J Coast Conserv (2018) 22:235–245
https://doi.org/10.1007/s11852-017-0568-7

Marine uses, synergies and conflicts. Evidence from Crete Island, Greece

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Received: 24 July 2017 / Revised: 22 September 2017 / Accepted: 5 October 2017 / Published online: 12 October 2017

Abstract Coastal zones and marine areas attract a large number of people and productive activities, a fact that causes important pressures on ecosystems and affects the cohesion of local societies. These areas – that is, the large number of islands and the extended coastline - are important for Greece, because of its geography. Coastal zones and marine areas are vulnerable socio-spatial systems exposed to menaces, such as: sea level rising, desertification phenomenon, built-up areas excessive expansion etc., thus, spatial planning is required for their sustainable management, something that is not always easy to implement. The paper aims to discuss key issues of spatial planning emerged from the ratification of an integrated framework for marine planning in the national spatial planning system. For better understanding of the particularities of Greek spatial planning procedures, the island of Crete is chosen as a case study area, where synergies, conflicts and methodological issues come up at regional and local level.

Keywords Spatial planning · Marine spatial planning · Marine uses · The island of Crete · Greece

Introduction

In recent decades, at the international level, a large number of documents that are related directly or indirectly to coastal and marine areas have been enacted, so that these vulnerable environments are managed in a sustainable way. These documents focus primarily on protecting areas of ecological and aesthetic interest and on the durable use of natural and cultural resources (UNEP / MAP 1976, UNCLOS 1982, UNCED 1992, UNEP 1995, UNEP / MAP/PAP 2008), In these documents - despite the fact that the concept, principles and perceptions can be seen evolving – the principal priority is sustainable management of the environment. Within this context, in 2007, the European Union (EU) took an important step towards protecting and managing sustainably marine areas by adopting the Integrated Marine Policy (IMP) (CEC 2007). In 2008, the European Parliament and Council (EP&C) adopted the Directive 2008/56/ EC on Marine Strategy (MS) which establishes a common framework and objectives to prevent, protect and preserve the marine environment so that the sustainable use of the seas and their resources as well as the conservation of marine ecosystems can be promoted (EP&C 2008). In 2013, the EP&C adopted the Directive 2013/133 which established an integrated framework for Marine Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) (EP&C 2013), and the Directive 2014/89/EU of the EP&C in July 2014 established principal guidelines for a common framework for MSP.

As it is known, the importance of coastal and marine areas has been widely recognized, because in these areas a large number of permanent and seasonal habitats and productive activities is concentrated, many principal development poles and communication axes are located, and there are important food resources, energy sources, and natural and cultural heritage properties (Maes et al. 2005, CEC 2007). Human concentration and dependence on coastal and marine areas are expected to intensify, while technological innovations enable the exploitation of significant resources and the development of massive activities in marine areas (CEC 2012; Freeman

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et al. 2016). The overexploitation of terrestrial resources that in many cases exceed the carrying capacity of the local socio-spatial systems will also lead to intensification and dependency on coastal zones and marine areas (Ehler and Douvere 2007, 2009). However, apart from their importance of socio-economic status, marine and coastal ecosystems are of environmental significance, contributing to global biodiversity.

The potentiality of exploitation of resources and the development of coastal zones and marine areas are of great importance for Greece, because its geography is characterized by coastality and insularity. The length of the coastline exceeds 15,000 km, while the number of islands exceeds 3000, since each km2 represents approximately 113 m coastal areas, while the corresponding global average is 4.3 m (Coccossis and Mexa 2002). The importance of these areas for Greece is reflected in the fact that the majority of population and productive activities are concentrated in proximity to the sea. (Gounaridis and Koukoulas 2016; Tsilimigkas and Kizos 2014).

For the purposes of the present paper, however, it should be noted that of the large number of activities and uses concentrated in coastal zones and marine areas (Smith et al. 2011), the following categories are recognized and grouped as the principal ones: (a) marine transports and connections infrastructures; (b) extraction and resources exports; (c) protected natural and cultural environment; and (d) military uses (Douvere 2008; Smith et al. 2011). The pressure exerted by marine uses and activities on coastal and marine areas increases primarily for three reasons: First, the existing traditional marine uses (fishing, transports military uses etc.) can become more and more intensive and extensive, thus leading very often to significant pressures on local socio-spatial systems. Second, new forms of activities and new marine uses have emerged over time (energy sources, extraction of natural resources etc.; and, third, what should be taken into consideration is the contribution of environmental change to vulnerability of these areas. This environmental change is connected with climate change, desertification, lack of fresh water etc., factors that have critical effects on local socio-spatial systems (Schultz-Zehden et al. 2008).

