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Article

Marine Molluscs from Two Contrasted Algal Habitats in Tossa de Mar (Costa Brava, NE Spain)

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Abstract: The malacological fauna of two algal habitats with different lighting conditions -a sciophilous wall and a photophilous one- both located in Tossa de Mar (Costa Brava, Girona, NE Spain), have been studied to examine differences in the malacological communities, their distribution over time, and the role played by micromollusks in these algal habitats. Every two months, for a year, samples were collected by scuba diving and scraping standardized surfaces (20x20 cm) of the algal communities. In the laboratory, the samples were washed and filtered using two metal sieves (2 mm for coarse fraction and 513 µm for fine fraction). Mollusks were separated, identified, and later analyzed statistically to assess biodiversity indices and sample grouping. A total of 7,913 mollusk specimens from 148 species (112 Gastropoda; 32 Bivalvia and 4 Polyplacophora) were identified across all samples, with 1,669 specimens (84 species) from the sciophilous algae and 6,244 specimens (133 species) from the photophilous algae. 10 species accounted for 76.27% of the total abundance, with each species represented by over 100 specimens in the total samples. *Bittium latreillii* was the most abundant species, with 2,106 specimens recorded. Regarding the two fractions, 337 specimens (69 species) were found in the coarse fraction, while 7,576 specimens (111 species) were found in the fine fraction. Significant differences were obtained between samples with respect to time, habitat type, and size fraction. The Shannon-Wiener biodiversity index values indicated differences between the two communities over time, as well as variations in biodiversity, with the photophilous community exhibiting higher values. Additionally, it was demonstrated that algal thalli provide a highly suitable substrate for juvenile forms and micromollusks. Our findings, combined with records from the literature and various online citations, establish Tossa de Mar as the town on the Catalan coast with the best-documented malacological fauna.

Keywords: algal mollusks; diversity; abundance; habitats; Tossa de Mar (NE Spain)

1. Introduction

In the upper infralittoral of all seas and oceans, seaweeds are essential components for the development of animal populations, particularly invertebrates, which find protection, shelter, food and reproductive sites [1-5]. In some cases, they even form true mutualistic symbiotic relationships between algae and animals [6].

In the Mediterranean Sea, many studies emphasize the structural complexity of the various habitats found there, which is why comparisons between different communities and their associated fauna are necessary. Focussing on mollusks in shallow marine environments, Chemello et al. [7] noted that the spatial distribution of the malacological fauna associated with the photophilous algal communities is influenced by factors such as depth and the algal substrate. However, others, like

García et al. [8], observe a more homogeneous distribution of gastropod species across all types of algae and habitats, except for certain groups like Sacoglossa gastropods, which are associated with specific species of *Caulerpa* algae, such as *Berthelinia caribbea* Edmunds, 1963.

Avila et al. [9] highlight that the floristic composition and algal biomass are crucial in determining the distinctiveness of the micromollusk community, as in the intertidal zone of the Azores, where these factors provide protection from waves, high temperatures, and desiccation. The so-called algal architecture is also critical for the settlement and abundance of epibiont marine invertebrate species, particularly mollusks [10, 11]. Various sources also report behavioral patterns shifts and the advantages smaller species have over larger adults when living among algae fronds. The behavioral changes observed by Terlizzi et al. [12] show that the species within the same genus can exhibit differences in juvenile abundance due to differences in their life cycles. This is exemplified by *Bittium latreillii* (Payraudeau, 1826) and *Bittium reticulatum* (da Costa, 1778), where the former has an 18 month life cycle with semelparous reproduction, recruiting in October, February and June, while the latter shows a single recruitment peak in May, reflected in its abundance throughout the year. On the other hand, smaller species benefit from reduced dispersal capacity [9] and the protection offered by the interstices within algal fronds [8].

It is well known that infralittoral algal communities can be classified according to hydrodynamism (calm or turbulent) and the light they receive (sciophilous or photophilous). In the Mediterranean Sea, typical algal species that characterize sciophilous habitats in the upper infralittoral zone include, among others, *Flabellia petiolata* (Turra) Nizamuddin, 1987, *Halopteris filicina* (Grateloup) Kützinger, 1843, *Peyssonnelia rubra* (Greville) J. Agardh, 1851 and *Halimeda tuna* (J. Ellis & Solander) J.V. Lamouroux, 1816. Photophilous habitats are mainly defined by the presence of algae such as *Halopteris scoparia* (Linnaeus) Sauvageau, 1904, *Padina pavonica* (Linnaeus) Thivy, 1960, *Dictyota dichotoma* (Hudson) J.V. Lamouroux, 1809 and *Corallina officinalis* Linnaeus, 1758, the latter being more closely studied in relation to malacological fauna.

In recent decades, several studies in the Mediterranean Sea have explored the relationship between mollusks and different types of algae. For example on calcareous algae [13, 14]; on photophilous algae [7, 10, 15, 16]; on *Halopteris scoparia* (Linnaeus) Sauvageau, 1904 [17]; on *Cystoseira* [18]; or on the malacofauna of *Posidonia oceanica* meadows [19], among others.

Tossa de Mar (Girona, NE Spain) is a tourist town on the Spanish Costa Brava very popular among scuba divers. From the beach, divers can access rocky and sandy seabeds, caves and *Posidonia oceanica* meadows, all teeming with marine biodiversity.

This study aims to contribute to the knowledge of the algal-associated marine malacofauna in this locality. Specifically we aim to determine the role of micromollusks and juvenile forms of larger species in algal communities. We also assess whether significant differences exist in the biodiversity and abundance of mollusk populations between two contrasting algal communities -one photophilous and the other sciophilous- located on two nearby rock walls. Lastly, we examine abundance and diversity patterns in these two contrasting environments over the course of an annual cycle.

2. Material and Methods

2.1. Study Area

The study was conducted in the town of Tossa de Mar, located in the La Selva region of Girona province, on the southern Costa Brava (NE Spain), approximately 100 km north of Barcelona. The sampling site was at the location known as “Sa Banyera de ses Dones” (Figure 1) situated at the northern end of La Mar Menuda beach. This site features a rocky corridor with a thick sandy bottom flanked by nearly vertical rock walls that are about 10 m apart. The bathymetric levels of these walls range from 2 to 11 meters in depth. The southern wall is vertical and faces northwest, giving it distinctly sciophilic characteristics. In contrast, the northern wall has a slope of about 70° and faces southeast, allowing it to receive direct sunlight, which results in a community dominated by photophilous algae (Figure 2).



Figure 1. Location of Tossa de Mar on the Iberian Peninsula, showing La Banyera de ses Dones (1) and the sampling site (2).

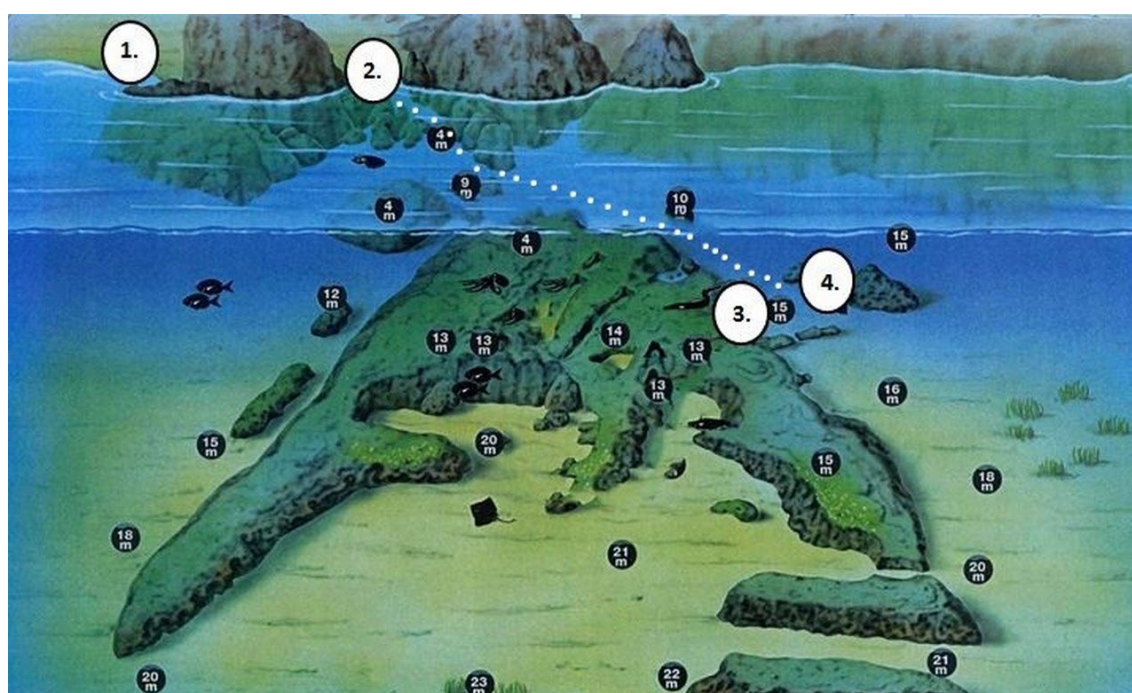


Figure 2. Artistic recreation of the sampling area. 1: Mar Menuda beach; 2: Sa Banyera de ses Dones; 3: sampled sciophillous wall; 4: sampled photophilous wall. Image extracted with permission [20].

2.2. The Studied Communities

At depths between 1,5 and 3m, the sciophilous wall is dominated by photophilous algae, including *Osmundea pinnatifida*, *Ellisolandia elongata* (J.Ellis & Solander) K.R.Hind & G.W.Saunders, 2013, *Padina pavonica* and some thalli of *Codium vermilara* (Olivi) Delle Chiaje, 1829. Additionally the community includes the unicellular green alga *Acetabularia acetabulum* (Linnaeus) P.C.Silva, 1952, cirriped crustaceans of the genus *Semibalanus balanoides* (Linnaeus, 1767), sea urchins (*Arbacia lixula* (Linnaeus, 1758)) and sponges such as *Sarcotragus fasciculatus* (Pallas, 1766). At depths of 3 to 4 meters, the wall becomes slightly more sciophilic (Figure 3B) with abundant fronds of *Halopteris scoparia*, the red algae *Peyssonnellia squamaria* (S.G.Gmelin) Decaisne ex J.Agardh, 1842, and the brown algae

Dictyota dichotoma. Here, red encrusting sponges (*Crambe crambe* Schmidt, 1862) and some *Sarcotragus fasciculatus* are also observed. From 5 to 6 m. (Figure 3C) calcareous algae such as *Mesophyllum lichenoides* (J. Ellis) Me. Lemoine, 1928, and the red alga *Sphaerococcus coronopifolius* Stackhouse, 1797, as well as hydrozoans of the genus *Eudendrium*, become abundant. Scattered thalli of *Halimeda tuna* (J. Ellis & Solander) J.V. Lamouroux, 1816, along with the red algae *Halopteris scoparia* and *Peyssonnelia squamaria* (S. G. Gmelin) Decaisne ex J. Agardh, 1842, some thalli of *Codium bursa* (Olivi) C. Agardh, 1817, the sponge *Crambe crambe*, and the zoantharian cnidarian *Parazoanthus axinellae* (Schmidt, 1862) are also present. From depths of 7 to 8 m down to the bottom of the wall (11 m) (Figure 3D) the alga *Flabellia petiolata* predominates, with abundant polychaete spirorbids growing on its fronds. The community also includes encrusting calcareous algae, *Peyssonnelia squamaria*, *Parazoanthus axinellae*, the sponges *Phorbos tenacior* (Topsent, 1925), *Petrosia* (*Petrosia*) *ficiformis* (Poiret, 1789), *Chondrosia reniformis* Spikenard, 1847 and *Clathrina clathrus* (Schmidt, 1864), as well as serpulid polychaetes like *Serpula vermicularis* Linnaeus, 1767.

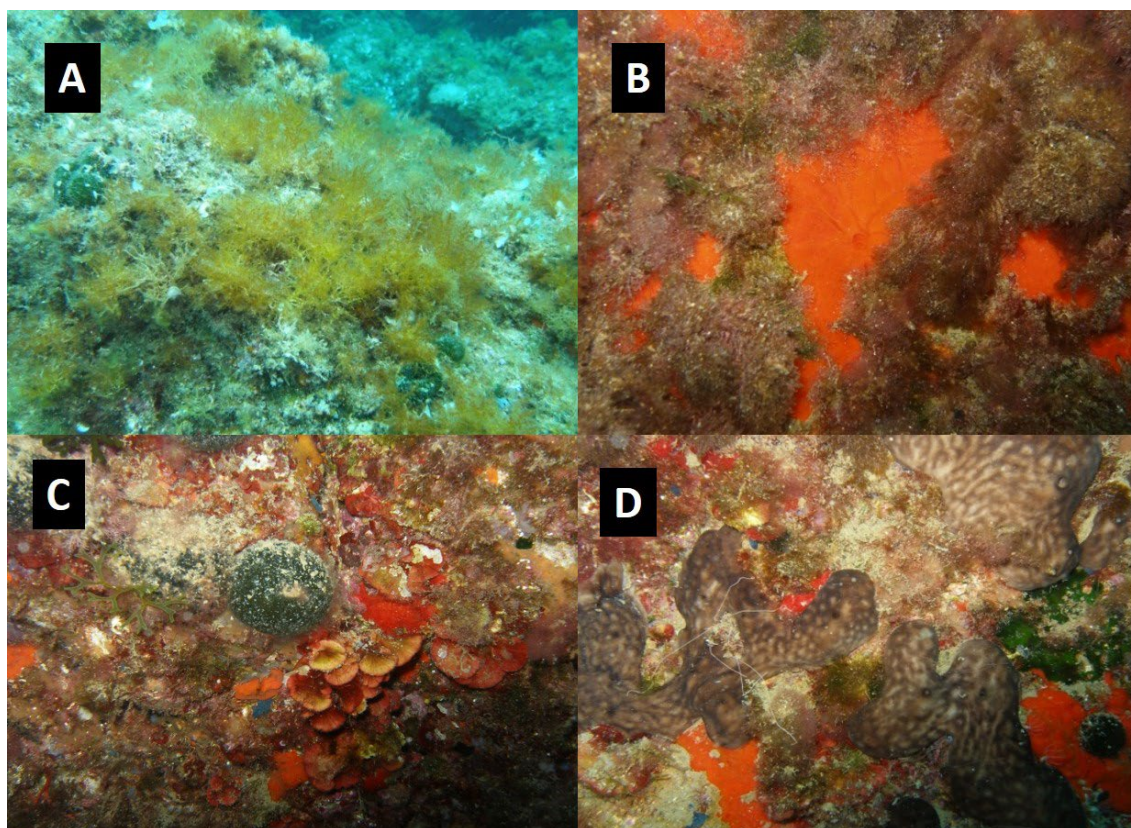


Figure 3. Images of the sciophilic wall. A: *Osmundea pinnatifida*; B: *Halopteris scoparia*; C: *Codium bursa* and *Peyssonnelia squamaria*; D: *Chondrosia reniformis*. Photos by M. Ballesteros.

The photophilous wall exhibits a fairly homogeneous algal community, with few macroscopic invertebrates observed. At depths between 2 and 4 meters, the wall is vertical and dominated by photophilous algae in a wave-beaten mode (Figure 4A), primarily *Osmundea pinnatifida*, *Acetabularia* (*Acetabularia*) *acetabulum*, filamentous brown algae, *Corallina elongata* and *Padina pavonica*. Among these algae, numerous specimens of the cirriped crustacean *Semibalanus balanoides* (Linnaeus, 1767) can be found. From 4 meters to the bottom (11 meters), the wall becomes slightly inclined and is nearly completely covered by photophilous algae, with abundant thalli of *Padina pavonica* and *Halopteris scoparia* (Figure 4D), *Acetabularia* (*Acetabularia*) *acetabulum* (Figure 4B). Scattered specimens of *Codium bursa*, *Dictyota*, thalli of *Sphaerococcus coronopifolius*, and encrusting red algae are present beneath the high thallus algal mat. There are also several isolated thalli of *Codium vermicularis* (Figure 4C). Among the macroscopic fauna, sea urchins (*Arbacia lixula*), sponges (*Sarcotragus fasciculatus*) and some polychaete spirographs (*Sabella spallanzanii* (Gmelin, 1791)) can be observed. Additionally, there

are also small sciophilous enclaves featuring *Peyssonnelia squamaria*, the serpulid polychaete *Protula tubularia* (Gmelin, 1791), the sponge *Aplysina aerophoba* (Nardo, 1833) and the equiurid *Bonellia viridis* Rolando, 1822.

