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Biodiversity and structure of rocky reef fish assemblages in the Sierra Helada Natural Park (South–western Mediterranean Sea)

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Abstract

Biodiversity and structure of rocky reef fish assemblages in the Sierra Helada Natural Park (South–western Mediterranean Sea).— In the present study the fish assemblages in the rocky–bottom habitat of the Sierra Helada Natural Park (Alicante, Spain) were recorded to provide data for future evaluation of any changes induced by long–term management. Visual censuses were carried out along strip transects by Scuba diving on rocky bottoms at depths between 1 and 32 m. In the seven localities sampled, 44 species were recorded. Number of species, abundance, biomass and size structure values recorded did not show differences between high and low protection areas. Species composition was similar to other marine protected areas of the western–Mediterranean. The main differences found between localities can be attributed to the high heterogeneity and complexity of the habitat at smaller spatial scales.

Key words: Fish assemblages, Rocky bottom, Biodiversity, Distribution, Visual census, Mediterranean sea

Resumen

Biodiversidad y estructura de la comunidad íctica litoral sobre sustrato rocoso del Parque Natural de Sierra Helada (sudoeste del mar Mediterráneo).— En el presente estudio se analiza la comunidad íctica litoral sobre sustrato rocoso del Parque Natural de Sierra Helada (Alicante, España) y se aportan datos de base que permitirán evaluar a largo plazo los cambios debidos a diferentes medidas de gestión. Se realizaron censos visuales en transectos lineales sobre fondos rocosos entre 1 y 32 m de profundidad. En las siete localidades estudiadas se contaron 44 especies. El número de especies, abundancia, biomasa y estructura de tallas fueron similares entre las zonas con alta y baja protección. La composición de especies observada fue similar a los de otras áreas marinas protegidas del Mediterráneo occidental. Las diferencias entre localidades podrían ser causadas por la alta heterogeneidad y complejidad del hábitat a pequeña escala.

Palabras clave: Comunidad íctica, Fondos rocosos, Biodiversidad, Distribución, Censos visuales, Mar Mediterráneo

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Introduction

Fishes are the main group of marine vertebrates and an important component of the marine biodiversity of the rocky Mediterranean infralittoral habitats. Their ecological role in the functioning of the ecosystems is often key to the structure and dynamics of marine communities. This may be due to either their position in the trophic chain or to the influence of their interactions with other fish, invertebrates and macroalgae (competition, depredation, parasitism). Furthermore, fishing has been practised in the area since ancient times and is a traditional source of economic activity.

Fish distribution patterns are influenced by biological and physical factors, such as variations in depth (Dufour et al., 1995), habitat structure resulting in differential availability of resources such as food or shelter (García–Charton et al., 2004), climatic differences (Holbrook et al., 1997), predation (Hixon, 1991), competition (Gladfelter et al., 1980), episodic disturbances (Chabanet et al., 1995), larval dynamics (Leis & McCormick, 2002), and recruitment variability (Booth & Brosnan, 1995). Additionally, in some places, management can promote differences in the fish assemblage depending on the level of protection applied (Russ, 2002). Many studies have shown significant relationships between fish assemblage and habitat structure (e.g. Jenkins & Weatley, 1998). Habitat structure may strongly affect fish assemblages and many marine protected areas have been chosen due to their intrinsic complex seascape. The most reasonable way to achieve better management and understanding of the functioning of these rocky habitats, particularly in the case of marine protected areas (MPAs), fishing areas or even artificial structures, is to have the best possible knowledge of the manner in which fish assemblages respond to this habitat complexity. In this way, it may be possible to avoid confusion between variability that is due to natural factors and effects derived from management.

Marine protected areas are being established worldwide at a rapid rate. Locations with important ecological and socio–economic features are being managed to protect habitats and biological richness, and restore fishing stocks and degraded areas (Agardy, 2000). In this framework, the study of spatial pattern of fish assemblages is crucial as a first step to understanding the causes of their distribution and abundance (Levin, 1992) and to provide a basis for monitoring their long–term changes due to both natural and human disturbances (Underwood, 1990). The Sierra Helada Natural Park (Alicante, Spain – Western Mediterranean) was constituted as a Natural Park with an extensive marine protected area (4920 ha) in 2005 (DOGV nº 4967, 16/03/05). The great heterogeneity of the bottoms, where a large number of the more characteristic benthic communities of the west and central Mediterranean are found, and their good state of conservation make the Sierra Helada an ideal place for the study of fish communities and the factors that determine their structure in the oligotrophic areas of the south–western Mediterranean. It is clear that to manage these marine protected areas and to adopt measures of conservation and regulation, it is necessary to define the criteria of action. To do so, we need to increase our knowledge on the different types of habitats and the species present in the area. The aim of this study was to characterize the fish assemblages inhabiting the rocky reefs in the Sierra Helada Natural Park (western Mediterranean Sea) in order to determine species composition, defining the distribution and quantifying population abundance, biomass and size structure. Moreover, the selection of the study localities in areas that are affected by different management measures should provide a baseline for future evaluations of the changes produced by management and a source of data for future meta–analysis.

Material and methods

Study site and sampling design

The study was carried out in the Sierra Helada Natural Park (Alicante coast, Spain, SW–Mediterranean). The littoral zone is characterised by the large abundance and diversity of rocky infralittoral bottoms, composed primarily of boulders of diverse sizes interspersed with patches of sand and Posidonia oceanica seagrass meadow (DOGV nº 4967, 16/03/05). Wide zones with rocky blocks larger than 0.5 m in height, without patches of Posidonia oceanica and without sand were selected, ranging from 1 to 32 m depth. Seven areas were sampled in summer, between June and August 2007.

We selected three specially protected areas, Benidorm island, Mitjana island and Mascarat–Toix, where a number of activities (anchoring, fishing, motor–sailing, aquaculture) are forbidden but others are allowed (swimming, snorkelling, windsurfing, sailing, scientific research). The other four localities selected in this study have a lower level of protection (L'Olla island, Punta Albir, Punta Caballo and Finestrat) (fig. 1, table 1).

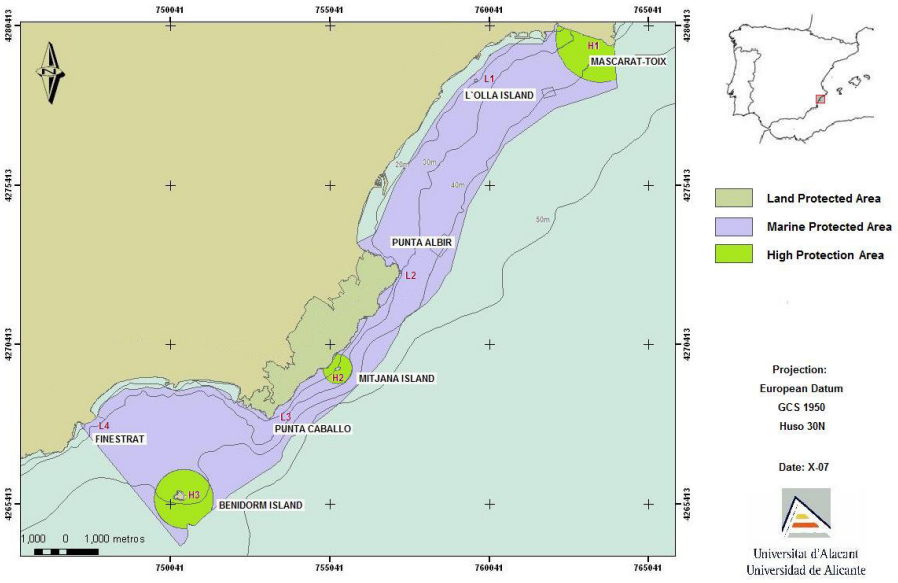

Fig. 1. Map of study area showing limits and zonation. The position of the localities sampled at each protection level is also indicated: H1. High protection locality one; H2. High protection locality two; H3. High protection locality three; L1. Low protection locality one; L2. Low protection locality two; L3. Low protection locality three; L4. Low protection locality four.