Within this context, increasing demand and competition in coastal and marine areas from various marine uses and activities have shown the vulnerability of these areas (Stefani et al. 2016, Schultz-Zehden et al. 2008). It should also be considered that future requirements on coastal and marine areas will exert further pressure both on existing marine uses and activities and on natural and cultural environment (Maes 2008, Luz Fernandes et al. 2017). New marine uses and activities (Freeman et al. 2016), combined with the expansion and intensification of the existing ones and the growing need for conservation and protection of natural and cultural environment, will lead to increased competition in coastal and marine areas (Maes 2008, Maes et al. 2005), thus endangering their sustainability and increasing the risk for coastal populations (EP and C 2013; Dawson et al. 2009).

Furthermore, priority issues related to economic growth, social justice and cohesion as well as environmental protection are expected to intensify (Chang and Lin 2016). Thus, MSP is required for the sustainable management of coastal and marine areas, a complex process that demands a multi-scale and multi-dimensional approach, not always easy to implement. It is important to emphasize here that marine areas have three dimensions: the *seabed*, *the water column and the surface* area, where more than one uses may take place simultaneously in the same area, a fact that complicates the management process of marine uses and raises potential conflict (Douvere 2010).

Threats to *coastal and marine environments* derive either from natural hazards or from human induced practices. According to Ehler and Douvere (2009), there are two types of conflict in *coastal and marine environments*: The first concerns conflicts between human induced activities (user-user conflicts); and the second conflicts between human induced activities and the environment (user-environment conflicts). Within this framework, Gramolini et al. (2013) classify uses of and activities in the marine environment according to four characteristics: (a) Mobility that describes mobile activities, such as navigation, and fixed activities, such as protection areas or permanent infrastructures (i.e. wind turbines); (b) Spatial scale (small; medium; large), the determination of which define the study area; (c) Vertical "scale" (z dimension) that signifies where the activity takes place, (i.e. pelagic; benthic; whole water column); and (d) Temporal scale that indicates the time period that can be distinguished in short/medium (< 365 days) and long/permanent (> 365 days). On a time scale, it is also worth mentioning the periodic or not character of the activity.

MSP is required so that activities and sea use conflicts can be managed in order to develop synergies between both: activities and marine uses that take place on the same site (e.g. fish farms and tourist activities); or/and activities and marine uses that take place simultaneously in one of the three dimensions of the marine space (seabed, water column and surface, as mentioned earlier) e.g. ancient antiquities and tourism. In addition, the time dimension should be taken into consideration, a fact that adds thereby the complexity of the MSP process. As it becomes conspicuous, all the aforementioned dimensions of activities and marine uses add and intensify the complexity and the multidimensional character of the MSP process.

Within this context, the key issues to determine marine management are: compatibility between marine uses; synergies from their coexistence; and (c) management of conflicts developed between no compatible marine uses (Ehler and Douvere 2009). The existence of synergies or non-synergies and/or conflicts as well as their extent and intensity are considered as critical variables to characterize marine typologies, since they are significant factors that determine MSP nature. Additionally, in order to determine the character of MSP, the

identity and the particularities of each marine sub-region should be highlighted, by identifying basic marine typologies as they result from marine uses, activities character and localization. In order to respond to the paper's question a summary will be provided and the principles identifying MSP nature will be mentioned. These principles are defined by:: (a) the Road Map for MSP (CEC 2008) that achieves Common Principles for MSP in the EU; (b) the Directive 2014/89 (EP&C 2008) that establishes a framework for MSP; and (c) the Directive 2008/56 (EP&C 2008) that establishes a framework for community action in the field of marine environmental policy.

Principles of defining issues and clarifying concepts of MSP:

(1) It is proposed that topological continuity is not a requirement for delineating the area for MSP implementation. It is rather based on the characteristics of an area; rights and international obligations; and on the scope of the study, according to the principle, the area can be defined by ad-hoc procedures.
(2) When MSP is implemented, all three dimensions of the marine space (i.e. the seabed, the water column and the surface) and the dimension of time should be taken into consideration simultaneously, as they affect its ability to engage different marine uses and the location of productive activities.
(3) Features and peculiarities of each area determine the character of MSP and result from the assessment of the following: the type of the existing activities in the sea area; their intensity; the relationships among them; and their impact on the environment.
(4) MSP helps manage existing and future marine uses and the *location of productive activities*. At large spatial scales the guidelines on the overall management of marine space are set, while the compatibility of MSP choices are ensured with: national spatial policies; development planning on national and regional level; sectoral policies on national level; and with ratification of European and international conventions. At small spatial scales, MSP must specify and complement guidelines from the upper planning level based on local characteristics, resolve malfunctions resulted by the use of conflicts and competitive sectoral priorities; and promote synergies between marine uses, activities and sectoral priorities.

