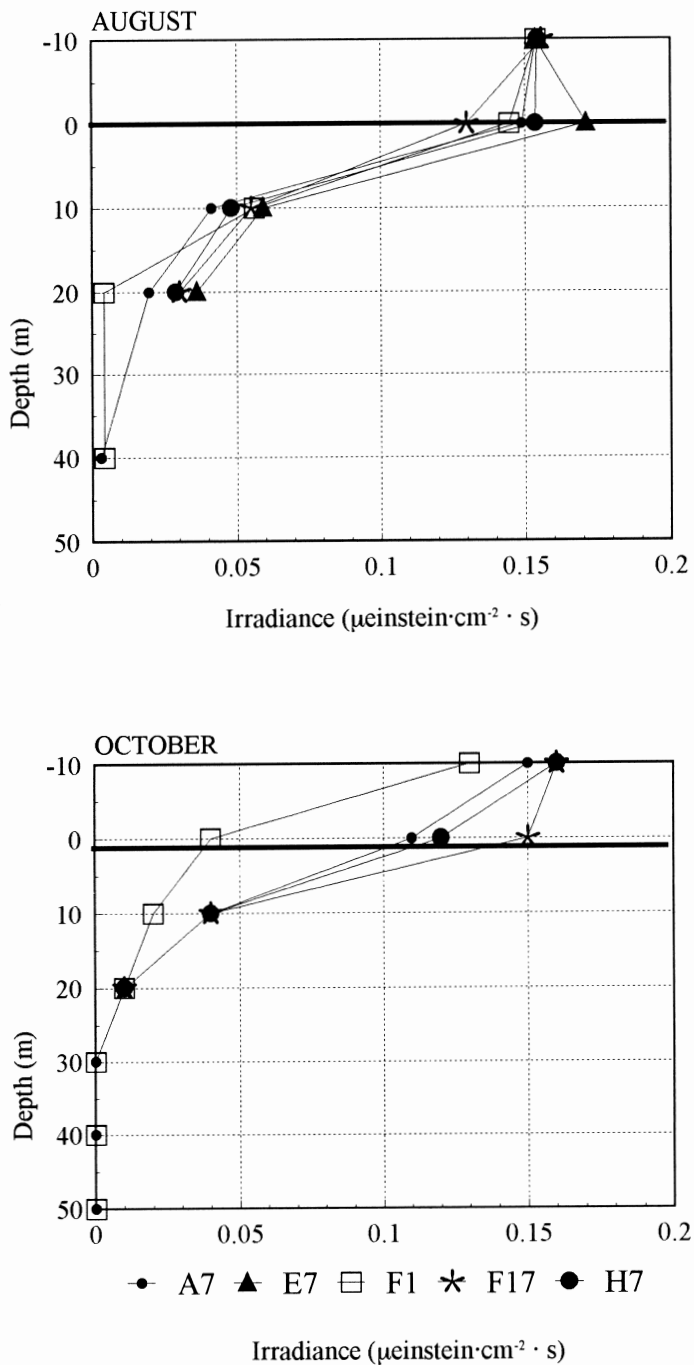


Figure 2. Irradiance as a function of depth during August and October of 1994.

istic facies were found: *Corallina elongata* and *Cystoseira tamariscifolia*. Their maximum development can be found in the NE and N sectors of Rey Francisco I island, the N and NW sectors of Isabel II island, and around Congress Island. The facies with *C. tamariscifolia* has a crustose basal substratum of *Lithophyllum incrustans*, erect *C. elongata* and *Valonia utricularis*, and an important epiphytic stratum with *Ceramium rubrum*, *Polysiphonia deludens*, *Corallina granifera*, *Jania rubens*, *J. adhaerens* and *Titanoderma corallinae* as the most abundant species.

Below the midlittoral belt, the first 10–15 m of the infralittoral zone are dominated by different facies of sheltered environments: (1) facies with *Stypocaulum scoparium* - *Cladostephus hirsutus*, typical of environments with low wave action and high sediment settlement distributed throughout horizontal and well-illuminated sea bottoms, mainly on the southern side of the three islands, and (2) facies with *Padina pavonica* also located on well-illuminated bottoms but more exposed to wave action than the previous facies.

The facies of crustose calcareous rhodophytes with sea urchins (*Arbacia lixula* and *Paracentrotus lividus*) occurs on submarine promontories at 2 to 10 m depth. This facies shows an algal laminar cover with *L. incrustans* and a poor stratum of soft algae. *A. lixula* and *P. lividus* function as grazers of *Lithophyllum* and epiphytics, respectively (Kempf, 1962).

Sampling was conducted by either free diving or SCUBA in the summer of 1991 and the autumn of 1994 at depths ranging from 0 to 6 m. The 18 stations (Table 1) were distributed on rock surfaces along the eight transects shown in Figure 1. Samples were collected by scraping quadrants 25 × 25 cm, following the method of Boudouresque (1971).

