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Promoting ancillary conservation through marine spatial planning

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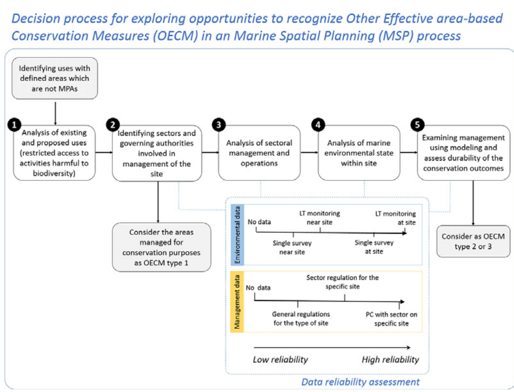
HIGHLIGHTS

- Framework for decision making for planners to identify potential OECMs
- Decision process requires screening of information reliability.
- Novel scale for data reliability and accountability

GRAPHICAL ABSTRACT



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ABSTRACT

The term Other Effective Conservation Measures (OECMs) refers to areas which are not protected areas and yet significantly contribute to conservation; they were recently defined by the Convention on Biological Diversity. Efforts to address the designation of OECMs include further definition of the term and the development of typologies of OECMs and of screening tools which can be applied to identify potential OECMs. While the designation process of OECMs is still unclear, especially in the marine environment, we suggest a decision process which can be used by planners to identify and designate specific types of OECMs as part of the marine spatial planning (MSP) process. These OECMs are areas where marine communities benefit from access restrictions established due to safety or security concerns. We applied the suggested process on two case studies of the Italian Northern Adriatic and the Israeli Mediterranean seas. When consideration of OECMs comes at the expense of designating marine protected areas, OECMs can become controversial. However, OECM designation can promote achievement of marine conservation goals and of ecosystem-based management of uses. Therefore, we suggest that while spatial targets for conservation should focus mainly on areas dedicated for marine reserves, OECMs, especially of the type for ancillary conservation discussed in this paper, can be achieved through MSP. Using MSP for the designation of recognized OECMs may significantly promote marine conservation goals in unexpected ways and may ¬help realize ecosystem-based management.

1. Introduction

While the use of the oceans is increasing, there is a growing debate on how to achieve conservation goals beyond the establishment of marine protected areas (MPAs) (e.g., Allison et al., 1998; Agardy et al.,

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2011; Zupan et al., 2018). The recognition of the contribution of environmentally-valuable areas that are not MPAs to the achievement of marine conservation goals is expressed in the Aichi Target 11 of the Convention on Biological Diversity (CBD). This target refers to other effective area-based conservation measures (OECM) that could contribute to the achievement of conservation goals. OECMs differ from protected areas mainly by their management objectives, meaning the purpose and scope of their designation. While protected areas have conservation as their primary objective, OECMs may deliver in-situ conservation, regardless of their management objectives (IUCN WCPA, 2018).

MPAs and OECMs are meant to achieve marine conservation goals most commonly by the sustainment and recovery of biological diversity. Biological diversity is broadly defined as the variability among all living organisms and the ecological milieu which they are part of (CBD, 1992). In addition, marine conservation goals often focus on a particular marine species that planners and managers are interested in protecting. Marine conservation occurring within the environment considered within the context of marine planning can be roughly divided into two types: in-situ and ex-situ conservation. The first involves the conservation of natural habitats including species populations in their natural surroundings; the latter is the conservation of biological diversity components outside their natural habitat (e.g., captivity) (CBD, 1992). Although this context is not mentioned in the CBD's Aichi targets, the IUCN definition of an OECM clearly states that OECM should deliver in-situ conservation (IUCN WCPA, 2018).

In addition to its primary goal of achieving socio-economic objectives, marine/maritime spatial planning (MSP) is a tool for achieving ecosystem-based management and promoting sustainable development in order to meet environmental protection goals (e.g. The Marine Strategy Framework Directive of the EUEC 2015). MSP is gaining in use worldwide (Ehler and Douvere, 2009; Portman, 2016). It usually aims to allocate uses in such a way that conflicts among uses are prevented or reduced and negative impacts on the marine environment are minimized (Ansong et al., 2017). In addition, MSP can also implement recommendations arrived at through marine conservation planning processes that prioritize areas for protection or conservation (e.g., Wilson et al., 2009). Such implementation often results in the allocation of MPAs (see The Nature Conservancy, 2017). Moreover, the focus on the spatial allocation of uses allows MSP to address area-targeted marine protection goals (Foley et al., 2010; Agardy et al., 2011; Portman, 2015; Agardy et al., 2016).

Efforts to protect marine biodiversity include setting aside a minimum set of spatial areas for MPAs that together will achieve the desired spatial conservation targets for a particular area (Wilson et al., 2009). Aichi Biodiversity Target 11 determines that 10% of the coastal and marine area should be protected by year 2020. The areas set aside must be ecologically representative, and effectively managed as well-connected systems of MPAs.

Indeed, spatial targets for marine conservation are frequently required as part of MSP (e.g. EC, 2014, 2015). Moreover, MSP has the ability to “zoom-out” from looking at singular, specific MPAs, thus obtaining a wider perspective on the interactions between human activity and marine ecosystems. For example, MSP can effectively allocate buffer areas and other environmentally valuable areas for further protection of MPAs from human activities that could negatively impact the marine environment (e.g., Tuda et al., 2014; WWF, 2016).

1.1. Broad perspective for marine conservation using MSP

Recent approaches to MSP include suggestions on how to promote conservation goals beyond the allocation of MPAs. For example, Dunstan et al. (2016) suggest an MSP approach based on the identification of ecologically or biologically significant marine areas (EBSAs). They suggest that these areas could be a starting point for MSP processes that will increasingly involve more sectors. This approach may ensure sustainable development, because pressures on biologically and ecologically significant areas are constantly examined to reduce the risk caused by management of uses in the marine space (Dunn et al., 2014). As a case in point, Portman et al. (2013) suggest giving standing or “political endorsement” to the already identified eleven ecologically and biologically significant areas (EBSAs) in the Mediterranean Sea through MSP.

