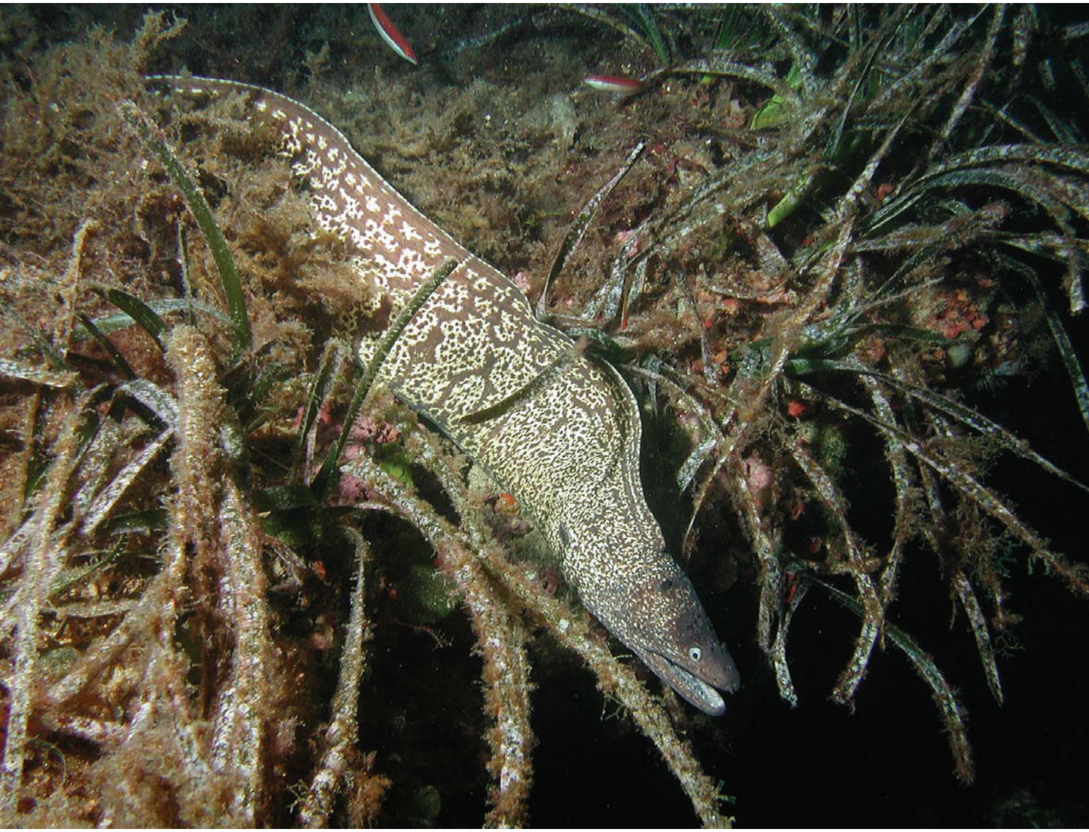

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JUAN EDUARDO GUILLÉN, DAVID GRAS, GABRIEL SOLER & ALEJANDRO TRIVIÑO

Relationship between taxocenoses of decapod crustaceans and characteristics of coastal detritic bottoms in the east and southeast of the Spanish coast

Índice

Relationship between taxocenoses of decapod crustaceans and characteristics of coastal detritic bottoms in the east and southeast of the Spanish coast

Juan Eduardo Guillén (1), David Gras (1), Gabriel Soler (1) & Alejandro Triviño (1)

Summary

This paper studies the composition of decapod crustacean populations in coastal detritic bottoms of east and south-east Spain. A series of statistical analyses were performed in order to compare composition and diversity. The decapod taxocenoses shows higher levels of abundance, wealth and diversity in the locations identified as typical detritic bottoms. Finally, some groups of species could be used for typify the biocenoses of typical coastal detritic bottom, like: *Paguristes eremita*, *Ebalia edwardsi*, *E. deshayesi*, *Eurynome aspera*, *Galathea intermedia*, *Parthenope massena*, and *Anapagurus* *hyndmani*; the biocenoses of muddy coastal detritic bottoms: *Ebalia tuberosa*, *Atelecyclus rotundatus*, *Ethusa mascarone* and *Liocarcinus zariquieyi*; and Muddy sand biocenoses: *Upogebia deltaura*, *Goneplax rhomboides*.

