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ALBORAN SEA: STATUS AND CONSERVATION OF SEABIRDS



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INTRODUCTION

The Mediterranean basin is recognised as a major biodiversity hotspot, with a high degree of endemic species both inland and at sea (CEPF 2010). Regarding the marine ecosystem, the Mediterranean Sea holds 7.5% of the world's marine fauna and 18% of marine flora. This remarkable diversity of species is found in only 0.8 percent of the surface area and 0.3 percent of the volume of the World's oceans (Bianchi & Morri 2000, Hofrichter 2001). The isolation of the basin is reflected in the high degree of endemism, estimated to be roughly 28%. Most of the biodiversity is concentrated in shallow coastal areas, although there are key biodiversity elements associated with deep waters, as well as with offshore pelagic waters (Hofrichter 2001).

Since 2008, the Regional Activity Centre for Specially Protected Areas (RAC-SPA) under the framework of the Mediterranean Action Plan (MAP) of the United Nations Environment Programme (UNEP) has been implementing the "MedOpenSeas" project to identify and establish Marine Protected Areas (MPAs) in the open seas, including the deep seas. The primary objective of this project is to promote the establishment of a representative ecological network of MPAs in the Mediterranean within the framework of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol) on the establishment of Specially Protected Areas of Mediterranean Importance (SPAMIs). The first phase of the project, completed in late 2009, led to the identification of twelve priority conservation areas in the open seas, including the deep seas. These priority areas could become candidates for SPAMI listing and/or be recommended for inclusion in other frameworks, such as Ecologically or Biologically Significant Areas (EBSAs) developed under the Convention on Biological Diversity (CBD). The aim of the project's second phase, completed in early 2012, was to support neighbouring Parties of the above-mentioned priority areas in evaluating and potentially presenting these sites as candidate(s) for inclusion in the SPAMI List, in accordance with the provisions of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean.

The present document corresponds to the third phase, which focuses on the spatial planning and evaluation of three priority areas: Adriatic Sea, Alboran Sea and the Sicily Channel/Tunisian Plateau. In particular the Alboran Sea is addressed here, with regard to the seabird community. Specific aims of the report were settled as follows:

- (1) Assess the population status of the seabird species which frequent the priority area open sea (ecology, behaviour, breeding, diet, IUCN conservation status, international measures of protection, and national measures of protection).
- (2) Illustrate and analyse the distribution of those populations of seabirds which regularly frequent the target priority area (including breeding colonies) and identify critical sites in the open seas (taking into account any temporal and spatial variation).
- (3) Assess the impact of threats affecting the species present, taking into account any interactions with human activities.
- (4) Review and refine the spatial mapping of critical sites proposed for different seabird species in the target priority area, including the work on Important Bird Areas published by RAC/SPA in 2009.

Overview of the Alboran Sea

The Alboran Sea is a transition area between two major oceanic basins, the Atlantic and the Mediterranean (Fig. 1). It is surrounded by three countries, Spain in the northern shore (plus Gibraltar), and Morocco and Algeria in the southern shore, which also holds a handful of Spanish territories. Between both, the only emerged land is the Alboran Island (1,650 ha), which belongs to Spain and lays 56 km north from Cap Tres Forcas. Other than that a few archipelagos and islets lay off the African coast, the most distant being the Habibas Islands, about 10 km off Algeria in the easternmost side of the basin.

The oceanographic dynamics of the Alboran Sea is highly influenced by the exchange of waters between the Mediterranean and the Atlantic, which is constrained by the Straits of Gibraltar (14 km wide) in the west end. The oceanography is also influenced by the topography of the basin, with predominantly narrow continental shelves and a moderately deep seabed, down to 2000 m. Sparse seamounts and submarine ridges, most of them of volcanic origin, complete the picture.



Fig. 1. Alboran basin and adjacent Atlantic (west) and Mediterranean (east) waters. Credit: Provided by the SeaWiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE.

The cooler and less saline Atlantic waters, richer in nutrients, enter through Gibraltar and form two large anticyclonic eddies across the Alboran Sea (Fig. 2). The most stable of these is the eastern eddy, which forms at its distal end the important Almeria-Oran front (Tintoré et al. 1988, Hernández-Almeida et al. 2005). Overall, the Alboran Sea is an area of high biological productivity compared to the adjacent Mediterranean waters. This gives rise to a high biodiversity, which is accentuated by the role of the area at connecting two major oceanic basins. Of particular interest are some of the seamounts, such as the *Seco de los Olivos* and Alboran Island. The region is also very important for cetaceans and sea turtles (Cañadas et al. 2005).

Fisheries are not so relevant in the region, largely due to the narrow continental shelves, although some areas are important for small pelagic fish, such as the Almeria and Malaga bays (Bellido et al. 2008, CopeMed II. 2011), and demersal fish and crustaceans are also locally important.

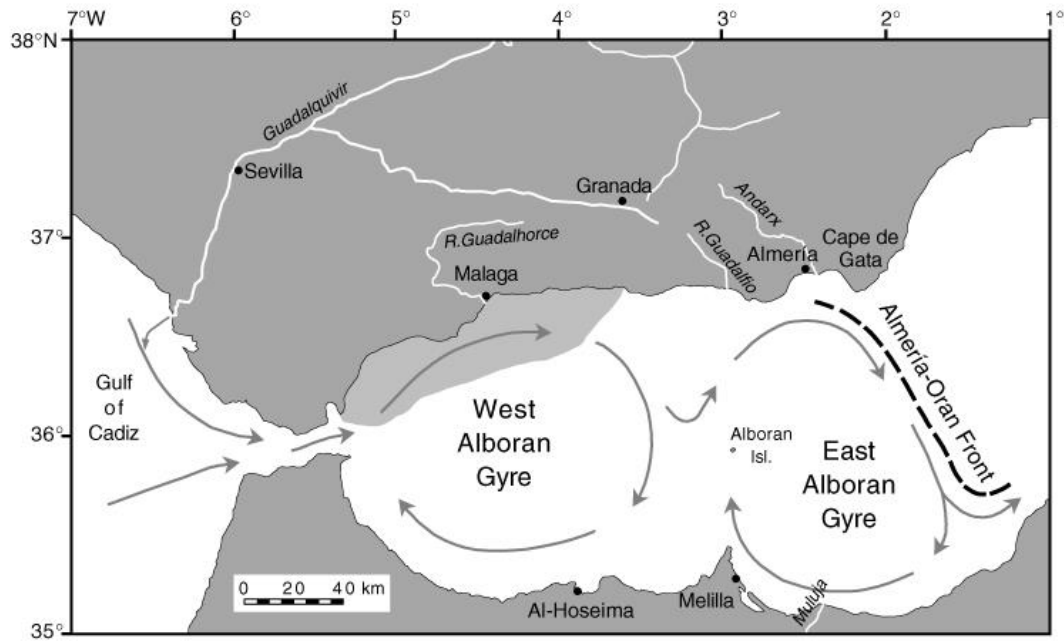


Fig. 2. Outline of the major oceanographic events in the Alboran Sea, highlighting the two anticyclonic eddies formed by the entering Atlantic waters. Source: Hauschildt et al. *Anticyclonic gyres of the Alboran Sea* [map]. In: Alboran Sea (eoeearth.org) at <http://www.eoeearth.org/view/article/149961/>. Date: 27/11/2014

THE ALBORAN SEABIRD COMMUNITY

Seabirds: What species are accounted for?

Seabirds are bird species belonging to a wide diversity of taxonomic groups, which have in common their spending of at least part of the annual cycle in the marine environment. The exact families and species included in the definition of seabirds vary according to different sources, since there is no absolute distinction between birds that are strictly marine and birds that are not. Here, the term seabird is used in a rather restrictive way, since the main aim of the report is to focus on the open ocean, and hence in the species that are best adapted to the marine environment. However, a few groups that include largely coastal species are also considered (terns). Specifically, all Procellariiforms (shearwaters and storm-petrels), Pelcaniforms (gannets, cormorants), Larids (gulls), Sternids (terns) and Alcids (auks) have been considered here as seabirds. On the other hand, The Podicipediformes (grebes) and Gaviiformes (divers) have been disregarded, although some species largely spend the winter at sea, in coastal and shallow waters. This last decision has been taken as these groups are scarcely represented in the region, and the most regular species (crested grebe *Podiceps cristatus*, Black-necked grebe *Podiceps nigricollis* and little grebe *Tachybaptus ruficollis*) mostly occur in wetlands in the region, rather than at sea. The seaducks have also been disregarded although they tend to occur at sea in winter, because they are very scarce in the region. Finally, raptors breeding in coastal areas and using the coastal marine environment to some extent have not been treated here

due to their rather coastal distribution and main link to the land. These species include the osprey *Pandion haliaetus* and the Eleonora's falcon *Falco eleonora*.

Table 1. List of species of seabirds occurring regularly in the Alboran Sea, indicating their occurrence status (abundant, A; common, C, sparse, S), its breeding status (yes/no), and its conservation status according to different lists and agreements .

English name	Scientific name	Occurrence status	Breeding status	SPA/BD	IUCN	EU Birds Directive	SPEC	ETS	Bonn	Bern	AEWA
Scopoli's shearwater	<i>Calonectris d. diomedea</i>	A	N	II	LC	I	SPEC 2	(VU)	-	II	-
Cory's shearwater	<i>Calonectris d. borealis</i>	S	Y	-	LC	I	SPEC 2	(VU)	-	II	-
Balearic shearwater	<i>Puffinus mauretanicus</i>	A	N	II	CR	I	SPEC 1	CR	-	II	-
Yelkouan shearwater	<i>Puffinus yelkouan</i>	S	?	II	VU	I	No-SPEC ³	S	-	II	-
European storm-petrel	<i>Hydrobates pelagicus melitensis</i>	C	?	II	LC	I	No-SPEC ^E	(S)	-	II	-
Northern gannet	<i>Morus bassanus</i>	C	N	-	LC	-	No-SPEC ^E	S	-	III	-
Great cormorant	<i>Phalacrocorax carbo</i>	C	N	-	LC	-	-	S	-	III	-
Mediterranean shag	<i>Phalacrocorax aristotelis desmarestii</i>	S	Y	II	LC	I	No-SPEC ^E	(S)	-	III	-
Pomarine skua	<i>Stercorarius pomarinus</i>	S	N	-	LC	-	No-SPEC	(S)	-	III	-
Arctic skua	<i>Stercorarius parasiticus</i>	S	N	-	LC	-	No-SPEC	(S)	-	III	-
Great skua	<i>Stercorarius skua</i>	C	N	-	LC	-	No-SPEC ^E	S	-	III	-
Mediterranean gull	<i>Larus melanocephalus</i>	A	Y	II	LC	I	No-SPEC ^E	S	II	III	Y
Little gull	<i>Larus minutus</i>	S	N	-	LC	I	SPEC 3	(H)	-	III	-
Black-headed gull	<i>Chroicocephalus ridibundus</i>	A	Y	-	LC	II/2	No-SPEC ^E	(S)	-	III	-
Slender-billed gull	<i>Chroicocephalus genei</i>	C	Y	II	LC	I	SPEC 3	L	II	III	Y
Audouin's gull	<i>Larus audouinii</i>	A	Y	II	LC	I	SPEC 1	L	I,II	III	Y
Lesser black-b. gull	<i>Larus fuscus</i>	A	N	-	LC	II/2	No-SPEC ^E	S	-	-	-
Yellow-legged gull	<i>Larus michahellis</i>	A	Y	-	LC	II/2	No-SPEC ^E	S	-	III	-
Black-legged kittiwake	<i>Rissa tridactyla</i>	S	N	-	LC	-	No-SPEC	(S)	-	III	-

English name	Scientific name	Occurrence status	Breeding status	SPA/BD	IUCN	EU Birds Directive	SPEC	ETS	Bonn	Bern	AEWA
Gull-billed tern	<i>Sterna nilotica</i>	C	Y	II	LC	I	SPEC 3	(VU)	II	III	Y
Sandwich tern	<i>Sterna sandvicensis</i>	C	N	II	LC	I	SPEC 2	H	II	III	Y
Lesser-crested tern	<i>Sterna bengalensis</i>	S	N	II	LC	-	SPEC 3	(S)	II	III	Y
Common tern	<i>Sterna hirundo</i>	C	Y	-	LC	I	No-SPEC	S	II	III	Y
Little tern	<i>Sternula albifrons</i>	C	Y	II	LC	I	SPEC 3	D	II	III	Y
Black tern	<i>Chlidonias niger</i>	C	N	-	LC	I	SPEC 3	(H)	II	III	Y
Razorbill	<i>Alca torda</i>	C	N	-	NT	-	No-SPEC ^E	(S)	-	III	-
Atlantic puffin	<i>Fratercula arctica</i>	C	N	-	VU	-	SPEC 2	(H)	-	III	-

***SPA/BD (Barcelona Convention).** Priority species are listed under Annex II. **EC Birds Directive** (2009/147/EC). Annex I lists those species that require special conservation measures. Annex II and III refer to game and commercialised species, respectively. **IUCN (2015 global assessment)** threat status LC – Least Concern; NT – Near Threatened; VU - Vulnerable; EN – Endangered; CR – Critically Endangered. **SPEC.** European status as defined by BirdLife International. SPEC 1 – European species with global threat status; SPEC 2 - species which concentrates its population in Europe, where conservation status is not favourable; SPEC 3 – species widespread beyond Europe but with unfavourable conservation status there; Non-SPEC^E - species which concentrates its population in Europe, where conservation status is favourable; Non-SPEC: species widespread beyond Europe and with favourable conservation status there. **ETS.** European threat status, defined by BirdLife International following IUCN criteria. NE: not evaluated; S: secure; DD: data deficient; L: localized; H: harvested; R: rare; D: declining; VU: vulnerable; EN: endangered; CR: critically endangered. **Bonn Convention.** Annex I includes those species considered as threatened. Annex II is for those species whose habitats on migration require conservation improvement. **Bern Convention.** Annex II - strictly protected species; Annex III - protected species. **AEWA (Agreement on the Conservation of African-Eurasian Waterbirds).**

Overview of the Alboran Seabird Community

The seabird community of the Alboran Sea is notoriously diverse, due to the influence of both Atlantic and Mediterranean basins. Moreover, the region acts as a migration corridor for any seabird movements between these two major basins, thus representing a huge migration bottleneck for hundreds of thousands of seabirds of several species. About 25 seabird taxa are regular in the region (Table 1), whereas several others occur there on an irregular basis or accidentally.

