

RESEARCH ARTICLE

# An interview-based approach assessing interactions between seals and small-scale fisheries informs the conservation strategy of the endangered Mediterranean monk seal

Alexandros A. Karamanlidis<sup>1</sup>  | Styliani Adamantopoulou<sup>1</sup> | Argyris A. Kallianiotis<sup>2</sup> | Eleni Tounta<sup>1</sup> | Panagiotis Dendrinou<sup>1</sup>

<sup>1</sup>MOm/Hellenic Society for the Study and Protection of the Monk Seal, Athens, Greece

<sup>2</sup>National Agricultural Research Foundation, Fisheries Research Institute, Kavala, Greece

## Correspondence

Alexandros A. Karamanlidis, MOm/Hellenic Society for the Study and Protection of the Monk Seal, Solomou Str. 18, 10682, Athens, Greece.  
Email: akaramanlidis@gmail.com

## Abstract

1. Small-scale fisheries may pose a serious threat to the conservation of marine mammals. At the same time various factors have led to the decline of small-scale fisheries, often making them unsustainable. Current rates of biodiversity loss and the reduction of fish stocks and fisheries dictate a thorough understanding of fisheries-related issues and the implementation of effective management actions.
2. The Mediterranean monk seal is one of the most endangered marine mammals on Earth; its survival in the eastern Mediterranean Sea is threatened by negative interactions with fisheries. A nationwide questionnaire survey among fishers and port police authorities was carried out in Greece to describe the main characteristics of small-scale fisheries, and to understand the nature and assess the magnitude of negative interactions between the monk seal and these fisheries. Questionnaire information was verified by a second round of interviews during landings.
3. The main attributes of the fishers, their fishing boats, and their practices were characteristic of the small-scale fisheries sector. Overfishing was considered the main reason for fish-stock reduction, and negative interactions with marine mammals was considered the main issue for the fishing sector.
4. Monk seals were present, caused damage, and got accidentally entangled in fishing gear throughout Greece. Damage to fishing gear was recorded mainly during spring and summer, and on average affected 21% of all fishing trips and 1% of nets deployed during a fishing trip.
5. Based on these results, the implementation of general and specific nationwide fishery management and conservation actions are proposed. These actions are mainly aimed at improving fish stock status, changing the behaviour of the fishers, and mitigating seal–fishery interactions in Greece, while promoting the recovery of the Mediterranean monk seal in the eastern Mediterranean Sea.

## KEYWORDS

by-catch, coastal, compensation, conservation priorities, endangered species, fisheries regulation, Greece, human–marine mammal coexistence, mammals, Mediterranean monk seal

## 1 | INTRODUCTION

Fisheries may have a significant impact on marine ecosystems (Hawkins & Roberts, 2004) through the reduction of fish populations (Lloret, Muñoz, & Casadevall, 2012) and the disruption of ecological processes (Solan et al., 2004). Direct fisheries interactions may also pose a serious threat to the conservation of some species of marine mammals (e.g. Jaramillo-Legorreta et al., 2007; Mangel et al., 2010; Peckham et al., 2008): negative interactions with small-scale fisheries have pushed the Yangtze River dolphin or baiji (*Lipotes vexillifer*) to extinction (Turvey et al., 2007) and are currently doing the same to the vaquita (*Phocoena sinus*) (Taylor et al., 2017). Ecological extinctions caused by overfishing are considered to have a greater negative impact than all other pervasive human disturbances to coastal ecosystems together (Jackson et al., 2001). At the same time various socio-cultural, economic, and environmental factors have led to the decline of small-scale fisheries (Cinner, Daw, & McClanahan, 2009; Gómez, Lloret, Demestre, & Riera, 2006), often making them unsustainable. Current rates of biodiversity loss, the reduction of fish stocks, and declining small-scale fisheries dictate the need for a thorough understanding of issues relating to small-scale fisheries and the implementation of fishery management plans that are integrated in coastal management plans.

With fewer than an estimated 700 individuals surviving (Karamanlidis et al., 2016), the Mediterranean monk seal (*Monachus monachus*) is listed as 'Endangered' by the International Union for the Conservation of Nature (IUCN) (Karamanlidis & Dendrinos, 2015) and is one of the most endangered marine mammals on Earth. One of the biggest subpopulations of the species occurs in the eastern Mediterranean Sea, around the islands of the Aegean and Ionian seas and along the coasts of mainland Greece, Turkey, and Cyprus (Karamanlidis, Adamantopoulou, Tounta, & Dendrinos, 2019). Despite encouraging signs of partial subpopulation recovery (Karamanlidis et al., 2019; Nicolaou, Dendrinos, Marcou, Michaelides, & Karamanlidis, 2019), the species is still threatened in this part of its distribution by various factors, including, most importantly, negative interactions with small-scale fisheries (Androukaki, Adamantopoulou, Dendrinos, Tounta, & Kotomatas, 1999; Karamanlidis et al., 2008; Karamanlidis et al., 2016).

Interactions between the Mediterranean monk seal and small-scale fisheries are a complex issue, negatively affecting both the seals and the fishers. Field research throughout Greece has shown that accidental entanglement in fishing gear and deliberate killing by fishers are among the main causes of death for the Mediterranean monk seal (Androukaki et al., 1999; Karamanlidis et al., 2008). Accidental entanglement in fishing gear affects mainly inexperienced, subadult individuals, whereas deliberate killing by fishers is often triggered by actual or perceived damage to catches and/or fishing gear, and affects mainly adult individuals (Androukaki et al., 1999). Furthermore, research on the dietary preferences of the species in Greece indicates an overlap between the prey of the Mediterranean monk seal and some commercially important species targeted by small-scale fisheries (Karamanlidis et al., 2014; Karamanlidis, Kallianiotis, Psaradellis, & Adamantopoulou, 2011;