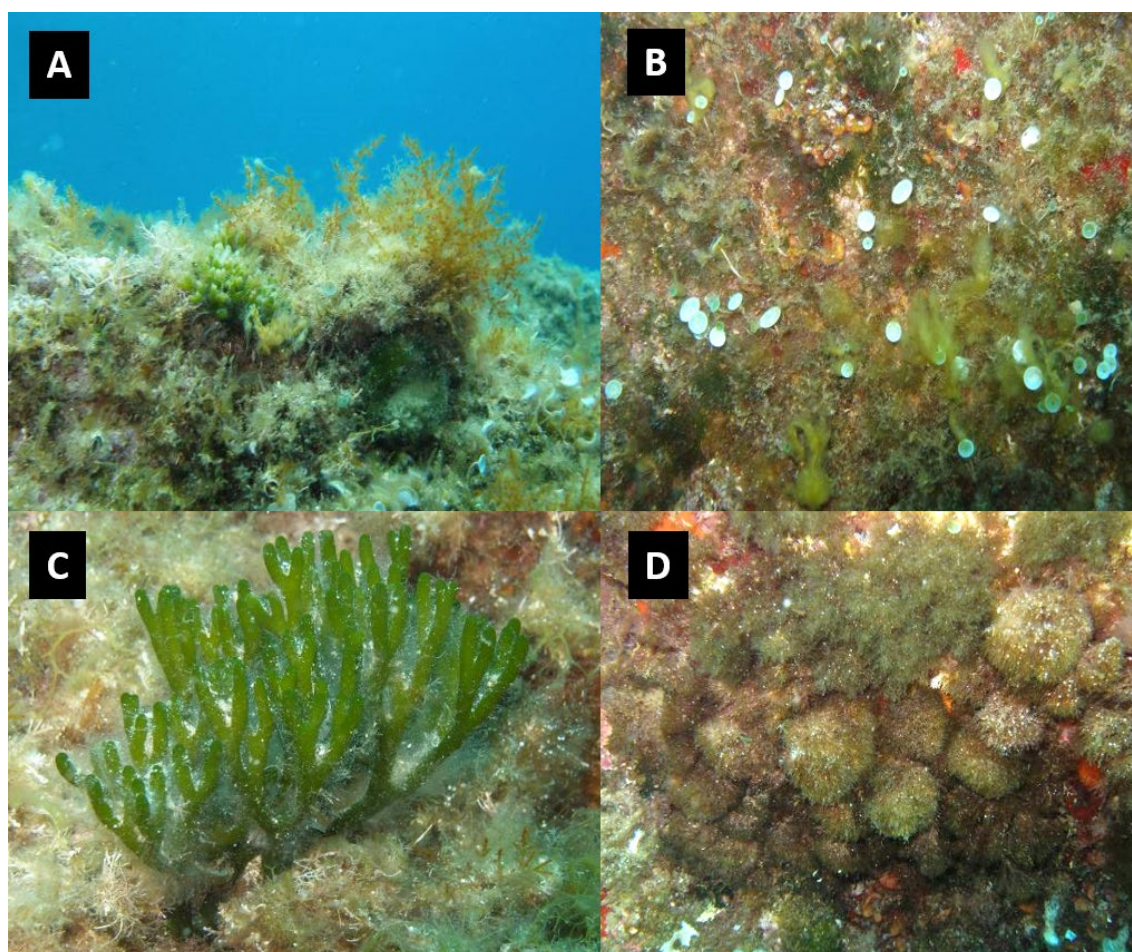


Figure 4. Images of the photophilic wall. A: *Osmundea pinnatifida*; B: *Acetabularia* (*Acetabularia*) *acetabulum*; C: *Codium vermilara*; D: *Halopteris scoparia*. Photos by M. Ballesteros.

2.3. Sampling and Processing of Samples

Sampling was conducted every two months from January to November 2011 by two divers using scuba gear. Underwater photographs of the main communities present on both walls were taken with an Olympus SP-350 camera inside a waterproof housing.

Algal samples were collected by scraping the existing algal community inside a metal square measuring 20 x 20 cm. During each sampling dive, three replicates were randomly collected from each wall, (photophilous and sciophilous. Samples were introduced in plastic bags in situ. After surfacing and draining most of the water, 70% alcohol was added to each bag. In total, 36 samples were obtained, with 18 corresponding to the photophilous wall (6 samples x 3 replicates) and another 18 to the sciophilous wall (6 samples x 3 replicates).

2.4. Work in the Laboratory

In the laboratory, each sample was washed under running water using two metal filters with mesh sizes of 2 mm and 315 μ m. This process allowed the separation of the algal and invertebrate specimens into two fractions: the coarse fraction and the fine fraction respectively. From these two fractions, the mollusk specimens were separated from the other invertebrates using a Carl Zeiss binocular magnifying glass model GmbH STEMI 2000-C.

Next, the mollusk specimens from both fractions were sorted by morphotype in plastic classification racks for subsequent counting and taxonomic identification up to the species or higher

level. Various general identification guides were employed [21-27] along with specialized literature for identifying juvenile mollusk stages [28] For the current taxonomy and nomenclature of the species, the recommendations of World Register of Marine Species [29] were generally followed.

Specimens that posed challenges in their taxonomic determination or were unusual were photographed and preserved in Eppendorf tubes for identification by specialists. However, some specimens (especially bivalves) were only identified at the class level due to their early development stages.

2.5. Data Analysis and Statistical Methods

Species abundance data were expressed as number of individuals per replicate sample (no. individuals / 400 cm²). Species richness (S), total abundance of individuals (N), Shannon-Wiener diversity index (H') and Pielou evenness (J') were calculated for each sampling site. For diversity and evenness, permutation tests (within the PERMANOVA framework) were performed to determine whether there were significant differences between habitats, fractions and months.

To analyse and compare community composition in relation to habitat, fraction, and seasonal variation, a proximity matrix was constructed using Bray-Curtis similarity. Prior to this, a fourth root transformation was applied to reduce the influence of extreme values and obtain less asymmetric distributions of abundances. PERMANOVA designs were then used to assess significant differences based on habitat, fraction, and months. Two-dimensional representations using the NMDS technique (Kruskal's algorithm) were created to visualise relationships across habitats, fractions and months.. To identify potential clusters, dendrograms were constructed using the UPGMA method, and significant branches were tested with the SIMPROF test ($\alpha=5\%$). The clusters identified through this methodology were then represented as ellipsoids on NMDS plots. Finally, species abundance data were grouped by trophic level, and some of the above techniques were re-applied.

All analyses were carried out using PRIMER 7 with PERMANOVA (Plymouth Routines In Multivariate Ecological Research).

3. Results

3.1. General Abundance and Specific Richness

A total of 7,913 mollusc specimens, representing 148 different species, were counted across all samples. Of these, 32 belong to the class Bivalvia, 112 to Gastropoda, and 4 to Polyplacophora. Some specimens, due to their small size and immaturity, were identified only to the genus level, higher taxon or simply as morphotypes. Table I lists the species found in the samples, ordered by total abundance, along with their abundance in the two environments (photophilous and sciophilous) and their trophic categories. Supplementary Table I shows the species' abundance according to their presence in the two studied fractions, fine and coarse. Regarding the two habitats, the photophilous environment proved to be the most abundant, with 6,244 mollusk specimens (6,017 in fine fraction and 227 in coarse fraction), while the sciophilic algae environment contained 1,669 specimens (1,559 in fine fraction and 110 in the coarse fraction). In terms of specific richness, the photophilous environment again stood out, with 133 different species (105 in the fine fraction and 58 in the coarse fraction), compared to 84 species in the sciophilous environment (62 in the fine fraction and 38 in the coarse fraction). Of the total number of species, 15 were exclusive to the sciophilous environment, 65 were found only in the photophilous environment, and 68 were present in both environments. Of all species, 35 were found only in the coarse fraction, 76 only in the fine fraction, and 37 species were present in both fine and coarse fractions. Among the mollusks of the fine fraction, 57 species were found in both the photophilous and sciophilous samples, 50 species were exclusive to the photophilous environment, and 6 were exclusive to the sciophilous environment. In the coarse fraction, 25 species were present in both sciophilous environments, 33 were found only in the photophilous samples, and 12 species appeared only in sciophilous samples. A total of 72 species were identified in the coarse fraction samples, and 111 in the fine fraction.

Table 1. List of species according to their abundances and trophic categories. “C”: carnivore; “EC”: ectoparasite; “F”: filter feeder; “HE”: herbivore; “SC”: scavenger; “SDF”: surface depot feeder; “UN”: unknown. “Sc”: sciophilous environment; “Ph”: photophilous environment. Note: Some authors classify the species from the Pyramidelloidea group as ectoparasites of echinoderms or other invertebrates, while others consider them microcarnivores. In this study, they are classified as ectoparasites.

Species	Trophic categories	Total abundances	Sc	Ph
<i>Bittium latreillii</i>	HE	2106	55	2,051
<i>Musculus costulatus</i>	F	1282	486	796
<i>Pusillina philippi</i>	C	817	272	545
<i>Pusillina radiata</i>	F	546	179	367
<i>Hiatella arctica</i>	HE	404	162	242
<i>Rissoella diaphana</i>	HE	228	0	228
<i>Odostomia striolata</i>	HE	217	50	167
<i>Alvania lineata</i>	HE	176	49	127
<i>Chauvetia mamillata</i>	C	130	22	108
<i>Parvicardium scriptum</i>	F	130	29	101
Triphoridae indet.	C	130	16	114
<i>Bittium reticulatum</i>	HE	96	10	86
<i>Clanculus cruciatus</i>	HE	88	8	80
<i>Striarca lactea</i>	F	88	13	75
<i>Tritia incrassata</i>	SC	80	20	60
<i>Ammonicera fischeriana</i>	HE	79	13	66
<i>Modiolula phaseolina</i>	F	67	11	56
<i>Vitreolina perminima</i>	C	65	6	59
<i>Jujubinus ruscurianus</i>	HE	62	13	49
<i>Mytilus galloprovincialis</i> juv.	F	57	11	46
<i>Crisilla semistriata</i>	HE	53	29	24
<i>Cerithium vulgatum</i>	SDF	41	2	39
<i>Parvamussium fenestratum</i>	F	41	22	19
<i>Aplysia punctata</i> juv.	HE	40	10	30
<i>Arca noae</i>	F	40	1	39
<i>Runcina</i> sp.	HE	39	4	35
<i>Aequipecten opercularis</i>	F	36	23	13
<i>Parthenina emaciata</i>	C	36	0	36
<i>Alvania cancellata</i>	HE	35	3	31
<i>Runcina adriatica</i>	C	30	3	27
<i>Cyrellia linearis</i>	C	29	1	28
<i>Cerithiopsis tubercularis</i>	C	25	2	23
<i>Limaria tuberculata</i>	F	24	13	11
<i>Irus irus</i>	F	22	5	17
<i>Mimachlamys varia</i>	F	22	13	8
<i>Scissurella costata</i>	HE	22	1	21
<i>Gibberula turgidula</i>	C	20	0	20
<i>Odostomia plicata</i>	EP	20	11	9
<i>Tricolia</i> sp.	HE	20	3	17
<i>Chauvetia brunnea</i>	C	17	9	8
<i>Cerithiopsis jeffreysi</i>	C	16	0	16

Species	Trophic categories	Total abundances	Sc	Ph
<i>Gregariella semigranata</i>	F	16	8	8
<i>Mitromorpha columbellaria</i>	C	16	5	11
<i>Ocenebrina aciculata</i>	C	16	2	14
<i>Odostomella doliolum</i>	EC	16	1	15
<i>Bulla striata</i>	C	15	3	12
<i>Setia pulcherrima</i>	HE	15	5	10
<i>Haminoea navicula</i>	HE	13	0	13
<i>Petricola lithophaga</i>	F	13	0	13
<i>Chama gryphoides</i>	F	12	8	4
<i>Rissoa lia</i>	HE	11	1	10
<i>Monophorus erythrosoma</i>	C	10	2	8
<i>Alvania nestaresi</i>	HE	9	0	9
<i>Bittium</i> sp.	HE	9	0	9
<i>Cerithiopsis</i> sp.	C	9	0	9
<i>Modiolus barbatus</i>	F	9	1	8
<i>Rissoa variabilis</i>	HE	9	1	8
<i>Bivalvia</i> morph. 1	F	8	0	8
<i>Doridina nudibranch</i>	C	8	3	5
<i>Hexaplex trunculus</i>	C	8	4	4
<i>Pusia tricolor</i>	C	8	2	6
<i>Raphitoma echinata</i>	C	8	2	6
<i>Anomia ephippium</i>	F	6	4	2
<i>Diodora graeca</i>	HE	6	2	4
<i>Marshallora adversa</i>	C	6	2	4
<i>Muricopsis cristata</i>	C	6	4	2
<i>Philine</i> sp.	C	6	0	6
<i>Pseudochama gryphina</i>	F	6	3	3
<i>Rhyssoplax corallina</i>	HE	6	3	3
<i>Alvania aspera</i>	HE	5	0	5
<i>Alvania</i> sp.	HE	5	0	5
<i>Gastropoda</i> morph. 1	UN	5	0	5
<i>Gibberula miliaria</i>	C	5	0	5
<i>Mitromorpha olivoidea</i>	C	5	1	4
<i>Tricolia tingitana</i>	HE	5	0	5
<i>Trinchesia genovae</i>	C	5	0	5
<i>Acanthochitona</i> sp.	HE	4	0	4
<i>Chauvetia recondita</i>	C	4	0	4
<i>Nodulus contortus</i>	HE	4	0	4
<i>Smithiella costulata</i>	C	4	1	3
<i>Spiralina alpinoligustica</i>	EC	4	2	2
<i>Acanthochitona fascicularis</i>	HE	3	2	1
<i>Aegires leuckartii</i>	C	3	1	2
<i>Bivalvia</i> morph. 2	F	3	0	3
<i>Gibberula</i> morph. 1	UN	3	0	3
<i>Haliotis tuberculata</i>	HE	3	2	1
<i>Lima lima</i>	F	3	0	3
<i>Limaria hians</i>	F	3	2	1

Species	Trophic categories	Total abundances	Sc	Ph
<i>Pusillina inconspicua</i>	HE	3	0	3
Veneridae indet.	F	3	1	2
Bivalvia morph. 4	F	2	1	1
<i>Brachystomia scalaris</i>	EC	2	0	2
<i>Calliostoma zizyphinum</i>	C	2	0	2
<i>Crisilla simulans</i>	HE	2	0	2
<i>Diodora italica</i>	HE	2	2	0
<i>Doris ocelligera</i>	C	2	2	0
<i>Emarginula pustula</i>	C	2	1	1
<i>Episcomitra cornicula</i>	C	2	2	0
<i>Folinella excavata</i>	EC	2	0	2
<i>Fusinus rudis</i>	C	2	0	2
Gastropoda morph. 2	UN	2	0	2
<i>Jujubinus exasperatus</i>	HE	2	1	1
Polyplacophoran indet.	HE	2	0	2
<i>Raphitoma laviae</i>	C	2	0	2
<i>Raphitoma</i> morph. 1	C	2	0	2
<i>Rissoa guerinii</i>	HE	2	0	2
<i>Weinkauffia turgidula</i>	C	2	0	2
<i>Alvania cimex</i>	HE	1	1	0
<i>Alvania discors</i>	HE	1	0	1
<i>Aplus dorbignyi</i>	SC	1	0	1
<i>Babelomurex cariniferus</i>	C	1	1	0
Bivalvia morph. 3	F	1	0	1
<i>Caloria elegans</i>	C	1	1	0
Cardiidae morph. 1	F	1	0	1
Cardiidae morph. 2	F	1	0	1
<i>Chauvetia</i> morph. 1	UN	1	0	1
<i>Chauvetia</i> morph. 2	UN	1	0	1
<i>Columbella rustica</i>	HE	1	1	0
<i>Doto</i> sp.	C	1	1	0
<i>Felimare</i> sp.	C	1	0	1
<i>Gari tellinella</i>	F	1	0	1
Gastropoda morph 3	UN	1	1	0
<i>Gibberula</i> morph. 2	UN	1	0	1
<i>Idas</i> sp.	F	1	1	0
Ischnochitonidae indet.	HE	1	0	1
<i>Lithophaga lithophaga</i>	F	1	1	0
<i>Mangelia multilineolata</i>	C	1	0	1
<i>Mangelia</i> morph. 1	UN	1	0	1
<i>Mangelia</i> morph. 2	UN	1	0	1
<i>Mitrella broderipii</i>	C	1	0	1
Muricidae indet.	C	1	0	1
<i>Nodulus spiralis</i>	HE	1	0	1
<i>Otina ovata</i>	UN	1	0	1
<i>Paradoris indecora</i>	C	1	0	1
<i>Patella</i> sp.	HE	1	0	1

Species	Trophic categories	Total abundances	Sc	Ph
<i>Philine intricata</i>	C	1	0	1
<i>Phorcus richardi</i>	HE	1	0	1
<i>Pseudomangelia vauquelini</i>	C	1	0	1
<i>Pusia ebenus</i>	C	1	0	1
<i>Raphitoma</i> morph. 2	C	1	0	1
<i>Retilaskeya horrida</i>	C	1	1	0
<i>Retusa mammillata</i>	C	1	0	1
<i>Runcina coronata</i>	HE	1	0	1
<i>Spondylus gaederopus</i>	F	1	1	0
<i>Talochlamys multistriata</i>	F	1	0	1
<i>Tarantinaea lignaria</i>	C	1	0	1
<i>Tectura virginea</i>	HE	1	1	0
<i>Williamia gussoni</i>	HE	1	1	0

76.27% of the total abundance is represented by 10 species: *Bittium latreillii* (Payraudeau, 1826), *Musculus costulatus* (Risso, 1826), *Pusillina philippi* (Aradas & Maggiore, 1844), *Pusillina radiata* (R. A. Philippi, 1836), *Hiatella arctica* (Linnaeus, 1767), *Rissoella diaphana* (Alder, 1848), *Odostomia striolata* Forbes & Hanley, 1850, *Alvania lineata* Risso, 1826, *Parvicardium scriptum* (Bucquoy, Dautzenberg & Dollfus, 1892) and *Chauvetia mamillata* (Risso, 1826), each with more than 100 specimens counted across all samples. Notably, a large number of juvenile gastropods from the family Triphoridae (130 specimens) were also recorded but could not be identified at the species or genus level.