Breeding populations

Despite the relevance of the region for seabirds, breeding populations are rather small and restricted to a few suitable nesting sites. A few species of gulls and terns breed locally in coastal marshes and wetlands, particularly in Almeria (NE Alboran): slender-billed and black-headed gulls, and common and little terns (Paracuellos & Nevado

2003, Molina et al. 2009, Corbacho et al. 2009). The Mediterranean shag also breeds, very locally, in Cabo de Gata (Almería, in the NE limit of the Alboran Sea) and Gibraltar (W limit). But the most relevant breeding species related with the open sea are Cory's/Scopoli's and Yelkouan shearwaters, and Audouin's gull (Martí & del Moral 2003, Bourgeois et al. 2012). Cory's/Scopoli's shearwater is restricted to the Chafarinas islands, where the population is roughly estimated at 800-1000 breeding pairs, and in decline (Afán et al. 2011), with occurrence of both taxonomic forms. The Yelkouan shearwater has been reported to breed in the Algerian coast, outside the limits of the Alboran Sea (Kalah islet, 8-10 pairs; Ledant et al. 1981, Bourgeois et al. 2012). In both cases, a thorough prospection of suitable places along the relatively low prospected African coast might bring new colonies of these pelagic seabirds, as well as breeding evidences for the European storm-petrel. Cory's shearwater also breeds in Terreros islet (close to the Alboran Sea, in the Spanish Mediterranean coast), and this shearwater plus the European storm-petrel also breed in Terreros and Palomas islets, a bit further north. As for Audouin's gull, the Alboran sea holds two of its most traditional breeding sites, the archipelago (with up to 4300 breeding pairs in 1992, and around 2000 at present) and Alboran island (about 500 breeding pairs). The species was also found breeding in Al Hoceima islet in recent years (Afán et al. 2010).

Regarding the most pelagic species, the Alboran Sea also attracts breeding birds from colonies outside the region, such as Balearic shearwaters (both breeders and non-breeders), Cory's shearwaters (from as far as Columbretes islands), European storm-petrels and Audouin's gulls. On the other hand, some of the Cory's shearwaters breeding in Chafarinas move to the adjacent Atlantic waters to forage (Navarro et al. 2009). Foraging hotspots at this time of the year are concentrated across the borders of the two anticyclonic eddies (Arcos et al. 2009), particularly Malaga and Almería bays (good for Cory's and Balearic shearwaters; the latter also supporting local populations of gulls and terns), the Alborán island – Cape Tres Forcas area (particularly Cory's shearwaters and local Audouin's gulls), the Almeria-Oran front (potentially good for European storm-petrels; Arcos & Pou 1999) and the Algerian shelf (visited by breeding Balearic shearwaters; Ruiz & Martí 2004, Louzao et al. 2011). The latter was also regularly visited by PTT-tracked Audouin's gulls from Menorca during the breeding period, although these birds appeared to have abandoned their nests (Arcos et al. 2009). In their movements between the colonies and all these foraging areas, these seabird species cross the Alboran Sea in any direction, though most often following the anticyclonic eddies in the region (i.e. crossing in the Málaga Bay-Cape Tres Forcas or the Almería-Oran “flyways”).

Non-breeding populations

One of the key roles of the region, as stated above, is as the unique migration corridor between the Atlantic and the Mediterranean. Practically the whole global population of Balearic and Scopoli's shearwaters leave the Mediterranean after breeding (Ruiz & Martí 2004, Arroyo et al. 2011b, Arcos et al. 2012a), as well as about 70% of the Audouin's gull population (Bécares et al. 2013). During their migration, these species tend to spend some time in specific areas of the Alboran Sea, or concentrate their migration flow in some others (see details in the Species account below). Of particular relevance is, obviously, the Strait of Gibraltar, with some differences between both

sides (African – European) (Arroyo et al. 2011a). The African coast concentrates for instance the bulk of the Scopoli's shearwater migration, particularly in autumn, when over 500.000 are estimated from Ceuta (Navarrete 2011). Another priority species for the Mediterranean, the Lesser-crested tern, also migrates through the southern side of the Strait. On the other hand, the bulk of the population of Balearic shearwaters crosses close to the northern side, particularly during the post-breeding migration (Arcos et al. 2012). Movements between the two coasts also occur throughout the region, but are most relevant in the Gibraltar area, as well as following the two anticyclonic eddies (i.e. Malaga Bay-Cape Tres Forcas and Almería-Oran).

As for wintering seabirds, the available information is scarcer, particularly along the African coasts. In the northern side, the Almería Bay and adjacent areas (extending to the Seco de los Olivos in the SW) holds a wintering population of Audouin's gull, and is regularly visited by Balearic shearwaters, sometimes in considerable numbers (several hundreds or up to thousands), while the area is also frequented by wintering species from the Atlantic (northern gannets, great skuas, razorbills, puffins) (Arcos 2005, Arcos et al. 2009). Malaga Bay is also good for Balearic shearwaters and for some of the Atlantic species, but its most relevant visitor is the Mediterranean gull, that can reach up to 15.000 wintering birds, becoming the second most important wintering area in the Mediterranean, equal to that in central Portugal (Arcos 2005, García-Barcelona 2009, Cama et al. 2011). The African coast represents a wintering area of relevance for Audouin's gull, and also appears to be important for the Balearic shearwater (particularly the area around Cape Tres Forcas and the Algerian coast).

Monitoring Programmes, Information Sources and Gaps

Information regarding seabirds in the Alboran Sea is patchy and requires of further research, particularly on the African side. The following is a summary of the most relevant work conducted in the area, according to the type of information.

Breeding colonies

The location of seabird breeding colonies is reasonably well known in the Spanish territory of the Alboran Sea. These colonies are mainly located in the Chafarinas and Alboran Islands, as well as coastal areas of Almería (particularly wetlands) (De Juana et al. 1984, Paracuellos & Nevado 2003, Bertolero et al. 2009, Corbacho et al. 2009, Afán et al. 2011, Arcos et al. 2012b). In the Moroccan and Algerian coasts information is more limited, and includes the recent finding of an important Audouin's gull colony in Al Hoceima islet (Afán et al. 2010) and the location of a few Yelkouan shearwaters in Kalah islet, in Algeria (Ledant et al. 1981, Bourgeois et al. 2012).

Gulls and terns colonies, more conspicuous, are likely well known in the whole region. However, Procellariiforms (shearwaters and storm-petrels) are more difficult to survey, due to their nocturnal behaviour at attending the colonies and their preference for remote areas of difficult access (sea cliffs, islets), and the current picture could be biased. For this group, the unique data is restricted to the Chafarinas Islands (where several hundreds Cory's/Scopoli's shearwaters breed) and the aforementioned presence of Yelkouan shearwater at Kalah islet. It is unlikely that other colonies of shearwaters or storm-petrels would be discovered in the Spanish coasts, due to lack of

suitable breeding places. However, specific work has been limited in the African coast, and a thorough prospection of suitable places might bring new colonies of these species.

As for long-term monitoring, regular surveys have been conducted for the Audouin's gull in Chafarinas and Alborán islands (Bertolero et al. 2009), as well as for other gulls and terns in the Almería wetlands (Paracuellos & Nevado 2003). Monitoring of the Cory's/Scopoli's shearwater in Chafarinas has also been conducted for several years, in this case restricted to the follow-up of (accessible) control nests rather than a whole census of the colony (Afán et al. 2011). Keeping these monitoring programmes (promoted so far by local administrations and/or independent research groups) and extending them to other colonies is essential to assess seabird population trends in the region and properly address conservation action.

Coastal monitoring of seabird movements

Given the relevance of the Alboran Sea as a migration corridor between the Atlantic and the Mediterranean, coastal monitoring programmes could be of relevance to assess migration flows. Of particular interest is the Strait of Gibraltar, where regular monitoring has been implemented in the northern side of the Strait in the last few years under the framework of Migres Project (Arroyo et al. 2011a), following older work (Tellería 1981, Finlayson & Cortés 1987). Similarly, a monitoring scheme has been intermittently working in Ceuta (African coast of the Strait) in recent years (Navarrete 2011). These studies have been of relevance to establish global counts for some seabird species, such as the Balearic shearwater (Arroyo et al. 2011b, Arcos et al. 2012a) and Scopoli's shearwater (Navarrete 2011). It is worth mentioning the work by Paracuellos and Jerez (2003), which compared seabird movements from opposite sides of the Alboran Sea away from the Strait of Gibraltar, in Melilla and Almería, in 1997-1998 (weekly counts). More recently a network of coastal counts (RAM) has been established in Spain, although survey effort is limited (3 hours per month) (Valeiras et al. 2011).

At sea monitoring – boat based seabird surveys

Seabirds have received relatively little attention in the Alboran Sea region, particularly regarding the study of their distribution patterns at sea. The most extensive coverage of the region regarding marine top predators has been probably conducted by Alnitak, an organization that has conducted several surveys since 1990. However, seabirds have been only marginal to a research work focused on cetaceans and sea turtles (Cañadas et al. 2005, Hyrenbach et al. 2008), and little information is available for the target group of this report. On the other hand, a handful of seabird surveys have been conducted in the last few years in the Spanish side, providing the most relevant information for the region. Of particular interest for the length of the series is the MEDITS fishing trawl research cruise organized by the Spanish Institute of Oceanography (IEO), where seabird data has been collected both as point-counts during trawling operations (since 1994; Abelló et al. 2003) and using specific transect surveys (since 1999; Arcos & Oro 2002, Louzao et al. 2006b, Arcos et al. 2012c). Seabird surveys taking profit of the MEDITS cruise extended later to other

oceanographic cruises (Arcos & Pou 1999, Arcos 2005), and were consolidated with occasion of a LIFE Project conducted by SEO/BirdLife to identify the marine Important Bird Areas in Spain (2004-2009; Arcos et al. 2009), and LIFE+ INDEMARES (2009-2014) afterwards. These latter projects included modelling seabird distribution patterns and allowed to get a wider view of the Alboran Sea region. Finally, in 2007 the Government of Andalusia launched a monitoring program for seabirds and cetaceans, consisting of regular pre-established transects covering the coastal waters of the northern coast of the region (Fernández -Casado et al. 2011).

At sea monitoring – seabird tracking

Seabird tracking work has been conducted in recent years in the region, providing new insights on the distribution patterns and behaviour of seabirds at sea. Studies include:

Satellite (PTT) Tracking of Cory's/Scopoli's shearwaters was carried out in Chafarinas in 2007 under the frame of LIFE project on marine IBAs carried out by SEO/BirdLife (2004-2009; Arcos et al. 2009). This action allowed understanding the foraging patterns of these two related taxa, which clearly differed at sea (Navarro et al. 2009).

GPS Tracking of Cory's/Scopoli's shearwater was carried out in Chafarinas in 2011, under the frame of LIFE+ INDEMARES (2009-2013) and Interreg FAME, conducted by SEO/BirdLife in collaboration with the Estación Biológica de Doñana (EBD-CSIC) (Afán et al. 2014).

PTT tracking of breeding Balearic shearwaters was conducted in the Balearic Islands within the frame of a LIFE Project for the conservation of this species (Balearic Government and SEO/BirdLife; 1998-2001) and Interreg Project FAME (LPO, CEBC-CNRS & SEO/BirdLife, 2010-2012). Results showed in both cases that breeding birds from the Balearic Islands do use the waters off the Algerian coast regularly as foraging grounds, an issue that deserves further attention (Ruiz & Martí 2004, Louzao et al. 2012).

Geolocators (GLS) tracking of Balearic shearwaters has been conducted by two independent initiatives in 2010-2014, revealing the detailed movements of the species outside the breeding range, which include the Alboran Sea area as migration corridor (Guilford et al. 2012).

GPS tracking of breeding Balearic shearwaters was conducted in Ibiza (Balearic Islands) by SEO/BirdLife within the frame of LIFE+ INDEMARES, and also supported by the Ibiza Preservation Fund. Results confirmed the occurrence of breeding birds off Algeria and Morocco, although inter-annual variability was important.

PTT tracking of Audouin's Gulls was conducted in 2006 and 2007 in 4 different colonies of Spain, including Alboran Island, under LIFE Project to identify marine IBAs in Spain (Arcos et al. 2009). About 70% of the birds moved across the Alboran Sea to winter in the NW African coasts in the Atlantic. The remaining birds mostly remained in the Alboran Sea area, particularly around coastal wetlands of Almeria and Algeria (SEO/BirdLife 2012). The tracking also revealed movements along the Alboran African coast during the breeding season.

At sea monitoring – assessment of threats

Information at sea regarding the evaluation of threats, particularly of seabird bycatch in fishing gear, is very limited in the Alboran Sea. The Spanish Institute of Oceanography keeps an observers programme to monitor bycatch in the pelagic longline fishery, including seabird data since 1997 (systematized since 2008; Garcia Barcelona et al. 2010a,b). In the near future it would be necessary to extend this initiative to all fisheries observer programs, also incorporating Morocco and Algeria.

Threats to Seabirds

Overview

Seabirds are among the most threatened bird groups in the world (Croxall et al. 2012), and their conservation requires urgent and well-coordinated action (Lewison et al. 2012). This vulnerability is partly due to the fact that seabirds commute between two totally different environments, the sea and the land (breeding colonies), each with its inherent threats (Boersma et al. 2002). Furthermore, they are highly mobile organisms that can travel across most of the planet during their life cycle, and therefore face different threats in different regions. To complete the picture, seabirds' life history is characterized by high adult survival (usually around 90% annual survival in many species) and low reproductive success. Hence, their populations are very sensitive to any factors increasing adult mortality, as the population cannot compensate this “extra” loss of individuals by increasing its productivity (Croxall & Rothery 1991, Weimerskirch 2002).