Fig. 1. Mapa del área de estudio mostrando los límites y las zonas. Se indica también la posición de las localidades muestreadas para cada nivel de protección: H1. Localidad uno de alta protección; H2. Localidad dos de alta protección; H3. Locadidad tres de alta protección; L1. Localidad uno de baja protección. L2. Localidad dos de baja protección; L3. Localidad tres de baja protección; L4. Localidad cuatro de baja protección.

Table 1. Geographical coordinates of the study locations using UTM (Universal Transversal Mercator). (For other abbreviations see fig. 1.)
Tabla 1. Coordenadas geográficas de las localidades de estudio usando UTM (Universal Transversal Mercator). (Para otras abreviaturas, ver fig. 1.)

Localities	Code	Geographical zone	Latitude (X)	Longitude (Y)
L'Olla Island	L1	30S	759576 E	4278430 N
Punta Albir	L2	30S	757153 E	4272566 N
Punta Caballo	L3	30S	753025 E	4267852 N
Finestrat	L4	30S	747502 E	4267789 N
Mascarat–Toix	H1	31S	241052 E	4279618 N
Mitjana Island	H2	30S	755096 E	4269481 N
Benidorm Island	H3	30S	750353 E	4265542 N

Underwater visual census and data analysis

Fish assemblages were visually surveyed by scuba diving (Harmelin–Vivien et al., 1985) along each 25 x 5 m strip transect, recording the abundances and individual sizes in 2 cm size classes for each species encountered. Several observers participated in the sampling operations, after several training sessions. It has been observed in previous studies that fish counts, size estimations and habitat measurements do not differ significantly among trained observers (Bell et al., 1985). Small–sized, cryptic species (belonging to families Gobiidae, Callyonimidae, Bleniidae, Gobioesocidae and Tripterygidae) were excluded from the censuses to avoid biases. Each observation was assigned to one of nine predetermined abundance classes proposed by Harmelin (1987), the limits of which coincide with the terms of a geometric series (base 2). Geometric means of each fish abundance class were used for calculations. All censuses were done between 10:00 and 15:00 h, with optimal water conditions (turbidity and swell). These sampling methods have been used extensively in MPAs because they are non–destructive and guarantee that the fish community is not affected by sampling. Interference with previous evaluations of the effects of protection is avoided, and a high degree of consistency of gathered data among observers is maintained over time (i.e., performance to survey the most visually observable fraction of the fish with the same efficiency) (Harmelin–Vivien & Francour, 1992).

After counting fishes, the same observer covered the transect length in the opposite direction to record data on the habitat heterogeneity and complexity within each transect. We visually measured (i) the relative percentage of cover of different substrate types (rock, clumps of *Posidonia oceanica* over rock, and patches of sand), (ii) the number of rocky boulders (classified by the size of their major length [ML]: small [ML $\leq$ 1 m], medium [1 m < ML $\leq$ 2 m], and large [ML>2 m]) and (iii) the maximum depth and a verticality index (vertical distance between the deepest and shallowest point inside each transect). Fish species biomass was estimated from the abundance data by size–classes within each transect, using weight–length relationships calculated from experimental and commercial fishing data obtained in the same geographical area.

Table 2. Number of census (N) and medium values of habitat heterogeneity and complexity carried on low and high protection areas: SEM. Standard error of the mean.
Tabla 2. Número de censos (N) y valores medios de la heterogeneidad y complejidad del hábitat realizados en áreas de baja y alta protección: SEM. Error estándar de la media.

	Medium values (± SEM)			
	Low protection area			
	L'Olla Island	**Punta Albir**	**Punta Caballo**	**Finestrat**
N	5	17	14	4
Rock (%)	67,00 ± 10,44	87,29 ± 3,02	76,28 ± 4,58	96,25 ± 2,39
Min. depth (m)	4,20 ± 0,80	10,75 ± 1,63	3,55 ± 0,31	1,75 ± 0,32
Máx. depth (m)	5,30 ± 0,94	12,72 ± 1,64	4,67 ± 0,30	3,45 ± 0,26
Verticality (m)	2,20 ± 0,37	5,07 ± 1,29	2,05 ± 0,26	1,12 ± 0,37
Number of boulders	8,40 ± 2,63	18,85 ± 3,43	18,50 ± 5,15	12,50 ± 1,19
Number of blocks	3,60 ± 0,97	10,35 ± 1,75	5,50 ± 1,40	11,00 ± 1,00
Number of big blocks	5,40 ± 1,07	10,71 ± 3,00	2,28 ± 0,72	5,50 ± 1,65

	High protection area		
	Mascarat–Toix	**Mitjana Island**	**Benidorm Island**
N	16	11	26
Rock (%)	76,50 ± 4,15	88,63 ± 4,37	97,11 ± 1,04
Min. depth (m)	7,75 ± 0,78	4,95 ± 0,41	12,97 ± 1,53
Max depth (m)	9,53 ± 0,79	10,68 ± 1,48	15,93 ± 1,60
Verticality (m)	2,81 ± 0,77	3,00 ± 0,26	2,84 ± 0,77
Number of boulders	11,43 ± 2,29	9,09 ± 1,92	13,61 ± 3,95
number of blocks	4,75 ± 0,72	10,18 ± 3,17	2,61 ± 0,49
Number of big blocks	3,50 ± 0,83	6,54 ± 0,87	3,57 ± 0,69

Results

We carried out a total of 93 census in all study localities, 40 of these in low protection areas and 53 in higher ones (table 2). The highest percentages for rocky habitat and maximum depth were in Benidorm Island (97,11 ± 1,04% and 15,93 ± 1,60 m depth). The lowest values of minimum depth and verticality were in Finestrat (1,75 ± 0,32 m and 1,12 ± 0,37 m, respectively). The highest values of verticality (5,07 ± 1,29 m) and highest number of boulders, blocks and big blocks were in Punta Albir.

We observed a total of 44 fish species (belonging to 17 families); 11 of these species appeared in all localities (annex 1). In terms of species richness, between 15 and 33 species appeared in low protection areas, whereas in high protection areas we observed between 26 and 31 species. High protection areas showed a relatively higher abundance and higher biomass values than low protection areas. The highest mean total abundance was recorded in Mitjana Island (411,14 ± 34,28 individuals/125 m^2), while the lowest value was recorded in Finestrat (54,25 ± 1,18

individuals/125 m^2) (table 3). The 6 most abundant species in the study area were *Chromis chromis, Sarpa salpa, Diplodus vulgaris, Diplodus sargus, Oblada melanura* and *Coris julis*. The highest mean total biomass ranged between a maximum of 13345,319 ± 1605,896 g/125 m^2 in Mitjana Island, and a minimum of 1133,85 ± 28,370 g/125 m^2 in Finestrat (table 4). The species that showed the highest values of biomass in the study area were *D. vulgaris, D. sargus, S. salpa* and *C. chromis*. Ten species (*C. julis, Symphodus ocellatus, S. roissalii, S. tinca, Thalassoma pavo, Serranus scriba, Diplodus cervinus, D. vulgaris, O. melanura* and *S. salpa*) were very common and appeared in every site. Other species like *Sardina pilchardus, Mugil* spp., *Boops boops, Scorpaena* spp., *Phycis phycis, Symphodus doderleini, Mycteroperca rubra, Lithognatus mormyrus* and *Pagrus* spp. were recorded with very low frequencies.