Key words: Decapod crustaceans, Coastal detritic bottoms, Mediterranean, Spain.

Résumé

Nous avons étudié la composition des populations de crustacés décapodes à l'Est des fonds détritiques circalittoral et du Sud-Ibérique par rapport aux différents faciès, la réalisation de diverses analyses statistiques sur la composition et la diversité. Le taxocenosis crustacés décapodes montre des valeurs élevées de l'abondance, la richesse et la diversité dans les endroits identifiés comme des fonds détritiques côtiers aspect typique. Enfin, certains groupes d'espèces pourraient être utilisées pour caractériser les débris de fonds typiques biocénose côtières, telles que: *Paguristes eremita, Ebalia edwardsi*, *E. deshayesi, Eurynome aspera*, *Galathea intermedia, Parthenope massena* et *Anapagurus hyndmani*; biocénose des boueuse détritiques côtiers: *Ebalia tuberosa, Atelecyclus rotundatus*, *Ethusa mascarone*, *Liocarcinus zari-*

quieyi; et biocénose sable vaseux: *Upogebia deltaura*, *Goneplax rhomboides*.

Mots-clés: crustacés décapodes, des détritus, de la Méditerranée, en Espagne.

Resumen

Se ha estudiado la composición de las poblaciones de crustáceos decápodos en los fondos detríticos circalitorales del Este y Sureste ibérico, con relación a sus diferentes *facies*, efectuándose diferentes análisis estadísticos sobre la composición y diversidad. La taxocenosis de crustáceos decápodos muestra elevados valores de abundancia, riqueza y diversidad en las localidades identificadas como fondos detríticos costeros de aspecto típico. Por último, algunos grupos de especies podrían ser utilizados para caracterizar las biocenosis típica de fondos detríticos costeros, tales como: *Paguristes eremita*, *Ebalia edwardsi*, *E. deshayesi*, *Eurynome aspera*, *Galathea intermedia*, *Parthenope massena*, y *Anapagurus hyndmani*; la biocenosis del detrítico costero enfangada: *Ebalia tuberosa*, *Atelecyclus rotundatus*, *Ethusa mascarone*, y *Liocarcinus zariquieyi*; y la biocenosis de arenas fangosas:*Upogebia deltaura*, *Goneplax rhomboides*.

Palabras Clave: Crustáceos decápodos, Detrítico, Mediterráneo, España.

Introduction

Mediterranean coastal detritic biocenoses were described by Pérès & Picard (1964), and Meinesz *et al.* (1983), as a biocenoses found in these bottoms of the circalittoral level, where various *facies*, such as the "pralinés" (maërl) facies, *Osmundaria volubilis* beds (Ballesteros, 1988, 1992)*,* and *facies* with free *Squamariaceae* facies (*Peyssonnelia spp.*) (Ballesteros, 1994). These habitats are characterised by high levels of diversity (Sciberras *et al*., 2009), because: i) biota includes taxons of both hard and soft substrata; ii) the *Corallinaceae* rhodoliths increase microhabitats and architecture facilitates considerable spatial heterogeneity; and iii) to contain a wide variety of trophic species. Due to the great biodiversity and currently highly localised distribution (specifically in the maërl beds) these detrital beds are considered to be a "threatened Mediterranean landscape" (UNEP/IUCN/GIS Posidonie, 1990) and a habitat that requires EU management measures (92/43 European Directive). Anthropic impacts caused mainly by trawl fishing and dredging are the main reasons for the rarefaction of this type of beds in the Mediterranean (Wilson *et al.*, 2004).

The sediments of the coastal detrital beds are a mixture of terrigenous and particularly biogenic elements (remains of seashells and exoskeletons). In east and south-east Spain, the biocenoses is typified by *Arthrocladia villosa* and *Sporochnus pedunculatus*, indicating the presence of bottom currents (Ballesteros, 1988). The structural algae species include sciaphilic algae, such as *Halimeda tuna, Halopteris filicina, Valonia macrophysa, Dyctiota linearis, Cryptonemia lomation, C. tunaeformis, Mesophyllum lichenoides, Peyssonnelia polimorpha, P. rosa-marina* and *Phymatolithon calcareum* (Boisset, F., 1992). When physical conditions allow, specially bottom currents (De Grave, S., 1999; Everett, R.A., 1994), maërl *facies* can occur, with free calcareous red algae on the substratum, mainly *Phymatolithon calcareum*, with a presence of soft algae during the summer. Another facies to be found on the detrital bed in its most advanced stages is the free *Peyssonnelia*, although it does not occur frequently in the Spanish Mediterranean, which is typified by the presence of *Peyssonnelia rubra* and *P. orientalis* and other associated algae such as *Aglaozonia parvula, A. chilosa, Rhodymenia ardissonei, Botryocladia boergesenii, Cryptonemia lomation,C. tunaeformis* and *Polysiphonia subulifera* (Ballesteros, E., 1988; Bordehore, *et al*., 2003).