Overall there is some consensus on major threats affecting seabirds (Boersma et al., 2002, Croxall et al. 2012). Inland, the most relevant are the pressure posed by invasive species (particularly predation by introduced mammals), habitat lost or degradation (due to coastal development), human disturbance, poaching and environmental change. At sea, the interaction with fisheries (especially bycatch), pollution, the proliferation of infrastructures and environmental change complete the list.

The relative importance of these threats may vary between regions and species, according to their geographical and ecological characteristics, and with the weight of the various human activities that take place in them. In the case of Alboran Sea, it is important to keep in mind that the local seabird community is diverse but partly composed by species that count with relatively small populations (due to the low productivity of the Mediterranean region), thus being of particular conservation concern (De Juana 1984, Zotier et al. 1999, Mínguez et al. 2003, Madroño et al. 2004, Arcos et al. 2009). Taking this into account, as well as the most relevant human activities in the area (MARM, 2008), the most relevant threats in the region appear to be as follows.

Threats Inland (Colonies)

Predation by invasive species

Predation by rats has been described in the Chafarinas archipelago as a factor negatively influencing the breeding performance of Cory's shearwaters (Igal et al.

2005, 2007, 2009), whereas the effect on gulls seems marginal (Prieto et al. 2003). Moreover, smaller Procellariiforms such as the European storm-petrel and the Yelkouan shearwater could be prevented of breeding there due to the presence of rats, and the same is likely in other potentially suitable areas along the African coastline.

Coastal development

The increasing humanisation of the coastline, including urban development, infrastructures, light pollution and disturbance, poses a threat to seabirds, particularly on their breeding grounds. This likely affects both coasts of the Alboran Sea, and is particularly relevant for gulls and terns breeding in wetlands, as these habitats have been severely affected by human activities.

Threats at Sea

Fisheries bycatch

Seabird bycatch in fishing gear is one of the most serious threats to many seabird species, including some of the most common seabirds in the Alboran Sea (e.g. Cory's and Balearic shearwaters). However, the available evidence is very limited for the region (Arcos et al. 2012b). Only pelagic longlines have been monitored to some degree (García-Barcelona et al. 2010a,b), reporting very low bycatch rates in the region. On the other hand, reports from beached bird surveys suggest that demersal longlines, nets and pole lines could have some impacts on seabirds (García-Barcelona et al. 2010c). Further research is necessary to properly assess the incidence of bycatch in the Alboran Sea, as high levels have been described in neighbouring areas of the Mediterranean Sea.

Fishing overexploitation

The Alboran Sea holds an important fishery for small-pelagic fish species, mainly sardine and anchovy, which has undergone severe fluctuations and is likely overexploited (Copemed II. 2011). Since these are the main natural prey for most seabird species, keeping severe exploitation without proper assessment and management could cause impact on the seabird populations, both breeders and non-breeders (e.g. Louzao et al. 2006a, Cury et al. 2011).

Pollution

Both background and acute-events pollution pose a serious threat to seabirds worldwide, and the Alboran Sea is no exception. Of particular relevance is the risk of acute events of pollution such as oil spills, since the Alboran Sea holds one of the busiest maritime routes of the world (Sánchez de Vivero 2013), thus raising the likelihood of accidents and other impacts on marine biodiversity (Abdulla & Linden 2008). Background pollution includes potential impacts from plastic ingestion (Arcos et al. 2012b).

Marine infrastructures

Development of infrastructures at sea could pose a risk to seabirds. Within the context of the Alboran Sea, windfarms pose a particular threat given the relevance of the region for migrating seabirds (i.e. intense flow of seabirds prone to colliding with these infrastructures). So far the area includes a few proposals of wind-farm development, all of them in the Straits of Gibraltar area (Sánchez de Vivero 2013), where the risk to seabirds would be highest.

Table 2. Overview of potential threats to the most relevant seabird species in the Alboran Sea (from a conservation perspective: those listed in the SPA/BD -Barcelona Convention- and/or included in Annex I of EU Birds Directive). Red: high impact; orange: moderate impact; green: low impact; na: not applicable.

English name	Scientific name	Threats inland Threats at sea								
		Predation by introduced mammals	Coastal development	Human disturbance	Poaching	Fisheries bycatch	Prey depletion	Pollution	Infrastructures	Environmental change
Scopoli's shearwater	<i>Calonectris (d.) diomedea</i>									
Cory's shearwater	<i>Calonectris (d.) borealis</i>									
Balearic shearwater	<i>Puffinus mauretanicus</i>	na	na	na	na					
Yelkouan shearwater	<i>Puffinus yelkouan</i>	?								
European storm-petrel	<i>Hydrobates pelagicus</i>	?								
Mediterranean shag	<i>Phalacrocorax a. desmarestii</i>				?					
Mediterranean gull	<i>Larus melanocephalus</i>	?								
Slender-billed gull	<i>Larus genei</i>	?								
Audouin's gull	<i>Larus audouinii</i>									
Sandwich tern	<i>Sterna sandvicensis</i>	na			na					
Lesser-crested tern	<i>Sterna bengalensis</i>	na			na					
Common tern	<i>Sterna hirundo</i>	?								
Little tern	<i>Sterna albifrons</i>	?								

Species' Account

Information on the most relevant breeding seabird species in the Alboran Sea (or nearby areas), from a conservation point of view, is provided here with some more detail. The most coastal species have been excluded, thus focusing on the open seas.

Scopoli's/ Cory's shearwater (Calonectris diomedea/borealis)

Cory's shearwater (*Calonectris diomedea* spp.) has been recently split into two different species, Scopoli's (*Calonectris diomedea*) in the Mediterranean and Cory's shearwater (*Calonectris borealis*) in the Atlantic. Scopoli's shearwater is the most common of these two sister species in the Alboran Sea, although a few Cory's shearwaters also breed in the region (Navarro et al. 2009, Afán et al. 2014). Breeding of both forms is restricted to the Chafarinas Islands according to available information, where about 800-1000 breeding pairs are estimated (Martí & del Moral 2003, Afán et al. 2011). Other areas of the African coast could be also suitable for breeding, but no positive data have been reported on this regard. According to monitoring data from Chafarinas, the species is declining in the region (Iguar et al. 2009).

At sea, the species is common throughout the region, particularly during migration peaks. This is particularly so during the post-breeding migration, from mid October to mid November, when an estimated number of more than 500,000 birds leave the Mediterranean, largely following the southern coast of the Alboran Sea (Navarrete et al. 2011).

Balearic shearwater (Puffinus mauretanicus)

The critically endangered Balearic shearwater is restricted as a breeder to the Balearic archipelago, in the western Mediterranean. Virtually the whole population of this species moves to the Atlantic waters off SW Europe after breeding (Le Mao & Yésou 1993, Ruiz & Martí 2004, Arcos 2011, Guiford et al. 2012). Balearic shearwaters are therefore common in the region, particularly when leaving the Mediterranean (May-July) and on their return (September-November), also extending their stay in the area during the first months of winter (Arcos et al. 2009, Arroyo et al. 2011b, Arcos et al. 2012a). Key hotspots in the region include the Straits of Gibraltar (which concentrates the migration flow), Malaga Bay (an important stopover area during migration) and Almería Bay (which represents an important foraging area most of the year, including the late breeding period). The North African coast has received less attention, but important concentrations have been reported in the central coast of Morocco (around Cape Tres Forcas) in winter. Moreover, remote tracking suggests that breeding birds often forage in Algerian waters, and even off the Moroccan coast (Louzao et al. 2012).

Yelkouan shearwater (Puffinus yelkouan)

This shearwater has been not confirmed as a breeder in the Alboran Sea region, although a few (8-10) pairs have been reported in the nearby Kalah islet, in the eastern Algerian coast, and larger colonies are known off Tunisia (Ledant et al. 1981, Bourgeois et al. 2012, Derhé 2012). Further prospection of suitable places along the

relatively low studied African coast might bring new colonies within the Alboran Sea region in the future, but for now the species must be considered as a scarce visitor.

At sea, large summer concentrations of Yelkouan shearwaters used to be reported in the western Alboran Sea until the early 1980s, particularly near the Straits of Gibraltar (Tellería 1981, De Juana & Paterson 1986, Bourgeois & Vidal 2008), but these gatherings have disappeared in recent decades, and the species has become very scarce in the whole Alboran Sea. According to GLS tracking of birds from the French colonies, birds from these populations could visit the Algerian and eastern Moroccan coast during the summer, though there is considerable uncertainty associated to this type of information (Péron et al. 2013). Further research is necessary to clarify the status of the species in the region, particularly given its conservation status (classified as Vulnerable) and its distribution range restricted to the Mediterranean and the Black Sea (Del Hoyo et al. 2014). Particular interest deserves elucidating why the post-breeding concentrations reported over 30 years ago have disappeared.

European storm-petrel (Hydrobates pelagicus)

The European storm-petrel is a regular, though scarce visitor to the Alboran Sea. Breeding has not been confirmed in the region, though potential breeding sites have been relatively little surveyed. The closest known colonies at present are located off the Iberian Mediterranean coast, namely Terreros and Palomas islets (Martí & Del Moral 2003). The species is regular at sea, however, being particularly common in the Bay of Almeria and along the Almeria-Orán front (Arcos & Pou 1999, García-Muñoz 2008, Arcos et al. 2009). The movements of the Mediterranean population outside the breeding period are little understood, and it is unclear if the species leaves the Mediterranean in winter. This does not appear to be the case (Bourne 1993, Hashmi & Fliege 1994, SEO/BirdLife 2012), but otherwise the Alboran Sea would play a more relevant role than previously thought, as the unique marine route communicating the Mediterranean with the Atlantic.

Mediterranean gull (Larus melanocephalus)

The Alboran Sea represents one of the most important wintering grounds for this gull species (Arcos 2005, García-Barcelona 2009, Cama et al. 2011). The wintering population is concentrated in the area of Malaga Bay and the surrounding offshore waters (Arcos et al. 2009), though the species seems to also occur regularly off the Moroccan coast (Paracuellos & Jerez 2003). The species requires attention from a conservation point of view, since recent estimates suggest a global population size far lower than previously expected (Cama et al. 2011). Its pelagic habits in winter, on the other hand, reinforce this need of attention when addressing the conservation of the open seas.

Audouin's gull (Larus audouinii)

The Alboran sea holds two historical breeding sites of this seabird species endemic to the Mediterranean: the Chafarinas archipelago (formerly the largest colony in the World, with up to 4300 breeding pairs in 1992, and around 2000 at present) and

Alboran island (about 500 breeding pairs) (Bertolero et al. 2009). The species was also found breeding in Al Hoceima islet in recent years, with 800 breeding pairs (Afán et al. 2010). Audouin's gull presents semi-pelagic habits, and therefore make extensive use of the open sea, particularly around Alboran Island. However most of the foraging activity of the species occurs in continental shelf waters. In addition to the waters surrounding the breeding sites, the Almeria Bay is also a relevant foraging area for migrating birds. The Straits of Gibraltar plays a major role as a flyway between the Alboran/Mediterranean breeding grounds and the wintering grounds of a large proportion of the species, along the NW (Atlantic) African coast (Oro & Martínez-Vilalta 1994, SEO/BirdLife 2012).

PRIORISATION OF AREAS

The prioritization of marine protected areas for seabirds in the Alboran Sea should take into account which the main values of the region for this group of birds are. As described in this document, these include breeding sites (wetlands and islands), migration hotspots and foraging areas for breeding, migrating and wintering birds. These values point to different key areas to be protected:

Breeding sites

Seabird breeding sites within the region are somewhat the areas that have received most attention from a protection point of view. Among the wetlands, the Almería wetlands in Spain and Sebkh Bou Areg in Morocco are likely the most relevant. The islands in the region include the Alboran and Chafarinas islands, Al Hoceima and Habibas Islands (plus Kalah islet, beyond the limits of the Alboran Sea region). For all these sites, it is important to provide protection not only to the breeding colonies but also to their marine surrounding waters. The marine extension of these colonies should be determined taking into account the foraging ecology and behavior of the breeding species.

Migration hotspots

The whole of the Alboran Sea is a major migration hotspot funnelling the flow of seabirds between the Atlantic and the Mediterranean. However, the true bottleneck is posed by the Strait of Gibraltar, where the passage between these two basins is narrowed to 14 km. This is the area deserving most protection in the region regarding migratory movements.

Foraging areas

For some species, such as terns, protecting the surrounding of their colonies ensures the protection of the main foraging grounds during the breeding period, since their foraging ranges are rather small. However, other species, like the shearwaters, can travel hundreds of km between their breeding and foraging sites, and foraging areas

have to be addressed independently. Moreover, some of these areas are also relevant for migratory and wintering birds.

Within the Alboran Sea basin, obvious foraging areas are those with relatively shallow and wide continental shelf, which in turn tend to coincide with the richest margins of the two anticyclonic eddies in the region. In the northern coast, Malaga Bay (inner eddy) and Almería Bay (outer eddy) are the most relevant foraging areas, including pelagic seabirds such as shearwaters and storm petrels. In the southern coast, the continental shelf at both sides of Cape Tres Forcas (inner eddy) and the Habibas area (outer eddy) appear to be the most relevant foraging grounds. In the centre of the basin seabird densities are rather low, but higher numbers occur again in the margin of the eddies, both the inner (that coincides with Alboran Island) and the outer eddy (Almería-Oran front, likely the most relevant for pelagic species such as the European storm-petrel).

Conservation Measures

This section presents an overview of undergoing conservation measures in the Alboran Sea region that provide protection to the seabird community of the region, either at international, regional or national level.

International and Regional Agreements

The seabird community in the Alboran Sea already benefits from several international agreements that prioritise the protection of particular species, as listed in Table 1.

Of these agreements, the most relevant is the Barcelona Convention, also named as Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (UNEP-MAP). The convention includes a list of priority species for conservation (Table 1), and also promotes the identification of Marine Protected Areas under the Regional Activity Centre for Specially Protected Areas (RAC/SPA), which endorses the present work. At present five Specially Protected Areas of Mediterranean Importance (SPAMI) have been identified in the Alboran Sea region: *Al Hoceima National Park* in Morocco, *Habibas Islands* in Algeria, and *Alboran Island, Maro-Cerro Gordo Cliffs* and *Natural Park of Cabo de Gata-Níjar* in Spain. A further two sites lay very close to the region, the *Banc des Kabyles Marine Reserve in Algeria* and the *Sea Bottom of the Levante of Almería* in Spain.