The taxonomic organization of Pettibone (1982) was used and the nomenclature of the families followed Read (1996). The following structural parameters were calculated: diversity according to Shannon-Wiener index (H') (Shannon and Weaver, 1949), mean richness (Hill's numbers N_0 and N_2) and evenness (E5, modified Hill's ratio) (Ludwig and Reynolds, 1988) (Table 2). The organization of the community and its different facies were analyzed, taking into account the biology of the species occurring there, including their trophic ecology and life styles. We have defined seven biological forms or life styles for the polychaetes of the photophilic algae community. Life styles classification is based on the spatial distribution and the motility of the polychaetes as suggested by Laubier (1966) (Table 3). The assignment of the species to the different categories was based on our observations in the Chafarinas Islands as well as on information reported by others (Laubier, 1966; Rasmussen, 1973; Pérès, 1976; Fauchald and Jumars, 1979; Ballesteros et al., 1984). We have grouped the species into seven feeding guilds (Table 4) based on the model established by Fauchald and Jumars (1979), which was subsequently modified by other authors (Gambi and Giangrande, 1985a; Paiva, 1993; Pinedo et al., 1997). The inclusion of a group termed mixed deposit/suspension feeders (D/S) is based on the fact that various authors have shown that some Sabellidae, Oweniidae, Spionidae, and Terebellidae have an alternative trophic behavior (Fauchald and Jumars, 1979; Okamura, 1990). The percentage contribution of each feeding guild was calculated from the species density (Bachelet, 1981; Maurer and Leathem, 1981; Gaston, 1987).

We performed a cluster analysis of the facies and 17 pair combinations of life styles/feeding guilds, based on the Bray-Curtis similarity index and the 'average linkage clustering' technique (Bray and Curtis, 1957). As the specimens of Spirorbidae could not be counted, they were excluded from the analysis. Calculations were made by means of Ludwig and Reynolds (1988) statistical integrated package.

RESULTS

Photophilic assemblages, such as the community of the photophilic algae of the infralittoral hard bottoms, in the Chafarinas Islands are limited and located at a lower depth than in other places of the Mediterranean and restricted to depths of 10–15 m. As was mentioned, the relatively low transparency of water is probably due to the proximity of the Moroccan sandy beach systems and the outlet of the Mouluya River. This turbid

Table 1. Description of samples (StyCla = Facies with *Styopocaulum scoparium* - *Cladostephus hirsutus*; Padpav = Facies with *Padina pavonica*; Rhodo = Facies of crustose calcareous Rhodophytes with sea-urchins; Coralli = Facies with *Corallina elongata*; Cystose = Facies with *Cystoseira tamariscifolia*).

Sample code	Transect	Date	Facies	Depth	Inclination substrate	Cover (%)	Main algal species
CON15	T-16	7/19/91	Cystose	0	Horizontal	100	<i>Cystoseira tamariscifolia</i> , <i>C. stricta</i> , <i>Sargassum vulgare</i> , <i>Hypnea musciformis</i> , <i>Jania rubens</i> , <i>Valonia utricularis</i> , <i>Boergeseniella fruticulosa</i> , <i>Amphitroa cryptarthrodia</i> , <i>Styopocaulum scoparium</i>
ISA04-94	T-1	8/7/94	Cystose	0	Horizontal	100	<i>Cystoseira tamariscifolia</i> , <i>Corallina elongata</i> , <i>C. granifera</i> , <i>Valonia utricularis</i> , <i>Jania rubens</i>
CON03-94	T-5	10/3/94	Cystose	1	Horizontal	100	<i>Cystoseira tamariscifolia</i> , <i>Corallina elongata</i> , <i>Jania rubens</i>
REY21	T-17	8/6/91	Coralli	0	Subhorizontal	100	<i>Corallina elongata</i> , <i>Cladophora</i> sp.
CON43	T-2	7/25/91	Coralli	2	Subhorizontal	100	<i>Corallina elongata</i> , <i>Jania adherens</i>
CON13	T-16	7/19/91	StyCla	1	Horizontal	80	<i>Cladostephus hirsutus</i> , <i>Styopocaulum scoparium</i>
REY20	T-17	8/6/91	Padpav	1	Horizontal	100	<i>Padina pavonica</i> , <i>Styopocaulum scoparium</i> , <i>Acetabularia acetabulum</i> , <i>Flabellia petiolata</i> , <i>Corallina elongata</i> , <i>Cladocora caespitosa</i>
CON21	T-16	7/19/91	StyCla	2	Horizontal	100	<i>Styopocaulum scoparium</i> , <i>Corallina granifera</i> , <i>Jania rubens</i> , <i>Cladostephus hirsutus</i>
REY28	T-17	8/8/91	StyCla	2	Horizontal	70	<i>Styopocaulum scoparium</i> , <i>Acetabularia acetabulum</i> , <i>Cladostephus hirsutus</i> , <i>Jania adherens</i>
CON47	T-2	7/25/91	StyCla	3	Horizontal	80	<i>Cladostephus hirsutus</i> , <i>Styopocaulum scoparium</i> , <i>Boergeseniella fruticulosa</i>
CON45	T-2	7/25/91	StyCla	3	Horizontal	100	<i>Styopocaulum scoparium</i> , <i>Jania rubens</i> , <i>J. adherens</i> , <i>Sargassum cf. furcatum</i> , <i>Sphacelaria cirrosa</i> , <i>Padina pavonica</i>
ISA36	T-15	8/11/91	Padpav	3	Horizontal	70	<i>Padina pavonica</i> , <i>Styopocaulum scoparium</i> , <i>Acetabularia acetabulum</i> , <i>Cladostephus hirsutus</i> , <i>Sargassum cf. Furcatum</i> , <i>Flabellia petiolata</i> , <i>Jania rubens</i>
REY02-94	T-6	10/12/94	StyCla	3	Horizontal	75	<i>Styopocaulum scoparium</i> , <i>Corallina elongata</i> , <i>Jania adherens</i> , <i>J. rubens</i>
ISA11	T-4	7/25/91	StyCla	4	Subhorizontal	100	<i>Styopocaulum scoparium</i> , <i>Jania rubens</i> , <i>Corallina elongata</i> , <i>C. granifera</i> , <i>Gelidium latifolium</i> .
ISA03-94	T-1	8/7/94	StyCla	5	Horizontal	90	<i>Styopocaulum scoparium</i> , <i>Acetabularia acetabulum</i> , <i>Jania rubens</i>
ISA05-94	T-4	10/2/94	Rhodo	5	Horizontal	20	<i>Corallina elongata</i> , <i>Jania rubens</i> , <i>Styopocaulum scoparium</i> , <i>Valonia utricularis</i>
CON02-94	T-5	10/3/94	Rhodo	6	Horizontal	30	<i>Corallina elongata</i> , <i>Flabellia petiolata</i> , <i>Sargassum cf. furcatum</i> , <i>Jania rubens</i> , <i>Rhodymenia ardissonae</i>
REY11	T-6	7/22/91	StyCla	6	Subhorizontal	100	<i>Styopocaulum scoparium</i> , <i>Colpomenia sinuosa</i> , <i>Corallina elongata</i> , <i>Padina pavonica</i> , <i>Rhodymenia ardissonae</i> , <i>Sargassum cf. furcatum</i>

