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Mediterranean monk seals increased detection in the Gulf of Corinth (Greece) during CoViD-19 lockdown

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***Abstract* – Cryptic endangered species, such as the Mediterranean monk seal, need special conservation measures for their survival and habitat protection. Globally, CoViD-19 lockdown played as an environmental simulation of protection measures and practical conservation actions, such as the ban or mitigation of human activities in key habitats for the marine species.**
An analysis of the comparison between historical data and lockdown data about the presence of monk seal in the Gulf of Corinth remarked the evidence of increased sightings frequency of free-ranging individuals within the Alkionides Gulf, along the Perachora Peninsula, which could have beneficiated of the low anthropogenic impact situation. This area of the Gulf of Corinth indeed represents an essential habitat for this endangered species in Greek waters, where the enforcement of conservation measures will lead to effective protection, allowing seals population to increase, disperse, and re-colonise crucial sites.

I. INTRODUCTION

The Mediterranean monk seal (*Monachus monachus*, Hermann 1779) is one of the most endangered mammals in the world, classified as "Endangered" by IUCN experts [1].
While the species was historically widespread in the Mediterranean Sea, the Black Sea and Eastern Atlantic Ocean [2], the surviving population is now concentrated and fragmented in the Ionian and Aegean waters, the Madeira archipelago, and Cabo Blanco waters in the Eastern Atlantic Ocean [1], with occasional sightings in other areas. Indeed, the main surviving groups of Mediterranean monk seal are found in Greece and Mauritania. The dramatic decline of the species is addressed to several anthropogenic threats, such as habitat degradation, historical persecution and deliberate killing, negative interaction with fishery as well as natural causes [1].
The Ionian Archipelago features one of the most breeding areas globally for the Endangered Mediterranean monk seal. Therefore, the archipelago is identified as an Important Marine Mammal Area (IMMA) [3].
The erratic behaviour of this elusive species and the similar oceanographic characteristic of the adjacent Gulf of Corinth make this gulf suitable for the Mediterranean monk seal survival and conservation. Moreover, the Gulf of Corinth is already classified as IMMA [4]. Moreover, it is included in the Natura 2000 European network of protected areas (Site Code: GR2530007) thanks to its rich biodiversity of marine flora and fauna [5].
While regularly observed in the last century [6,7,8], when a colony of monk seals was considered the only important population known for continental Greece, a certain number of monk seals sightings are constantly reported in the Gulf [9] but many of them are still unpublished.
A regular land-based and boat-based monitoring activity carried out since June 2009, together with numerous reports provided by local citizens and tourists, confirms the regular presence of the species in the Northern Eastern area of the Gulf of Corinth during the last 11 years. Land-based monitoring surveys carried out during Corona Virus Disease of 2019 (CoViD-2019) lockdown showed an increased presence of monk seals, and for the first time in this century, a couple of individuals were observed together in the Gulf.

II. METHODS

A. The area of study: the Gulf of Corinth

The Gulf of Corinth belongs to the north-eastern Ionian Sea and separates the Peloponnesus Region from Northern Greece (Figure 1). On its western portion the Rion Strait, 2km wide and 65m deep, links the Gulf to the Ionian Sea. On its eastern side, the artificial channel of

Corinth leads to the Saronic Gulf and the Aegean Sea. Even if it is a semi-closed basin, the Gulf of Corinth presents a great variety of marine habitats, including pelagic waters, and upwelling currents induced by the wind [10]. In this scenario, the Gulf of Corinth offers the perfect conditions for the survival of many marine species.

B. Data collection

Monk seals presence has been investigated through boat-based and land-based surveys focusing on dolphins, starting from summer 2009.
Boat surveys were carried out in standard weather conditions (Beaufort $\leqslant 3$, Douglas $\leqslant 3$, visibility $\geqslant 5$ miles), employing a 12m sailing vessel, mainly during the summer season (Figure 1).
Land-based surveys were carried out year-round, in the same standard weather condition, from 3 different sites located in the Alkionides Gulf (Northern Eastern): Melangavi Cape, Milokopi, Petrita (Figure 1,2).
During the lockdown, following the CoViD-19 pandemic restrictions, only land-based surveys has been carried out.