Shabtay et al. (2018a) recently suggested an approach to MSP that considers marine conservation within areas of human activity in order to enhance connectivity between MPAs and further promote sustainable planning and management. The authors examined conservation opportunities at marine infrastructure sites within which fishing and general public access are prohibited. Additional studies found that such areas support high species diversity including those species that are vulnerable and endangered, compared to unprotected, yet undisturbed habitats in a heavily exploited environment (e.g., García-Gómez et al., 2015; Shabtay et al., 2018b). This approach, and that of Dunstan et al. (2016) and Portman et al. (2013), can be further expanded to promote conservation opportunities in areas not primarily designated for conservation through MSP.

1.2. The contribution of OECMs

Under the CBD's Aichi Target 11, OECMs could be counted for achieving the target of protecting 10% of the total area. Yet, recent literature highlights the gap that exists between the concept of OECMs and the actual implementation of the concept in planning processes (Laffoley et al., 2017; Diz et al., 2018). In their work, Diz et al. (2018) demonstrate how locally-managed marine areas in Mozambique could be recognized as OECMs. They highlight challenges of setting operational criteria to identify OECMs, especially, if these areas are to be counted within the CBD 10% target. Furthermore, MacKinnon et al. (2015) suggested a decision-screening tool to assess whether sites should be included in the 10% target or not. Instead of simply counting the amount of area in order to reach the 10% CBD target, they highlight the importance of incorporating multiple operative actions and measures to determine whether they achieve the general goal of conservation based on case-by-case analyses.

To render the concept of OECM operational as part of a planning process, the IUCN established an advisory task force to set criteria for identifying OECMs and provide guidance. The IUCN identifies three types of approaches that lead to the recognition of OECMs (see IUCN WCPA, 2018): **1**) primary conservation, **2**) secondary conservation, and **3**) ancillary conservation. The first type, refers to areas that meet all elements of an MPA but are not designated as such due to governmental priorities. OECM for secondary conservation refers to areas where conservation outcomes are actively pursued, but only as secondary management objectives. The third type, OECM for ancillary conservation, refers to “areas that deliver conservation outcomes as a by-product of management activities even though biodiversity conservation is not a management objective” (p. 15). In addition, the IUCN suggests a screening tool for users to examine the compatibility of suggested areas to be recognized as OECMs. However, the screening tool has yet to be used in the MSP context to identify and to acknowledge potential OECMs.

The goal of this study is to make a first attempt to explore the establishment of a process for recognizing OECMs as part of MSP. We developed a framework for decision-making that includes and articulates the use of the tools proposed by the IUCN and MacKinnon et al. (2015); it can be applied in an MSP process to explore potential OECM areas through a case-based approach. We tested our framework on two ongoing MSP processes: the first in the Northern Adriatic Sea in Italy, and the second using the Israel Marine Plan for the Israeli Mediterranean coast. We adopt the approach suggested by Shabtay et al. (2018a) of exploring the ecological value of marine areas that restrict unauthorized access to their territory (hereafter, “restricted-access sites”) with the aim of identifying areas that could be recognized as ‘ancillary conservation’ OECMs.

In this study, we first present the operational framework to guide in the identification of OECMs through a decision process consisting of six steps. Each step includes a simple question that could be answered using data collected from suggested sources and key informants. The answer of each question leads to suggested actions or to a follow-up step. Secondly, we test the application of the decision process in the two case studies mentioned above where planners and policy makers are currently working to develop a marine spatial plan. We simulate a decision process that examines whether several specific sites within the regions can be considered as OECMs and as such, be afforded some level of recognition within MSP.

2. Developing an operational framework to identify OECMs during decision making

Although both the IUCN (2018) and MacKinnon et al. (2015) suggest useful screening tools to assess which areas could be recognized as OECMs, they do not propose the means for integrating this screening within planning. The framework for the decision process that operationalizes the screening tools of IUCN (2018) and MacKinnon et al. (2015) is presented in Fig. 1. The process is organized as a sequence of activities and decisions to be taken based on best available knowledge and scientific evidence at different stages. The subsequent questions and activities are organized in order to guide planners while exploring potential OECMs in their cases.

In our approach to address OECM recognition, MSP focuses firstly on uses rather than on environmental features of a region. Therefore, mapping maritime uses in the area should be performed as part of the early stages of MSP when the existing state of a region is explored. Additionally, the early stages of MSP should include an exploration and understanding of the conservation challenges in the region (see Box 1). Preferably, the suggested decision process will take place at an early stage of MSP to allow further examination and data collection when required. Subsequently, final decisions would be made later in the planning process or in the next planning cycle (see Fig. 1).

