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Expanding protected areas to encompass the conservation of the endangered common dolphin (*Delphinus delphis*) in the Alboran Sea

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ABSTRACT

The Natura 2000 network is the centerpiece of the European Union conservation strategy to safeguard priority species and habitats. The question of whether other co-occurring species of conservation concern may also benefit from this network, however, remains largely unknown. Here, we used a systematic approach (MARXAN) for i) evaluating if the current Natura 2000 network in the Alboran Sea (western Mediterranean Sea), initially proposed to protect the common bottlenose dolphin (*Tursiops truncatus*) and priority habitats, is also spatially protecting the endangered common dolphin (*Delphinus delphis*), and ii) identifying additional marine areas that should be protected to reach adequate conservation targets for the common dolphin. While the current Natura 2000 network encompass *ca.* 22% of predicted abundances for common dolphins, this percentage might be enhanced by protecting coastal areas nearby the Strait of Gibraltar. However, dolphins and fisheries largely overlap spatially nearby the coastline, and only segregate in offshore areas that represent the marginal distribution of the species. Thus, conservation decision-makers must achieve a trade-off between cetacean conservation and fisheries by combining an area-based approach (*i.e.,* new protected areas close to the Strait of Gibraltar) together with a basin-wide threat-based approach (e.g., regulation of fisheries).

1. Introduction

There is virtually no area or ecosystem that humans have left unchanged. Over millennia, humans have altered natural ecosystems; however these impacts have been recently exacerbated during the so-called Anthropocene (Hoekstra et al., 2005; Hooper et al., 2012; Rockström et al., 2009; Steffen et al., 2011; Worm et al., 2006).

Marine ecosystems are of particular concern since they are likely among the most complex and impacted of Earth's biomes (Halpern et al., 2015; Hoegh-Guldberg and Bruno, 2010). Besides climate impacts (Cheung et al., 2009), pollution (Derraik, 2002; Eriksen et al., 2014; Yamashita et al., 2005), species extinction (McCauley et al., 2015), and biological invasions (Ruiz et al., 1997), fisheries represent a major harvest that has largely impacted marine ecosystems (Anticamara et al., 2011; FAO, 2020; Sumaila et al., 2015; Watson et al., 2004). Indeed, fisheries have resulted in the overexploitation and decimation of about 94% of world fish stocks (FAO, 2020), with important consequences for fish communities and marine trophic pathways (Anticamara et al., 2011; Lotze et al., 2019; Worm et al., 2006). Fisheries, however, constitute an important socio-economic sector that, in addition to providing a major food source for humanity, provide employment and economic benefits to those engaged in the activity (FAO, 2020; Pinello et al., 2017). Area-based approaches, such as Marine Protected Areas (MPAs) have been proposed as an effective tool for efficiently balancing marine biodiversity conservation and the sustainable development of this essential supporting service (Claudet et al., 2008; Halpern and Warner, 2002; Lubchenco et al., 2003; Watson et al., 2014).

Only 3% of the Earth's ocean surface is protected, which contrasts with protection levels for their terrestrial counterpart (Jenkins and Joppa, 2009). Effective methods for the revaluation and enhancement of

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protected areas are required to achieve further progress in the complex designation of MPAs. In contrast to conventional methods to design MPAs based on scientific knowledge and/or expert opinion (e.g., Cañadas et al. (2005), Hooker et al. (2011), WWF/Adena (2005), UICN (2012)), systematic conservation planning (Watts et al., 2017) that combines spatially-explicit information on marine species and threats (*i. e.,* cost of protection) provides transparent, open, and repeatable methods for revisiting and enhancing MPAs. Indeed, these methods have the key advantage of maximizing conservation targets, minimizing potential costs, and optimizing the allocation of limited economic resources to define more meaningful and sustainable MPAs. In other words, it minimizes the conflict between wildlife conservation and important environmental services though the spatial redistribution of economic sectors (Afán et al., 2018; Ball et al., 2009; Beyer et al., 2016; Giménez et al., 2020).

Area-based approaches in marine conservation have been extensively promoted by several European Union (EU) directives, especially the Habitats Directive [92/43/EEC], which implemented the Natura 2000 network of protected areas as the centerpiece of the EU conservation strategy. Within this framework, EU member states propose Sites of Community Importance (SCI) that, once accepted by the European Commission, must be designated as Special Areas of Conservation (SAC) within the Nature 2000 network (Habitats Directive). The Natura 2000 network of protected areas has been largely designed through expert opinion and focuses on habitats and/or species of European priority. Regarding cetacean species, only the common bottlenose dolphin (*Tursiops truncatus*), hereafter bottlenose dolphin, and the harbor porpoise (*Phocoena phocoena*) are listed in Annex II of the Habitats Directive, thus deserving the establishment of SAC. These flagship species of conservation priority are also considered as umbrella species for designing conservation planning and making conservation-related decisions (Hooker et al., 2011). This is because protecting these species indirectly protects other species of conservation concern that make up the ecological communities of their habitats. This is the case for the Mediterranean common dolphin (*Delphinus delphis*) that is listed as an endangered subpopulation because is currently threatened by multiple stressors such as overfishing, habitat degradation, pollution, climate change, and bycatch, and has undergone alarming population decline (Bearzi, 2003; Vella et al., 2021). Accordingly, the Mediterranean common dolphin should also benefit from area-based protection to face their main threats as recommended in its Mediterranean conservation plan (Bearzi et al., 2004).

