Faunal affinities of the Sponges (Porifera) of the Balearic Islands with those of other biogeographical areas

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SUMMARY

An evaluation is made of the affinities of the marine sponge fauna of the Balearic Islands (158 species; Bibiloni, 1990) with those of other biogeographical areas and regions of the world, as well as with those of other Mediterranean areas (on the basis of the literature and interpreting the synonymies), by the simple method of calculating the percentage of Balearic species cited for the other areas considered. With respect to other Mediterranean areas, the greatest affinity of the Balearic sponge fauna is with those in the Gulf of Lyons (79.3%) and the Tyrrhenian Sea (56.8%); with respect to other areas in the world, the greatest affinity is with those in the Mauritanian-Senegalian (46.2%) and boreal regions (45.6%). If the results are compared with those of Vacelet (1980) for the Demospongiae of the whole Mediterranean, the sponges of the Balearic Islands show marked subtropical characteristics.

KEYWORDS: Sponges, biogeography, Balearic Is.

RESUMEN

Afinidades faunísticas de las esponjas (Poríferos) de las islas Baleares con las de otras áreas biogeográficas. Se estiman las afinidades de la fauna de esponjas marinas de las islas Baleares (158 especies; Bibiloni, 1990) con las de otras regiones y provincias biogeográficas mundiales, así como con las de otras regiones mediterráneas (a partir de la bibliografía e interpretando las sinonimias), mediante el simple procedimiento de calcular el porcentaje de especies de Baleares citadas para las demás áreas consideradas. La mayor afinidad de la fauna de esponjas de Baleares con las de otras áreas del Mediterráneo es con el golfo de León (79,3%) y el mar Tirreno (56,8%); cuando se consideran otras áreas mundiales, la mayor afinidad es con las regiones mauritano-senegaliense (46,2%) y boreal (45,6%). Si se comparan los resultados con los de Vacelet (1980) para las demosponjas de todo el Mediterráneo, las esponjas de las Baleares manifiestan un marcado carácter subtropical.

PALABRAS CLAVE: Esponjas, biogeografía, islas Baleares.

INTRODUCTION

In order to be able to interpret the origin of the benthic Mediterranean fauna, it is essential to bear the geological history of this sea in mind. To give a broad outline (see Maldonado, 1985; Reguant, 1986, among others, for a more detailed analysis), in the Tertiary period the Mediterranean and the Indo-Pacific were joined. This meant that the planktonic larvae of many benthic species of the Indo-Pacific Ocean could pass freely into the Mediterranean. At the same time, the barrier which existed between the Mediterranean and the Atlantic was much greater than it is now, as a result of which

the waters of the Mediterranean were both warmer and more saline than the waters of the Atlantic. Due to the stenohaline characteristics of the sponges, the population of Mediterranean porifera dwindled or probably disappeared, especially as a result of some of the periods when the sea desiccated.

Once the link with the Atlantic was re-established and the link with the Indian Ocean was closed off, the faunal population of the Mediterranean evolved from the few surviving taxa and, in particular, from cold (Boreal) and warm (Senegalian) fauna which arrived successively from the Atlantic during the glacial and interglacial periods respectively (Mars, 1963; Zibrowius, 1980; Pérès, 1985).

Due to the genetic plasticity of the sponges, we should also consider a phenomenon of recent speciation in the Mediterranean, or at least the appearance of varieties and forms, which was aided by the isolation of this phylum. This would explain the formation of neoendemisms.

Thus the benthic fauna of the western Mediterranean is the result of a mixture of elements of diverse geographical origin. With particular reference to sponges, species of Atlantic origin and/or affinities, both tropical and boreal, species of Indo-Pacific lineage and also endemic species may be found.

In general, little time has been devoted in the past to studying the biogeography of the sponges in the Mediterranean. Pérès (1958) alone tried to establish the biogeographical elements (Atlanto-Mediterranean, Senegalian, Palaeo-Mediterranean, endemic, Arctic, immigrants from the Red Sea, circumtropical, cosmopolitan) which make up this fauna, thereby offering a necessary overall perspective. Uriz (1984) studied the biogeographical affinities of the horny or keratose sponges of the Catalan coast, Martínez-Inglés (1992) did likewise for the porifera of the coast of Murcia, and Maldonado (1993) seek to gain knowledge of the Atlantic-Mediterranean affinities of the sponges of Alborán.

The aim of this work is to learn of the biogeographical affinities which the sponges of the Balearic archipelago may have with both those of other Mediterranean areas and those of other biogeographical regions and world areas.

MATERIAL AND METHODS

Material and provenance

Over the course of 4 years (1986-1989), 83 stations scattered around the entire Balearic coast have been prospected (Fig. 1), from which specimens of sponges have been obtained directly (by scuba or free diving) from shallow to medium deep bottoms (0 to 50 metres), and indirectly, by means of commercial trawling, from medium deep to fairly deep sea bottoms (50-150 metres). Particulars of the sampling stations can be found in Bibiloni (1990), where a taxonomic list of the 158 species of porifera identified is also provided.

The affinity between the sponge fauna of the Balearic Islands and those of the other areas considered (see below) has been evaluated by the simple calculation of the percentage of common species. To do this, we have used all the bibliographical material published which has been available to us, from complete monographs to articles in which only particular species are mentioned. This bibliography may be consulted in extenso in Bibiloni (1990); here the most representative pieces of work are cited (numerical references in the list in the following section, which are identified in the bibliography references).