Table 2. Richness (Hill's numbers N_0 , N_2), Evenness (E5) and Diversity (H') of each facies of the photophilic algal community. (StyCla = facies with *Stypocaulum scoparium* - *Cladostephus hirsutus*; Padpav = facies with *Padina pavonica*; Rhodo = Facies of crustose calcareous rhodophytes with sea urchins; Coralli = facies with *Corallina elongata*; Cystose = facies with *Cystoseira tamariscifolia*).

		StyCla	Padpav	Rhodo	Coralli	Cystose
Richness	N_0	19.30	25.50	14.00	22.30	27.00
	N_2	6.65	5.42	7.39	6.99	8.46
Evenness (E5)		0.66	0.75	0.83	0.67	0.59
Diversity (H')		2.07	2.27	2.14	2.28	2.56

water permits the development of the sciaphilic communities, such as the infralittoral sciaphilous and circalittoral algae, at relatively shallow depths.

A total of 105 species of polychaetes belonging to 21 families were found (Table 5). The dominant family in both the number of species (39) and specimen numbers (1040) was Syllidae. Other well represented families were Nereididae with 14 species and 923 specimens and Sabellidae with seven species and 526 individuals. Frequency values of species in this community reveal that several species are always present. These include *Platynereis dumerilii*, *Syllis prolifera*, *Amphiglena mediterranea*, *Perinereis cultrifera*, *Sphaerosyllis hystrix*, and *Odontosyllis ctenostoma*.

The analysis of the feeding guilds showed little diversification with three main groups: herbivores (31.5%), carnivores (27.5%), and omnivores (19.6%) (Fig. 3A). This distribution may be attributed to the importance of the algal turf and to the scarcity of sediments. A diagram showing the distribution of species according to their life styles indicates that motile forms living in microcavities and crevices make up the largest percentage (57.5%), followed by the motile epibenthos on the algal substrate (25.7%) (Fig. 3B). These values reflect the large number of fissures, crevices, hollows, etc., available to this community. The fact that the burrowing endobenthos and sessile forms are less represented may be due to the absence of the sedimentary stratum in this community as described by Pérès (1982) because the strong wave action impedes the settling of suspended particles.

In the *Stypocaulum scoparium* - *Cladostephus hirsutus* facies the dominant taxonomic groups are Syllidae, Nereididae and Sabellidae. *Platynereis dumerilii* is the dominant species. The trophic structure is dominated by herbivores (39.4%), carnivores (23.0%), omnivores (15.1%), and suspension feeders (13.4%) (Fig. 3A). The dominant life styles

Table 3. Description of life styles.

Life Style	Definition
Motile epibenthos on algal substrate	Species with higher mobility in the fronds of the algae
Burrowing endobenthos	They burrow into sedimentarian substrates
Motile sedentary	Discreetly motile, capable of slow movements and generally of weak width
Sessile forms	Forms strongly adhered to the substrate, as much mineral as biogenic. They lack capacity of displacement
Motile in microcavities and crevices	They live in the interstices and in natural or artificial microcavities. They are motile but activity is reduced
Endobionthic forms	Live in the interior of other organisms
Boring forms	Boring by mechanical or chemical means

Table 4. Description of feeding guilds.