Few studies to date have used systematic conservation approaches to evaluate the suitability of the current marine Natura 2000 network for protecting priority species (*i.e.* those included in the EU Habitats Directive, Giakoumi et al. (2012)). Here, we contribute to fill this lack of systematic approaches to evaluated the Nature 2000 network design for cetacean conservation by combining data on common and bottlenose dolphin's distribution in the Alboran Sea (western Mediterranean) with spatially-explicit information on fishing effort (Kroodsma et al., 2018). Prioritization algorithms will not be used traditionally by incorporating all components of the ecosystem (e.g. Mazor et al. (2014)), but for evaluating which sites are important for common dolphin conservation when taken in conjunction with bottlenose dolphins (a priority species in the Habitats Directive). Thus, the objective of this analysis was not to construct a comprehensive ecosystem based MPA, but rather to evaluate if priority areas change when including spatially-explicit common dolphins abundance information in conjunction with information on the bottlenose dolphins abundance, as well as the effect of including fishing effort as a conservation cost. We explored different alternative scenarios that included varying conservation targets (*i.e.,* different percentage of cetacean predicted abundance protected), the effect of considering the extent of the reserve network and fishing pressure as proxies to costs of protection, and the effect of locking-in or out the existing Natura 2000 sites. Based on our analyses and outputs, we propose new sites for protection that might be considered within other initiatives and agreements, such as ACCOBAMS or the Barcelona Convention, that also promote the creation of protected areas for cetacean conservation.

2. Methods

2.1. Study area

The Alboran Sea (western Mediterranean Sea, Spain) is one of the most productive areas in the Mediterranean Sea (Font, 1987; Videau et al., 1994) and has been identified as a hotspot for cetacean diversity. Eight cetacean species, the long-finned pilot whale (*Globicephala melas*), the Cuvier's beaked whale (*Ziphius cavirostris*), the Risso's dolphin (*Grampus griseus*), the striped dolphin (*Stenella coeruleoalba*), the bottlenose dolphin, and the common dolphin are sighted regularly in the basin (Cañadas et al, 2002, 2005; Cañadas and Hammond, 2006, 2008; Cañadas and Sagarminaga, 2000; Cañadas and Vázquez, 2014), although some sporadic sightings of other cetacean species are also recorded (Cañadas et al., 2005). The last healthy remnant population of the Mediterranean common dolphin remains here (Bearzi et al., 2003; Cañadas and Vázquez, 2017; Vella et al., 2021). In the last decades, several calls have been made to enhance its conservation (Bearzi et al., 2004; Pace et al., 2016; Vella et al., 2021) but most of the proposed actions stated in its Mediterranean conservation plan have not been implemented yet (Pace et al., 2016; Vella et al., 2021). Although three Important Marine Mammal Areas (IMMAs) have been proposed for the Alboran Sea (IUCN-MMPATF, 2017a; 2017b; 2017c), no marine protected area has been implemented for common dolphin protection.

To date, two large marine areas (*i.e.,* Sur de Almería-Seco de los Olivos [ESZZ16003] and Estrecho Oriental [ES6120032]) have been approved and proposed for the designation of Special Areas of Conservation (SACs) in the Alboran Sea because of the presence of essential priority habitats and the occurrence of bottlenose dolphins. Furthermore, other small sites have been designated along the coast where the presence of bottlenose dolphins is not as significant as in the former sites but still crucial for the habitats they comprise (Fig. 1).

2.2. Cetacean abundance data

Spatially-explicit abundance data of common and bottlenose dolphins were obtained from published studies (Fig. 1) where line transect data and environmental variables were modeled through density surface models (Giménez et al., 2017). Predicted cetacean abundance data consist of regular grid cells of 2×2 min latitude-longitude of resolution. These high-resolution data are considered more suitable to inform conservation planning rather than merely relying on encounter rates data, polygons of occurrence, or probabilities of occurrence (Delavenne et al., 2017).