The Convention on Biological Diversity (CBD) also promotes the protection of relevant sites across the world, including the marine environment. A commitment has been established to protect at least 10% of the seas by 2020. A specific figure of protection has been created within the CBD, the Ecologically or Biologically Significant Marine Areas (EBSAs). The results of the present work are intended to contribute to the proposal of EBSAs in the Alboran Sea (as well as new SPAMIs).

Also relevant from a protection site perspective in the case of seabirds is the BirdLife International Important Bird Areas (IBA) Programme, which seeks the identification of priority sites for bird conservation across the world. Work in recent years has addressed the marine environment, with the launch of an e-Atlas of marine IBAs in 2012 (<http://maps.birdlife.org/marineIBAs/default.html>).

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), or Bonn Convention, aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme (UNEP), concerned with the conservation of wildlife and habitats on a global scale. The CMS lists species threatened with extinction (Appendix I) and other species whose conservation would benefit from international cooperation (Annex II) (Table 1). Several Agreements have been concluded under the auspices of CMS. Among them, the Agreement for the Conservation of Albatrosses and Petrels (ACAP) lists among its priority species the Critically Endangered Balearic shearwater. Also relevant to the seabirds in the Alboran Sea is the The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

Finally, the Ramsar Convention (or Convention on Wetlands of International Importance), is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Although this convention does not directly address the marine environment, it covers the breeding grounds of some relevant seabird species in the Alboran Sea (gulls and terns).

At the European level, environmental legislation also promotes the creation of protected areas, specifically the Natura 2000 network. This network includes two types of figures: Sites of Community Importance (SCIs) under the Habitats Directive (92/43/EC), and Special Protection Areas (SPAs) under the Birds Directive (2009/147/EC). The aim of Natura 2000 is to preserve the natural values triggering the designation of these sites while keeping human activities in a sustainable way. The Birds Directive also envisions special measures of conservation for those bird species included in its Annex I (see Table 1). Within the Alboran Sea, these directives are only applicable to the Spanish side, and are further commented below (conservation measures at national level). Also at the European level, the Marine Strategy Framework Directive (2008/56/EC) also encourages the protection of seabirds and other marine biota to attain a “good environmental status”.

Also at European level, three of the seabird species present in the region have conservation action plans: the Balearic shearwater *Puffinus mauretanicus* (updated in 2011), the Mediterranean shag *Phalacrocorax aristotelis desmarestii* (1999) and Audouin’s gull *Larus audouinii* (1996).

National Conservation Measures

Spain

All relevant breeding sites in the Alboran Sea region in Spain are protected under different figures, often overlapping. However, far less attention has received the marine environment. Until very recently, there was only one marine SPA in the whole region, namely *Cabo de Gata-Níjar* (ES0000046), which includes a 2.5 km wide fringe of coastal waters. The area is also protected as a Natural Park and has been listed as SPAMI. In July 2014, a major extension of that SPA (Bahía de Almería) and two new SPAs (*Bahía de Málaga-Cerro Gordo* and *Entorno marino de la Isla de Alborán*) were

designated by the Spanish Government. These sites sum up over 2,500 km² of marine protected areas. The proposal is based on the inventory of marine IBAs elaborated by SEO/BirdLife in 2004-2009 (Arcos et al. 2009). However, two sites have been disregarded so far: the Strait of Gibraltar and the surroundings of the Chafarinas Islands. Beyond the designation of these sites, management plans are necessary to ensure their protection. In this regard, the new Spanish designation includes the commitment to develop and approve management plans for the marine SPAs within 2 years after designation.

Morocco

Some of the wetlands holding breeding seabird colonies have been designated as Ramsar sites. However, no marine protected areas have been proposed, with the exception of the *Al Hoceima* SPAMI (about 20 km² of marine area), also designated as National Park. The marine IBAs identified by SEO/BirdLife in Gibraltar and Chafarinas include Moroccan waters, and deserve protection. The Spanish inventory of marine IBAs also proposed sites of importance in Moroccan waters based on tracking data of Cory's/Scopoli's shearwaters and Audouin's gulls, one east of Cape Tres Forcas to Chafarinas (off Sebkh Bou Areg area, a very important wintering site for gulls and terns) and another between Al Hoceima and Cape Tres Forcas.

Algeria

Algeria holds several Ramsar sites and one SPAMI within the region (Habibas Islands, about 27 km²), the latter being a Marine Nature Reserve. Little information is available for the marine environment, but recent tracking work suggest that the Algerian shelf is of relevance as a foraging ground for at least the Critically Endangered Balearic shearwater (Louzao et al. 2012).

Overview of the Ongoing Work on MPAs

The Spanish Government has recently designated 39 marine Special Protection Areas (SPAs), which include 3 coastal-offshore areas within the Alboran Sea region (MAGRAMA, July 2014; see Fig. 3). The proposal was based on the inventory of marine Important Bird Areas (IBAs) elaborated by SEO/BirdLife (Arcos et al. 2009). Other two marine IBAs, which encompass Spanish and Moroccan waters (Fig. 3), were not included in this designation but deserve future attention, particularly the Strait of Gibraltar. Fig. 3 also shows two areas identified by SEO/BirdLife in Moroccan waters based on tracking data. These areas deserve further attention by conducting boat-based surveys that will allow a wider picture for the whole seabird community, maybe redefining limits. Beyond all these sites depicted in Fig. 3, the true open seas in the Alboran Sea have received less attention, and might require further research to assess if potential MPAs are required. This could be particularly relevant for the Almería-Oran front.

The main values for the three SPAs designated by Spain are the following:

- 1) **Almería Bay.** This is a relatively productive area within the Alboran Sea context, holding important populations of small pelagic fish. The area is good as extension to colonies of breeding gulls (particularly slender-billed gull, 225 breeding pairs) and terns (common and little terns). Audouin's gull also concentrates in the coastal wetlands outside the breeding season, and make extensive use of the marine environment. Finally, the marine area is a typical foraging ground for the Balearic shearwater, with hundreds of birds regularly in autumn and winter (up to over 2000 birds).
- 2) **Malaga Bay – Cerro Gordo.** This is the other area with relatively wide continental shelf in the northern coast of the Alboran Sea, and with relatively high productivity, also holding important populations of small pelagic fish. Balearic shearwaters gather there in their migration routes, often hundreds, as well as several other seabird species. However, the most relevant species is the Mediterranean gull, which finds here its second largest wintering area in the Mediterranean, with up to over 20,000 birds in late winter.
- 3) **Alboran Island marine area.** The area is proposed mainly as an extension to the breeding colony of Audouin's gull, one of the historical strongholds of the species, with over 500 breeding pairs at present.

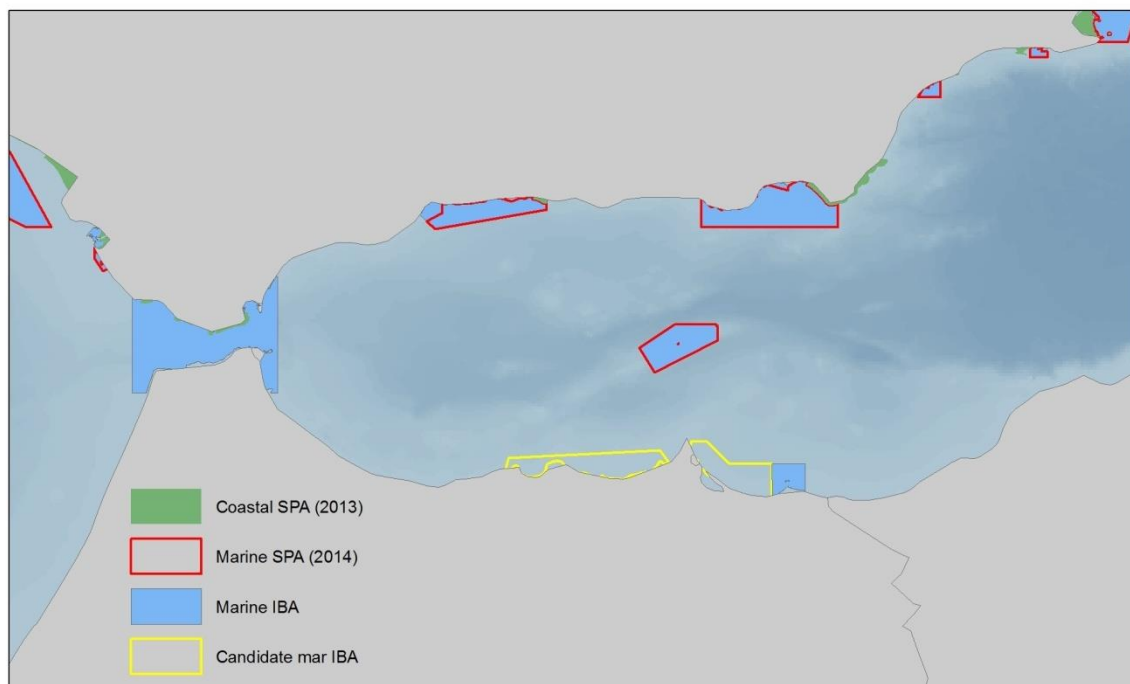


Fig. 3. Spanish recent proposal of SPAs in the Alboran Sea region (red lines), as well as marine IBAs identified by SEO/BirdLife and potential IBAs also proposed by SEO/BirdLife in 2009 (yellow lines).

CONCLUSIONS

The Alboran Sea represents a transition area between two major oceanic basins, the Atlantic and the Mediterranean, which deserves particular attention for its high biodiversity and relatively high productivity. The open seas have received particularly little attention, and an MPA approach is mandatory, to be combined with other conservation tools.

Seabirds are not exception, and the local seabird community is notoriously diverse, influenced by both the Atlantic and the Mediterranean basins. About 25 seabird taxa are regular in the region, whereas several others occur there on an irregular basis or accidentally. Despite the relevance of the region for seabirds, breeding populations are rather small and restricted to a few suitable nesting sites, although some potential areas remain poorly prospected and deserve future attention. Regarding the most pelagic species, the Alboran Sea also attracts breeding birds from colonies outside the region, particularly shearwaters. One of the key roles of the region is as the unique migration corridor between the Atlantic and the Mediterranean. Hundreds of thousands of seabirds of several species cross the area regularly to migrate between these two basins.

Information regarding seabirds in the Alboran Sea is patchy and requires of further research, particularly on the African side. This includes information on seabird breeding populations, as well as on distribution patterns at sea. But it is also necessary to improve the knowledge on human activities and their potential impact on seabirds. Information (and conservation action) regarding predation by introduced mammals in the colonies, and fisheries bycatch at sea, deserve particular attention.

The prioritization of marine protected areas for seabirds in the Alboran Sea should take into account which the main values of the region for this group of birds are. As described in this document, these include breeding sites (wetlands and islands), migration hotspots and foraging areas for breeding, migrating and wintering birds. These values point to different key areas to be protected. Current conservation action at international, regional and national level is already addressing these needs.

Regional Priorities

The following actions should be considered as priority to improve the knowledge on seabirds and to address their conservation in the Alboran Sea:

1. **Monitoring of seabird colonies.** There are relatively few known seabird colonies in the Alboran Sea, but there is potential for new sites, particularly along the African coast. Assessing breeding seabird numbers is mandatory, which includes sound counts of the known colonies (to be maintained on a regular basis), as well as surveying for potential new colonies. A few colonies of reference should be taken for a more detailed monitoring, which allowed to

assess demographic parameters and hence assess population trends. Shearwaters and the European storm-petrel deserve particular attention.

2. **Monitoring at sea distribution.** Information on spatiotemporal distribution patterns at sea is key to understand the role of seabirds in the Alboran Sea, assess potential threats and address their conservation. A combination of boat-based surveys and remote tracking is recommended to optimise results. The African coast deserves particular attention, as well as the most pelagic regions of the Alboran Sea, as fewer studies have been conducted there.
3. **Assessment of threats.** Efforts to properly assess the main threats that seabirds face in the Alboran Sea are necessary to ultimately improve their conservation status. Particular attention deserve the monitoring of predation at colonies and of fisheries bycatch at sea (observer's programmes, questionnaires). Small artisanal vessels, particularly longliners, should receive particular attention regarding bycatch, as they can have a major impact on the shearwaters.
4. **Identification, designation of Marine Protected Areas (MPAs).** The most relevant marine hotspots for seabirds have been already been identified, although further work is necessary to complete the current picture. A combination of further work to identify new hotspots (related to point 2) and policy work to designate the known ones is necessary. Particular attention deserve the open seas, where jurisdiction might be shared by different countries, and international agreements are necessary. Specifically, and given its relevance as a migration hotspot at regional and even global level, it is necessary to find the best formula to provide protection to the Straits of Gibraltar.
5. **Implementing management plans for the MPAs.** So far a few seabird hotspots have been already designated, and other are already identified and pending the best formula for their designation. Providing actual protection for these sites is mandatory, through the implementation of appropriate management plans. This way, seabirds will receive effective protection at least in their main hotspots. This would also provide protection to other marine organisms within these hotspots (umbrella effect). On the other hand, conservation work developed in these sites could be also a model to implement wider regional conservation measures.
6. **Conservation action beyond the MPAs.** The MPA approach is a promising tool for conservation, but complementary work is necessary to properly address seabird conservation, and ultimately the conservation of the Alboran Sea marine ecosystems. This includes addressing regional regulation of activities, as well as implementing species' action plans that help improving the status of the most threatened seabirds.

7. **Communication and dissemination with stakeholders and the general public.** For any conservation measure to be successful, it is mandatory to properly communicate the conservation problems of the region to the stakeholders and the general public, and to involve them in any conservation action. They must understand that working towards the conservation of the marine environment is equivalent to ensure their future income, particularly for wide implemented practices such as fishing.

8. **Improve cooperation between countries.** As stated above, international cooperation is mandatory to properly address the conservation of the Alboran Sea region, as this is a small basin surrounded by different countries.