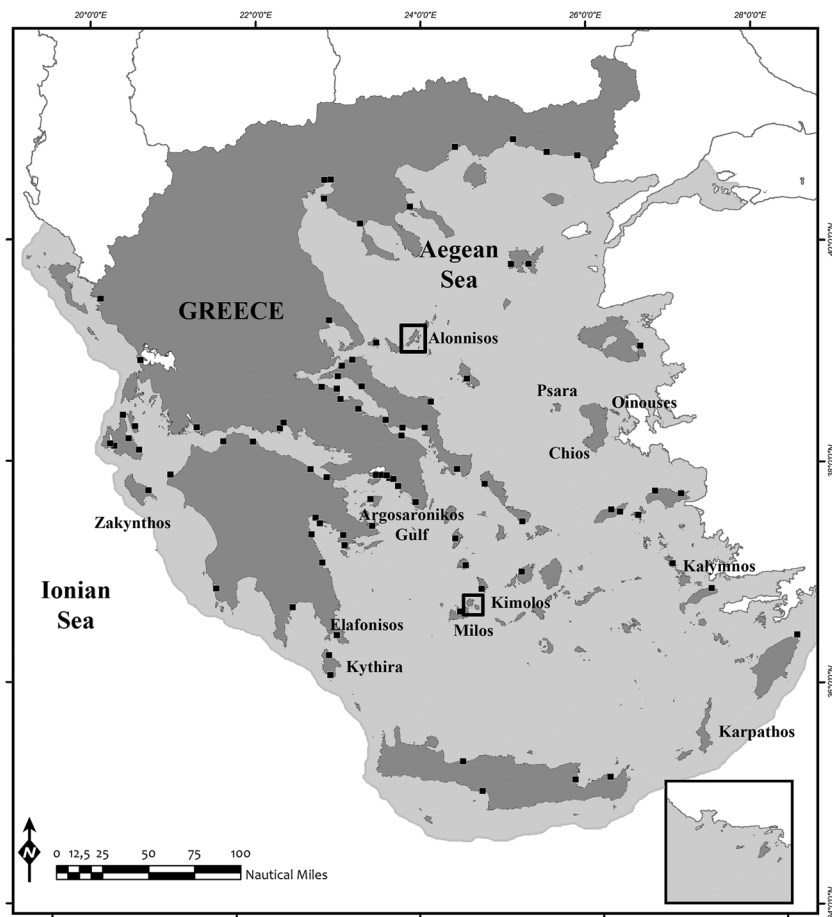
Pierce et al., 2011), thus creating the potential for negative seal-fishery interactions.

The Endangered status of the Mediterranean monk seal (Karamanlidis & Dendrinos, 2015) and the importance of small-scale fisheries to the economy and social structure of Greece (Papaconstantinou, Zenetos, Vassilopoulou, & Tserpes, 2007) dictate the need for a thorough understanding of interactions between the seals and small-scale fisheries in the country. This understanding should include knowledge of the present nature, extent, and impact of the conflicts between seals and fishers, and should ultimately lead to the development of effective conservation strategies that will alleviate some concerns and reduce financial losses, thus increasing support for the recovery of the species in the country. The aims of the present study were to: (i) describe the main characteristics of the small-scale fisheries involved in negative seal-fishery interactions in Greece; and (ii) understand the nature and assess the magnitude of interactions between the Mediterranean monk seal and small-scale fisheries in the country. This information is used to identify priority management actions within the framework of the development of an effective conservation strategy for the Mediterranean monk seal in Greece.

## 2 | METHODS

### 2.1 | Data collection and analysis

Data on interactions between the Mediterranean monk seal and small-scale fisheries were collected through a nationwide questionnaire survey among professional fishers and port police authorities in Greece; questionnaire surveys have been useful in the study of the Mediterranean monk seal and other marine mammal-fishery interactions in Greece (Glain, Kotomatas, & Adamantopoulou, 2001; Pardalou & Tsikliras, 2018). The questionnaire survey involved in-person interviews with fishers over the period 2006–2017 from 12 areas (i.e. the Argosaronic Gulf and the islands of Alonnisos, Chios, Elafonisos, Kalymnos, Karpathos, Kimolos, Kythira, Milos, Oinouises, Psara, and Zakynthos; Figure 1) that are considered to host important Mediterranean monk seal subpopulations in Greece (MOM, 2007). The questionnaires were carried out in the fishers' main fishing ports and included two types of questions (i.e. open and closed) addressing five thematic issues: (i) the demographic and socio-economic characteristics of small-scale fishers in Greece; (ii) the technical characteristics of small-scale fishing boats in Greece; (iii) small-scale fishing practices in Greece; (iv) problems of small-scale fisheries in Greece; and (v) local status of Mediterranean monk seal populations and their interactions with small-scale fisheries in Greece. The questionnaires were slightly modified and sent to the port police authorities throughout the country. The questionnaires to the port police authorities were returned via fax or e-mail. The combination of on- and off-site questionnaires with fishers and port police authorities, respectively, formed a representative sample for the nationwide evaluation of interactions between the Mediterranean monk seal and fisheries in Greece.



**FIGURE 1** Map of Greece indicating the 12 areas and the locations of 64 port police authorities () where a questionnaire survey on interactions between Mediterranean monk seals and small-scale fisheries was carried out (2006–2017). A second round of interviews conducted during landings was carried out in two areas in 2006–2009 (Alonissos and Kimolos, boxed). The light-grey shaded marine area indicates the distribution of the Mediterranean monk seal in the northeastern Mediterranean Sea, according to Karamanlidis and Dendrinos (2015)

To complement or substantiate the results of our nationwide questionnaire survey, a second round of interviews was carried out with fishers in two of the questionnaire areas: the islands of Alonissos and Kimolos. At the end of each fishing trip, during landing operations, fishing boats were visited and information regarding the gear damaged, the depth and area of any incident, the severity of the damage, and the size of the net damaged were collected. Following extensive discussions with the fishers in the preparatory phase of the study, and considering the complexity of the issue (i.e. attacked nets may be characterized by higher catches per unit effort than un-attacked nets; Rocklin et al., 2009), only seal–fisheries interactions related to material damage were recorded and not the damage caused to the fish caught, because Mediterranean monk seals are capable of removing fishes from the hooks of longlines without leaving a trace of their presence. The severity of the damage was estimated in terms of days required to repair the damage: ‘small’ damage required 1 day or less to be repaired, whereas ‘medium’ and ‘large’ damage required 1–2 and >3 days of work to be repaired, respectively (where a day represents 8 hours of work).

To describe the size and nature of small-scale fisheries and assess the type and magnitude of interactions between the Mediterranean monk seal and small-scale fisheries we used descriptive statistics to summarize results and non-parametric tests (e.g. Mann–Whitney test, Kruskal–Wallis test, or  $\chi^2$  test of independence), where appropriate, for comparisons (Siegel & Castellan,

1988; Zar, 1999). We set all significance levels to  $\alpha = 0.05$  and carried out the analyses using SPSS 15.

### 3 | RESULTS

#### 3.1 | Questionnaire survey

From 2006 to 2017 we interviewed 252 fishers in Greece (i.e. Alonissos = 17, Argosaronic Gulf = 56, Chios = 41, Elafonisos = 26, Kalymnos = 40, Karpathos = 14, Kimolos = 1, Kithira = 17, Milos = 2, Oinousses = 5, Psara = 13, and Zakynthos = 20). The sample was chosen randomly and represented between 50 and 100% of the professional fishers registered in the local fishing association, with the exception of the Argosaronic Gulf (i.e. 23%). In addition, 64 completed questionnaires were received from port police authorities in Greece (Figure 1).