Table A1 in Appendix A details the abundances of each species by environment and by their presence in either the fine or coarse fraction. In the sciophilous environment the most abundant species -those with over 50 observed specimens- were *Musculus costulatus* with 486 specimens (all but two in the fine fraction), *Pusillina philippi* with 272 specimens (all in the fine fraction), *Pusillina radiata* with 179 specimens (all in the fine fraction), *Hiatella arctica* with 162 specimens (153 in the fine fraction and 9 in the coarse fraction), *Bittium latreillii* with 55 specimens (all but one in the fine fraction) and *Odostomia striolata* with 50 specimens (all in the fine fraction).

The samples from the photophilous wall, due to their greater specimen abundance, displayed a higher species diversity, with 16 species exceeding 50 observed specimens. Among those with more than 100 observed specimens, the most abundant by far was *Bittium latreillii* with 2,051 specimens (only one in the coarse fraction), followed by the bivalve *Musculus costulatus* with 796 specimens (only 8 in the coarse fraction), *Pusillina philippi* with 545 specimens (all in the fine fraction), *Pusillina radiata* with 367 specimens (all in the fine fraction), *Hiatella arctica* with 242 specimens (only three in the coarse fraction), *Rissoella diaphana* with 228 specimens (all in the fine fraction), *Odostomia striolata* with 167 specimens (all in the fine fraction), *Alvania lineata* with 127 specimens (only 11 in the coarse fraction), *Chauvetia mamillata* with 108 specimens (only 16 of them in the coarse fraction), and *Parvicardium scriptum* with 101 specimens (only one in the coarse fraction).

Regarding the two studied fractions, in the coarse one the most abundant species was *Tritia incrassata* with 40 specimens (35 in the photophilous environment), followed by *Alvania lineata* with 33 specimens (16 in the photophilous environment and 17 in the sciophilous environment), *Chauvetia mamillata* with 21 specimens (16 in the photophilous environment and 5 in the sciophilous) and *Chauvetia brunnea* with 17 specimens (8 in the photophilous environment and 9 in the sciophilous). In the fine fraction, the highest abundance corresponded to *Bittium latreillii*, with 2,104 specimens (2,050 in the photophilous environment and 54 in the sciophilous), followed by *Musculus costulatus* with 1,272 specimens (788 in the photophilous environment and 484 in the sciophilous), *Pusillina philippi* with 817 specimens (545 in the photophilous environment and 272 in the sciophilous), *Pusillina radiata* with 546 specimens (367 in the photophilous environment and 179 in the sciophilous) and *Hiatella arctica* with 242 specimens (239 in the photophilous environment and only 3 in the sciophilous).

3.2. Species Richness, Abundance, Diversity and Evenness Throughout the Year

The families Cerithiidae, Mytilidae and Rissoidae show a clear contrast in terms of abundance compared to the other families in almost all the samples from the two studied environments. Mytilidae were the most abundant in nearly all samples, both photophilous and sciophilous, except in July and September, when Cerithiidae dominated, and in November, when Rissoidae dominated both environments. The Rissoidae family exhibited a consistent presence throughout the year in both habitats, with their abundance peaking in the winter months (January and November).

The species found in the photophilous and sciophilous habitats showed different fluctuations over the study period (Figure 5). In the photophilous community, mollusk species richness was lowest from January to March, while the highest richness was observed from May to September, peaking in July. In the sciophilous environment, species richness was generally lower, but followed a similar pattern, with slight increases from July to September.

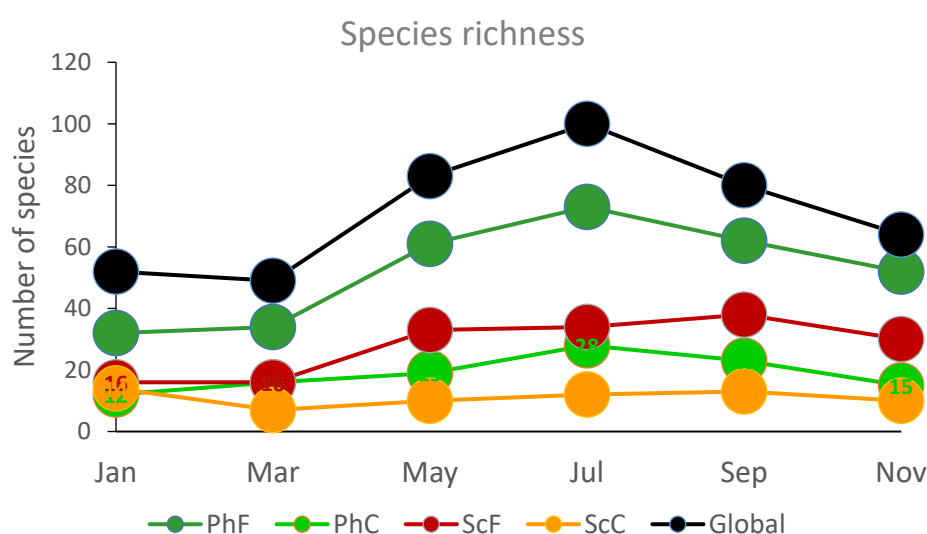


Figure 5. Species richness throughout the year. “Ph” and “Sc” indicate the photophilous and sciophilous communities, respectively, while “F” refers to the fine fraction and “C” to the coarse fraction.

The seasonal abundance (Figure 6) of individuals in the sciophilous habitat remained relatively low throughout the sampling period, with November showing the highest abundance, with almost 500 specimens. The increase in the number of specimens from July to November was primarily driven by the abundance of species from the families Rissoidae and Mytilidae. In the photophilous community, the greatest abundance of individuals occurred in July, mainly due to species from the Cerithiidae Family.

Overall, it was observed that for both environments, the peak in species richness and individuals abundance occurred during the summer months.

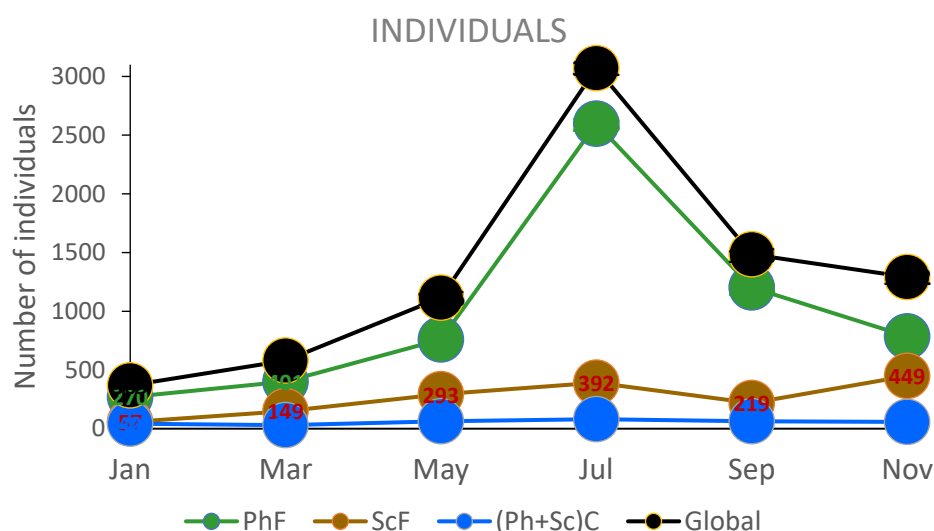


Figure 6. Number of individuals collected throughout the year. “Ph” and “Sc” indicate the photophilous and sciophilous habitats, respectively, while F refers to the fine fraction and C to the coarse fraction. Due to the low number of specimens in the coarse fraction, individuals from both habitats are grouped together.

The Shannon-Wiener diversity index (H') values (Figure 7) obtained from the samples (combining the three replicates) are not particularly high, ranging from 1.087 (March) to 2.765 (September) in the sciophilous environment, and from 2.084 (March) to 3.091 (July) in the photophilous environment. A 3-factor PERMANOVA analysis shows significant differences between environments ($p=0.0079$) and fractions ($p=0.0266$), although the month factor approaches significance ($p=0.0850$). No interactions between the factors are detected.

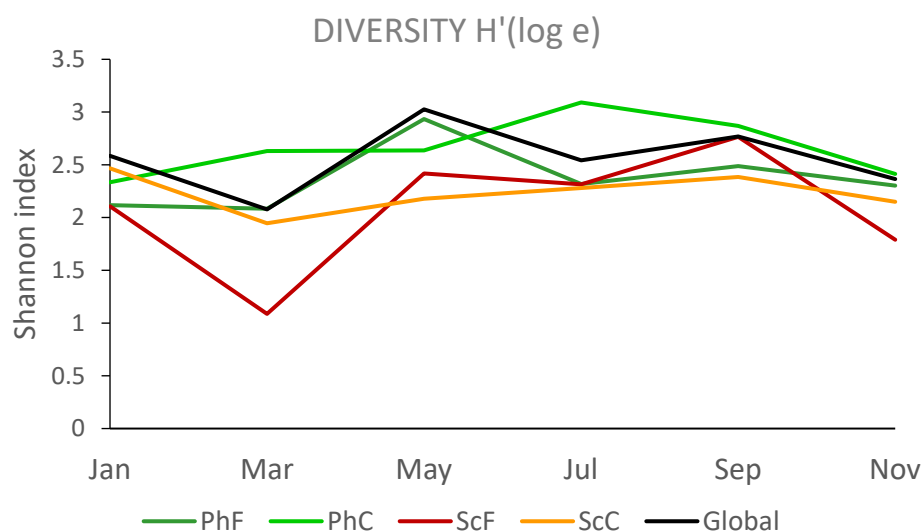


Figure 7. Shannon diversity index throughout the year. “Ph” and “Sc” refer to the photophilous and sciophilous habitats, respectively, while “F” refers to the fine fraction and “C” to the coarse fraction.

Regarding evenness (Pielou’s J' index) (Figure 8), the values for the fine fraction range from 0.392 (March) to 0.760 (January and September) in the sciophilous environment, and from 0.540 (July) to 0.714 (May) in the photophilous environment. Evenness is higher in the coarse fraction due to the small number of individuals, which are relatively evenly distributed across several species (Figure 8). A 3-factor PERMANOVA analysis shows significant differences only between fractions ($p=0.0001$).

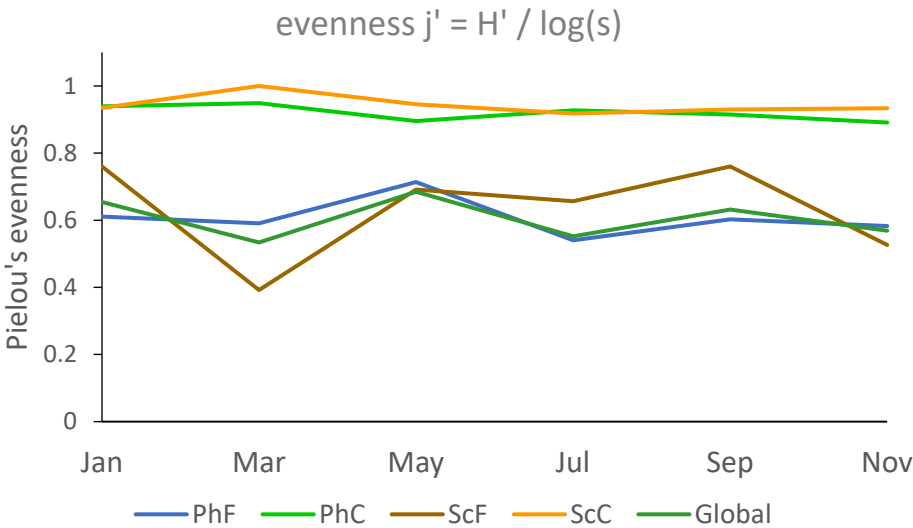


Figure 8. Pielou's evenness index throughout the year. “Ph” and “Sc” indicate the photophilous and sciophilous habitats, respectively, while “F” refers to the fine fraction and “C” to the coarse fraction.

3.3. Community Composition According to Environment, Fraction and Changes over the Year

A 3-factor PERMANOVA design (En=environment, Fr=fraction and Mo=month) shows that all main effects and two-way interactions are significant (En, $p=0.0001$; Fr, $p=0.0001$; Mo, $p=0.0001$; En x Fr, $p=0.0001$; En x Mo, $p=0.0238$; Fr x Mo, $p=0.0001$), with only the three-way interaction being non-significant (En x Fr x Mo, $p=0.2539$). These results indicate that the composition and evolution of the community throughout the year varies depending on environment and fraction.

Based on these findings, a SIMPER analysis was conducted to examine the En x Fr groups (i.e., PhF, PhC, ScF and ScC) and months (Table II and Table 3A). The results show clear differences between groups (environments and fractions) and across months.

Table 2. Results of SIMPER analysis, detailing the species that contribute to similarities within En x Fr groups (i.e. PhF, PhC, ScF and ScC) and months. Cut-off points of 80% for similarity and 50% for dissimilarity were applied. For the months, only the average dissimilarities between En x Fr groups are listed.

