

RESEARCH ARTICLE

On sightings of (vagrant?) monk seals, *Monachus monachus*, in the Mediterranean Basin and their importance for the conservation of the species

Luigi Bundone¹  | Aliko Panou^{1,2}  | Emanuela Molinaroli³ 

¹ Archipelagos—Ambiente e Sviluppo Italia, Venice, Italy

² Archipelagos—Environment and Development, Athens, Greece

³ Dipartimento di Scienze Ambientali Informatica e Statistica, Università Ca' Foscari, Venice, Italy

Correspondence

Luigi Bundone, Archipelagos—Ambiente e Sviluppo, Italia, Calle Asiago 4, Sant'Elena, 30132, Venice, Italy.
Email: luigibundone@tiscali.it

Abstract

1. In ancient times, the distribution range of the Mediterranean monk seal (*Monachus monachus*) extended all over the coasts of the Mediterranean, the Black Sea and parts of the north-eastern Atlantic coast.
2. Nowadays, the species is classified as Endangered and the current total world population is stated to consist of ~700 animals, though numbers mostly express best estimates. Distribution patterns in documents of international authorities from the last 15 years indicate the species' extinction in a number of Mediterranean countries, whereas in some of them only a few individuals are thought to survive and in others the status is unknown.
3. This study analyses recent monk seal sightings over the period from 2000 to 2014 in the Mediterranean Basin. The locations of the sightings cover most of the study area and indicate a spreading of individual seals or a more stable presence in regions where the species was considered extinct.
4. The investigation pointed out that efforts for the protection of monk seals, the most endangered marine mammal in Europe, should encompass all areas where monk seal sightings have been recorded, including the protection and conservation of potential suitable habitats in countries where the species apparently no longer exists.
5. Appropriate conservation measures, such as the establishment of marine protected areas and sustainable management of fisheries, will aid natural recolonization and enhance gene flow between distant regions throughout the Mediterranean Basin, allowing the reconnection of distant populations or individual animals.

KEYWORDS

coastal, conservation evaluation, endangered species, fishing, mammals, monitoring

1 | INTRODUCTION

The Mediterranean monk seal, *Monachus monachus* (Hermann, 1779), was the first pinniped species studied by humans (Aristotle, *Historia Animalium*, 350 BC). In spite of this fact, the dramatic decrease of the

population over the centuries, along with limited knowledge of the species' biology and ecology, makes the monk seal today one of the least understood species within the suborder Pinnipedia.

In ancient times, the distribution range of *M. monachus* extended all around the coast of the Mediterranean Sea, the Black Sea, the coasts of

north-west Africa as far south as the Cabo Verde Archipelago and Gambia, including the Canary Islands and up to Madeira, the Azores, and along the Atlantic coast of the Iberian peninsula (González, 2015; Johnson & Lavigne, 1999) (Figure 1). Since classical times and throughout the following centuries the monk seal population was significantly reduced. The main reasons for the population decline in the past were: (a) large-scale historical hunting during the period of the Roman Empire and later, mainly during the 15th and 16th centuries by the Portuguese and Spanish in the Atlantic (Johnson, 2004; Johnson & Lavigne, 1999); and (b) subsistence hunting (skin and fat) throughout the Mediterranean Basin, in Greece, for instance, up to the late 1940s (Jacobs & Panou, 1988; King, 1956; Marchessaux & Duguay, 1976; A. Panou, unpublished data). Additionally, fishers have traditionally killed seals because of the damage they cause to their catch and gear (Androukaki, Adamantopoulou, Dendrinis, Tounta, & Kotomatas, 1999; Panou, Beudels, & Harwood, 1987; Panou, Jacobs, & Panos, 1993). Today, interaction with fisheries, mainly through deliberate killing of monk seals and entanglement in fishing gear, is one of the main threats to the species' survival, along with disturbance and habitat degradation that eventually lead to the loss of habitat (Archipelagos-MOM, 1996; Israëls, 1992; Panou et al., 1993).

The Mediterranean monk seal is the rarest seal species in the world, and in 1996 it was classified by the International Union for the Conservation of Nature (IUCN) as Critically Endangered. According to the IUCN (Aguilar & Lowry, 2013), the General Fisheries Commission for the Mediterranean (GFCM, 2012), the United Nations Environment Programme Mediterranean Action Plan-Regional Activity Center for Specially Protected Areas (UNEP-MAP-RAC/SPA, 2005) and the Scientific Council of the Convention on the Conservation of Migratory Species of Wild Animals (González & Fernández de Larrinoa, 2005), the world population was estimated to consist of ~500–600 individuals at most. In 2015, the world population of the species was updated to ~700 individuals (Karamanlidis et al., 2015) and the IUCN conservation status was reclassified as Endangered

(Karamanlidis & Dendrinis, 2015), indicating a possible, very localized increase in numbers. The major known reproductive groups are located in (a) the north-eastern Mediterranean Sea along the Greek coasts, the Turkish Aegean Sea, and the adjacent waters in southern Turkey, and (b) the north-eastern Atlantic Ocean, on the Cabo Blanco peninsula, Morocco/Mauritania and in the Desertas Islands, Madeira, Portugal. The Greek-Turkish population is estimated to consist of ~350 seals spread over a wide-ranging area (Karamanlidis et al., 2015). The Cabo Blanco colony is composed of at least 330 identified individuals (e.g. CBD Habitat, personal communication, January 2018). Finally ~40 individuals are reported to live along the coast of Madeira and the Desertas Islands (Pires, 2011). Apart from the well-studied Cabo Blanco colony, most of the population numbers given in the aforementioned official documents (hereafter 'officially accepted documents') express best estimates and do not reflect actual seal numbers. Minor subpopulations are considered to survive along the coasts of the Mediterranean African countries (Karamanlidis et al., 2015; Mo, Bazairi, Bayed, & Agnesi, 2011), but no information about numbers of individuals and their reproductive rates are available.

The present distribution of the species as portrayed in the aforementioned officially accepted documents indicates that the species is extinct or possibly extinct in most of its former range throughout the Mediterranean Basin (see Table 2). According to these documents, in some countries only a few individuals survive and in others the status is considered unknown. The species' status is classified as vanishing or extinct in countries where no seal sightings have been recorded. Where occasional seal sightings but no births were recorded and/or the actual use of the habitat is not properly known seals are considered as 'vagrants' (GFCM, 2012; Karamanlidis & Dendrinis, 2015; UNEP-MAP-RAC/SPA, 2005).