When the coastal detrital biocenoses contains a significant amount of muddy fraction, the composition of *facies* shows lower specific diversity. This may be a regressive stage with regard to typical detrital *facies* that is generated mainly in the study area due to the impact of trawl fishing which leaves visible marks at certain stations. Finally, where more degradation has occurred, gravel and coarser sediment are absent, giving way to a muddy sand biocenoses, with no algae populations and a predominance of polychaete and bivalve taxocenoses (Grall & Hall-Spencer, 2003).

Studies of relationships between decapod crustaceans and benthic biocenoses are not widespread. The most important works carried out in this field include those by García-Raso & Fernández-Muñoz (1987), García-Raso (1988) on sea beds with calcareous concretions of *Mesophyllum lichenoides*; González-Gurriarán (1982) and Iglesias & González-Gurriarán (1984) on *rias* and communities associated with mussel farms in the Atlantic; Silvestre (1990) on port environments; Vadon (1981), García-Raso (1990), and Sánchez-Jerez (1994) on the *Posidonia oceanica* meadow; Abelló (1986), Sardà & Palomera (1981), Castelló & Abelló (1983), Abelló (1986), Tunesi (1986); García-Raso (1987) and Guillén (1997) on soft-bed communities; Carbonell (1984) and Pérez-

Yuste (1984) on communities associated with islands; Gili & McPherson (1987) on cave communities; and Guillén (1997) and García-Muñoz *et al*. (2008) on littoral biocenoses.

The objective of this study was to identify the taxocenoses of decapod crustaceans in the biocenoses of the coastal detritic bottoms in east and south-east Spain, and the varying composition of this taxocenoses with regard to the different substrata observed

Material and methods

Samples were collected in 11 locations of the east and south-east coast of Spain, on coastal detritic bottoms between 20 and 40 m depth, at different sampling periods (1999 and 2005 during the summer months -June to October-) (Figure 1).

A series of transect video sweeps were made to characterise the benthic composition of each location, by fitting a camera to a sled with a co-ordinate plotting system. At each location, was covered an area of at least 1 km^2 and the stations were positioned at least 1,000 m away from other biocenoses (eg: *Posidonia oceanica*), which could affect the composition of decapod taxocenoses. These films were used to characterize the different coastal detritic *facies*: muddy sand biocenoses;

