hydrobiology

MDPI

Supplementary Materials for Using Fish Assemblages to Assess the Ecological Effects of Marine Protection on Rocky Habitats in a Portuguese Natural Park

Nuno Castro [1,2,*], Tadeu J. Pereira [2], André Costa [3], Joana Sertório [2], António Fernandes [2], Maria J. Tavares [2] and João J. Castro [3,4]

Table S1. Non-cryptic fish's average abundance (nº/m² ± standard error) observed in partially protected areas (PP) and adjacent complementary protected areas (CP) sampled in northern marine PNSACV (2011, 2012 and total).

	2011		2012		Total	
Taxa	**CP**	**PP**	**CP**	**PP**	**CP**	**PP**
Chelon labrosus 20-40 cm	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0013±0.0009	0.0000±0.0000	0.0006±0.0004
Chelon labrosus >40 cm	0.0002±0.0002	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Lithognathus mormyrus <18.3 cm	0.0002±0.0002	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Scomber colias >20 cm	0.0002±0.0002	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Symphodus roissali >10.4 cm	0.0002±0.0002	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Dicentrarchus labrax 36-72 cm	0.0000±0.0000	0.0000±0.0000	0.0002±0.0002	0.0038±0.0038	0.0001±0.0001	0.0019±0.0019
Diplodus cervinus >30 cm	0.0000±0.0000	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Diplodus sargus >30 cm	0.0000±0.0000	0.0000±0.0000	0.0002±0.0002	0.0013±0.0009	0.0001±0.0001	0.0006±0.0004
Oblada melanura < 10 cm	0.0000±0.0000	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Symphodus roissali < 5.7c m	0.0004±0.0003	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0002±0.0001	0.0000±0.0000
Diplodus cervinus 15-30 cm	0.0002±0.0002	0.0000±0.0000	0.0002±0.0002	0.0019±0.0014	0.0002±0.0002	0.0009±0.0007
Mullus surmuletus 18-36 cm	0.0002±0.0002	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000
Symphodus spp. >10 cm	0.0000±0.0000	0.0000±0.0000	0.0004±0.0004	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000
Mullus surmuletus <18 cm	0.0006±0.0005	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0003±0.0002	0.0000±0.0000
Trachurus trachurus >30 cm	0.0006±0.0005	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0003±0.0002	0.0000±0.0000