Principles regarding methodological features of MSP studies:

(5) The implementation of participatory processes at small spatial scales, which involve local societies and stakeholders, is a key factor of how MSP is implemented and accepted. At larger spatial scales, a pertinent framework of consultation between the political governance and administration bodies should be ensured.
(6) It needs to take into consideration that both natural and anthropogenic environment are transformed, so the variables on which MSP is based are changed constantly. Therefore, monitoring and assessment procedures should be integrated. To that end, an observatory on MSP could be an appropriate solution.
(7) The choice of the competent MSP administration and governance body is a central issue on managing marine space in order to ensure complementarity on sectoral and development policies and the appropriate framework for the implementation of MSP.
(8) It is also important to underline that data and knowledge from various scientific fields is a requirement for implementing MSP. Therefore, the establishment of a reliable database of geospatial data, pertinent to support the mechanism of adaptive management is considered an important issue on implementing MSP. To this end, EU Member States should organize the use of available geospatial data in an optimal way and promote the exchange of information.

Principles concerning policy implementation and institutional enactment.

(9) Consistency between terrestrial and marine spatial planning should be ensured. The land-sea interaction, which has been growing over the years, has a direct impact on the marine environment.
(10) An institutional framework, which should be acceptable from the local society and, more particularly, from marine space users, is necessary for the effective implementation of MSP. The political will to implement this framework is crucial but not always an evident priority.
(11) States sharing sea water should cooperate to develop common standards and procedures in order to implement MSP so that the necessary coherence of planning across common marine areas is ensured.

Thus, within this context, the paper attempts to identify marine typologies that come out of the existing marine uses and activities in the Region of Crete, an entirely insular region, whose economy is largely based on marine areas and coastal zone. It is considered as a step in MSP implementation that could help implement spatial policy which faces significant difficulties in Greece.

Methodology

Case study

The region of Crete is the largest Greek island and the fifth largest in the Mediterranean, with a total coastline length of 1300 km (Alexandrakis et al. 2015). Its total surface area is

8335.88 km2 (6.3% of the Greek territory) (ELSTAT 2011). There are significant inequalities between the north and south both in terms of economic growth and population concentration. Island population is 682,928 people (ELSTAT 2011). The economy of the island is based on tourism, which is concentrated mainly on the northern coast of the island. The northern coast of Crete receives intense erosion pressures (65.8% of its total length) which has both developmental and environmental negative effects (Alexandrakis et al. 2013, 2015). Case study is the marine zone around Crete as the boundary of the territorial waters. *Greece's territorial sea* is set at 6 nautical miles from the natural coastline (OGG 1936).

Data

Geospatial data were used in the analysis of synergies and conflicts of the marine uses and activities of the Region of Crete. The studies of principal marine uses and activities here concern the following categories (Table 1): Category (a) Marine transports and connections infrastructures, composed by: (i) Shipping routes; (ii) Port infrastructures and anchorage; and (iii) Submarine cables and pipelines; Category (b) Extraction and resources exports that principally concern: (i) Fisheries areas; (ii) Aquaculture zones; and (iii) Extraction zones (Oil and gas); Category (c) Protected natural and cultural environment: (i) Underwater cultural heritage; and (ii) Natura 2000; and Category (d) Military uses. Offshore renewable energy production, dive parks and underwater tourism are expected to grow in the coming years (MEE 2016).

In Fig. 1 the marine uses data collected for the region of Crete are depicted, their cross will lead to marine typologies. In Fig. 1.a.i, shipping routes and areas with the highest navigation densities are depicted. In the study area there is an established maritime channel in the bay of Souda in the regional unit ["perifereiaki enótita, in Greek"] of Chania, (Navionics Webapp 2017). Additionally, areas with the highest navigation densities are recaptured from the on-line density map of the Marine Traffic site, based on data for 2015 (AIS Marine Traffic 2015). In Fig. 1.a.ii, port infrastructures and anchorages are depicted. The data obtained by the International Ship and Port Facility Security (ISPS). Port infrastructures were identified and digitized as polygons using aerial *Orthophotos*. The polygon includes the endpoints of the port infrastructure. The ISPS anchorages were identified and digitized in polygons from Navionics maps (Navionics Webapp 2017). In Fig. 1.a.iii, submarine cables and submarine pipelines are depicted. The data was obtained by Navy maps (Navionics Webapp 2017). In Fig. 1.b.i, fishing areas irrespective of mechanical means are depicted. The data was obtained from the Hellenic Coast Guard ["Dieythynsh Elenchou Alieias", in Greek] (Directorate of Fisheries Control 2017). In Fig. 1.b.ii, fish farming infrastructures are depicted. According to the RFSPSD regarding aquaculture in Crete, large concentrations of aquaculture farms are not allowed (OGG 2011a). The RFSPSD of Crete proposes the creation