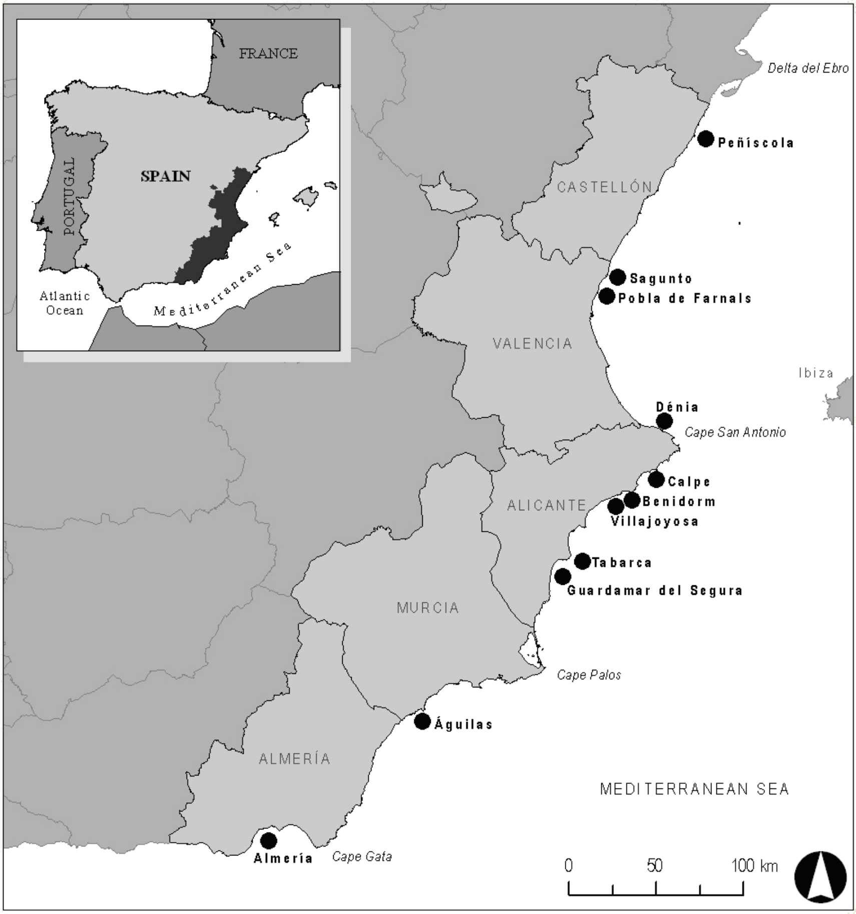

Fig. 1. Location map for the sampling locations studied.

Fig. 1. Mapa de localización de las estaciones de muestreo estudiadas.

muddy detritic coastal bottom; and typical detritic coastal bottoms.

The samples were gathered using Van Veen grabs with a sampling surface of 400 cm^2, at a depth of 5 cm, approximately, within the sediment. Nine replicates were taken at each station, except at the Guardamar del Segura station, where six were taken, and the Benidorm and Tabarca islands, where 12 replicates were taken. The total amount of samples was 102. Each sample was sieved using a 500 µm mesh sieve. The samples were then fixed in formaldehyde at a concentration of 3% in filtered seawater, and were then separated and classified in the laboratory.

Sediment characteristics were studied from sediment grain size, organic content, and pH and redox potential. Grain size was analysed and organic matter assessed using the method described by Buchanan (1984), grouping sediment fractions into six categories: muds and clays (⃠< 0,062 mm), very fine sand (0,062 to 0,125 mm), fine sands (0,125 to 0,250 mm), medium-coarse sand (0,250 to 0,500 mm), course sand (0,500 to 1 mm) and gravel (⃠> 1 mm). Organic matter was calculated by weighing the sample before and after calcination in a muffle furnace (at 600º C for two hours). The pH and redox potential were measured *in situ* on board the craft immediately after the grab, using a HANNA HI 9025c pH meter.

The Margalef Index was used to assess the diversity of each station: I=(s-1)/Ln N, where I is diversity, s is the number of species present, and N is the total number of individuals found (of all species). The Shannon-Weaver Index was also used: $H' = - \Sigma p_i$, where p_i is the proportion of individuals of the species with regard to the total number of individuals (i.e. the relative abundance of species i). The index thus considers the amount of species present in the study area (species wealth) and the abundance of each one of those species.

The results obtained were statistically analysed. Logarithmic transformation was used on abundance species data. Non-parametric techniques (Clarke & Wallis, 1994) were used to analyse the data, by means of MDS analysis, after a logarithmic transformation, using the stress quotient as the reliability parameter, with the following confidence intervals: <0,05: excellent data interpretation; 0,05 - 0,1: good data interpretation; values of more than 0,2, are considered random distributions. (Clarke, 1993). To discriminate species groups, taxa above that species were eliminated, as were any species found in fewer than five stations. A cluster graph was used to depict species groups (Clarke & Wallis, 1994).

Results

Sedimentological parameters

Table 1 shows the average values for the different types of sediment, according to the values observed in the sediment type and their identification by the observations made in the biocenoses using the transect videos.

Species Composition

A total of 50 taxa were identified in the 11 locations stations studied. Table 2 shows the results for each location.

Table 3 shows the diversity index and abundance values for each location. The Tabarca sampling location contained 352 specimens/m^2, followed by the Island of Benidorm, with 157, La Pobla de Farnals, with 103, and Sagunto, with 92 specimens/m^2. Abundance was much lower in all other sampling locations, ranging from 33 specimens/m^2 in Guardamar del Segura, to 11 specimens/m^2 in Peñíscola. Species wealth was highest in the Benidorm sampling location (30), followed by Tabarca (18) and Sagunto (15). All other locations recorded fewer than six species.