Ctenolabrus rupestris >12 cm	0.0002±0.0002	0.0013±0.0013	0.0004±0.0003	0.0000±0.0000	0.0003±0.0002	0.0006±0.0006
Spondyliosoma cantharus 23-46 cm	0.0000±0.0000	0.0000±0.0000	0.0006±0.0006	0.0006±0.0006	0.0003±0.0003	0.0003±0.0003
Symphodus cinereus <5.3 cm	0.0000±0.0000	0.0000±0.0000	0.0006±0.0006	0.0000±0.0000	0.0003±0.0003	0.0000±0.0000
Scomber sp. >20 cm	0.0008±0.0008	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0004±0.0004	0.0000±0.0000
Pagellus sp. <18 cm	0.0010±0.0004	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0005±0.0002	0.0000±0.0000
Sparus aurata 19-38 cm	0.0010±0.0007	0.0000±0.0000	0.0000±0.0000	0.0006±0.0006	0.0005±0.0004	0.0003±0.0003
Symphodus melops >18.6 cm	0.0006±0.0005	0.0000±0.0000	0.0004±0.0003	0.0000±0.0000	0.0005±0.0004	0.0000±0.0000
Ctenolabrus exoletus >8.6 cm	0.0004±0.0004	0.0031±0.0031	0.0008±0.0008	0.0013±0.0013	0.0006±0.0006	0.0022±0.0022
Diplodus cervinus <15 cm	0.0000±0.0000	0.0000±0.0000	0.0013±0.0009	0.0006±0.0006	0.0006±0.0004	0.0003±0.0003
Labrus mixtus <11.7 cm	0.0000±0.0000	0.0000±0.0000	0.0013±0.0005	0.0000±0.0000	0.0006±0.0002	0.0000±0.0000
Trachurus trachurus 15-30 cm	0.0000±0.0000	0.0000±0.0000	0.0015±0.0011	0.0000±0.0000	0.0007±0.0006	0.0000±0.0000
Diplodus annularis <15 cm	0.0016±0.0006	0.0000±0.0000	0.0000±0.0000	0.0006±0.0006	0.0008±0.0003	0.0003±0.0003
Symphodus bailloni >13.3 cm	0.0008±0.0004	0.0006±0.0006	0.0010±0.0005	0.0006±0.0006	0.0009±0.0005	0.0006±0.0006
Symphodus roissali 5.7-10.4 cm	0.0020±0.0008	0.0019±0.0014	0.0006±0.0005	0.0000±0.0000	0.0013±0.0006	0.0009±0.0007
Diplodus annularis 15-30 cm	0.0031±0.0015	0.0000±0.0000	0.0000±0.0000	0.0006±0.0006	0.0015±0.0008	0.0003±0.0003
Symphodus cinereus 5.3-10.6 cm	0.0010±0.0004	0.0006±0.0006	0.0021±0.0007	0.0019±0.0010	0.0016±0.0006	0.0013±0.0008
Symphodus bailloni <6.7 cm	0.0010±0.0004	0.0000±0.0000	0.0029±0.0008	0.0000±0.0000	0.0020±0.0006	0.0000±0.0000
Labrus bergylta <20 cm	0.0022±0.0007	0.0019±0.0010	0.0019±0.0006	0.0063±0.0020	0.0021±0.0007	0.0041±0.0015
Labrus bergylta 20-40 cm	0.0010±0.0004	0.0019±0.0014	0.0031±0.0008	0.0031±0.0015	0.0021±0.0006	0.0025±0.0014
Balistes capriscus 20-40 cm	0.0000±0.0000	0.0000±0.0000	0.0048±0.0042	0.0000±0.0000	0.0024±0.0021	0.0000±0.0000