In a related document produced by UNEP-MAP-RAC/SPA (2003), a series of concrete actions for the conservation of the Mediterranean monk seal were discussed. These actions were divided into actions to be taken in 'high-density areas' (HDAs) and in 'low-density

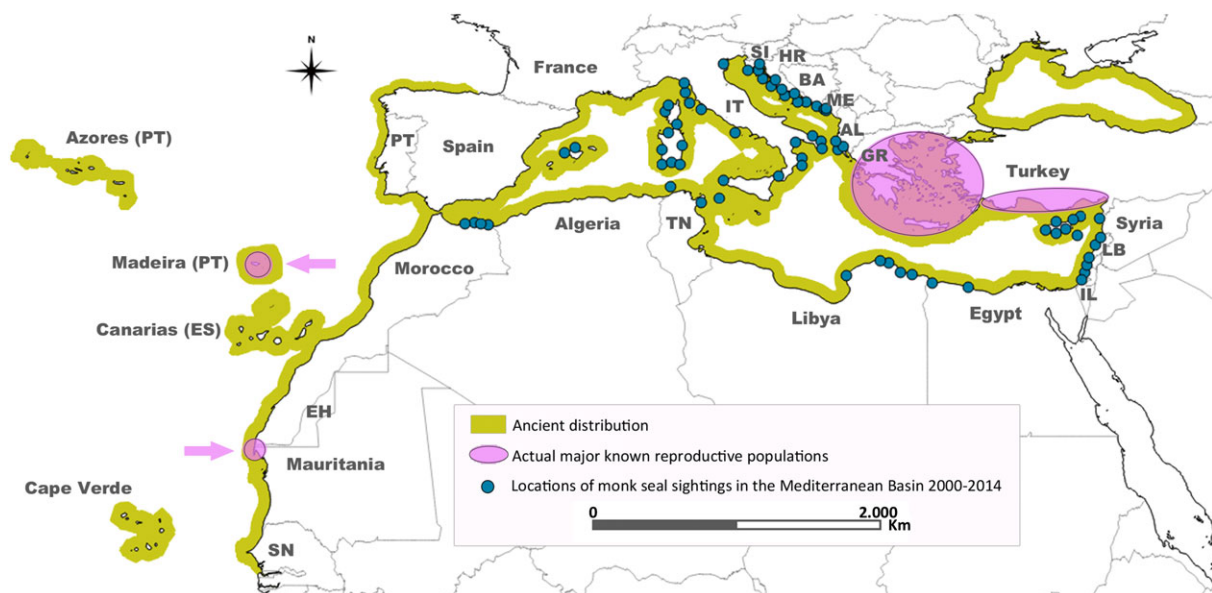


FIGURE 1 Ancient distribution of the Mediterranean monk seal, actual major known reproductive populations, and locations of monk seal sightings in the Mediterranean Basin excluding Greece and Turkey in 2000–2014 (the spots do not reflect numbers of sightings). Country codes follow the standard ISO 3166-1 alpha 2

areas' (LDAs). HDAs represent the areas in the Mediterranean Basin where known reproductive populations are present and where most of the animals are concentrated; that is, the Greek and Turkish coasts, including the islands. According to UNEP-MAP-RAC/SPA (2003), LDAs refer to areas with the following characteristics: unknown monk seal populations, recent single animal sightings, and medium-high estimated habitat availability. The actions mentioned earlier were confirmed in 2013, underlining that activities should have ranging priority according to monk seal's conservation status in each country within the Mediterranean Sea (UNEP-MAP-RAC/SPA, 2013).

Here, recent monk seal sightings throughout the Mediterranean Basin outside the HDAs are analysed as the basis for future conservation activities.

2 | MATERIAL AND METHODS

This study focused on collecting and analysing monk seal sightings outside the known reproductive populations in HDAs in the north-eastern Mediterranean (i.e. Greece and Turkey), that have been studied for several years. The aim was to depict the species' distribution in LDAs from a new perspective and to propose appropriate conservation measures.

The data analysed were from monk seal sightings between 2000 and 2014 from the Mediterranean Basin. The data were collected through: (1) a thorough analysis of the existing scientific bibliography including the grey literature along with an additional search on the web in order to include other types of testimonies, (2) unpublished reports of expert scientists or conservationists from all over the area under consideration via personal communication, and (3) the authors' own research studies. These types of data were considered altogether as verified seal sightings.

The bibliographical research was carried out by consulting Karamanlidis and Johnson (2002), Web of Science, ResearchGate, and Google Scholar. Furthermore, several national and international library and museum archives were consulted. In addition, expert scientists or conservationists were contacted in order to update the information collected through the bibliographical consultation and verify the information published on the web.

Own data were obtained through direct interviews conducted with local stakeholders (fishers in particular) in Montenegro and in southern Apulia, Italy. In Montenegro, information on sightings was collected by interviewing individual witnesses who had reported their encounters to the official organization (IBM—Institute of Marine Biology, Kotor) after repeated sensitization activities. In southern Apulia, information on sightings was obtained through systematically interviewing artisanal fishers and through directly contacting the witnesses of seal sightings who had reported the event to the local authorities and to official organizations (coastguard, protected areas, museums and the University of Salento).

Data obtained through direct interviews were considered as verified seal sightings if photographic or video material was available. In the absence of such material, the reliability of the sightings was evaluated according to the protocol for registering seal sightings developed by the non-governmental organization Archipelagos,

Environment and Development. In this protocol the following information was requested:

- information on the witness (name, address, occupation, activity during the sighting, position of the witness);
- information on the sightings (date, duration, number and exact position of the animals, and also maps or drawings if available);
- characteristics of the individuals (physical conditions, colour of the fur, scars and other marks), and also photographs if available;
- other details such as behaviour, interaction with fisheries, and so on.

Data from witnesses who were not sure about their information or reported incongruent information were discarded and are not included in this paper.

In addition, information obtained through photo-identification studies conducted by one of the authors (L.B.) in Croatia and in Israel was used for evaluating actual numbers of animals in these two areas.

A number of the reported seal sightings proved to belong to other pinniped species and not to monk seals. The animals obviously either entered the basin as vagrants or escaped from some aquaria. These sightings of other Pinnipedia species along with sightings that could not be verified as monk seal sightings were not taken into account in this paper.

The distribution maps were designed with the Quantum GIS v. 2.2 Valmiera software (<https://qgis.org/>). The shape files of the countries' borders were downloaded from the Natural Earth website (<https://www.naturalearthdata.com/>) and Global Administrative Areas (<http://www.gadm.org/>).

Details on the data, including historical information on seal presence when needed in order to obtain a more accurate insight on the status of the species, are provided in the Supporting Information in the publisher's web site.

3 | RESULTS

The verified monk seal sightings collected between 2000 and 2014 cover most of the historical distribution range of the species throughout the Mediterranean Basin (Figures 1 and 2; Table 1; for more detail, see Supporting Information). In most cases, it was not possible to deduce further information on the number of animals nor on the duration or the reoccurrence of individual sightings.

From countries where the monk seal status has been monitored most regularly, the information was more detailed than in comparison where monitoring has been irregular.

Information on monk seal sightings was not available for Malta, Algeria, Slovenia, and Bosnia and Herzegovina, nor from the mainland coasts of Spain and France and large parts of the Libyan coastline. Data were rather scarce from several other areas: the Balearic Islands (Spain), Corsica (France), western Egypt, and Tunisia. In the case of the Balearic Islands, all sightings might refer to only one individual frequenting Mallorca in 2008 and 2009 but never reported again subsequently.