PhF (photophilous, fine fraction) Average similarity: 60,28					
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,50	6,53	1,65	10,83	10,83
<i>Bittium latreillii</i>	2,49	4,51	1,91	7,49	18,31
<i>Pusillina philippi</i>	2,09	4,30	2,03	7,13	25,45
<i>Chauvetia mamillata</i>	1,46	3,51	2,42	5,83	31,27
<i>Hiatella arctica</i>	1,71	3,51	1,79	5,82	37,09
<i>Parvicardium scriptum</i>	1,40	2,76	2,14	4,58	41,67
<i>Odostomia striolata</i>	1,43	2,38	1,48	3,95	45,62
<i>Alvania lineata</i>	1,28	2,12	1,21	3,52	49,14
<i>Aplysia punctata</i>	1,00	2,02	1,52	3,36	52,50
<i>Bittium reticulatum</i>	1,17	1,96	0,85	3,26	55,76
<i>Pusillina radiata</i>	1,25	1,87	0,71	3,09	58,85
<i>Alvania cancellata</i>	0,82	1,35	0,94	2,23	61,08
<i>Clanculus cruciatus</i>	1,05	1,31	1,05	2,17	63,25
<i>Striarca lactea</i>	0,87	1,29	0,98	2,14	65,39
<i>Rissoella diaphana</i>	1,04	1,25	0,77	2,07	67,46

<i>Runcina</i> sp.	0,77	1,13	0,81	1,87	69,33
<i>Vitreolina perminima</i>	0,95	1,09	0,79	1,82	71,15
<i>Ammonicera fischeriana</i>	0,84	1,08	0,86	1,79	72,93
<i>Modiolula phaseolina</i>	0,93	1,06	0,82	1,77	74,70
Triphoridae indet.	0,88	0,93	0,76	1,55	76,25
<i>Arca noae</i>	0,77	0,91	0,79	1,51	77,76
<i>Jujubinus ruscurianus</i>	0,60	0,82	0,63	1,37	79,13
<i>Mytilus galloprovincialis</i>	0,74	0,78	0,74	1,30	80,43

ScF (sciophilous, fine fraction) Average similarity: 49,55

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,08	10,77	1,92	21,74	21,74
<i>Hiatella arctica</i>	1,43	6,83	1,52	13,78	35,52
<i>Pusillina philippi</i>	1,48	5,06	1,37	10,21	45,73
<i>Odostomia striolata</i>	1,04	4,14	1,36	8,36	54,08
<i>Alvania lineata</i>	0,81	3,18	0,72	6,42	60,50
<i>Pusillina radiata</i>	0,86	2,73	0,61	5,51	66,01
<i>Chauvetia mamillata</i>	0,61	1,88	0,53	3,78	69,80
Triphoridae indet.	0,51	1,49	0,67	3,00	72,80
<i>Aequipecten opercularis</i>	0,48	1,47	0,67	2,97	75,77
<i>Odostomia plicata</i>	0,47	1,27	0,59	2,57	78,33
<i>Bittium latreillii</i>	0,71	1,22	0,59	2,47	80,80

PhC (photophilous, coarse fraction) Average similarity: 27,62

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Tritia incrassata</i>	1,05	9,04	1,50	32,72	32,72
<i>Arca noae</i>	0,52	2,88	0,58	10,43	43,16
<i>Chauvetia mamillata</i>	0,31	2,37	0,43	8,60	51,75
<i>Modiolus barbatus</i>	0,35	1,73	0,51	6,25	58,01
<i>Alvania lineata</i>	0,57	1,48	0,43	5,35	63,36
<i>Alvania aspera</i>	0,23	1,17	0,43	4,24	67,60
<i>Cyrrillia linearis</i>	0,33	1,15	0,33	4,17	71,76
<i>Chauvetia recondita</i>	0,13	1,08	0,24	3,90	75,66
Triphoridae indet.	0,23	0,88	0,34	3,20	78,86
<i>Chama gryphoides</i>	0,18	0,75	0,24	2,70	81,56

ScC (sciophilous, coarse fraction) Average similarity: 28,56

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Chama gryphoides</i>	0,47	7,68	0,83	26,89	26,89
<i>Alvania lineata</i>	0,63	5,61	0,72	19,66	46,55
<i>Hiatella arctica</i>	0,39	4,23	0,56	14,81	61,36
<i>Chauvetia brunnea</i>	0,33	2,90	0,46	10,15	71,51
<i>Chauvetia mamillata</i>	0,20	1,88	0,25	6,60	78,11
<i>Muricopsis cristata</i>	0,24	1,31	0,25	4,57	82,68

PhF & ScF Average dissimilarity = 57,05

Species	Group PhF Av.Abund	Group ScF Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Bittium latreillii</i>	2,49	0,71	2,92	1,79	5,12	5,12
<i>Bittium reticulatum</i>	1,17	0,35	1,98	1,10	3,46	8,58
<i>Pusillina philippi</i>	2,09	1,48	1,96	1,02	3,44	12,02
<i>Chauvetia mamillata</i>	1,46	0,61	1,65	1,19	2,89	14,91
<i>Parvicardium scriptum</i>	1,40	0,56	1,54	1,14	2,69	17,60

<i>Pusillina radiata</i>	1,25	0,86	1,45	0,91	2,54	20,14
<i>Alvania cancellata</i>	0,82	0,18	1,36	1,13	2,38	22,51
<i>Alvania lineata</i>	1,28	0,81	1,35	1,00	2,37	24,89
<i>Vitreolina perminima</i>	0,95	0,29	1,33	1,07	2,34	27,22
<i>Musculus costulatus</i>	2,50	2,08	1,33	1,00	2,33	29,55
<i>Rissoella diaphana</i>	1,04	0,00	1,30	0,92	2,28	31,84
<i>Modiolula phaseolina</i>	0,93	0,38	1,17	0,91	2,06	33,89
<i>Aplysia punctata</i>	1,00	0,37	1,15	1,05	2,01	35,90
<i>Clanculus cruciatus</i>	1,05	0,25	1,13	1,17	1,99	37,89
<i>Arca noae</i>	0,77	0,06	1,13	1,11	1,98	39,87
<i>Limaria tuberculata</i>	0,47	0,49	1,02	0,87	1,80	41,67
<i>Runcina</i> sp.	0,77	0,22	1,01	1,01	1,77	43,44
<i>Cerithiopsis tubercularis</i>	0,57	0,07	0,95	0,78	1,67	45,10
<i>Parthenina emaciata</i>	0,68	0,00	0,95	0,85	1,66	46,76
<i>Crisilla semistriata</i>	0,45	0,53	0,93	0,66	1,64	48,40
<i>Rissoa lia</i>	0,42	0,06	0,91	0,57	1,59	49,99
<i>Hiatella arctica</i>	1,71	1,43	0,86	0,69	1,51	51,50

PhF & PhC Average dissimilarity = 88,50

Species	Group Ph Av.Abund	Group PhC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,50	0,30	5,26	1,45	5,95	5,95
<i>Bittium latreillii</i>	2,49	0,06	4,28	2,22	4,84	10,79
<i>Pusillina philippi</i>	2,09	0,00	4,27	2,30	4,83	15,62
<i>Hiatella arctica</i>	1,71	0,12	3,21	2,08	3,63	19,25
<i>Parvicardium scriptum</i>	1,40	0,00	2,78	2,36	3,15	22,39
<i>Chauvetia mamillata</i>	1,46	0,31	2,62	1,47	2,96	25,36
<i>Pusillina radiata</i>	1,25	0,00	2,54	0,96	2,87	28,22
<i>Odostomia striolata</i>	1,43	0,00	2,53	1,83	2,86	31,08
<i>Bittium reticulatum</i>	1,17	0,11	2,43	1,19	2,75	33,83
<i>Aplysia punctata</i>	1,00	0,11	1,98	1,44	2,24	36,07
<i>Alvania lineata</i>	1,28	0,57	1,91	1,12	2,16	38,24
<i>Vitreolina perminima</i>	0,95	0,00	1,70	1,19	1,92	40,16
<i>Modiolula phaseolina</i>	0,93	0,12	1,63	1,13	1,85	42,00
<i>Clanculus cruciatus</i>	1,05	0,06	1,62	1,40	1,83	43,83
<i>Rissoella diaphana</i>	1,04	0,00	1,56	0,92	1,77	45,60
<i>Runcina</i> sp.	0,77	0,00	1,47	1,09	1,67	47,26
<i>Alvania cancellata</i>	0,82	0,00	1,47	1,18	1,66	48,92
<i>Tritia incrassata</i>	0,63	1,05	1,46	0,85	1,65	50,57

ScF & PhC Average dissimilarity = 89,04

Species	Group ScF Av.Abund	Group PhC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,08	0,30	7,51	1,61	8,43	8,43
<i>Pusillina philippi</i>	1,48	0,00	5,13	1,57	5,76	14,19
<i>Hiatella arctica</i>	1,43	0,12	5,07	2,05	5,69	19,88
<i>Pusillina radiata</i>	0,86	0,00	3,62	0,87	4,06	23,94
<i>Odostomia striolata</i>	1,04	0,00	3,53	1,48	3,96	27,90
<i>Tritia incrassata</i>	0,27	1,05	3,43	1,33	3,85	31,75
<i>Alvania lineata</i>	0,81	0,57	2,82	0,91	3,16	34,92
<i>Chauvetia mamillata</i>	0,61	0,31	2,71	0,93	3,04	37,96

<i>Bittium latreillii</i>	0,71	0,06	2,13	0,93	2,39	40,35
<i>Aplysia punctata</i>	0,37	0,11	1,93	0,68	2,17	42,52
<i>Arca noae</i>	0,06	0,52	1,91	0,84	2,14	44,66
<i>Parvicardium scriptum</i>	0,56	0,00	1,84	0,81	2,07	46,73
<i>Limaria tuberculata</i>	0,49	0,06	1,79	0,84	2,01	48,75
<i>Crisilla semistriata</i>	0,53	0,00	1,70	0,66	1,91	50,66

PhF & ScC Average dissimilarity = 93,59

Species	Group PhF Av.Abund	Group ScC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,50	0,12	5,99	1,78	6,40	6,40
<i>Pusillina philippi</i>	2,09	0,00	4,54	2,44	4,85	11,25
<i>Bittium latreillii</i>	2,49	0,06	4,53	2,12	4,84	16,09
<i>Hiatella arctica</i>	1,71	0,39	3,11	1,62	3,32	19,41
<i>Parvicardium scriptum</i>	1,40	0,00	2,98	2,34	3,18	22,59
<i>Chauvetia mamillata</i>	1,46	0,20	2,89	1,80	3,09	25,68
<i>Pusillina radiata</i>	1,25	0,00	2,77	0,96	2,96	28,63
<i>Odostomia striolata</i>	1,43	0,00	2,72	1,75	2,90	31,54
<i>Bittium reticulatum</i>	1,17	0,00	2,72	1,33	2,90	34,44
<i>Alvania lineata</i>	1,28	0,63	2,16	1,27	2,31	36,75
<i>Aplysia punctata</i>	1,00	0,00	2,16	1,67	2,31	39,06
<i>Clanculus cruciatus</i>	1,05	0,06	1,92	1,44	2,05	41,10
<i>Modiolula phaseolina</i>	0,93	0,00	1,78	1,18	1,91	43,01
<i>Vitreolina perminima</i>	0,95	0,00	1,78	1,13	1,90	44,91
<i>Alvania cancellata</i>	0,82	0,00	1,61	1,15	1,72	46,63
<i>Rissoella diaphana</i>	1,04	0,00	1,58	0,88	1,69	48,32
<i>Runcina</i> sp.	0,77	0,00	1,54	1,06	1,64	49,96
<i>Arca noae</i>	0,77	0,00	1,47	1,13	1,57	51,54

ScF & ScC Average dissimilarity = 89,73

Species	Group PhF Av.Abund	Group ScC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,50	0,12	5,99	1,78	6,40	6,40
<i>Pusillina philippi</i>	2,09	0,00	4,54	2,44	4,85	11,25
<i>Bittium latreillii</i>	2,49	0,06	4,53	2,12	4,84	16,09
<i>Hiatella arctica</i>	1,71	0,39	3,11	1,62	3,32	19,41
<i>Parvicardium scriptum</i>	1,40	0,00	2,98	2,34	3,18	22,59
<i>Chauvetia mamillata</i>	1,46	0,20	2,89	1,80	3,09	25,68
<i>Pusillina radiata</i>	1,25	0,00	2,77	0,96	2,96	28,63
<i>Odostomia striolata</i>	1,43	0,00	2,72	1,75	2,90	31,54
<i>Bittium reticulatum</i>	1,17	0,00	2,72	1,33	2,90	34,44
<i>Alvania lineata</i>	1,28	0,63	2,16	1,27	2,31	36,75
<i>Aplysia punctata</i>	1,00	0,00	2,16	1,67	2,31	39,06
<i>Clanculus cruciatus</i>	1,05	0,06	1,92	1,44	2,05	41,10
<i>Modiolula phaseolina</i>	0,93	0,00	1,78	1,18	1,91	43,01
<i>Vitreolina perminima</i>	0,95	0,00	1,78	1,13	1,90	44,91
<i>Alvania cancellata</i>	0,82	0,00	1,61	1,15	1,72	46,63
<i>Rissoella diaphana</i>	1,04	0,00	1,58	0,88	1,69	48,32
<i>Runcina</i> sp.	0,77	0,00	1,54	1,06	1,64	49,96
<i>Arca noae</i>	0,77	0,00	1,47	1,13	1,57	51,54

PhC & ScC Average dissimilarity = 78,87

Species	Group PhC Av.Abund	Group ScC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Tritia incrassata</i>	1,05	0,29	6,45	1,20	8,17	8,17
<i>Alvania lineata</i>	0,57	0,63	4,64	0,98	5,89	14,06
<i>Arca noae</i>	0,52	0,00	4,15	0,80	5,26	19,32
<i>Hiatella arctica</i>	0,12	0,39	3,57	0,73	4,52	23,85
<i>Striarca lactea</i>	0,36	0,14	2,92	0,77	3,70	27,55
<i>Modiolus barbatus</i>	0,35	0,06	2,60	0,79	3,29	30,84
<i>Chama gryphoides</i>	0,18	0,47	2,48	0,60	3,14	33,98
<i>Musculus costulatus</i>	0,30	0,12	2,40	0,61	3,05	37,03
<i>Muricopsis cristata</i>	0,11	0,24	2,21	0,63	2,80	39,83
<i>Pusia tricolor</i>	0,22	0,12	2,19	0,54	2,78	42,61
<i>Marshallora adversa</i>	0,22	0,12	2,12	0,53	2,69	45,29
<i>Mimachlamys varia</i>	0,25	0,19	2,09	0,51	2,65	47,95
<i>Cyrrillia linearis</i>	0,33	0,06	2,08	0,59	2,64	50,58

January Average similarity: 34,80

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	1,05	7,45	0,91	21,40	21,40
<i>Alvania lineata</i>	0,83	7,32	0,97	21,02	42,42
<i>Chama gryphoides</i>	0,43	5,19	0,65	14,92	57,35
<i>Pusillina philippi</i>	0,62	2,60	0,65	7,49	64,83
<i>Chauvetia mamillata</i>	0,48	2,60	0,58	7,47	72,30
<i>Hexaplex trunculus</i>	0,35	2,20	0,43	6,33	78,64
<i>Pusillina radiata</i>	0,46	1,69	0,39	4,86	83,50

March Average similarity: 29,72

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	1,45	7,26	0,86	24,42	24,42
<i>Hiatella arctica</i>	1,01	5,33	0,84	17,93	42,34
<i>Parvicardium scriptum</i>	0,47	1,75	0,59	5,89	48,23
<i>Bittium latreillii</i>	0,54	1,64	0,55	5,53	53,76
<i>Chauvetia recondita</i>	0,19	1,62	0,29	5,44	59,20
<i>Pusillina philippi</i>	0,52	1,44	0,55	4,86	64,06
<i>Tritia incrassata</i>	0,27	1,25	0,29	4,19	68,25
<i>Chauvetia mamillata</i>	0,41	1,21	0,55	4,06	72,31
<i>Odostomia striolata</i>	0,35	1,20	0,38	4,03	76,34
<i>Alvania lineata</i>	0,51	1,13	0,55	3,81	80,15

May Average similarity: 46,60

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Chama gryphoides</i>	0,33	4,73	0,55	10,14	10,14
<i>Hiatella arctica</i>	1,30	4,55	0,83	9,77	19,92
<i>Tritia incrassata</i>	0,82	4,49	0,70	9,64	29,56
<i>Alvania lineata</i>	1,14	4,21	0,84	9,04	38,60
<i>Musculus costulatus</i>	1,38	3,23	0,90	6,92	45,52
<i>Pusillina philippi</i>	0,92	2,31	0,94	4,95	50,47
<i>Odostomia striolata</i>	0,84	2,18	0,93	4,68	55,14
<i>Muricopsis cristata</i>	0,17	1,74	0,29	3,74	58,88
<i>Aequipecten opercularis</i>	0,48	1,25	0,55	2,69	61,57
<i>Bittium latreillii</i>	0,66	1,19	0,67	2,54	64,11
<i>Jujubinus ruscurianus</i>	0,63	1,15	0,67	2,46	66,58

<i>Mimachlamys varia</i>	0,49	1,05	0,55	2,25	68,83
<i>Gregariella semigranata</i>	0,33	0,99	0,55	2,13	70,96
<i>Clanculus cruciatus</i>	0,66	0,96	0,65	2,06	73,01
<i>Chauvetia mamillata</i>	0,55	0,96	0,67	2,05	75,07
<i>Crisilla semistriata</i>	0,57	0,94	0,61	2,02	77,09
<i>Arca noae</i>	0,25	0,87	0,29	1,86	78,95
<i>Mitromorpha olivoidea</i>	0,18	0,87	0,29	1,86	80,80

July Average similarity: 54,60

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Hiatella arctica</i>	1,25	6,39	0,98	11,71	11,71
<i>Chauvetia brunnea</i>	0,46	4,47	0,64	8,19	19,90
<i>Musculus costulatus</i>	1,36	2,76	0,82	5,06	24,96
<i>Pusillina philippi</i>	1,24	2,72	0,84	4,98	29,94
<i>Alvania lineata</i>	1,10	2,63	0,67	4,82	34,75
<i>Tritia incrassata</i>	0,80	2,17	0,71	3,98	38,74
Triphoridae indet.	0,90	1,92	0,87	3,51	42,24
<i>Odostomia striolata</i>	0,88	1,87	0,86	3,43	45,68
<i>Modiolus barbatus</i>	0,28	1,87	0,55	3,42	49,10
<i>Mimachlamys varia</i>	0,49	1,86	0,42	3,41	52,50
<i>Alvania aspera</i>	0,27	1,76	0,55	3,22	55,72
<i>Bittium latreillii</i>	1,42	1,65	0,66	3,02	58,74
<i>Ammonicera fischeriana</i>	0,79	1,63	0,88	2,98	61,73
<i>Modiolula phaseolina</i>	0,68	1,60	0,82	2,93	64,65
<i>Chama gryphoides</i>	0,17	1,44	0,29	2,64	67,29
<i>Aequipecten opercularis</i>	0,57	1,30	0,79	2,38	69,67
<i>Striarca lactea</i>	0,64	1,03	0,49	1,89	71,56
<i>Cyrellia linearis</i>	0,52	0,95	0,46	1,74	73,31
<i>Parvicardium scriptum</i>	0,66	0,89	0,63	1,62	74,93
<i>Pusillina radiata</i>	0,63	0,88	0,61	1,61	76,54
<i>Chauvetia mamillata</i>	0,61	0,87	0,61	1,60	78,14
<i>Bittium reticulatum</i>	0,68	0,83	0,60	1,53	79,66
<i>Rissoella diaphana</i>	0,68	0,81	0,55	1,49	81,15