Large sparids showed the highest abundance values for size 2 (table 5), and they were most abundant at Mitjana Island. Small sparids, however, were widely distributed, and the highest value was size 2, also at Mitjana Island. Large serranids were less abundant than smaller serranid, and both had highest values of size 2. Large labrids were frequent throughout the study area, with highest values of size 3 and 4. A similar occurrence was observed for small labrids where sizes 2 and 3 recorded the highest abundance values. The other commercial species, red mullet (*Mullus surmuletus*) and brown meagre (*Sciaena umbra*), exhibited the highest abundance values of size 2, but size 4 was recorded frequently in high protection areas in both cases. Biomass recorded for large and small sparids showed a maximum value in size 2 and the highest sizes were recorded in Benidorm and Mitjana Islands (table 6). Large serranids showed the highest values of biomass in size 2, and small serranids were more frequent in size 3. Large and small labrids exhibited higher biomass values in sizes 4 and 3, respectively. The highest size of red mullets was recorded in Mascarat–Toix, a high protection area, and the maximum of biomass was size 2. The highest size and biomass values for brown meagre were observed in Benidorm Island.

Discussion

In terms of composition, the rocky reef fish assemblages of the Sierra Helada Natural Park were similar to those recorded in other marine protected areas in the western–Mediterranean sea (e.g. Reñones et al., 1997; Forcada, 2004). Species richness, total abundance and biomass values recorded did not show great differences between high and low protection areas as regulations limiting fishing were not yet I enforced. The main differences found between localities can be attributed to differences in the heterogeneity and complexity of the habitat (García Charton et al., 2004). Those factors changed at a very small scale, conditioning the distribution and presence of fishes, and should be taken into account in order to assess the effect of protection without bias. Our findings suggest that the intrinsic complexity of the habitat in Mitjana and Benidorm Islands may favour the appearance of targeted species such as big serranids (*Epinephelus* spp.) or large sparids (*Dentex dentex*) when regulations are enforced.

Table 3. List of species observed, species richness (total number of species observed), mean specific and total abundance (individuals/125 m^2 ± standard error of the mean) recorded in each site of low and high protection areas.
Tabla 3. Lista de especies observadas, riqueza específica (número total de especies observadas), media por especie y abundancia total (individuos/125 m^2 ± error estándar de la media) registradas en cada tipo de áreas de baja y alta protección.

	Low protection area				High protection area		
Species	**L´Olla Island**	**Punta Albir**	**Punta Caballo**	**Finestrat**	**Mascarat–Toix**	**Mitjana Island**	**Benidorm Island**
Apogon imberbis	6,40 ± 4,53	2,00 ± 0,56	0,21 ± 0,21	0 ± 0	2,56 ± 1,28	0,36 ± 0,29	2,80 ± 1,50
Spicara maena	0 ± 0	4,17 ± 4,17	0,64 ± 0,64	0 ± 0	0 ± 0	0,09 ± 0,09	0 ± 0
Sardina pilchardus	0 ± 0	1,05 ± 1,05	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Phycis phycis	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0,11 ± 0,06	0 ± 0
Pomadasys incisus	0 ± 0	0,06 ± 0,06	0,64 ± 0,57	0 ± 0	0 ± 0	70,09 ± 39,44	0 ± 0
Coris julis	8,00 ± 1,81	8,94 ± 1,27	4,21 ± 1,07	3,75 ± 1,43	4,75 ± 1,19	4,27 ± 1,17	7,92 ± 1,99
Labrus merula	0,40 ± 0,24	0,29 ± 0,14	0,14 ± 0,09	0 ± 0	0,31± 0,11	0,27 ± 0,20	0,07 ± 0,05
Symphodus cinereus	0 ± 0	0,11 ± 0,11	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Symphodus doderleini	0 ± 0	0 ± 0	0,07 ± 0,07	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Symphodus mediterraneus	0 ± 0	0,23 ± 0,10	0,71 ± 0,71	0 ± 0	0,18 ± 0,10	0 ± 0	0,15 ± 0,09
Symphodus melanocercus	0 ± 0	0,11 ± 0,11	0,78 ± 0,71	0 ± 0	0,06 ± 0,06	0 ± 0	0 ± 0
Symphodus ocellatus	3,20 ± 1,93	1,35 ± 0,42	0,28 ± 0,28	0,75 ± 0,47	1,50 ± 0,61	0,36 ± 0,21	0,07 ± 0,05
Symphodus roissalii	0,80 ± 0,37	0,11 ± 0,08	0,42 ± 0,17	0,75 ± 0,47	0,68 ± 0,31	0,27 ± 0,20	0,11 ± 0,06
Symphodus tinca	1,20 ± 0,58	3,17 ± 0,87	1,5 ± 0,4	1,75 ± 0,85	2,75 ± 0,56	3,09 ± 0,85	0,61 ± 0,16
Thalassoma pavo	1,00 ± 0,31	2,17 ± 0,67	5,71 ± 1,36	0,50 ± 0,28	0,93 ± 0,23	3,00 ± 1,42	5,19 ± 2,14
Liza aurata	0 ± 0	1,06 ± 1,06	0 ± 0	0 ± 0	0 ±0	0 ± 0	0,73 ± 0,73
Mugil spp.	0 ± 0	0 ± 0	0 ± 0	5,75 ± 4,80	0 ±0	0 ± 0	0 ± 0
Mullus surmuletus	0 ± 0	0,41 ± 0,24	0,21 ± 0,11	4,50 ± 4,50	1,18 ± 0,8	0,91 ± 0,38	0,42 ± 0,25
Muraena helena	0,20 ± 0,20	0 ± 0	0,07 ± 0,07	0 ± 0	0,06 ± 0,06	0 ± 0	0,07 ± 0,07
Chromis chromis	37,00 ± 21,01	108,05 ± 32,02	118,28 ± 48,52	0 ± 0	45,31 ± 13,61	283,63 ± 75,74	99,42 ± 23,96
Sciaena umbra	0 ± 0	0,11 ± 0,08	0,14 ± 0,09	0 ± 0	0 ± 0	0 ± 0	0,88 ± 0,66
Scorpaena porcus	0 ± 0	0,06 ± 0,06	0 ± 0	0 ± 0	0 ± 0	0,18 ± 0,12	0 ± 0
Scorpaena scrofa	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0,03 ± 0,03
Anthias anthias	0 ± 0	0,11 ± 0,11	0 ± 0	0 ± 0	0 ± 0	0 ± 0	6,96 ± 3,37

Table 3. (Cont.)