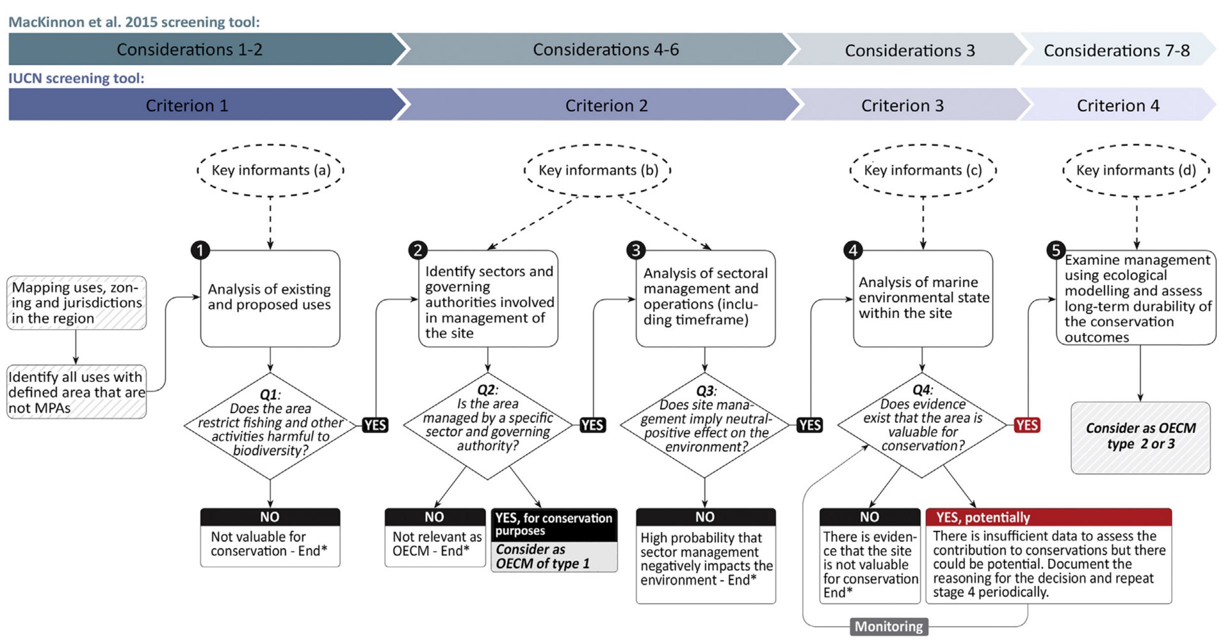
2.1. Data and information required

Decisions regarding the ability of a site to promote marine conservation require specific types of data and information. The decision entails a reflection not only on the availability of the data on the site, but also on the quality of data with regard to its ability to reflect the ecological state of the site, the activity that occurs there, and changing conditions over time.

For the process of identifying potential OECMs, data reliability is crucial. Peer-reviewed data are not likely to be available for all the potential sites under study, but it is required that OECMs should be scientifically robust (Diz et al., 2018). The suggested decision process about OECMs requires obtaining data from multiple sources which often means considering non-peer-reviewed data, grey literature and personal communications with key informants. Key informants can be local actors involved in the management activities of the site, or from local environmental agencies, or other actors that might have (direct, local, traditional) knowledge on the site (Nursey-Bray et al., 2014; Bastari et al., 2017; Vince et al., 2017). Such non-peer-reviewed data sources might be highly valuable to decide about a site's potential to promote marine conservation (Cigliano et al., 2015; Theobald et al., 2015; McKinley et al., 2017).

In order to make robust and transparent decisions regarding OECMs, available data should first be assessed according to the following characteristics: i) relevance for marine conservation (i.e., species richness and diversity, rare/vulnerable/key species abundance), ii) level of site specificity, referring to whether data pertain to the site being assessed or to similar sites at some distance; iii) periodicity, meaning the period of data collection (short-term to long-term) and age (old or up-to-date); iv) source (provider), ranging from informants that are well-acquainted with the site and activities within the site, to informants that have generalist knowledge about the site and activity within it.

We suggest a grading scale for environmental and management data reliability (Fig. 2) required for the suggested decision process regarding the recognition of OECMs. Grading data quality is a relatively common process for planning and management decision making (Caldow et al.,



a) Spatial databases, spatial planning schemes, spatial regulations, sectoral zoning.
b) Managers, operators, harbour masters, stakeholders, practicioners (local knowledge and expert knowledge), experts' opinion.
c) Databases regarding habitats and environmental lconditions, experts' opinion, environmental monitoring reports, local knowledge about species diversity.
d) Modellers, experts for specific environment.

* End means that the area is not suitable to be considered for propoting conservation.
■ At this stage planners can suggest the site as OECM, yet further action is required for final decision in next planning cycles.

Fig. 1. Decision process for exploring opportunities to recognize OECMs in an MSP process.

Table 1
Description of decision process steps represented in Fig. 1.

Step no.	Definition	Purpose	Proposed analysis	Outcomes	Geographic scope R = study region S = in situ
0	Preliminary steps	1. Understand conservation priorities and goals in the region. 2. Map uses, zoning schemes and jurisdictions. 3. Screen all relevant uses whose area is defined and which are not MPAs	1. Inquire about the main reasons for establishing existing MPAs or proposing new MPAs in the region 2. No analysis is required. 3. Explore mapping products to select relevant sites.	1. A list of priorities and goals, protected species, nursery habitats, endemism, nesting sites etc. 2. Map that presents the boundaries of all area-specific uses and of MPAs. 3. A list of use sites or areas (including several sites) of interest.[a]	R
1	Analyzing existing and proposed uses	Identify restricted-access sites/areas that prevent fishing and other activities potentially harmful to biodiversity[b]	Map of access and fishing regulations, and restrictions derived from maritime activity and marine conservation measures.	A list of sites which restrict access, including for fishing and other activities potentially harmful to biodiversity.	R
2	Identifying governing entities	Determine whether the site is governed and managed by a specific authority (e.g., one representing a particular sector).	Explore various data sources (e.g. key informants, footnote b in Fig. 1) to verify which authorities and sectors operate on site.	If the site is not governed and/or managed it should not be considered as OECM. If governed and/or managed by a specific authority for conservation purposes, it could be further considered as OECM type 1 (1 - primary conservation, see IUCN WCPA, 2018). If governed and/or managed by a specific authority but not for conservation purposes, it could be further considered as OECM (type 2 - secondary or 3- ancillary conservation)	S
3	Analyzing management of the site	Determine whether activities within can harm the marine environment	Collecting information on all or most activities that occur on regular and occasional basis. Each activity should be assessed based on its actual or potential effect on the marine environment	If management implies negative impact to the marine environment, the site should not be further considered an OECM. If management implies neutral or positive impact, the site could be further considered as OECM.	S
4	Analyzing marine environmental conditions within the site	Determine the ability of the site to support marine conservation	Analysis requires site-specific environmental data including communities' traits such as species diversity, vulnerability, endemism, and rareness. The analysis should also determine the extent to which the site includes species' natural habitats. Analysis may also focus on other conservation measures or the functionality of the site based on specific regional conservation goals (detected in step 0).	If the site doesn't deliver marine conservation or protection relevant to the region it should not be considered an OECM. If the site is potentially valuable for conservation yet further conservation evidence is required, the site can be identified as potential OECM and further assessed in future planning cycles after extensive monitoring. If found to be valuable for conservation based on collected evidence collected, it should be recognized as an OECM.	S
5	Examining management scenarios	Examine the ability of the site to support marine conservation over time and propose ideal management schemes, considering the management and the capacity to ensure that the conservation efforts cannot be easily reversed and that they are consistent with the ecological timeframes of the ecosystem (Diz et al., 2018)	The analysis should include usage in modelling to examine the effectiveness of the area in delivering conservation measures and the management schemes that may promote this. The management scenarios should include various potential trends and challenges to the area (see case study two) and would be constructed together with the governing authority of the site to reflect its willingness and ability to support marine conservation. Preferably, scenarios would be examined using ecological modelling tools; however, other reliable tools may be used (e.g. Ban et al., 2015). A specific analysis of the management timeframe is developed to demonstrate the endurance and irreversibility of conservation benefits.	Once a site's management and its effect on the ecosystem within the site are well understood, planners may finally suggest the site as OECM within the wider scope on MSP. Most importantly, planners should assess the willingness and ability of the governing authority of the site to commit to the protection of valuable species and habitats in the site over the relevant timeframe for the ecosystems or conservation features at stake.	S