September Average similarity: 44,42

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Tritia incrassata</i>	0,77	4,62	0,78	10,40	10,40
<i>Bittium latreillii</i>	1,44	3,10	1,15	6,98	17,38
<i>Musculus costulatus</i>	1,26	2,75	1,08	6,18	23,56
<i>Pusillina philippi</i>	1,12	2,73	1,12	6,14	29,70
<i>Hiatella arctica</i>	0,89	2,63	0,97	5,91	35,61
Triphoridae indet.	0,90	2,51	1,12	5,65	41,26
<i>Odostomia striolata</i>	0,88	2,38	1,08	5,35	46,61
<i>Chauvetia mamillata</i>	0,90	1,95	1,10	4,40	51,01
<i>Runcina</i> sp.	0,67	1,86	1,05	4,18	55,19
<i>Alvania lineata</i>	0,84	1,72	0,48	3,88	59,06
<i>Parvicardium scriptum</i>	0,81	1,49	0,73	3,36	62,42
<i>Jujubinus ruscurianus</i>	0,51	1,34	0,32	3,03	65,45
<i>Arca noae</i>	0,53	1,26	0,58	2,84	68,28
<i>Pusia tricolor</i>	0,27	1,13	0,32	2,54	70,83
<i>Vitreolina perminima</i>	0,62	1,13	0,74	2,53	73,36

<i>Rissoella diaphana</i>	0,51	0,97	0,61	2,18	75,54
<i>Aplysia punctata</i>	0,53	0,97	0,67	2,18	77,72
<i>Modiolula phaseolina</i>	0,55	0,87	0,39	1,95	79,67
<i>Mitromorpha columbellaria</i>	0,36	0,69	0,32	1,56	81,23

November Average similarity: 41,53

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Chauvetia mamillata</i>	0,98	6,89	0,72	16,60	16,60
<i>Pusillina radiata</i>	1,37	3,83	0,92	9,22	25,82
<i>Tritia incrassata</i>	0,48	3,09	0,54	7,43	33,25
<i>Arca noae</i>	0,43	3,08	0,59	7,42	40,67
<i>Musculus costulatus</i>	1,08	2,97	0,91	7,15	47,81
<i>Pusillina philippi</i>	1,03	2,69	0,64	6,48	54,29
<i>Odostomia striolata</i>	0,75	2,55	0,87	6,15	60,44
<i>Hiatella arctica</i>	0,75	2,28	0,90	5,48	65,92
<i>Pseudochama gryphina</i>	0,33	2,20	0,40	5,29	71,21
<i>Odostomia plicata</i>	0,56	1,91	0,87	4,60	75,81
<i>Bittium latreillii</i>	0,77	1,54	0,54	3,71	79,52
<i>Striarca lactea</i>	0,78	1,17	0,66	2,83	82,34

The NMDS representation (Figure 9) reveals a distinct separation between the fine and coarse fraction, highlighting differences in species composition. Differences between habitats are also observed, although in the coarse fraction, the separation between September-October and the rest of the year appears to be more pronounced.

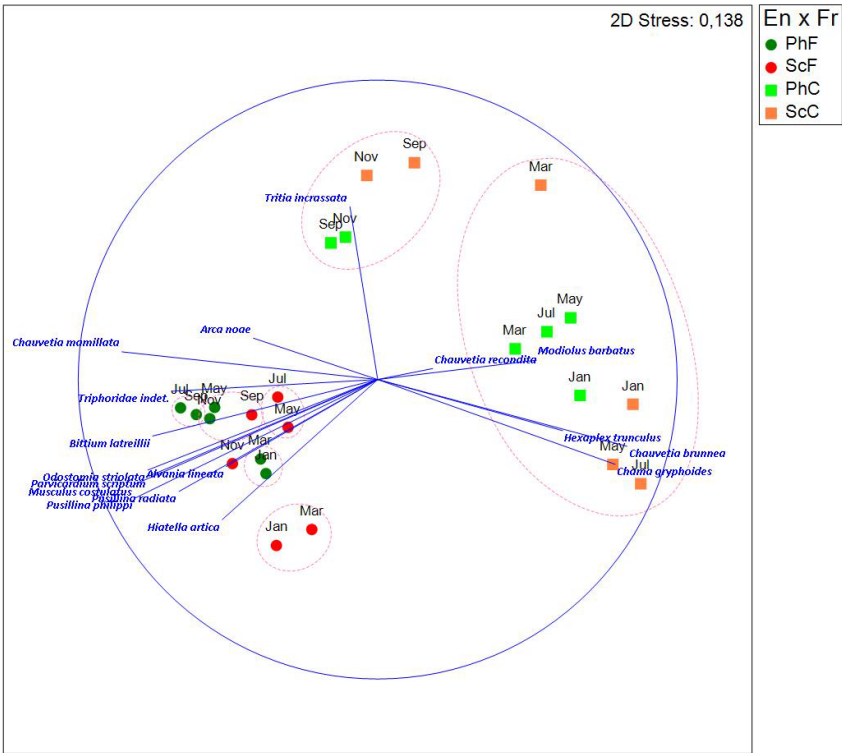


Figure 9. NMDS representation of the sample sites. Clusters are represented by ellipsoids, which were obtained using the UPGMA method, with significant branches verified by the SIMPROF test ($\alpha=5\%$). “Ph” and “Sc” indicate photophilous and sciophilous habitats, respectively, while “F” refers to the fine fraction and “C” to the coarse fraction. The segments represent the correlation between species and the axes, and the circle delineates the maximum correlation range (-1 to 1). For each environment,

fraction, and month, species contributing at least 5% to the similarity (based on SIMPER analysis) were selected.

To further investigate differences in community composition within the fine fraction, a new NMDS was performed, excluding data from the coarse fraction (Figure 10). This allowed for a clearer separation between environments, particularly at certain times of the year, highlighting distinct differences in community composition.

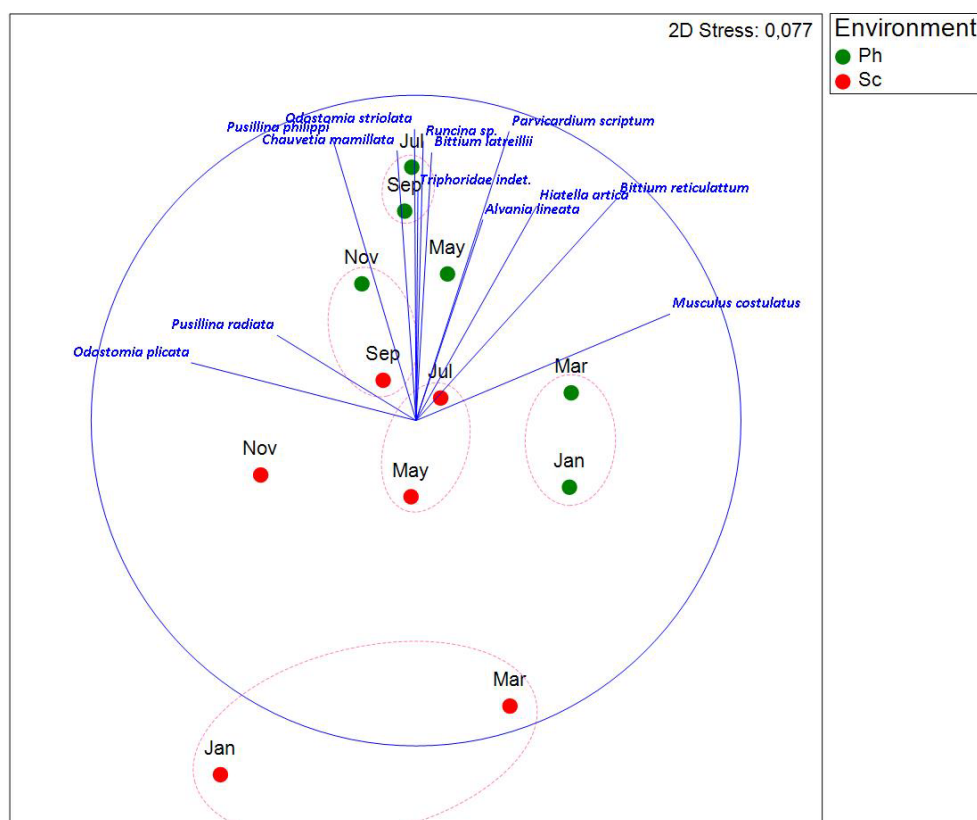


Figure 10. NMDS representation of fine fraction data. Clusters are represented by ellipsoids and have been obtained by applying the UPGMA method and checking significant branches with the SIMPROF test ($\alpha=5\%$). “Ph” and “Sc” indicate photophilous and sciophilous environment respectively. The segments represent the correlation between species and axes, with the circle delimiting maximum correlation (-1 to 1). For each environment and month, species contributing at least 5% to the similarity (based on SIMPER analysis) were selected.

3.4. Trophic Level According to Environment, Fraction and Evolution over the Year

For each sampling site and replicate, species abundance data were aggregated according to trophic category. Subsequently, the fourth-root transformation was applied, and a Bray-Curtis similarity matrix was calculated. Running a 3-factor PERMANOVA design (En=environment, Fr=fraction and Mo=month) showed that all main effects and the En x Fr interaction and the Fr x Mo interaction were significant (En, $p=0.0001$; Fr, $p=0.0001$; Mo, $p=0.0392$; En x Fr, $p=0.0104$; Fr x Mo, $p=0.0329$). The double interaction En x Mo and the triple interaction were not significant ($p=0.8155$ and $p=0.9902$, respectively).

The NMDS representation (Figure 11) again shows a clear separation between the fine and coarse fraction. Differences between habitats and months are also evident. The community composition by trophic category is shown in more detail in a bar chart (Figure 12), notice that surface depot feeders (SDF) and ectoparasites (EC) were absent in the coarse fraction.

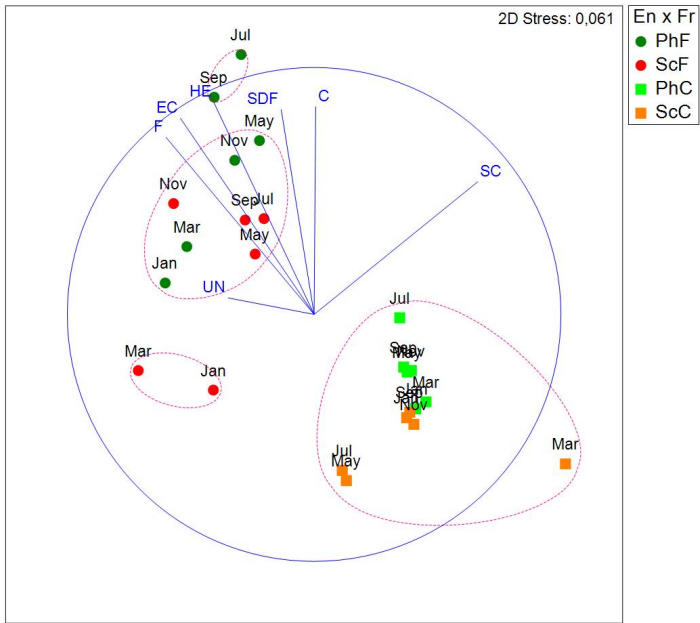


Figure 11. NMDS representation of the sample sites according to trophic categories. Clusters are represented by ellipsoids and were obtained by applying the UPGMA method, with significant branches verified using the SIMPROF test ($\alpha=5\%$). “Ph” and “Sc” indicate photophilous and sciophilous habitats, respectively, while “F” refers to the fine fraction and “C” to the coarse fraction. The segments represent the correlation between species and axes, and the circle delimits maximum correlation (-1 to 1). Trophic categories: herbivore (HE), filter feeder (F), surface depot feeder (SDF), carnivore (C), scavenger (SC), ectoparasite (EC), unknown (UN).

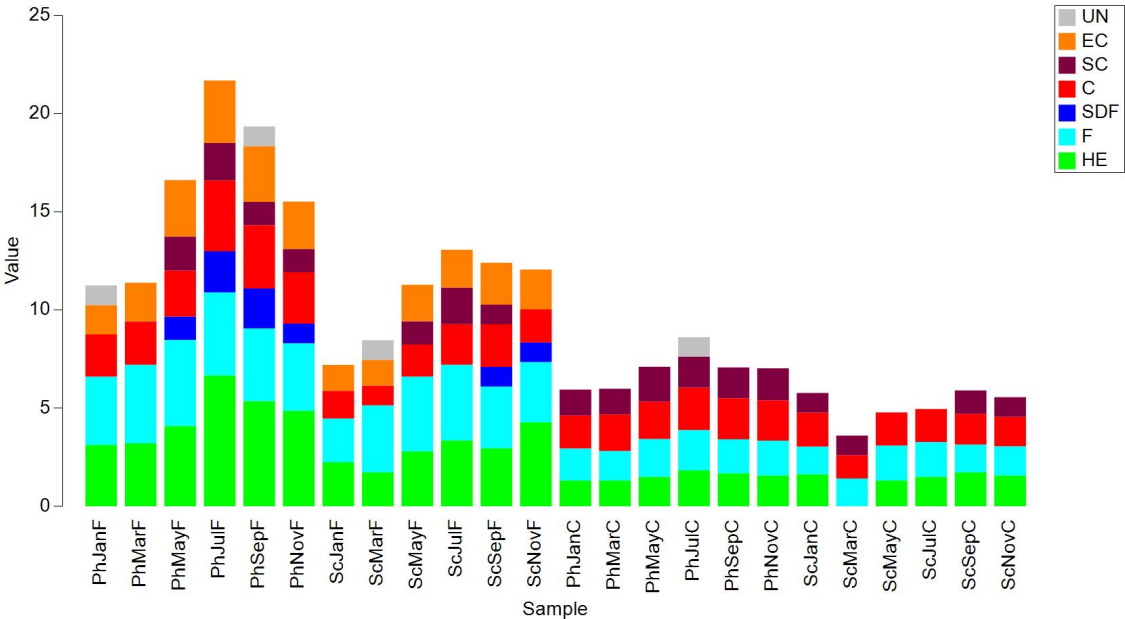


Figure 12. Bar chart of community composition according to trophic categories for each sample site and month. Abundances were previously fourth-root transformed. “Ph” and “Sc” indicate photophilous and sciophilous habitat respectively, while “F” refers to the fine fraction and “C” to the coarse fraction. Trophic categories: herbivore (HE), filter feeder (F), surface depot feeder (SDF), carnivore (C), scavenger (SC), ectoparasite (EC), unknown (UN).

4. Discussion

The structural complexity of a marine habitat is influenced by various factors and is a dynamic process. Over time, local alterations can lead to changes, which may modify the community’s fauna

and flora [3]. Additionally, fluctuations in abundance, particularly in smaller species, can be affected by various disturbances. These include catastrophic events like large waves or high sea temperatures, predation, the emergence of juveniles from new generations, and the availability of nutrients provided by the algae in which they live, or by epibiont algae. This has been observed in the gastropods of the families Trochidae, Tricoliidae and Rissoidae in the present study.

This study identified rich malacological populations (148 species) associated with algae, comparable to other studies such as on the Spanish Costa Brava (131 species) [14] and on the island of Formentera (118 species) [30]. Studies from other regions also report similar specific richness associated with certain types of algae, such as La Goulette Bay, Tunisia (93 species) associated with photophilous algae with *Corallina officinalis* being the most abundant [31]; Lampedusa Island, Italy (176 species) in the algae community of the genus *Cystoseira* [32]; Algeciras, Spain (98 species) [17] and the Alboran Sea, Spain (193 species) [16] both in algal communities dominated by *Halopteris*; and Aegean Sea (184 species) [33] associated with photophilous algal turfs. However, these studies are not strictly comparable to ours due to differences in methodology and sampling effort.