Symphodus melops <9.3 cm	0.0019±0.0008	0.0000±0.0000	0.0031±0.0009	0.0019±0.0014	0.0025±0.0009	0.0009±0.0007
Serranus cabrilla <13.3 cm	0.0053±0.0024	0.0006±0.0006	0.0010±0.0005	0.0000±0.0000	0.0032±0.0015	0.0003±0.0003
Diplodus vulgaris >30 cm	0.0065±0.0017	0.0000±0.0000	0.0004±0.0003	0.0088±0.0041	0.0035±0.0010	0.0044±0.0020
Serranus cabrilla 13.3-26.6 cm	0.0063±0.0016	0.0013±0.0009	0.0006±0.0004	0.0006±0.0006	0.0035±0.0010	0.0009±0.0007
Ctenolabrus exoletus <4.3 cm	0.0076±0.0045	0.0075±0.0056	0.0017±0.0007	0.0000±0.0000	0.0046±0.0026	0.0038±0.0028
Ctenolabrus rupestris <6 cm	0.0077±0.0020	0.0059±0.0030	0.0029±0.0010	0.0000±0.0000	0.0053±0.0015	0.0030±0.0015
Symphodus melops 9.3-18.6 cm	0.0067±0.0019	0.0050±0.0026	0.0065±0.0015	0.0031±0.0015	0.0066±0.0017	0.0041±0.0020
Spondyliosoma cantharus <23 cm	0.0010±0.0004	0.0000±0.0000	0.0149±0.0085	0.0025±0.0025	0.0080±0.0045	0.0013±0.0013
Trisopterus luscus <17 cm	0.0000±0.0000	0.0000±0.0000	0.0171±0.0120	0.0000±0.0000	0.0085±0.0060	0.0000±0.0000
Ctenolabrus rupestris 6-12 cm	0.0112±0.0030	0.0088±0.0033	0.0060±0.0019	0.0075±0.0030	0.0086±0.0024	0.0081±0.0031
Symphodus bailloni 6.7-13.3 cm	0.0069±0.0018	0.0000±0.0000	0.0115±0.0021	0.0081±0.0029	0.0092±0.0020	0.0041±0.0015
Diplodus sargus 15-30 cm	0.0096±0.0034	0.0031±0.0020	0.0115±0.0030	0.0131±0.0060	0.0105±0.0032	0.0081±0.0040
Coris julis > 16.7 cm	0.0127±0.0032	0.0031±0.0018	0.0100±0.0033	0.0113±0.0040	0.0113±0.0033	0.0072±0.0029
Pomastochistus flavescens >4 cm	0.0231±0.0136	0.0000±0.0000	0.0008±0.0007	0.0000±0.0000	0.0119±0.0071	0.0000±0.0000
Ctenolabrus exoletus 4.3-8.6 cm	0.0131±0.0039	0.0075±0.0030	0.0113±0.0030	0.0094±0.0028	0.0122±0.0034	0.0084±0.0029
Diplodus sargus < 15 cm	0.0255±0.0080	0.0019±0.0010	0.0002±0.0002	0.0025±0.0019	0.0129±0.0041	0.0022±0.0015
Sarpa salpa 18-36 cm	0.0561±0.0561	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0281±0.0281	0.0000±0.0000
Diplodus vulgaris 15-30 cm	0.0282±0.0043	0.0381±0.0112	0.0404±0.0062	0.0756±0.0118	0.0343±0.0053	0.0569±0.0115
Diplodus vulgaris < 15 cm	0.0453±0.0053	0.0169±0.0030	0.0398±0.0064	0.0594±0.0131	0.0425±0.0058	0.0381±0.0080
Coris julis 8.3-16.7 cm	0.0412±0.0078	0.0288±0.0079	0.0466±0.0160	0.0675±0.0209	0.0439±0.0119	0.0481±0.0144
Boops boops 15-30 cm	0.1146±0.0539	0.0000±0.0000	0.0178±0.0136	0.0469±0.0469	0.0662±0.0337	0.0234±0.0234
Pomastochistus flavescens 2-4 cm	0.0272±0.0135	0.0025±0.0017	0.1069±0.0268	0.0947±0.0522	0.0671±0.0202	0.0486±0.0269
Pomastochistus flavescens <2 cm	0.0478±0.0287	0.0000±0.0000	0.1026±0.0296	0.1131±0.0578	0.0752±0.0292	0.0566±0.0289
Atherina sp. <5 cm	0.0000±0.0000	0.0000±0.0000	0.1510±0.0967	0.0000±0.0000	0.0755±0.0483	0.0000±0.0000
Coris julis < 8.3 cm	0.0833±0.0141	0.0163±0.0039	0.0954±0.0161	0.0831±0.0298	0.0893±0.0151	0.0497±0.0168
Boops boops <15 cm	0.0551±0.0295	0.0188±0.0188	0.1293±0.0707	0.0000±0.0000	0.0922±0.0501	0.0094±0.0094