Feeding Guild	Definition
Carnivores	Jawed or unarmed, the principal origin of their food is animal (includes carrion feeders)
Herbivores	The principal origin of their food is vegetal
Omnivores	Very variable diets. They could be considered opportunistic in their trophic behavior
Surface deposit feeders	Microphages. With or without tentacles. They capture food on the surface of sediment
Sub-surface deposit feeders	Microphages. They capture food below the surface of sediment
Suspension feeders	Microphages whose source of food is in the particles of the water column. Usually, they are sessile forms with tentacles for capturing the food
Mixed deposit/suspension feeders	They indiscriminately take food deposited on the surface of sediment

are the motile forms in microcavities and crevices (55.3%) and the motile epibenthos on algal substrate (28.1%) (*Platynereis dumerillii*, *S. prolifera*, *Pseudobrania vieitezzi*); the motile sedentary contingent constitutes 14.5% (*A. mediterranea*, *Fabricia stellaris*). This facies shows the lowest diversity ($H' = 2.07$) among the sampled facies (Table 2).

The facies with *Padina pavonica* displays a greater diversity ($H' = 2.27$). The distribution of feeding guilds (Fig. 3A) is similar to that found in the *Stypocaulum scoparium* - *Cladostephus hirsutus* facies, and it is dominated by the herbivores and carnivores (mainly *P. dumerillii* and *S. prolifera*), although in this case the suspension feeders slightly exceed the omnivores because the species *Oriopsis armandi* and *A. mediterranea* are more abundant. The life styles also show a distribution very similar to that of the previous facies (Fig. 3B).

The dominant families in the facies with *C. tamariscifolia* were the Syllidae and the Nereididae although the Lumbrineridae make an important contribution in comparison with other facies. *S. prolifera* and *Nereis funchalensis* are the dominant species. This facies shows the highest richness and diversity ($N_0 = 27$, $H' = 2.56$) and the lowest evenness (0.59) of all the represented facies (Table 2). The *Cystoseira* facies shows the greatest degree of spatial complexity in the photophilic algal community and its maximum algal turf development is in summer (Ballesteros, 1988) coinciding with our sampling. In this facies, a change was detected in the dominance of the feeding guilds (Fig. 3A), the carnivores being first, the omnivores second and the herbivores third. While the suspension feeders show the lowest percentage (4%). In this facies the most common life styles are the motile forms in microcavities and crevices (78.1%), while motile sedentary forms represent only 2.8% (Fig. 3B).

In the *Corallina elongata* facies the dominant group is Syllidae followed by Nereididae and Sabellidae. The most abundant species are *Perinereis cultrifera*, *S. prolifera*, and *A. mediterranea*. *Perinereis macropus* shows high affinity for superficial facies in exposed areas in the Chafarinas Islands (Tena, 1996). As in the *Cystoseira* facies, carnivores are the dominant group, followed by herbivores, suspension feeders and omnivores, the latter two with equal dominances (19.8%) (Fig. 3A). Life styles follow the same rule as in the facies already described (Fig. 3B) and with representation by burrowing endobenthos (1.6%) due to the presence of *Lumbrineris latreilli*.

Table 5. Total number of specimens per facies (StyCla = Facies with *Styocaulum scoparium* - *Cladostephus hirsutus*; Padpav = Facies with Padina pavonica; Rhodo = Facies of Crustose Calcareous Rhodophytes with sea urchins; Coralli = Facies with *Corallina elongata*; Cystose = Facies with *Cystoseira tamariscifolia*), Feeding guilds (FG) (C = Carnivores; H = Herbivores; O = Omnivores; DS = Surface Deposit Feeders; DSS = Sub-Surface Deposit Feeders; S = Suspension Feeders; M = Mixed DS/S), Life styles (LS) (ME = Motile epibenthos on algal substrate; BE = Burrowing endobenthos; MS = Motile sedentary; SF = Sessile forms; MM = Motile in microcavities and crevices; EF = Endobiothic forms; BF = Boring forms) and frequency index (F) (Guille, 1970) in the photophilic algal community (Ct = Constant; C = Common A = Accidental) (* = could not be quantified).

SPECIES	StyCla	Padpav	Rhodo	Coralli	Cystose	FG	LS	F
<i>Eulalia viridis</i> (Linnaeus, 1767)	-	-	-	-	3	C	MM	A
<i>Pterocirrus macroceros</i> (Grube, 1860)	1	-	-	-	-	C	MM	A
<i>Glycera tessellata</i> Grube, 1863	2	-	-	-	-	C	ME	A
<i>Kefersteinia cirrata</i> (Keferstein, 1862)	1	-	-	-	1	C	ME	A
<i>Podarke pallida</i> Claparède, 1864	2	5	-	1	-	C	MM	A
<i>Ophiotromus</i> sp.	6	-	-	-	-	-	-	A
<i>Syllidia armata</i> Quatrefages, 1865	2	10	2	-	-	C	ME	A
<i>Ehlersia ferruginea</i> Langerhans, 1881	-	-	-	-	1	C	MM	A
<i>Odontosyllis ctenostoma</i> Claparède, 1868	7	-	1	1	16	C	MM/ME Ct	
<i>Odontosyllis fulgurans</i> (Audouin & M. Edwards, 1863)	1	-	-	-	-	C	MM/ME A	
<i>Pionosyllis lamelligera</i> Saint-Joseph, 1856	5	2	-	-	-	C	MM	A
<i>Syllides fulvus</i> (Marion & Bobretzky, 1875)	-	1	-	-	-	C	MM	A
<i>Brania pusilla</i> (Dujardin, 1839)	-	-	-	1	-	H	MM/ME A	
<i>Evogone naidina</i> Oersted, 1845	10	3	-	-	8	O	MM/ME C	
<i>Evogone verugera</i> Claparède, 1868	1	-	-	-	-	O	MM/ME A	
<i>Grubeosyllis clavata</i> (Claparède, 1868)	-	5	1	-	-	H	MM/ME A	
<i>Grubeosyllis limbata</i> (Claparède, 1868)	1	-	-	1	-	O	MM/ME A	
<i>Grubeosyllis vieitezii</i> (San Martín, 1984)	88	8	-	-	12	H	MM/ME C	
<i>Sphaerosyllis austriaca</i> Banse, 1959	25	5	4	-	3	H	MM/ME C	
<i>Sphaerosyllis cryptica</i> Ben-Eliahu, 1977	1	-	-	-	-	O	MM	A
<i>Sphaerosyllis hystrix</i> Claparède, 1863	38	16	7	1	12	O	MM/ME Ct	
<i>Sphaerosyllis pirifera</i> Claparède, 1868	30	7	20	-	-	O	MM/ME C	
<i>Sphaerosyllis taylori</i> Perkins, 1981	7	-	-	-	1	H	MM/ME A	
<i>Sphaerosyllis magnidentata</i> Perkins, 1981	1	-	-	-	-	O	MM	A

