

Invading the Greek Seas: spatiotemporal patterns of marine impactful alien and cryptogenic species

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Supplementary Material



Figure S1. Map of the study area, depicting all the main marine ecoregions considered according to the Marine Reporting Units (MRUs) of the Marine Strategy Framework Directive (MSFD): the Aegean Sea, the Levantine Sea, the Ionian Sea, and a small part of the Adriatic Sea. Points represent stations that were assessed *in-situ* through underwater scientific surveys.

Table S1. List of stations covered during scientific surveys, along with their geographic location, geographic coordinates and habitat type, which were assessed *in-situ* through underwater scientific surveys.

AA	Marine region	Marine area	x	y	Habitat type
1	Ionian	Korinthiakos Gulf	22.380	38.143	Hard substrates (both rocky and artificial)
2	Ionian	Lakonikos Gulf	22.620	36.800	Hard substrates (both rocky and artificial)
3	S Aegean	Argolikos Gulf	22.909	37.188	Hard substrates (both rocky and artificial)
4	S Aegean	Peloponnese E	22.995	36.971	Hard substrates (both rocky and artificial)

AA	Marine region	Marine area	x	y	Habitat type
5	S Aegean	Peloponnese E	23.087	36.785	Hard substrates (both rocky and artificial)
6	S Aegean	Peloponnese E	23.113	36.434	Hard substrates (both rocky and artificial)
7	Ionian	Peloponnese W	21.575	37.061	Artificial substrates
8	Ionian	Korinthiakos Gulf	22.755	38.009	Artificial substrates
9	Ionian	Korinthiakos Gulf	22.932	37.945	Artificial substrates
10	N Aegean	Evoikos Gulf	23.518	38.482	Artificial substrates
11	Levantine	Crete	24.412	35.171	Artificial substrates
12	S Aegean	Cyclades IsIs	26.983	36.949	Artificial substrates
13	Ionian	Thespotia	20.233	39.395	Rocky substrates
14	Ionian	Peloponnese W	20.338	39.286	Rocky substrates
15	Ionian	Ionian IsIs	20.534	38.439	Rocky substrates
16	Ionian	Ionian IsIs	20.547	38.562	Rocky substrates
17	Ionian	Ionian IsIs	20.614	38.792	Rocky substrates
18	Ionian	Ionian IsIs	20.673	38.263	Rocky substrates
19	Ionian	Ionian IsIs	20.674	38.262	Rocky substrates
20	Ionian	Ionian IsIs	20.687	38.854	Rocky substrates
21	Ionian	Ionian IsIs	20.688	38.853	Rocky substrates
22	Ionian	Kyparisiakos Gulf	21.306	37.639	Rocky substrates
23	Ionian	Peloponnese W	21.558	37.045	Rocky substrates
24	Ionian	Peloponnese W	21.559	37.044	Rocky substrates
25	Ionian	Kyparisiakos Gulf	21.580	37.089	Rocky substrates
26	Ionian	Peloponnese E	21.690	36.914	Rocky substrates
27	Ionian	Messiniakos	21.919	36.752	Rocky substrates
28	Ionian	Messiniakos	22.139	36.929	Rocky substrates
29	Ionian	Kyparisiakos Gulf	22.296	36.810	Rocky substrates
30	Ionian	Lakonikos Gulf	22.487	36.429	Rocky substrates
31	Ionian	Peloponnese W	22.829	36.681	Rocky substrates
32	Ionian	Ionian IsIs	22.949	36.159	Rocky substrates
33	S Aegean	Ionian IsIs	22.972	36.353	Rocky substrates
34	S Aegean	Peloponnese E	22.983	36.464	Rocky substrates
35	Ionian	Peloponnese W	23.046	36.737	Rocky substrates
36	N Aegean	Evoikos Gulf	23.354	38.509	Rocky substrates
37	N Aegean	Evoikos Gulf	23.391	38.522	Rocky substrates
38	N Aegean	Evoikos Gulf	23.423	38.503	Rocky substrates
39	Ionian	Crete	23.573	35.488	Rocky substrates
40	S Aegean	Cretan Sea	24.067	35.550	Rocky substrates
41	Levantine	Crete	24.410	35.171	Rocky substrates
42	S Aegean	Cretan Sea	24.419	35.165	Rocky substrates
43	S Aegean	Cyclades IsIs	24.436	37.460	Rocky substrates
44	S Aegean	Cyclades IsIs	24.458	37.384	Rocky substrates
45	N Aegean	N Sporades IsIs	24.466	38.917	Rocky substrates
46	S Aegean	Cyclades IsIs	24.488	36.753	Rocky substrates
47	N Aegean	N Sporades IsIs	24.507	38.853	Rocky substrates