Regarding the Margalef Index, the Island of Benidorm station recorded a high-diversity value of more than 5 (6,12), with values between 2 and 5 recorded for the Tabarca and Sa-

Stations	**Depth**	**Mode**	**D_{50}**	**Org. Matter**	**Redox**	**pH**	**Sediment type**	**Biocenosis code**
Villajoyosa	24,7±8,0	0,04	0,05	1,49±0,10	-22,63±1,54	7,41±0,60	Mud and clay	1
Almería	35,0±5,0	0,1	0,07	8,19±0,58	-269,33±11,93	7,64±0,10	Very fine sand	1
Guardamar	25,0±2,0	0,11	0,08	7,88±1,61	-243,07±13,32	7,28±0,02	Very fine sand	1
Calpe	33,3±4,51	0,13	0,15	7,92±0,68	-216±8,62	7,25±0,12	Fine Sand	2
Sagunto	24,9±3,0	0,14	0,16	4,34±0,37	-240,67±7,51	7,49±0,13	Fine Sand	2
Denia	34,7±2,1	0,18	0,18	2,94±0,15	22,58±1,93	7,22±0,13	Fine Sand	2
Pobla de Farnals	21,0±1,0	0,2	0,22	8,81±0,20	-318,7±2,71	7,00±0,17	Fine Sand	2
Peñíscola	29,0±1,0	0,21	0,19	7,01±0,25	-332,07±1,54	7,43±0,03	Fine Sand	2
Tabarca	30,7±3,1	0,45	0,42	7,32±0,29	-45,53±26,85	7,2±0,05	Medium Sand	3
Benidorm	31,3±1,5	0,47	0,16	7,77±0,77	-50,17±33,01	7,22±0,12	Medium Sand	3
Águilas	40,0±6,6	0,92	0,46	8,28±0,29	-26,7±1,83	7,22±0,06	Medium Sand	3

Table 1. Average values for the different parameters studied in the sampling stations (biocenoses code: 1: Muddy sand biocenoses; 2: Muddy detritic coastal bottom; 3: Typical detritic coastal bottoms) (± Standard deviation).

Tabla 1. Valores promedio de los parámetros estudiados en las estaciones de muestreo. (Código de biocenosis: 1: Arenas fangosas; 2: Detrítico enfangado; 3: detrítico de aspecto típico) (± Desviación estándar).

STATION		Sagunto	Pobla de Farnals	Guardamar	Villajoyosa	Denia	Águilas	Almería	Peñíscola	Calpe	Benidorm	Tabarca
Code Biocenosis		2	2	1	1	2	3	1	2	2	3	3
SPECIES	**Symbol**	***06/99***	***06/99***	***06/05***	***07/99***	***10/00***	***07/02***	***06/01***	***07/01***	***07/99***	***06/01***	***07/01***
Hippolyte longirostris											1	
Thoralus cranchii	T-CRA								3		5	48
Alpheus dentipes	A-DEN			8		3					5	
Alpheus macrocheles	A-MAC							6				
Athanas nitescens	A-NIT								3		5	23
Automate branchalis	A-BRA	6										
Synalpheus gambarelloides										3		
Processa modica carolii	P-MOD	11	11	8	11	11	6					
Processa sp.								3		3	4	7
Periclimenes scriptus											1	
Aegaeon cataphracta				4								
Callianassa tyrrhena	C-TYR	8	8		6		3	3			5	1
Upogebia deltaura	U-DEL									8		
Clibanarius erythropus		3										
Paguristes eremita	P-ERE											15
Dardanus arrosor							3					
Pagurus forbesi											3	
Pagurus cuanensis											1	
Pagurus excavatus											1	
Pagurus alatus											1	
Pagurus prideaux												
Paguridae										3	1	
Anapagurus hyndmanni	A-HYN					6					9	26
Anapagurus petiti	A-PET	6	8									
Anapagurus sp.							8				3	28
Galathea intermedia	G-INT	3	22								15	109
Galathea bolivari	G-BOL								6			
Pisidia longimana	P-LON	19	50	4								
Homola barbata											1	
Ethusa mascarone	E-MAS					3			3		3	
Ebalia edwardsi	E-EDW	6								3	22	47
Ebalia deshayesi	E-DES										13	7
Ebalia tuberosa	E-TUB			4							1	
Atelecyclus rotundatus	A-ROT	3		4							8	
Sirpus zariquieyi											1	
Liocarcinus vernalis							3					
Liocarcinus zariquieyi	L-ZAR	3				3					16	1
Pilumnus hirtellus												1
Pilumnus villosissimus	P-VIL											5
Xantho pilipes	X-PIL	8					3				1	
Xantho hydrophilus	X-HYD										4	2

Table 2. Abundance of specimens/m² (averages per station and species). Code biocenoses (see table 2).