Table 5. Continued.

SPECIES	StyCla	Padpav	Rhodo	Coralli	Cystose	FG	LS	F
<i>Branchiosyllis exilis</i> Ehlers, 1887	1	-	-	-	-	C	MM/ME	A
<i>Eurysyllis tuberculata</i> Ehlers, 1864	5	3	-	-	1	C	MM/ME	A
<i>Haplosyllis spongicola</i> (Grube, 1855)	9	1	1	9	-	C	EF	C
<i>Pseudosyllides balearica</i> San Martín, 1982	-	1	-	-	3	C	MM/ME	A
<i>Pseudosyllis brevipennis</i> Grube, 1863	2	1	-	1	3	C	MM	A
<i>Syllis amica</i> Quatrefages, 1865	-	-	-	-	3	C	MM/ME	A
<i>Syllis armillaris</i> (Müller, 1776)	2	2	-	24	7	C	MM/ME	C
<i>Syllis columbretensis</i> (Campoy, 1982)	1	1	5	38	7	C	MM/ME	C
<i>Syllis compacta</i> Gravier, 1900	3	1	-	1	18	C	MM/ME	C
<i>Syllis gerlachi</i> (Hartmann-Schröder, 1960)	2	-	-	-	1	C	MM	A
<i>Syllis gracilis</i> Grube, 1840	6	1	-	13	35	O	MM	C
<i>Syllis prolifera</i> Krohn, 1852	174	48	19	57	111	C	MM/ME	Ct
<i>Syllis rosea</i> (Langerhans, 1879)	-	1	-	2	1	C	MM	A
<i>Syllis schulzi</i> (Hartmann-Schröder, 1960)	-	-	-	1	-	C	MM	A
<i>Syllis truncata cryptica</i> Ben-Eliahu, 1977	-	-	-	-	3	C	MM	A
<i>Syllis variegata</i> Grube, 1860	6	-	-	1	1	C	MM/ME	A
<i>Syllis westheidei</i> San Martín, 1984	1	-	-	4	7	C	MM	A
<i>Syllis zonata</i> Haswell, 1883	1	-	-	-	1	C	MM	A
<i>Trypanosyllis zebra</i> (Grube, 1860)	8	4	-	-	10	C	MM	C
<i>Xenosyllis scabra</i> (Ehlers, 1864)	-	1	-	-	-	C	MM/ME	A
<i>Autolytus brachycephalus</i> (Marenzeller, 874)	1	-	1	-	1	C	MM	A
<i>Autolytus quindecimdentatus</i> Langerhan, 1884	9	2	-	-	-	C	MM	A
<i>Micronereis variegata</i> Claparède, 1863	3	1	-	-	-	H	MM	A
<i>Neanthes fucata</i> (Savigni, 1820)	1	-	-	-	-	C	MM	A
<i>Neanthes irrorata</i> (Malmgren, 1867)	-	-	-	3	-	H	MM	A
<i>Nereis funchalensis</i> (Langerhans, 1880)	30	-	-	12	98	O	MM	C
<i>Nereis pelagica</i> Linnaeus, 1758	1	-	-	-	4	H	MM	A
<i>Nereis rava</i> Ehlers, 1868	4	4	-	-	3	O	MM	C

Table 5. Continued.