2.3. Fishing effort data

Global Fishing Watch database (https://globalfishingwatch.org) was used to obtain the fishing effort of the studied area. Global Fishing Watch is a global repository of fishing activity where Automatic Identification System (AIS) data are processed to discern fishing activities from transiting. Kroodsma et al. (2018) trained two convolutional neural networks to identify vessel characteristics and fishing activity globally. A vessel was considered to be fishing during the period that the fishing gear was in the water. AIS data has been demonstrated a useful source of data to track fishing activities in space and time locally (de Souza et al., 2016; McCauley et al., 2016; Natale et al., 2015; Vespe et al., 2016; White et al., 2017) and globally (Kroodsma et al., 2018). Global Fishing Watch data contain globally 50–75% of active vessels larger than 24 m and >75% vessels larger than 36 m being the best fishing effort proxy publicly available (Kroodsma et al., 2018). Furthermore, it is strongly correlated with the official regional fisheries management organizations validating its use (Kroodsma et al., 2018),

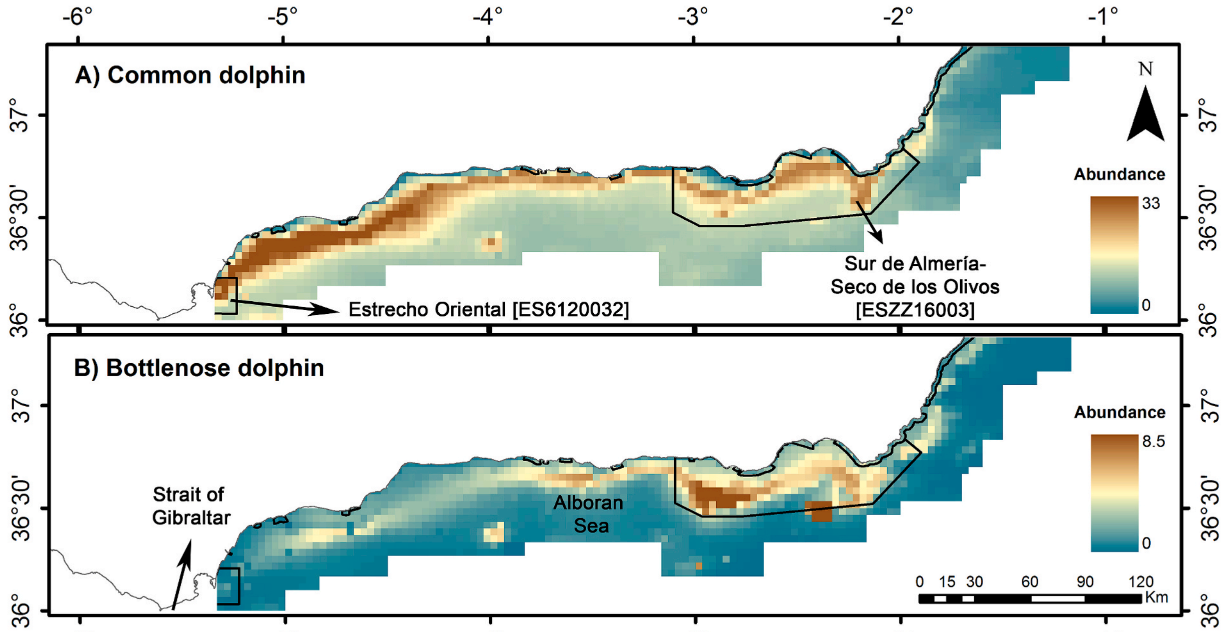

Fig. 1. Distribution of common and bottlenose dolphins in the Alboran Sea. In black are the Sites of Community Importance (SCI) and Special Areas of Conservation (SAC) of the Natura 2000 network.

especially for our research area where satellite coverage is good (Vespe et al., 2016) as well as the country AIS adoption (Kroodsma et al., 2018). Here, rasterized data from 2013 to 2016 for purse seiners, drifting long-lines, trawlers, and fixed gears (*i.e.,* pots and traps, set gillnets, and set longlines) at 0.01-degree resolution was used and summarized in each planning unit (Fig. 2).

2.4. Spatial prioritization

To evaluate where should be place the new sites for common dolphin conservation in the Alboran Sea, we performed a spatial prioritization analysis to achieve a good representation of cetacean predicted abundance (*i.e.,* common and bottlenose dolphin abundance) in the minimum area or with the minimum cost associated to regulations in fishing activities.

The planning region (*i.e.,* Alboran Sea) was divided into planning units (PU) using the same resolution as the predicted abundance data (2 × 2 min latitude–longitude). Planning unit size and shape can impact prioritization outputs, thus it is strongly recommended to adapt the PU size to data resolution (Hermoso and Kennard, 2012; Nhancale and Smith, 2011; Smith et al., 2008). Different scenarios (Table 1) were constructed in order to evaluate: a) the effect of varying the cost (*i.e* area or fishing pressure), and b) the effect of locking-in or out the existing Natura 2000 sites. In scenarios A and B, area was considered a proxy of the protection cost while in scenarios C and D, fishing effort (AIS messages), a proxy to economic costs of potential regulations in fishing practices, was considered as the main cost for protection. In scenarios B and D, the existing Natura 2000 sites were locked-in considering that these planning units are already protected. For each of the main scenarios, four sub-scenarios were considered varying the representation targets of common dolphin's abundance (*i.e.,* 1 = 30%, 2 = 40%, 3 = 50%, 4 = 60%, see Table 1). The bottlenose dolphin protection target was fixed in all sub-scenarios to the already protected abundance (*ca.* 45%) by the Natura 2000 sites, as the current areas protected are considered appropriate to conserve the bottlenose dolphin population of the Alboran Sea.