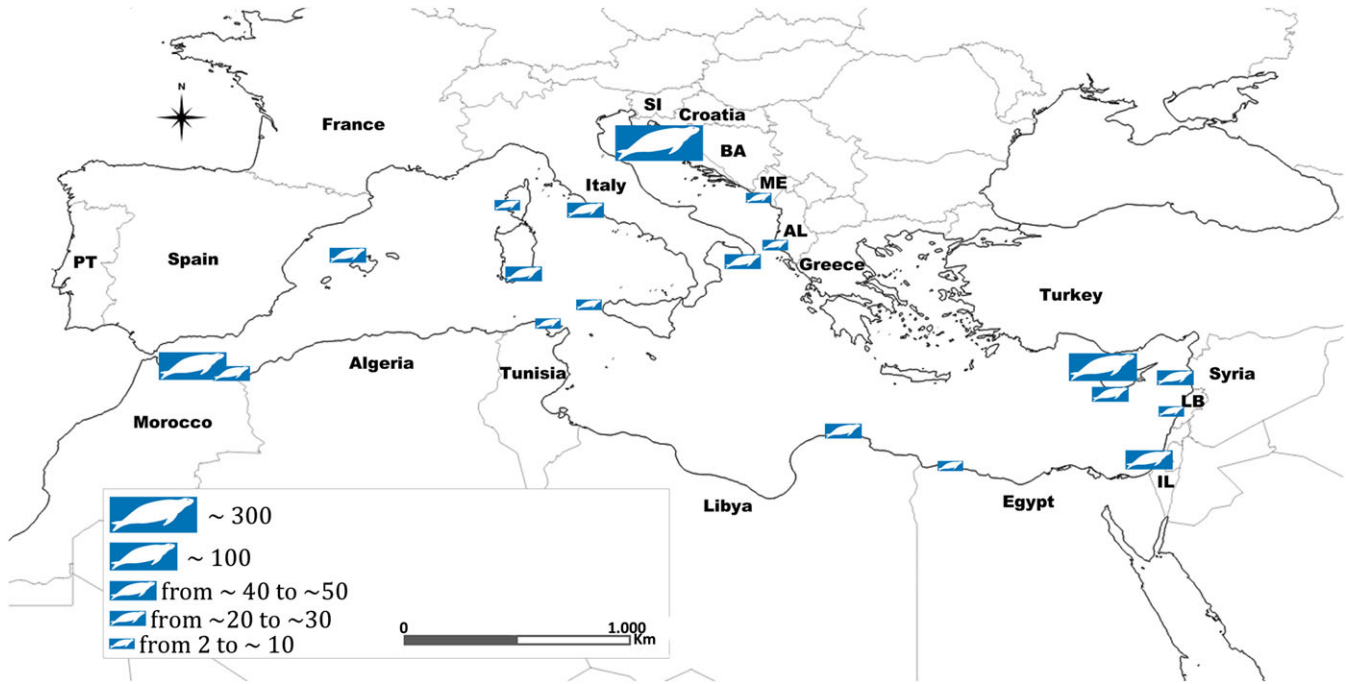


FIGURE 2 Numbers of monk seal sightings in the Mediterranean Basin in 2000–2014 excluding Greece and Turkey according to the scientific literature, including grey literature, reports of experts, and own research. The dimension of the seal icons reflects the number of sightings obtained from each country, not the actual number of animals present during the years of the study nor the frequencies per year of the sightings themselves

TABLE 1 Monk seal sightings in the Mediterranean Basin in 2000–2014

Country	Location	Year	S	M	I	B	V
Syria	Northern coast	2001–2013	>25	1	D, F	P	Y
Cyprus	Northern coast	2005–2007	N*	1	D, F	P	Y
	Southern coast	2001–2014	~20	2	D, W	Y	Y
Lebanon	Northern coast	2010	2	1	W	-	Y
	Near Beirut	2011–2014	3	2	W	-	Y
Israel	Entire coast	2009–2013	>47	1	D, W	-	Y
Egypt	Western coast	2000–2002	>1	1	F	-	-
	Marsa Matrouth	2011	1	1	D	-	Y
Lybia	Eastern coast	2000–2002	~20	1	F	-	-
	Ain El Ghazala	2012	1	1	D	-	Y
Tunisia	Mainland	2007	1	1	?	-	-
	La Galite	2010	1	1	?	-	-
Algeria	<i>No information available</i>						
Morocco Med. Coast	Central-eastern coast	2000–2006	>100	2	F	P	-
Spain	Chafarinas	2000–2012	~20	2	D, F	P	-
	Balearic Islands	2008–2009	~19	1	W	-	Y
France	Corse	2009–2011	5	2	W	-	-
Italy	Mainland	2000–2014	~50	2	D, F, W	-	Y
	Sardinia		~20	2	W	-	Y
	Sicily		>10	2	D, F, W	-	Y
Malta	<i>No information available</i>						
Slovenia	<i>No information available</i>						
Croatia	Entire coast	2000–2014	~300	1	D, F, W	-	Y
Bosnia & Herzegovina	<i>No information available</i>						
Montenegro	Northern & central part of the coast	2004–2010	7	1	W, F	-	-
Albania	Southern coast	2000–2012	>10	2	D, F	-	Y

S: number of reported sightings (>: minimum number; ~: tentative numbers); M: maximum number of animals per sighting; I: type of information (D: direct observation through researchers or verified by photographs; F: interview with fishermen; W: interview with witnesses other than fishermen; ?: no information available); B: breeding (P: probable; Y: yes); V: video/photographic material (Y: yes).

*The presence of at least four animals along the northern coast of Cyprus is given in Gücü et al. (2006, 2009) for the period 2005–2007 but the analysis of the data does not allow an evaluation of seal sighting numbers.

On the other hand, more detailed information was obtained from several other regions in the Mediterranean that allowed a more accurate evaluation of the species' status.

From the analysis of the data shown in Table 1 (for details see Supporting Information), four main regions can be identified with different patterns of monk seal presence based on sightings: (1) the central and western parts of the northern Mediterranean, (2) the southern Mediterranean (i.e. North African countries), (3) the Levantine Sea in the eastern Mediterranean, and (4) the Adriatic-Ionian region in the central Mediterranean.

Central and western parts of the northern Mediterranean: Along the Italian Tyrrhenian coast, seal sightings were repeatedly reported from all regions known to have historically been used by the species, but it was not possible to deduce the numbers of animals frequenting these coasts. In particular, the sightings were frequently reported, from 2010 onward, along the coast of the Egadi Islands, western Sicily.

Southern Mediterranean, North African countries: From the coasts of Morocco and eastern Libya, a considerable number of seal sightings were reported, but most of the information was derived from interviews with fishers and not from direct observations or through photoidentification of individuals; thus, it is not possible to estimate the population size. Reproduction may still occur in Morocco.

Eastern Mediterranean, Levantine Sea: Along the coast of northern Syria and northern and southern Cyprus, frequent sightings and evidence of breeding were reported, but from the available data it was not possible to estimate actual population numbers. In Lebanon, apart from a single sighting on the northern coast of the country in 1997, the last information available on monk seal presence was at the end of the 1960s. New seal sightings were reported from 2010 onwards; one sighting refers to two individuals together. In Israel, after half a century of absence of records, several verified seal sightings were recorded from 2009 onwards. Photoidentification analysis of the corresponding photographic and video material available indicates the presence of at least two individuals during the period under consideration. Only one of those two individuals was repeatedly recorded over the period 2009–2014.

Central Mediterranean, Adriatic-Ionian region: Along the coast of southern Apulia, Italy, 10 sightings referring to the years 2009–2014 were recorded. In the case of Croatia, ~300 sightings were recorded over the period of concern from the entire country's coastline. The photographic/video material available from the northern coast of the country (Istria) allows the identification of one adult female frequenting this stretch of coast since 2009. The animal was found dead in August 2014. A seal corpse was also recorded from 2008 in southern Croatia. Seven verified monk seal sightings were recorded through interviews with stakeholders (mainly fishers), referring to the years 2013–15 along the entire Montenegrin coastline as also six earlier records in the years 1986–1998. In Albania, information, obtained mainly by fishers, underlines the presence of the species along the southern coast of the country. Additionally, circumstantial information on monk seal presence in this country was obtained through researchers and yachtsmen sailing along the Albanian waters.

