

Re-establishment of the Mediterranean monk seal *Monachus monachus* in Cyprus: priorities for conservation

HARIS NICOLAOU, PANAGIOTIS DENDRINOS, MELINA MARCOU
SAVVAS MICHAELIDES and ALEXANDROS A. KARAMANLIDIS

Abstract Once widespread throughout the Black and Mediterranean Seas and the coasts of north Africa, the Endangered Mediterranean monk seal *Monachus monachus* has disappeared throughout most of its original range. In Cyprus evidence suggests that the species became effectively extinct at the end of the 20th century. Following an increase of seal sightings around the island, a monitoring programme was established in 2009 to evaluate the status of the species. During 2009–2018, using field surveys, photographs from camera traps and an information network, we recorded an increasing number of seal sightings, and the birth of several pups, indicating the permanent presence of the species on the island. This is the first recorded re-establishment of a Mediterranean monk seal population in an area of its former range following near eradication.

Keywords Cyprus, eastern Mediterranean Sea, Endangered species, marine mammal, *Monachus monachus*, population recovery, scientific monitoring

Worldwide biodiversity is in decline and conservation success stories are comparatively rare (Butchart et al., 2010). However, although conservation successes do occur (e.g. Halley & Rosell, 2002; Balmford, 2017; Knowlton, 2019), highlighting the importance of conservation action, continued monitoring is required. Whilst species may return to areas where they were previously extirpated, many populations remain below historical abundance levels and do not reach the numbers necessary to secure long-term survival (Deinet et al., 2013). In such cases continued conservation actions are necessary to facilitate population recovery.

HARIS NICOLAOU Department of Forests, Ministry of Agriculture, Rural Development and Environment, Nicosia, Cyprus

PANAGIOTIS DENDRINOS and ALEXANDROS A. KARAMANLIDIS (Corresponding author, orcid.org/0000-0003-0943-1619) MOm/Hellenic Society for the Study and Protection of the Monk Seal, Athens, Greece
E-mail akaramanlidis@gmail.com

MELINA MARCOU and SAVVAS MICHAELIDES Department of Fisheries and Marine Research, Ministry of Agriculture, Rural Development and Environment, Nicosia, Cyprus

Received 5 March 2019. Revision requested 9 May 2019.

Accepted 11 June 2019. First published online 23 December 2019.

The Mediterranean monk seal *Monachus monachus* is categorized as Endangered on the IUCN Red List, with < 700 individuals remaining (Karamanlidis & Dendrinos, 2015). The species is, however, showing some signs of recovery. The population has increased in its principal range and extralimital sightings have been recorded throughout the eastern Mediterranean (Karamanlidis et al., 2016a). This increase in abundance resulted in a re-categorization from Critically Endangered to Endangered in 2015 (Karamanlidis & Dendrinos, 2015).

Monk seals were first mentioned as part of the native fauna of Cyprus in 1959 (Davidson, 1959), and the species appears to have steadily declined since then (Hadjichristophorou & Demetropoulos, 1994); the last previously reported reproductive activity was recorded during 1955–1958. However, during 1972–2006, 46 sightings of subadult and adult seals were recorded. Field surveys in 1997 and in 2005–2006 verified the existence of suitable habitat for the species and recorded its occasional presence, but failed to document any reproductive activity (Dendrinos & Demetropoulos, 2000; Demetropoulos et al., 2006; Demetropoulos, 2011), leading to the conclusion that only a small number of seals survived (Demetropoulos, 2011) or that the species was effectively extinct in Cyprus (Aguilar & Lowry, 2008). Following the report of a dead pup in 2009 (Demetropoulos, 2011) a study was initiated to evaluate the status of the Mediterranean monk seal in Cyprus and to identify priority conservation actions.

During 2009–2018 we evaluated the status of the Mediterranean monk seal in Cyprus (i.e. the coastline under the effective control of the Government of the Republic of Cyprus) following the monitoring framework used for the monk seal in Greece (MOm, 2007). This comprised (1) the establishment of a national information network to collect information on monk seal sightings reported by the general public (Adamantopoulou et al., 1999), (2) a coastline survey that evaluated potentially suitable seal habitat based on pre-defined criteria (Dendrinos et al., 2007), and (3) surveys that recorded terrestrial habitat use, identified individuals and recorded annual pup production through visual observations and the use of camera traps. Photo-identification used standard techniques (Forcada & Aguilar, 2000) and morphological criteria for monk seals (Samaranch & González, 2000).

The information network recorded 361 monk seal sightings (Fig. 1), most of which were in three areas in the north-

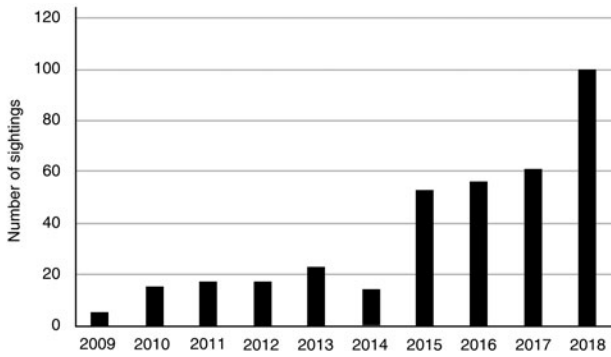


Fig. 1 Number of sightings of the Mediterranean monk seal *Monachus monachus* on and around Cyprus during 2009–2018.

west and south: Pafos–Akamas (166 sightings), Limassol (118 sightings), and Kavο Greko–Kavο Pyla (68 sightings; Fig. 2a). The majority of sightings (95%) were of juvenile and adult individuals, but 18 sightings of new-born pups were also reported. Some of these sightings may refer to the same individuals. No negative human–seal interactions were recorded.