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INTRODUCTION

The Mediterranean basin is recognised as a major biodiversity hotspot, with a high degree of endemic species both inland and at sea (CEPF 2010). Regarding the marine ecosystem, the Mediterranean Sea holds 7.5% of the world's marine fauna and 18% of marine flora. This remarkable diversity of species is found in only 0.8 percent of the surface area and 0.3 percent of the volume of the World's oceans (Bianchi & Morri 2000, Hofrichter 2001). The isolation of the basin is reflected in the high degree of endemism, estimated to be roughly 28%. Most of the biodiversity is concentrated in shallow coastal areas, although there are key biodiversity elements associated with deep waters, as well as with offshore pelagic waters (Hofrichter 2001).

Since 2008, the Regional Activity Centre for Specially Protected Areas (RAC-SPA) under the framework of the Mediterranean Action Plan (MAP) of the United Nations Environment Programme (UNEP) has been implementing the "MedOpenSeas" project to identify and establish Marine Protected Areas (MPAs) in the open seas, including the deep seas. The primary objective of this project is to promote the establishment of a representative ecological network of MPAs in the Mediterranean within the framework of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol) on the establishment of Specially Protected Areas of Mediterranean Importance (SPAMIs). The first phase of the project, completed in late 2009, led to the identification of twelve priority conservation areas in the open seas, including the deep seas. These priority areas could become candidates for SPAMI listing and/or be recommended for inclusion in other frameworks, such as Ecologically or Biologically Significant Areas (EBSAs) developed under the Convention on Biological Diversity (CBD). The aim of the project's second phase, completed in early 2012, was to support neighbouring Parties of the above-mentioned priority areas in evaluating and potentially presenting these sites as candidate(s) for inclusion in the SPAMI List, in accordance with the provisions of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean.

The present document corresponds to the third phase, which focuses on the spatial planning and evaluation of three priority areas: Adriatic Sea, Alboran Sea and the Sicily Channel/Tunisian Plateau. In particular the Alboran Sea is addressed here, with regard to the seabird community. Specific aims of the report were settled as follows:

- (1) Assess the population status of the seabird species which frequent the priority area open sea (ecology, behaviour, breeding, diet, IUCN conservation status, international measures of protection, and national measures of protection).
- (2) Illustrate and analyse the distribution of those populations of seabirds which regularly frequent the target priority area (including breeding colonies) and identify critical sites in the open seas (taking into account any temporal and spatial variation).
- (3) Assess the impact of threats affecting the species present, taking into account any interactions with human activities.
- (4) Review and refine the spatial mapping of critical sites proposed for different seabird species in the target priority area, including the work on Important Bird Areas published by RAC/SPA in 2009.

Overview of the Alboran Sea

The Alboran Sea is a transition area between two major oceanic basins, the Atlantic and the Mediterranean (Fig. 1). It is surrounded by three countries, Spain in the northern shore (plus Gibraltar), and Morocco and Algeria in the southern shore, which also holds a handful of Spanish territories. Between both, the only emerged land is the Alboran Island (1,650 ha), which belongs to Spain and lays 56 km north from Cap Tres Forcas. Other than that a few archipelagos and islets lay off the African coast, the most distant being the Habibas Islands, about 10 km off Algeria in the easternmost side of the basin.

The oceanographic dynamics of the Alboran Sea is highly influenced by the exchange of waters between the Mediterranean and the Atlantic, which is constrained by the Straits of Gibraltar (14 km wide) in the west end. The oceanography is also influenced by the topography of the basin, with predominantly narrow continental shelves and a moderately deep seabed, down to 2000 m. Sparse seamounts and submarine ridges, most of them of volcanic origin, complete the picture.



Fig. 1. Alboran basin and adjacent Atlantic (west) and Mediterranean (east) waters. Credit: Provided by the SeaWiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE.

The cooler and less saline Atlantic waters, richer in nutrients, enter through Gibraltar and form two large anticyclonic eddies across the Alboran Sea (Fig. 2). The most stable of these is the eastern eddy, which forms at its distal end the important Almeria-Oran front (Tintoré et al. 1988, Hernández-Almeida et al. 2005). Overall, the Alboran Sea is an area of high biological productivity compared to the adjacent Mediterranean waters. This gives rise to a high biodiversity, which is accentuated by the role of the area at connecting two major oceanic basins. Of particular interest are some of the seamounts, such as the *Seco de los Olivos* and Alboran Island. The region is also very important for cetaceans and sea turtles (Cañadas et al. 2005).

Fisheries are not so relevant in the region, largely due to the narrow continental shelves, although some areas are important for small pelagic fish, such as the Almeria and Malaga bays (Bellido et al. 2008, CopeMed II. 2011), and demersal fish and crustaceans are also locally important.

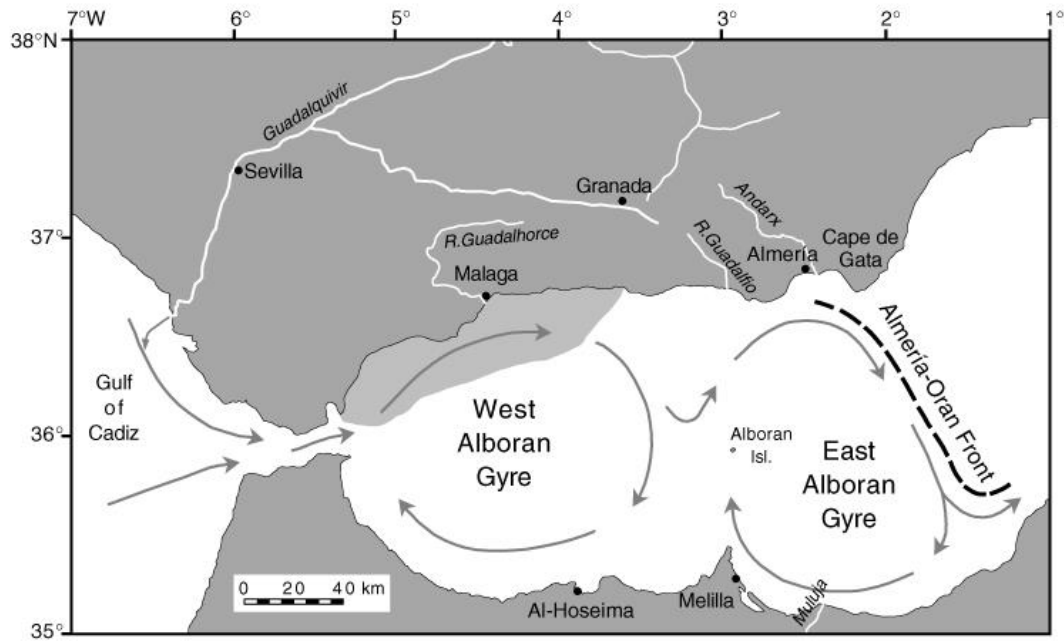


Fig. 2. Outline of the major oceanographic events in the Alboran Sea, highlighting the two anticyclonic eddies formed by the entering Atlantic waters. Source: Hauschildt et al. *Anticyclonic gyres of the Alboran Sea* [map]. In: Alboran Sea (eoeearth.org) at <http://www.eoeearth.org/view/article/149961/>. Date: 27/11/2014

THE ALBORAN SEABIRD COMMUNITY

Seabirds: What species are accounted for?

Seabirds are bird species belonging to a wide diversity of taxonomic groups, which have in common their spending of at least part of the annual cycle in the marine environment. The exact families and species included in the definition of seabirds vary according to different sources, since there is no absolute distinction between birds that are strictly marine and birds that are not. Here, the term seabird is used in a rather restrictive way, since the main aim of the report is to focus on the open ocean, and hence in the species that are best adapted to the marine environment. However, a few groups that include largely coastal species are also considered (terns). Specifically, all Procellariiforms (shearwaters and storm-petrels), Pelcaniforms (gannets, cormorants), Larids (gulls), Sternids (terns) and Alcids (auks) have been considered here as seabirds. On the other hand, The Podicipediformes (grebes) and Gaviiformes (divers) have been disregarded, although some species largely spend the winter at sea, in coastal and shallow waters. This last decision has been taken as these groups are scarcely represented in the region, and the most regular species (crested grebe *Podiceps cristatus*, Black-necked grebe *Podiceps nigricollis* and little grebe *Tachybaptus ruficollis*) mostly occur in wetlands in the region, rather than at sea. The seaducks have also been disregarded although they tend to occur at sea in winter, because they are very scarce in the region. Finally, raptors breeding in coastal areas and using the coastal marine environment to some extent have not been treated here

due to their rather coastal distribution and main link to the land. These species include the osprey *Pandion haliaetus* and the Eleonora's falcon *Falco eleonora*.

Table 1. List of species of seabirds occurring regularly in the Alboran Sea, indicating their occurrence status (abundant, A; common, C, sparse, S), its breeding status (yes/no), and its conservation status according to different lists and agreements .

English name	Scientific name	Occurrence status	Breeding status	SPA/BD	IUCN	EU Birds Directive	SPEC	ETS	Bonn	Bern	AEWA
Scopoli's shearwater	<i>Calonectris d. diomedea</i>	A	N	II	LC	I	SPEC 2	(VU)	-	II	-
Cory's shearwater	<i>Calonectris d. borealis</i>	S	Y	-	LC	I	SPEC 2	(VU)	-	II	-
Balearic shearwater	<i>Puffinus mauretanicus</i>	A	N	II	CR	I	SPEC 1	CR	-	II	-
Yelkouan shearwater	<i>Puffinus yelkouan</i>	S	?	II	VU	I	No-SPEC ³	S	-	II	-
European storm-petrel	<i>Hydrobates pelagicus melitensis</i>	C	?	II	LC	I	No-SPEC ^E	(S)	-	II	-
Northern gannet	<i>Morus bassanus</i>	C	N	-	LC	-	No-SPEC ^E	S	-	III	-
Great cormorant	<i>Phalacrocorax carbo</i>	C	N	-	LC	-	-	S	-	III	-
Mediterranean shag	<i>Phalacrocorax aristotelis desmarestii</i>	S	Y	II	LC	I	No-SPEC ^E	(S)	-	III	-
Pomarine skua	<i>Stercorarius pomarinus</i>	S	N	-	LC	-	No-SPEC	(S)	-	III	-
Arctic skua	<i>Stercorarius parasiticus</i>	S	N	-	LC	-	No-SPEC	(S)	-	III	-
Great skua	<i>Stercorarius skua</i>	C	N	-	LC	-	No-SPEC ^E	S	-	III	-
Mediterranean gull	<i>Larus melanocephalus</i>	A	Y	II	LC	I	No-SPEC ^E	S	II	III	Y
Little gull	<i>Larus minutus</i>	S	N	-	LC	I	SPEC 3	(H)	-	III	-
Black-headed gull	<i>Chroicocephalus ridibundus</i>	A	Y	-	LC	II/2	No-SPEC ^E	(S)	-	III	-
Slender-billed gull	<i>Chroicocephalus genei</i>	C	Y	II	LC	I	SPEC 3	L	II	III	Y
Audouin's gull	<i>Larus audouinii</i>	A	Y	II	LC	I	SPEC 1	L	I,II	III	Y
Lesser black-b. gull	<i>Larus fuscus</i>	A	N	-	LC	II/2	No-SPEC ^E	S	-	-	-
Yellow-legged gull	<i>Larus michahellis</i>	A	Y	-	LC	II/2	No-SPEC ^E	S	-	III	-
Black-legged kittiwake	<i>Rissa tridactyla</i>	S	N	-	LC	-	No-SPEC	(S)	-	III	-

English name	Scientific name	Occurrence status	Breeding status	SPA/BD	IUCN	EU Birds Directive	SPEC	ETS	Bonn	Bern	AEWA
Gull-billed tern	<i>Sterna nilotica</i>	C	Y	II	LC	I	SPEC 3	(VU)	II	III	Y
Sandwich tern	<i>Sterna sandvicensis</i>	C	N	II	LC	I	SPEC 2	H	II	III	Y
Lesser-crested tern	<i>Sterna bengalensis</i>	S	N	II	LC	-	SPEC 3	(S)	II	III	Y
Common tern	<i>Sterna hirundo</i>	C	Y	-	LC	I	No-SPEC	S	II	III	Y
Little tern	<i>Sternula albifrons</i>	C	Y	II	LC	I	SPEC 3	D	II	III	Y
Black tern	<i>Chlidonias niger</i>	C	N	-	LC	I	SPEC 3	(H)	II	III	Y
Razorbill	<i>Alca torda</i>	C	N	-	NT	-	No-SPEC ^E	(S)	-	III	-
Atlantic puffin	<i>Fratercula arctica</i>	C	N	-	VU	-	SPEC 2	(H)	-	III	-

***SPA/BD (Barcelona Convention).** Priority species are listed under Annex II. **EC Birds Directive** (2009/147/EC). Annex I lists those species that require special conservation measures. Annex II and III refer to game and commercialised species, respectively. **IUCN (2015 global assessment)** threat status LC – Least Concern; NT – Near Threatened; VU - Vulnerable; EN – Endangered; CR – Critically Endangered. **SPEC.** European status as defined by BirdLife International. SPEC 1 – European species with global threat status; SPEC 2 - species which concentrates its population in Europe, where conservation status is not favourable; SPEC 3 – species widespread beyond Europe but with unfavourable conservation status there; Non-SPEC^E - species which concentrates its population in Europe, where conservation status is favourable; Non-SPEC: species widespread beyond Europe and with favourable conservation status there. **ETS.** European threat status, defined by BirdLife International following IUCN criteria. NE: not evaluated; S: secure; DD: data deficient; L: localized; H: harvested; R: rare; D: declining; VU: vulnerable; EN: endangered; CR: critically endangered. **Bonn Convention.** Annex I includes those species considered as threatened. Annex II is for those species whose habitats on migration require conservation improvement. **Bern Convention.** Annex II - strictly protected species; Annex III - protected species. **AEWA (Agreement on the Conservation of African-Eurasian Waterbirds).**

Overview of the Alboran Seabird Community

The seabird community of the Alboran Sea is notoriously diverse, due to the influence of both Atlantic and Mediterranean basins. Moreover, the region acts as a migration corridor for any seabird movements between these two major basins, thus representing a huge migration bottleneck for hundreds of thousands of seabirds of several species. About 25 seabird taxa are regular in the region (Table 1), whereas several others occur there on an irregular basis or accidentally.