4 | DISCUSSION

The official status of monk seal populations in the Mediterranean is shown in Table 2; the information was extracted from data published by international authorities (IUCN, UNEP-MAP-RAC/SPA, and GFCM). The terms 'extinct' or 'vanished' refer to the disappearance of the species in a country and represent the approach used by international conventions and authorities to delineate and determine the various countries' conservation obligations. Of course, seals do not recognize national boundaries; however, the approach used here is to facilitate comparison with official documents. In some of the countries the species is considered extinct; this may sometimes provide justification for inaction in those countries where its conservation is not a priority, according to its supposed absence. Society and politics act as important factors in orientating economic resources to species at lower risk, and even the scientific community might advise against large expenditure of available resources on species considered doomed to extinction; however, it can be agreed that conservation processes can, and should, be characterized by different stages (in

TABLE 2 Status of *Monachus monachus* in the Mediterranean Basin (Greece and Turkey excluded) as stated in official documents

Country	IUCN	RAC/SPA	GFCM
Syria	Possibly extinct	Vagrants	Vagrants
Cyprus	Native	+2	+2
Lebanon	Possibly extinct	Vagrants	Vagrants
Israel	Possibly extinct	Vanished	Vanished
Egypt	Possibly extinct	Vanished	Vagrants
Libya	Possibly extinct	+2	+2
Tunisia, mainland	Possibly extinct	Vanished	+1
Tunisia, La Galite	Possibly extinct	Vanished	+1
Algeria	No information available	10	Vagrants
Mediterranean Morocco	No information available	Vanished?	Vagrants
Spain, Chafarinas Islands	No information available	Vanished?	Vanished?
Spain, mainland	Regionally extinct	Vanished	Vanished
Spain, Balearic Islands	Possibly extinct	Vanished	Vanished
France, mainland	Possibly extinct	Vanished	Vanished
France, Corsica	Possibly extinct	Vanished	Vanished
Italy, mainland	Possibly extinct	Vagrants	Vagrants
Italy, Sardinia	Possibly extinct	Vagrants	Vagrants
Italy, Sicily	Possibly extinct	Vagrants	Vagrants
Malta	No information available	Vanished	Vanished
Slovenia	Regionally extinct	Vanished	Vanished
Croatia	Possibly extinct	Vanished	+1
Bosnia and Herzegovina	Regionally extinct	Vanished	Vanished
Montenegro	Regionally extinct	Vanished	Vanished
Albania	Possibly extinct	Vanished?	Vagrants

+N: minimum number of seals. Sources: IUCN—International Union for the Conservation of Nature (Karamanlidis & Dendrinis, 2015); RAC/SPA—Regional Activity Center for Specially Protected Areas (UNEP-MAP-RAC/SPA, 2005); GFCM—General Fisheries Commission for the Mediterranean (GFCM, 2012).

terms of economics, monitoring, and protection efforts) to meet the actual needs (Gerber, DeMaster, & Perry, 2000; Read, 2010; Reynolds, Marsh, & Ragen, 2009).

The data presented in Table 1 show that absence of seal sightings from some areas does not necessarily imply the actual absence of the species; it may simply indicate the absence of sufficient monitoring efforts (e.g. Malta, parts of Libya, Algeria, Tunisia, and Egypt). This aspect has also been pointed out by the GFCM (2012). For instance, in Italy, taking into account the numerous sightings recorded in the last two decades, the species was downlisted from 'Extinct' to 'Data Deficient' (Rondinini, Battistoni, Peronace, & Teofili, 2013). In most locations of sightings within the species' former distribution range (Figure 1), the coasts have never been monitored in a regular manner (i.e. habitat surveys and/or interviews), partly due to the difficulties and costs related to a systematic monitoring of the vast habitat in question spread throughout the Mediterranean Sea. On the other hand, in the case of both Slovenia and Bosnia and Herzegovina, the absence of reports may reflect a real absence of the species, possibly due to their extremely short coastline with high levels of human activity (Slovenia: ~45 km of low and sandy coastline; Bosnia and Herzegovina: 24.5 km of coastline). The same applies for continental Spain and France with their heavily used coastlines. However, it must be stressed that reports of seal sightings generally reflect the distribution of potential observers in time and space, willing to communicate their data rather than the species' actual distribution and numbers. For instance, most of the 130 sightings recorded in the area around Istria–northern Croatia belonged to one single photo-identified female animal repeatedly observed in numerous locations within a distance of 130–150 km (Bundone et al., 2013). The same situation may also apply in the case of Israel (Bundone, Roditi-Elasar, Goffman, Scheinin, & Kerem, 2016). Therefore, the information extracted from sightings should be considered as a first approach to identify areas where more close monitoring is required.

4.1 | Regional approach

The four main regions that emerged in the monk seal's sightings pattern should be considered for applying different monitoring and conservation approaches.

Central and western parts of the northern Mediterranean: The rather low frequency of sightings in this region may be explained by movements of vagrant animals. However, the term 'vagrant' does not seem to apply for all seal sightings' since no breeding nuclei within the known movement range of the species are known from this part of the Mediterranean (i.e. 12–40 km per day and up to ~300 km within a few months; Adamantopoulou et al., 2011). The frequency of the sightings recorded along the Egadi Islands (Sicily) might reflect a permanent presence.

Southern Mediterranean, North African countries: Small and fragmented breeding populations of seals might still survive along the coasts of the North African countries (Hamza, Mo, & Tayeb, 2003; Karamanlidis et al., 2015; Mo et al., 2011).

Eastern Mediterranean, Levantine Sea: The entire area (i.e. Syria, Lebanon, and Israel) seems to be more often frequented by small

groups of monk seals than the two areas already discussed. One indication is the pregnant animal found dead in Syria (see Supporting Information). More recent data on relatively frequent observations of seals along the Lebanese coast up to 2016 and the confirmation of breeding in this area (Bariche & Crocetta, 2017: e.g. A. Serhal, personal communication, January 2017) are not incorporated in the data analysed in the present paper but may also corroborate a rather permanent seal presence in this region. In Israel, monk seal sightings along the coast continued to be regularly recorded after 2014 (Bundone et al., 2016; e.g. M. Roditi-Elasar, personal communication, January 2018). Altogether, the sightings in the Levantine Sea may either belong to the same subpopulation or are remnants of an ancient larger population that also included the seals in southern Turkey and Cyprus. A monk seal sighting 70 km off the south-eastern coast of Cyprus in 2013 (Ryan et al., 2014) supports this suggestion and underlines the species' ability to cover long distances over open waters.

Central Mediterranean, Adriatic-Ionian region: It should be noted that our own studies mainly focused on this region; in particular, Croatia, Montenegro, and Salento in southern Apulia, Italy. In Croatia, reports of seal sightings were rather frequent. This fact and the finding of a dead animal in southern Croatia possibly indicates one or more resident group(s) of monk seal(s). In Montenegro, the species was considered extinct, since the 'last' monk seal was publicly killed in 1969 (Panou, Varda, & Bundone, 2017). The data obtained through the present study indicate at least the occasional passage of monk seals in these waters during the last four decades. Additional sightings, outside of the period considered, continued to be recorded from Albania (Bakiu & Cakalli, 2018) and southern Apulia, Italy (Bundone et al., 2017; Bundone, Fai, & Molinaroli, 2018).