Table 1 Marine uses

Category	Variable	Criteria
(a) Marine transports and connections infrastructures	(i) Shipping routes	1: Presence of shipping channel or maritime connection
		0: Absence
	(ii) Port infrastructures and anchorage	1: Presence of port infrastructure or International Ship and Port Facility Security (ISPS) anchorages or informal anchorages
		0: Absence
	(iii) Submarine cables and pipelines	1: Presence of cable or/and pipeline
		0: Absence
(b) Extraction and resources exports	(i) Fishery areas	1: Permitted fishing (regardless of mechanical means)
		0: Prohibition of fishing
	(ii) Aquaculture zones	1: Presence of aquaculture facility
		0: Absence
	(iii) Extraction zones	1: Area of hydrocarbon exploration
		0: Absence
(c) Protected Natural and Cultural environment	(i) Natura 2000 and Posidonia meadows	1: Presence of protected or to be protected natural or/and cultural environment or underwater scientific research park
	(ii) Under water cultural heritage	0: Absence
(d) Military uses	(i) Military areas	1: Military uses
		0: Absence

Source: authors' analysis

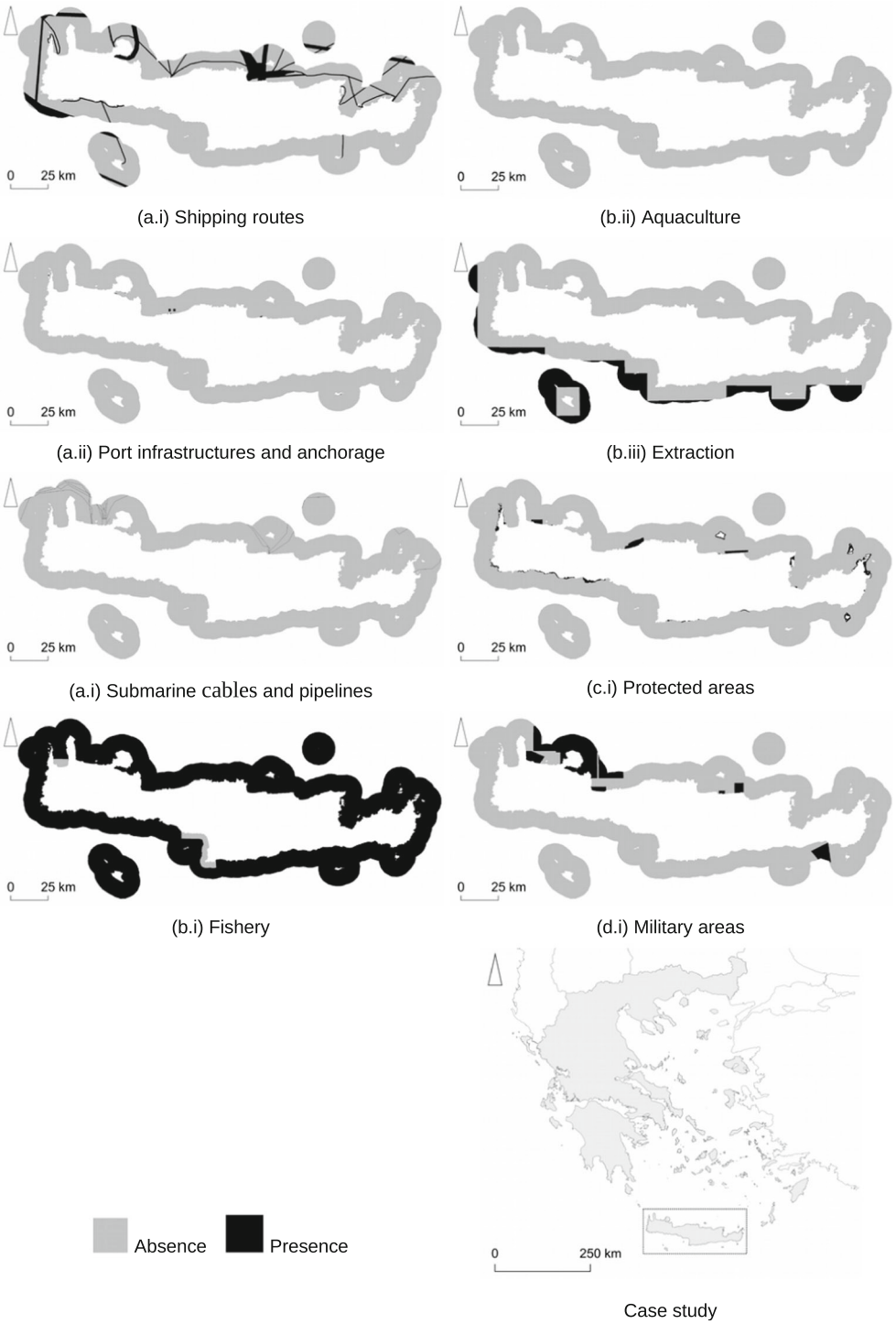

Fig. 1 Marine uses. Source: authors' analysis; (a.i) Navionics Webapp 2017 and AIS Marine Traffic 2015; (a.ii) Navionics Webapp 2017 and NCMA 2015; (a.iii) Navionics Webapp 2017; (b.i) Directorate of Fisheries Control 2017; (b.ii) RFSPSD of Crete, OGG 2003 and NCMA 2015; (b.iii) Ministry of the Environment and Energy 2011; (c.i) Natura 2000 sites and SFSP&SDF Maps for Aquaculture (OGG 2011a) and Hellenic Center for Marine Research 2016 and Hellenic Ministry of Culture and Sports 2016 (d.i) Navionics Webapp 2017