SPECIES	StyCla	Padpav	Rhodo	Coralli	Cystose	FG	LS	F
<i>Nereis zonata</i> Malmgren, 1867	16	-	-	15	6	O	MM	C
<i>Nereis</i> sp.	-	-	-	-	4	-	-	A
<i>Perinereis cultrifera</i> (Grube, 1840)	18	6	1	66	33	H	MM	Ct
<i>Perinereis macropus</i> (Claparède, 1870)	-	-	-	15	-	O	MM	A
<i>Perinereis oliverae</i> (Horst, 1889)	1	-	-	-	-	O	MM	A
<i>Platynereis dumerilii</i> (Audouin & M. Edwards, 1833)	297	176	23	12	75	H	MM	Ct
<i>Rullierinereis</i> sp.	-	-	1	-	-	-	MM	A
<i>Websterinereis glauca</i> (Claparède, 1870)	-	8	-	-	1	O	MM	A
<i>Pontogenia chrysocoma</i> (Baird, 1865)	-	1	-	-	-	C	ME	A
<i>Harmothoe spinifera</i> (Ehlers, 1864)	2	-	-	1	2	C	ME	C
<i>Lepidonotus clava</i> (Montagu, 1808)	3	1	-	1	-	C	ME	A
<i>Pholoe synophthalmica</i> Claparède, 1868	1	-	-	-	-	C	ME	A
<i>Sthenelais boa</i> (Johnston, 1839)	1	-	-	-	-	C	ME	A
<i>Bhawania reynssi</i> Katzmann, Laubier & Ramos, 1974	-	-	-	2	-	C	MM	A
<i>Chrysopetalum debile</i> (Grube, 1855)	1	6	-	-	2	C	MM	A
<i>Palaeanotus chrysolepis</i> Schmarda, 1861	1	-	-	-	3	C	MM	A
<i>Eurythoe complanata</i> (Pallas, 1766)	-	7	-	-	-	C	MM	A
<i>Eunice harassii</i> Audouin & M. Edwards, 1833	4	1	-	8	13	O	MM/ME	C
<i>Nematoneis unicoloris</i> (Grube, 1840)	1	-	-	-	-	O	MM	A
<i>Palola siciliensis</i> (Grube, 1840)	-	-	-	1	1	O	MM	A
<i>Lumbrineris coecinea</i> (Renier, 1804)	-	2	3	12	18	C	MM	C
<i>Lumbrineris latreilli</i> Audouin & M. Edwards, 1834	-	-	-	9	15	O	BE	A
<i>Scoletoma funchalensis</i> (Kimberg, 1855)	9	2	1	1	17	O	MM	C
<i>Scoletoma impatiens</i> (Claparède, 1868)	3	-	1	-	-	O	BE/MM	A
<i>Nainereis</i> sp. a	2	-	-	-	1	-	-	A
<i>Nainereis</i> sp. b	3	-	-	-	-	-	-	A
<i>Protoarcia oerstedii</i> (Claparède, 1864)	3	1	-	2	11	DSS	MM	C
<i>Polydora armata</i> Langerhans, 1880	-	1	-	-	-	M	BF	A

Table 5. Continued.

SPECIES	StyCla	Padpav	Rhodo	Coralli	Cystose	FG	LS	F
<i>Polydora colonia</i> Moore, 1907	-	2	-	1	-	M	BF	A
<i>Caulerliella bioculata</i> (Keferstein, 1862)	2	-	-	-	-	DS	MM	A
<i>Caulerliella</i> sp.	1	-	-	-	-	-	-	A
<i>Dodecaceria concharum</i> Oersted, 1843	2	-	-	-	-	DS	BF	A
<i>Polyophthalmus pictus</i> (Dujardin, 1839)	12	19	1	1	2	O	MM/ME	C
<i>Capitomastus minimus</i> (Langerhans, 1880)	1	1	-	-	-	DSS	BE/MM	A
<i>Amphitrite rubra</i> (Risso, 1828)	-	-	1	-	-	DS	SF	A
<i>Eupolyomia nebulosa</i> (Montagu, 1818)	5	13	-	-	-	DS	SF	A
<i>Eupolyomia nesidensis</i> (delle Chiaje, 1828)	1	-	-	-	-	DS	SF	A
<i>Nicolea venustula</i> (Montagu, 1818)	5	-	-	-	-	DS	SF	A
<i>Pista cristata</i> (Müller, 1776)	3	-	7	1	-	DS	SF	C
<i>Thelepus cincinnatus</i> (Fabricius, 1780)	-	-	-	3	-	DS	MS	A
<i>Amphiglena mediterranea</i> (Leydig, 1851)	136	38	27	51	23	S	MS	Ct
<i>Chone collaris</i> Langerhans, 1880	1	-	-	-	-	S	MS/EF	A
<i>Demonax langerhansi</i> Knight-Jones, 1983	1	-	-	-	-	S	SF	A
<i>Fabricia stellaris</i> (Müller, 1774)	79	44	-	10	-	DS	MS	C
<i>Oriopsis alata-pectinata</i> Banse, 1957	1	-	-	-	-	S	MS	A
<i>Oriopsis armandi</i> Claparède, 1864	8	58	17	12	-	S	MS	C
<i>Oriopsis eimeri eimeri</i> (Langerhans, 1880)	-	2	-	18	-	S	MS	A
<i>Protula tabularia</i> (Montagu, 1803)	-	1	-	-	-	S	SF	A
<i>Serpula vermicularis</i> Linnaeus, 1767	2	-	-	1	-	S	SF	A
<i>Vermiltopsis striaticeps</i> (Grube, 1862)	-	-	2	-	1	S	SF	A
<i>Janua pagenstecheri</i> (Quatrefages, 1865)	*	-	-	-	-	S	SF	A
<i>Janua pseudocorrugata</i> (Bush, 1904)	*	*	-	*	*	S	SF	C
<i>Pileolaria militaris</i> Claparède, 1860	-	-	-	*	-	S	SF	A