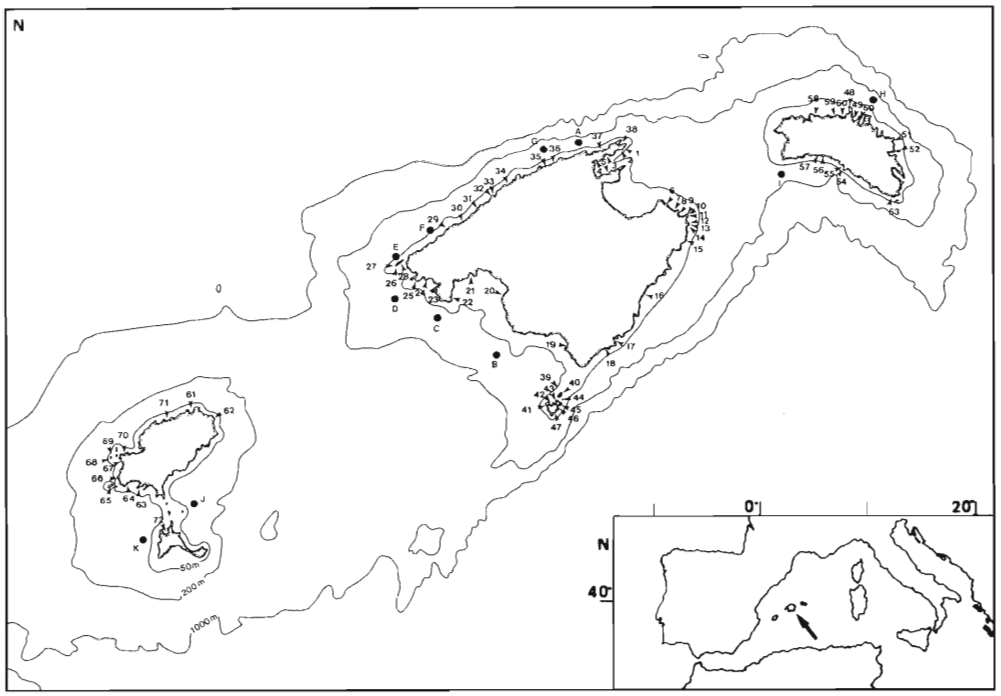

FIGURE 1. Balearic Islands; location of the sampling stations. See the list in Bibiloni (1990). *Localización de las estaciones de muestreo en las islas Baleares. Véase la lista en Bibiloni (1990).*

Biogeographical areas considered

A certain number of biogeographical areas have been distinguished, on the basis of the work completed by Boury-Esnault & Lopes (1985) and Uriz (1988) for the Atlantic, and by Pérès & Picard (1964) and Fredj (1974) for the Western Mediterranean. In the latter case, some biogeographical units have been broken down into smaller ones, in order to make them correspond with areas whose sponge faunas are relatively well-known.

At the same time, there is a lesser degree of definition of the Eastern Mediterranean areas and the non-Atlantic biogeographical regions: these areas are less well-defined the further they are from the Mediterranean. The areas and regions considered (Figs. 2 and 3) are listed hereunder:

a) North-east Atlantic: limited to the N by Iceland-Norway, to the S by the equator and to the E by the Mid Atlantic ridge. From north to south, three regions are distinguished:

1) Arctic region: limited to the S by the Norwegian coast (7);

2) Boreal region: limited to the N by Iceland-Faeroes and to the S by the SW entrance to the English Channel (1);

3) Atlanto-Mediterranean region: this extends from the entrance to the English Channel to the equator; it is traditionally divided into 4 areas:

i) Lusitanian area: from the English Channel to Gibraltar (22);

ii) Mediterranean area (see further below);

iii) Mauritanian area: from Gibraltar to Cabo Blanco; includes the Canary Islands and Madeira (20);

iv) Senegalian area: between Cabo Blanco and the equator; includes the Cape Verde Islands and the islands in the Gulf

of Guinea: St. Thomas, Prince, Annobón and Fernando Poo (9).

b) South Atlantic: from the equator to the coast of South Africa (25).

c) North-west Atlantic: area between Newfoundland-Iceland and the equator. Includes three regions:

1) North American region (18);
2) Caribbean region (17);
3) Brazilian-Argentinian region (5).

d) Indo-Pacific (2).

e) Antarctic (8).