For the prioritization analysis we used the systematic conservation planning tool MARXAN, the most commonly used conservation planning software worldwide (Ball and Possingham, 2000; Possingham et al., 2000; Watts et al., 2009). MARXAN uses simulating annealing, an optimization method to find a cost-efficient area that satisfies a specific conservation target (*i.e.,* minimum set problem). MARXAN produces near-optimal solutions of priority areas that meet the set objectives while minimizing costs (Ball et al., 2009). Also, it includes a penalty for

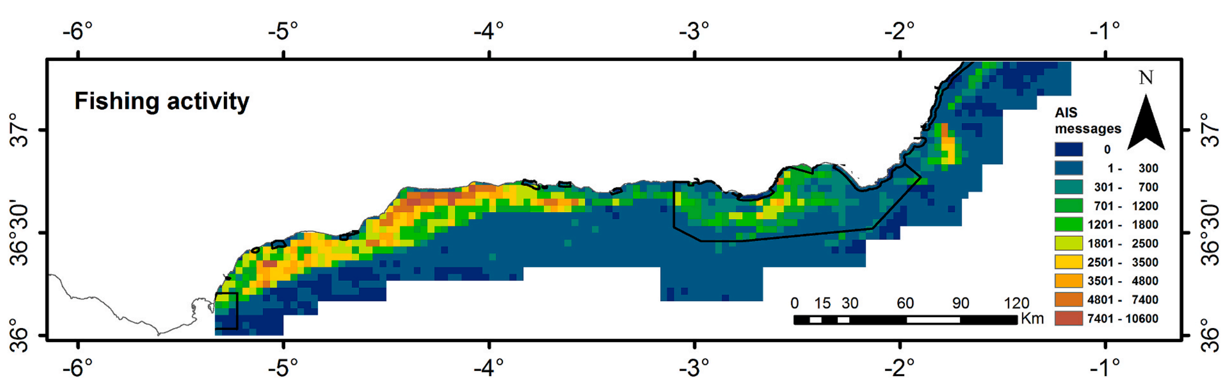

Fig. 2. Fishing activity in the Alboran Sea. Automatic Information System (AIS) messages per planning unit (Global Fishing Watch data). In black are depicted the Sites of Community Importance (SCI) and Special Areas of Conservation (SAC) of the Natura 2000 network.

Table 1
Twenty-four conservation scenarios varying the cost, the fixed area, and the percentage protected for common dolphins in the Alboran Sea. SCI = Sites of Community Importance; SAC = Special Areas of Conservation; HA = High abundance.

	Cost	Fixed area	Percentage protected (%)	Figure
Scenarios A				
A1	area	–	30	Fig. 3a – 1
A2	area	–	40	Fig. 3a – 2
A3	area	–	50	Fig. 3a – 3
A4	area	–	60	Fig. 3a – 4
Scenarios B				
B1	area	SCI/SAC	30	Fig. 3b – 1
B2	area	SCI/SAC	40	Fig. 3b – 2
B3	area	SCI/SAC	50	Fig. 3b – 3
B4	area	SCI/SAC	60	Fig. 3b – 4
Scenarios C				
C1	fishing activity	–	30	Fig. 3c – 1
C2	fishing activity	–	40	Fig. 3c – 2
C3	fishing activity	–	50	Fig. 3c – 3
C4	fishing activity	–	60	Fig. 3c – 4
Scenarios D				
D1	fishing activity	SCI/SAC	30	Fig. 3d – 1
D2	fishing activity	SCI/SAC	40	Fig. 3d – 2
D3	fishing activity	SCI/SAC	50	Fig. 3d – 3
D4	fishing activity	SCI/SAC	60	Fig. 3d – 4

the selection of non-adjacent planning units, so the compactness of the solutions can be controlled to avoid very fragmented solutions (Ball and Possingham, 2000). For each scenario, we generated 100 solutions with MARXAN. We evaluated the results obtained using the best solution (*i.e.,* best solution of the 100 near-optimal solutions generated with MARXAN) and the selection frequency (*i.e.,* number of times a planning unit was selected in the 100 near-optimal solutions). Species penalty factors (SPF) and boundary length modifier (BLM) were calibrated with the free software Zonae Cogito (Segan et al., 2011). Calibration was considered a trade-off between BLM and boundary length, and SPF and missing values, a common approach to MARXAN problems (Ardron et al., 2010; Segan et al., 2011). The objective of this calibration consists of obtaining solutions where all targets are met with an appropriate degree of compactness to avoid patchy solutions (Ardron et al., 2010).

3. Results

The current Natura 2000 network (SCI and SAC) is protecting 44.97 and 21.84% of the predicted abundance of bottlenose dolphins and common dolphins respectively in the Alboran Sea (Table 2). The configuration of the reserve network design, however, varied greatly depending on the scenario considered.