[a] Defined according to the specific conservation priorities of the region, the spatial allocation of uses, or based on some other motivation to recognize OECM (e.g. poor connectivity between MPAs, opportunities to take advantage of underdeveloped area for conservation purposes, buffering MPAs).
[b] Since fishing exerts great pressure on marine ecosystems (Costello et al., 2010; Coll et al., 2016; Sala and Giakoumi, 2017), these areas can potentially deliver benefits for conservation, despite their not being dedicated to it (see Shabtay et al., 2018a).

2015; Morgan et al., 2016; Stelzenmüller et al., 2018). For both environmental and management data, we suggest that the planner assess the reliability of the data to reflect the site's state based on two criteria: i) spatial reliability, and ii) sampling period or informants' accountability for environmental and management data, respectively. High relevancy of the available environmental data for marine conservation should be regarded as a prior condition for using the grading scale. The spatial reliability criterion is used for both environmental and management data and it ranges from low site specificity (distant sites) to high site specificity (Yoccoz et al., 2001).

The second criterion for environmental data is the sampling period that ranges from low reliability (short sampling period) to high reliability (long sampling period). The second dimension for management data is informant accountability that ranges from low accountability where

Box 1
Understanding conservation challenges in a specific marine region.

Exploring and understanding marine conservation goals and challenges specific to the region being planned is crucial before applying the proposed decision process. Further in the decision process, each potential OECM site should be assessed based on its capacity to deliver conservation measures that are relevant to the region (e.g., refuge for endangered species, nursery habitats, nesting site). As a starting point for planners to understand marine conservation priorities in a specific region, we suggest investigating the main reasons for establishing existing MPAs or proposing new MPAs in the region. Since establishment of MPAs are in response to well-defined conservation goals, understanding the reason for their establishment should supply planners with a general understanding of which habitats, species, communities, and functions needing protection in the region (e.g. Pressey et al., 2015). This understanding can be used in the decision process (see Table 1) as a compass that assists the decision-makers to evaluate the contribution of a site to *in-situ* marine conservation if it will be designated as an OECM, while keeping in mind its overall conservation value within the study region.

management data are acquired from general regulations for the type of the site, to high accountability where management data is acquired from informants who live or work in the site. For environmental data, the length of the sampling period is given relatively more weight compared to the specificity of the site because the information about the environmental state after disturbance (usually some type of construction) over time and the long-term effect of the site on the marine environment is generally more important (Pickett, 1989; De Palma et al., 2018).

In the evaluation process weight can be given also to the age of the data, generally old data can be ranked as less reliable than updated data. For management data, the specificity of the site is given relatively more weight compared to informant accountability since it is assumed that regulations that only apply to a specific site are based on the management needs of the site, and, therefore, reflect the activities that occur within the site (e.g. Marques et al., 2014; Shabtay et al., 2018b). To further adjust the ability of MSP to explore and recognize sites and areas as OECMs, we provide further examples of the type of data needed for every stage of the decision process presented in Fig. 1 and in the case studies (see Tables 2 and 3 and Appendices 1 and 2).

3. Application in two case studies

We applied the proposed operational framework to two case study regions where marine spatial plans are being developed: 1) the Adriatic Sea off the northern coast of Italy, and 2) the Mediterranean Sea off the coast of Israel. First, we used spatial data to map the main uses within offshore waters, particularly restricted-access sites, and MPAs or other areas officially recognized as environmentally valuable. Second, to get an initial perspective on the spatial distribution of restricted-access sites along the coasts, we used ArcGIS 10.2 to measure the distances (minimal, maximal and average distances) among protected areas, restricted-access areas, and between these. Third, we focused on specific sites within each case study region and applied the proposed decision process (Fig. 1) to each of the sites and lastly analyzed the distribution of the specific sites in each with relation to MPAs. A discussion follows in Section 4.

3.1. Case study 1 - the Italian Northern Adriatic

The Northern Adriatic is considered among the most productive basins of the Mediterranean Sea yet it suffers from cumulative impacts to the marine environment from neighboring Italy, Slovenia and Croatia and it is of significant conservation concern (Coll et al., 2012; Bastari et al., 2016; Gissi et al., 2017; Menegon et al., 2018). This shallow, semi-enclosed area receives high nutrient input from several rivers, which sustain high productivity in the area (Cozzi and Giani, 2011) and contributes to high biodiversity and endemism rates (Bastari et al., 2016). The region hosts important spawning areas of diverse fish species of high economic value. For example, the common sole (*Solea solea*), severely threatened by overfishing, taking place in nursery habitats where juveniles aggregate (Scarcella et al., 2014). Moreover, the region contains unique habitats of conservation interest, recognized as biodiversity hotspots called “Trezze” or “Tegnùe”; coralligenous concretions valued for their ecological function and highly vulnerable to perturbations (Ponti et al., 2011; Falace et al., 2015).