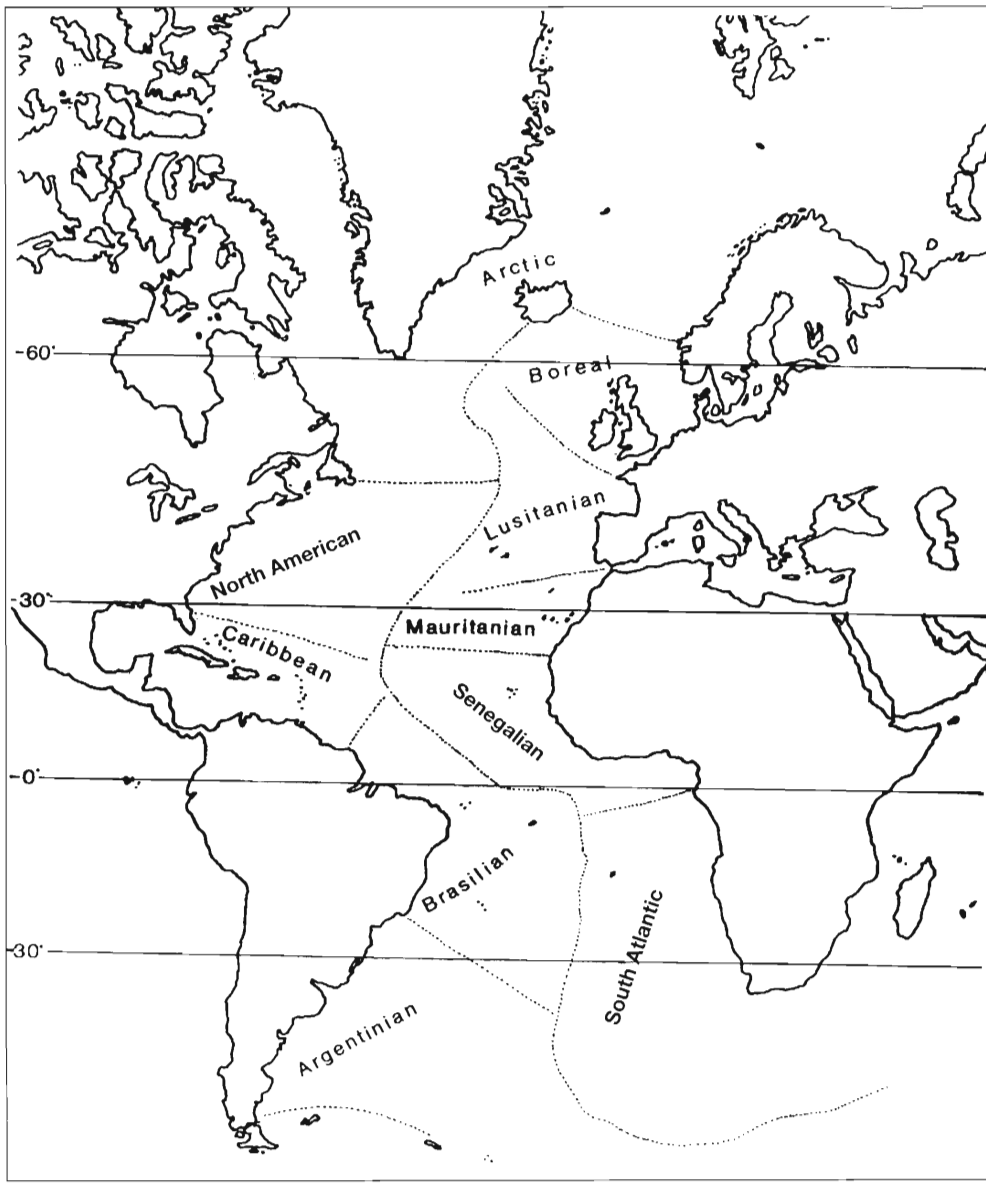

FIGURE 2. Biogeographical regions and areas considered. *Regiones y áreas biogeográficas consideradas.*

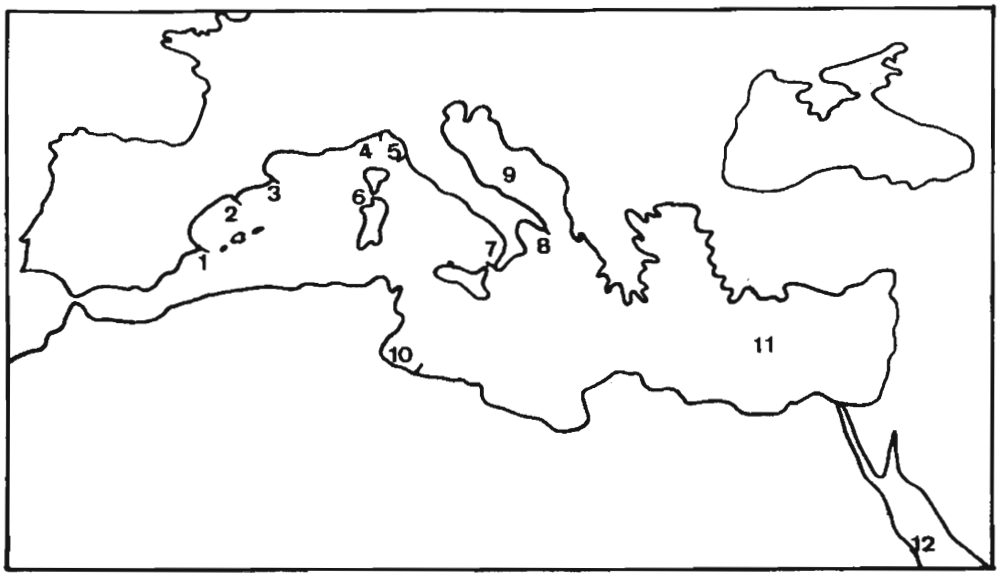

FIGURE 3. Biogeographical units considered in the Mediterranean; the numbers correspond to the areas indicated in the text. *Unidades biogeográficas consideradas en el Mediterráneo; los números corresponden a las áreas que se indican en el texto.*

For the purposes of this work, 12 areas in the Mediterranean have been distinguished (although the Red Sea is not Mediterranean, it is included due to its geographical proximity and following the opinion of Lévi, 1958, who indicates a close affinity between the poriferan fauna of both seas):

1) Alborán: from the Straits of Gibraltar to the Cape of Palos (12);
2) Coast of Alicante and Valencia: from the Cape of Palos to the Ebro Delta (13);
3) Catalan coast: from the Ebro Delta to Cape Creus (3, 24);
4) Gulf of Lyons: from Cape Creus to Genoa (including the Cassidaigne canyon; 4, 6, 23, 26, 28);
5) Ligurian Sea: from Genoa to Piombino (15);
6) Corsica and Sardinia (26);
7) Tyrrhenian Sea: from Piombino to the Straits of Messina (21);
8) Ionian Sea: from Sicily to the Gulf of Taranto (13, 14);
9) Adriatic Sea (15);
10) Mediterranean coast of West Africa: coast of Morocco, Algeria and Tunisia (19);
11) East Mediterranean coast (the remainder of the Mediterranean coast): coast of Greece, Turkey, Syria, Israel, Egypt, Libya and islands in the area (10);
12) Red Sea (11).

RESULTS AND DISCUSSION

The percentages of species of sponges from the Balearic Islands which are also found in other Mediterranean areas are as follows (Table I and Fig. 4): Gulf of Lyons, 126 species (79.7%); Tyrrhenian Sea, 92 (58.2%); Catalan coast, 84 (53.2%); Adriatic Sea, 76, (48.1%); Ligurian Sea, 69 (43.7%); Corsica-Sardinia, 61 (38.6%); coast of Valencia-Alicante, 56

(35.4%); Alborán, 52 (32.9%); Ionian Sea, 49 (31%); Mediterranean coast of West Africa, 41 (25.9%); east Mediterranean coast, 31 (19.6%); Red Sea, 10 (6.3%). It is to be noted that the greatest affinities are found with areas of the western Mediterranean which are relatively far away from the Balearic archipelago (to its N and E), while there is a lesser affinity with areas which are nearer (Iberian coast, to the W and to the S).

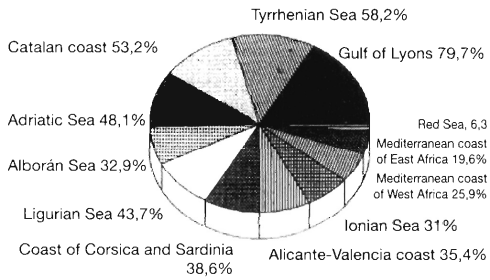

FIGURE 4. Faunal affinities (percentage of common species) between the sponge fauna of the Balearics and those of the different Mediterranean units considered. *Afinidades faunísticas (porcentaje de especies comunes) entre la fauna de esponjas de las islas Baleares y las de las distintas unidades consideradas en el Mediterráneo.*

Of all the species of sponges found in the Balearic Islands, 34 (21.5%) are endemic to the Mediterranean; of these, 11 may be considered to be widely distributed in this sea (being present in the Western Mediterranean, the Adriatic and/or the Eastern Mediterranean). The remaining 23 endemic species (of which 4 are new to science, 4 were found for the first time in the Mediterranean and 7 were cited for the second or third time in this sea; Bibiloni, 1993) are found in specific areas. It should be emphasised that there are 49 (31%) species of sponges in the Balearic fauna which are also found in the Cassidaigne canyon. Situated between Corsica and the Gulf of Lyons, this canyon has been considered, for purposes of geographical distribution, as belonging to the Gulf of Lyons, which has led to a notable increase in the number of species this area has in common with the Balearics. 4 of these 49 species, which had been cited for the first time for the Cassidaigne canyon, have been found for the second time on detritic bottoms in the Balearic Islands.