of individual infrastructures in two locations in the northern sea area of the island, which have been implemented (OGG 2003). These locations were identified using aerial *Orthophotos* (Open geospatial data and services for Greece 2015). In Fig. 1.b.iii, the areas to be leased for exploration and exploitation of hydrocarbons are depicted. Data was obtained from the "Ministry of the Environment and Energy" (Ministry of the Environment and Energy 2011). In Fig. 1.c.i, the protected areas of both natural and cultural environment are depicted. On the one hand, data on natural environment includes the marine part of Natura 2000 sites, which were provided by open geospatial data and services for Greece (geodata.gov.gr); the areas where Posidonia meadows were derived are from SFSP&SDF Maps for Aquaculture (OGG 2011a) and an underwater research park of the Institute of Marine Biology, Biotechnology and

Aquaculture of Hellenic Center for Marine Research, which was identified using aerial Orthophotos (Hellenic Center for Marine Research 2016). On the other hand, data on cultural environment includes underwater antiquities, both institutionalized and non-statutory. Institutional antiquities have been identified by the corresponding OGG issued by the Ministry of Culture and Sport and provided from both the "Standing List of Proclaimed Archaeological Sites and Monuments" ["Diarkis Katalogos ton Kirigmenon Arxaiologikon Xoron kai Mnimeion", in Greek] and the Ephorate of Underwater Antiquities of Crete ["Eforeia Enalion Arxaiotiton Kritis", in Greek]. The non-institutionalized antiquities, which were not available through the Ministry's on-line database, were indicated as points by the Ephorate of Underwater Antiquities of Crete (Hellenic Ministry of Culture and Sports 2016). Finally, in Fig. 1.d.i, military areas are depicted.

Working scale

In order to determine the working scale two key issues were taken into account. Data availability and the character of the central question of the present paper about regional - local planning. Within this context, the chosen working scale is 1: 100,000 and, therefore, spatial resolution of the data-set, namely the dimension of the cell size representing the area covered on the ground is set on 100*100 m. (Waldo 1988). All vector files were converted to raster for practical purposes.

Methodological approach

For each variable a raster layer was created, the pixels of which take the (1) value, when they contain the use or activity and the value (0) in the opposite. The variable layers (Fig. 1) then crosses out to result a final raster that includes all possible combinations of original layers.

The methodology is pertinent in order to develop delineation of marine typologies, according to chosen physical-geographical and human-induced variables. When eight variables are crossed according to certain criteria, as shown in Fig. 1, an overlay raster of their respective values is resulted. Using this method, it is understood that for every pixel 100*100 m on the grid the exact marine typologies are derived from various variables used. This process aims to identify marine typologies in a clear and systematic mode and provide key features of marine typologies, patches, geometries and spatial distribution.

In order to determine whether or not marine uses are compatible with the character of the use and their environmental impact, issues such as mobility, spatial scale, and temporal scale are also considered as important factors (Gramolini et al. 2013). Having taken into account all the aforementioned, the present research paper draws the following conclusions:

Extraction and resources exports category (b) - consisting of: Fishery areas (b.i) and Aquaculture zones (b.ii) - are considered incompatible with environmentally sensitive and environmentally degraded areas as well as with the areas of marine transports and connections (a) (Protected Natural and Cultural environment (c), Shipping routes (a.i), Port infrastructure and anchorage (a.ii); and Extraction zones (b) which, due to environmental risks in the event of an accident, should fulfill certain terms and conditions in order to coexist with other uses. Protected Natural and Cultural environment (c) is considered to have distinct terms and conditions to coexist with another use. Military use (d), due to its nature, is considered incompatible with all other marine uses.

Results

As shown in Table 3, 64.58% of the whole marine study area of Crete are the existing uses that are compatible with each other, 16.88% are uses whose coexistence may create conflicts, when conditions and their delineation have not been determined, whereas 18.55% are areas of conflicts and incompatibilities between existing uses.

As illustrated in Fig. 2, most of Incompatible or Compatible Under Condition (CUC) typologies are in proximity to some part of the coastal zone of the island, thus revealing the direct interdependence between the land and the part of the coastal zone, especially in the coastal zone that has significant concentration and diffusion of human-induced activities. In areas characterized by usage Compatibility, the dominant category Code b.1 represents 63.65%, which includes Fishery alone (Table 2). Because of its nature, this use takes place in almost the whole of marine zone of the study and at a great distance from the shoreline. The only category limitation is fishing means and protected areas.