Altogether, the Adriatic–Ionian region is characterized by (a) the presence of an actively reproducing subpopulation in the Greek Ionian islands (Jacobs & Panou, 1988; 1996; Panou, 2009; Panou et al., 1993), (b) occasional sightings in most of the other countries (i.e. southern Albania, Montenegro, Croatia, and southern Italy), (c) habitat availability in all the aforementioned countries, and (d) short distances to be covered relative to the species' ability to travel over the open sea.

4.2 | Monitoring efforts

The systematic monitoring of seal sightings is an effective tool to (a) gather valuable and needed information on seal presence and, possibly, reproduction in an area, and (b) involve local people and visitors in the conservation of this rare and endangered species. The role of public participation in assessing long-lived and rare species was demonstrated in several cases (e.g. Beck et al., 2014; Bundone et al., 2013; Cheney et al., 2013; Ryan et al., 2016). To assess monk seal presence, a key issue is the direct involvement of important stakeholders, such as artisanal fishers. Artisanal fishers are the people most likely to observe a monk seal; they may supply important and valuable information on seal presence in areas where the species is thought to be extinct, along with other types of information (Jacobs & Panou, 1988, 1996; Johannes, Freeman, & Hamilton, 2000; Manyou et al., 2011; Moore et al., 2010; Neis et al., 1999; Panou et al., 1999; Pirounakis et al., 1999). In the Greek Ionian Sea, the data on monk seal

sightings provided by cooperating fishers since 1985 proved to be extremely valuable and allowed a more accurate estimation of seal numbers (Panou, 2009; Panou et al., 1993). In addition to the fishers' contribution, the involvement of the general public in scientific research oriented towards collection of data (citizen science) is also a useful approach for retrieving monk seal sightings. Information networks for collecting monk seal sightings have already been established in most of the known breeding population areas in the Mediterranean, as well as in the Atlantic. Local sensitization campaigns and the creation of a strong network of communication allow the collection of information previously simply not communicated at all (i.e. the cases of Montenegro and southern Apulia, Italy). The wide diffusion of new technology devices and communication systems (i.e. broad use of internet-based communication, widespread diffusion of mobile phones with high-quality videos/cameras, etc.) made useful tools available in order to reach a wider public and, consequently, collect more data. Therefore, the development and diffusion of new instruments for an easy and fast process for communicating data, designed according to accurate scientific protocols in an easily applicable form, should be considered in surveys devoted to the collection of data on seal sightings, particularly in LDAs.

The collection and analysis of sightings, as already mentioned, represent a baseline with which to understand where to focus and implement monitoring efforts. It is obvious that only systematic and thorough habitat and/or population surveys, including photoidentification studies, may reveal the actual numbers of seals in a given area, as has been done in the Cabo Blanco colony, Morocco/Mauritania where almost all individuals have been photo-identified (Muñoz-Cañas et al., 2017).

4.3 | Final considerations

The protection of species whose populations have been reduced to low numbers should encompass every individual, along with the preservation and enhancement of their habitat, including the potential habitats and ecosystems that might be critical for the species' survival (MacMillan, Moore, Augé, & Chilvers, 2016; Reeves, 2008; Reeves & Reijnders, 2002). Relict subpopulations across a species' range might have an important role by which severely depleted populations can recover (Bonin, Goebel, Forcada, Burton, & Hoffman, 2013; Notarbartolo di Sciarra & Kotomatas, 2016); in this context, LDAs may play an important role in the survival, recovery, and the overall distribution of the Mediterranean monk seal.

Examples of recovery and recolonization of former habitat by pinniped species are widely acknowledged (Bonin et al., 2013; Cammen et al., 2018; Grandi et al., 2018; Hoelzel, Fleischer, Campagna, Le Boeuf, & Alvord, 2002; Kirkwood, Warneke, & Arnould, 2009; MacMillan et al., 2016; Pyle, Long, Shonewald, Jones, & Roletto, 2001; Reijnders, van Dijk, & Kuiper, 1995). In addition, temporary migration and the occurrence of transient or visitor animals may have important implications for conservation of the populations and groups of many endangered marine mammals ranging across borders of different countries (Bearzi, Bonizzoni, & Gonzalvo, 2011; Genov et al., 2016; Stern, 2009).

The main factors for the recovery of a species include the reduction of human impacts (Lotze, Coll, Magera, Ward-Paige, & Airoldi, 2011). The establishment and enforcement of areas restricted to certain human activities (i.e. marine protected areas, MPAs) have an important role in the survival and conservation of marine mammals (Abate, 2009; AMWG, 2016; Gormley et al., 2012; Hoyt, 2005; Notarbartolo di Sciarra et al., 2016; Reeves, 2000; Womble & Gende, 2013). Within the Mediterranean Sea, establishing a network of MPAs and ecological corridors that includes potential habitat for the monk seal should be applied following a regional, multinational approach. Fishery policies and the inclusion in the management of MPAs of traditional fishers are key elements in order to lower possible threats (direct killing, entanglement, etc.) to marine mammals (Reeves, 2008); for instance, monitoring and research projects that envisage the (compensative) involvement of this category in the activities. Such measures might also facilitate the safe movements of individuals aiding natural recolonization and, by allowing the reconnection of distant populations or individual animals, enhance the gene flow between distant regions throughout the Mediterranean Basin as also recommended by IUCN (2009).

Coastal protection measures (i.e. MPAs and fishery management) have also been acknowledged by the Convention on Biological Diversity of the United Nations (1990) as measures for preventing or mitigating biodiversity loss worldwide. Such measures were more recently reconfirmed and enhanced by the Marine Strategy Framework Directive of the European Union (Directive 2008/56/EC) aiming at reaching a Good Environmental Status of the member states of the EU by 2020.

The analysis of the sightings data used in this study allowed us to identify different regions (the Adriatic-Ionian and the Levantine regions in particular) with high frequencies of sightings, where efforts to monitor the species' presence should be implemented, and therefore where to expand the activities for protection that might become essential for the overall survival of the Mediterranean monk seal.