Currently, none of the bordering countries of the Northern Adriatic has a proper marine spatial plan. The ADRIPLAN project was an MSP pilot project, launched in 2013 in the region, that defined objectives including ecosystem-based planning and management along with objectives to support economic development and multiple sectors' and political entities' participation (see Barbanti et al., 2015). The area was designated to test MSP, because of the coexistence of multiple uses as

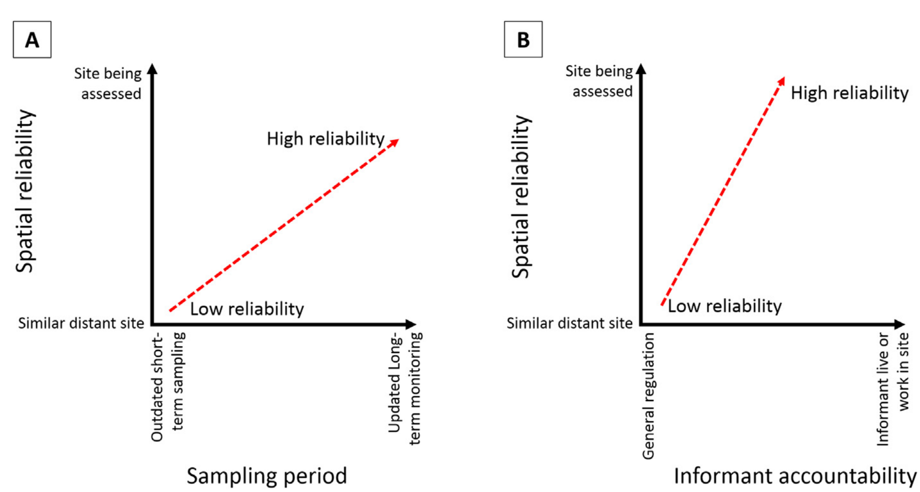


Fig. 2. Qualitative assessment of reliability of the data – i.e., the ability of the data to reflect the environmental and management state of the site being evaluated for OECM status. **A**) Environmental data. **B**) Management data.

Table 2
Summarized decision process applied on the Italian case study (see a detailed description of the process in Appendix 1).

Case	Site description	Main arguments	Decision
A. Laguna di Marano	The area contains two sites of underwater pipelines for urban water discharge	The area contains sea grass and Tegnùes which are unique and vulnerable habitats in the region. The access is restricted to the site so that only small-scale fishery occurs around the pipelines. However, shortage of data regarding sites' management and environmental state limit the capability to conclude regarding its contribution to marine conservation over time. Similarly, the time frame within which the site is managed is unclear, It is expected that pipelines will be stay in operation, and related management will last long.	The sites in the area should NOT be suggested as OECM in the current planning cycle. Further examinations should be assessed in future planning cycles basis on site monitoring on regular base
B. Chioggia	The area is composed of a biological protection zone and three sites: mussel farms, LNG and small gas platforms, and ship wrecks.	The area is characterized by presence Tegnùes. Access and therefore fishing is restricted in all sites in the area in addition to fishing restrictions within the biological protection zone. Several years of monitoring around LNG site imply neutral or positive effect on marine. The platform is expected to remain under similar management in the next decades. Yet, for the aquaculture site, data is obtained from other similar and not from the site being analyzed. Aquaculture sites are in operation through concessions for the activities, which usually lasts for 6 years, and then renewed.	The aquaculture site should be considered as valuable for conservation and may be suggested as OECM after extensive monitoring. The LNG and gas platforms are found valuable for conservation and should be suggested as OECM. Yet, further monitoring and ecological modelling is required to validate the decision. Wrecks should not be considered as OECMs since the site is not managed by a specific sector
C. Ravenna	The area is composed of biological protection zone surrounded by several sites: military area, mussels' aquaculture farms, and about 15 gas platforms.	The biological protection zone in the area protects nursery habitats of valuable fish species for fishery (*Solea solea*) and includes several Tegnùe. Access, and therefore fishing, is restricted in all sites in the area. Data obtained from distant sites suggest that aquaculture site attracts heavily exploited fish species and that biomass of invertebrates and fish increase near gas platforms compared to their surroundings. Yet, no environmental data exist for the military area. The site is expected to maintain the management for more than a decade, because of the renewal of aquaculture concessions and gas platforms are operational	The military site should not be suggested as valuable for conservation since data is lacking. The aquaculture site and the gas platform should be considered as valuable for conservation and may be suggested as OECM after extensive monitoring.

well as the presence of important environmental features deserving protection. The pilot project yielded, in addition to outcomes, some methodological tools that can be used for MSP to promote sustainable development (see Depellegrin et al., 2017; Gissi et al., 2017). Both planning outcomes and the methodological tools, including the decision process tool developed from there, may be used in the future to develop a marine spatial plan in the region.

We focused on the Northern Italian coast of the Adriatic, between Veneto Region from Laguna di Marano in the north, to Emilia Romagna municipality with Ravenna in the south (see Fig. 3). Spatial data on the different uses and their distribution were taken from the ADRIPLAN

Table 3
Summarized decision process applied on the Israeli case study (for a detailed description of the process see Appendix 2).

Case	Area description	Maim arguments	Decision
A. Hadera	The area is composed of two sites: Orot Rabin power station and desalination plant, and a gas terminal.	The area is adjacent to large Kurkar rock which is considered as unique habitat that supports diverse marine communities. The power station site host significantly high species diversity including relatively large populations of vulnerable species. Access and therefore fishing is restricted in the 100 m from the infrastructure of the power station and 1 km around the gas terminal. Between the power station and the gas terminal access is not restricted. The infrastructures are expected to remain in site for more than a decade. Further examination should focus on the gas terminal site.	Orot Rabin site should be considered as OECM as it was found highly valuable for conservation. The gas terminal site should be considered as valuable for conservation and may be suggested as OECM after extensive monitoring. In current planning cycle, additional fishing restrictions might be applied in the areas between the power station and the gas terminal. Willingness and ability of the governing authority should be assessed prior to further recognition of the site as OECM
B. Reading power station	The area of the coastal water in northern Tel-Aviv includes a single site of Reading power station.	The site is adjacent to large Kurkar rock. It hosts vulnerable populations and high species diversity. Access restrictions prevent fishing in the site. The site is expected to remain as it is with similar management for more than a decade. Additional monitoring and ecological modelling will enable planners to construct ideal management plan for the site.	The site should be considered as OECM as it was found valuable for conservation. Yet, further monitoring and ecological modelling is required. Additionally, willingness and ability of the governing authority should be assessed prior to further recognition of the site as OECM
C. *Trans*-Israel Pipeline facilities (TIP)	The area is composed of TIP facilities, Rutenberg power station, and a desalination station.	The site is considered valuable for pelagic fish communities and Chelonoidea species. It hosts vulnerable species. Access restrictions prevent fishing in the site. Yet, the environmental data available for the site does not provide significant evidence for marine conservation and further monitoring is required. Furthermore, the time frame of which the site is expected to be managed in a similar way is unclear.	The site should not be suggested as valuable for conservation until extensive monitoring and data collection will allow the site to be considered as OECM.