When the extent of protected areas was the only protection cost in our reserve network design, selected areas for cetacean conservation were placed in those marine areas with the highest predicted abundances of common and bottlenose dolphins. In particular, these areas were located in the proximity of the Strait of Gibraltar and in the already protected area of “Sur de Almeria - Seco de los Olivos” (Fig. 3a-3b-S1a-S1b). In contrast, when fishing effort was used as a proxy of protection cost, oceanic areas were systematically selected (Figure 3c-3d-S1c-S1d). The current Natura 2000 sites already established for bottlenose dolphins were consistently selected in scenario A regardless of the protection percentage selected for common dolphins (Figs. 3a–4a). Furthermore, in the other lock-out scenario (*i.e.,* Scenario C) the importance of the Natura 2000 sites is still relevant (Fig. 3c-S1c).

In general, we found low flexible configuration outputs in all scenarios considered (*i.e.,* high selection frequencies for the majority of PU selected). The exceptions were scenarios A and B, where more flexibility was achieved from the absence of fishing effort data as a protection cost (Fig. 3). The smallest reserve network was achieved in scenario A when area was included as a protection cost but it is the least cost-efficient solution due to the overlook of the fishing pressure (Figs. 3a–4 and Figure S1a). The most cost-efficient scenario was scenario C, but selected areas for cetacean protection occurred mainly in offshore waters where fishing pressure is relatively low (Figs. 3c–4).

Table 2
Protected and not protected percentage of bottlenose and common dolphin population in the Alboran Sea within current SCI.

	Bottlenose dolphins		Common dolphins	
	Abundance	**%**	**Abundance**	**%**
Protected	326	44.97	3689	21.84
Not protected	399	55.03	13 206	78.16
Total	725		16 895	

4. Discussion

The Natura 2000 network constitutes a huge step forward in the conservation of marine species and habitats in European waters. In the Alboran Sea, the current Natura 2000 network is protecting *ca.* 45% of bottlenose dolphins predicted abundance. Simultaneously, this network encompasses the 22% of the predicted abundance of common dolphins. Natura 2000 management tools, if properly implemented, might restore ecosystem functioning and benefit marine food webs by providing shelter to marine species, thus contributing to the recovery of depleted dolphin prey (Agardy, 1997). Consequently common dolphins will also benefit from the conservation of Natura 2000 sites even though they were not initially designed for their conservation. Nevertheless, some important unprotected areas were detected at the western side of its distribution (close to the Strait of Gibraltar). We therefore provide evidence that the areas already proposed in the Alboran Sea are not enough for the protection of the endangered Mediterranean common dolphin.

The consideration of cost in the designation of protected areas is vital if we pursue a cost-efficient protected network (Ban and Klein, 2009; Mazor et al., 2014). Reserve network configuration can change a lot when considering potential costs such as those ascribed to regulation of fishing practices, especially when species distribution largely overlaps with human activities. Under this scenario, a threat-based approach based on mitigation actions might be needed in conjunction with space-based approaches for efficiently dealing with conflicts between human interests and biodiversity conservation.

Fisheries are among the most important threats for common dolphins because of direct interactions (*i.e.,* bycatch) and/or competition for limited resources (Bearzi et al., 2003; Vella et al., 2021). In the Alboran Sea, common dolphins feed mainly on non-commercial mesopelagic preys (Giménez et al., 2018), but competition with local fisheries is possible due to the consumption of some commercial species, such as hake (*Merluccius merluccius*) and sardine (*Sardina pilchardus*), whose stocks are overexploited or remain uncertain with large fluctuations, respectively (FAO, 2018; STECF, 2017). In addition, some stranded animals present signs of lethal interactions with fishing gear (Vázquez et al., 2014). As a result, cetacean conservation in the Alboran Sea must focus on fisheries management considering the trade-offs between conservation and resource exploitation for a proper conservation decision making. The best option for cetacean conservation in the Alboran Sea would be to place protected areas in high predicted abundance areas for common and bottlenose dolphins. Unfortunately, common and bottlenose dolphins and local fisheries are distributed in similar areas because they are the most productive zones in the Alboran Sea. Thus, this option would entail to spatially manage fisheries moving them to secondary fishing grounds, which would be costly and unrealistic due to the high impact on the fishing industry.