Tabla 2. Abundancia de specimens/m² (promedios por estación y especie). Código de biocenosis (ver tabla 2).

	Sagunto	Pobla de Farnals	Guardamar	Villajoyosa	Denia	Águilas	Almería	Peñíscola	Calpe	Benidorm	Tabarca
Code Biocenosis	2	2	**1**	**1**	**2**	**3**	**1**	**2**	**2**	**3**	3
Specimens/m2	92	103	33	19	28	25	14	11	22	157	352
Richness	15	6	6	3	6	6	4	3	6	30	18
Margalef Index (DMg)	2,9035	1,0811	1,4427	0,6676	1,4849	1,5346	1,1078	1,1078	1,5946	6,1157	3,1685
Shannon Index (H')	2,4504	1,4235	1,7329	0,9746	1,6324	1,6977	1,3322	1,3322	1,6957	2,9527	2,2978
Shannon Index variance	0,0040	0,0062	0,0025	0,0098	0,0101	0,0056	0,0043	0,0043	0,0071	0,0050	0,0022

Table 3. Assessment indexes of the decapod taxocenoses structure of the coastal detrital biocenoses studied. Code biocenoses (see table 2).

Tabla 3. Índices de evaluación de la estructura de la taxocenosis de decápodos en las biocenosis de detrítico costero estudiadas. Código de biocenosis (ver tabla 2).

gunto stations (3,17 and 2,90, respectively), which represents an intermediate level of diversity. All other stations recorded values of less than 2, indicating low diversity and revealing a possible process of environmental degradation.

Similar values were obtained with the Shannon-Weaver Index. The highest values and consequently the greatest levels of diversity were also recorded at the Island of Benidorm (2,93), followed by Tabarca (2,30) and Sagunto (2,45). All other stations recorded values of less than 2, ranging from 1,97 in Villajoyosa to 1,73 in Guardamar del Segura.

Figure 2 shows the cluster obtained from the Bray-Curtis analysis, divided into the following groups of species:

A. Species group comprising *Upogebia deltaura, Alpheus macrocheles* and *Goneplax rhomboides*, considered as a group pertaining to sampling stations with muddy sands. These are species commonly caught during trawl fishing on the circalittoral level.*U. deltaura* and *G. rhomboides* are species with affinities for soft substrates (Guillén, 1997), *G. rhomboides* in addition to being a typical species of muddy substrates, has a wide bathymetric distribution, ranging up to 600 m depth (Castelló & Abelló, 1983); *A. macrocheles* is also prevalent in the floor infralitoral in *Posidonia oceanica* meadows or sciafilous biocoenosis (García-Raso, 1990; Guillén, 1997).

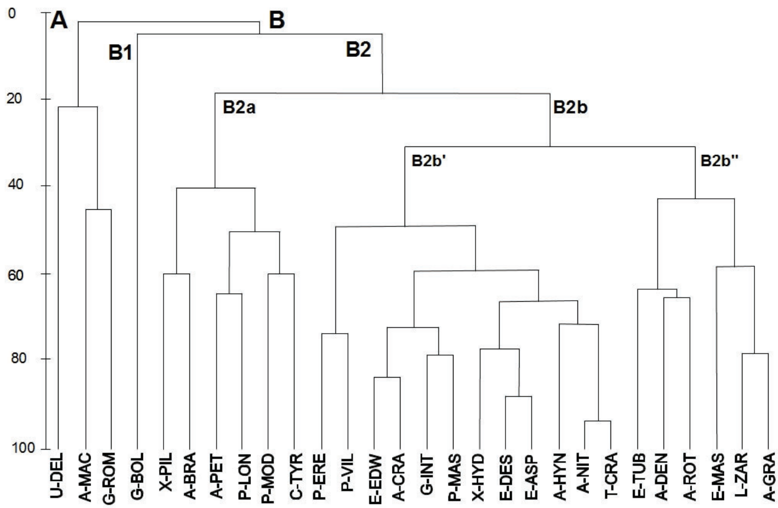

Fig. 2. Cluster graph with species groupings (symbols included in Table 3).