The percentages of species of sponges from the Balearic Islands which are also found in other areas of the world are as follows (Table II and Fig. 5): 150 species (95%) are found in some other part of the Mediterranean; 74 species (47%) are found in the Mauritanian-Senegalian region; 73 species (46%) in the Boreal region; 72 species (46%) in the Lusitanian region; 41 species (26%) in the Arctic; 39 species (25%) in the Indo-Pacific; 17 species (11%) in the western Atlantic; 14 species (8.9%) in the south Atlantic; 11 species (7%) in the Antarctic. 10.7% are widely distributed species and 36.7% are cold-water species. (The total of these percentages exceeds 100, because there are species present in two or more of the areas considered, and thus they have been assigned to two or more areas.) For the sponges of Alicante, Martínez-Inglés (1992) obtains the following values: Mediterranean, 98%; Lusitanian, 60.8%; Mauritanian-Senegalian, 58.8%; boreal, 54.9%; south Atlantic, 9.8%; Indo-Pacific, 33.3%. All of these values are comparable with the ones obtained for the Balearics.

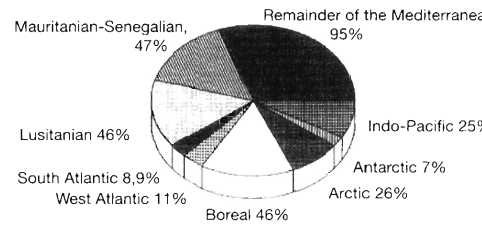

FIGURE 5. Faunal affinities (percentage of common species) between the sponge fauna of the Balearics and those of the different world biogeographical units considered. *Afinidades faunísticas (porcentaje de especies comunes) entre la fauna de esponjas de las islas Baleares y las de las distintas unidades biogeográficas consideradas a nivel mundial.*

If these results are compared with those obtained by Vacelet (1980) for the Mediterranean Demospongiae (Table III), some differences can be seen which show that, compared with the remaining Mediterranean sponges, those of the Balearic Islands have a greater affinity with sponges of subtropical regions, as well as a greater affinity with the population of warm Atlantic porifera and a lower degree of endemism. The affinities evaluated by Martínez-Inglés (1992) for the sponges of the Alicante coast (Table III) also show this tendency.

Such a trend is only partly applicable to the population of porifera of the Western Mediterranean, judging by the evaluations made for two other areas. Indeed, Maldonado (1993), who studied the affinities of the Demospongiae of the Alborán Sea with those in several Atlanto-Mediterranean island areas (Açores, Canary Is., Cabrera, Medes, Ischia), calculated that the percentage of endemisms for the demospongiae of Alborán is 23%, close to our figure of 21.5%, but at considerable variance with Vacelet's figure of 44.6% (1980) and Pansini's figure of 45.7% (1990). Without doubt, this low proportion of endemisms is explained by the fact that the areas considered by the Spanish authors (Alborán, Alicante, Balearics) are closer to the Atlantic: the greatest affinity of the sponges of Alborán is with the poriferan fauna of the Açores (Maldonado, 1993), while this author finds a strong affinity between the respective fauna of the Mediterranean islands studied.

TABLE I. Presence-absence of species of Balearic sponges in the Mediterranean biogeographical units: A, Alborán Sea; C, Catalan coast; D, Adriatic Sea; G, Gulf of Lyons; L, Ligurian Sea; I, coast of Corsica and Sardinia; J, Ionian Sea; N, Mediterranean coast of West Africa; R, Red Sea; T, Tyrrhenian Sea; V, Alicante-Valencia coast; W, Mediterranean coast of East Africa. *Presencia-ausencia de especies de esponjas baleares en las unidades biogeográficas del Mediterráneo: A, mar de Alborán; C, costa catalana; D, mar Adriático; G, golfo de León; L, mar Ligur; I, costas de Córcega y Cerdeña; J, mar Jónico; N, costa mediterránea del África occidental; R, mar Rojo; T, mar Tirreno; V, costa de Alicante y Valencia; W, costa mediterránea de África oriental.*

	A	V	C	G	L	I	T	D	J	N	W	R
Clathrina clathrus	0	1	1	1	1	0	0	1	1	0	1	0
Clathrina coriacea	0	1	1	1	1	1	1	1	1	0	1	0
Clathrina contorta	0	1	0	0	0	0	0	0	0	0	0	0
Sycon raphanus	1	1	1	1	1	0	1	1	1	1	0	0
Leuconia nivea	0	0	0	1	0	0	0	0	0	0	1	0
Leuconia variabilis	0	1	1	1	1	1	1	1	0	0	0	0
Oscarella lobularis	0	1	1	1	1	1	1	1	1	0	0	0
Plakina trilopha	1	0	1	1	1	0	0	0	0	0	0	0
Geodia cydonium	1	1	1	1	1	1	1	1	1	1	1	0
Erylus euastrum	0	0	1	1	1	1	1	1	0	0	0	0
Penares helleri	1	1	1	1	1	0	1	1	1	0	1	0
Stryphnus mucronatus	0	0	0	1	0	0	0	0	0	1	0	0
Pachastrella monilifera	1	0	0	1	0	0	1	0	0	1	0	0
Poecillastra compressa	1	0	1	1	0	1	0	1	0	0	0	0
Caltropella pathologica	0	0	1	1	0	0	0	0	0	1	0	0
Dercitus plicatus	1	0	1	1	0	1	1	0	0	1	0	0
Chondrosia reniformis	1	1	1	1	1	1	1	1	1	0	1	0
Jaspis johnstoni	1	1	1	1	1	1	0	0	1	1	0	1
Tehya aurantium	1	1	1	1	1	1	1	1	1	1	1	0
Aaptos aaptos	0	1	1	1	1	1	1	1	1	1	0	1
Polymastia polytylota	1	0	0	1	0	1	1	0	0	0	0	0
Weberella verrucosa	0	1	1	1	1	1	0	0	0	0	0	0
Pseudosuberites sulphureus	0	1	0	0	1	1	1	1	0	0	0	0
Pseudosuberites hyalinus	1	0	1	1	0	0	0	1	0	0	0	1