The inclusion of fishing effort as a cost profoundly influences the spatial configuration of proposed sites. Indeed, when fishing effort is included as a cost for conservation, offshore areas are systematically selected as important areas for conservation. Fishing effort at such

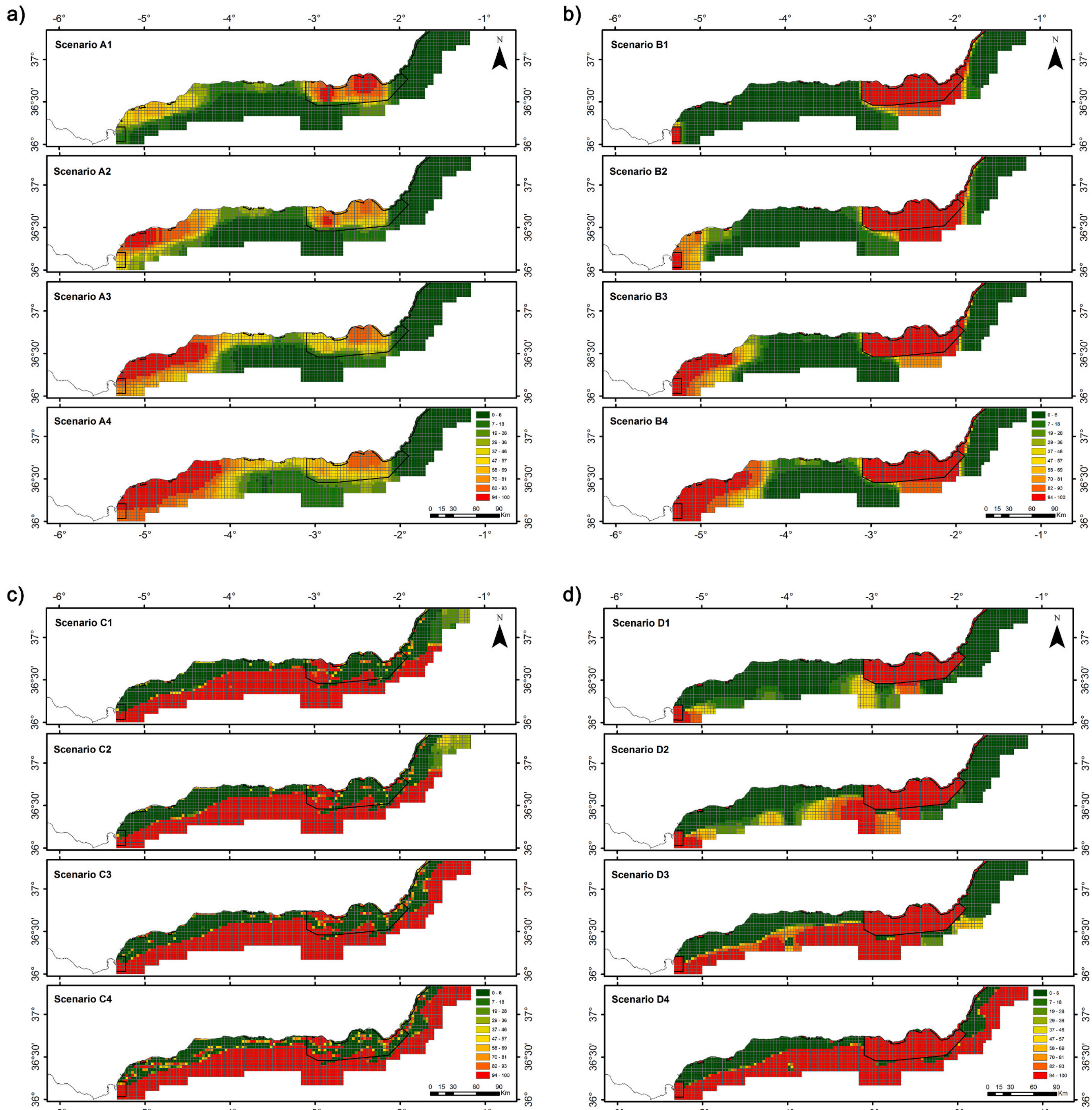

Fig. 3. Planning unit selection frequency for each scenario. Frequency is the percentage of times that a planning unit is selected from 100 MARXAN runs as a priority area for conservation. See Table 1 for scenario information.

offshore areas is meager compared to that within main core areas for dolphins' distribution, so they are "cheaper" to protect. However, these sites likely encompass less optimal areas at the trailing edge of cetacean distributions, while harmful interaction would continue in the main "core areas". Although we have found the best cost-efficient marine protected areas (*i.e.* delimitating areas with high cetacean predicted abundance and low fishing effort) to avoid conflict with the fishing sector through a systematic approach, conservation of the endangered common dolphin population in the Alboran Sea may be difficult or even unrealistic with only a spatial solution based on marine protected areas.