Fig. 2. Gráfico cluster de grupos de especies (los símbolos están incluidos en la Tabla 3).

B. All other species, with the following subsets:

B1. Only with *Galathea bolivari*, as a species with a wide distribution spectrum, and is also part of the species of the *Posidonia oceanica* meadow (García-Raso, 1990).

B2. With two main groupings:

B2a. Comprising species with a wide distribution spectrum, such as *Xantho pilipes, Anapagurus petiti, Pisidia longimana,* y *Processa modica carolii*, and others common to the biocenoses of soft substrata, such as *Automate branchialis,* and *Callianassa tyrrhena*. Of these species, *P. modica carolii*, *A. branchialis* and *C. tyrrhena*, in the studied area, are common to shallow waters and soft substrates. While *X. pilipes* and *P.longimana*, are also frequent at shallow depth, but on hard substrates, gravel, or as the case of *P. longimana,* in calcareous algae (García-Raso & Fernández-Muñoz, 1987).

B2b. This is the main subset of species, and can be considered the group of species pertaining to detritic bottoms. There are two groups:

B2b'. The majority of the species recorded at the sampling stations with the highest levels of diversity (Benidorm and Tabarca), which are considered species pertaining to the decapod taxocenoses found in typical detritic bottoms: *Paguristes eremita, Pilumnus villosissimus, Ebalia edwardsi, Achaeus cranchii, Galathea intermedia, Parthenope massena, Xantho hydrophilus, Ebalia desh-*

ayesi, Eurynome aspera, Anapagurus hyndmani, Athanas nitescens, and *Thoralus cranchii*. Some of these have been referenced in detritic bottoms: *P. villosissimus* (García-Raso, 1982; Pérez-Yuste, 1984; Turkay *et al*., 1987), *P. massena* (Abelló, 1986; Guillén, 1997), and *E. aspera* (Guillén, 1997). Other species are also common in other biocenoses, mainly in the *Posidonia oceanica* meadow.

B2b’’. Group of species also frequent in muddy detrital stations, mainly *Atelecyclus rotundatus, Ethusa mascarone, Liocarcinus zariquieyi* (Castelló & Abelló, 1983; Tunesi, 1986; García-Raso, 1987; Guillén, 1997). Also included in this group *Ebalia tuberosa, Alpheus dentipes,* and *Achaeus gracilis,* species with a greater range of habitats, frequently found in the rock infralittoral photophilous biocoenosis, and in *Posidonia oceanica* meadows.

Differentiation of sampling stations

MDS analysis gives a stress quotient of 0,07, which allows for a satisfactory degree of reliability in their representa-

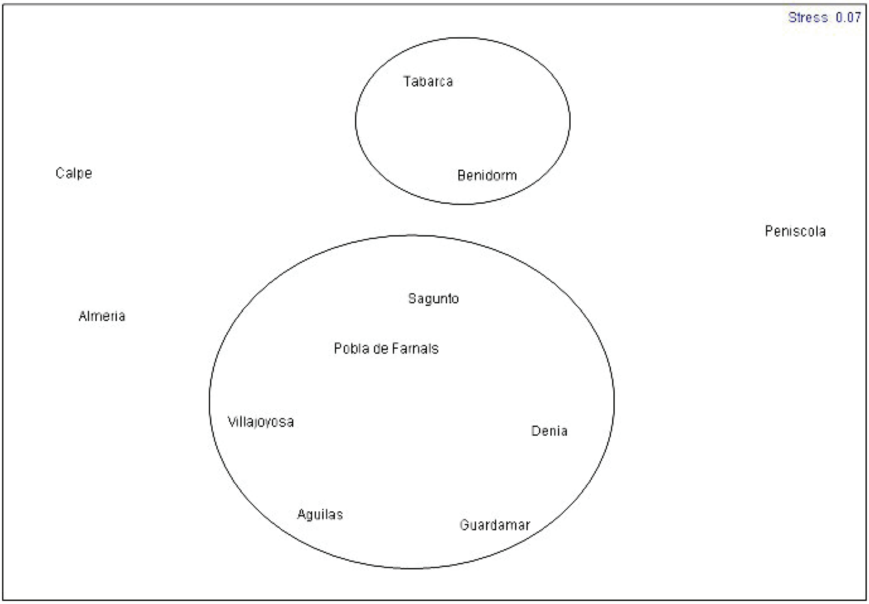

Fig. 3. MDS analysis of the sampling locations according to species composition.