	Low protection area				High protection area		
Species	**L´Olla Island**	**Punta Albir**	**Punta Caballo**	**Finestrat**	**Mascarat–Toix**	**Mitjana Island**	**Benidorm Island**
Epinephelus marginatus	0 ± 0	0,11 ± 0,08	0,07 ± 0,07	0 ± 0	0 ± 0	0 ± 0	0,04 ± 0,04
Mycteroperca rubra	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0,04 ± 0,04
Serranus cabrilla	0 ± 0	0,82 ± 0,38	0,28 ± 0,16	0 ± 0	0,06 ± 0,06	0,27 ± 0,20	1,11 ± 0,23
Serranus scriba	1,20 ± 0,37	1,41 ± 0,33	1,35 ± 0,32	0,25 ± 0,25	1,81 ± 0,39	1,54 ± 0,57	1,03 ± 0,27
Boops boops	0 ± 0	0 ± 0	1,28 ± 1,28	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dentex dentex	0,2 ± 0,2	0,11 ± 0,11	0,78 ± 0,71	0 ± 0	0,06 ± 0,06	0 ± 0	0,42 ± 0,12
Diplodus annularis	1,60 ± 0,97	1,00 ± 0,36	0,28 ± 0,19	0 ± 0	2,12 ± 1,08	0,63 ± 0,40	0,30 ± 0,23
Diplodus cervinus	0,40 ± 0,24	0,05 ± 0,05	0,21 ± 0,11	0,25 ± 0,25	0,12 ± 0,08	0,36 ± 0,21	0,27 ± 0,10
Diplodus puntazzo	0 ± 0	0,29 ± 0,11	0,14 ± 0,09	0 ± 0	0,25 ± 0,14	0,36 ± 0,21	0,84 ± 0,35
Diplodus sargus	3,00 ± 1,41	6,94 ± 1,68	14,42 ± 4,08	6,75 ± 1,65	10,18 ± 2,44	36,36 ± 11,91	9,57 ± 1,94
Diplodus vulgaris	3,40 ± 1,03	15,00 ± 2,47	16,85 ± 4,27	7,75 ± 1,10	17,56 ± 5,13	164,45 ± 73,04	21,04 ± 5,16
Lithognathus mormyrus	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0,27 ± 0,20	0 ± 0
Oblada melanura	55,20 ± 22,67	3,64 ± 1,73	188,28 ± 86,41	0,75 ± 0,25	6,50 ± 3,55	18,36 ± 14,22	0,46 ± 0,24
Pagrus auriga	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0,06 ± 0,06	0 ± 0	0 ± 0
Pagellus erythrinus	0 ± 0	0,11 ± 0,08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Pagrus pagrus	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0,37 ± 0,15	0 ± 0	0,65 ± 0,38
Sparus aurata	0 ± 0	0,11 ± 0,08	0,07 ± 0,07	0 ± 0	0,12 ± 0,12	0,09 ± 0,09	0,11 ± 0,08
Spondyliosoma cantharus	0 ± 0	0,17 ± 0,12	0,07 ± 0,07	0,25 ± 0,25	0,06 ± 0,06	26,45 ± 14,18	0,42 ± 0,24
Sarpa salpa	38,60 ± 15,42	8,82 ± 3,43	21,00 ± 5,95	11,50 ± 4,33	12,37 ± 4,44	50,63 ± 18,15	6,30 ± 2,05
Sphyraena sphyraena	0 ± 0	0 ± 0	0 ± 0	9,00 ± 5,19	0 ± 0	6,45 ± 6,76	0,03 ± 0,03
Mean total abundance	135,25 ± 6,47	173,8 ± 16,31	354,71 ± 27,99	54,25 ± 1,18	114,26 ± 8,41	411,14 ± 34,28	186,46 ± 15,50
Species richness	17	33	30	15	26	26	31

Table 4. List of species observed, mean specific and total biomass (gr/125 m^2 ± standard error of the mean) recorded in each site of low and high protection areas.
Tabla 4. Lista de especies observadas, biomasa específica media y total (gr/125 m^2 ± error estándar de la media) registradas en cada lugar de las áreas de baja y alta protección.

	Low protection area				High protection area		
Species	**L´Olla Island**	**Punta Albir**	**Punta Caballo**	**Finestrat**	**Mascarat–Toix**	**Mitjana Island**	**Benidorm Island**
Apogon imberbis	86,28 ± 43,86	13,20 ± 3,56	0,7 ± 0,7	0 ± 0	40,90 ± 20,55	5,80 ± 4,45	17,82 ± 7,26
Spicara maena	0 ± 0	31,64 ± 31,64	2,8 ± 2,8	0 ± 0	0 ± 0	0,69 ± 0,69	0 ± 0
Sardina pilchardus	0 ± 0	63,29 ± 63,29	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Phycis phycis	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	34,04 ± 23,51
Pomadasys incisus	0 ± 0	3,7 ± 3,7	40,40 ± 35,84	0 ± 0	0 ± 0	6024,89 ± 3312,16	0 ± 0
Coris julis	105,78 ± 18,13	110,08 ± 18,46	47,20 ± 15,06	45,15 ± 19,07	68,10 ± 15,10	65,91 ± 23,11	92,10 ± 22,91
Labrus merula	128,06 ± 79,14	33,75 ± 17,53	7,33 ± 4,98	0 ± 0	45,61 ± 28,52	17,01 ± 13,95	13,84 ± 11,26
Symphodus cinereus	0 ± 0	1,60 ± 1,60	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Symphodus doderleini	0 ± 0	0 ± 0	0,93 ± 0,93	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Symphodus mediterraneus	0 ± 0	5,33 ± 2,77	19,42 ± 19,42	0 ± 0	5,35 ± 3,12	0 ± 0	4,25 ± 2,69
Symphodus melanocercus	0 ± 0	1,31 ± 1,31	12,33 ± 11,50	0 ± 0	0,70 ± 0,70	0 ± 0	0 ± 0
Symphodus ocellatus	13,68 ± 6,22	27,83 ± 12,91	0,76 ± 0,76	8,42 ± 5,05	18,56 ± 7,24	4,29 ± 2,27	0,51 ± 0,35
Symphodus roissalii	16,08 ± 9,44	1,26 ± 0,92	4,07 ± 1,62	8,97 ± 5,38	15,03 ± 6,00	3,92 ± 2,80	1,10 ± 0,65
Symphodus tinca	46,16 ± 26,89	205,66 ± 44,90	54,42 ± 15,32	111,92 ± 57,43	216,04 ± 38,55	123,47 ± 45,04	88,41 ± 24,41
Thalassoma pavo	9,68 ± 4,01	19,41 ± 7,34	29,98 ± 9,68	4,08 ± 3,53	13,11 ± 3,70	26,61 ± 10,72	48,42 ± 17,83
Liza aurata	0 ± 0	108,57 ± 108,57	0 ± 0	0 ± 0	0 ± 0	0 ± 0	335,24 ± 335,24
Mugil spp.	0 ± 0	0 ± 0	0 ± 0	126,50 ± 105,65	0 ± 0	0 ± 0	0 ± 0
Mullus surmuletus	0 ± 0	28,65 ± 17,59	9,32 ± 5,05	51,92 ± 51,92	52,83 ± 22,33	30,29 ± 13,34	15,78 ± 8,15
Muraena helena	101,1 ± 101,1	0 ± 0	14,37 ± 14,37	0 ± 0	40,97 ± 40,97	0 ± 0	20,03 ± 20,03
Chromis chromis	6,56 ± 3,72	703,57 ± 217,65	451,23 ± 245,51	0 ± 0	175,25 ± 50,14	2291,14 ± 579,66	999,68 ± 319,28
Sciaena umbra	0 ± 0	5,70 ± 3,97	4,73 ± 3,29	0 ± 0	0 ± 0	0 ± 0	196,07 ± 153,57
Scorpaena porcus	0 ± 0	6,02 ± 6,02	0 ± 0	0 ± 0	0 ± 0	10,89 ± 7,47	0 ± 0
Scorpaena scrofa	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	5,59 ± 5,59
Anthias anthias	0 ± 0	1,82 ± 1,82	0 ± 0	0 ± 0	0 ± 0	0 ± 0	146,48 ± 84,16
Epinephelus marginatus	0 ± 0	167,02 ± 129,10	85,78 ± 85,78	0 ± 0	0 ± 0	0 ± 0	71,40 ± 71,40

Table 4. (Cont.)