In areas with CUC uses, Fishery (b.1) is used as a common component of all codes, as mentioned above, since the category nature permits its localization in almost the whole of marine zone of the study. The greatest overlap of Fishery (b.1) with the use of Extraction (b.iii) Area of Hydrocarbon Exploration, reveals the need to set precise conditions and delineations (e.g. distance from quays, quality water controls, etc.). At much smaller percentage of 1%, there are issues on uses where of Fishery (b.1) and Protected areas (c) overlap. In this particular case, both mechanical means and the fishing season, which are the main factors, should be defined so that local marine flora and fauna can be preserved and protected Table 3.

With regard to areas with incompatible uses, most of them are in marine waters in the Northern part of the island of Crete.

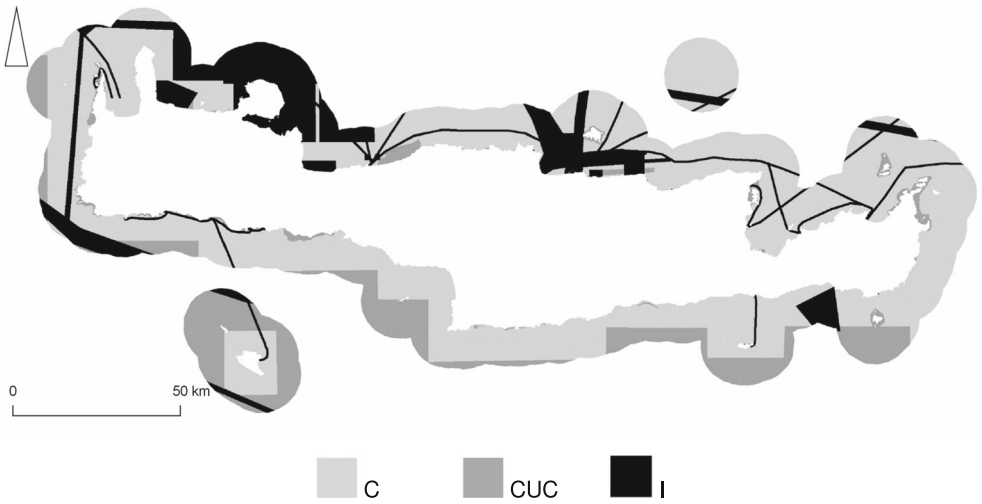

Fig. 2 Marine uses cross. Source: authors' own analysis

As it is illustrated in Table 2, the highest percentages of conflict result from the coexistence of Fishery (b.1) use with the use of Shipping (a.i) and / or Military (d) (Codes: a.1; b.1 - b.1; d - a.1; b.1; 1; b.1; b.3).

The distribution of incompatible marine typologies is due to overconcentration of human induced activities on the Northern coast of Crete, and, more specifically, on the northern central coastal zone, where Heraklion - the administrative capital and the principal urban center of the region - is located. Here the third largest in passenger traffic port in Greece is located (ELSTAT 2011) that links Crete with Athens and many southern Aegean islands. Apart from passengers' transportation, other industrial activities that are in direct interaction with the marine space - that is, mostly the transport of raw materials and merchandise - are also concentrated in the Gulf of Heraklion. The same occurs on the North-East coast, where navigation is heavy primarily because of day-ships and private pleasure crafts that carry a number of routes mainly during the tourist season.

In contrast, on the North-Western coastal zone, the conflicts are mainly due to the large number of marine military zones delineated from the nautical base in Souda. However, navigation in the wider area is also heavy since it is important, first, for connecting Souda with Chania - the second largest urban center of Crete that has a number of tourist attractions, and, second, for allowing the frequent transportation of day-ships that carry a number of routes.

On the South-Western coastal zone, there are conflicts near the land which are due to numerous tourist spots, coastal settlements and problems on roads links because of the intense geomorphological relief of the area. In the rest of the South-Western coastal zone, the incompatibility of uses is due not only to the connection between Crete and other small Greek islands in proximity but primarily to the passage of commercial and passenger ships that sail to other ports of the Mediterranean.

Discussion

MSP is a complex and multidimensional process, whose character is principally determined by the application scale. At small spatial scales, the character of MSP is regulatory. It focuses on specifying and complementing guidelines from the upper planning level, based on local characteristics, as well as on resolving conflicts in use and promoting synergies between marine uses. At large spatial scales, strategic MSP should ensure and promote synergies and compatibilities between spatial, development and sectoral policies and establish a pertinent framework of consultation between the political governance and administration bodies. In Greece, no such spatial planning process has been implemented, with the result that major infrastructure projects and development choices with significant spatial impacts occur with ad-hoc procedures with significant social, economic and environmental costs.