We propose to combine an area-based approach (*i.e.,* marine protected areas) with a cetacean orientated threat-based approach where threat mitigation actions are implemented to preserve cetacean populations (Authier et al., 2017). Area-based approaches can be successful for the conservation of marine mammals (Gormley et al., 2012), but they are just one of the possible strategies to enhance their conservation status. The addition of a threat-based approach may be more successful and cost-efficient than relying only on a conventional area-based approach, as this traditional approach has been criticized for highly mobile marine mammals (Hooker et al., 2011; Hoyt, 2012; Wilson, 2016). Improvement of fishing gear to enhance selectivity, and behavioral changes in fishing operations to avoid bycatch, can be

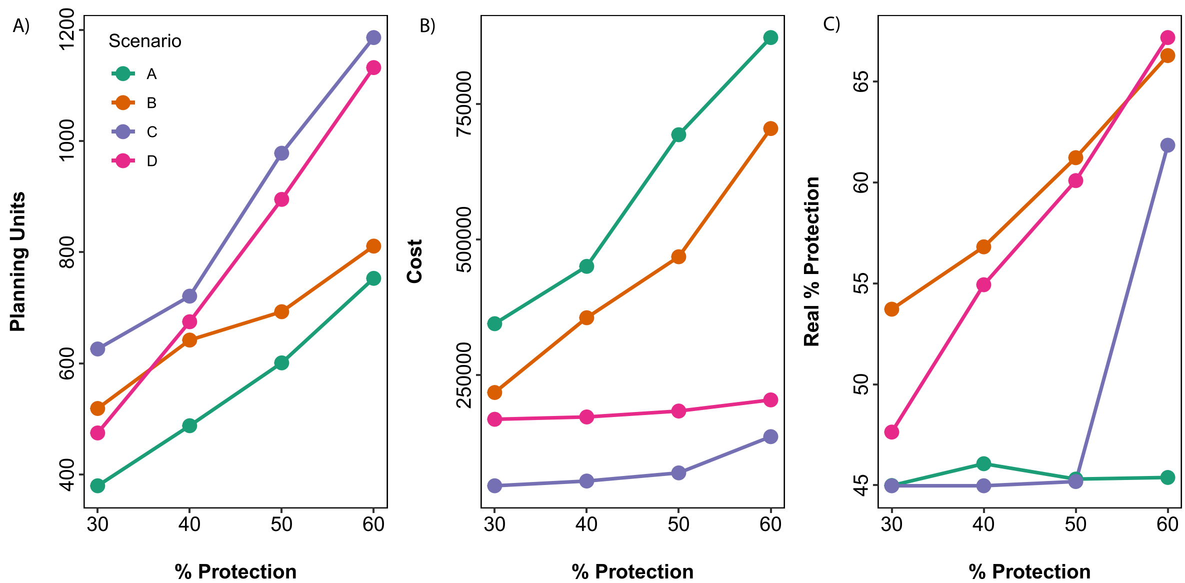

Fig. 4. a) Planning units selected and b) cost for the protection of common and bottlenose dolphins in each scenario. C) Percentage of protection achieved for bottlenose dolphins when achieving the conservation target for common dolphins in each scenario.

successful measures to improve the conservation status of common and bottlenose dolphins in the Alboran Sea. Spatial and threat-based approaches should be seen as complementary management tools rather than distinct conservation instruments (Authier et al., 2017). The EU Marine Strategy Framework Directive (2008/56/EC) is currently unifying these two approaches promoting the mitigation of pressures with the monitoring of the species conservation status in a precautionary and holistic approach (Authier et al., 2017). In this context, the extension of the "Estrecho Oriental" SAC would be desirable to protect the abundance and distribution of the endangered Mediterranean common dolphin population (*i.e.,* areas highlighted in scenarios A and B), while ensuring a threat-based approach in the whole basin. Permanent or temporal fisheries closures may help to restore fish stocks, which is a proper conservation measurement for cetaceans but also beneficial for the fishing industry. The spillover of these areas and a potentially better conserved and sustainable ecosystem can benefit the fishing industry that could perpetuate its activities and avoid the future collapse of the system (Gell and Roberts, 2003; Le Pape et al., 2014).

Progress in marine conservation requires observing, experimenting with, and modeling the living biome with unprecedented completeness, accuracy, and rapidity. Accordingly, marine protected areas should be revised periodically due to putative temporal changes in species distributions and abundance (Campbell et al., 2015; Forney and Barlow, 1998; Hoyt, 2012; Marubini et al., 2009; Rayment et al., 2010). Marine spatial planning should be considered a dynamic field in marine conservation. Although high spatial resolution data were used for species and fisheries distribution, the models should be rerun with the improvement of resolution and quality of the data. All year round cetacean distribution data are urgently needed to assess if there are seasonal changes that justify the creation of seasonal marine protected areas. Furthermore, it would be useful to integrate vessel monitoring system (VMS) data with existing AIS data to improve the information on fishing effort activities in the area for the whole operating fleet. It is worth noting that our spatial assessments on the distribution of fishing pressure are rather conservative and may only represent a fraction of the overall fishing activities in our study area. The spatial distribution of fishing pressure from GFW relies on the automatic identification system (AIS) for fishing vessel monitoring, which does not account for artisanal fisheries or illegal unreported and unregulated (IUU) fishing. This may represent an important percentage of global fishing captures (Zeller and Pauly, 2007), especially in the Mediterranean Sea (Coll et al., 2014).