Breeding populations

Despite the relevance of the region for seabirds, breeding populations are rather small and restricted to a few suitable nesting sites. A few species of gulls and terns breed locally in coastal marshes and wetlands, particularly in Almeria (NE Alboran): slender-billed and black-headed gulls, and common and little terns (Paracuellos & Nevado

2003, Molina et al. 2009, Corbacho et al. 2009). The Mediterranean shag also breeds, very locally, in Cabo de Gata (Almería, in the NE limit of the Alboran Sea) and Gibraltar (W limit). But the most relevant breeding species related with the open sea are Cory's/Scopoli's and Yelkouan shearwaters, and Audouin's gull (Martí & del Moral 2003, Bourgeois et al. 2012). Cory's/Scopoli's shearwater is restricted to the Chafarinas islands, where the population is roughly estimated at 800-1000 breeding pairs, and in decline (Afán et al. 2011), with occurrence of both taxonomic forms. The Yelkouan shearwater has been reported to breed in the Algerian coast, outside the limits of the Alboran Sea (Kalah islet, 8-10 pairs; Ledant et al. 1981, Bourgeois et al. 2012). In both cases, a thorough prospection of suitable places along the relatively low prospected African coast might bring new colonies of these pelagic seabirds, as well as breeding evidences for the European storm-petrel. Cory's shearwater also breeds in Terreros islet (close to the Alboran Sea, in the Spanish Mediterranean coast), and this shearwater plus the European storm-petrel also breed in Terreros and Palomas islets, a bit further north. As for Audouin's gull, the Alboran sea holds two of its most traditional breeding sites, the archipelago (with up to 4300 breeding pairs in 1992, and around 2000 at present) and Alboran island (about 500 breeding pairs). The species was also found breeding in Al Hoceima islet in recent years (Afán et al. 2010).

Regarding the most pelagic species, the Alboran Sea also attracts breeding birds from colonies outside the region, such as Balearic shearwaters (both breeders and non-breeders), Cory's shearwaters (from as far as Columbretes islands), European storm-petrels and Audouin's gulls. On the other hand, some of the Cory's shearwaters breeding in Chafarinas move to the adjacent Atlantic waters to forage (Navarro et al. 2009). Foraging hotspots at this time of the year are concentrated across the borders of the two anticyclonic eddies (Arcos et al. 2009), particularly Malaga and Almería bays (good for Cory's and Balearic shearwaters; the latter also supporting local populations of gulls and terns), the Alborán island – Cape Tres Forcas area (particularly Cory's shearwaters and local Audouin's gulls), the Almeria-Oran front (potentially good for European storm-petrels; Arcos & Pou 1999) and the Algerian shelf (visited by breeding Balearic shearwaters; Ruiz & Martí 2004, Louzao et al. 2011). The latter was also regularly visited by PTT-tracked Audouin's gulls from Menorca during the breeding period, although these birds appeared to have abandoned their nests (Arcos et al. 2009). In their movements between the colonies and all these foraging areas, these seabird species cross the Alboran Sea in any direction, though most often following the anticyclonic eddies in the region (i.e. crossing in the Málaga Bay-Cape Tres Forcas or the Almería-Oran “flyways”).

Non-breeding populations

One of the key roles of the region, as stated above, is as the unique migration corridor between the Atlantic and the Mediterranean. Practically the whole global population of Balearic and Scopoli's shearwaters leave the Mediterranean after breeding (Ruiz & Martí 2004, Arroyo et al. 2011b, Arcos et al. 2012a), as well as about 70% of the Audouin's gull population (Bécares et al. 2013). During their migration, these species tend to spend some time in specific areas of the Alboran Sea, or concentrate their migration flow in some others (see details in the Species account below). Of particular relevance is, obviously, the Strait of Gibraltar, with some differences between both

sides (African – European) (Arroyo et al. 2011a). The African coast concentrates for instance the bulk of the Scopoli's shearwater migration, particularly in autumn, when over 500.000 are estimated from Ceuta (Navarrete 2011). Another priority species for the Mediterranean, the Lesser-crested tern, also migrates through the southern side of the Strait. On the other hand, the bulk of the population of Balearic shearwaters crosses close to the northern side, particularly during the post-breeding migration (Arcos et al. 2012). Movements between the two coasts also occur throughout the region, but are most relevant in the Gibraltar area, as well as following the two anticyclonic eddies (i.e. Malaga Bay-Cape Tres Forcas and Almería-Oran).

As for wintering seabirds, the available information is scarcer, particularly along the African coasts. In the northern side, the Almería Bay and adjacent areas (extending to the Seco de los Olivos in the SW) holds a wintering population of Audouin's gull, and is regularly visited by Balearic shearwaters, sometimes in considerable numbers (several hundreds or up to thousands), while the area is also frequented by wintering species from the Atlantic (northern gannets, great skuas, razorbills, puffins) (Arcos 2005, Arcos et al. 2009). Malaga Bay is also good for Balearic shearwaters and for some of the Atlantic species, but its most relevant visitor is the Mediterranean gull, that can reach up to 15.000 wintering birds, becoming the second most important wintering area in the Mediterranean, equal to that in central Portugal (Arcos 2005, García-Barcelona 2009, Cama et al. 2011). The African coast represents a wintering area of relevance for Audouin's gull, and also appears to be important for the Balearic shearwater (particularly the area around Cape Tres Forcas and the Algerian coast).

Monitoring Programmes, Information Sources and Gaps

Information regarding seabirds in the Alboran Sea is patchy and requires of further research, particularly on the African side. The following is a summary of the most relevant work conducted in the area, according to the type of information.

Breeding colonies

The location of seabird breeding colonies is reasonably well known in the Spanish territory of the Alboran Sea. These colonies are mainly located in the Chafarinas and Alboran Islands, as well as coastal areas of Almería (particularly wetlands) (De Juana et al. 1984, Paracuellos & Nevado 2003, Bertolero et al. 2009, Corbacho et al. 2009, Afán et al. 2011, Arcos et al. 2012b). In the Moroccan and Algerian coasts information is more limited, and includes the recent finding of an important Audouin's gull colony in Al Hoceima islet (Afán et al. 2010) and the location of a few Yelkouan shearwaters in Kalah islet, in Algeria (Ledant et al. 1981, Bourgeois et al. 2012).

Gulls and terns colonies, more conspicuous, are likely well known in the whole region. However, Procellariiforms (shearwaters and storm-petrels) are more difficult to survey, due to their nocturnal behaviour at attending the colonies and their preference for remote areas of difficult access (sea cliffs, islets), and the current picture could be biased. For this group, the unique data is restricted to the Chafarinas Islands (where several hundreds Cory's/Scopoli's shearwaters breed) and the aforementioned presence of Yelkouan shearwater at Kalah islet. It is unlikely that other colonies of shearwaters or storm-petrels would be discovered in the Spanish coasts, due to lack of

suitable breeding places. However, specific work has been limited in the African coast, and a thorough prospection of suitable places might bring new colonies of these species.

As for long-term monitoring, regular surveys have been conducted for the Audouin's gull in Chafarinas and Alborán islands (Bertolero et al. 2009), as well as for other gulls and terns in the Almería wetlands (Paracuellos & Nevado 2003). Monitoring of the Cory's/Scopoli's shearwater in Chafarinas has also been conducted for several years, in this case restricted to the follow-up of (accessible) control nests rather than a whole census of the colony (Afán et al. 2011). Keeping these monitoring programmes (promoted so far by local administrations and/or independent research groups) and extending them to other colonies is essential to assess seabird population trends in the region and properly address conservation action.

Coastal monitoring of seabird movements

Given the relevance of the Alboran Sea as a migration corridor between the Atlantic and the Mediterranean, coastal monitoring programmes could be of relevance to assess migration flows. Of particular interest is the Strait of Gibraltar, where regular monitoring has been implemented in the northern side of the Strait in the last few years under the framework of Migres Project (Arroyo et al. 2011a), following older work (Tellería 1981, Finlayson & Cortés 1987). Similarly, a monitoring scheme has been intermittently working in Ceuta (African coast of the Strait) in recent years (Navarrete 2011). These studies have been of relevance to establish global counts for some seabird species, such as the Balearic shearwater (Arroyo et al. 2011b, Arcos et al. 2012a) and Scopoli's shearwater (Navarrete 2011). It is worth mentioning the work by Paracuellos and Jerez (2003), which compared seabird movements from opposite sides of the Alboran Sea away from the Strait of Gibraltar, in Melilla and Almería, in 1997-1998 (weekly counts). More recently a network of coastal counts (RAM) has been established in Spain, although survey effort is limited (3 hours per month) (Valeiras et al. 2011).

At sea monitoring – boat based seabird surveys

Seabirds have received relatively little attention in the Alboran Sea region, particularly regarding the study of their distribution patterns at sea. The most extensive coverage of the region regarding marine top predators has been probably conducted by Alnitak, an organization that has conducted several surveys since 1990. However, seabirds have been only marginal to a research work focused on cetaceans and sea turtles (Cañadas et al. 2005, Hyrenbach et al. 2008), and little information is available for the target group of this report. On the other hand, a handful of seabird surveys have been conducted in the last few years in the Spanish side, providing the most relevant information for the region. Of particular interest for the length of the series is the MEDITS fishing trawl research cruise organized by the Spanish Institute of Oceanography (IEO), where seabird data has been collected both as point-counts during trawling operations (since 1994; Abelló et al. 2003) and using specific transect surveys (since 1999; Arcos & Oro 2002, Louzao et al. 2006b, Arcos et al. 2012c). Seabird surveys taking profit of the MEDITS cruise extended later to other

oceanographic cruises (Arcos & Pou 1999, Arcos 2005), and were consolidated with occasion of a LIFE Project conducted by SEO/BirdLife to identify the marine Important Bird Areas in Spain (2004-2009; Arcos et al. 2009), and LIFE+ INDEMARES (2009-2014) afterwards. These latter projects included modelling seabird distribution patterns and allowed to get a wider view of the Alboran Sea region. Finally, in 2007 the Government of Andalusia launched a monitoring program for seabirds and cetaceans, consisting of regular pre-established transects covering the coastal waters of the northern coast of the region (Fernández -Casado et al. 2011).

At sea monitoring – seabird tracking

Seabird tracking work has been conducted in recent years in the region, providing new insights on the distribution patterns and behaviour of seabirds at sea. Studies include:

Satellite (PTT) Tracking of Cory's/Scopoli's shearwaters was carried out in Chafarinas in 2007 under the frame of LIFE project on marine IBAs carried out by SEO/BirdLife (2004-2009; Arcos et al. 2009). This action allowed understanding the foraging patterns of these two related taxa, which clearly differed at sea (Navarro et al. 2009).

GPS Tracking of Cory's/Scopoli's shearwater was carried out in Chafarinas in 2011, under the frame of LIFE+ INDEMARES (2009-2013) and Interreg FAME, conducted by SEO/BirdLife in collaboration with the Estación Biológica de Doñana (EBD-CSIC) (Afán et al. 2014).

PTT tracking of breeding Balearic shearwaters was conducted in the Balearic Islands within the frame of a LIFE Project for the conservation of this species (Balearic Government and SEO/BirdLife; 1998-2001) and Interreg Project FAME (LPO, CEBC-CNRS & SEO/BirdLife, 2010-2012). Results showed in both cases that breeding birds from the Balearic Islands do use the waters off the Algerian coast regularly as foraging grounds, an issue that deserves further attention (Ruiz & Martí 2004, Louzao et al. 2012).

Geolocators (GLS) tracking of Balearic shearwaters has been conducted by two independent initiatives in 2010-2014, revealing the detailed movements of the species outside the breeding range, which include the Alboran Sea area as migration corridor (Guilford et al. 2012).

GPS tracking of breeding Balearic shearwaters was conducted in Ibiza (Balearic Islands) by SEO/BirdLife within the frame of LIFE+ INDEMARES, and also supported by the Ibiza Preservation Fund. Results confirmed the occurrence of breeding birds off Algeria and Morocco, although inter-annual variability was important.

PTT tracking of Audouin's Gulls was conducted in 2006 and 2007 in 4 different colonies of Spain, including Alboran Island, under LIFE Project to identify marine IBAs in Spain (Arcos et al. 2009). About 70% of the birds moved across the Alboran Sea to winter in the NW African coasts in the Atlantic. The remaining birds mostly remained in the Alboran Sea area, particularly around coastal wetlands of Almeria and Algeria (SEO/BirdLife 2012). The tracking also revealed movements along the Alboran African coast during the breeding season.

At sea monitoring – assessment of threats

Information at sea regarding the evaluation of threats, particularly of seabird bycatch in fishing gear, is very limited in the Alboran Sea. The Spanish Institute of Oceanography keeps an observers programme to monitor bycatch in the pelagic longline fishery, including seabird data since 1997 (systematized since 2008; Garcia Barcelona et al. 2010a,b). In the near future it would be necessary to extend this initiative to all fisheries observer programs, also incorporating Morocco and Algeria.

Threats to Seabirds

Overview

Seabirds are among the most threatened bird groups in the world (Croxall et al. 2012), and their conservation requires urgent and well-coordinated action (Lewison et al. 2012). This vulnerability is partly due to the fact that seabirds commute between two totally different environments, the sea and the land (breeding colonies), each with its inherent threats (Boersma et al. 2002). Furthermore, they are highly mobile organisms that can travel across most of the planet during their life cycle, and therefore face different threats in different regions. To complete the picture, seabirds' life history is characterized by high adult survival (usually around 90% annual survival in many species) and low reproductive success. Hence, their populations are very sensitive to any factors increasing adult mortality, as the population cannot compensate this “extra” loss of individuals by increasing its productivity (Croxall & Rothery 1991, Weimerskirch 2002).