AA	Marine region	Marine area	x	y	Habitat type
48	Levantine	Crete	24.551	35.114	Rocky substrates
49	N Aegean	N Sporades IsIs	24.582	38.924	Rocky substrates
50	S Aegean	Cretan Sea	25.388	35.329	Rocky substrates
51	Levantine	Crete	25.572	34.996	Rocky substrates
52	S Aegean	Cretan Sea	25.745	35.257	Rocky substrates
53	N Aegean	NE Aegean IsIs	25.944	38.299	Rocky substrates
54	Levantine	Crete	26.154	35.011	Rocky substrates
55	Levantine	Crete	26.156	35.010	Rocky substrates
56	N Aegean	NE Aegean IsIs	26.168	39.005	Rocky substrates
57	N Aegean	NE Aegean IsIs	26.291	39.169	Rocky substrates
58	S Aegean	Cretan Sea	26.294	35.291	Rocky substrates
59	S Aegean	Cretan Sea	26.295	35.291	Rocky substrates
60	N Aegean	NE Aegean IsIs	26.359	39.370	Rocky substrates
61	N Aegean	NE Aegean IsIs	26.478	38.971	Rocky substrates
62	N Aegean	NE Aegean IsIs	26.513	38.975	Rocky substrates
63	N Aegean	NE Aegean IsIs	26.567	39.112	Rocky substrates
64	N Aegean	NE Aegean IsIs	26.610	39.011	Rocky substrates
65	S Aegean	Dodecanese IsIs	26.940	37.010	Rocky substrates
66	N Aegean	NE Aegean IsIs	26.982	37.795	Rocky substrates
67	Levantine	Dodecanese IsIs	27.213	35.537	Rocky substrates
68	Levantine	Dodecanese IsIs	27.216	35.551	Rocky substrates
69	Levantine	Dodecanese IsIs	28.098	36.165	Rocky substrates
70	Levantine	Dodecanese IsIs	28.213	36.325	Rocky substrates
71	Levantine	Dodecanese IsIs	29.579	36.126	Rocky substrates
72	Levantine	Dodecanese IsIs	29.604	36.147	Rocky substrates
73	Ionian	Peloponnese W	22.389	36.545	Rocky substrates, caverns
74	Ionian	Lakonikos Gulf	22.472	36.590	Rocky substrates, caverns
75	S Aegean	Cyclades IsIs	25.121	36.969	Marine caves
76	S Aegean	Cyclades IsIs	26.972	36.926	Marine caves
77	N Aegean	NE Aegean IsIs	27.060	37.772	Marine caves
78	Levantine	Dodecanese IsIs	27.204	35.559	Marine caves
79	Levantine	Dodecanese IsIs	27.205	35.559	Marine caves
80	Levantine	Dodecanese IsIs	27.210	35.557	Marine caves
81	Levantine	Dodecanese IsIs	27.213	35.537	Marine caves
82	Levantine	Dodecanese IsIs	28.215	36.326	Marine caves
83	Levantine	Dodecanese IsIs	29.579	36.126	Marine caves
84	N Aegean	N Sporades IsIs	24.487	38.818	Marine caves
85	S Aegean	Cyclades IsIs	24.581	36.774	Marine caves
86	Ionian	Ionian IsIs	20.536	38.439	Mixed substrates
87	Ionian	Ionian IsIs	20.627	38.602	Mixed substrates
88	Ionian	Peloponnese W	21.348	38.104	Mixed substrates
89	Ionian	Peloponnese W	21.684	37.291	Mixed substrates
90	Ionian	Korinthiakos Gulf	22.314	38.172	Mixed substrates