It is worth mentioning here that the provision related to the management of marine space was incorporated into Greek legislative framework in 2011, modifying Law "Spatial Planning and Sustainable Development and Other Provisions" ["Chorotaxikos sxediasmos kai aeiforos anaptyxi kai alles diataxeis", In Greek] (OGG 1999). More particularly, principles that are to be considered in spatial plans should ensure the integrated management of marine space in relation to coastal zones, by coordinating and harmonizing individual policies, programmes and investment plans for the development of productive activities carried out by different operators in the same area, thus aiming to protect the marine ecosystem and promote integrated and sustainable development (OGG 2008a). In addition, Article 7 that is a Special Framework for Spatial Planning and Sustainable Development, ["Eidika plaisia Chorotaxikoú Schediasmou kai Aeifóroy Anaptyxis", in Greek] has been amended and aims to specify and complement guidelines from the upper planning level that are about the development and spatial organization of national space,

Table 2 Marine typologies

s/n	Code	Cross	Cover (km^2)	Cover (%)	Compatibility
1	c	Protected areas	2,35	0,02	C
2	b.1	Fishery	6962,48	63,65	C
3	b.1; d	Military; Fishery	779,91	7,13	I
4	b.1; c	Protected areas; Fishery	208,44	1,91	CUC
5	b.1; c; d	Protected areas; Fishery; Military	25,38	0,23	I
6	b.1; b.3	Fishery; Extraction	1668,05	15,25	CUC
7	b.1; b.3; d	Military; Fishery; Extraction	2,71	0,02	I
8	b.1; b.3; c	Protected areas; Fishery; Extraction	1,21	0,01	CUC
9	b.1; b.2; d	Military; Fishery; Aquaculture	0,01	0,00	I
10	b.1; b.2; c	Protected areas; Fishery; Aquaculture	0,01	0,00	I
11	b.1; a.3	Fishery; Cables-pipelines	20,98	0,19	C
12	b.1; a.3; d	Fishery; Cables-pipelines; Military	10,31	0,09	I
13	b.1; a.3; c	Fishery; Cables-pipelines; Protected areas	0,80	0,01	CUC
14	b.1; a.3; c; d	Fishery; Cables-pipelines; Protected areas; Military	0,37	0,00	I
15	b.1; a.3; b.3	Fishery; Cables-pipelines; Extraction	1,28	0,01	CUC
16	a.2	Port infrastructures and anchorage	0,18	0,00	C
17	a.2; b.1	Port infrastructures and anchorage; Fishery	3,09	0,03	I
18	a.2; a.1;d	Port infrastructures and anchorage; Shipping; Military	0,11	0,00	I
19	a.2; b.1; c	Protected areas; Fishery; Port infrastructures and anchorage	0,54	0,00	I
20	a.2; a.3; b.1	Fishery; Cables-pipelines; Port infrastructures and anchorage	0,01	0,00	I
21	a.1	Shipping	6,73	0,06	C
22	a.1; b.1	Shipping; Fishery	912,03	8,34	I
23	a.1; b.1; d	Military; Fishery; Shipping	165,40	1,51	I
24	a.1; b.1; c	Protected areas; Fishery; Shipping	14,64	0,13	I
25	a.1; b.1; b.3	Shipping; Fishery; Extraction	135,86	1,24	I
26	a.1; a.3; b.1	Fishery; Cables-pipelines; Shipping	8,20	0,07	I
27	a.1; a.3; b.1; d	Fishery; Cables-pipelines; Shipping; Military	0,44	0,00	I
28	a.1; a.2	Port infrastructures and anchorage; Shipping	0,11	0,00	C
29	a.1; a.2; b.1	Port infrastructures and anchorage; Fishery; Shipping	5,85	0,05	I
30	a.1; a.2; b.1; d	Port infrastructures and anchorage; Shipping; Military; Fishery	0,85	0,01	I
31	a.1; a.2; b.1; c	Protected areas; Fishery; Port infrastructures and anchorage; Shipping	0,51	0,00	I
32	a.1; a.2; b.1; c; d	Protected areas; Fishery; Port infrastructures and anchorage; Shipping; Military	0,01	0,00	I

Source: authors' own analysis

and, more particularly, about certain areas, such as marine space, coastal and island regions. (OGG 2008a).

Table 3 Marine typologies Compatibility

Compatibility	Cover (km^2)	Cover (%)
C	7193,28	64,58
CUC	1879,78	16,88
I	2066,22	18,55
TOTAL	11,139,28	100,00

C Compatible, *I* Incompatible, *CUC* Compatible under conditions

In 2014, Law 4269/2014 "Regional Planning and Urban Development reformation- Sustainable Development" ["Chorotaxiki kai poleodomiki metarithmisi ke Viosimi anaptyksi", in Greek] was enacted (OGG 2014). This Law follows similar guidelines for Strategic Spatial Planning and spatial development and organization of particular areas where development issues, social difficulties, environmental vulnerability etc. occur. In these guidelines, coastal and marine areas and island regions are also included (OGG 2014). The aforementioned Law was replaced two years later by the enactment of Law 4447/2016 (OGG 2016): "Spatial planning - Sustainable development and other provisions" [Chorikos

schediasmos - Viósimi anaptyxi kai alles diataxeis, in Greek], without significant changes in the content of strategic guidelines as formulated by Law 4269/2014.