Overall there is some consensus on major threats affecting seabirds (Boersma et al., 2002, Croxall et al. 2012). Inland, the most relevant are the pressure posed by invasive species (particularly predation by introduced mammals), habitat lost or degradation (due to coastal development), human disturbance, poaching and environmental change. At sea, the interaction with fisheries (especially bycatch), pollution, the proliferation of infrastructures and environmental change complete the list.

The relative importance of these threats may vary between regions and species, according to their geographical and ecological characteristics, and with the weight of the various human activities that take place in them. In the case of Alboran Sea, it is important to keep in mind that the local seabird community is diverse but partly composed by species that count with relatively small populations (due to the low productivity of the Mediterranean region), thus being of particular conservation concern (De Juana 1984, Zotier et al. 1999, Mínguez et al. 2003, Madroño et al. 2004, Arcos et al. 2009). Taking this into account, as well as the most relevant human activities in the area (MARM, 2008), the most relevant threats in the region appear to be as follows.

Threats Inland (Colonies)

Predation by invasive species

Predation by rats has been described in the Chafarinas archipelago as a factor negatively influencing the breeding performance of Cory's shearwaters (Igal et al.

2005, 2007, 2009), whereas the effect on gulls seems marginal (Prieto et al. 2003). Moreover, smaller Procellariiforms such as the European storm-petrel and the Yelkouan shearwater could be prevented of breeding there due to the presence of rats, and the same is likely in other potentially suitable areas along the African coastline.

Coastal development

The increasing humanisation of the coastline, including urban development, infrastructures, light pollution and disturbance, poses a threat to seabirds, particularly on their breeding grounds. This likely affects both coasts of the Alboran Sea, and is particularly relevant for gulls and terns breeding in wetlands, as these habitats have been severely affected by human activities.

Threats at Sea

Fisheries bycatch

Seabird bycatch in fishing gear is one of the most serious threats to many seabird species, including some of the most common seabirds in the Alboran Sea (e.g. Cory's and Balearic shearwaters). However, the available evidence is very limited for the region (Arcos et al. 2012b). Only pelagic longlines have been monitored to some degree (García-Barcelona et al. 2010a,b), reporting very low bycatch rates in the region. On the other hand, reports from beached bird surveys suggest that demersal longlines, nets and pole lines could have some impacts on seabirds (García-Barcelona et al. 2010c). Further research is necessary to properly assess the incidence of bycatch in the Alboran Sea, as high levels have been described in neighbouring areas of the Mediterranean Sea.

Fishing overexploitation

The Alboran Sea holds an important fishery for small-pelagic fish species, mainly sardine and anchovy, which has undergone severe fluctuations and is likely overexploited (Copemed II. 2011). Since these are the main natural prey for most seabird species, keeping severe exploitation without proper assessment and management could cause impact on the seabird populations, both breeders and non-breeders (e.g. Louzao et al. 2006a, Cury et al. 2011).

Pollution

Both background and acute-events pollution pose a serious threat to seabirds worldwide, and the Alboran Sea is no exception. Of particular relevance is the risk of acute events of pollution such as oil spills, since the Alboran Sea holds one of the busiest maritime routes of the world (Sánchez de Vivero 2013), thus raising the likelihood of accidents and other impacts on marine biodiversity (Abdulla & Linden 2008). Background pollution includes potential impacts from plastic ingestion (Arcos et al. 2012b).

Marine infrastructures

Development of infrastructures at sea could pose a risk to seabirds. Within the context of the Alboran Sea, windfarms pose a particular threat given the relevance of the region for migrating seabirds (i.e. intense flow of seabirds prone to colliding with these infrastructures). So far the area includes a few proposals of wind-farm development, all of them in the Straits of Gibraltar area (Sánchez de Vivero 2013), where the risk to seabirds would be highest.

Table 2. Overview of potential threats to the most relevant seabird species in the Alboran Sea (from a conservation perspective: those listed in the SPA/BD -Barcelona Convention- and/or included in Annex I of EU Birds Directive). Red: high impact; orange: moderate impact; green: low impact; na: not applicable.

English name	Scientific name	Threats inland Threats at sea								
		Predation by introduced mammals	Coastal development	Human disturbance	Poaching	Fisheries bycatch	Prey depletion	Pollution	Infrastructures	Environmental change
Scopoli's shearwater	<i>Calonectris (d.) diomedea</i>									
Cory's shearwater	<i>Calonectris (d.) borealis</i>									
Balearic shearwater	<i>Puffinus mauretanicus</i>	na	na	na	na					
Yelkouan shearwater	<i>Puffinus yelkouan</i>	?								
European storm-petrel	<i>Hydrobates pelagicus</i>	?								
Mediterranean shag	<i>Phalacrocorax a. desmarestii</i>				?					
Mediterranean gull	<i>Larus melanocephalus</i>	?								
Slender-billed gull	<i>Larus genei</i>	?								
Audouin's gull	<i>Larus audouinii</i>									
Sandwich tern	<i>Sterna sandvicensis</i>	na			na					
Lesser-crested tern	<i>Sterna bengalensis</i>	na			na					
Common tern	<i>Sterna hirundo</i>	?								
Little tern	<i>Sterna albifrons</i>	?								

Species' Account

Information on the most relevant breeding seabird species in the Alboran Sea (or nearby areas), from a conservation point of view, is provided here with some more detail. The most coastal species have been excluded, thus focusing on the open seas.

Scopoli's/ Cory's shearwater (Calonectris diomedea/borealis)

Cory's shearwater (*Calonectris diomedea* spp.) has been recently split into two different species, Scopoli's (*Calonectris diomedea*) in the Mediterranean and Cory's shearwater (*Calonectris borealis*) in the Atlantic. Scopoli's shearwater is the most common of these two sister species in the Alboran Sea, although a few Cory's shearwaters also breed in the region (Navarro et al. 2009, Afán et al. 2014). Breeding of both forms is restricted to the Chafarinas Islands according to available information, where about 800-1000 breeding pairs are estimated (Martí & del Moral 2003, Afán et al. 2011). Other areas of the African coast could be also suitable for breeding, but no positive data have been reported on this regard. According to monitoring data from Chafarinas, the species is declining in the region (Iguar et al. 2009).

At sea, the species is common throughout the region, particularly during migration peaks. This is particularly so during the post-breeding migration, from mid October to mid November, when an estimated number of more than 500,000 birds leave the Mediterranean, largely following the southern coast of the Alboran Sea (Navarrete et al. 2011).

Balearic shearwater (Puffinus mauretanicus)

The critically endangered Balearic shearwater is restricted as a breeder to the Balearic archipelago, in the western Mediterranean. Virtually the whole population of this species moves to the Atlantic waters off SW Europe after breeding (Le Mao & Yésou 1993, Ruiz & Martí 2004, Arcos 2011, Guiford et al. 2012). Balearic shearwaters are therefore common in the region, particularly when leaving the Mediterranean (May-July) and on their return (September-November), also extending their stay in the area during the first months of winter (Arcos et al. 2009, Arroyo et al. 2011b, Arcos et al. 2012a). Key hotspots in the region include the Straits of Gibraltar (which concentrates the migration flow), Malaga Bay (an important stopover area during migration) and Almería Bay (which represents an important foraging area most of the year, including the late breeding period). The North African coast has received less attention, but important concentrations have been reported in the central coast of Morocco (around Cape Tres Forcas) in winter. Moreover, remote tracking suggests that breeding birds often forage in Algerian waters, and even off the Moroccan coast (Louzao et al. 2012).

Yelkouan shearwater (Puffinus yelkouan)

This shearwater has been not confirmed as a breeder in the Alboran Sea region, although a few (8-10) pairs have been reported in the nearby Kalah islet, in the eastern Algerian coast, and larger colonies are known off Tunisia (Ledant et al. 1981, Bourgeois et al. 2012, Derhé 2012). Further prospection of suitable places along the

relatively low studied African coast might bring new colonies within the Alboran Sea region in the future, but for now the species must be considered as a scarce visitor.

At sea, large summer concentrations of Yelkouan shearwaters used to be reported in the western Alboran Sea until the early 1980s, particularly near the Straits of Gibraltar (Tellería 1981, De Juana & Paterson 1986, Bourgeois & Vidal 2008), but these gatherings have disappeared in recent decades, and the species has become very scarce in the whole Alboran Sea. According to GLS tracking of birds from the French colonies, birds from these populations could visit the Algerian and eastern Moroccan coast during the summer, though there is considerable uncertainty associated to this type of information (Péron et al. 2013). Further research is necessary to clarify the status of the species in the region, particularly given its conservation status (classified as Vulnerable) and its distribution range restricted to the Mediterranean and the Black Sea (Del Hoyo et al. 2014). Particular interest deserves elucidating why the post-breeding concentrations reported over 30 years ago have disappeared.

European storm-petrel (Hydrobates pelagicus)

The European storm-petrel is a regular, though scarce visitor to the Alboran Sea. Breeding has not been confirmed in the region, though potential breeding sites have been relatively little surveyed. The closest known colonies at present are located off the Iberian Mediterranean coast, namely Terreros and Palomas islets (Martí & Del Moral 2003). The species is regular at sea, however, being particularly common in the Bay of Almeria and along the Almeria-Orán front (Arcos & Pou 1999, García-Muñoz 2008, Arcos et al. 2009). The movements of the Mediterranean population outside the breeding period are little understood, and it is unclear if the species leaves the Mediterranean in winter. This does not appear to be the case (Bourne 1993, Hashmi & Fliege 1994, SEO/BirdLife 2012), but otherwise the Alboran Sea would play a more relevant role than previously thought, as the unique marine route communicating the Mediterranean with the Atlantic.

Mediterranean gull (Larus melanocephalus)

The Alboran Sea represents one of the most important wintering grounds for this gull species (Arcos 2005, García-Barcelona 2009, Cama et al. 2011). The wintering population is concentrated in the area of Malaga Bay and the surrounding offshore waters (Arcos et al. 2009), though the species seems to also occur regularly off the Moroccan coast (Paracuellos & Jerez 2003). The species requires attention from a conservation point of view, since recent estimates suggest a global population size far lower than previously expected (Cama et al. 2011). Its pelagic habits in winter, on the other hand, reinforce this need of attention when addressing the conservation of the open seas.

Audouin's gull (Larus audouinii)

The Alboran sea holds two historical breeding sites of this seabird species endemic to the Mediterranean: the Chafarinas archipelago (formerly the largest colony in the World, with up to 4300 breeding pairs in 1992, and around 2000 at present) and

Alboran island (about 500 breeding pairs) (Bertolero et al. 2009). The species was also found breeding in Al Hoceima islet in recent years, with 800 breeding pairs (Afán et al. 2010). Audouin's gull presents semi-pelagic habits, and therefore make extensive use of the open sea, particularly around Alboran Island. However most of the foraging activity of the species occurs in continental shelf waters. In addition to the waters surrounding the breeding sites, the Almeria Bay is also a relevant foraging area for migrating birds. The Straits of Gibraltar plays a major role as a flyway between the Alboran/Mediterranean breeding grounds and the wintering grounds of a large proportion of the species, along the NW (Atlantic) African coast (Oro & Martínez-Vilalta 1994, SEO/BirdLife 2012).

PRIORISATION OF AREAS

The prioritization of marine protected areas for seabirds in the Alboran Sea should take into account which the main values of the region for this group of birds are. As described in this document, these include breeding sites (wetlands and islands), migration hotspots and foraging areas for breeding, migrating and wintering birds. These values point to different key areas to be protected:

Breeding sites

Seabird breeding sites within the region are somewhat the areas that have received most attention from a protection point of view. Among the wetlands, the Almería wetlands in Spain and Sebkh Bou Areg in Morocco are likely the most relevant. The islands in the region include the Alboran and Chafarinas islands, Al Hoceima and Habibas Islands (plus Kalah islet, beyond the limits of the Alboran Sea region). For all these sites, it is important to provide protection not only to the breeding colonies but also to their marine surrounding waters. The marine extension of these colonies should be determined taking into account the foraging ecology and behavior of the breeding species.

Migration hotspots

The whole of the Alboran Sea is a major migration hotspot funnelling the flow of seabirds between the Atlantic and the Mediterranean. However, the true bottleneck is posed by the Strait of Gibraltar, where the passage between these two basins is narrowed to 14 km. This is the area deserving most protection in the region regarding migratory movements.

Foraging areas

For some species, such as terns, protecting the surrounding of their colonies ensures the protection of the main foraging grounds during the breeding period, since their foraging ranges are rather small. However, other species, like the shearwaters, can travel hundreds of km between their breeding and foraging sites, and foraging areas

have to be addressed independently. Moreover, some of these areas are also relevant for migratory and wintering birds.

Within the Alboran Sea basin, obvious foraging areas are those with relatively shallow and wide continental shelf, which in turn tend to coincide with the richest margins of the two anticyclonic eddies in the region. In the northern coast, Malaga Bay (inner eddy) and Almería Bay (outer eddy) are the most relevant foraging areas, including pelagic seabirds such as shearwaters and storm petrels. In the southern coast, the continental shelf at both sides of Cape Tres Forcas (inner eddy) and the Habibas area (outer eddy) appear to be the most relevant foraging grounds. In the centre of the basin seabird densities are rather low, but higher numbers occur again in the margin of the eddies, both the inner (that coincides with Alboran Island) and the outer eddy (Almería-Oran front, likely the most relevant for pelagic species such as the European storm-petrel).

Conservation Measures

This section presents an overview of undergoing conservation measures in the Alboran Sea region that provide protection to the seabird community of the region, either at international, regional or national level.

International and Regional Agreements

The seabird community in the Alboran Sea already benefits from several international agreements that prioritise the protection of particular species, as listed in Table 1.

Of these agreements, the most relevant is the Barcelona Convention, also named as Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (UNEP-MAP). The convention includes a list of priority species for conservation (Table 1), and also promotes the identification of Marine Protected Areas under the Regional Activity Centre for Specially Protected Areas (RAC/SPA), which endorses the present work. At present five Specially Protected Areas of Mediterranean Importance (SPAMI) have been identified in the Alboran Sea region: *Al Hoceima National Park* in Morocco, *Habibas Islands* in Algeria, and *Alboran Island, Maro-Cerro Gordo Cliffs* and *Natural Park of Cabo de Gata-Níjar* in Spain. A further two sites lay very close to the region, the *Banc des Kabyles Marine Reserve in Algeria* and the *Sea Bottom of the Levante of Almería* in Spain.