	A	V	C	G	L	I	T	D	J	N	W	R
Prosuberites longispina	1	0	1	1	1	1	1	1	0	0	1	0
Prosuberites rugosus	0	0	0	1	0	0	0	0	0	0	0	0
Prosuberites epiphytum	0	0	0	1	1	0	1	1	0	0	0	0
Laxosuberites rugosus	0	0	0	1	0	0	0	0	0	1	0	0
Laxosuberites ectyoninus	1	0	0	1	0	1	0	0	0	0	0	0
Terpios fugax	0	0	0	0	0	0	0	0	0	0	0	0
Suberites domuncula	1	1	0	1	1	1	1	1	1	0	0	0
S.carnosus typicus	1	0	1	1	1	1	1	1	1	0	1	1
S.carnosus incrustans	1	1	1	1	1	0	0	0	0	0	0	0
Rhizaxinella pyrifera	0	0	1	1	0	1	1	0	1	0	0	0
Spirastrella cunctatrix	1	1	1	1	1	1	1	1	1	0	1	1
Timea hallezi	0	0	0	0	0	0	0	0	0	0	0	0
Timea unistellata	1	1	1	1	0	1	1	1	0	1	0	0
Timea mixta	0	0	0	1	0	1	0	0	0	0	0	0
Diplastrella bistellata	0	0	1	1	1	0	1	1	0	1	0	0
Cliona celata	0	1	0	1	1	1	0	1	1	0	1	1
Cliona viridis	1	1	1	1	1	1	1	1	1	1	1	0
Cliona schmidti	0	0	1	1	0	0	0	1	1	1	0	0
Cliona levispira	0	0	0	1	0	0	0	0	0	0	0	0
Latrunculia insignis	1	0	0	0	0	1	0	0	0	0	0	0
Axinella polypoides	1	1	1	1	1	1	1	1	0	1	0	0
Axinella damicornis	0	1	1	1	1	1	1	1	0	0	1	0
Axinella verrucosa	1	1	1	1	1	1	1	1	1	1	1	0
Axinella vaceleti	0	0	1	1	1	1	0	0	0	0	0	0

	A	V	C	G	L	I	T	D	J	N	W	R
Axinella pseudominuta	0	0	0	0	0	0	0	0	0	0	0	0
Axinella pumila	0	0	1	0	0	1	0	1	0	0	1	0
Acanthella acuta	0	0	1	1	1	1	1	1	0	1	0	0
Phakellia rugosa	0	0	0	1	0	0	1	0	0	0	0	0
Ceratopsiom minor	0	0	0	0	0	1	0	0	0	0	0	0
Bubaris carcisis	1	0	0	1	0	1	1	0	0	0	0	0
Bubaris subtyla	0	1	0	0	0	1	0	0	0	0	0	0
Monocrepidium vermiculatum	1	1	0	1	0	1	1	0	0	0	0	0
Rabdoploca curvispiculifera	0	0	0	1	0	0	0	0	0	0	0	0
Hymerhabdia oxytrunca	0	0	0	1	0	0	0	0	0	0	0	0
Halicnemia patera	1	0	1	1	0	0	1	0	0	0	0	0
Agelas oroides	0	1	1	1	1	1	1	1	1	1	0	0
Rhabderemia minutula	1	0	0	1	1	0	0	1	0	0	0	0
Raspaciona aculeata	0	0	1	1	1	1	1	1	0	0	1	0
Eurypon topsenti	1	0	0	1	0	0	1	0	0	0	0	0
Eurypon lacazei	1	0	0	1	0	0	1	0	0	1	0	0
Eurypon clavatum	0	0	0	1	1	0	0	0	1	0	0	0
Eurypon major	0	0	0	0	0	0	1	0	0	0	0	0
Tricheurypon viride	1	0	0	1	1	0	1	0	0	1	0	0
Rhabdeurypon spinosum	0	0	0	1	0	0	0	0	0	0	0	0
Mycale massa	0	1	1	1	1	1	1	1	0	0	1	0
Mycale contarenii	0	1	1	1	0	0	1	1	1	0	1	0
Mycale srynx	0	0	1	1	0	0	1	1	0	0	0	0
Hamacantha falcula	1	1	0	1	0	1	0	0	1	0	0	0
Biemna peachi	0	0	0	1	0	0	0	0	0	0	0	0
Tylodesma rosea	0	0	0	0	0	0	0	0	0	0	0	0
Sygmatoxella annexa	1	0	1	1	0	0	1	1	0	0	0	0
Crambe crambe	0	1	1	1	1	0	1	1	0	1	0	0
Crambe tailliezi	0	0	0	1	0	0	0	0	0	0	0	0
Crella pulvinar	1	0	0	1	1	0	0	1	0	0	0	0
Crella sigmata	0	0	1	1	0	1	0	1	0	0	0	0
Crella rosea	0	0	0	1	0	0	1	0	0	1	0	0
Lissodendoryx cavernosa	0	0	1	1	0	0	1	0	0	0	0	0
Lissodendoryx basispinosa	0	0	1	1	0	0	1	0	0	0	0	0
Myxilla rosacea	0	0	1	1	1	0	1	1	1	1	1	0
Hymedesmia pansa	1	1	1	1	0	0	1	1	1	0	0	0
Hymedesmia versicolor	0	0	1	1	1	0	1	1	0	0	0	0
Hymedesmia peachi	0	0	0	1	0	0	1	0	1	0	0	0
Hymedesmia dujardini	0	0	1	1	0	1	1	0	0	1	0	0
Hymedesmia baculifera	0	0	0	1	0	0	1	0	0	1	0	0
Phorbas coriaceus	0	0	1	1	0	0	1	0	0	0	0	0
Phorbas fictitius	1	0	1	1	1	0	1	1	1	0	0	0
Phorbas tenacior	0	1	1	1	1	0	1	1	1	0	0	0
Phorbas dendyi	0	0	0	0	0	0	0	0	0	0	0	0
Hamigera hamigera	0	1	1	1	0	1	0	1	1	1	0	0
Pronax dives	1	0	1	1	1	0	0	0	1	1	0	0
Pronax fibulatum	0	0	1	1	0	1	1	0	0	0	0	0
Plocamione dirrhopalina	0	0	0	0	0	0	0	0	0	0	0	0
Microciona duplex	0	0	0	0	0	0	1	0	0	0	0	0
Microciona tenuissima	0	0	0	0	0	0	0	0	0	0	0	0
Microciona armata	0	0	0	0	0	0	1	0	1	0	0	0
Microciona gradalis	1	1	0	0	0	0	1	0	1	0	0	0
Microciona spinarcus	0	0	0	1	0	0	0	0	0	0	0	0
Microciona atrassanguinea	0	0	1	0	1	0	0	0	0	0	0	0
Halichondria tenuiderma	0	0	0	0	0	0	0	0	0	0	0	0