Fig. 3. Análisis MDS de la composición de especies en las localidades de muestreo.

tion. Figure 3 shows a segregation of samples by stations with the highest levels of diversity, which are those with typical detrital beds: Tabarca and the Island of Benidorm, followed lower down by Sagunto (muddy detritus), but with a high level of diversity in the decapod taxocenoses. Further down there is a group of stations with lower diversity values and finer sediments, which are considered as having muddy detritus and muddy sand beds. To the right are the stations with muddy detritus and muddy sand stations: Calpe, Almería and Peñíscola, which are separate from the rest due to the weighting in these samples of species only recorded in these stations, such as *Alpheus macrocheles* in Almería, *Synalpheus gambarelloides* and *Upogebia deltaura* in Calpe and *Galathea bolivari,* in Peñíscola.

Discussion

The video recordings made it possible to identify the different *facies* of the detritic coastal bottoms in the various sampling locations: typical beds (Benidorm, Tabarca and Águilas); muddy detritic bottoms beds (Calpe, Sagunto, Peñíscola and Pobla de Farnals); and muddy sand beds (Guardamar, Almería and Villajoyosa). This classification relates to sediment type, which is medium-coarse sand for typical detritic beds, fine sand for muddy detritic beds, and very fine or silty clayey sand for muddy sand beds.

The decapod taxocenoses shows higher levels of abundance, wealth and diversity in the locations identified as typical detritic bottoms: Benidorm and Tabarca (though not in the Águilas station). The intermediate diversity values are for locations classified as muddy detritic bottoms, and the lowest values are for muddy sand locations.

Applying the Margalef Index in the taxocenoses of decapod crustaceans in coastal detritic bottoms reveals the differences on their structure, with values of less than two. Conversely, in *facies* considered with greater degree of ecological maturity, the decapod taxocenoses reveals high levels of diversity.

Despite factors that make it difficult to identify a taxocenoses of decapod crustaceans in the biocenoses of detritic bottoms, such as the mobility of many of the decapod species; the seasonal changes in algae production, and therefore the amount of habitat; the different requirements of decapod microhabitats depending on the development stage (young and adult) due to the proximity of other biocenoses or due to reproductive behaviours, it is nevertheless possible to identify species with higher levels of affinity for detrital beds. Some of these species show a greater level of resilience, and may endure in a process of environmental regression towards muddy *facies*. However, some of these species are also observed in other biocenoses on the infralittoral level (Guillén, 1997) and as such are species with a wide distribution spectrum. This is the case of *Alpheus macrocheles, A.dentipes, Athanas nites-*

cens and *Achaeus cranchii*, which is present in the sciaphilic biocenoses on infralittoral rock; *Galathea bolivari, Xantho pilipes, X. hydrophilus, Pilumnus villosissimus, Pisidia longimana, Processa modica carolii, Athanas nitescens, Thoralus cranchii* and *Achaeus gracilis*, pertaining to the biocenoses of the *Posidonia oceanica* meadow, and the group of photophilic biocenoses on infralittoral rock.

Finally, it can be concluded that, once species with a wide distribution spectrum in habitats are eliminated, the groups that would typify the different *facies* of coastal detritic bottoms, would be:

– biocenoses of typical coastal detritic bottom: *Paguristes eremita, Ebalia edwardsi, E. deshayesi, Eurynome aspera, Galathea intermedia, Parthenope massena*, and *Anapagurus hyndmani.*

– biocenoses of muddy coastal detritic bottoms: *Ebalia tuberosa, Atelecyclus rotundatus, Ethusa mascarone* and *Liocarcinus zariquieyi.*

– Muddy sand biocenoses: *Upogebia deltaura, Goneplax rhomboides.*

The species *Paguristes eremita* and *Anapagurus hyndmani* are considered as being characteristic for the decapod taxocenoses on detritic bottoms, accord with García-Muñoz *et al*. (2008).

Finally, this study does not include species with sizes greater, like *Dardanus* spp. and *Pagurus* spp., as these require sampling methods that cover larger sampling areas, such as trawling.

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