Considering previous records from Tossa de Mar [34, 35] the observations of amateur naturalists (published with photos on the internet), and our own study, it can be said that the marine mollusks of Tossa de Mar are well-known. The only published work focusing on mollusks observed in Tossa de Mar [34] reports 98 species of gastropods (58 previously classified as “prosobranchs” and 40 as traditional “opisthobranchs”) from the area, including the coast and nearby coves. Of these, 73 species were also recorded in our study area. Among the approximately 1,300 species of marine mollusk species documented in Catalonia (NE Spain) (MB, personal observation), 296 species are known from Tossa de Mar (Table A2). This means that 22.3% of all known mollusk species from the 580 km of the Catalan coast are found at this single location.

Notably, sea slugs belonging to the marine Heterobranchia group (formerly “Opisthobranchia”), have attracted significant interest over several decades on the Catalan coast, both from scientists and amateur divers. As a result, the Heterobranchia are particularly well documented in Tossa de Mar, with about 130 species cited, representing around 52% of the total species listed in the Catalan coast’s “opisthobranch” catalog [36]. Moreover, two regional Catalan platforms on the Internet [37, 38] are dedicated to these gastropods. However, only a few species of Polyplacophora and Bivalvia have been recorded, and there is no data available on the observation of species from other mollusk groups in Tossa de Mar.

Regarding specimen abundance, our findings confirm the importance of algal communities for the establishment of mollusk populations. By extrapolating the abundances obtained from the three replicates (surface 20 cm x 20 cm x 3 = 1,200 cm²) per month to a surface area of 1m² of the algal community, we found that mollusk abundances in the photophilous habitat range from 2,425 specimens/m² in January to 22,133 specimens/m² in July. In the sciophilous environment, abundance values ranged from 650 specimens/m² in January to 3,883 specimens/m² in November. These data suggest that algal communities provide various resources, including food, shelter, protection and reproductive support, for a wide variety of medium- and small-sized mollusk species.

The low abundance of specimens in January (296 in the photophilous environment and 78 in the sciophilous one) compared to the other sampling days could be attributed to strong wave action in the days prior to the sampling, which may have negatively impacted the communities of the two rock walls studied.

The abundance values of mollusks per square meter in this study may appear exceedingly high and possibly questionable. However, similarly high abundance figures have been reported in other research studies. For instance, have been observed between 2,400 and 6,300 individuals per square meter in photophilous algae communities dominated by *Cystoseira* species on the island of Ustica (Tyrrhenian Sea, Italy), with species richness ranging from 101 to 121 [39]. In Antarctica, have been recorded up to 7,358 small invertebrates per square meter in the intertidal zone of Adelaide Island [40]; other authors [41] reported a staggering 130,000 invertebrates per square meter in the intertidal soft substrates of King George Island (South Shetland) while in the same island have been [42] found abundances as high as 100,000 invertebrate per square meter in intertidal algae on hard substrate,

highlighting specific mollusk species such as the Littorinidae *Laevilittorina caliginosa* (3,933 specimens per square meter), the bivalve *Mysella subquadrata* (12,250 specimens per square meter) and the extraordinary count of 42,268 individuals per square meter of the littorinid *Eatoniella kerguelensis*.

These findings illustrate that small mollusks can thrive in algae fronds, establishing highly dense populations across diverse geographical regions, from the western Mediterranean to the icy waters of Antarctica.

Most of the species identified in this study are well-known in the western Mediterranean and align with findings from similar research. For instance, a study on the seasonal dynamics of mollusks living among photophilous algae in the Alboran Sea [16], reported several abundant species, including *Musculus costulatus*, *Mytilus galloprovincialis*, *Hiatella arctica*, *Bittium reticulatum*, *Pusillina philippi*, *Chauvetia mamillata*, *Parvicardium scriptum*, and *Tritia incrassata*. These species also appear frequently in our samples. However, species such as *Eatonina fulgida*, *Rissoa guerini*, *Nodulus contortus*, *Setia amabilis* or *Rissoa similis*, which were abundant in their study, were either absent or present in very low numbers in our findings. The same work also observed that the highest abundances of individuals and species occurred during the summer months, coinciding with the peak growth of photophilous algae thalli -a pattern similarly noted in our study.

The most abundant species identified in this study was *Bittium latreillii* with 2,106 specimens, the vast majority (2,051) found in samples from the photophilous environment. Along with its congener *B. reticulatum* (96 specimens), these two species account for 27.8% of all mollusks found in our study. Their significant presence, particularly during the summer months, plays a role in determining the seasonal peak in mollusk abundance. Both species of *Bittium* are generalist herbivores distributed throughout the Mediterranean and nearby Atlantic regions, including the North Sea, the Cantabrian Sea, the coasts of Portugal, the Azores, Madeira, the Canary Islands and Mauritania [29, 45] They are often abundant in various algal environments, and our study confirms their preference for photophilous algae-dominated habitats.

The second most abundant species, the mytilid bivalve *Musculus costulatus*, totaled 1,282 specimens. Unlike the *Bittium* species, *M. costulatus* was found in photophilous and sciophilous environments, with 486 specimens in the sciophilous and 796 in the photophilous samples, indicating no strong preference for well-lit or darker environments. A characteristic feature of this bivalve genus is its well-developed muscular foot, which facilitates movement and likely contributes to its wide distribution across different algal communities.

Some species identified in this study, though low in abundance, are particularly interesting despite not contributing significantly to the characterization of their respective habitats. For instance, *Otina ovata* (T. Brown, 1827) (Heterobranchia, Eupulmonata, Family Otinidae) and *Williamia gussoni* (O.G. Costa, 1829) (Heterobranchia, Siphonariomorpha, Family Siphonariidae), with only one specimen of each found, belong to groups of mollusks that breathe atmospheric air and are typically found in the intertidal zone of the Mediterranean. They are often found under stones, among algae, and associated with cirriped crustaceans [42, 43]. However, in our study, these species were found at depths that do not align with the usual habitat described by most authors.

Species of the Siphonariidae family are generally considered intertidal and air-breathing [46]. However, A study that redescribes *Williamia gussoni* and performs a 3D analysis of its morphology [47], notes that this species typically inhabits subtidal zones and never comes into contact with atmospheric air. He further suggests that its pallial cavity does not function as a lung, making it an anomaly within its family. Based on this, the presence of *W. gussoni* at several meters depth in our study is not unusual.

As for *Otina ovata*, we speculate that its presence in deeper habitats could be attributed to transport by waves and currents. Interestingly, *O. ovata* had not been recorded previously in Catalanian waters, along the Spanish Levant coast, or the Balearic Islands, according to the marine mollusk census for the Spanish coast [48] This discovery may represent a new record for this species in these regions.

In this study, we found a distinct preference among the algal mollusks of Tossa de Mar for photophilous environments over sciophilous ones, with 6,244 specimens and 133 species in the

former, compared to 1,669 specimens and 84 species in the latter. This suggests that rocky substrates dominated by photophilous algae offer a wider variety of ecological niches, where mollusks and other marine invertebrates can access food resources [49]. The dense fronds and large biomass in certain months create numerous microhabitats, including small sciophilous enclaves, where diatoms and particulate organic matter accumulate. These deposits serve as food for micromollusks, such as *Rissoa guerinii* and other rissoaceans, which “graze” on the periphyton of the algae. The presence of these herbivorous mollusks and invertebrates also influences the abundance of carnivorous mollusk species that feed on them.

Regarding specimen size, we observed a significant abundance of smaller mollusks in the fine fraction than in the coarse fraction. A total of 7,576 specimens smaller than 2 mm (fine fraction) were counted, compared to just 337 specimens larger than 2 mm (coarse fraction) (Table A1). This indicates that micromollusks and juvenile forms smaller than 2 mm from larger species find an ideal habitat among algae, both in photophilous environments (6,017 specimens, 105 species) and sciophilous environments (1,559 specimens, 62 species).

Regarding the statistical analysis of biodiversity, the results indicate significant differences between the two environments (photophilous and sciophilous) and between the two fractions (coarse and fine). Additionally, the sampling month factor is close to reaching statistical significance, as shown in Figure 7.

When analyzing evenness, the coarse fraction exhibits notably higher values compared to the fine fraction. This is likely due to the fact that, although there are fewer specimens in the coarse fraction, they tend to be more evenly distributed among the various species. In other words, no single species dominates the abundance. In contrast, no clear temporal variations were detected across different months, as illustrated in Figure 8.

Regarding the species community composition, a clear distinction emerges between the fine and coarse fractions, as illustrated in the NMDS representation (Figure 9). Notably, the coarse fraction samples from both photophilous and sciophilous environments during September and November occupy a space between the two groups. This positioning may be attributed to the low number of specimens and limited species richness observed in those months. In contrast, samples from the other months in the coarse fraction appear to form a separate group, although some differences between photophilous and sciophilous environments are still evident.

Focusing on the fine fraction, the months of January and March are distinctly separated from the sciophilous environment, indicating a unique composition compared to the other months (Figures 9 and 10). This differentiation is likely due to these months having the fewest total specimens and the lowest species richness. Overall, a clear distinction between environments is apparent, with the months of May to November clustering at the top of the graph (Figure 10), correlating with a higher number of individuals and greater species richness. Specifically, July in the photophilous environment stands out at the top of the graph, reflecting the peak in both species' richness and total specimens during that month.

The analysis of trophic categories reveals noteworthy findings, particularly in terms of the distinct separation between the fractions (Figure 11). This separation is attributed not only to the lower species richness and number of specimens in the coarse fraction, but also to the different compositions of the trophic categories. In the bar plot representation (Figure 12), it is evident that the coarse fraction lacks the presence of Species Feeding on Detritus (SDF) or Epifaunal Consumers (EC), exhibiting a higher relative proportion of Collector (C) and Scraper (SC) species. The reduced number of specimens found in the sciophilous environment, along with slight compositional differences between environments, results in a slight differentiation in the graph. March stands out as particularly unique within the sciophilous environment, characterized by a lower number of individuals and species. Notably, no herbivorous (HE) species were detected during this month, a finding that is challenging to explain. This anomaly may stem from undetected sampling issues or complications in the laboratory analysis of the samples.

5. Conclusions

The algal communities of the upper infralittoral zone, subjected to different light intensities allow the characterization of two contrasting environments that differ in terms of structure, abundance and species biodiversity. This has been demonstrated in this study by examining the molluscs on algal populations.

The photophilic algal community exhibits greater spatial heterogeneity compared to poorly lit bottoms, with well-lit areas alternating with small sciophilous microenvironments. This variation enhances habitat diversity. In contrast, the sciophilous wall excludes much of the flora and fauna typically found in photophilous zones. This is confirmed by the significantly higher abundance and species richness of molluscs in samples from the photophilous environment compared to the sciophilous one.

Although both communities are similar at the trophic level, due to the high contribution of herbivores and filter feeders, specific species distinguish the sciophilous community, such as: *Musculus costulatus*, *Hiatella arctica*, *Pusillina philippi*, *Alvania lineata* and *Pusillina radiata*. In the photophilous community, species like *Musculus costulatus*, *Bittium latreillii*, *Pusillina philippi*, *Hiatella arctica*, *Chauvetia mamillata*, *Parvicardium scriptum*, *Alvania lineata*, *Bittium reticulatum*, *Odostomia striolata* and *Pusillina radiata* are predominant.

The results in terms of abundance and specific richness indicate that in Tossa de Mar, micromollusks (less than 2 mm) and juvenile individuals of larger species find an extremely suitable environment for living and carrying out all their vital functions within both photophilous and sciophilous algal communities.

Based on our data and other studies published in journals and online platforms, we can conclude that the malacofauna of Tossa de Mar is the best documented along the Catalan coast, with a total of 296 species recorded (Table A2). Notably, the sea slugs (in the broad sense) of the subclass Heterobranchia are particularly well-represented, with around 130 species cited in this locality. However, there is still much to be explored in terms of biodiversity of Bivalves, Cephalopods and other minor mollusk groups.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Species abundance by environment and fraction. Species are listed alphabetically. “Sc”: sciophilous environment; “Ph”: photophilous environment.

Species	Sciophilous environment (Sc)			Photophilous environment (Ph)			Total Sc + Ph
	Sc Coarse	Sc Fine	Total Sc	Ph Coarse	Ph Fine	Total Ph	
<i>Acanthochitona fascicularis</i>	2		2	1		1	3
<i>Acanthochitona</i> sp.					4	4	4
<i>Aegires leuckartii</i>		1	1		2	2	3
<i>Aequipecten opercularis</i>		23	23		13	13	36
<i>Alvania aspera</i>				5		5	5
<i>Alvania cancellata</i>		4	3		31	31	35
<i>Alvania cimex</i>	1		1				1
<i>Alvania discors</i>					1	1	1
<i>Alvania lineata</i>	17	32	49	16	111	127	176
<i>Alvania nestaresi</i>				2	7	9	9
<i>Alvania</i> sp.					5	5	5
<i>Ammonicera fischeriana</i>		13	13		66	66	79
<i>Anomia ephippium</i>	1	3	4	1	1	2	6
<i>Aplus dorbignyi</i>					1	1	1
<i>Aplysia punctata</i> juv.		10	10	2	28	30	40
<i>Arca noae</i>		1	1	11	28	39	40
<i>Babelomurex cariniferus</i>	1		1				1
<i>Bittium latreillii</i>	1	54	55	1	2.050	2.051	2.106
<i>Bittium reticulatum</i>		10	10	4	82	86	96
<i>Bittium</i> sp.				2	7	9	9
<i>Bivalvia</i> morph. 1				2	6	8	8
<i>Bivalvia</i> morph. 2				2	1	3	3
<i>Bivalvia</i> morph. 3					1	1	1
<i>Bivalvia</i> morph. 4		1	1		1	1	2
<i>Brachystomia scalaris</i>					2	2	2
<i>Bulla striata</i>		3	3		12	12	15
<i>Calliostoma zizyphinum</i>				2		2	2
<i>Caloria elegans</i>	1		1				1
<i>Cardiidae</i> morph. 1					1	1	1
<i>Cardiidae</i> morph. 2					1	1	1
<i>Cerithiopsis jeffreysi</i>					16	16	16
<i>Cerithiopsis tubercularis</i>		2	2		23	23	25
<i>Cerithiopsis</i> sp.					9	9	9
<i>Cerithium vulgatum</i>		2	2		39	39	41
<i>Chama gryphoides</i>	8		8	4		4	12
<i>Chauvetia brunnea</i>	9		9	8		8	17
<i>Chauvetia mamillata</i>	5	17	22	16	92	108	130
<i>Chauvetia recondita</i>				4		4	4
<i>Chauvetia</i> morph. 1				1		1	1
<i>Chauvetia</i> morph. 2				1		1	1
<i>Clanculus cruciatus</i>	1	7	8	1	79	80	88
<i>Columbella rustica</i>	1		1				1
<i>Crisilla semistriata</i>		29	29		24	24	53
<i>Crisilla simulans</i>					2	2	2
<i>Cyrrillia linearis</i>	1		1	10	18	28	29

Species	Sciophilous environment (Sc)			Photophilous environment (Ph)			Total Sc + Ph
	Sc Coarse	Sc Fine	Total Sc	Ph Coarse	Ph Fine	Total Ph	
<i>Diodora graeca</i>		2	2	2	2	4	6
<i>Diodora italica</i>	2		2				2
<i>Doridina nudibranch</i>		3	3		5	5	8
<i>Doris ocelligera</i>		2	2				2
<i>Doto</i> sp.		1	1				1
<i>Emarginula pustula</i>		1	1		1	1	2
<i>Episcomitra cornicula</i>	2		2				2
<i>Felimare</i> sp.				1		1	1
<i>Folinella excavata</i>					2	2	2
<i>Fusinus rudis</i>				2		2	2
<i>Gari tellinella</i>				1		1	1
Gastropoda morph. 1				2	3	5	5
Gastropoda morph. 2				1	1	2	2
Gastropoda morph. 3		1	1				1
<i>Gibberula miliaria</i>				5		5	5
<i>Gibberula turgidula</i>				2	18	20	20
<i>Gibberula</i> morph. 1					3	3	3
<i>Gibberula</i> morph. 2					1	1	1
<i>Gregariella semigranata</i>		8	8		8	8	16
<i>Haliotis tuberculata</i>		2	2		1	1	3
<i>Haminoea navicula</i>					13	13	13
<i>Hexaplex trunculus</i>	4		4	4		4	8
<i>Hiatella arctica</i>	9	153	162	3	239	242	404
<i>Idas</i> sp.	1		1				1
<i>Irus irus</i>		5	5		17	17	22
<i>Ischnochitonidae</i> sp.					1	1	1
<i>Jujubinus exasperatus</i>	1		1	1		1	2
<i>Jujubinus ruscurianus</i>	7	6	13	3	46	49	62
<i>Lima lima</i>					3	3	3
<i>Limaria hians</i>	2		2	1		1	3
<i>Limaria tuberculata</i>		13	13	1	10	11	24
<i>Lithophaga lithophaga</i>		1	1				1
<i>Mangelia multilineolata</i>				1		1	1
<i>Mangelia</i> morph. 1					1	1	1
<i>Mangelia</i> morph. 2					1	1	1
<i>Marshallora adversa</i>	2		2		4	4	6
<i>Mimachlamys varia</i>	4	9	13	7	2	8	22
<i>Mitrella broderipii</i>				1		1	1
<i>Mitromorpha columbellaria</i>	1	4	5	2	9	11	16
<i>Mitromorpha olivoidea</i>	1		1	4		4	5
<i>Modiolula phaseolina</i>		11	11	3	53	56	67
<i>Modiolus barbatus</i>	1		1	8		8	9
<i>Monophorus erythrosoma</i>	1	1	2		8	8	10
<i>Muricidae</i> indet.				1		1	1
<i>Muricopsis cristata</i>	4		4	2		2	6