##### 3.1.1 | Demographic and socio-economic characteristics of small-scale fishers in Greece and technical characteristics of their fishing boats

The majority of the small-scale fishers interviewed owned their own fishing boat, were 40–60 years of age, and had completed compulsory

education. Fishing was in general their main year-round occupation and their sole source of income. In general, old and small fishing boats were used in the small-scale fisheries of Greece (for details on the demographic and socio-economic characteristics of small-scale fishers in Greece and the technical characteristics of their fishing boats see Tables S1 and S2, respectively).

### 3.1.2 | Small-scale fishing practices in Greece

A wide variety of fishing practices were deployed throughout Greece (for details, see Table S3). Fishing trips varied according to season: in winter (i.e. December–February) fishers fished a mean of 13.57 days per month and each fishing trip lasted 1.58 days. In spring (i.e. March–May), summer (i.e. June–August), and autumn (i.e. September–November) fishers fished a mean of 19.86, 22.45, and 18.80 days per month, and each fishing trip lasted on average 2.55, 3.11, and 1.95 days, respectively. The differences in the time spent fishing per season and the duration of a fishing trip were both significant (time spent fishing per season, Kruskal–Wallis  $\chi^2 = 150.57$ ,  $df = 3$ ,  $P < 0.05$ ; fishing trip duration, Kruskal–Wallis  $\chi^2 = 32.79$ ,  $df = 3$ ,  $P < 0.05$ ). Most fishing trips occurred and lasted longer in summer; the least and shortest fishing trips occurred in winter. The annual fishing effort averaged 201.55 days and varied significantly throughout Greece (Kruskal–Wallis  $\chi^2 = 42.09$ ,  $df = 11$ ,  $P < 0.05$ ). Fishing activity was highest in Kalymnos and lowest in Psara (for details, see Table S4).

### 3.1.3 | General problems of small-scale fisheries in Greece

The majority (97.6%) of fishers in Greece believed that there was a reduction of fish stocks in their respective fishing grounds, mainly as a

result of overfishing (35%) and illegal fishing by amateur (25.1%) and professional fishers (18.9%). As a solution to overfishing, the majority of fishers believed that the better implementation of the already existing legal framework (31.96%) and the temporal and geographical closure of areas to fishing (23.24%), to allow fish stocks to recover, would be the most effective solutions. The biggest problem to the small-scale fishery in Greece that fishers identified most often was the damage caused by marine mammals, before overfishing, illegal fishing by amateur and professional fishers, and pollution (chi-square goodness of fit  $\chi^2 = 808.66$ ,  $df = 5$ ,  $P < 0.05$ ; for details, see Table S5).

### 3.1.4 | Status of local Mediterranean monk seal populations and their interactions with small-scale fisheries in Greece

During the surveys, detailed information on the status of local Mediterranean monk seal populations and their interactions with small-scale fisheries was collected. Monk seals were present, caused damage, and got accidentally entangled in fishing gear in all areas surveyed (Table 1).

Mediterranean monk seals were found to interact in various ways with small-scale fisheries throughout the year (i.e. scare fish away, remove fish from the fishing equipment, and damage fishing equipment and catch). In all questionnaire areas most damage was recorded during spring and summer (chi-square goodness of fit  $\chi^2 = 12.67$ ,  $df = 3$ ,  $P < 0.05$ ) at a mean depth of 31.62 m (SD = 20.64 m). Compared with the damage caused by dolphins (as reported by the fishers during the questionnaire survey), Mediterranean monk seal damage occurred in shallower depths and was less frequent (Mann–Whitney  $U$ -test = 5363.0,  $P < 0.05$ ; chi-square test of association  $\chi^2 = 6.28$ ,

**TABLE 1** Descriptive statistics of 252 questionnaires carried out with fishers in 12 survey areas in Greece (2006–2017) and characteristics of local Mediterranean monk seal populations and their interactions with small-scale fisheries (Pp. est., population estimate in individuals; Dm., causing damage; Ent., number of individuals accidentally entangled annually; Eq., type of equipment accidentally entangled in; Y, yes; LI, longline; percentages indicate the percentage that a specific answer was given compared with the total number of questionnaires carried out in a specific area)

Area	Questionnaires		Seals				
	<i>n</i>	Questionnaire period	Presence	Pp. Est.	Dm.	Ent.	Eq.
Alonnisos	17	2006–2009	Y = 100%	69.8	Y = 94%	0	–
Argosaronic Gulf	56	2015–2017	Y = 100%	18.5	Y = 82%	2	Net
Chios	41	2006–2009	Y = 98%	14.16	Y = 95%	1.4	Net
Elafonisos	26	2006–2009	Y = 100%	14.38	Y = 100%	3.3	Net
Kalymnos	40	2006–2009	Y = 100%	20.3	Y = 100%	1.3	Net
Karpathos	14	2006–2009	Y = 100%	26.68	Y = 100%	1	LI
Kimolos	1	2006–2009	Y = 100%	100	Y = 100%	0	–
Kythira	17	2006–2009	Y = 100%	11.69	Y = 82%	1	Net
Milos	2	2006–2009	Y = 100%	67.5	Y = 100%	3	Net
Oinousses	5	2006–2009	Y = 100%	7.8	Y = 100%	1	Net
Psara	13	2006–2009	Y = 100%	12.67	Y = 92.3%	1	Net
Zakynthos	20	2006–2009	Y = 95%	14.76	Y = 95%	1.7	Net

df = 2,  $P < 0.05$ ). Fishers claimed to be able to distinguish between Mediterranean monk seal and dolphin damage to fishing gear, mainly by the damage patterns on the nets (i.e. seals create between three and five distinctive holes in the net, whereas dolphins make one big hole or rip a strip off the net). Seals more often than expected damaged nets and long lines, whereas dolphins more often damaged nets (chi-square test of association  $\chi^2 = 27.63$ , df = 2,  $P < 0.05$ ). The financial impact of this damage also differed significantly: in all questionnaire areas Mediterranean monk seals more often than expected caused small and medium damage, whereas dolphins more often caused big damage (chi-square test of association  $\chi^2 = 27.63$ , df = 2,  $P < 0.05$ ). As a response to this damage most fishers did not take mitigation measures, as they generally believed (either through experience or through hearsay) that the mitigation measures available were not an effective solution to the problem. As the most appropriate solution to alleviate their losses from damage caused by marine species (i.e. monk seals, dolphins, sharks, and turtles), the majority of fishers regarded compensation (62.5%) and/or subsidies (26.5%) to purchase new fishing equipment as the best solution. A minority (11%) did not hesitate to suggest killing marine animals as the most effective solution, however.