	Low protection area				High protection area		
Species	**L´Olla Island**	**Punta Albir**	**Punta Caballo**	**Finestrat**	**Mascarat–Toix**	**Mitjana Island**	**Benidorm Island**
Mycteroperca rubra	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	71,40 ± 71,40
Serranus cabrilla	0 ± 0	19,99 ± 9,72	3,02 ± 1,80	0 ± 0	1,79 ± 1,79	5,98 ± 4,05	33,86 ± 7,29
Serranus scriba	70,50 ± 34,95	35,58 ± 8,88	39,69 ± 9,95	5,50 ± 5,50	91,55 ± 31,68	45,82 ± 16,56	62,49 ± 20,56
Boops boops	0 ± 0	0 ± 0	7,17 ± 7,17	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dentex dentex	15,26 ± 15,26	16,58 ± 16,58	45,52 ± 38,17	0 ± 0	11,50 ± 11,50	0 ± 0	396,50 ± 171,72
Diplodus annularis	25,96 ± 18,86	55,38 ± 36,68	3,45 ± 2,48	0 ± 0	27,32 ± 9,53	12,25 ± 7,19	44,81 ± 38,76
Diplodus cervinus	16,22 ± 10,37	1,83 ± 1,83	25,91 ± 18,84	27,10 ± 27,10	18,73 ± 12,80	30,16 ± 16,37	146,16 ± 71,73
Diplodus puntazzo	0 ± 0	14,72 ± 7,51	4,44 ± 3,01	0 ± 0	76,95 ± 55,32	28,11 ± 16,04	277,60 ± 144,13
Diplodus sargus	122,50 ± 55,08	333,27 ± 87,86	685,50 ± 268,27	184,1 ± 38,06	668,17 ± 232,47	3108,97 ± 1298,84	1824,02 ± 399,78
Diplodus vulgaris	171,04 ± 70,80	624,34 ± 125,61	409,10 ± 93,78	163,85 ± 48,78	944,81 ± 317,38	8590,35 ± 5106,96	1795,57 ± 379,42
Lithognathus mormyrus	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	37,64 ± 25,85	0 ± 0
Oblada melanura	1631,12 ± 988,19	67,62 ± 34,14	67,00 ± 22,56	7,47 ± 3,04	149,49 ± 82,99	571,81 ± 465,75	143,51 ± 102,55
Pagrus auriga	0 ± 0	0 ± 0	0 ± 0	0 ± 0	5,23 ± 5,23	0 ± 0	0 ± 0
Pagellus erythrinus	0 ± 0	3,69 ± 2,99	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Pagrus pagrus	0 ± 0	0 ± 0	0 ± 0	0 ± 0	25,98 ± 12,08	0 ± 0	141,75 ± 84,94
Sparus aurata	0 ± 0	14,43 ± 9,88	8,76 ± 8,76	0 ± 0	20,48 ± 20,48	38,24 ± 38,24	125,51 ± 93,27
Spondyliosoma cantharus	0 ± 0	2,43 ± 1,77	0,98 ± 0,98	0,45 ± 0,45	0,50 ± 0,50	561,12 ± 293,27	12,89 ± 6,35
Sarpa salpa	1842,46 ± 725,92	771,92 ± 385,58	2308,59 ± 1804,12	341,87 ± 119,74	537,60 ± 169,39	4850,48 ± 1995,12	1259,32 ± 474,77
Sphyraena sphyraena	0 ± 0	0 ± 0	0 ± 0	46,52 ± 28,53	0 ± 0	3215,03 ± 3215,03	64,92 ± 64,92
Mean Total Biomass	3906,925 ± 295,359	3673,67 ± 352,655	1608,257 ± 103,21	1133,85 ± 28,370	3342,95 ± 249,506	8807,846 ± 13345,319	558,012 ± 1605,896

Table 5 . Mean total abundance (individuals/125 m^2 ± standard error of the mean) of different sizes within each group selected recorded in the study area.
Tabla 5. Abundancia total media (individuos/125 m^2 ± error estándar de la media) registrada para los distintos tamaños dentro de cada grupo seleccionado en el área de estudio.

Group Protection level **Localities**	**Size 1**	**Size 2**	**Size 3**	**Size 4**
Big sparids group (*Dentex dentex, Pagrus* spp.*, Pagellus erythrinus, Sparus aurata, Spondyliosoma cantharus*)				
Low protection areas				
L'Olla Island	0,03 ± 0,03	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0,04 ± 0,02	0,05 ± 0,02	0 ± 0	0 ± 0
Punta Caballo	0,14 ± 0,11	0,01 ± 0,01	0 ± 0	0 ± 0
Finestrat	0,04 ± 0,04	0 ± 0	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0,07 ± 0,03	0,04 ± 0,02	0 ± 0	0 ± 0
Mitjana Island	0,32 ± 0,27	4,09 ± 2,44	0,01 ± 0,01	0 ± 0
Benidorm Island	0,09 ± 0,06	0,12 ± 0,04	0,04 ± 0,02	0,01 ± 0,01
Small sparids group (*Diplodus* spp.)				
Low protection areas				
L'Olla Island	0,12 ± 0,06	1,40 ± 0,42	0,12 ± 0,08	0,04 ± 0,04
Punta Albir	0,29 ± 0,22	4,02 ± 0,81	0,27 ± 0,09	0,01 ± 0,01
Punta Caballo	0,35 ± 0,25	5,98 ± 1,44	0,04 ± 0,03	0 ± 0
Finestrat	0,40 ± 0,18	2,55 ± 0,76	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0,32 ± 0,22	4,97 ± 1,23	0,72 ± 0,19	0,02 ± 0,01
Mitjana Island	0,74 ± 0,70	38,98 ± 15,83	0,71 ± 0,41	0 ± 0
Benidorm Island	0,01 ± 0,01	3,67 ± 1,10	2,50 ± 0,49	0,16 ± 0,04
Big serranids *group* (*Epinephelus marginatus, Mycteroperca rubra*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0 ± 0	0,05 ± 0,04	0 ± 0	0 ± 0
Punta Caballo	0 ± 0	0,03 ± 0,03	0 ± 0	0 ± 0
Finestrat	0 ± 0	0 ± 0	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mitjana Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Benidorm Island	0 ± 0	0,02 ± 0,02	0,02 ± 0,02	0 ± 0

Table 5. (Cont.)