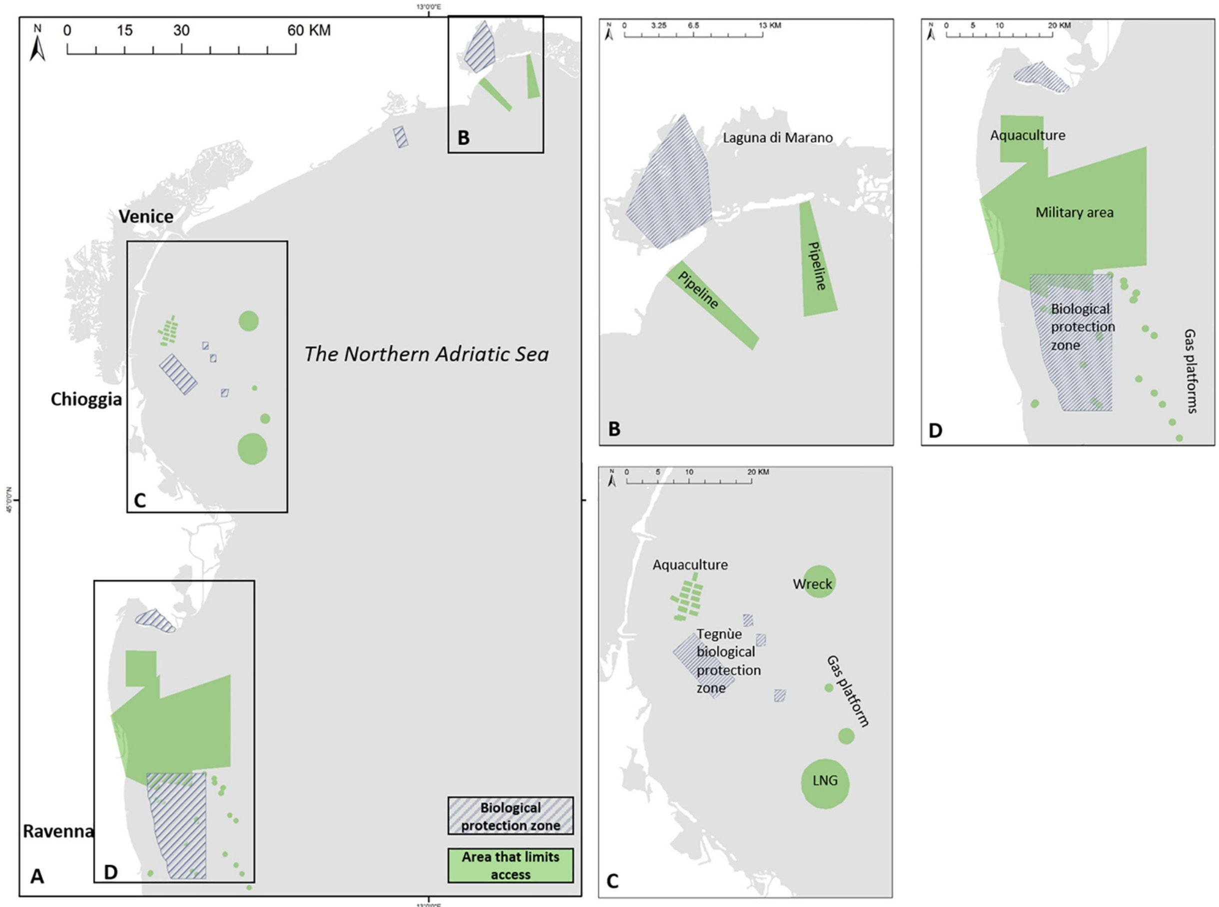


Fig. 3. A) The Italian Northern Adriatic case study areas: **B**) marine waters in front of the Lagoon of Marano, **C**) Gulf of Venice in front of Chioggia, and **D**) marine waters in front of Ravenna Harbour.

data portal (source: http://data.adriplan.eu/). Along the 470-km coast (from Laguna di Marano to Ravenna) the restricted-access sites include military areas, ports, gas platforms, and aquaculture farms with a total use area of approximately 2000 km^2. The total area of the biological protected zones, a local type of MPA, along the coast is 350 km^2 (see Fig. 3). Distances between restricted-access sites and biological protected zones is between 0 and 22 km. Seventy-five percent of the area where access is restricted is situated between 0 and 3 km from an MPA, while only 0.04% of the area is >15 km from an MPA.

We chose to focus on sites that contain multiple restricted-access uses and that are in proximity to one another. We focused on three specific areas (see Fig. 3): A) marine waters in front of the Lagoon of Marano, B) Gulf of Venice in front of Chioggia, and C) marine waters in front of Ravenna Harbour. The results of the decision process applied to the region are presented in Table 2.

3.2. Case study 2 - the Israeli Mediterranean coast

The Israeli Mediterranean coast in the eastern Mediterranean Sea is considered oligotrophic with less species diversity than the sea's western basin, yet containing many unique habitats and thousands of marine species, some endemic and rare (Scheinin et al., 2013). Among the most unique habitats of the Israeli Mediterranean coast are the Kurkar sand stone ridges and abrasion platforms consisting of kurkar and covered with biogenic formation supporting high species diversity and rates of endemism (INPA, 2012). However, the region is subjected to intense species migration from the Red Sea through the Suez Canal (since 1869) that threatens many indigenous species along the coast (Galil, 2007). Furthermore, rapid human population increases together with recent discoveries of off-shore natural gas has resulted in numerous environmental stresses along the coast that endanger the continued existence of many species and their unique habitats (INPA, 2012; Scheinin et al., 2013).

Currently, Israel does not have an approved official marine plan, nor an "oceans policy". Two initiatives exist which aim to regulate activities in the marine environment; the Israel Marine Plan (Israel Marine Plan, 2016), and the Israel Marine Spatial Policy project (IMSPP, 2016). The first is an academic initiative of the Center of Urban and Regional Studies of the Technion; the marine plan promotes sustainable development, but has not received official governmental recognition (Portman, 2015). The second is a governmental initiative that began in 2013, aims to establish marine spatial policy yet has not yet resulted in a plan proposed for government approval. As for the Northern Adriatic case study, an official marine spatial plan for the Israeli Mediterranean coast will likely be established in the next few years and it may benefit from the methodology suggested here.