	A	V	C	G	L	I	T	D	J	N	W	R
Raphisia spelea	0	0	0	0	0	0	1	1	1	0	0	0
Spongosorites flavens	0	0	0	0	0	1	0	1	1	0	0	0
Spongosorites genitrix	0	0	1	0	0	1	1	0	0	1	0	0
Spongosorites intrincata	0	1	0	1	0	0	1	1	1	0	0	0
Spongosorites cavernicola	0	0	0	0	0	0	0	0	0	0	0	0
Topsentia contorta	0	0	0	0	0	1	0	0	1	0	0	0
Topsentia garciae	0	0	0	0	0	0	0	0	0	0	0	0
Scopalina lophyropoda	0	0	1	1	0	0	0	1	0	0	0	0
Scopalina azurea	0	0	0	0	0	0	0	0	0	0	0	0
Dictyonella marsillii	0	0	1	1	1	1	0	1	0	0	0	0
Dictyonella incisa	1	0	0	1	1	1	1	1	1	0	0	0
Dictionella plicata	0	0	0	1	0	0	1	0	1	1	0	0
Hemimycale columella	0	1	1	1	1	0	1	1	1	1	0	0
Haliclona elegans	0	0	1	1	1	0	0	1	1	0	0	0
Haliclona limbata	0	0	0	0	0	0	1	0	0	0	0	0
Haliclona cinerea	0	0	0	0	1	0	1	0	0	0	0	0
Haliclona subtylis	0	0	0	1	0	0	0	1	0	0	0	0
Reniera rosea	0	0	1	1	1	0	1	1	0	0	0	0
Reniera fulva	0	0	0	1	0	0	1	0	0	0	0	0
Reniera mucosa	0	0	1	1	1	0	0	1	0	0	0	0
Reniera cratera	0	0	0	1	1	1	1	0	0	0	0	0
Reniera valliculata	0	0	0	1	0	0	1	0	0	0	0	0
Reniera plana	0	0	1	1	0	0	0	0	0	0	0	0
Reniera clavata	0	0	0	0	0	0	0	0	0	0	0	0
Gellius uncinatus	0	0	0	1	0	0	0	0	0	0	0	0
Gellius flagellifer	0	0	1	1	0	0	1	1	0	0	0	0
Gellius angulatus	0	0	1	1	1	0	1	0	0	1	0	0
Gellius lacazei	0	0	0	1	0	0	0	0	0	0	0	0
Adocia simulans	0	1	1	1	0	1	1	0	1	1	1	0
Siphonochalina balearica	1	1	0	0	0	0	0	0	0	0	0	0
Rizhoniera rhizopora	0	0	0	1	0	0	0	0	0	0	0	0
Dendroxea lenis	0	1	0	1	0	0	1	0	0	0	0	0
Pellina semitubulosa	1	0	0	0	0	0	0	1	1	0	0	0
Petrosia ficiformis	1	1	1	1	1	1	1	1	1	1	1	0
Aplysilla sulphurea	0	1	1	1	1	1	1	1	1	0	0	0
Aplysilla rosea	0	0	0	1	1	0	1	1	0	0	0	0
Pleraplysilla spinifera	0	1	1	1	1	0	1	1	0	0	0	0
Hexadella racovitzai	0	1	1	1	0	0	0	0	0	0	1	0
Halisarca dujardini	0	1	1	1	0	1	1	1	0	1	0	0
Dysidea fragilis	1	1	1	1	1	1	1	1	0	0	1	1
Dysidea avara	1	0	0	1	1	1	1	1	1	0	0	0
Spongia officinalis	1	1	1	1	1	0	1	1	1	1	1	1
Spongia agaricina	1	0	0	1	0	1	0	0	0	1	0	0
Spongia virgultosa	1	1	0	1	1	0	1	1	0	1	1	1
Hyppospongia communis	0	1	1	1	1	0	1	1	1	0	0	0
Oligoceras collectrix	0	1	1	1	0	1	1	0	0	0	0	0
Ircinia fasciculata	1	1	1	1	1	1	1	1	1	1	1	0
Ircinia variabilis	1	1	1	1	1	1	1	1	1	1	1	0
Ircinia dendroides	1	1	1	1	0	1	1	1	0	0	0	0
Ircinia oros	0	1	1	1	1	0	0	0	0	1	0	0
Sarcotragus spinosula	1	1	1	1	1	1	1	1	1	0	0	0
Sarcotragus muscarum	0	0	1	1	1	1	0	1	1	0	1	0
Cacospongia scalaris	1	1	1	1	1	0	1	1	1	0	1	0
Cacospongia mollior	1	1	1	1	1	0	1	1	0	1	1	1
Merlia normani	0	0	1	0	0	0	1	0	0	0	1	0

TABLE II. Presence-absence of species of Balearic sponges in the world biogeographical units: A, Arctic; B, Boreal; E, Mauritanian-Senegalian; L, Lusitanian; M, remainder of the Mediterranean; N, Antarctic; P, Indo-Pacific; S, South Atlantic; W, West Atlantic. *Presencia-ausencia de especies de esponjas baleares en las unidades biogeográficas mundiales: A, Ártica; B, Boreal; E, Mauritano-senegaliense; L, Lusitánica; M, resto del Mediterráneo; N, Antártica; P, Indopacífica; S, Atlántica sur; W, Atlántica occidental.*