Mediterranean monk seals were present in most of the port police authorities' areas of jurisdiction and were considered to cause damage to nets, mainly during the summer. This damage was considered to be less frequent than that caused by dolphins. The majority of the port police authorities did not receive any reports of seals being accidentally entangled in fishing gear. Most port police authorities believed that there was a significant decrease of fish stocks and that overfishing was the biggest issue for small-scale fisheries in their area of jurisdiction (for details, see Table S6).

### 3.2 | Second round of interviews during landings

From 2006 to 2009 a second round of interviews was carried out in Alonnisos and Kimolos with information collected from 355 and 342 fishing trips, respectively (Table 2). Damage to fishing gear was recorded in 20.5% of fishing trips, mostly during the spring in Alonnisos and in the summer in Kimolos, at depths of 40–60 m, and affected all gear used in the two areas, i.e. trammel nets, gill nets, and long lines. The damage to fishing gear was usually classed as small (i.e. Alonnisos) or medium (i.e. Kimolos) (Table 2). On average 1% of a net was destroyed by a Mediterranean monk seal and needed to be replaced after each daily fishing trip.

## 4 | DISCUSSION

Small-scale fisheries are of primary importance to the economic and socio-cultural life of Greek society, especially in the coastal and insular areas of the country (Tzanatos et al., 2006; Tzanatos, Dimitriou, Katselis, Georgiadis, & Koutsikopoulos, 2005); this fisheries sector has recently undergone major structural changes and is showing a decreasing trend (Tzanatos et al., 2005), which may even have been exacerbated by the financial crisis affecting Greece since 2010 (Machias, Tsagarakis, & Matsaganis, 2016). In this context, negative interactions between marine mammals and fishers can become increasingly frustrating for both parties. This is the first study to look into the interactions of the endangered Mediterranean monk seal and fishers on a national scale in Greece and propose concrete management actions to mitigate them. Interactions between monk seals and small-scale fisheries were assessed through questionnaires that made use of local ecological knowledge, primarily from fishers; this

**TABLE 2** Summary results of the on-site monitoring of small-scale fishery trips in two areas of Greece (2006–2009) (the most frequent results are highlighted in bold)

	Alonnisos	Kimolos
Number of fishing trips monitored	355	342
Fishing gear attacked	Trammel nets, gill nets, longlines	Trammel nets, longlines
Number of attacks	68 (19%)	76 (22%)
Damage frequency (in %) per fishing gear	<b>Trammel nets (56%)</b> , gill nets (29%), longlines (15%)	<b>Trammel nets (75%)</b> , longlines (25%)
Seasons the gear were attacked	<b>Spring 34%</b> , Summer 32%, Autumn 19%, Winter 15%	Spring 21%, <b>Summer 29%</b> , Autumn 24%, Winter 26%
Depths at which attacks were recorded	<20 m 3%, 20 – 40 m 31%, <b>40–60 m 59%</b> , >60 m 7%	<20 m 18%, 20 – 40 m 34%, <b>40–60 m 41%</b> , >60 m 7%
Severity of the damage	<b>Small damage 50%</b> , Medium damage 20%, Large damage 30%	Small damage 28%, <b>Medium damage 44%</b> , Large damage 28%
Description of the damage	Most of the times seals made one or more round holes of 0.5–1.0 m <sup>2</sup> in size, along the length of the nets. The distance between damage points was sometimes large (i.e. up to 400 m), indicating that seals are capable of damaging a large part of the net	Most of the time seals made one or more round holes of 0.5–1.0 m <sup>2</sup> in size, along the length of the nets. The distance between damage points was sometimes large (i.e. up to 400 m), indicating that seals are capable of damaging a large part of the net

methodology is widely used and has been successful in the study of fisheries- and biodiversity-related issues elsewhere (e.g. Bender et al., 2014; Dmitrieva et al., 2013).

Our results with regards to the demographic and socio-economic characteristics of small-scale fishers and the technical characteristics of the fishing boats and the fishing practices involved in negative interactions with Mediterranean monk seals were all in accordance with the typology of small-scale fisheries in Greece. Small-scale fishers in Greece were relatively old, had mostly received compulsory education, and fishing was their sole source of income (Conides, 2007; Tzanatos et al., 2006); this type of fishing activity may be a last refuge if other income-generating activities are not available (Betke, 1985). The boats used in small-scale fisheries in Greece were relatively old, poorly equipped, and usually small, which in turn confines them to operate mostly at depths of <100 m and close to the coast (i.e. usually less than 2 miles offshore; Petrakis & Stergiou, 1995). As a result, and in order to maximize potential income-generating activities, small-scale fisheries in Greece are forced to use a wide variety of fishing gear, targeting a large number of species (Adamidou, 2007). Fishing activity in Greece varied significantly depending on the region and the season (Tzanatos et al., 2005). All these facts are indicative of a fishing sector that is of limited operational and financial capacity, and highlight the great heterogeneity and complexity of the small-scale fishing sector in Greece (Tzanatos et al., 2005).

Overfishing was commonly perceived as the main reason for the reduction of fish stocks throughout Greece, which is in accordance with the overall negative trends in fish landings in Greece (Stergiou, Moutopoulos, & Tsikliras, 2007; Stergiou, Moutopoulos, Tsikliras, & Papaconstantinou, 2007), and with the local reduction of commercially valuable species (Bearzi, Politi, Agazzi, & Azzellino, 2006) and fish species important to the diet of the Mediterranean monk seal, such as the octopus (*Octopus vulgaris*) (Tsangridis, Sánchez, & Ioannidou, 2002). Overfishing also appears to have negatively affected common dolphin populations (*Delphinus delphis*) in the eastern Ionian Sea (Bearzi et al., 2008) and marine turtles (*Caretta caretta*) in Crete (Panagopoulou, Meletis, Margaritoulis, & Spotila, 2017). Throughout the country the better implementation of the existing legal framework was generally considered as the most appropriate solution for dealing with overfishing (Gonzalvo, Giovos, & Moutopoulos, 2015; Gonzalvo, Moutopoulos, Bearzi, & Stergiou, 2011). Despite the universal recognition of overfishing as the main cause of fish stock reduction in Greece, fishers prioritized the need to find a solution to marine mammal-fishery interactions over any other fishery-related problem (see also Panagopoulou et al., 2017). As in other areas of Greece where questionnaire surveys have been carried out to assess marine mammal-fishery interactions (Bearzi, Bonizzoni, & Gonzalvo, 2011), we believe that the urgent desire to solve this problem was not indicative of the actual scale of the problem, and most likely was a reflection of the desire to provide a 'favourable' answer to a receptive ear, a phenomenon that is not uncommon in social survey data (Gilchrist, Mallory, & Merkel, 2005).