We focused on the territorial waters of the Israeli Mediterranean coast from Rosh Hanikra in the north to Ashkelon in the south (see Fig. 4). We used spatial data from the Technion's Israel Marine Plan available from an interactive website on-line tool (https://gisweb.technion.ac.il/flexviewers/asda) and followed the decision process presented in Fig. 1 to select three sites—Hadera, Tel Aviv and Ashkelon (see Fig. 4)—which can be recognized as OECMs within the region.

Along the 190-km Israeli Mediterranean coast, restricted-access use area include those set aside for military areas, civilian fire ranges, power stations, ports, gas platforms, and oil facilities (Trans-Israel Pipeline). In addition, both of the borders from north and south (Lebanon and Gaza, respectively) are areas of active conflict where civil access is prohibited

Fig. 4. A) Map of the Israeli Mediterranean coast case study area. **B**) Orot Rabin Power Station site, **C**) Reading Power Station site, **D**) Trans-Israel Pipeline facilities (TIP) site.

(i.e., "military areas"). The total area of restricted-access sites in the territorial waters is 661 km^2. Although the current area along the coast which is assigned as MPAs includes only a few km^2, there is an ongoing process to establish six proposed MPAs with a total area of 981 km^2 (see Fig. 4). The distances between the restricted-access sites and the proposed MPAs are between 0 and 21 km. Most (60%) of the area included within the restricted-access sites is situated between 0 and 3 km from an MPA, while only 0.5% of the area is more distant than 15 km from an MPA.

The area of existing and proposed MPAs is not evenly distributed along the coast. Fifty-five percent of the total MPA area is situated along the northern 60 km of coast, while two additional MPAs, with a total area of 433 km^2, are proposed in the center and the south. We chose to focus on restricted-access sites which are situated in the center and south of the coast and may therefore enhance connectivity between MPAs which are more distant from one another. In addition, we focused on three sites (see Fig. 4 and Table 3) which could successfully demonstrate the use of the suggested decision process tool (Fig. 1) since some data regarding their management and environmental conditions exist from previous studies.

3.3. Data quality assessment of both case studies

We assessed the data used in the decision process of both case studies using our suggested data quality scale (see Fig. 2). The type, spatial specificity, data providers and period of sampling varies among case studies (Fig. 5). The two Israeli cases of Orot Rabin and Reading power stations where site-specific monitoring environmental data were available, as well as site specific management information (personal

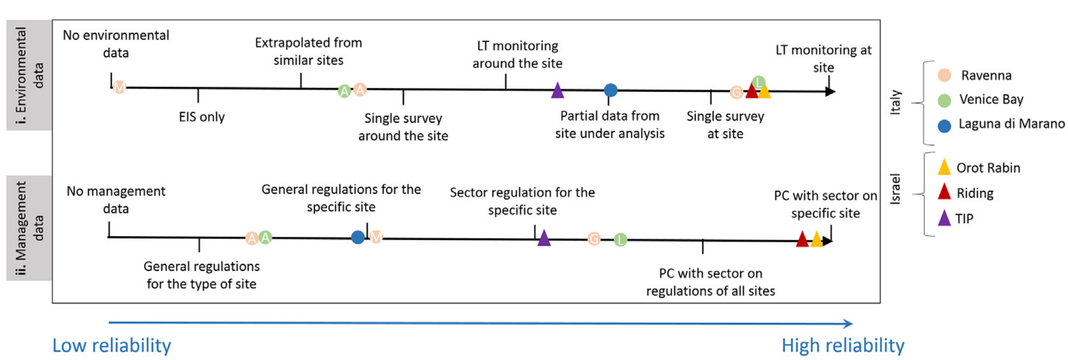


Fig. 5. Data reliability for the Italian and Israeli case studies on a continuum from low to high. EIS = environmental impact surveys, LT = long term, PC = personal communication, A = aquaculture, L = LNG platform, G = gas platform, M = military site.

communication with sector representatives working at the sites), were characterized by high reliability of data.

By contrast, for the Ravenna (Italy) case the environmental information pertains to similar sites adjacent to the site under analysis. With respect to management, for the site in front of Marano-Grado Lagoon it was only possible to obtain information about the general regulation. This assessment could be used in decision processes taking place in future planning cycles to evaluate the change in the reliability of the data from one planning cycle to the other. This may be an important input especially for sites which were not assigned as OECMs in the current planning cycle.

4. Discussion

This study suggests a new perspective on how marine conservation goals might be promoted and achieved beyond the establishment of MPAs through the recognition of Other Effective Conservation Measures (OECMs). Growing attention is given to the adoption of holistic strategies that promote sustainable development and ecosystem-based management of uses in the marine environment (Katsanevakis et al., 2011; EC, 2014; Katsanevakis et al., 2015). Therefore, this study focused on analyzing the potential contribution of non-MPA areas for marine conservation, recognized as OECMs, to achieve a variety of goals and objectives in marine planning. Enlarging conservation perspectives to incorporate potential synergies and coexistence between uses within the marine environment may direct MSP towards the achievement of more elaborate marine conservation goals over larger areas of the sea, as required by the Aichi Targets (CBD, 2012).

The approach presented in this study emphasizes the need to understand the environmental effect of marine uses over time and to conduct planning that considers these use impacts. For example, environmental impact assessments of new development projects may include surveying of existing similar projects in areas with similar environmental characteristics, which are already operating for a decade or more. First off, this may reveal additional aspects of environmental impact of the new project (Stewart-Oaten and Bence, 2001) and secondly, it may supply data on the marine ecosystem within the area of existing projects, often scarce due to the lack of ecosystem surveys in sites that are not dedicated to marine conservation, or do not discharge hazardous substances to the sea (e.g. Ministry of Environmental Protection, 2012). In addition, post-construction monitoring which is ideally suggested for projects (e.g. EC, 2011), may also include assessment of a site's management effects on specific ecosystem components that are valuable for delivering marine conservation. The resulting data can constitute evidence needed to bring about the recognition of OECMs.