	A	B	L	M	E	S	W	P	N
Clathrina clathrus	0	1	1	1	0	0	0	1	0
Clathrina coriacea	1	1	1	1	1	0	0	1	1
Clathrina contorta	0	1	0	0	0	0	0	0	0
Sycon raphanus	1	1	1	1	1	0	0	0	0
Leuconia nivea	0	1	1	1	0	0	0	1	0
Leuconia variabilis	1	1	1	0	0	0	0	0	0
Oscarella lobularis	1	1	1	1	1	0	0	0	1
Plakina trilopha	0	0	0	1	1	0	0	1	1
Geodia cydinium	1	1	1	1	1	0	0	1	0
Erylus euastrum	0	0	1	1	1	0	1	1	0
Penares helleri	0	0	0	1	1	0	0	0	0
Stryphnus mucronatus	0	0	0	1	0	0	0	0	0
Pachastrella monilifera	0	0	1	1	1	1	1	1	1
Poecillastra compressa	1	1	1	1	1	0	0	1	1
Caltropella pathologica	0	0	1	1	0	0	0	0	0
Dercitus plicatus	0	0	0	1	1	0	0	0	0
Chondrosia reniformis	0	0	1	1	1	0	0	0	0
Jaspis johnstoni	0	0	1	1	1	0	1	0	0
Tehya aurantium	1	1	1	1	1	1	1	1	1
Aaptos aaptos	0	0	0	1	1	0	1	1	1
Polymastia polytylota	0	0	0	1	0	0	0	0	0
Weberella verrucosa	0	0	0	1	0	0	0	0	0
Pseudosuberites sulphureus	1	1	1	1	1	0	0	1	0
Pseudosuberites hyalinus	1	1	1	1	0	1	0	1	0
Prosuberites longispina	0	0	1	1	1	0	0	0	0
Prosuberites rugosus	0	0	0	1	0	0	0	0	0
Prosuberites epiphytum	1	1	1	1	1	1	1	1	1
Laxosuberites rugosus	0	0	0	1	0	0	0	1	0
Laxosuberites ectyoninus	0	1	0	1	0	0	0	0	0
Terpios fugax	0	1	1	1	1	0	0	1	0
Suberites domuncula	1	1	1	1	1	0	0	1	0
S.carnosus typicus	1	1	1	1	0	0	1	1	0
S.carnosus incrustans	1	1	1	1	0	1	1	0	0
Rhizaxinella pyrifera	0	0	1	1	0	0	0	0	0
Spirastrella cunctatrix	0	0	1	1	1	0	1	1	0
Timea hallezi	1	1	1	0	0	1	0	0	0
Timea unistellata	0	1	0	1	1	0	0	1	0
Timea mixta	0	0	0	1	1	0	0	0	0
Diplastrella bistellata	0	0	1	1	1	0	0	0	0
Cliona celata	1	1	1	1	1	0	1	1	0
Cliona viridis	1	1	1	1	1	0	1	1	0
Cliona schmidti	0	0	0	1	0	1	0	1	0
Cliona levispira	0	0	0	1	1	0	0	0	0
Latrunculia insignis	1	1	0	1	1	0	0	0	0
Axinella polypoides	0	1	1	1	1	0	0	0	0
Axinella damicornis	0	0	0	1	0	0	0	0	0
Axinella verrucosa	0	1	0	1	1	0	0	0	0
Axinella vaceleti	0	0	0	1	0	0	0	0	0
Axinella pseudominuta	0	0	0	0	0	0	0	0	0
Axinella pumila	0	0	0	1	0	0	0	0	0

	A	B	L	M	E	S	W	P	N
Acanthella acuta	0	0	0	1	1	0	0	0	0
Phakellia rugosa	1	1	0	1	0	0	0	0	0
Ceratopsiom minor	0	0	0	1	0	0	0	0	0
Bubaris carcisis	0	0	0	1	0	0	0	0	0
Bubaris subtyla	0	0	0	1	0	0	0	0	0
Monocrepidium vermiculatum	0	0	0	1	0	0	0	0	0
Rabdoploca curvispiculifera	0	0	0	1	0	0	0	0	0
Hymerhabdia oxytrunca	0	0	1	1	0	0	0	0	0
Halicnemia patera	0	1	0	1	1	0	0	0	0
Agelas oroides	0	0	0	1	1	0	0	0	0
Rhabderemia minutula	0	0	0	1	1	0	0	0	0
Raspaciona aculeata	0	1	1	1	0	0	0	1	0
Eurypon topsenti	0	1	0	1	0	0	0	0	0
Eurypon lacazei	0	1	1	1	1	0	0	0	0
Eurupon clavatum	1	1	1	1	1	0	0	0	0
Eurypon major	0	1	0	1	0	0	0	0	0
Tricheurypon viride	0	1	0	1	1	0	1	0	0
Rhabdeurypon spinosum	0	0	0	1	0	0	0	0	0
Mycale massa	0	0	0	1	1	0	1	0	0
Mycale contarenii	1	1	1	1	1	0	0	0	0
Mycale srynx	0	0	1	1	1	0	0	0	0
Hamacantha falcula	1	1	1	1	1	0	0	0	0
Biemna peachi	1	1	1	1	0	0	0	0	0
Tylodesma rosea	0	1	1	0	0	0	0	0	0
Sygmatoxella annexa	0	1	1	1	0	0	1	1	0
Crambe crambe	0	1	1	1	0	0	0	0	0
Crambe tailliezi	0	0	0	1	0	0	0	0	0
Crella pulvinar	0	0	0	1	1	0	0	0	0
Crella sigmata	0	0	1	1	0	0	0	0	0
Crella rosea	0	0	1	1	1	0	0	0	0
Lissodendoryx cavernosa	0	0	0	1	0	0	0	0	0
Lissodendoryx basispino	0	0	0	1	0	0	0	0	0
Myxilla rosacea	1	1	1	1	1	1	1	1	0
Hymedesmia pansa	0	1	1	1	1	0	0	0	0
Hymedesmia versicolor	0	1	0	1	0	0	0	0	0
Hymedesmia peachi	1	1	0	1	1	0	0	0	0
Hymedesmia dujardini	1	1	1	1	0	0	0	0	0
Hymedesmia baculifera	1	1	0	1	1	0	0	0	0
Phorbas coriaceus	1	1	0	1	1	0	0	0	0
Phorbas fictitius	0	1	1	1	1	0	0	0	0
Phorbas tenacior	0	0	0	1	1	0	0	0	0
Phorbas dendyi	0	1	1	0	0	0	0	0	0
Hamigera hamigera	0	0	0	1	0	0	0	0	0
Pronax dives	0	1	1	1	0	0	0	0	0
Pronax fibulatum	0	0	0	1	0	0	0	0	0
Plocamione dirrhopalina	0	0	1	0	0	0	0	0	0
Microciona duplex	0	0	0	1	0	0	0	0	0
Microciona tenuissima	0	1	0	0	0	0	0	0	0
Microciona armata	1	1	0	1	1	0	0	0	0
Microciona gradalis	0	1	0	1	1	0	0	0	0