Table S2. Cryptic fish's average abundance (nº/m² ± standard error) observed in partially protected areas (PP), and adjacent complementary protected areas (CP) sampled in northern marine PNSACV (2011, 2012 and total).

	2011		**2012**		**Total**	
	CP	**PP**	**CP**	**PP**	**CP**	**PP**
Parablennius rouxi	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0013±0.0013	0.0000±0.0000	0.0006±0.0006
Scorpaena sp.	0.0002±0.0002	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0001±0.0001	0.0000±0.0000
Gobius sp.	0.0004±0.0004	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000
Callionymus lyra	0.0000±0.0000	0.0000±0.0000	0.0004±0.0003	0.0013±0.0013	0.0002±0.0001	0.0006±0.0006
Gobius xanthocephalus	0.0000±0.0000	0.0000±0.0000	0.0004±0.0004	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000
Parablennius sp.	0.0000±0.0000	0.0000±0.0000	0.0004±0.0004	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000
Syngnathus acus	0.0000±0.0000	0.0000±0.0000	0.0004±0.0004	0.0000±0.0000	0.0002±0.0002	0.0000±0.0000
Gobius cruentatus	0.0006±0.0005	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0003±0.0002	0.0000±0.0000
Scorpaena porcus	0.0006±0.0003	0.0000±0.0000	0.0000±0.0000	0.0006±0.0006	0.0003±0.0002	0.0003±0.0003
Scorpaena notata	0.0004±0.0004	0.0013±0.0013	0.0002±0.0002	0.0006±0.0006	0.0003±0.0003	0.0009±0.0009
Parablennius tentacularis	0.0002±0.0002	0.0000±0.0000	0.0004±0.0004	0.0000±0.0000	0.0003±0.0003	0.0000±0.0000
Pomatoschistus marmoratus	0.0018±0.0012	0.0000±0.0000	0.0000±0.0000	0.0000±0.0000	0.0009±0.0006	0.0000±0.0000
Gobius gasteveni	0.0019±0.0009	0.0000±0.0000	0.0001±0.0001	0.0008±0.0008	0.0010±0.0005	0.0004±0.0004
Parablennius ruber	0.0024±0.0012	0.0004±0.0004	0.0003±0.0003	0.0000±0.0000	0.0014±0.0007	0.0002±0.0002
Gobius cobitis	0.0022±0.0008	0.0008±0.0006	0.0011±0.0005	0.0000±0.0000	0.0016±0.0007	0.0004±0.0003
Tripterygion delaisi	0.0016±0.0008	0.0000±0.0000	0.0017±0.0007	0.0017±0.0010	0.0016±0.0008	0.0008±0.0005
Gobius paganellus	0.0012±0.0007	0.0006±0.0006	0.0027±0.0015	0.0000±0.0000	0.0020±0.0011	0.0003±0.0003
Parablennius pilicornis	0.0185±0.0043	0.0017±0.0011	0.0029±0.0010	0.0025±0.0012	0.0107±0.0027	0.0021±0.0012

Parablennius gattorugine	0.0218±0.0032	0.0033±0.0019	0.0132±0.0027	0.0063±0.0025	0.0175±0.0029	0.0048±0.0022

Table S3. Results of SIMPER analysis showing the averaged dissimilarity between "Years" (2011 and 2012) of Cabo Sardão (CS) partially protected area, considering the abundance of non-cryptic fishes in northern marine PNSACV. Av.Abund = average abundance, Av.Diss = average dissimilarity, Diss/SD = dissimilarity divided by the standard deviation, Contrib% = Contribution to the dissimilarities, Cum% = Cumulative contribution to the dissimilarities.

Groups 2011 CS & 2012 CS						
Average dissimilarity = 70.07%						
Species	Group 2011 CS Av.Abund	Group 2012 CS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Coris julis < 8.3cm	0.1	0.3	9.66	1.23	13.78	13.78
Diplodus vulgaris 15-30 cm	0.09	0.24	8.87	1.11	12.66	26.44
Gobiusculus flavescens <2 cm	0	0.23	7.73	0.78	11.04	37.47
Coris julis 8.3-16.7cm	0.15	0.13	5.99	0.97	8.54	46.02
Diplodus vulgaris < 15 cm	0.11	0.17	5.38	1.4	7.68	53.70
Ctenolabrus rupestris 6-12 cm	0.1	0.04	4.08	1.06	5.82	59.52
Gobiusculus flavescens 2-4 cm	0	0.12	4.02	0.6	5.74	65.26
Ctenolabrus exoletus 4.3-8.6 cm	0.1	0.05	3.98	1	5.68	70.94

Table S4. Results of SIMPER analysis showing the averaged dissimilarity between "Years" (2011 and 2012) of Zambujeira (ZB) complementary protection area, considering the abundance of non-cryptic fishes in northern marine PNSACV. Av.Abund = average abundance, Av.Diss = average dissimilarity, Diss/SD = dissimilarity divided by the standard deviation, Contrib% = Contribution to the dissimilarities, Cum% = Cumulative contribution to the dissimilarities.