Within this context and legal framework, it should be noted that spatial organization and development of the coastal and insular space as well as the management of the marine space have already been components of basic strategic options to organize the national space adopted by "National Spatial Planning and Sustainable Development Framework" ["Geniko plaisio xorotaxikou sxediasmoy kai aiforou anaptiksi", in Greek] (OGG 2008a). More specialized guidelines are also included in the main priorities and strategic directions for integrated spatial development and organization of the national space enacted by the "Special Framework for Spatial Planning and Sustainable Development Framework (SFSP&SDF)" ["Eidika plaisia Chorotaxikoú Schediasmou kai Aeifóroy Anaptyxis", in Greek] for Renewable Energy (OGG 2008b); for Tourism (OGG 2009); for Aquaculture (OGG 2011a). More specifically:

(a) The SFSP&SDF for Aquaculture (OGG 2011a) provides basic guidelines, rules and criteria for spatial organization and development of the sector with in order to employ comparative advantages of the Greek seas and achieve social, economic and environmental objectives. (b) The SFSP&SDF for Renewable Energy (OGG 2008b) aims to create viable Renewable Energy installations by harmonizing them in the natural and human environment. To this end, rules and criteria for their localization are set by activity category and space particularities. With regard to the location of wind farms, the national area is divided in zones, including among others inhabited islands, offshore seas and uninhabited islets (Article 5). (c) The SFSP&SDF for Tourism (OGG (Official Government Gazette) 2009), apart from guidelines on the model of tourism development in the coastal area, promotes development of sea tourism (i.e. cruise, pleasure boats, diving, fishing) as a special form of tourism aiming to expand the tourist season and improve its competitiveness.

At a regional scale, the "Regional Framework of Spatial Planning and Sustainable Development (RFSP&SD)" ["Periferiaka plaisia Chorotaxikoú Schediasmou kai Aeifóroy Anaptyxis", in Greek] regulates many issues on coastal and marine areas (OGG 2011b). Among others, it proposes regulations for: (a) marine transport and connections for commercial and passenger purposes; (b) fisheries and aquaculture, activities; (c) protection of marine resources and the management of coastal space (Stefani et al. 2016); and (d) localization of diving parks. It is worth mentioning here that the RFSP&SD has been under assessment, amendment and specialization since 2010. This significant delay is due not only to objective questions related to the administrative inability to support the process and procedure but also to the complexity of the task in a particularly unfavorable socially, economically, and politically conjuncture.

To sum up, despite the existing institutional tools, there is no implementation of an integrated framework of the management of coastal and marine space as a whole. Within the spatial planning framework, tools and instruments that have an impact on marine and coastal areas are enacted but they are characterized by fragmentation and inconsistency (Tsilimigkas et al. 2016; Tsilimigkas and Rempis 2017). It is possible that the implementation of the institutional framework for the MSP is likely to contribute to this direction since Greece must proceed to incorporate it in the national legislation framework, determine the competent authority (or authorities) for MSP application and to enact maritime spatial plans.

Conclusions

Within this framework, the methodology proposed is pertinent to identify marine typologies that come out of the existing marine uses and activities applied in the Region of Crete. Detection of synergies and conflicts of marine uses and activities and their quantitative representation by using geospatial data could contribute to a spatial diagnosis based on objective criteria. As already mentioned, the principal studies of marine uses and activities here concern: Marine transports and connections infrastructures; extraction and resources exports; and protected natural and cultural environment; and Military uses. It is conspicuous that the criteria may change and be adapted to social and economic priorities and development targets. Offshore renewable energy production, dive parks and underwater tourism are expected to grow in the years to come.

The analysis of this paper has shown that 65% of the study area are the existing marine uses that are characterized by compatibility, whereas the remaining 35% are conflicts. The extent and the type of conflicts illustrate that there is need for a regulatory MSP implementation, in which limits and conditions of both existing marine uses and activities - emerging from offshore renewable energy production, dive parks and underwater tourism - will be set in such a way that both the environment is preserved and synergies between spatial, developmental and priorities in sectoral policies are achieved.

The present study – through the case study area of Crete - has also tried to show that there is need for an integrated spatial planning system that considers both land and marine areas rather than planning for the marine area and the land at a parallel level. The results of this study (Figure 2) have also illustrated that a big number of conflicts occurs where the land and the marine area are in proximity and where human induced activities are intense as in the northern coasts of the island of Crete.

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