AA	Marine region	Marine area	x	y	Habitat type
91	Ionian	Mani	22.379	36.639	Mixed substrates
92	Ionian	Argolikos Gulf	22.738	37.513	Mixed substrates
93	Ionian	Argolikos Gulf	22.769	37.425	Mixed substrates
94	S Aegean	Saronikos Gulf	22.899	37.533	Mixed substrates
95	S Aegean	Argolikos Gulf	22.921	37.532	Mixed substrates
96	Ionian	Ionian Isls	22.968	36.354	Mixed substrates
97	S Aegean	Peloponnese E	23.040	36.686	Mixed substrates
98	S Aegean	Saronikos Gulf	23.063	37.840	Mixed substrates
99	Ionian	Saronikos Gulf	23.127	37.837	Mixed substrates
100	S Aegean	Saronikos Gulf	23.132	37.759	Mixed substrates
101	Ionian	Saronikos Gulf	23.163	37.632	Mixed substrates
102	Ionian	Argolikos Gulf	23.201	37.296	Mixed substrates
103	S Aegean	Saronikos Gulf	23.348	37.583	Mixed substrates
104	N Aegean	Evoikos Gulf	23.353	38.505	Mixed substrates
105	S Aegean	Saronikos Gulf	23.484	37.532	Mixed substrates
106	Ionian	Crete	23.573	35.491	Mixed substrates
107	Levantine	Crete	24.412	35.171	Mixed substrates
108	N Aegean	N Sporades Isls	24.476	38.850	Mixed substrates
109	Levantine	Crete	26.154	35.011	Mixed substrates
110	N Aegean	NE Aegean Isls	26.478	38.971	Mixed substrates
111	N Aegean	NE Aegean Isls	26.512	39.048	Mixed substrates
112	Levantine	Dodecanese Isls	28.225	36.454	Mixed substrates
113	Levantine	Dodecanese Isls	29.598	36.149	Mixed substrates
114	Levantine	Dodecanese Isls	29.604	36.147	Mixed substrates
115	Ionian	Ionian Isls	20.674	38.262	Mobile substrates
116	Ionian	Ionian Isls	22.949	36.159	Mobile substrates
117	N Aegean	Chalkidiki	23.766	40.203	Mobile substrates
118	N Aegean	Chalkidiki	23.775	40.223	Mobile substrates
119	S Aegean	Cretan Sea	24.067	35.550	Mobile substrates
120	S Aegean	Cyclades Isls	24.455	37.385	Mobile substrates
121	N Aegean	N Sporades Isls	24.505	38.840	Mobile substrates
122	Levantine	Crete	24.551	35.114	Mobile substrates
123	S Aegean	Cyclades Isls	25.447	36.664	Mobile substrates
124	Levantine	Crete	25.572	34.996	Mobile substrates
125	Levantine	Crete	26.154	35.011	Mobile substrates
126	S Aegean	Cretan Sea	26.295	35.291	Mobile substrates
127	N Aegean	NE Aegean Isls	26.513	38.975	Mobile substrates
128	N Aegean	NE Aegean Isls	26.984	37.794	Mobile substrates
129	Levantine	Dodecanese Isls	27.205	35.528	Mobile substrates
130	Levantine	Dodecanese Isls	28.095	36.164	Mobile substrates
131	Levantine	Dodecanese Isls	28.233	36.404	Mobile substrates
132	Levantine	Dodecanese Isls	29.604	36.147	Mobile substrates
133	Ionian	Ionian Isls	21.558	37.045	Seagrasses

AA	Marine region	Marine area	x	y	Habitat type
134	Ionian	Ionian IsIs	22.949	36.159	Seagrasses
135	S Aegean	Cyclades IsIs	24.372	37.311	Seagrasses
136	Levantine	Crete	24.412	35.171	Seagrasses
137	S Aegean	Cyclades IsIs	24.530	36.766	Seagrasses
138	Levantine	Crete	24.551	35.114	Seagrasses
139	Levantine	Crete	26.154	35.011	Seagrasses
140	N Aegean	NE Aegean IsIs	26.156	39.162	Seagrasses
141	N Aegean	NE Aegean IsIs	26.513	38.975	Seagrasses
142	N Aegean	NE Aegean IsIs	26.541	39.001	Seagrasses
143	S Aegean	Dodecanese IsIs	26.966	37.016	Seagrasses
144	N Aegean	NE Aegean IsIs	27.037	37.732	Seagrasses
145	Levantine	Dodecanese IsIs	27.153	35.609	Seagrasses
146	Levantine	Dodecanese IsIs	28.233	36.404	Seagrasses
147	Levantine	Dodecanese IsIs	29.598	36.149	Seagrasses
148	Levantine	Dodecanese IsIs	29.603	36.148	Seagrasses
149	N Aegean	Evoikos Gulf	23.353	38.505	Water column
150	N Aegean	Evoikos Gulf	23.423	38.503	Water column