Group / Protection level / **Localities**	**Size 1**	**Size 2**	**Size 3**	**Size 4**
Small serranids group (*Serranus* spp.)				
Low protection areas				
L'Olla Island	0 ± 0	0,30 ± 0,15	0,30 ± 0,21	0 ± 0
Punta Albir	0,03 ± 0,03	1,00 ± 0,24	0,08 ± 0,06	0 ± 0
Punta Caballo	0,07 ± 0,07	0,64 ± 0,18	0,10 ± 0,05	0 ± 0
Finestrat	0 ± 0	0,12 ± 0,12	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0 ± 0	0,37 ± 0,11	0,56 ± 0,23	0 ± 0
Mitjana Island	0 ± 0	0,82 ± 0,92	0,09 ± 0,09	0 ± 0
Benidorm Island	0,02 ± 0,02	0,77 ± 0,16	0,21 ± 0,07	0,07 ± 0,04
Big labrids group (*Labrus merula, Symphodus tinca*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0,50 ± 0,26	0,30 ± 0,15
Punta Albir	0 ± 0	0,06 ± 0,04	0,47 ± 0,25	1,08 ± 0,34
Punta Caballo	0 ± 0	0,14 ± 0,06	0,50 ± 0,20	0,17 ± 0,07
Finestrat	0 ± 0	0 ± 0	0,25 ± 0,25	0,62 ± 0,32
High protection areas				
Mascarat–Toix	0,03 ± 0,03	0,03 ± 0,03	0,62 ± 0,24	0,50 ± 0,14
Mitjana Island	0 ± 0	0,32 ± 0,15	0,68 ± 0,25	0,68 ± 0,34
Benidorm Island	0 ± 0	0,02 ± 0,02	0,03 ± 0,02	0,15 ± 0,06
Small labrids group (*Symphodus* spp*., Coris julis, Thalassoma pavo*)				
Low protection areas				
L'Olla Island	0 ± 0	0,55 ± 0,25	0,85 ± 0,31	0,17 ± 0,08
Punta Albir	0 ± 0	0,69 ± 0,19	0,67 ± 0,17	0,14 ± 0,05
Punta Caballo	0,01 ± 0,01	0,92 ± 0,24	0,38 ± 0,11	0,13 ± 0,09
Finestrat	0 ± 0	0,25 ± 0,12	0,37 ± 0,17	0,03 ± 0,03
High protection areas				
Mascarat–Toix	0 ± 0	0,28 ± 0,10	0,40 ± 0,11	0,18 ± 0,05
Mitjana Island	0 ± 0	0,47 ± 0,17	0,36 ± 0,11	0,11 ± 0,07
Benidorm Island	0 ± 0	1,00 ± 0,29	0,57 ± 0,17	0,10 ± 0,02

Table 5. (Cont.)

Group Protection level **Localities**	**Size 1**	**Size 2**	**Size 3**	**Size 4**
Red mullet group (*Mullus surmuletus*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0 ± 0	0,05 ± 0,05	0,35 ± 0,24	0 ± 0
Punta Caballo	0 ± 0	0,21 ± 0,11	0 ± 0	0 ± 0
Finestrat	0 ± 0	4,50 ± 4,50	0 ± 0	0 ± 0
High protection reas				
Mascarat–Toix	0,43 ± 0,43	0,43 ± 0,37	0,25 ± 0,14	0,06 ± 0,06
Mitjana Island	0 ± 0	0,90 ± 0,36	0 ± 0	0 ± 0
Benidorm Island	0 ± 0	0,38 ± 0,25	0,03 ± 0,03	0 ± 0
Brown meagre group (*Sciaena umbra*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0 ± 0	0,11 ± 0,08	0 ± 0	0 ± 0
Punta Caballo	0 ± 0	0,14 ± 0,09	0 ± 0	0 ± 0
Finestrat	0 ± 0	0 ± 0	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mitjana Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Benidorm Island	0 ± 0	0 ± 0	0,73 ± 0,52	0,15 ± 0,15

Table 6. Mean total biomass (gr/125 m^2 ± standard error of the mean) of different sizes within each group selected recorded in the study area.
Tabla 6. Biomasa total media (gr/125 m^2 ± error estándar de la media) registrada en los distintos tamaños dentro cada grupo seleccionado en el área de estudio.

Groups Protection level **Localities**	**Size 1**	**Size 2**	**Size 3**	**Size 4**
Big sparids group (*Dentex dentex, Pagrus* spp.*, Pagellus erythrinus, Sparus aurata, Spondyliosoma cantharus*)				
Low protection areas				
L'Olla Island	2,54 ± 2,54	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0,53 ± 0,32	5,66 ± 3,25	0 ± 0	0 ± 0
Punta Caballo	7,75 ± 6,44	1,46 ± 1,46	0 ± 0	0 ± 0
Finestrat	0,07 ± 0,07	0 ± 0	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	3,58 ± 1,64	7,03 ± 4,23	0 ± 0	0 ± 0
Mitjana Island	4,31 ± 3,77	89,21 ± 53,23	6,37 ± 6,37	0 ± 0
Benidorm Island	4,67 ± 3,90	34,40 ± 15,43	59,34 ± 30,49	14,35 ± 14,35
Small sparids group (*Diplodus* spp.)				
Low protection areas				
L'Olla Island	0,62 ± 0,42	57,68 ± 18,88	6,24 ± 5,07	2,59 ± 2,59
Punta Albir	3,09 ± 2,04	169,43 ± 35,08	25,18 ± 12,75	0,76 ± 0,76
Punta Caballo	3,59 ± 2,37	217,87 ± 64,57	4,21 ± 3,77	0 ± 0
Finestrat	1,54 ± 0,78	73,47 ± 21,76	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0,52 ± 0,25	242,82 ± 65,87	101,88 ± 31,43	1,96 ± 1,40
Mitjana Island	0,04 ± 0,03	2248,43 ±1110,43	105,48 ± 69,88	0 ± 0
Benidorm Island	0,06 ± 0,06	239,56 ± 52,61	499,41 ± 97,32	70,84 ± 22,46
Big serranids group (*Epinephelus marginatus, Mycteroperca rubra*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0 ± 0	83,51 ± 65,20	0 ± 0	0 ± 0
Punta Caballo	0 ± 0	42,89 ± 42,89	0 ± 0	0 ± 0
Finestrat	0 ± 0	0 ± 0	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mitjana Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Benidorm Island	0 ± 0	35,70 ± 35,70	35,70 ± 35,70	0 ± 0

Table 6. (Cont.)

Group Protection level **Localities**	**Size 1**	**Size 2**	**Size 3**	**Size 4**
Small serranids group (*Serranus* spp.)				
Low protection areas				
L'Olla Island	0 ± 0	7,87 ± 4,15	27,37 ± 19,04	0 ± 0
Punta Albir	0,02 ± 0,02	22,81 ± 5,47	4,95 ± 3,71	0 ± 0
Punta Caballo	0,18 ± 0,18	15,63 ± 4,27	5,53 ± 3,07	0 ± 0
Finestrat	0 ± 0	2,75 ± 2,75	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0 ± 0	9,67 ± 3,26	36,99 ± 17,67	0 ± 0
Mitjana Island	0 ± 0	21,20 ± 7,74	4,69 ± 4,69	0 ± 0
Benidorm Island	0,11 ± 0,11	21,42 ± 4,28	16,40 ± 5,88	10,23 ± 6,16
Big labrids group (*Labrus merula, Symphodus tinca*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	15,72 ± 8,96	71,39 ± 42,39
Punta Albir	0 ± 0	3,16 ± 2,35	25,95 ± 10,82	70,60 ± 21,44
Punta Caballo	0 ± 0	4,52 ± 2,56	13,79 ± 5,76	12,55 ± 5,40
Finestrat	0 ± 0	0 ± 0	8,50 ± 8,50	47,46 ± 26,51
High protection areas				
Mascarat–Toix	0,19 ± 0,19	0,37 ± 0,37	26,27 ± 9,24	47,69 ± 17,24
Mitjana Island	0 ± 0	6,62 ± 3,09	21,02 ± 7,85	42,59 ± 22,75
Benidorm Island	0 ± 0	1,41 ± 1,41	1,30 ± 0,91	16,18 ± 7,17
Small labrids group (*Symphodus* spp*., Coris julis, Thalassoma pavo*)				
Low protection areas				
L'Olla Island	0 ± 0	3,75 ± 1,72	8,88 ± 3,34	4,84 ± 2,66
Punta Albir	0 ± 0	3,76 ± 0,93	10,61 ± 2,85	3,26 ± 1,34
Punta Caballo	0,01 ± 0,01	3,42 ± 0,88	5,80 ± 1,85	3,66 ± 2,51
Finestrat	0 ± 0	1,55 ± 0,84	5,72 ± 2,67	0,21 ± 0,21
High protection areas				
Mascarat–Toix	0 ± 0	2,05 ± 0,68	6,12 ± 1,82	4,24 ± 1,11
Mitjana Island	0 ± 0	2,98 ± 1,00	5,74 ± 1,78	3,40 ± 2,36
Benidorm Island	0 ± 0	6,33 ± 1,90	8,64 ± 2,36	3,01 ± 0,92