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ORCID

Luigi Bundone  <https://orcid.org/0000-0002-4961-7410>

Aliki Panou  <https://orcid.org/0000-0002-3312-4662>

Emanuela Molinaroli  <https://orcid.org/0000-0001-6638-0411>

REFERENCES

- Abate, R. S. (2009). Marine protected areas as a mechanism to promote marine mammal conservation: international and comparative law lessons for the United States. *Oregon Law Review*, 88, 255–310.
- Adamantopoulou, S., Androukaki, E., Dendrinou, P., Kotomatas, S., Paravas, V., Psaradellis, M., ... Karamanlidis, A. A. (2011). Movements of Mediterranean monk seals (*Monachus monachus*) in the eastern Mediterranean Sea. *Aquatic Mammals*, 37, 256–261. <https://doi.org/10.1578/AM.37.3.2011.256>
- Aguilar, A., & Lowry L. (IUCN SSC Pinniped Specialist Group). (2013). *Monachus monachus*. The IUCN Red List of Threatened Species. Version 2014.3. Retrieved from <http://www.iucnredlist.org> [10 January 2015]
- Androukaki, E., Adamantopoulou, S., Dendrinou, P., Tounta, E., & Kotomatas, S. (1999). Causes of mortality in the Mediterranean monk seal (*Monachus monachus*) in Greece. Proceedings of the 7th international congress on the zoogeography and ecology of Greece and adjacent regions, Athens, Greece, 1–5 April 1996: Contributions to the zoogeography and ecology of the eastern Mediterranean region. S. Giokas A. Legakis R. Polymeni S. Sfenthourakis M. Thessalou-Legaki and A. Zenetos. 1: 405–411. Hellenic Zoological Society: Athens.
- Archipelagos-MOM. (1996). Strategy for the protection of the Mediterranean monk seal, *Monachus monachus*, in Greece. Compiled by Zavras, V., Kotomatas, S., & Panou, A. Athens, Greece: Greek Ministry of Environment (in Greek and English).
- AMWG. (2016). Important Marine Mammal Areas (IMMAs). 1st Meeting of the Sessional Committee of the CMS Scientific Council (ScC-SC1). Bonn, Germany, 18–21 April 2016. Document prepared by the Aquatic Mammals Working Group (AMWG). Convention on the Conservation of Migratory Species of Wild Animals (CMS), secretariat provided by the United Nations Environmental Programme (UNEP). UNEP/CMS/Sc-SC1/Doc.10.4.2.1.
- Bakui, R., & Cakalli, M. (2018). New Mediterranean biodiversity records (December 2017). 5.2 Recent sightings of the Mediterranean monk seal (*Monachus monachus*) in the Albanian Ionian Sea. *Mediterranean Marine Science*, 18, 542–544.
- Bariche, M., & Crocetta, F. (2017). New Mediterranean biodiversity records (November 2016). 4.11 Status of the Mediterranean monk seal *Monachus monachus* in Lebanon: From extinct (1968) to regular sightings (2003–2016). *Mediterranean Marine Science*, 17, 814–815. <https://doi.org/10.12681/mms.1976>
- Bearzi, G., Bonizzoni, S., & Gonzalvo, J. (2011). Mid-distance movements of common bottlenose dolphins in the coastal waters of Greece. *Journal of Ethology*, 29, 369–374. <https://doi.org/10.1007/s10164-010-0245-x>
- Beck, S., Foote, A. D., Kötter, S., Harries, O., Mandleberg, L., Stevick, P. T., ... Durban, J. W. (2014). Using opportunistic photo-identifications to detect a population decline of killer whales (*Orcinus orca*) in British and Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, 94, 1327–1333. <https://doi.org/10.1017/S0025315413001124>
- Bonin, C. A., Goebel, M. E., Forcada, J., Burton, R. S., & Hoffman, J. I. (2013). Unexpected genetic differentiation between recently recolonized populations of a long-lived and highly vagile marine mammal. *Ecology and Evolution*, 3, 3701–3712. <https://doi.org/10.1002/ece3.732>
- Bundone, L., Antolović, J., Coppola, E., Žalac, S., Hervat, M., Antolović, N., & Molinaroli, E. (2013). Habitat use, movements and sightings of monk seals in Croatia between 2010 and 2012–2013. *Rapport de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée*, 40, 608.
- Bundone, L., Fai, S., & Molinaroli, E. (2018). First video documented presence of Mediterranean monk seal in southern Apulia (Italy). Paper presented at the 32nd Conference of the European Cetacean Society, La Spezia, Italy, 6–10 April 2018 (abstract book, p. 143).
- Bundone, L., Fai, S., Rizzo, L., De Marchi, B., Guerzoni, S., & Molinaroli, E. (2017). Sightings and historical presence of Mediterranean monk seal along the coast of Salento (southern Italy). Paper presented at the Proceedings of the 45th Annual Symposium of the European Association for Aquatic Mammals, Genoa, Italy, 8–11 March 2017 (p. 27).
- Bundone, L., Roditi-Elasar, M., Goffman, O., Scheinin, A. P., & Kerem, D. (2016). Monk seal sightings, identification and habitat survey in Israel. Paper presented at the 30th Conference of the European Cetacean Society, Funchal, Madeira, 14–16 March 2016 (abstract book, p. 222).
- Cammen, K. M., Vincze, S., Heller, A. S., McLeod, B. A., Wood, S. A., Bowen, W. D., ... Fraiser, T. R. (2018). Genetic diversity from pre-bottleneck to recovery in two sympatric pinniped species in the northwest Atlantic. *Conservation Genetics*, 19, 555–569. <https://doi.org/10.1007/s10592-017-1032-9>
- Cheney, B., Thompson, P. M., Ingram, S. N., Hammond, P. S., Stevick, P. T., Durban, J. W., ... Reid, J. B. (2013). Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins *Tursiops truncatus* in Scottish waters. *Mammal Review*, 43, 71–88. <https://doi.org/10.1111/j.1365-2907.2011.00208.x>
- Genov, T., Angelini, V., Hace, A., Palmisano, G., Petelin, B., Malačič, V., ... Mazzariol, S. (2016). Mid-distance re-sighting of a common bottlenose dolphin in the northern Adriatic Sea: Insight into regional movement patterns. *Journal of the Marine Biological Association of the United Kingdom*, 96, 909–914. <https://doi.org/10.1017/S0025315415001241>
- Gerber, L. R., DeMaster, D. P., & Perry, S. L. (2000). Measuring success in conservation. Assessing efforts to restore populations of marine mammals is partly a matter of epistemology: How do you know when enough is enough? *American Scientist*, 88, 316–324. <https://doi.org/10.1511/2000.29.773>
- General Fisheries Commission for the Mediterranean (2012). *Report of the thirty-fifth session. FAO Headquarters, Rome, 9–14 May 2011. GFCM Report No. 35*. Rome, Italy: FAO.
- González, L. M. (2015). Prehistoric and historic distributions of the critically endangered Mediterranean monk seal (*Monachus monachus*) in the eastern Atlantic. *Marine Mammal Science*, 31, 1168–1192. <https://doi.org/10.1111/mms.12228>
- González, L. M., & Fernández de Larrinoa, P. (2005). Mediterranean monk seal (*Monachus monachus*): Update of the status and conservation progress in the Atlantic populations. Report prepared for the Thirteenth Meeting of the CMS Scientific Council, Nairobi, Kenya, 16–18 November 2005. CMS/ScC13/Doc.7.1.
- Gormley, A. M., Slooten, E., Dawson, S., Barker, R. J., Rayment, W., du Fresne, S., & Bräger, S. (2012). First evidence that marine protected areas can work for marine mammals. *Journal of Applied Ecology*, 49, 474–480. <https://doi.org/10.1111/j.1365-2664.2012.02121.x>