Groups 2011 ZB & 2012 ZB						
Average dissimilarity = 64.97%						
Species	Group 2011 ZB Av.Abund	Group 2012 ZB Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Boops boops 15-30 cm	0.25	0	5.42	0.79	8.34	8.34
Coris julis 8.3-16.7 cm	0.23	0.09	3.32	1.57	5.11	13.45
Coris julis < 8.3 cm	0.46	0.4	3.2	1.49	4.93	18.38
Ctenolabrus exoletus <4.3 cm	0.15	0.01	3.16	1.11	4.86	23.24
Gobiusculus flavescens 2-4 cm	0.15	0.02	3.13	0.94	4.81	28.05
Sarpa salpa 18-36 cm	0.21	0	3.06	0.37	4.72	32.77
Diplodus vulgaris < 15 cm	0.24	0.16	2.94	1.23	4.52	37.29
Ctenolabrus rupestris 6-12 cm	0.15	0.03	2.82	1.51	4.34	41.63
Ctenolabrus exoletus 4.3-8.6 cm	0.18	0.06	2.77	1.48	4.26	45.9
Boops boops <15 cm	0.07	0.08	2.72	0.52	4.18	50.08
Coris julis > 16.7 cm	0.14	0.04	2.7	1.68	4.15	54.23
Diplodus vulgaris 15-30 cm	0.14	0.07	2.59	1.34	3.98	58.21
Gobiusculus flavescens <2 cm	0.12	0	2.44	1.07	3.76	61.97
Ctenolabrus rupestris <6 cm	0.11	0.01	2.34	1.42	3.6	65.57

Symphodus bailloni 6.7-13.3 cm	0	0.1	2.26	1.88	3.48	69.05
Diplodus sargus 15-30 cm	0.07	0.02	2.04	0.58	3.14	72.2

Table S5. Results of the four-factor PERMANOVA test considering "Year" (2 levels, fixed), "Protection" (2 levels, fixed), "Area" (8 levels, random and nested in "Protection") and "Site" (2 levels, random and nested in "Area) factors for the analysis of average taxa richness of non-cryptic fishes in northern marine PNSACV. Bold values highlight significant effects and interactions (p <0.05).

Scheme .	df	MS	Pseudo-F	P (perms)	Unique perms
Year	1	36.213	0.30901	0.585	995
Protection	1	58.873	2.1932	0.223	151
Area (Protection)	6	26.951	4.7902	**0.021**	999
Year × Protection	1	75.595	0.64506	0.473	997
Site (Area (Protection))	8	5.6233	0.94772	0.472	998
Year × Area (Protection)	6	117.76	14.153	**0.001**	999
Year ×Site (Area (Protection))	8	8.3157	1.4015	0.219	999
Res	97	5.9335			
Total	128				

Note: df— degrees of freedom; MS — mean squares; Pseudo-F — pseudo-F ratio; P(perm) —P-value based on permutations.

Table S6. Results of the four-factor PERMANOVA test considering "Year" (2 levels, fixed), "Protection" (2 levels, fixed), "Area" (8 levels, random and nested in "Protection") and "Site" (2 levels, random and nested in "Area") factors for the analysis of average taxa richness of cryptic fishes in northern marine PNSACV. Bold values highlight significant effects and interactions (p <0.05).

Source of variation	df	MS	Pseudo-F	P (perms)	Unique perms	PERMDISP
Year	1	0.13528	6.35E-02	0.809	996	
Protection	1	34.632	8.3545	**0.038**	156	0.126
Area (Protection)	6	4.1598	3.2145	0.069	997	
Year × Protection	1	21.705	10.194	**0.022**	999	
Site (Area (Protection))	8	1.2935	0.97038	0.456	999	
Year × Area (Protection)	6	2.1333	0.43817	0.834	997	
Year × Site (Area (Protection))	8	4.8675	3.6516	**0.001**	998	
Res	97	1.333				
Total	128					

Note: df— degrees of freedom; MS — mean squares; Pseudo-F — pseudo-F ratio; P(perm) —P-value based on permutations.

Table S7. Results of the four-factor PERMANOVA test considering "Year" (2 levels, fixed), "Protection" (2 levels, fixed), "Area" (8 levels, random and nested in "Protection") and "Site" (2 levels, random and nested in "Area") factors for the analysis of average total abundance (nº/m²) of non-cryptic fishes in northern marine PNSACV. Bold values highlight significant effects (p <0.05). * Criterion of p < 0.01 was used to reject the null hypothesis.