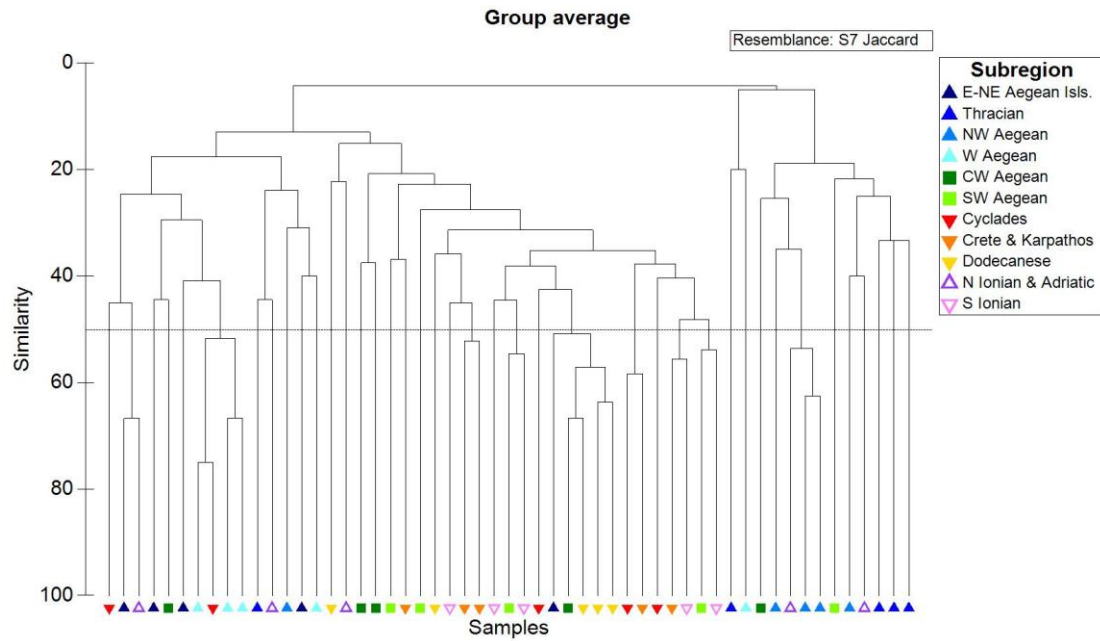


Figure S2. Dendrogram resulting from the Hierarchical Cluster Analysis depicting the level of similarity of distinct marine subregions in the Greek Seas based on ICAS composition. The analysis was conducted using a similarity matrix of presence/absence data based on Jaccard's coefficient, and the unweighted pair group method with arithmetic mean. The horizontal line signifies the 50% similarity level.

Table S2. PERMANOVA results regarding the total number of ICAS (a) and ICAS community composition (b) located within/close to and far from large ports of the Greek Seas

(a) Number of species						
Source	df	Sums of squares	Mean of squares	Pseudo-F	permutations	p-value
Port	6	1122.8	187.13	8.871	9947	0.0001
Location	1	152.38	152.38	7.2235	9808	0.012
Port x Location	6	251.29	41.881	1.9853	9940	0.0965
Res	28	590.67	21.095			
Total	41	2117.1				
(b) Community composition						
Source	df	Sums of squares	Mean of squares	Pseudo-F	permutations	p-value
Port	6	44631	7438.5	2.1486	9809	0.0001
Location	1	6192.4	6192.4	1.7887	9904	0.04
Port x Location	6	26249	4374.8	1.2637	9811	0.0696
Res	28	96937	3462			
Total	41	1.74E+05				