Species	Sciophilous environment (Sc)			Photophilous environment (Ph)			Total Sc + Ph
	Sc Coarse	Sc Fine	Total Sc	Ph Coarse	Ph Fine	Total Ph	
<i>Musculus costulatus</i>	2	484	486	8	788	796	1.282
<i>Mytilus galloprovincialis</i> juv.	1	10	11		46	46	57
<i>Nodulus contortus</i>					4	4	4
<i>Nodulus spiralis</i>					1	1	1
<i>Ocinebrina aciculata</i>	1	1	2	3	11	14	16
<i>Odostomella doliolum</i>		1	1		15	15	16
<i>Odostomia plicata</i>		11	11		9	8	20
<i>Odostomia striolata</i>		50	50		167	167	217
<i>Otina ovata</i>					1	1	1
<i>Paradoris indecora</i>					1	1	1
<i>Parthenina emaciata</i>					36	36	36
<i>Parvamussium fenestratum</i>		22	22		19	19	41
<i>Parvicardium scriptum</i>	2	27	29	1	100	101	130
<i>Patella</i> sp.					1	1	1
<i>Petricola lithophaga</i>					13	13	13
<i>Philine intricata</i>					1	1	1
<i>Philine</i> sp.					6	6	6
<i>Phorcus richardi</i>				1		1	1
<i>Polyplacophora</i> indet.					2	2	2
<i>Pseudochama gryphina</i>	3		3	3		3	6
<i>Pseudomangelia vauquelini</i>					1	1	1
<i>Pusia ebenus</i>					1	1	1
<i>Pusia tricolor</i>	2		2	4	2	6	8
<i>Pusillina inconspicua</i>					3	3	3
<i>Pusillina philippi</i>		272	272		545	545	817
<i>Pusillina radiata</i>		179	179		367	367	546
<i>Raphitoma echinata</i>		2	2	1	5	6	8
<i>Raphitoma laviae</i>				2		2	2
<i>Raphitoma</i> morph. 1					2	2	2
<i>Raphitoma</i> morph. 2					1	1	1
<i>Retilaskeya horrida</i>	1		1				1
<i>Retusa mammillata</i>					1	1	1
<i>Rhyssoplax corallina</i>	2	1	3		3	3	6
<i>Rissoa guerinii</i>					2	2	2
<i>Rissoa lia</i>		1	1		10	10	11
<i>Rissoa variabilis</i>		1	1	1	7	8	9
<i>Rissoella diaphana</i>					228	228	228
<i>Runcina adriatica</i>		3	3		27	27	30
<i>Runcina coronata</i>					1	1	1
<i>Runcina</i> sp.		4	4		35	35	39
<i>Scissurella costata</i>		1	1		21	21	22
<i>Setia pulcherrima</i>		5	5		10	10	15
<i>Smithiella costulata</i>		1	1	1	2	3	4
<i>Spiralina alpinoligustica</i>		2	2		2	2	4
<i>Spondylus gaederopus</i>	1		1				1

Species	Sciophilous environment (Sc)			Photophilous environment (Ph)			Total Sc + Ph
	Sc Coarse	Sc Fine	Total Sc	Ph Coarse	Ph Fine	Total Ph	
<i>Striarca lactea</i>	4	9	13	9	66	75	88
<i>Talochlamys multistriata</i>				1		1	1
<i>Tarantinaea lignaria</i>				1		1	1
<i>Tectura virginea</i>		1	1				1
<i>Tricolia tingitana</i>					5	5	5
<i>Tricolia</i> sp.		3	3		17	17	20
<i>Trinchesia genovae</i>					5	5	5
Triphoridae indet.		16	16	5	109	114	130
<i>Tritia incrassata</i>	5	15	20	35	25	60	80
Veneridae indet.		1	1		2	2	3
<i>Vitreolina perminima</i>		6	6		59	59	65
<i>Weinkauffia turgidula</i>					2	2	2
<i>Williamia gussoni</i>		1	1				1
Total specimens	110	1.559	1.669	227	6.017	6.244	7.913
Total species	38	62	84	58	105	133	148

Table A2. List of mollusk species recorded in Tossa de Mar. (* : present study). Species within each family are listed in alphabetical order.

Class GASTROPODA 257 species

Sub Class Caenogastropoda

Order Littorinimorpha

Littorinidae

Melarhappe neritoides

Skeneopsidae

Skeneopsis planorbis

Naticidae

Notocochlis dillwynii

Rissoidae

**Alvania aspera*

**Alvania cancellata*

**Alvania cimex*

**Alvania discors*

**Alvania lineata*

**Alvania nestaresi*

Alvania subcrenulata

Alvania tenera

**Crisilla semistriata*

**Crisilla simulans*

**Pusillina incospicua*

Pusillina lineolata

**Pusillina philippi*

**Pusillina radiata*

Rissoa decorata

**Rissoa guerini*

**Rissoa lia*

Rissoa splendida

**Rissoa variabilis*

**Setia pulcherrima*

Anabathridae

**Nodulus contortus*

**Nodulus spiralis*

Cypraeidae

Luria lurida

Eulimidae

Vitreolina antiflexa

**Vitreolina perminima*

Ovulidae

Simnia spelta

Triviidae

Trivia monacha

Vermetidae

Vermetus triquetrus

Order Neogastropoda

Chauvetiidae

**Chauvetia brunnea*

**Chauvetia mamillata*

**Chauvetia recondita*

Columbellidae

**Columbella rustica*

Mitrella broderipii

Mitrella scripta

Fasciolariidae

**Fusinus rudis*

Pseudofusus rostratus

**Tarantinaea lignaria*

Nassariidae

Tritia corrugata

**Tritia incrassata*

Tritia reticulata

Tritia varicosa

Pisaniidae

**Aplus dorbignyi*

Pisania striata

Conidae

Conus ventricosus

Mangeliidae

Mangelia multilineolata*Pseudomangelia vauquelini***Smithiela costulata*

Mitromorphidae

Mitromorphacolumbellaria*Mitromorpha olivoidea*

Raphitomidae

Cyrillia linearis*Raphitoma echinata***Raphitoma laviae**Raphitoma leufroyi*

Mitridae

Episcomitra corniculaIsara cornea*

Muricidae

Babelomurex cariniferusCoralliophila meyendorffii***Hexaplex trunculus**Hirtomurex squamosus***Muricopsis cristata**Pseudofusus rostratus**Ocenebra edwardsii***Ocenebrina aciculata**Stramonita haemastoma*

Cystiscidae

Gibberula miliaria*Gibberula turgidula*

Costellariidae

Pusia ebenus*Pusia tricolor*

Order Caenogastropoda incertae sedis

Cerithiidae

Bittium latreillii*Bittium reticulatum**Cerithium africanum***Cerithium vulgatum*

Cerithiopsidae

Cerithiopsis jeffreysi*Cerithiopsis tubercularis*

Newtoniellidae

**Retilaskeya horrida*

Triphoridae

Marshallora adversa

**Monophorus erythrosoma*

Turritellidae

Turritellinella tricarinata

Sub Class Heterobranchia

SuperOrder Acochliidiomorpha

Hedylopsidae

Hedylopsis spiculifera

Order Aplysiida

Aplysiidae

Aplysia depilans

Aplysia fasciata

**Aplysia punctata*

Petalifera petalifera

Phyllaplysia lafonti

Order Cephalaspidea

Aglajidae

Aglaja tricolorata

Camachoaglaja africana

Melanochlamys miqueli

Spinoaglaja wildpretii

Bullidae

**Bulla striata*

Haminoeidae

Haminoea exigua

Haminoea hydatis

**Haminoea navicula*

**Weinkauffia turgidula*

Philinidae

**Philine intricata*

Philine catena

Retusidae

**Retusa mammillata*

Retusa truncatula

Order Ellobiida

Otinidae

**Otina ovata*

Order Nudibranchia

Aegiridae

**Aegires leuckartii*

Aegires punctilucens

Aeolidiidae

Aeolidiella alderi

Berghia coerulescens

Spurilla neapolitana

Arminidae

Armina tigrina

Cadlinidae

Aldisa banyulensis

Calycidorididae

Diaphorodoris alba

Diaphorodoris luteocincta

Diaphorodoris papillata

Chromodorididae

Felimare bilineata

Felimare fontandraui

Felimare orsinii

Felimare picta

Felimare tricolor

Felimare villafranca

Felimida binza

Felimida krohni

Felimida luteorosea

Felimida purpurea

Coryphellidae

Coryphella lineata

Dendrodorididae

Dendrodoris grandiflora

Dendrodoris limbata

Discodorididae

Discodoris rosi

Discodoris stellifera

Geitodoris planata

Jorunna tomentosa

**Paradoris indecora*

Peltodoris atromaculata

Platydorid argo

Rostanga rubra

Tayuva lilacina

Dorididae

**Doris ocelligera*

Dotidae

Doto coronata

Doto dunnei

Doto eireana

Doto floridicola

Doto fragaria
Doto koenneckeri
Doto paulinae
Doto rosea
Embletoniidae
Embletonia pulchra
Eubbranchidae
Amphorina farrani
Capellinia doriae
Eubbranchus capellinii
Eubbranchus exiguus
Eubbranchus vittatus
Facelinidae
**Caloria elegans*
Caloria quatrefagesi
Cratena peregrina
Facelina annulicornis
Facelina auriculata
Facelina rubrovittata
Facelinopsis marioni
Favorinus branchialis
Flabellinidae
Calmella cavolini
Calmella gaditana
Edmundsella pedata
Flabellina affinis
Paraflabellina gabinieri
Paraflabellina ischitana
Goniodorididae
Okenia mediterranea
Trapania lineata
Trapania maculata
Hancockiidae
Hancockia uncinata
Janolidae
Antiopella cristata
Myrrhinidae
Nemesignis banyulensis
Onchidorididae
Atalodoris pictoni
Atalodoris sparsa
Idaliadoris neapolitana
Phyllidiidae

Phyllidia flava

Piseinotecidae

Piseinotecus soussi

Polyceridae

Crimora papillata

Kaloplocamus ramosus

Limacia inesae

Polycera elegans

Polycera quadrilineata

Samlidae

Luisella babai

Trinchesiidae

Rubramoena amoena

Trinchesia caerulea

Trinchesia cuanensis

Trinchesia foliata

**Trinchesia genovae*

Trinchesia miniostrata

Trinchesia morrowae

Trinchesia ocellata

Tritoniidae

Candiella manicata

Candiella odhneri

Candiella striata

Marionia blainvillea

Order Pleurobranchida

Pleurobranchidae

Berthella ocellata

Pleurehdera stellata

Pleurobranchus testudinarius

Order Runcinida

Runcinidae

**Runcina adriatica*

Runcina africana

Runcina bahiensis

**Runcina coronata*

Runcina hansbechi

Super Order Sacoglossa

Hermaeidae

Cyerce cristallina

Hermaea bifida

Hermaea variopicta

Limapontiidae

Placida cremoniana

Placida dendritica

Placida verticilata

Plakobranchidae

Bosellia mimetica

Elysia margaritae

Elysia timida

Elysia viridis

Thuridilla hopei

Order Umbraculida

Tylodinidae

Tylodina perversa

Umbraculidae

Umbraculum umbraculum

Order Siphonariida

Siphonariidae

**Williamia gussoni*

Super family Omalogyroidea

Omalogyridae

Ammonicera rota

Ammonicera fischeriana

Superfamily Pyramidelloidea

Pyramidellidae

**Brachystomia scalaris*

**Folinella excavata*

**Odostomella doliolum*

**Odostomia plicata*

**Odostomia striolata*

**Parthenina emaciata*

Parthenina monozona

**Spiralina alpinoligustica*

Super family Rissoelloidea

Rissoellidae

**Rissoella diaphana*

Sub Class Patellogastropoda

Super Family Lottioidea

Lotiidae

**Tectura virginea*

Superfamily Patelloidea

Patellidae

Patella aspera

Patella caerulea

Patella rustica

Patella ulyssiponensis

Sub Class Vetigastropoda

Order Lepetellida

Fissurellidae

Diodora gibberula

**Diodora graeca*

**Diodora italica*

Emarginula huzardii

Emarginula octaviana

**Emarginula pustula*

Emarginula sicula

Fissurella nubecula

Puncturella noachina

Haliotidae

**Haliotis tuberculata*

Scissurellidae

**Scissurella costata*

Order Trochida

Phasianellidae

**Tricolia tingitana*

Calliostomatidae

Calliostoma laugierii

**Calliostoma zizyphinum*

Calliostoma conulus

Trochidae

Clanculus corallinus

**Clanculus cruciatus*

Gibbula ardens

Gibbula divaricata

Gibbula drepanensis

**Jujubinus exasperatus*

**Jujubinus ruscurianus*

Jujubinus striatus

**Phorcus richardi*

Phorcus turbinatus

Steromphala divaricata

Steromphala umbilicalis

Turbinidae

Bolma rugosa

Class BIVALVIA 32 species

Sub Class Autobranchia

Order Cardiida

Cardiidae

**Parvicardium scriptum*

Psammobiidae

**Gari tellinella*

Order Venerida

Chamidae

**Chama gryphoides*

**Pseudochama gryphina*

Veneridae

Gouldia minima

**Irus irus*

**Petricola lithophaga*

Venus casina

Venus verrucosa

Order Adapedonta

Hiatellidae

**Hiatella arctica*

Super order Anomalodesmata

Thraciidae

Thracia phaseolina

Order Arcoida

Arcidae

**Arca noae*

Noetiidae

**Striarca lactea*

Order Galeommatida

Galiommatidae

Galeomma turtoni

Lasaeidae

Kellia suborbicularis

Order Gastrochaenida

Gastrochaenidae

Rocellaria dubia

Order Limida

Limidae

**Lima lima*

**Limaria hians*

**Limaria tuberculata*

Order Mytilida

Mytilidae

**Gregariella semigranata*

**Lithophaga lithophaga*

**Modiolula phaseolina*

**Modiolus barbatus*

**Musculus costulatus*
**Mytilus galloprovincialis*
Order Pectinida
Anomiidae
**Anomia ephippium*
Pododesmus patelliformis
Pectinidae
**Aequipecten opercularis*
**Mimachlamys varia*
**Talochlamys multistriata*
Propeamussiidae
**Parvamussium fenestratum*
Spondylidae
**Spondylus gaederopus*

Class POLYPLACOPHORA 7 species

Sub Classe Neoloricata

Order Chitonida
Acanthochitonidae
Acanthochitona crinita
**Acanthochitona fascicularis*
Chitonidae
**Rhyssoplax corallina*
Rhyssoplax olivacea
Ischnochiton rissoi
Lepidochitona caprearum
Order Lepidopleurida
Leptochitonidae
Leptochiton sarsi

Table A3. Additional results from the SIMPER analysis, detailing the species that contribute to dissimilarities across Environment x Fraction groups (PhF, PhC, ScF and ScC) and the similarities observed within each month. Cut-off thresholds of 80% for similarity and 50% for dissimilarity were applied.