The presence of Mediterranean monk seals and negative interactions of seals with fisheries were reported by all fishers and the majority of the port police authorities from most areas in Greece, including areas with high human presence (e.g. the Argosaronic Gulf), which is consistent with the best understanding of the current distribution and the recovery process of the species in Greece (Adamantopoulou, Androukaki, & Kotomatas, 1999; Karamanlidis et al., 2016). Negative interactions with small-scale fisheries were similar to those recorded previously within the country (Karamanlidis et al., 2008; Ríos, Drakulic, Paradinas, Milliou, & Cox, 2017; Tounta, Karamanlidis, Kotomatas, & Dendrinis, 2006), and throughout the range of the species in Turkey (Güçlüsoy, 2008), Madeira (Hale, Pires, Santos, & Karamanlidis, 2011), and Cabo Blanco (González & Fernandez de Larrinoa, 2012). As in other seal species (Moore, 2003), these interactions included the damage of fishing gear and catches and entanglement in fishing gear. Accidental entanglement in fishing nets is considered one of the main threats for the Mediterranean monk seal in Greece (Karamanlidis et al., 2008) and in the eastern Mediterranean Sea in general (Karamanlidis et al., 2016).

The questionnaire surveys in combination with the second round of interviews during landings suggested that the damage to fishing gear caused by Mediterranean monk seals occurred throughout the year, with a peak in spring-summer; a similar pattern has been recorded for Mediterranean monk seals in the eastern Aegean (Ríos et al., 2017) and for dolphins in the Ionian Sea (Gonzalvo et al., 2015). This pattern most likely reflects the local fishing patterns and efforts of small-scale fisheries in Greece (Tzanatos et al., 2005) rather than an actual damage pattern. Similarly, the fact that damage to nets caused by Mediterranean monk seals was less frequent than damage caused by dolphins most likely reflects the smaller seal populations locally, as compared with dolphin populations. The frequency of seal damage to fishing nets recorded during the second round of interviews during landings (i.e. 20.5%) was similar to that recorded in the eastern Aegean Sea (Ríos et al., 2017) and was considered moderate to high (for a comparison, see Szteren & Páez, 2002; Kauppinen, Siira, & Suuronen, 2005; Königson, Lundström, Hemmingsson, Lunneryd, & Westerberg, 2006).

#### 4.1 | Relevance for the conservation of the Mediterranean monk seal

Considering the wide-scale range of fish stock reduction (Tsikliras, Dinouli, Tsiros, & Tsalkou, 2015; Tsikliras, Tsiros, & Stergiou, 2013) and negative seal-fishery interactions in Greece, together with the current socio-economic reality of small-scale fisheries and the wide distribution of the Mediterranean monk seal in the country (MOM, 2007), and also the limited success of technical mitigation measures to reduce marine mammal by-catch and entanglement so far (Hamilton & Baker, 2019), we believe that priority management actions should focus on improving the overall status of fish stocks and changing the fishing behaviour of the fishers, while at the same time alleviating some of the financial losses. Also, taking into account the

temporal and spatial uniformity of the answers provided by the fishers to questions regarding monk seal–fishery interactions and the ability of monk seals to travel extensively throughout Greece (Adamantopoulou et al., 2011), we believe that priority management actions should be designed and implemented at a national level, and could include:

- General management actions to improve the overall status of fish stocks in Greece through the stricter enforcement of the existing legal framework and the establishment of fishing restrictions/no-take zones, which have proven to be successful in improving the status of fish populations (e.g. Dimarchopoulou, Dogrammatzi, Karachle, & Tsikliras, 2018) in Greece; the results of our study suggest that both actions are widely accepted by fishers in Greece
- Specific management actions, including:
  1. The cessation of fishing activities in Greece during May, an important month for the reproduction of many fish species and a period when 30% of juvenile monk seals are drowned as a result of entanglement in fishing gear (Androukaki et al., 1999)
  2. A change in the fishing behaviour of the fishers, where they can reduce depredation by increasing the mesh size of their static gear to a minimum of 40 mm stretched mesh size (this mesh size has been suggested to improve fishing selectivity and to be beneficial for the recovery of fish populations in Greece; Merino, Karlou-Riga, Anastopoulou, Maynou, & Leonart, 2007), and can also reduce depredation rates by reducing the soaking time, tending the gear more frequently, and/or fishing in deeper waters (Rafferty, Brazer, & Reina, 2012), and by using alternative fishing gear (e.g. fishing traps)
  3. Banning octopus fishing by recreational fishers and professional fishers using traps from May to July, as this is an important period for the reproduction of the octopus, which makes up a large portion of the monk seal diet in Greece (Karamanlidis et al., 2014; Pierce et al., 2011). Fishery restrictions have also been proposed elsewhere in Greece as a measure to protect octopus populations and the viability of the fisheries of the species (Tsangridis et al., 2002). Furthermore, we believe that an increase of the official minimum landing weight for octopus from 500 g (Katsanevakis & Verriopoulos, 2006) to 750 g would benefit octopus stocks in Greece
  4. The provision of compensation to help alleviate financial losses arising from attacks to fishing nets by Mediterranean monk seals has been suggested by fishers as a good conservation intervention (results of the present study, but also see Panagopoulou et al., 2017). The proposed financial aid (FA) for nets damaged by Mediterranean monk seals in Greece could be calculated as  $FA = X \cdot Y \cdot 0.21 \cdot 0.011 \cdot K$ , with  $X$  representing the average number of fishing days per year (e.g. 200 days, as determined by the present study),  $Y$  representing the maximum length of fishing gear allowed per fisher (e.g. 4000 m), 0.21 representing the average rate of damage to fishing gear by Mediterranean monk seals (as determined by the present study, but also see Ríos et al., 2017), 0.011 representing the average damage by Mediterranean monk seals per fishing day on the length

of nets (as determined by the present study), and  $K$  representing the cost of the fishing gear per metre

Currently, EU regulation no.508/2014, Article 40(1)h foresees the establishment of compensation schemes for damage caused by marine mammals to fish catches only. Considering the endangered status of the Mediterranean monk seal, the current lack of detailed information on the damage caused by the Mediterranean monk seal to fish catches, and also the difficulty in quantifying them, we suggest a change in the EU regulation so as to include the establishment of a compensation scheme for damage to fishing gear. In the case of the Mediterranean monk seal this would provide conservationists with a powerful tool for protecting the species and encouraging its recovery in the eastern Mediterranean Sea.