Future considerations for a proper conservation of the Alboran Sea must be placed in an ecosystem-based approach to fulfill the Marine Strategy Framework Directive, including other cetacean species and the maximum biodiversity features present in this area. It would be desirable to build a representative marine protected network that not only considers species and habitats listed in the European directive but all components of this important ecological area. High-resolution species modeling and threats mapping is highly encouraged in this Mediterranean biodiversity hotspot to ensure a representative and cost-efficient network (Ramírez et al., 2018). Mapping of other threats such as noise, maritime traffic, chemical and light pollution, ocean acidification, and invasive species should be a priority if an ecosystem-based approach is going to be implemented.

In the present work, we applied a transparent and systematic analysis to assess where new marine protected areas for common dolphins in the Alboran Sea should be allocated, while also accounting for the inclusion of the fishing sector activity as the main threat for conservation. The current Natura 2000 network is effective for preserving some important areas for common dolphin conservation, but they are not enough if we want a comparable protection to bottlenose dolphins. An extension of marine protected areas under national, European, or International agreements is desirable, coupled with a basin-wide mitigation threat strategy.

Author statement

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Declaration of competing interest

The authors declare no conflict of interests.

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Appendix A. Supplementary data

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Supplementary Material

Expanding protected areas to encompass the conservation of the endangered common dolphin (*Delphinus delphis*) in the Alboran Sea

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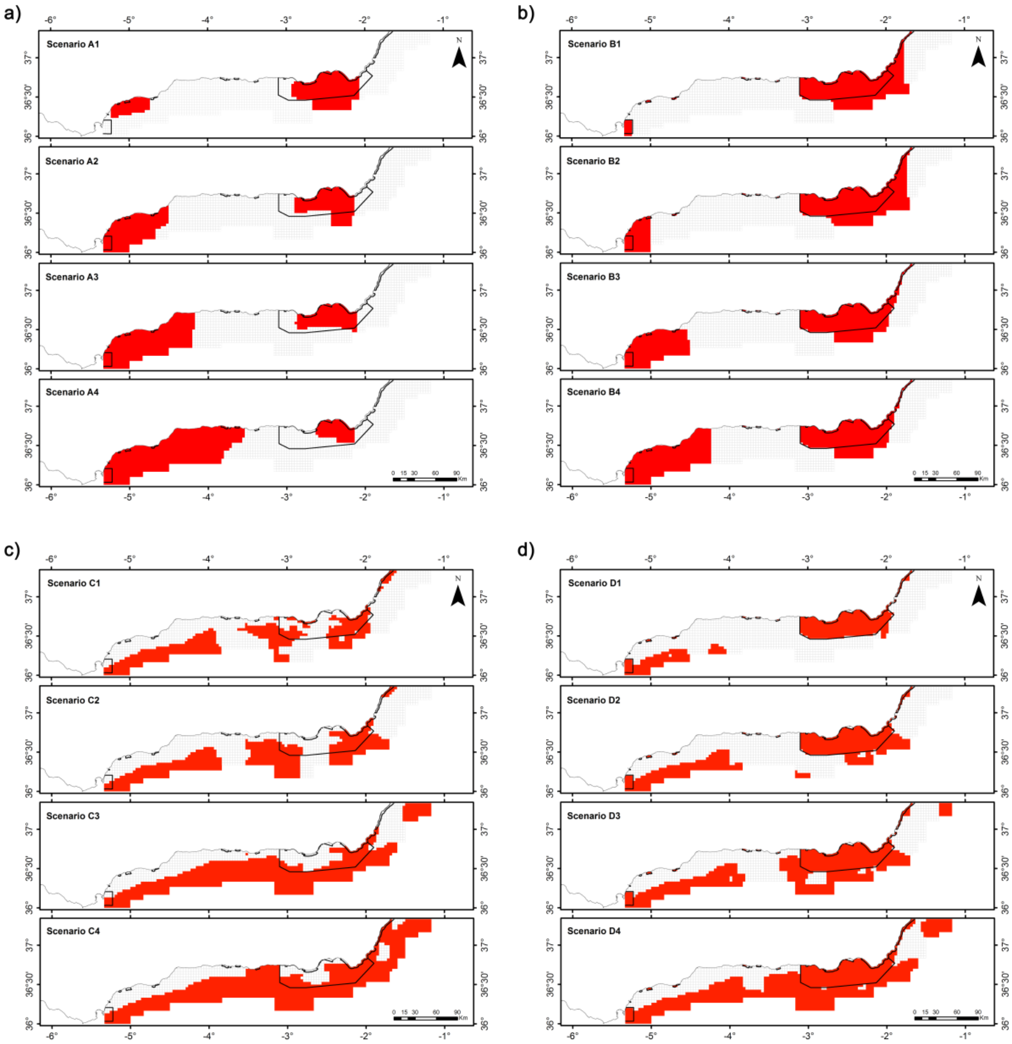

Figure S1: MARXAN best solution output for each scenario. Scenario A to D (see table 1). Subscenarios 1 to 4: 30 to 60 % of common dolphin abundance protection.