- Grandi, M. F., de Castro, R. L., Terán, E., Santos, M. R., Bailliet, G., & Crespo, E. A. (2018). Is recolonization pattern related to female philopatry? An insight into a colonially breeding mammal. *Mammalian Biology*, *89*, 21–29. <https://doi.org/10.1016/j.mambio.2017.12.002>
- Gücü, A. C., Ok, M., Sakinan, S., Celebi, B., & Akoglu, E. (2006). Seals of Northern Cyprus. *The Monachus Guardian*, *9*, 26–27.
- Gücü, A. C., Ok, M., & Sakinan, S. (2009). A survey of the Critically endangered Mediterranean monk seal, *Monachus monachus* (Hermann, 1779) along the coast of Northern Cyprus. *Israel Journal of Ecology and Evolution*, *55*, 77–82. <http://dx.doi.org/10.1560/IJEE.55.1.77>
- Hamza, A., Mo, G., & Tayeb, K. (2003). Results of a preliminary mission carried out in Cyrenaica, Libya, to assess monk seal presence and potential coastal habitat. *The Monachus Guardian*, *6*, 46–48.
- Hoelzel, A. R., Fleischer, R. C., Campagna, C., Le Boeuf, B. J., & Alvord, G. (2002). *Thirty years of Mediterranean monk seal protection, a review*. Nederlandse Commissie voor Internationale Natuurbescherming, Mededelingen no. 28. Amsterdam, Netherlands: Instituut voor Taxonomische Zoologie.
- Hoyt, E. (2005). *Marine protected areas for whales, dolphins and porpoises: A world handbook for cetacean habitat conservation*. London, UK: Earthscan.
- Israëls, L. D. E. (1992). Thirty years of Mediterranean monk seal Protection, a review. Zoölogisch Museum Amsterdam, Mededelingen n° 28.
- IUCN. (2009). Resolution 4.023: Conservation and recovery of the Mediterranean monk seal *Monachus monachus*. In *Resolutions and Recommendations: World Conservation Congress, Barcelona, 5–14 October 2008* (pp. 23–24). Gland, Switzerland: IUCN.
- Jacobs, J., & Panou, A. (1988). Conservation of the Mediterranean monk seal, *Monachus monachus*, in Kefalonia, Ithaca and Lefkada Islands, Ionian Sea, Greece. Final report for the Institut Royal des Sciences de Belgique, Brussels. Institute of Zoology, University of Munich, Munich, Germany.
- Jacobs, J., & Panou, A. (1996). Conservation programme for the Ionian: Activity 1: Kefalonia & Ithaca. Final report WWF Project GR0034.01, 1 July 1992–30 June 1995. Institute of Zoology, University of Munich, Germany.
- Johannes, R. E., Freeman, M. M. R., & Hamilton, R. J. (2000). Ignore fishers' knowledge and miss the boat. *Fish and Fisheries*, *1*, 257–271. <https://doi.org/10.1046/j.1467-2979.2000.00019.x>
- Johnson, W. M. (2004). *Monk seals in post-classical history. The role of the Mediterranean monk seal (Monachus monachus) in European history and culture, from the fall of Rome to the 20th century*. Nederlandse Commissie voor Internationale Natuurbescherming, Mededelingen no. 39. Leiden, Netherlands: Netherlands Commission for International Nature Protection.
- Johnson, W. M., & Lavigne, D. M. (1999). *Monk seals in antiquity. The Mediterranean monk seal (Monachus monachus) in ancient history and literature*. Nederlandse Commissie voor Internationale Natuurbescherming, Mededelingen no. 35. Leiden, Netherlands: Netherlands Commission for International Nature Protection.
- Karamanlidis, A. A., & Dendrinou, P. (2015). *Monachus monachus*. The IUCN Red List of Threatened Species 2015: e.T13653A45227543. [17 April 2016]. <https://doi.org/10.2305/IUCN.UK.2015-4.RLTS.T13653A45227543.en>
- Karamanlidis, A. A., Dendrinou, P., Fernández de Larrinoa, P., Gücü, A. C., Johnson, W. M., Kiraç, C. O., & Pires, R. (2015). The Mediterranean monk seal *Monachus monachus*: Status, biology, threats, and conservation priorities. *Mammal Review*, *46*, 92–105.
- Karamanlidis, A. A., & Johnson, W. M. (2002). Annotated bibliography on Mediterranean monk seals (*Monachus monachus*). Version 1.0: 1–105.
- King, J. E. (1956). The monk seals. *Bulletin of the British Museum (Natural History) Zoology, London*, *3*, 201–256. <https://doi.org/10.5962/bhl.part.4123>
- Kirkwood, R., Warneke, R. M., & Arnould, J. P. Y. (2009). Recolonization of Bass Strait, Australia, by the New Zealand fur seal, *Arctocephalus forsteri*. *Marine Mammal Science*, *25*, 441–449. <https://doi.org/10.1111/j.1748-7692.2008.00250.x>
- Lotze, H. K., Coll, M., Magera, A. M., Ward-Paige, C., & Airoidi, L. (2011). Recovery of marine animal populations and ecosystems. *Trends in Ecology & Evolution*, *26*, 595–605. <https://doi.org/10.1016/j.tree.2011.07.008>
- MacMillan, H., Moore, A. B., Augé, A. A., & Chilvers, B. L. (2016). GIS-based multi-criteria analysis of breeding habitats for recolonising species: New Zealand sea lions. *Ocean and Coastal Management*, *130*, 162–171. <https://doi.org/10.1016/j.ocecoaman.2016.06.008>
- Manyou, F., Sbrana, M., Sartor, P., Maravelias, C., Kavadas, S., Damalas, D., ... Osio, G. (2011). Estimating trends of population decline in long-lived marine species in the Mediterranean Sea based on fishers' perceptions. *PLoS ONE*, *6*, e21818. <https://doi.org/10.1371/journal.pone.0021818>
- Marchessaux, D., & Duguay, R. (1976). Note sur l'observation du phoque moine, *Monachus monachus*, en Grèce. In Proceedings of the Paper presented at the 25th Congrès-Assemblée Plénière, Comité des Vertébrés Marins et Céphalopodes, Split, Yugoslavia, 22–30 October 1976 (pp. 1–4).
- Mo, G., Bazairi, H., Bayed, A., & Agnesi, S. (2011). Survey on Mediterranean monk seal (*Monachus monachus*) sightings in Mediterranean Morocco. *Aquatic Mammals*, *37*, 248–255. <https://doi.org/10.1578/AM.37.3.2011.248>
- Moore, J. E., Cox, T. M., Lewison, R. L., Read, A. J., Bjorkland, R., McDonald, S. L., ... Kiszka, J. (2010). An interview-based approach to assess marine mammal and sea turtle captures in artisanal fisheries. *Biological Conservation*, *143*, 795–805. <https://doi.org/10.1016/j.biocon.2009.12.023>
- Muñoz-Cañas, M., Haya, M., M'Bareck, A., Cedenilla, M. A., Aparicio, F., M'Bareck, H., ... Fernández de Larrinoa, P. (2017). Assessing mortality at the Mediterranean monk seal colony of 'Costa de las Focas' reserve (Cabo Blanco peninsula). Paper presented at the 31st Conference of the European Cetacean Society, Middelfart, Denmark, 1–3 May 2017 (abstract book, p. 123).
- Neis, B., Schneider, D. C., Felt, L., Haedrich, R. L., Fischer, J., & Hutchings, J. A. (1999). Fisheries assessment: What can be learned from interviewing resource users? *Canadian Journal of Fisheries and Aquatic Sciences*, *56*, 1949–1963. <https://doi.org/10.1139/f99-115>
- Notarbartolo di Sciarra, G., Hoyt, E., Reeves, R., Ardrón, J., Marsh, H., Vongraven, D., & Barr, B. (2016). Place-based approaches to marine mammal conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *26*, 85–100. <https://doi.org/10.1002/aqc.2642>
- Notarbartolo di Sciarra, G., & Kotomatas, S. (2016). Are Mediterranean monk seal, *Monachus monachus*, being left to save themselves from extinction? In G. Notarbartolo di Sciarra, M. Podestà, & B. E. Curry (Eds.), *Mediterranean marine mammals ecology and conservation* (ed., Vol. 75). *Advances in Marine Biology*. (pp. 359–386). London, UK: Academic Press. <https://doi.org/10.1016/bs.amb.2016.08.004>
- Panou, A. (2009). Monk seal sightings in the central Ionian Sea: A network of fishermen for the protection of the marine resources. Paper presented at the Workshop 'Who are our seals?', Istanbul, 28 February 2009, within the framework of the 23rd Annual Conference of the European Cetacean Society, Istanbul, Turkey, 2–4 March 2009.
- Panou, A., Beudels, R., & Harwood, J. (1987). Interactions between monk seals and fishermen. In J. Harwood (Ed.), *Population biology of the Mediterranean monk seal in Greece* (pp. 45–50). Cambridge, UK: Sea Mammal Research Unit.
- Panou, A., Jacobs, J., & Panos, D. (1993). The endangered Mediterranean monk seal *Monachus monachus* in the Ionian Sea, Greece. *Biological Conservation*, *64*, 129–140. [https://doi.org/10.1016/0006-3207\(93\)90649-L](https://doi.org/10.1016/0006-3207(93)90649-L)
- Panou, A., Tselentis, L., Voutsinas, N., Mourelatos, C., Kaloupi, S., Voutsinas, V., & Moschonas, S. (1999). Incidental catches of marine turtles in surface long line fishery in the Ionian Sea, Greece. *Proceedings of the 7th international congress on the zoogeography and ecology of Greece and adjacent regions*, Athens, Greece, 1–5 April 1996: Contributions to the