## ACKNOWLEDGEMENTS

We would like to thank all the members of MOM and WWF Hellas that participated in different phases of this study. The study received funding from the LIFE05 NAT/GR/000083 'MOFI – Monk seal & fisheries: mitigating the conflict in Greek seas' project, the Bank of Piraeus, the Prefecture of Magnesia, the International Fund for Animal Welfare, the Stavros Niarchos Foundation, and the Thalassa Foundation ('The Mediterranean monk seal *Monachus monachus* returns to the coasts of the Argosaronic Gulf' project). All research activities were carried out within the framework of the research permits 184316/4337, 165523/88, and 118956/3033 of the Hellenic Ministry of Environment & Climate Change.

## CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

## ORCID

Alexandros A. Karamanlidis  <https://orcid.org/0000-0003-0943-1619>

## REFERENCES

- Adamantopoulou, S., Androukaki, E., Dendrinis, 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>
- Adamantopoulou, S., Androukaki, E., & Kotomatas, S. (1999). The distribution of the Mediterranean monk seal in Greece based on an information network. *Contributions to the Zoogeography and Ecology of the Eastern Mediterranean Region*, 1, 399–404.
- Adamidou, A. (2007). Commercial fishing gears and methods used in Hellas. In C. Papaconstantinou, A. Zenetos, V. Vassilopoulou, & G. Tserpes (Eds.), *State of Hellenic Fisheries* (pp. 118–131). Athens: HCMR Publications. ISBN: 978-960-98054-1-4.
- Androukaki, E., Adamantopoulou, S., Dendrinis, P., Tounta, E., & Kotomatas, S. (1999). Causes of mortality in the Mediterranean monk seal (*Monachus monachus*) in Greece. *Contributions to the Zoogeography and Ecology of the Eastern Mediterranean Region*, 1, 405–411.
- Bearzi, G., Agazzi, S., Gonzalvo, J., Costa, M., Bonizzoni, S., Politi, E., ... Reeves, R. R. (2008). Overfishing and the disappearance of short-beaked common dolphins from western Greece. *Endangered Species Research*, 5, 1–12. <https://doi.org/10.3354/esr00103>

- Bearzi, G., Bonizzoni, S., & Gonzalvo, J. (2011). Dolphins and coastal fisheries within a marine protected area: Mismatch between dolphin occurrence and reported depredation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 21, 261–267. <https://doi.org/10.1002/aqc.1179>
- Bearzi, G., Politi, E., Agazzi, S., & Azzellino, A. (2006). Prey depletion caused by overfishing and the decline of marine megafauna in eastern Ionian Sea coastal waters (central Mediterranean). *Biological Conservation*, 127, 373–382. <https://doi.org/10.1016/j.biocon.2005.08.017>
- Bender, M. G., Machado, G. R., de Azevedo Silva, P. J., Floeter, S. R., Monteiro-Netto, C., Luiz, O. J., & Ferreira, C. E. (2014). Local ecological knowledge and scientific data reveal overexploitation by multigear artisanal fisheries in the Southwestern Atlantic. *PLoS ONE*, 9, e110332. <https://doi.org/10.1371/journal.pone.0110332>
- Betke, F. (1985). Indonesia's seafishery today – the blue revolution, a new development tragedy. *International Asian Forum*, 16, 303–322.
- Cinner, J. E., Daw, T., & McClanahan, T. R. (2009). Socioeconomic factors that affect artisanal fishers' readiness to exit a declining fishery. *Conservation Biology*, 23, 124–130. <https://doi.org/10.1111/j.1523-1739.2008.01041.x>
- Conides, A. (2007). Socio-economic status of the Hellenic capture fisheries sector. In C. Papaconstantinou, A. Zenetos, V. Vassilopoulou, & G. Tserpes (Eds.), *State of Hellenic Fisheries* (pp. 172–178). Athens: HCMR Publications.
- Dimarchopoulou, D., Dogrammatzi, A., Karachle, P. K., & Tsikliras, A. C. (2018). Spatial fishing restrictions benefit demersal stocks in the north-eastern Mediterranean Sea. *Scientific Reports*, 8(5967), 1–11. <https://doi.org/10.1038/s41598-018-24468-y>
- Dmitrieva, L., Kondakov, A. A., Oleynikov, E., Kydyrmanov, A., Karamendin, K., Kasimbekov, Y., ... Goodman, S. J. (2013). Assessment of Caspian Seal By-Catch in an illegal fishery using an interview-based approach. *PLoS ONE*, 8, e67074. <https://doi.org/10.1371/journal.pone.0067074>
- Gilchrist, G., Mallory, M., & Merkel, F. (2005). Can local ecological knowledge contribute to wildlife management? *Ecology and Society*, 10(1), 20. <https://doi.org/10.5751/es-01275-100120>
- Glain, D., Kotomatas, S., & Adamantopoulou, S. (2001). Fishermen and seal conservation: Survey of attitudes towards monk seals in Greece and grey seals in Cornwall. *Mammalia*, 65, 309–317. <https://doi.org/10.1515/mamm.2001.65.3.309>
- Gómez, S., Lloret, J., Demestre, M., & Riera, V. (2006). The decline of the artisanal fisheries in Mediterranean coastal areas: The case of Cap de Creus (Cape Creus). *Coastal Management*, 34, 217–232. <https://doi.org/10.1080/08920750500531389>
- González, L. M., & Fernandez de Larrinoa, P. (2012). Mediterranean monk seal *Monachus monachus* distribution and fisheries interactions in the Atlantic Sahara during the second half of the 20<sup>th</sup> century. *Mammalia*, 77, 41–49. <https://doi.org/10.1515/mammalia-2012-0046>