Source of variation	df	MSs	Pseudo-F	P (perms)	Unique perms	PERMDISP
Year	1	2.4587	1.4797	0.259	998	
Protection	1	3.0711	5.5795	**0.001***	149	**0.027**
Area (Protection)	6	0.55093	1.2534	0.366	998	
Year × Protection	1	0.44818	0.26972	0.627	996	
Site (Area (Protection))	8	0.43949	0.97414	0.433	999	
Year × Area (Protection)	6	1.6679	2.0832	0.163	998	

Year × Site (Area (Protection))	8	0.80023	1.7737	0.083	999
Res	97	0.45116			
Total	128				

Note: df— degrees of freedom; MS — mean squares; Pseudo-F — pseudo-F ratio; P(perm) —P-value based on permutations.

Table S8. Results of the four-factor PERMANOVA test considering "Year" (2 levels, fixed), "Protection" (2 levels, fixed), "Area" (8 levels, random and nested in "Protection") and "Site" (2 levels, random and nested in "Area") factors for the analysis of average total abundance (nº/m²) of cryptic fishes in northern marine PNSACV. Bold values highlight significant effects and interactions (p <0.05).

Source of variation	df	MS	Pseudo-F	P (perms)	Unique perms
Year	1	3.16E-02	2.16E+00	0.216	998
Protection	1	0.15545	5.9795	0.053	161
Area (Protection)	6	2.61E-02	5.5149	**0.012**	999
Year x Protection	1	6.94E-02	4.74	0.066	998
Site (Area (Protection))	8	4.73E-03	1.2773	0.266	999
Year x Area (Protection)	6	1.47E-02	1.6953	0.244	998
Year x Site (Area (Protection))	8	8.67E-03	2.34	**0.025**	999
Res	97	3.70E-03			
Total	128				

Note: df— degrees of freedom; MS — mean squares; Pseudo-F — pseudo-F ratio; P(perm) —P-value based on permutations.

Table S9. Results of the four-factor PERMANOVA test considering "Year" (2 levels, fixed), "Protection" (2 levels, fixed), "Area" (8 levels, random and nested in "Protection") and "Site" (2 levels, random and nested in "Area) factors for the analysis of substrate physical characteristics in northern marine PNSACV. Bold values highlight significant effects and interactions (p <0.05). * When homogeneity was not achieved even after data transformation, a more rigorous criterion of p < 0.01 was used to reject the null hypothesis.

Source of variation	df	MS	Pseudo-F	P(perm)	PERMDISP
Year	1	5.53E+03	6.5491	**0.008***	**0.016**
Protection	1	5941.2	3.7516	**0.010**	0.912
Area (Protection)	6	1.54E+03	3.1391	**0.006**	
Year x Protection	1	5.18E+02	0.62293	0.580	
Site (Area (Protection))	8	4.93E+02	1.5621	0.084	
Year x Area (Protection)	6	8.23E+02	0.68519	0.778	
Year x Site (Area (Protection))	8	1.21E+03	3.8214	**0.001**	
Res	88	3.15E+02			
Total	119				

Note: df— degrees of freedom; MS — mean squares; Pseudo-F — pseudo-F ratio; P(perm) —P-value based on permutations.

Table S10. SIMPER analysis showing the averaged dissimilarity between complementary protection areas (CP) vs partially protected areas (PP) in northern marine PNSACV, considering the abundance of substrate types (sand, boulders, pebbles, and bedrock). Av.Abund = average abundance, Av.Diss = average dissimilarity, Diss/SD = dissimilarity divided by the standard deviation, Contrib% = Contribution to the dissimilarities, Cum% = Cumulative contribution to the dissimilarities.

Groups CP & PP						
Average dissimilarity = 32.53 %						
	Group CP	Group PP				
Substrate	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	0.67	1.88	11.22	1.25	34.48	34.48
Boulders	1.27	1.42	10.85	1.05	33.36	67.83
Pebbles	1.04	0.53	7.43	0.93	22.84	90.67

Table S11. SIMPER analysis showing the averaged similarity of complementary protection areas (CP) vs partially protected areas (PP) in northern marine PNSACV, considering the abundance of substrate types (sand, boulders, pebbles, and bedrock). Av.Abund = average abundance, Av.Diss = average dissimilarity, Diss/SD = dissimilarity divided by the standard deviation, Contrib% = Contribution to the dissimilarities, Cum% = Cumulative contribution to the dissimilarities.