TABLE II (Continuation)

	A	B	L	M	E	S	W	P	N
Microciona spinarcus	1	1	0	1	1	1	0	0	0
Microciona atrassanguinea	0	1	1	1	0	0	0	1	0
Halichondria tenuiderma	1	0	0	0	0	0	0	0	0
Raphisia spelea	0	0	0	1	0	0	0	0	0
Spongosorites flavens	0	0	0	1	0	0	0	0	0
Spongosorites genitrix	0	1	1	1	1	0	0	0	0
Spongosorites intrincat	0	1	0	1	0	0	0	0	0
Spongosorites cavernicola	0	0	0	0	0	0	0	0	0
Topsentia contorta	0	0	0	1	0	0	0	0	0
Topsentia garciae	0	0	0	0	0	0	0	0	0
Scopalina lophyropoda	0	0	0	1	0	0	0	1	0
Scopalina azurea	0	0	0	0	0	0	0	0	0
Dictyonella marsillii	0	0	0	1	0	0	0	0	0
Dictyonella incisa	1	1	0	1	1	0	0	0	0
Dictionella plicata	0	0	0	1	0	0	0	0	0
Hemimycale columella	1	1	1	1	1	0	0	0	0
Haliclona elegans	0	1	0	1	1	0	0	0	0
Haliclona limbata	0	0	0	1	0	0	0	0	0
Haliclona cinerea	1	1	1	1	0	0	0	1	0
Haliclona subtylis	0	0	0	1	0	0	0	0	0
Reniera rosea	0	1	0	1	0	0	0	1	0
Reniera fulva	0	0	0	1	0	0	0	0	0
Reniera mucosa	0	0	0	1	0	0	0	0	0
Reniera cratera	0	0	0	1	0	0	0	1	0
Reniera valliculata	0	0	0	1	0	0	0	0	0
Reniera plana	0	0	0	1	1	0	0	0	0
Reniera clavata	1	0	0	0	0	0	0	0	0
Gellius uncinatus	0	0	0	1	0	0	0	0	0
Gellius flagellifer	1	1	1	1	1	1	0	1	0
Gellius angulatus	0	1	1	1	1	1	0	1	0
Gellius lacazei	0	0	0	1	1	0	0	0	0
Adocia simulans	0	1	0	1	1	0	0	0	0
Siphonochalina balearica	0	0	0	1	0	0	0	0	0
Rizhoniera rhizopora	0	0	0	1	0	0	0	0	0
Dendroxea lenis	0	0	0	1	1	0	0	0	0
Pellina semitubulosa	0	0	0	1	1	0	0	1	0
Petrosia ficiformis	0	0	1	1	1	0	0	0	0
Aplysilla sulphurea	1	1	1	1	0	0	0	1	1
Aplysilla rosea	1	1	1	1	1	0	0	0	0
Pteraplysilla spinifera	0	0	0	1	0	0	0	1	0
Hexadella racovitzai	0	1	0	1	1	0	0	0	0
Halisarca dujardini	1	1	0	1	1	1	0	1	1
Dysidea fragilis	1	1	1	1	1	1	1	1	1
Dysidea avara	1	1	1	1	0	0	0	0	0
Spongia officinalis	0	1	1	1	0	0	0	0	0
Spongia agaricina	0	0	1	1	0	0	0	0	0
Spongia virgultosa	0	0	0	1	0	1	0	0	0
Hyppospongia communis	0	0	1	1	0	0	0	0	0
Oligoceras collectrix	0	0	1	1	0	0	0	0	0
Ircinia fasciculata	0	1	1	1	1	0	0	1	0
Ircinia variabilis	0	0	1	1	1	0	1	1	0
Ircinia dendroides	0	0	1	1	1	0	0	0	0
Ircinia oros	0	0	0	1	0	0	0	0	0
Sarcotragus spinosula	1	1	1	1	0	0	0	0	0
Sarcotragus muscarum	0	0	1	1	1	0	0	0	0
Cacospongia scalaris	0	0	1	1	1	0	0	0	0
Cacospongia mollior	0	0	1	1	1	0	0	0	0
Merlia normani	0	0	1	0	0	0	0	0	0

TABLE III. Biogeographical composition of the porifera fauna of the Mediterranean and of two of the areas considered in the text. 1: Vacelet (1980); 2: Martínez-Inglés (1992); 3: this study. *Composición biogeográfica de la fauna de poríferos del Mediterráneo y de dos de las áreas consideradas en el texto. 1: Vacelet (1980); 2: Martínez-Inglés (1992); 3: este estudio.*

Category	Demospongiae, Mediterranean (1)	Demospongiae + Calcareous, Alicante coast (2)	Demospongiae + Calcareous, Balearic Is. (3)
Endemic	202 (44.6%)	9 (17%)	34 (21.5%)
Lusitanian -Boreal	115 (24.7%)	31 (60.8%)	98 (62%)
Cosmopolitan	75 (16.5%)	- (19.6%)	17 (10.7%)
Mauritanian -Senegalian	15 (3.3%)	30 (58,8%)	74 (46.8%)
Indo-Pacific	12 (2.6%)	17 (33.3%)	39 (24.6%)

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