- Gonzalvo, J., Giovos, I., & Moutopoulos, D. K. (2015). Fishermen's perception on the sustainability of small-scale fisheries and dolphin-fisheries interactions in two increasingly fragile coastal ecosystems in western Greece. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 25, 91–106. <https://doi.org/10.1002/aqc.2444>
- Gonzalvo, J., Moutopoulos, D. K., Bearzi, G., & Stergiou, K. I. (2011). Fisheries mismanagement in a Natura 2000 area in western Greece. *Fisheries Management and Ecology*, 18, 25–38. <https://doi.org/10.1111/j.1365-2400.2010.00764.x>
- Güçlüsoy, H. (2008). Damage by monk seals to gear of the artisanal fishery in the Foça Monk Seal Pilot Conservation Area, Turkey. *Fisheries Research*, 90, 70–77. <https://doi.org/10.1016/j.fishres.2007.09.012>
- Hale, R., Pires, R., Santos, P., & Karamanlidis, A. A. (2011). Mediterranean monk seal (*Monachus monachus*): Fishery interactions in the Archipelago of Madeira. *Aquatic Mammals*, 37, 298–304. <https://doi.org/10.1578/AM.37.3.2011.298>
- Hamilton, S., & Baker, G. B. (2019). Technical mitigation to reduce marine mammal bycatch and entanglement in commercial fishing gear: Lessons learnt and future directions. *Reviews in Fish Biology and Fisheries*, 29, 223–247. <https://doi.org/10.1007/s11160-019-09550-6>
- Hawkins, J. P., & Roberts, C. M. (2004). Effects of artisanal fishing on Caribbean coral reefs. *Conservation Biology*, 18, 215–226. <https://doi.org/10.1111/j.1523-1739.2004.00328.x>
- Jackson, J. B., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., ... Hughes, T. P. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science*, 293, 629–637. <https://doi.org/10.1126/science.1059199>
- Jaramillo-Legorreta, J., Rojas-Bracho, L., Brownell, R. L. Jr., Read, A. J., Reeves, R. R., Ralls, K., & Taylor, B. L. (2007). Saving the vaquita: Immediate action, not more data. *Conservation Biology*, 21, 1653–1655. <https://doi.org/10.1111/j.1523-1739.2007.00825.x>
- Karamanlidis, A. A., Adamantopoulou, S., Tounta, E., & Dendrinos, D. (2019). *Monachus monachus* Eastern Mediterranean subpopulation. *The IUCN Red List of Threatened Species 2019*, e.T120868935A120869697. <https://doi.org/10.2305/IUCN.UK.2019-1.RLTS.T120868935A120869697.en>
- Karamanlidis, A. A., Androukaki, E., Adamantopoulou, S., Chatzispayrou, A., Johnson, W. M., Kotomatas, S., ... Dendrinos, P. (2008). Assessing accidental entanglement as a threat to the Mediterranean monk seal *Monachus monachus*. *Endangered Species Research*, 5, 205–213. <https://doi.org/10.3354/esr00092>
- Karamanlidis, A. A., Curtis, J. P., Hirons, A. C., Psaradellis, M., Dendrinos, D., & Hopkins, J. B. III (2014). Stable isotopes confirm a coastal diet for critically endangered Mediterranean monk seals. *Isotopes in Environmental and Health Studies*, 50, 332–342. <https://doi.org/10.1080/10256016.2014.931845>
- Karamanlidis, A. A., & Dendrinos, P. (2015). *Monachus monachus*. The IUCN Red List of Threatened Species 2015: ET13653A45227543.
- Karamanlidis, A. A., Dendrinos, P., Fernández de Larrinoa, P., Gücü, A. C., Johnson, W. M., Kiraç, C. O., & Pires, R. (2016). The Mediterranean monk seal *Monachus monachus*: Status, biology, threats, and conservation priorities. *Mammal Review*, 46, 92–105. <https://doi.org/10.1111/mam.12053>
- Karamanlidis, A. A., Kallianiotis, A., Psaradellis, M., & Adamantopoulou, S. (2011). Stomach contents of a subadult Mediterranean monk seal (*Monachus monachus*) from the Aegean Sea. *Aquatic Mammals*, 37, 280–283. <https://doi.org/10.1578/AM.37.3.2011.280>
- Katsanevakis, S., & Verriopoulos, G. (2006). Seasonal population dynamics of *Octopus vulgaris* in the eastern Mediterranean. *ICES Journal of Marine Science*, 63, 151–160. <https://doi.org/10.1016/j.icesjms.2005.07.004>
- Kauppinen, T., Siira, A., & Suuronen, P. (2005). Temporal and regional patterns in seal-induced catch and gear damage in the coastal trap-net fishery in the northern Baltic Sea: Effect of netting material on damage. *Fisheries Research*, 73, 99–109. <https://doi.org/10.1016/j.fishres.2005.01.003>
- Königson, S. J., Lundström, K. E., Hemmingsson, M. M., Lunneryd, S. G., & Westerberg, H. (2006). Feeding preferences of harbour seals (*Phoca vitulina*) specialised in raiding fishing gear. *Aquatic Mammals*, 32, 152–156. <https://doi.org/10.1578/AM.32.2.2006.152>
- Lloret, J., Muñoz, M., & Casadevall, M. (2012). Threats posed by artisanal fisheries to the reproduction of coastal fish species in a Mediterranean marine protected area. *Estuarine, Coastal and Shelf Science*, 113, 133–140. <https://doi.org/10.1016/j.ecss.2012.07.015>
- Machias, A., Tsagarakis, K., & Matsaganis, M. (2016). Greek fisheries and the economic crisis: structural analogies. *Ethics in Science and Environmental Politics*, 16, 19–23. <https://doi.org/10.3354/esep00170>