Table 6. (Cont.)

Group Protection level **Localities**	**Size 1**	**Size 2**	**Size 3**	**Size 4**
Red mullet group (*Mullus surmuletus*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0 ± 0	0,67 ± 0,67	27,98 ± 17,64	0 ± 0
Punta Caballo	0 ± 0	9,32 ± 5,05	0 ± 0	0 ± 0
Finestrat	0 ± 0	51,92 ± 51,92	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	2,54 ± 2,54	13,93 ± 11,09	19,26 ± 10,85	17,10 ± 17,10
Mitjana Island	0 ± 0	30,29 ± 13,34	0 ± 0	0 ± 0
Benidorm Island	0 ± 0	13,07 ± 7,87	2,70 ± 2,70	0 ± 0
Brown meagre group (*Sciaena umbra*)				
Low protection areas				
L'Olla Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Punta Albir	0 ± 0	5,70 ± 3,97	0 ± 0	0 ± 0
Punta Caballo	0 ± 0	4,73 ± 3,29	0 ± 0	0 ± 0
Finestrat	0 ± 0	0 ± 0	0 ± 0	0 ± 0
High protection areas				
Mascarat–Toix	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mitjana Island	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Benidorm Island	0 ± 0	0 ± 0	139,82 ± 101,74	56,24 ± 56,24

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Annex 1. Species and localities: Gz. Geographical zone.
Anexo 1. Relación de especies y localidades: Gz. Zona geográgfica.

Species	Locality	Gz	UTM–X	UTM–Y
Apogon imberbis	L´Olla Island	30S	759576	4278430
Apogon imberbis	Punta Albir	30S	757153	4272566
Apogon imberbis	Punta Caballo	30S	753025	4267852
Apogon imberbis	Mascarat–Toix	31S	241052	4279618
Apogon imberbis	Mitjana Island	30S	755096	4269481
Apogon imberbis	Benidorm Island	30S	750353	4265542
Spicara maena	Punta Albir	30S	757153	4272566
Spicara maena	Punta Caballo	30S	753025	4267852
Spicara maena	Mitjana Island	30S	755096	4269481
Sardina pilchardus	Punta Albir	30S	757153	4272566
Phycis phycis	Mitjana Island	30S	755096	4269481
Pomadasys incisus	Punta Albir	30S	757153	4272566
Pomadasys incisus	Punta Caballo	30S	753025	4267852
Pomadasys incisus	Mitjana Island	30S	755096	4269481
Coris julis	L'Olla Island	30S	759576	4278430
Coris julis	Punta Albir	30S	757153	4272566
Coris julis	Punta Caballo	30S	753025	4267852
Coris julis	Finestrat	30S	747502	4267789
Coris julis	Mascarat–Toix	31S	241052	4279618
Coris julis	Mitjana Island	30S	755096	4269481
Coris julis	Benidorm Island	30S	750353	4265542
Labrus merula	L'Olla Island	30S	759576	4278430
Labrus merula	Punta Albir	30S	757153	4272566
Labrus merula	Punta Caballo	30S	753025	4267852
Labrus merula	Mascarat–Toix	31S	241052	4279618
Labrus merula	Mitjana Island	30S	755096	4269481
Labrus merula	Benidorm Island	30S	750353	4265542
Symphodus cinereus	Punta Albir	30S	757153	4272566
Symphodus doderleini	Punta Caballo	30S	753025	4267852
Symphodus mediterraneus	Punta Albir	30S	757153	4272566
Symphodus mediterraneus	Punta Caballo	30S	753025	4267852
Symphodus mediterraneus	Mascarat–Toix	31S	241052	4279618
Symphodus mediterraneus	Benidorm Island	30S	750353	4265542
Symphodus melanocercus	Punta Albir	30S	757153	4272566
Symphodus melanocercus	Punta Caballo	30S	753025	4267852
Symphodus melanocercus	Mascarat–Toix	31S	241052	4279618
Symphodus ocellatus	L'Olla Island	30S	759576	4278430
Symphodus ocellatus	Punta Albir	30S	757153	4272566
Symphodus ocellatus	Punta Caballo	30S	753025	4267852
Symphodus ocellatus	Finestrat	30S	747502	4267789
Symphodus ocellatus	Mascarat–Toix	31S	241052	4279618
Symphodus ocellatus	Mitjana Island	30S	755096	4269481
Symphodus ocellatus	Benidorm Island	30S	750353	4265542
Symphodus roissalii	L'Olla Island	30S	759576	4278430

Annex 1. (Cont.)

Species	Locality	Gz	UTM–X	UTM–Y
Symphodus roissalii	Punta Albir	30S	757153	4272566
Symphodus roissalii	Punta Caballo	30S	753025	4267852
Symphodus roissalii	Finestrat	30S	747502	4267789
Symphodus roissalii	Mascarat–Toix	31S	241052	4279618
Symphodus roissalii	Mitjana Island	30S	755096	4269481
Symphodus roissalii	Benidorm Island	30S	750353	4265542
Symphodus tinca	L'Olla Island	30S	759576	4278430
Symphodus tinca	Punta Albir	30S	757153	4272566
Symphodus tinca	Punta Caballo	30S	753025	4267852
Symphodus tinca	Finestrat	30S	747502	4267789
Symphodus tinca	Mascarat–Toix	31S	241052	4279618
Symphodus tinca	Mitjana Island	30S	755096	4269481
Symphodus tinca	Benidorm Island	30S	750353	4265542
Thalassoma pavo	L'Olla Island	30S	759576	4278430
Thalassoma pavo	Punta Albir	30S	757153	4272566
Thalassoma pavo	Punta Caballo	30S	753025	4267852
Thalassoma pavo	Finestrat	30S	747502	4267789
Thalassoma pavo	Mascarat–Toix	31S	241052	4279618
Thalassoma pavo	Mitjana Island	30S	755096	4269481
Thalassoma pavo	Benidorm Island	30S	750353	4265542
Liza aurata	Punta Albir	30S	757153	4272566
Liza aurata	Benidorm Island	30S	750353	4265542
Mugil spp.	Finestrat	30S	747502	4267789
Mullus surmuletus	Punta Albir	30S	757153	4272566
Mullus surmuletus	Punta Caballo	30S	753025	4267852
Mullus surmuletus	Finestrat	30S	747502	4267789
Mullus surmuletus	Mascarat–Toix	31S	241052	4279618
Mullus surmuletus	Mitjana Island	30S	755096	4269481
Mullus surmuletus	Benidorm Island	30S	750353	4265542
Muraena helena	L'Olla Island	30S	759576	4278430
Muraena helena	Punta Caballo	30S	753025	4267852
Muraena helena	Mascarat–Toix	31S	241052	4279618
Muraena helena	Benidorm Island	30S	750353	4265542
Chromis chromis	L'Olla Island	30S	759576	4278430
Chromis chromis	Punta Albir	30S	757153	4272566
Chromis chromis	Punta Caballo	30S	753025	4267852
Chromis chromis	Mascarat–Toix	31S	241052	4279618
Chromis chromis	Mitjana Island	30S	755096	4269481
Chromis chromis	Benidorm Island	30S	750353	4265542
Sciaena umbra	Punta Albir	30S	757153	4272566
Sciaena umbra	Punta Caballo	30S	753025	4267852
Sciaena umbra	Benidorm Island	30S	750353	4265542
Scorpaena porcus	Punta Albir	30S	757153	4272566
Scorpaena porcus	Mitjana Island	30S	755096	4269481
Scorpaena scrofa	Benidorm Island	30S	750353	4265542