Group CP						**Group PP**					
Average similarity: 71.20						Average similarity: 69.81					
Substrate	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%	Substrate	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Bedrock	4.34	60.16	3.31	84.5	84.5	Bedrock	4.14	51.17	3.05	73.3	73.3
Boulders	1.27	5.01	0.44	7.04	91.54	Sand	1.88	12.39	0.87	17.75	91.05

Table S12. Results of pair-wise tests applied to the interaction "Year" (2011 and 2012, fixed) vs "Site" (two levels: North and South; random, nested in Area) for the analysis of substrate physical characteristics in northern marine PNSACV between years. Bold values highlight significant differences (p(MC) <0.05).

Protection	**Area**	**Site**	**2011-2012**
Adjacent complementary protected areas (CP)	Burrinho (BU)	North	**0.032**
	Burrinho (BU)	South	**0.028**
	Porto Covo (PC)	South	**0.028**
	Zambujeira (ZB)	South	**0.030**
Partially protected areas (PP)	Ilha do Pessegueiro (IP)	South	**0.029**

Table S13. Results of SIMPER analysis showing the average dissimilarity of the significant differences detected in "Year" (2011 and 2012, fixed) vs "Site" (two levels: North (N) and South (S); random, nested in the Areas (Burrinho (BU), Porto Covo (PC), Zambujeira (ZB), and Ilha do Pessegueiro (IP)), in northern marine PNSACV, considering the abundance of substrate types (sand, boulders, pebbles and bedrock) between years. Av.Abund = average abundance, Av.Diss = average dissimilarity, Diss/SD = dissimilarity divided by the standard deviation, Contrib% = Contribution to the dissimilarities, Cum% = Cumulative contribution to the dissimilarities.

Groups 2011 BU N and 2012 BU N						
Average dissimilarity = 31.32						
	Group 2011 BU N	Group 2012BUN				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Boulders	0	2.8	21.62	9.14	69.02	69.02
Pebbles	0	0.8	5.97	0.96	19.06	88.08
Groups 2011 BU S and 2012 BU N						
Average dissimilarity = 31.32						
	Group 2011 BU S	Group 2012 BU N				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Boulders	0	2.8	21.62	9.14	69.02	69.02
Pebbles	0	0.8	5.97	0.96	19.06	88.08
Groups 2011 PC S and2012 PC S						
Average dissimilarity = 49.78						
	Group 2011 PC S	Group 2012 PC S				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Boulders	0	3.76	26.04	4.34	52.31	52.31
Pebbles	0	1.31	8.92	1.23	17.93	70.24

	Groups 2011 ZB S and 2012 ZB S Average dissimilarity = 40.55					
	Group 2011 ZB S	Group 2012 ZB S				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Pebbles	0	2.89	18.76	5.63	46.26	46.26
Boulders	0	1.61	9.61	0.91	23.7	69.96
Sand	1.52	1.1	9.54	1.22	23.52	93.48
	Groups 2011IP S and 2012 IP S Average dissimilarity = 39.07					
	Group 2011 IP S	Group 2012 IP S				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Boulders	0	3.52	23.47	4.43	60.06	60.06
Sand	1.59	1.8	10.75	1.28	27.51	87.57

Table S14. Results of the four-factor PERMANOVA test considering "Year" (2 levels, fixed), "Protection" (2 levels, fixed), "Area" (8 levels, random and nested in "Protection") and "Site" (2 levels, random and nested in "Area) factors for the analysis of substrate heterogeneity in northern marine PNSACV. Bold values highlight significant effects and interactions (p <0.05).

Source of variation	df	MS	Pseudo-F	P (perms)	Unique perms
Year	1	1.0552	0.3117	0.607	999
Protection	1	7.5125	3.4748	0.157	877
Area (Protection)	6	2.0531	1.2631	0.361	999
Year x Protection	1	0.285	0.092557	0.822	997
Site (Area (Protection))	8	1.6571	2.7563	**0.008**	998
Year x Area (Protection)	6	3.3224	4.356	**0.034**	997
Year x Site (Area (Protection))	7	0.76547	1.2732	0.296	998
Res	86	0.60123			
Total	116				

Note: df— degrees of freedom; MS — mean squares; Pseudo-F — pseudo-F ratio; P(perm) —P-value based on permutations.