- Mangel, J. C., Alfaro-Shigueto, J., Van Waerebeek, K., Cáceres, C., Bearhop, S., Witt, M. J., & Godley, B. J. (2010). Small cetacean captures in Peruvian artisanal fisheries: High despite protective legislation. *Biological Conservation*, 143, 136–143. <https://doi.org/10.1016/j.biocon.2009.09.017>
- Merino, G., Karlou-Riga, C., Anastopoulou, I., Maynou, F., & Lleonart, J. (2007). Bioeconomic simulation analysis of hake and red mullet fishery in the Gulf of Saronikos (Greece). *Scientia Marina*, 71, 525–535. <https://doi.org/10.3989/scimar.2007.71n3525>
- MOm. (2007). *Status of the population of the Mediterranean monk seal (Monachus monachus) in Greece*. Athens, Greece: MOm/Hellenic Society for the Study and Protection of the Monk seal.
- Moore, P. G. (2003). Seals and fisheries in the Clyde Sea area (Scotland): Traditional knowledge informs science. *Fisheries Research*, 63, 51–61. [https://doi.org/10.1016/S0165-7836\(03\)00003-1](https://doi.org/10.1016/S0165-7836(03)00003-1)
- Nicolaou, H., Dendrinos, D., Marcou, M., Michaelides, S., & Karamanlidis, A. A. (2019). Re-establishment of the Mediterranean monk seal *Monachus monachus* in Cyprus: Priorities for conservation. *Oryx*, n/a, 1–3. <https://doi.org/10.1017/S0030605319000759>
- Panagopoulou, A., Meletis, Z. A., Margaritoulis, D., & Spotila, J. R. (2017). Caught in the same net? Small-scale fishermen's perceptions of fisheries interactions with sea turtles and other protected species. *Frontiers in Marine Science*, 4, Article 180, 1–15. <https://doi.org/10.3389/fmars.2017.00180>
- Papaconstantinou, C., Zenetos, A., Vassilopoulou, V., & Tserpes, G. (2007). *Status of Hellenic fisheries*. Athens: HCMR Publications.
- Pardalou, A., & Tsikliras, A. C. (2018). Anecdotal information on dolphin-fisheries interactions based on empirical knowledge of fishers in the northeastern Mediterranean Sea. *Ethics in Science and Environmental Politics*, 18, 1–8. <https://doi.org/10.3354/esep00179>
- Peckham, S. H., Maldonado-Díaz, D., Koch, V., Mancini, A., Gaos, A., Tinker, M. T., & Nichols, W. J. (2008). High mortality of loggerhead turtles due to bycatch, human consumption and strandings at Baja California Sur, Mexico, 2003 to 2007. *Endangered Species Research*, 5, 171–183. <https://doi.org/10.3354/esr00123>
- Petrakis, G., & Stergiou, K. I. (1995). Gill net selectivity for *Diplodus annularis* and *Mullus surmuletus* in the Hellenic waters. *Fisheries Research*, 21, 455–464. [https://doi.org/10.1016/0165-7836\(94\)00293-6](https://doi.org/10.1016/0165-7836(94)00293-6)
- Pierce, G. J., Hernandez-Milian, G., Santos, M. B., Dendrinos, P., Psaradellis, M., Tounta, E., ... Edridge, A. (2011). Diet of the Monk seal (*Monachus monachus*) in Greek waters. *Aquatic Mammals*, 37, 284–297. <https://doi.org/10.1578/AM.37.3.2011.284>
- Rafferty, A. R., Brazer, E. O. J., & Reina, R. D. (2012). Depredation by harbor seal and spiny dogfish in a Georges Bank gillnet fishery. *Fisheries Management and Ecology*, 19, 264–272. <https://doi.org/10.1111/j.1365-2400.2011.00837.x>
- Rios, N., Drakulic, M., Paradinas, I., Millioui, A., & Cox, R. (2017). Occurrence and impact of interactions between small-scale fisheries and predators, with focus on Mediterranean monk seals (*Monachus monachus* Hermann 1779), around Lipsi Island complex, Aegean Sea, Greece. *Fisheries Research*, 187, 1–10. <https://doi.org/10.1016/j.fishres.2016.10.013>
- Rocklin, D., Santoni, M.-C., Culioli, J.-M., Tomasini, J.-A., Pelletier, D., & Mouillot, D. (2009). Changes in the catch composition of artisanal fisheries attributable to dolphin depredation in a Mediterranean marine reserve. *ICES Journal of Marine Science*, 66, 699–707. <https://doi.org/10.1093/icesjms/fsp036>
- Siegel, S., & Castellan, N. J. (1988). *Non-parametric statistics for the behavioural sciences*. New York: Mc Graw-Hill Book Company.
- Solan, M., Cardinale, B. J., Downing, A. L., Engelhardt, K. A., Ruesink, J. L., & Srivastava, D. S. (2004). Extinction and ecosystem function in the marine benthos. *Science*, 306, 1177–1180. <https://doi.org/10.1126/science.1103960>
- Stergiou, K. I., Moutopoulos, D. K., & Tsikliras, A. C. (2007). Spatial and temporal variability in Hellenic marine fisheries landings. In A. Papaconstantinou, A. Zenetos, V. Vassilopoulou, & G. Tserpes (Eds.), *State of Hellenic Fisheries Athens* (pp. 141–150). Athens: HCMR Publications.
- Stergiou, K. I., Moutopoulos, D. K., Tsikliras, A. C., & Papaconstantinou, C. (2007). Hellenic marine fisheries: A general perspective from the National Statistical Service Data. In A. Papaconstantinou, A. Zenetos, V. Vassilopoulou, & G. Tserpes (Eds.), *State of Hellenic Fisheries* (pp. 132–140). Athens: HCMR Publications.
- Szteren, D., & Páez, E. (2002). Predation by southern sea lions (*Otaria flavescens*) on artisanal fishing catches in Uruguay. *Marine and Freshwater Research*, 53, 1161–1167. <https://doi.org/10.1071/MF02006>
- Taylor, B. L., Rojas-Bracho, L., Moore, J., Jaramillo-Legorreta, A., Ver Hoef, J. M., Cardenas-Hinojosa, G., ... Thomas, L. (2017). Extinction is imminent for Mexico's endemic porpoise unless fishery bycatch is eliminated. *Conservation Letters*, 10, 588–595. <https://doi.org/10.1111/conl.12331>
- Tounta, E., Karamanlidis, A. A., Kotomatas, S., & Dendrinos, P. (2006). Mediterranean monk seal and fishery interactions in the National Marine Park of Alonnisos, Northern Sporades. 10<sup>th</sup> International Congress on the Zoogeography and Ecology of the Eastern Mediterranean region, 26–30 June 2006; Patras, Greece.
- Tsangridis, A., Sánchez, P., & Ioannidou, D. (2002). Exploitation patterns of *Octopus vulgaris* in two Mediterranean areas. *Scientia Marina*, 66, 59–68. <https://doi.org/10.3989/scimar.2002.66n159>
- Tsikliras, A. C., Dinouli, A., Tsiros, V. Z., & Tsalkou, E. (2015). The Mediterranean and Black Sea fisheries at risk from overexploitation. *PLoS ONE*, 10, e0121188. <https://doi.org/10.1371/journal.pone.0121188>
- Tsikliras, A. C., Tsiros, V. Z., & Stergiou, K. I. (2013). Assessing the state of Greek marine fisheries resources. *Fisheries Management and Ecology*, 20, 34–41. <https://doi.org/10.1111/j.1365-2400.2012.00863.x>
- Turvey, S. T., Pitman, R. L., Taylor, B. L., Barlow, J., Akamatsu, T., Barrett, L. A., ... Wang, D. (2007). First human-caused extinction of a cetacean species? *Biology Letters*, 3, 537–540. <https://doi.org/10.1098/rsbl.2007.0292>
- Tzanatos, E., Dimitriou, E., Katselis, G., Georgiadis, M., & Koutsikopoulos, C. (2005). Composition, temporal dynamics and regional characteristics of small-scale fisheries in Greece. *Fisheries Research*, 73, 147–158. <https://doi.org/10.1016/j.fishres.2004.12.006>
- Tzanatos, E., Dimitriou, E., Papaharisis, L., Roussi, A., Somarakis, S., & Koutsikopoulos, C. (2006). Principal socio-economic characteristics of the Greek small-scale coastal fishermen. *Ocean and Coastal Management*, 49, 511–527. <https://doi.org/10.1016/j.ocecoaman.2006.04.002>
- Zar, J. H. (1999). *Biostatistical analysis*. Upper Saddle River, NJ: Prentice Hall.

## SUPPORTING INFORMATION

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

**How to cite this article:** Karamanlidis AA, Adamantopoulou S, Kallianiotis AA, Tounta E, Dendrinos P. An interview-based approach assessing interactions between seals and small-scale fisheries informs the conservation strategy of the endangered Mediterranean monk seal. *Aquatic Conserv: Mar Freshw Ecosyst*. 2020;30:928–936. <https://doi.org/10.1002/aqc.3307>