Annex 1. (Cont.)

Species	Locality	Gz	UTM–X	UTM–Y
Anthias anthias	Punta Albir	30S	757153	4272566
Anthias anthias	Benidorm Island	30S	750353	4265542
Epinephelus marginatus	Punta Albir	30S	757153	4272566
Epinephelus marginatus	Punta Caballo	30S	753025	4267852
Epinephelus marginatus	Benidorm Island	30S	750353	4265542
Mycteroperca rubra	Benidorm Island	30S	750353	4265542
Serranus cabrilla	Punta Albir	30S	757153	4272566
Serranus cabrilla	Punta Caballo	30S	753025	4267852
Serranus cabrilla	Mascarat–Toix	31S	241052	4279618
Serranus cabrilla	Mitjana Island	30S	755096	4269481
Serranus cabrilla	Benidorm Island	30S	750353	4265542
Serranus scriba	L'Olla Island	30S	759576	4278430
Serranus scriba	Punta Albir	30S	757153	4272566
Serranus scriba	Punta Caballo	30S	753025	4267852
Serranus scriba	Finestrat	30S	747502	4267789
Serranus scriba	Mascarat–Toix	31S	241052	4279618
Serranus scriba	Mitjana Island	30S	755096	4269481
Serranus scriba	Benidorm Island	30S	750353	4265542
Boops boops	Punta Caballo	30S	753025	4267852
Dentex dentex	L'Olla Island	30S	759576	4278430
Dentex dentex	Punta Albir	30S	757153	4272566
Dentex dentex	Punta Caballo	30S	753025	4267852
Dentex dentex	Mascarat–Toix	31S	241052	4279618
Dentex dentex	Benidorm Island	30S	750353	4265542
Diplodus annularis	L'Olla Island	30S	759576	4278430
Diplodus annularis	Punta Albir	30S	757153	4272566
Diplodus annularis	Punta Caballo	30S	753025	4267852
Diplodus annularis	Mascarat–Toix	31S	241052	4279618
Diplodus annularis	Mitjana Island	30S	755096	4269481
Diplodus annularis	Benidorm Island	30S	750353	4265542
Diplodus cervinus	L'Olla Island	30S	759576	4278430
Diplodus cervinus	Punta Albir	30S	757153	4272566
Diplodus cervinus	Punta Caballo	30S	753025	4267852
Diplodus cervinus	Finestrat	30S	747502	4267789
Diplodus cervinus	Mascarat–Toix	31S	241052	4279618
Diplodus cervinus	Mitjana Island	30S	755096	4269481
Diplodus cervinus	Benidorm Island	30S	750353	4265542
Diplodus puntazzo	Punta Albir	30S	757153	4272566
Diplodus puntazzo	Punta Caballo	30S	753025	4267852
Diplodus puntazzo	Mascarat–Toix	31S	241052	4279618
Diplodus puntazzo	Mitjana Island	30S	755096	4269481
Diplodus puntazzo	Benidorm Island	30S	750353	4265542
Diplodus sargus	L'Olla Island	30S	759576	4278430
Diplodus sargus	Punta Albir	30S	757153	4272566
Diplodus sargus	Punta Caballo	30S	753025	4267852

Annex 1. (Cont.)

Species	Locality	Gz	UTM–X	UTM–Y
Diplodus sargus	Finestrat	30S	747502	4267789
Diplodus sargus	Mascarat–Toix	31S	241052	4279618
Diplodus sargus	Mitjana Island	30S	755096	4269481
Diplodus sargus	Benidorm Island	30S	750353	4265542
Diplodus vulgaris	L'Olla Island	30S	759576	4278430
Diplodus vulgaris	Punta Albir	30S	757153	4272566
Diplodus vulgaris	Punta Caballo	30S	753025	4267852
Diplodus vulgaris	Finestrat	30S	747502	4267789
Diplodus vulgaris	Mascarat–Toix	31S	241052	4279618
Diplodus vulgaris	Mitjana Island	30S	755096	4269481
Diplodus vulgaris	Benidorm Island	30S	750353	4265542
Lithognathus mormyrus	Mitjana Island	30S	755096	4269481
Oblada melanura	L'Olla Island	30S	759576	4278430
Oblada melanura	Punta Albir	30S	757153	4272566
Oblada melanura	Punta Caballo	30S	753025	4267852
Oblada melanura	Finestrat	30S	747502	4267789
Oblada melanura	Mascarat–Toix	31S	241052	4279618
Oblada melanura	Mitjana Island	30S	755096	4269481
Oblada melanura	Benidorm Island	30S	750353	4265542
Pagellus erythrinus	Punta Albir	30S	757153	4272566
Pagrus auriga	Mascarat–Toix	31S	241052	4279618
Pagrus pagrus	Mascarat–Toix	31S	241052	4279618
Pagrus pagrus	Benidorm Island	30S	750353	4265542
Sparus aurata	Punta Albir	30S	757153	4272566
Sparus aurata	Punta Caballo	30S	753025	4267852
Sparus aurata	Mascarat–Toix	31S	241052	4279618
Sparus aurata	Mitjana Island	30S	755096	4269481
Sparus aurata	Benidorm Island	30S	750353	4265542
Spondyliosoma cantharus	Punta Albir	30S	757153	4272566
Spondyliosoma cantharus	Punta Caballo	30S	753025	4267852
Spondyliosoma cantharus	Finestrat	30S	747502	4267789
Spondyliosoma cantharus	Mascarat–Toix	31S	241052	4279618
Spondyliosoma cantharus	Mitjana Island	30S	755096	4269481
Spondyliosoma cantharus	Benidorm Island	30S	750353	4265542
Sarpa salpa	L'Olla Island	30S	759576	4278430
Sarpa salpa	Punta Albir	30S	757153	4272566
Sarpa salpa	Punta Caballo	30S	753025	4267852
Sarpa salpa	Finestrat	30S	747502	4267789
Sarpa salpa	Mascarat–Toix	31S	241052	4279618
Sarpa salpa	Mitjana Island	30S	755096	4269481
Sarpa salpa	Benidorm Island	30S	750353	4265542
Sphyraena sphyraena	Finestrat	30S	747502	4267789
Sphyraena sphyraena	Mitjana Island	30S	755096	4269481
Sphyraena sphyraena	Benidorm Island	30S	750353	4265542