PhF & ScF - Average dissimilarity = 57,05

Species	Group PhF Av.Abund	Group ScF Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Bittium latreillii</i>	2,49	0,71	2,92	1,79	5,12	5,12
<i>Bittium reticulatum</i>	1,17	0,35	1,98	1,10	3,46	8,58
<i>Pusillina philippi</i>	2,09	1,48	1,96	1,02	3,44	12,02
<i>Chauvetia mamillata</i>	1,46	0,61	1,65	1,19	2,89	14,91
<i>Parvicardium scriptum</i>	1,40	0,56	1,54	1,14	2,69	17,60
<i>Pusillina radiata</i>	1,25	0,86	1,45	0,91	2,54	20,14
<i>Alvania cancellata</i>	0,82	0,18	1,36	1,13	2,38	22,51
<i>Alvania lineata</i>	1,28	0,81	1,35	1,00	2,37	24,89
<i>Vitreolina perminima</i>	0,95	0,29	1,33	1,07	2,34	27,22

<i>Musculus costulatus</i>	2,50	2,08	1,33	1,00	2,33	29,55
<i>Rissoella diaphana</i>	1,04	0,00	1,30	0,92	2,28	31,84
<i>Modiolula phaseolina</i>	0,93	0,38	1,17	0,91	2,06	33,89
<i>Aplysia punctata</i>	1,00	0,37	1,15	1,05	2,01	35,90
<i>Clanculus cruciatus</i>	1,05	0,25	1,13	1,17	1,99	37,89
<i>Arca noae</i>	0,77	0,06	1,13	1,11	1,98	39,87
<i>Limaria tuberculata</i>	0,47	0,49	1,02	0,87	1,80	41,67
<i>Runcina</i> sp.	0,77	0,22	1,01	1,01	1,77	43,44
<i>Cerithiopsis tubercularis</i>	0,57	0,07	0,95	0,78	1,67	45,10
<i>Parthenina emaciata</i>	0,68	0,00	0,95	0,85	1,66	46,76
<i>Crisilla semistriata</i>	0,45	0,53	0,93	0,66	1,64	48,40
<i>Rissoa lia</i>	0,42	0,06	0,91	0,57	1,59	49,99
<i>Hiatella arctica</i>	1,71	1,43	0,86	0,69	1,51	51,50

PhF & PhC - Average dissimilarity = 88,50

Species	Group PhF Av.Abund	Group PhC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,50	0,30	5,26	1,45	5,95	5,95
<i>Bittium latreillii</i>	2,49	0,06	4,28	2,22	4,84	10,79
<i>Pusillina philippi</i>	2,09	0,00	4,27	2,30	4,83	15,62
<i>Hiatella arctica</i>	1,71	0,12	3,21	2,08	3,63	19,25
<i>Parvicardium scriptum</i>	1,40	0,00	2,78	2,36	3,15	22,39
<i>Chauvetia mamillata</i>	1,46	0,31	2,62	1,47	2,96	25,36
<i>Pusillina radiata</i>	1,25	0,00	2,54	0,96	2,87	28,22
<i>Odostomia striolata</i>	1,43	0,00	2,53	1,83	2,86	31,08
<i>Bittium reticulatum</i>	1,17	0,11	2,43	1,19	2,75	33,83
<i>Aplysia punctata</i>	1,00	0,11	1,98	1,44	2,24	36,07
<i>Alvania lineata</i>	1,28	0,57	1,91	1,12	2,16	38,24
<i>Vitreolina perminima</i>	0,95	0,00	1,70	1,19	1,92	40,16
<i>Modiolula phaseolina</i>	0,93	0,12	1,63	1,13	1,85	42,00
<i>Clanculus cruciatus</i>	1,05	0,06	1,62	1,40	1,83	43,83
<i>Rissoella diaphana</i>	1,04	0,00	1,56	0,92	1,77	45,60
<i>Runcina</i> sp.	0,77	0,00	1,47	1,09	1,67	47,26
<i>Alvania cancellata</i>	0,82	0,00	1,47	1,18	1,66	48,92
<i>Tritia incrassata</i>	0,63	1,05	1,46	0,85	1,65	50,57

ScF & PhC - Average dissimilarity = 89,04

Species	Group ScF Av.Abund	Group PhC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,08	0,30	7,51	1,61	8,43	8,43
<i>Pusillina philippi</i>	1,48	0,00	5,13	1,57	5,76	14,19
<i>Hiatella arctica</i>	1,43	0,12	5,07	2,05	5,69	19,88
<i>Pusillina radiata</i>	0,86	0,00	3,62	0,87	4,06	23,94

<i>Odostomia striolata</i>	1,04	0,00	3,53	1,48	3,96	27,90
<i>Tritia incrassata</i>	0,27	1,05	3,43	1,33	3,85	31,75
<i>Alvania lineata</i>	0,81	0,57	2,82	0,91	3,16	34,92
<i>Chauvetia mamillata</i>	0,61	0,31	2,71	0,93	3,04	37,96
<i>Bittium latreillii</i>	0,71	0,06	2,13	0,93	2,39	40,35
<i>Aplysia punctata</i>	0,37	0,11	1,93	0,68	2,17	42,52
<i>Arca noae</i>	0,06	0,52	1,91	0,84	2,14	44,66
<i>Parvicardium scriptum</i>	0,56	0,00	1,84	0,81	2,07	46,73
<i>Limaria tuberculata</i>	0,49	0,06	1,79	0,84	2,01	48,75
<i>Crisilla semistriata</i>	0,53	0,00	1,70	0,66	1,91	50,66

PhF & ScC - Average dissimilarity = 93,59

Species	Group PhF Av.Abund	Group ScC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,50	0,12	5,99	1,78	6,40	6,40
<i>Pusillina philippi</i>	2,09	0,00	4,54	2,44	4,85	11,25
<i>Bittium latreillii</i>	2,49	0,06	4,53	2,12	4,84	16,09
<i>Hiatella arctica</i>	1,71	0,39	3,11	1,62	3,32	19,41
<i>Parvicardium scriptum</i>	1,40	0,00	2,98	2,34	3,18	22,59
<i>Chauvetia mamillata</i>	1,46	0,20	2,89	1,80	3,09	25,68
<i>Pusillina radiata</i>	1,25	0,00	2,77	0,96	2,96	28,63
<i>Odostomia striolata</i>	1,43	0,00	2,72	1,75	2,90	31,54
<i>Bittium reticulattum</i>	1,17	0,00	2,72	1,33	2,90	34,44
<i>Alvania lineata</i>	1,28	0,63	2,16	1,27	2,31	36,75
<i>Aplysia punctata</i>	1,00	0,00	2,16	1,67	2,31	39,06
<i>Clanculus cruciatus</i>	1,05	0,06	1,92	1,44	2,05	41,10
<i>Modiolula phaseolina</i>	0,93	0,00	1,78	1,18	1,91	43,01
<i>Vitreolina perminima</i>	0,95	0,00	1,78	1,13	1,90	44,91
<i>Alvania cancellata</i>	0,82	0,00	1,61	1,15	1,72	46,63
<i>Rissoella diaphana</i>	1,04	0,00	1,58	0,88	1,69	48,32
<i>Runcina sp.</i>	0,77	0,00	1,54	1,06	1,64	49,96
<i>Arca noae</i>	0,77	0,00	1,47	1,13	1,57	51,54

ScF & ScC - Average dissimilarity = 89,73

Species	Group ScF Av.Abund	Group ScC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	2,08	0,12	9,43	1,87	10,51	10,51
<i>Pusillina philippi</i>	1,48	0,00	5,83	1,54	6,50	17,01
<i>Hiatella arctica</i>	1,43	0,39	4,71	1,13	5,25	22,26
<i>Pusillina radiata</i>	0,86	0,00	4,31	0,96	4,81	27,06
<i>Odostomia striolata</i>	1,04	0,00	4,24	1,33	4,72	31,79
<i>Chauvetia mamillata</i>	0,61	0,20	3,17	1,03	3,54	35,32
<i>Bittium latreillii</i>	0,71	0,06	2,55	0,95	2,85	38,17

<i>Chama gryphoides</i>	0,00	0,47	2,18	0,80	2,43	40,60
<i>Parvicardium scriptum</i>	0,56	0,00	2,13	0,76	2,37	42,97
<i>Tritia incrassata</i>	0,27	0,29	1,97	0,73	2,20	45,17
<i>Alvania lineata</i>	0,81	0,63	1,95	0,72	2,18	47,35
<i>Aequipecten opercularis</i>	0,48	0,00	1,90	0,73	2,12	49,47
<i>Crisilla semistriata</i>	0,53	0,00	1,86	0,70	2,08	51,54

PhC & ScC - Average dissimilarity = 78,87

Species	Group PhC Av.Abund	Group ScC Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
<i>Tritia incrassata</i>	1,05	0,29	6,45	1,20	8,17	8,17
<i>Alvania lineata</i>	0,57	0,63	4,64	0,98	5,89	14,06
<i>Arca noae</i>	0,52	0,00	4,15	0,80	5,26	19,32
<i>Hiatella arctica</i>	0,12	0,39	3,57	0,73	4,52	23,85
<i>Striarca lactea</i>	0,36	0,14	2,92	0,77	3,70	27,55
<i>Modiolus barbatus</i>	0,35	0,06	2,60	0,79	3,29	30,84
<i>Chama gryphoides</i>	0,18	0,47	2,48	0,60	3,14	33,98
<i>Musculus costulatus</i>	0,30	0,12	2,40	0,61	3,05	37,03
<i>Muricopsis cristata</i>	0,11	0,24	2,21	0,63	2,80	39,83
<i>Pusia tricolor</i>	0,22	0,12	2,19	0,54	2,78	42,61
<i>Marshallora adversa</i>	0,22	0,12	2,12	0,53	2,69	45,29
<i>Mimachlamys varia</i>	0,25	0,19	2,09	0,51	2,65	47,95
<i>Cyrellia linearis</i>	0,33	0,06	2,08	0,59	2,64	50,58

January - Average similarity: 34,80

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	1,05	7,45	0,91	21,40	21,40
<i>Alvania lineata</i>	0,83	7,32	0,97	21,02	42,42
<i>Chama gryphoides</i>	0,43	5,19	0,65	14,92	57,35
<i>Pusillina philippi</i>	0,62	2,60	0,65	7,49	64,83
<i>Chauvetia mamillata</i>	0,48	2,60	0,58	7,47	72,30
<i>Hexaplex trunculus</i>	0,35	2,20	0,43	6,33	78,64
<i>Pusillina radiata</i>	0,46	1,69	0,39	4,86	83,50

March - Average similarity: 29,72

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Musculus costulatus</i>	1,45	7,26	0,86	24,42	24,42
<i>Hiatella arctica</i>	1,01	5,33	0,84	17,93	42,34
<i>Parvicardium scriptum</i>	0,47	1,75	0,59	5,89	48,23
<i>Bittium latreillii</i>	0,54	1,64	0,55	5,53	53,76
<i>Chauvetia recondita</i>	0,19	1,62	0,29	5,44	59,20
<i>Pusillina philippi</i>	0,52	1,44	0,55	4,86	64,06
<i>Tritia incrassata</i>	0,27	1,25	0,29	4,19	68,25
<i>Chauvetia mamillata</i>	0,41	1,21	0,55	4,06	72,31

<i>Odostomia striolata</i>	0,35	1,20	0,38	4,03	76,34
<i>Alvania lineata</i>	0,51	1,13	0,55	3,81	80,15

May - Average similarity: 46,60

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Chama gryphoides</i>	0,33	4,73	0,55	10,14	10,14
<i>Hiatella arctica</i>	1,30	4,55	0,83	9,77	19,92
<i>Tritia incrassata</i>	0,82	4,49	0,70	9,64	29,56
<i>Alvania lineata</i>	1,14	4,21	0,84	9,04	38,60
<i>Musculus costulatus</i>	1,38	3,23	0,90	6,92	45,52
<i>Pusillina philippi</i>	0,92	2,31	0,94	4,95	50,47
<i>Odostomia striolata</i>	0,84	2,18	0,93	4,68	55,14
<i>Muricopsis cristata</i>	0,17	1,74	0,29	3,74	58,88
<i>Aequipecten opercularis</i>	0,48	1,25	0,55	2,69	61,57
<i>Bittium latreillii</i>	0,66	1,19	0,67	2,54	64,11
<i>Junjubinus ruscurianus</i>	0,63	1,15	0,67	2,46	66,58
<i>Mimachlamys varia</i>	0,49	1,05	0,55	2,25	68,83
<i>Gregariella semigranata</i>	0,33	0,99	0,55	2,13	70,96
<i>Clanculus cruciatus</i>	0,66	0,96	0,65	2,06	73,01
<i>Chauvetia mamillata</i>	0,55	0,96	0,67	2,05	75,07
<i>Crisilla semistriata</i>	0,57	0,94	0,61	2,02	77,09
<i>Arca noae</i>	0,25	0,87	0,29	1,86	78,95
<i>Mitromorpha olivoidea</i>	0,18	0,87	0,29	1,86	80,80

July - Average similarity: 54,60

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Hiatella arctica</i>	1,25	6,39	0,98	11,71	11,71
<i>Chauvetia brunnea</i>	0,46	4,47	0,64	8,19	19,90
<i>Musculus costulatus</i>	1,36	2,76	0,82	5,06	24,96
<i>Pusillina philippi</i>	1,24	2,72	0,84	4,98	29,94
<i>Alvania lineata</i>	1,10	2,63	0,67	4,82	34,75
<i>Tritia incrassata</i>	0,80	2,17	0,71	3,98	38,74
<i>Triphoridae indet.</i>	0,90	1,92	0,87	3,51	42,24
<i>Odostomia striolata</i>	0,88	1,87	0,86	3,43	45,68
<i>Modiolus barbatus</i>	0,28	1,87	0,55	3,42	49,10
<i>Mimachlamys varia</i>	0,49	1,86	0,42	3,41	52,50
<i>Alvania aspera</i>	0,27	1,76	0,55	3,22	55,72
<i>Bittium latreillii</i>	1,42	1,65	0,66	3,02	58,74
<i>Ammonicera fischeriana</i>	0,79	1,63	0,88	2,98	61,73
<i>Modiolula phaseolina</i>	0,68	1,60	0,82	2,93	64,65
<i>Chama gryphoides</i>	0,17	1,44	0,29	2,64	67,29
<i>Aequipecten opercularis</i>	0,57	1,30	0,79	2,38	69,67
<i>Striarca lactea</i>	0,64	1,03	0,49	1,89	71,56

<i>Cyrrillia linearis</i>	0,52	0,95	0,46	1,74	73,31
<i>Parvicardium scriptum</i>	0,66	0,89	0,63	1,62	74,93
<i>Pusillina radiata</i>	0,63	0,88	0,61	1,61	76,54
<i>Chauvetia mamillata</i>	0,61	0,87	0,61	1,60	78,14
<i>Bittium reticulatum</i>	0,68	0,83	0,60	1,53	79,66
<i>Rissoella diaphana</i>	0,68	0,81	0,55	1,49	81,15

September - Average similarity: 44,42

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Tritia incrassata</i>	0,77	4,62	0,78	10,40	10,40
<i>Bittium latreillii</i>	1,44	3,10	1,15	6,98	17,38
<i>Musculus costulatus</i>	1,26	2,75	1,08	6,18	23,56
<i>Pusillina philippi</i>	1,12	2,73	1,12	6,14	29,70
<i>Hiatella arctica</i>	0,89	2,63	0,97	5,91	35,61
<i>Triphoridae</i> indet.	0,90	2,51	1,12	5,65	41,26
<i>Odostomia striolata</i>	0,88	2,38	1,08	5,35	46,61
<i>Chauvetia mamillata</i>	0,90	1,95	1,10	4,40	51,01
<i>Runcina</i> sp.	0,67	1,86	1,05	4,18	55,19
<i>Alvania lineata</i>	0,84	1,72	0,48	3,88	59,06
<i>Parvicardium scriptum</i>	0,81	1,49	0,73	3,36	62,42
<i>Jujubinus ruscurianus</i>	0,51	1,34	0,32	3,03	65,45
<i>Arca noae</i>	0,53	1,26	0,58	2,84	68,28
<i>Pusia tricolor</i>	0,27	1,13	0,32	2,54	70,83
<i>Vitreolina perminima</i>	0,62	1,13	0,74	2,53	73,36
<i>Rissoella diaphana</i>	0,51	0,97	0,61	2,18	75,54
<i>Aplysia punctata</i>	0,53	0,97	0,67	2,18	77,72
<i>Modiolula phaseolina</i>	0,55	0,87	0,39	1,95	79,67
<i>Mitromorpha columbellaria</i>	0,36	0,69	0,32	1,56	81,23

November - Average similarity: 41,53

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
<i>Chauvetia mamillata</i>	0,98	6,89	0,72	16,60	16,60
<i>Pusillina radiata</i>	1,37	3,83	0,92	9,22	25,82
<i>Tritia incrassata</i>	0,48	3,09	0,54	7,43	33,25
<i>Arca noae</i>	0,43	3,08	0,59	7,42	40,67
<i>Musculus costulatus</i>	1,08	2,97	0,91	7,15	47,81
<i>Pusillina philippi</i>	1,03	2,69	0,64	6,48	54,29
<i>Odostomia striolata</i>	0,75	2,55	0,87	6,15	60,44
<i>Hiatella arctica</i>	0,75	2,28	0,90	5,48	65,92
<i>Pseudochama gryphina</i>	0,33	2,20	0,40	5,29	71,21
<i>Odostomia plicata</i>	0,56	1,91	0,87	4,60	75,81
<i>Bittium latreillii</i>	0,77	1,54	0,54	3,71	79,52
<i>Striarca lactea</i>	0,78	1,17	0,66	2,83	82,34

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