- zoogeography and ecology of the eastern Mediterranean region. S. Giokas A. Legakis R. Polymeni S. Sfenthourakis M. Thessalou-Legaki and A. Zenetos. 1: 435–445. Hellenic Zoological Society: Athens.
- Panou, A., Varda, D., & Bundone, L. (2017). The Mediterranean monk seal, *Monachus monachus*, in Montenegro. In V. Pešić (Ed.), *The Proceedings of the 7th International Symposium of Ecologists—ISEM7*, Sutomore, Montenegro, 4–7 October 2017 (pp. 94–101). Podgorica, Montenegro: Institute for Biodiversity and Ecology.
- Pires, R. (2011). *Lobos-marinhos do Arquipélago da Madeira/Monk seals of the Archipelago of Madeira*. Funchal, Portugal: Serviço do Parque Natural da Madeira.
- Pirounakis, K., Kaloupi, S., Moschonas, S., Mourelatos, Y., Tselentis, L., Voutsinas, N. ... Panou, A. (1999). Cetaceans in the Ionian Sea: Results of an observers' network. Proceedings of the 7th international congress on the zoogeography and ecology of Greece and adjacent regions, Athens, Greece, 1–5 April 1996: Contributions to the zoogeography and ecology of the eastern Mediterranean region. S. Giokas A. Legakis R. Polymeni S. Sfenthourakis M. Thessalou-Legaki and A. Zenetos. 1: 429–434. Hellenic Zoological Society: Athens.
- Pyle, P., Long, D. J., Shonewald, J., Jones, R. E., & Roletto, J. (2001). Historical and recent colonization of the South Farallon Islands, California, by northern fur seals (*Callorhinus ursinus*). *Marine Mammal Science*, 17, 397–402. <https://doi.org/10.1111/j.1748-7692.2001.tb01282.x>
- Read, A. J. (2010). Conservation biology. In I. L. Boyd, W. D. Bowen, & S. J. Iverson (Eds.), *Marine mammal ecology and conservation: A handbook of techniques* (pp. 340–359). Oxford, UK: Oxford University Press.
- Reeves, R. R. (2000). The value of sanctuaries, parks, and reserves (protected areas) as tools for conserving marine mammals. Final Report to the Marine Mammal Commission, contract number T74465385. Marine Mammal Commission, Bethesda, MD.
- Reeves, R. R. (2008). Conservation efforts. In W. F. Perrin, B. Würsig, & J. G. M. Thewissen (Eds.), *Encyclopedia of marine mammals* (2nd ed.) (pp. 275–289). San Diego, CA: Academic Press.
- Reeves, R. R., & Reijnders, J. H. (2002). Conservation and management. In A. R. Hoelzel (Ed.), *Marine mammal biology. An evolutionary approach* (pp. 388–415). Malden, MA: Blackwell.
- Reijnders, P. J. H., van Dijk, J., & Kuiper, D. (1995). Recolonization of the Dutch Wadden Sea by the grey seal *Halichoerus grypus*. *Biological Conservation*, 71, 231–235. [https://doi.org/10.1016/0006-3207\(94\)00032-L](https://doi.org/10.1016/0006-3207(94)00032-L)
- Reynolds, J. E. III, Marsh, H., & Ragen, T. J. (2009). Marine mammal conservation. *Endangered Species Research*, 7, 23–28. <https://doi.org/10.3354/esr00179>
- Rondinini, C., Battistoni, A., Peronace, V., & Teofili, C. (Eds.) (2013). *Lista Rossa IUCN dei Vertebrati Italiani*. Rome, Italy: Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare.
- Ryan, C., Cucknell, A. C., Romagosa, M., Boisseau, O., Moscrop, A., Frantzis, A., & McLanaghan, R. (2014). A visual and acoustic survey for marine mammals in the eastern Mediterranean Sea during summer 2013. Final report to the International Fund for Animal Welfare, Marine Conservation Research International, Kelvedon, UK.
- Ryan, C., Whooley, P., Berrow, S. D., Barnes, C., Massett, N., Strietman, W. J., ... Schmidt, C. (2016). A longitudinal study of humpback whales in Irish waters. *Journal of the Marine Biological Association of the United Kingdom*, 96, 877–883. <https://doi.org/10.1017/S0025315414002033>
- Stern, S. J. (2009). Migration and movement patterns. In W. F. Perrin, B. Würsig, & J. G. M. Thewissen (Eds.), *Encyclopedia of marine mammals* (2nd ed.) (pp. 726–730). San Diego, CA: Academic Press. <https://doi.org/10.1016/B978-0-12-373553-9.00168-1>
- United Nations Environment Programme Mediterranean Action Plan—Regional Activity Center for Specially Protected Areas. (2003). The conservation of the Mediterranean monk seal: Proposal of priority activities to be carried out in the Mediterranean Sea. Sixth Meeting of National Focal Points for SPAs, Marseilles, 17–20 June 2003. UNEP (DEC)/MED WG.232/Inf.6.
- United Nations Environment Programme Mediterranean Action Plan—Regional Activity Center for Specially Protected Areas. (2005). Evaluation of the Mediterranean monk seal status. Meeting of MAP focal points, Athens, Greece, 21–24 September 2005. UNEP (DEC)/MED WG.270/Inf.22.
- United Nations Environment Programme Mediterranean Action Plan—Regional Activity Center for Specially Protected Areas. (2013). Regional strategy for the conservation of the monk seals in the Mediterranean (2014–2019). Tunis, Tunisia: UNEP-MAP-RAC/SPA.
- Womble, J. N., Gende, S. M. (2013). Post-breeding season migrations of a top predator, the harbour seal (*Phoca vitulina richardii*), from a marine protected area in Alaska. *PLoS ONE*, 8, e55386. <https://doi.org/10.1371/journal.pone.0055386>

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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