A major component of OECMs recognition process is the effect it might have on the sector managing the suggested OECM site. In the 'ancillary conservation' OECM type, it is assumed that marine conservation occurs as a by-product of the management of the site. Although management is not expected to change as a result of recognition of the site as OECM, such acknowledgment may constrain further development within the site, due to subsequent obligations to protect valuable ecosystems contained within the site. The possibility a site would be recognized as an ecologically or biologically significant area may lead to further examination of the management of the site which may (OECM type 1) or may not (OECM type 3) regard conservation goals (e.g. Dunn et al., 2014). Therefore, the willingness of the sector to support the recognition of OECMs within their area of responsibility is assumed to have significant role in the process of OECM recognition. Planners should aim to engage maritime sectors in the MSP process and when developing management plans to increase their commitment to marine conservation (Gilliland and Laffoley, 2008; Gopnik et al., 2012). This may lead to coordination of expectations and willingness to share data between sectors including environmental agencies, marine conservationists, and planners, which would increase OECM potential within a site dedicated to intense human activity.

Although focusing on restricted-access sites makes a good starting point for planners to consider potential OECMs, it involves caveats, mainly related to the management of these areas. Sites within which unauthorized access is prohibited are usually managed for purposes other than conservation (e.g., military areas, aquaculture, oil and gas platforms, etc.). While these sites may promote ancillary conservation or even commit to further support conservation efforts, economic issues and politics may promote the sector's objective at the expense of the marine environment (Wever et al., 2015). Reduction of this risk may occur through legislative changes that formalize the status of OECMs and commit the sector to promote conservation (Arkema et al., 2006). Moreover, sectors may benefit from increased public support in their activity as a result of acknowledging marine conservation delivered by the management of their sites. (Noblet et al., 2015; Carlson and Palmer, 2016). Ideally, a sector will be involved in the process of recognizing sites as OECMs, especially when using ecological modelling to examine management effect on the ecosystem (see Fig. 1).

Suggesting 'ancillary conservation' OECM sites involves a risk that relates to the activity performed within the site and that has significant potential of harming the marine environment. Although routine activity may promote conservation, a single accident such as oil spills or explosions may cause environmental disasters. Yet, such accidents may affect not only the area where it occurred but also its surroundings, destroying valuable habitats even within MPAs in the area (e.g. Alves et al., 2015). Therefore, in the MSP process, planners should consider also the risk of such accidents to occur (e.g. MacKinnon et al., 2015; IUCN WCPA, 2018). In addition, habitats within potential OECMs may be assessed based on their resilience and their ability to survive and recover from damaging, yet rare, events.

The attempt made in this study to recognize OECMs in two regions where MSP is taking place, reveals that lack of empirical evidence on the environmental state of the sites, thus preventing sites from being recognized as OECMs. Further information is needed about the marine communities' characteristics in terms of species composition, organisms' behavior, ecological needs, sensitivity to environmental variations, and human pressures. The shortage of site-specific data should prevent sites from being recognized as OECM, as their contribution to conservation is uncertain (IUCN WCPA, 2018). However, we suggest that sites lacking empirical data but with a high probability of value to conservation, be considered in MSP process as potential OECMs. Nonetheless, the uncertainty involved in the recognition of human activity sites as OECMs leads us to suggest that OECMs should not be considered as part of the 10% spatial target defined by the CBD. OECMs could be considered as an additional 'spatially-explicit' tool that promotes conservation on top of the 10% solely dedicated for MPAs.

Furthermore, in our case studies we found sites which may significantly contribute to marine conservation through providing artificial habitat for endangered and highly-exploited species. This type of contribution to marine conservation may fall short when compared to the protection of marine populations in their natural habitats and it may encourage underestimation of natural habitats protection. By excluding OECMs from within the 10% spatial target, planners and conservationists may be better off – knowing that at least 10% of the marine area is well protected and managed as an MPA that surrounds natural habitats. Such approach may result in the achievement of the wider scope of Aichi Target 11 that is beyond the spatial target (Diz et al., 2018), and the acceptance of the need in non-MPA conservation measures that assist in achieving comprehensive marine conservation which could not be achieved by allocation of MPAs alone (Agardy et al., 2011; Rife et al., 2013).

To recognize 'ancillary conservation' OECMs in MSP processes, planners should use all data sources such as the key informants suggested in Fig. 1. Among the key informants, experts' opinion could determine the effectiveness of a site as OECM based on its size, geographical distance from MPAs, and cumulative impacts in the area (e.g. Edgar et al., 2014). For example, at the Reading site in the Israeli case study, an expert opinion can state whether the area of the site is large enough to function as a type of 'stepping-stone' for marine populations and to contribute to connectivity along the coast (Adams et al., 2014). Yet, in addition to the use of experts' opinion, planners may suggest recognizing or partially designating areas as OECMs based on the applied decision process even when empirical data are absent. An example is the case of Chioggia Bay and Ravenna sites in the Italian case study. In this case, the final decision suggests that planners apply fishing restrictions on the areas that contain several sites even though not all sites were identified as potential OECMs. This may provide further protection to marine communities in these areas that contain biological protection zones. In general, MSP provides an opportunity to consider various types of data, knowledge, and information, to include multiple sectors and experts, and to reflect on various regulations and management strategies.

5. Conclusions

The first step towards recognizing OECMs in the marine environment should be the translation (and operationalizing) of the OECM concept to planning and other regulatory processes. Further linking the process to regulatory actions related to marine planning or marine activities and development in general, increases the applicability of the process and the chances it will become commonplace for MSP.

We argue that the main contribution of the OECM concept to marine conservation can be realized through the effective management of human activities. We suggest that within the MSP framework, there is an opportunity through recognition of OECMs to enhance good environmental status and further ensure the effectiveness and the aims of MPAs and MPA networks to achieve comprehensive marine conservation.

MSP involves the capacity to promote cooperation between various sectors and to integrate multiple data sources and data types. Therefore, it is the ideal management framework for identifying OECMs and promoting their recognition. The decision process presented in this study can support planners in the process of OECMs allocation and to realize ecosystem-based management and planning.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2018.10.074.

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