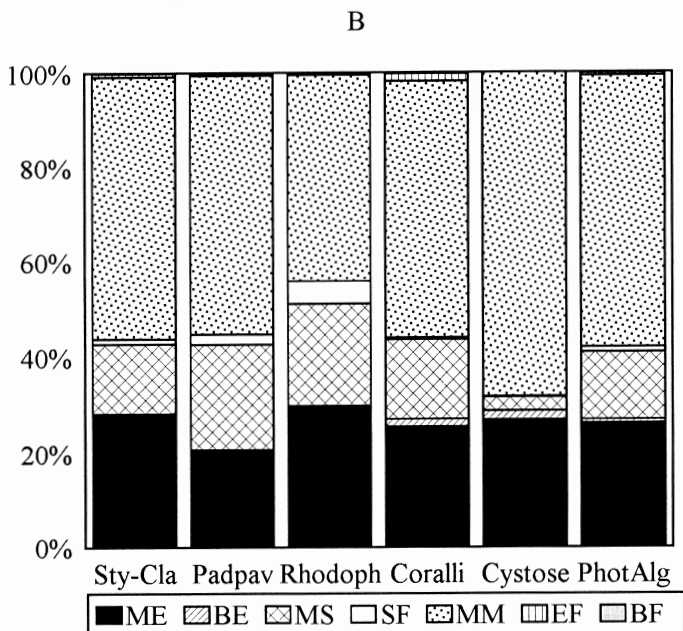
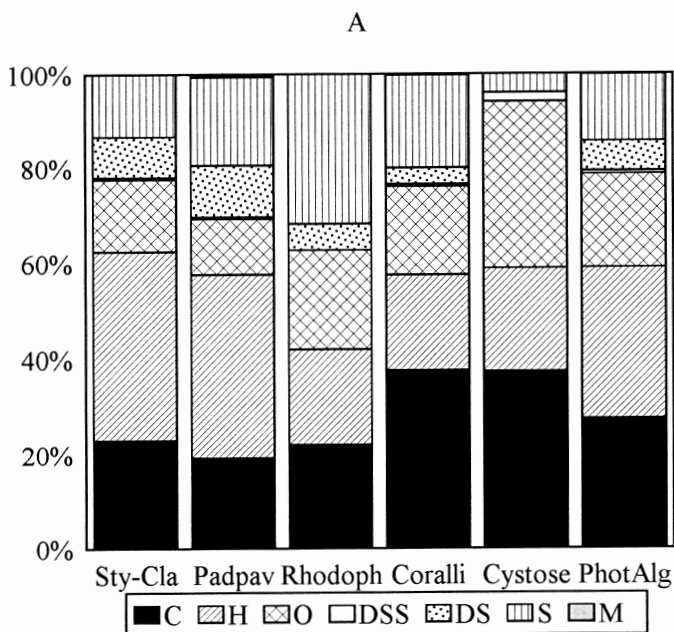


Figure 3. A.—Dominance (based on number of specimens) of the seven Feeding Guilds (ME, BE, MS, SF, MM, EF, BE see Table 5) at the five facies studied. B.—Dominance of the seven Life Styles (C, H, O, DSS, DS, S, M see Table 5) at the five facies studied. (Sty-Cla = Facies with *Stypocaulum scoparium*-*Cladostephus hirsutus*; Padpav = Facies with *Padina pavonica*; Rhodoph = Facies of Crustose Calcareous Rhodophytes with sea-urchins; Coralli = Facies with *Corallina elongata*; Cystose = Facies with *Cystoseira tamariscifolia*; PhotAlg = Global dominance of photophilic algal community).

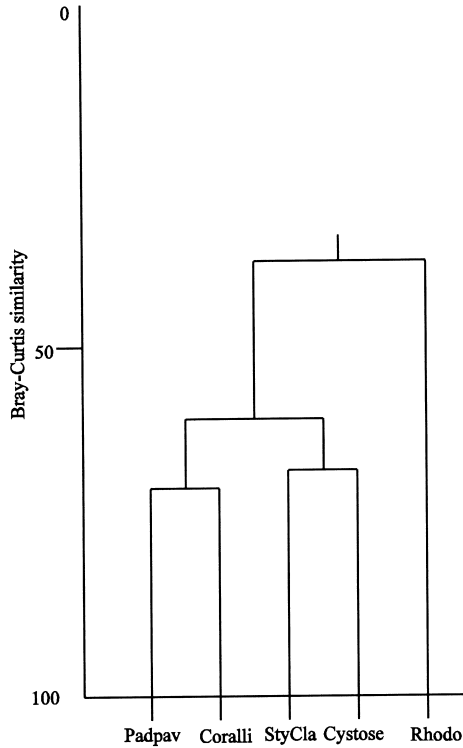


Fig. 4. Dendrogram of the Bray-Curtis similarity analysis.