In the survey of 370 km of coastline, 17 suitable monk seal shelters were identified (Fig. 2b), seven of which were suitable for pupping and 10 suitable only for resting. We visited the shelters a total of 185 times. On 78 occasions, we confirmed seal presence through direct observations or indirect evidence (e.g. scats, tracks). Twenty-three camera traps, installed at 13 of the shelters, covered a total of 4,120 trap days and recorded 342,000 images. A combination of visual observations, digital images and sightings reported by the general public led to the identification of 14 individual seals, including five new-born pups (one born in 2011, two in 2015 and one each in 2017 and 2018).

There is a long history of exploitation of, and negative interactions with, the Mediterranean monk seal, leading to the gradual disappearance of the species from most of its former

range (Karamanlidis et al., 2016a). Our findings, together with observations from northern Cyprus (Gücü et al., 2009), indicate that until 2009 the species was on the brink of extinction on the island (Aguilar & Lowry, 2008). Since the verified birth of a monk seal in Cyprus in 2009, sightings of the species have increased. Since 2015 births have been recorded almost annually, and pupping was recorded in 2018 in northern Cyprus (Taksent Nature Park, 2019). The presence of suitable habitat on the island (including in the north; Gücü et al., 2009), the increasing number of sightings and the recent pupping events indicate there is now a resident, reproducing Mediterranean monk seal population in the country. This is the first documented re-establishment of a Mediterranean monk seal population following its near eradication. We are unable to determine whether this recovery is attributable to the few animals that potentially survived on the island or is the result of immigration from populations in the Cilician Basin (Gücü et al., 2004) or Greece. In support of the latter, a pup born in 2015 shared the same haplotype as the monk seal population of the Cyclades Islands of Greece (MOM & DFMR, unpubl. data), the source of other extralimital sightings (Karamanlidis et al., 2016b).

Based on the current status of the Mediterranean monk seal in Cyprus we identify the following priority conservation actions for the species: (1) All habitat suitable for the Mediterranean monk seal in Cyprus (i.e. terrestrial and marine) should be effectively protected from tourism and development. (2) Human activity around pupping sites should be restricted by creation of 200 m protection zones. (3) A permanent monitoring plan should be established for the Mediterranean monk seal in Cyprus, including further development of the national information network, in combination with a rescue and rehabilitation plan for sick or injured seals and the involvement of the relevant public authorities and appropriate stakeholders. (4) An awareness campaign focusing on the general public and on

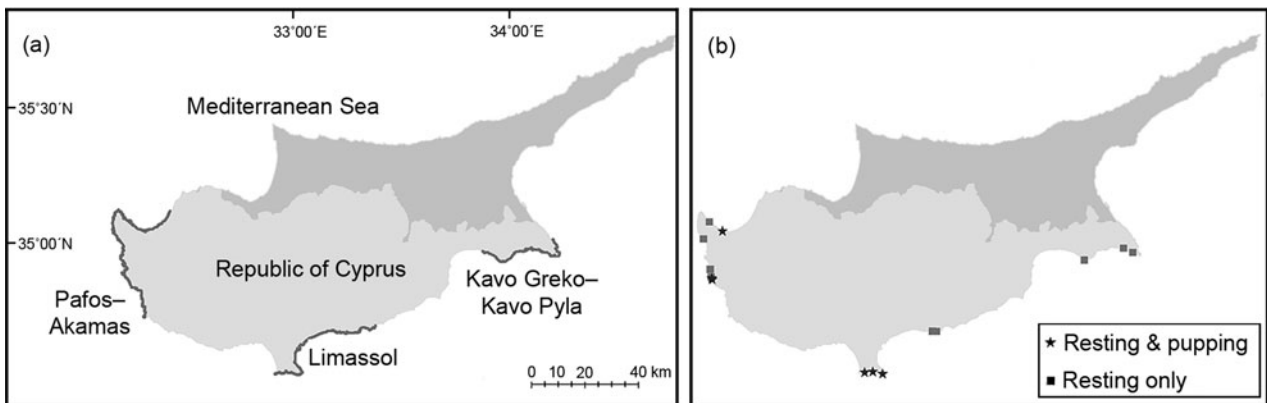


Fig. 2 Cyprus, showing (a) the three areas of the Republic of Cyprus where most of the monk seal sightings were made (Pafos–Akamas, 166 sightings; Limassol, 118 sightings; Kavο Greko–Kavο Pyla, 68 sightings), and (b) the locations of the 17 shelters identified as suitable for resting and pupping or resting only.

fishers should be developed, to help raise awareness of the status of, and threats to, the monk seal.

These actions are consistent with the National Action Plan for the conservation of the species (Demetropoulos, 2011). However, given the new information now available, the National Action Plan requires updating, to safeguard the future of the Mediterranean monk seal in Cyprus.

Acknowledgements We thank M. Hadjichristoforou and A. Demetropoulos for their assistance in establishing this project, and two anonymous reviewers for their critiques. This research received no specific grant from any funding agency, or commercial or not-for-profit sectors.

Author contributions Study design: all authors; fieldwork: HN, MM, SM; data analysis: HN, MM, SM, AAK; writing: all authors.

Conflicts of interest None.

Ethical standards This research abided by the *Oryx* guidelines on ethical standards.

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