The Convention on Biological Diversity (CBD) also promotes the protection of relevant sites across the world, including the marine environment. A commitment has been established to protect at least 10% of the seas by 2020. A specific figure of protection has been created within the CBD, the Ecologically or Biologically Significant Marine Areas (EBSAs). The results of the present work are intended to contribute to the proposal of EBSAs in the Alboran Sea (as well as new SPAMIs).

Also relevant from a protection site perspective in the case of seabirds is the BirdLife International Important Bird Areas (IBA) Programme, which seeks the identification of priority sites for bird conservation across the world. Work in recent years has addressed the marine environment, with the launch of an e-Atlas of marine IBAs in 2012 (<http://maps.birdlife.org/marineIBAs/default.html>).

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), or Bonn Convention, aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme (UNEP), concerned with the conservation of wildlife and habitats on a global scale. The CMS lists species threatened with extinction (Appendix I) and other species whose conservation would benefit from international cooperation (Annex II) (Table 1). Several Agreements have been concluded under the auspices of CMS. Among them, the Agreement for the Conservation of Albatrosses and Petrels (ACAP) lists among its priority species the Critically Endangered Balearic shearwater. Also relevant to the seabirds in the Alboran Sea is the The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

Finally, the Ramsar Convention (or Convention on Wetlands of International Importance), is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Although this convention does not directly address the marine environment, it covers the breeding grounds of some relevant seabird species in the Alboran Sea (gulls and terns).

At the European level, environmental legislation also promotes the creation of protected areas, specifically the Natura 2000 network. This network includes two types of figures: Sites of Community Importance (SCIs) under the Habitats Directive (92/43/EC), and Special Protection Areas (SPAs) under the Birds Directive (2009/147/EC). The aim of Natura 2000 is to preserve the natural values triggering the designation of these sites while keeping human activities in a sustainable way. The Birds Directive also envisions special measures of conservation for those bird species included in its Annex I (see Table 1). Within the Alboran Sea, these directives are only applicable to the Spanish side, and are further commented below (conservation measures at national level). Also at the European level, the Marine Strategy Framework Directive (2008/56/EC) also encourages the protection of seabirds and other marine biota to attain a “good environmental status”.

Also at European level, three of the seabird species present in the region have conservation action plans: the Balearic shearwater *Puffinus mauretanicus* (updated in 2011), the Mediterranean shag *Phalacrocorax aristotelis desmarestii* (1999) and Audouin’s gull *Larus audouinii* (1996).

National Conservation Measures

Spain

All relevant breeding sites in the Alboran Sea region in Spain are protected under different figures, often overlapping. However, far less attention has received the marine environment. Until very recently, there was only one marine SPA in the whole region, namely *Cabo de Gata-Níjar* (ES0000046), which includes a 2.5 km wide fringe of coastal waters. The area is also protected as a Natural Park and has been listed as SPAMI. In July 2014, a major extension of that SPA (Bahía de Almería) and two new SPAs (*Bahía de Málaga-Cerro Gordo* and *Entorno marino de la Isla de Alborán*) were

designated by the Spanish Government. These sites sum up over 2,500 km² of marine protected areas. The proposal is based on the inventory of marine IBAs elaborated by SEO/BirdLife in 2004-2009 (Arcos et al. 2009). However, two sites have been disregarded so far: the Strait of Gibraltar and the surroundings of the Chafarinas Islands. Beyond the designation of these sites, management plans are necessary to ensure their protection. In this regard, the new Spanish designation includes the commitment to develop and approve management plans for the marine SPAs within 2 years after designation.

Morocco

Some of the wetlands holding breeding seabird colonies have been designated as Ramsar sites. However, no marine protected areas have been proposed, with the exception of the *Al Hoceima* SPAMI (about 20 km² of marine area), also designated as National Park. The marine IBAs identified by SEO/BirdLife in Gibraltar and Chafarinas include Moroccan waters, and deserve protection. The Spanish inventory of marine IBAs also proposed sites of importance in Moroccan waters based on tracking data of Cory's/Scopoli's shearwaters and Audouin's gulls, one east of Cape Tres Forcas to Chafarinas (off Sebkh Bou Areg area, a very important wintering site for gulls and terns) and another between Al Hoceima and Cape Tres Forcas.

Algeria

Algeria holds several Ramsar sites and one SPAMI within the region (Habibas Islands, about 27 km²), the latter being a Marine Nature Reserve. Little information is available for the marine environment, but recent tracking work suggest that the Algerian shelf is of relevance as a foraging ground for at least the Critically Endangered Balearic shearwater (Louzao et al. 2012).

Overview of the Ongoing Work on MPAs

The Spanish Government has recently designated 39 marine Special Protection Areas (SPAs), which include 3 coastal-offshore areas within the Alboran Sea region (MAGRAMA, July 2014; see Fig. 3). The proposal was based on the inventory of marine Important Bird Areas (IBAs) elaborated by SEO/BirdLife (Arcos et al. 2009). Other two marine IBAs, which encompass Spanish and Moroccan waters (Fig. 3), were not included in this designation but deserve future attention, particularly the Strait of Gibraltar. Fig. 3 also shows two areas identified by SEO/BirdLife in Moroccan waters based on tracking data. These areas deserve further attention by conducting boat-based surveys that will allow a wider picture for the whole seabird community, maybe redefining limits. Beyond all these sites depicted in Fig. 3, the true open seas in the Alboran Sea have received less attention, and might require further research to assess if potential MPAs are required. This could be particularly relevant for the Almería-Oran front.

The main values for the three SPAs designated by Spain are the following:

- 1) **Almería Bay.** This is a relatively productive area within the Alboran Sea context, holding important populations of small pelagic fish. The area is good as extension to colonies of breeding gulls (particularly slender-billed gull, 225 breeding pairs) and terns (common and little terns). Audouin's gull also concentrates in the coastal wetlands outside the breeding season, and make extensive use of the marine environment. Finally, the marine area is a typical foraging ground for the Balearic shearwater, with hundreds of birds regularly in autumn and winter (up to over 2000 birds).
- 2) **Malaga Bay – Cerro Gordo.** This is the other area with relatively wide continental shelf in the northern coast of the Alboran Sea, and with relatively high productivity, also holding important populations of small pelagic fish. Balearic shearwaters gather there in their migration routes, often hundreds, as well as several other seabird species. However, the most relevant species is the Mediterranean gull, which finds here its second largest wintering area in the Mediterranean, with up to over 20,000 birds in late winter.
- 3) **Alboran Island marine area.** The area is proposed mainly as an extension to the breeding colony of Audouin's gull, one of the historical strongholds of the species, with over 500 breeding pairs at present.

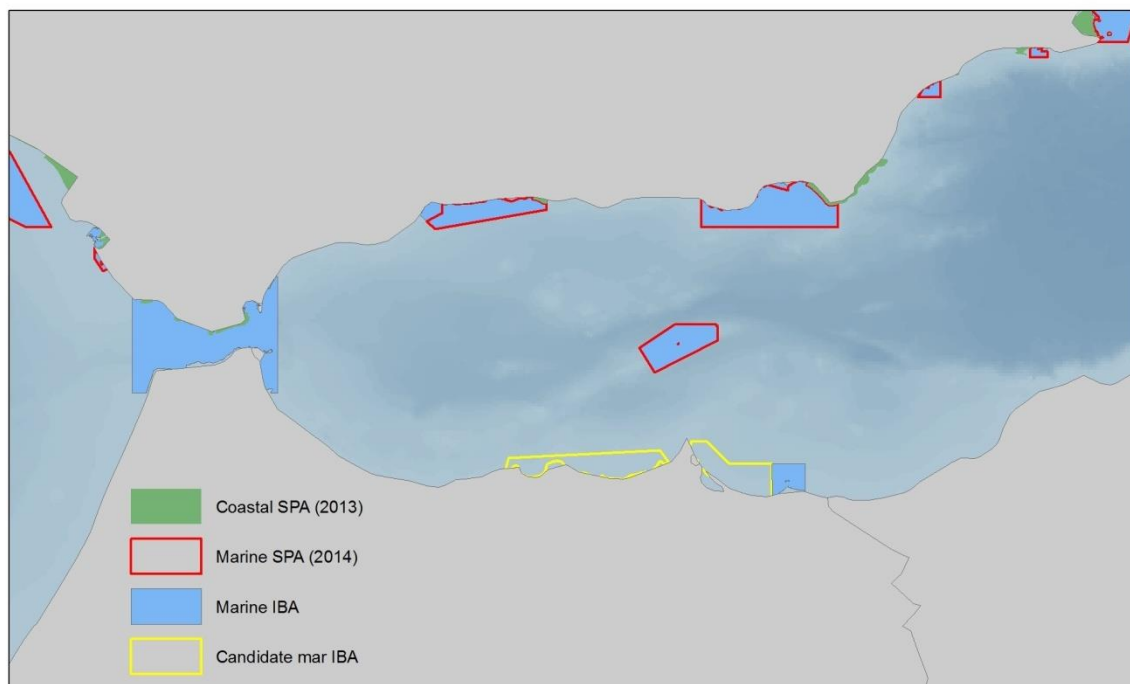


Fig. 3. Spanish recent proposal of SPAs in the Alboran Sea region (red lines), as well as marine IBAs identified by SEO/BirdLife and potential IBAs also proposed by SEO/BirdLife in 2009 (yellow lines).

CONCLUSIONS

The Alboran Sea represents a transition area between two major oceanic basins, the Atlantic and the Mediterranean, which deserves particular attention for its high biodiversity and relatively high productivity. The open seas have received particularly little attention, and an MPA approach is mandatory, to be combined with other conservation tools.

Seabirds are not exception, and the local seabird community is notoriously diverse, influenced by both the Atlantic and the Mediterranean basins. About 25 seabird taxa are regular in the region, whereas several others occur there on an irregular basis or accidentally. Despite the relevance of the region for seabirds, breeding populations are rather small and restricted to a few suitable nesting sites, although some potential areas remain poorly prospected and deserve future attention. Regarding the most pelagic species, the Alboran Sea also attracts breeding birds from colonies outside the region, particularly shearwaters. One of the key roles of the region is as the unique migration corridor between the Atlantic and the Mediterranean. Hundreds of thousands of seabirds of several species cross the area regularly to migrate between these two basins.

Information regarding seabirds in the Alboran Sea is patchy and requires of further research, particularly on the African side. This includes information on seabird breeding populations, as well as on distribution patterns at sea. But it is also necessary to improve the knowledge on human activities and their potential impact on seabirds. Information (and conservation action) regarding predation by introduced mammals in the colonies, and fisheries bycatch at sea, deserve particular attention.

The prioritization of marine protected areas for seabirds in the Alboran Sea should take into account which the main values of the region for this group of birds are. As described in this document, these include breeding sites (wetlands and islands), migration hotspots and foraging areas for breeding, migrating and wintering birds. These values point to different key areas to be protected. Current conservation action at international, regional and national level is already addressing these needs.

Regional Priorities

The following actions should be considered as priority to improve the knowledge on seabirds and to address their conservation in the Alboran Sea:

1. **Monitoring of seabird colonies.** There are relatively few known seabird colonies in the Alboran Sea, but there is potential for new sites, particularly along the African coast. Assessing breeding seabird numbers is mandatory, which includes sound counts of the known colonies (to be maintained on a regular basis), as well as surveying for potential new colonies. A few colonies of reference should be taken for a more detailed monitoring, which allowed to

assess demographic parameters and hence assess population trends. Shearwaters and the European storm-petrel deserve particular attention.

2. **Monitoring at sea distribution.** Information on spatiotemporal distribution patterns at sea is key to understand the role of seabirds in the alboran Sea, assess potential threats and address their conservation. A combination of boat-based surveys and remote tracking is recommended to optimise results. The African coast deserves particular attention, as well as the most pelagic regions of the Alboran Sea, as fewer studies have been conducted there.
3. **Assessment of threats.** Efforts to properly assess the main threats that seabirds face in the Alboran Sea are necessary to ultimately improve their conservation status. Particular attention deserve the monitoring of predation at colonies and of fisheries bycatch at sea (observer's programmes, questionnaires). Small artisanal vessels, particularly longliners, should receive particular attention regarding bycatch, as they can have a major impact on the shearwaters.
4. **Identification, designation of Marine Protected Areas (MPAs).** The most relevant marine hotspots for seabirds have been already been identified, although further work is necessary to complete the current picture. A combination of further work to identify new hotspots (related to point 2) and policy work to designate the known ones is necessary. Particular attention deserve the open seas, where jurisdiction might be shared by different countries, and international agreements are necessary. Specifically, and given its relevance as a migration hotspot at regional and even global level, it is necessary to find the best formula to provide protection to the Straits of Gibraltar.
5. **Implementing management plans for the MPAs.** So far a few seabird hotspots have been already designated, and other are already identified and pending the best formula for their designation. Providing actual protection for these sites is mandatory, through the implementation of appropriate management plans. This way, seabirds will receive effective protection at least in their main hotspots. This would also provide protection to other marine organisms within these hotspots (umbrella effect). On the other hand, conservation work developed in these sites could be also a model to implement wider regional conservation measures.
6. **Conservation action beyond the MPAs.** The MPA approach is a promising tool for conservation, but complementary work is necessary to properly address seabird conservation, and ultimately the conservation of the Alboran Sea marine ecosystems. This includes addressing regional regulation of activities, as well as implementing species' action plans that help improving the status of the most threatened seabirds.

7. **Communication and dissemination with stakeholders and the general public.** For any conservation measure to be successful, it is mandatory to properly communicate the conservation problems of the region to the stakeholders and the general public, and to involve them in any conservation action. They must understand that working towards the conservation of the marine environment is equivalent to ensure their future income, particularly for wide implemented practices such as fishing.

8. **Improve cooperation between countries.** As stated above, international cooperation is mandatory to properly address the conservation of the Alboran Sea region, as this is a small basin surrounded by different countries.

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