The most represented family in the facies of crustose calcareous rhodophytes was Syllidae, followed by Sabellidae and Nereididae. The diversity was relatively low ($H' = 2.14$) but evenness was high (0.83) (Table 2). The most abundant species were *A. mediterranea*, *P. dumerilii*, *Sphaerosyllis pirifera*, *S. prolifera* and *O. armandi*. The trophic structure (Fig. 3A) was dominated by suspension feeders, which reach the maximum dominance among the studied facies (31.7%) due principally to *A. mediterranea* and *O. armandi*. The carnivores, omnivores, and herbivores present similar values. In this case, despite the dominance of motile forms in microcavities and crevices similar to that of other facies, the representation of motile epibenthos on algal substrates increases to 29.5%, followed by the motile sedentary forms (21.3%) (Fig. 3B).

The similarity between the five facies taking into account the feeding guilds and life styles was rather high as shown in the dendrogram of the Bray-Curtis analysis (Fig. 4). As can be seen two main clusters have been identified. The first group is formed by the facies with *P. pavonica* and the facies with *C. elongata* (70% average similarity) which constitute a lower stratum of a few centimeters above the rocky surface. The second group contains the facies characterized by higher algal turf, *Stypocaulum scoparium* - *Cladostephus hirsutus* and *Cystoseira tamariscifolia* facies (66% average similarity). The facies of crustose calcareous rhodophytes with sea urchins, characterized by a laminar surface of *L. incrustans*, are clearly separated from the rest (37% average similarity).

DISCUSSION

Although hydrodynamism and irradiance are traditionally cited as the main factors influencing communities of photophilic algae, many authors have recently agreed that algal cover is the principal factor that directly affects the distribution and zonation of polychaetes (Abbiati et al., 1987; Giangrande, 1988; Sardá, 1991). As the algal component is the basic structural part of the community of photophilic algae, it is the principal factor responsible for the availability of microenvironments and trophic resources.

According to Tena (1996) the polychaete fauna cannot by itself be used to characterize the different communities of hard substrates from a bionomic point of view. Similarly, Alós (1988) at Creus Cap (Catalonian coast, western Mediterranean) did not find stocks of species characteristic of the different communities of hard substrates. Most of the polychaetes are cryptic and colonize microenvironments that occur in different communities on hard substrates. Despite their different physiognomy these assemblages offer very similar ecological niches which allow the occurrence of the same species. Sardá (1991) noted that in the Balearic Islands the species composition and diversity of both shallow photophilic algae communities and infralittoral sciaphilic communities are similar. A previous study carried out in the region of the Strait of Gibraltar (Sardá, 1984) showed that no characteristic group of polychaetes exists with photophilic facies of infralittoral. Abbiati et al. (1987, 1991) in a faunistic study of the mesolittoral and upper infralittoral zones, noted that it is not possible to recognize a group of different species for the superior and inferior parts of the 'biological zero', but only a difference in their quantitative composition. Bellan (1969) and Bellan-Santini (1969) noted that the index of similarity demonstrated that the annelid populations of different infralittoral upper facies are very similar.

As Alós (1988) pointed out, our lack of knowledge concerning the ecological requirements of most species results in contradictions among different authors when it comes to characterizing the communities of polychaete fauna. The previous comments together with the results of the present study illustrate the large number of factors determining the spatial heterogeneity in hard-substrate communities (which are as difficult to identify as they are to quantify), and the great variability of life strategies of polychaetes force us to adopt an alternative approach to this problem: to study in depth the particular biology of the species in order to understand the role of these worms in the community. This new approach to polychaete study began by utilizing feeding guilds (Gambi and Giangrande 1985a,b; Josefson, 1985; Abbiati et al., 1987; Gaston, 1987; Gaston et al., 1988; Tena et al., 1993). This approach is very useful for evaluating the organization and energy flows of the communities, although we should be conscious of the limitations involved with the utilization of only one group of the zoobenthos in order to describe the feeding guilds or flows of energy within that community.

Classification of the species in trophic guilds entails, however, several problems that have to be taken into account when evaluating the results. The association of the species with different diets is the principal limitation, due to the absence of reliable data on the feeding ecology of the different species, the divergent opinions of different authors, and the fact that many species are capable of varying their methods of alimentation according to the available resources (Pearson and Rosenberg, 1978). The latter constitutes the basic homeostatic mechanism for the stability of the community.

Life styles constitute another biological aspect that would determine the establishment and development of a species in a community. These two additional aspects of available resources and adequate conditions for reproduction, development and settlement determine the survival of a species in a given habitat.

The environmental heterogeneity resulting from algal cover and wave action could explain the distribution of species in the five facies studied. The distribution of life styles/feeding guilds in each facies depends on the availability of microenvironments in the Bray-Curtis similarity analysis. Based on the data contributed here and the current state of knowledge, we present a new perspective for the study of different facies in a photophilic algae community based on a more realistic approach to the role of Polychaeta in the benthos. As Camp (1976) mentioned, we should recognize the limitations of all methods of sampling of hard substrates, as there is no technical method that guarantees the extraction of 100% of the fauna. Sampling also becomes more complicated in mesolittoral and shallow infralittoral communities in the surf zone. For these reasons, we believe that the proper strategy for the analysis of this community in the Mediterranean Sea requires that the methodology as well as the minimal area of sampling are decided separately for each facies included in the study. We believe we should also standardize the facies and habitats and finally conduct an in depth study of the biology of the species, both in situ and in the laboratory. The final objective is to contribute decisive information to help establish the causes that condition the presence of these species in different facies.

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