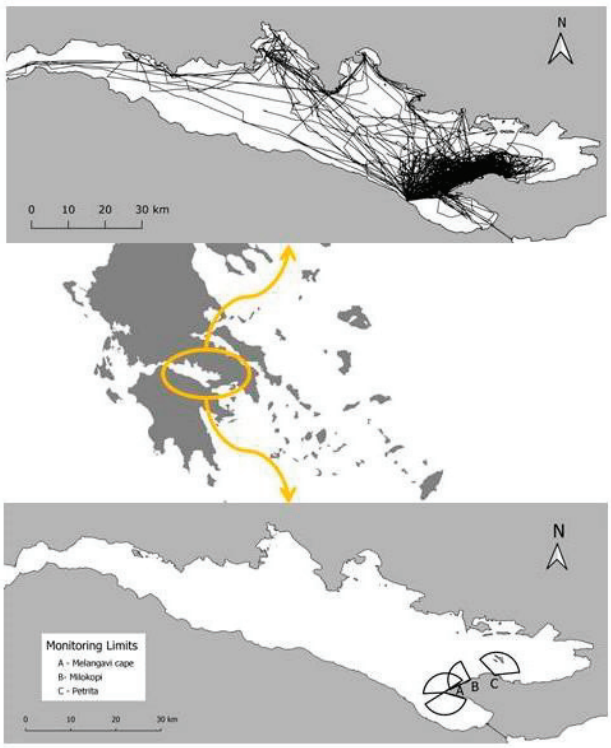

Figure 1: Area of Study. Central: Greece. The yellow oval shows the location of the Gulf of Corinth. Above: effort boat tracks in the Gulf of Corinth. Below: Land-based monitoring sites in the Alkionides Gulf.

Figure 2: Locations from which land based monitoring activity is regularly carried out: A) Melangavi Cape; B) Milokopi Cliff; C) Petrita Cliff.

C. Data analysis

Monk seals sighting frequency (number of sighting/hours of effort) has been calculated and compared among land-based and boat-based surveys.
Statistical analysis (Mann-Whitney Test) has been employed to investigate differences among monk seals sighting frequency of lockdown period and spring

seasons of previous years.

III. RESULTS

From June 2009 to June 2020, 243 boat surveys (729 hours of effort) 339 land surveys (778 hours of effort) were conducted during a dedicated monitoring activity carried out by experienced observer, in an area where monk seals were not previously reported.
Monk seals have been observed twelve times, twice in 2012, four times in 2018, six times in 2020 (Table 1).

Table 1. Monk seals sighting details

Date	Number of individuals	Time of the day
04/07/2012	1	19:50
24/07/2012	1	20:30
24/04/2018	1	11:52
08/05/2018	1	10:16
25/05/2018	1	17:51
12/07/2018	1	15:58
15/01/2020	1	11:00
10/04/2020	1	18:53
10/04/2020	2	19:32
11/04/2020	2	17:55
11/04/2020	1	17:02
12/04/2020	1	17:02

Ten sightings belong to the Alkionides Gulf, between Melangavi Cape and Strava, along the Perachora Peninsula, while a single sighting is referred to the Northern portion of the Gulf of Corinth (Figure 3).
Individual identification was not possible for all the sightings, because of the distance of observers (Figure 4).
64% of the sightings were recorded in the late afternoon, while the remaining 36% refers to the late morning.
Monk seal's sighting frequency results greater for land-based surveys (0.014 sight/effort hours) compared to boat-based surveys (0.003 sight/effort hours).
Latency among sightings varies between years. In July 2012, researchers sighted from the research vessel an adult individual in two distinct occasions, with a latency of 20 days, in two different areas, located 5 miles apart: Milokopi bay and the waters between Strava bay and the Alkionides Islands. During spring 2018 (April and May) an individual was sighted from Milokopi cliff with a latency of 16 days. Then, another adult was observed by the sailing vessel close to Pangalos Cape in the Northern portion of the Gulf. In 2020, during the CoViD-19 lockdown, four monk seals sightings were recorded from Milokopi cliff (Figure 4), with a latency varying from 1 to 22 hours.
Except for an opportunistic sighting in January 2020, monk seals have been observed by land just during the spring season. The mean sighting frequency raises to 0.022 sighting/hours of effort when considering only spring data. Statistical analysis (Mann-Whitney Test) shows that the sighting frequency of the lockdown period (0.140 sighting/hours of effort) is significantly greater ($P<0.05$) when compared to the one of the spring season of previous years (0.022 sighting/hours of effort).
During land-based surveys, monk seals were always spotted when no boat was around, neither the research vessel. Even the sightings at sea were in the absence of boats, except for the research vessel. These results indicate a monk seal preference for quiet areas without marine traffic.
Finally, during the lockdown period, for the first time in the century in the Gulf, two adults were observed together.

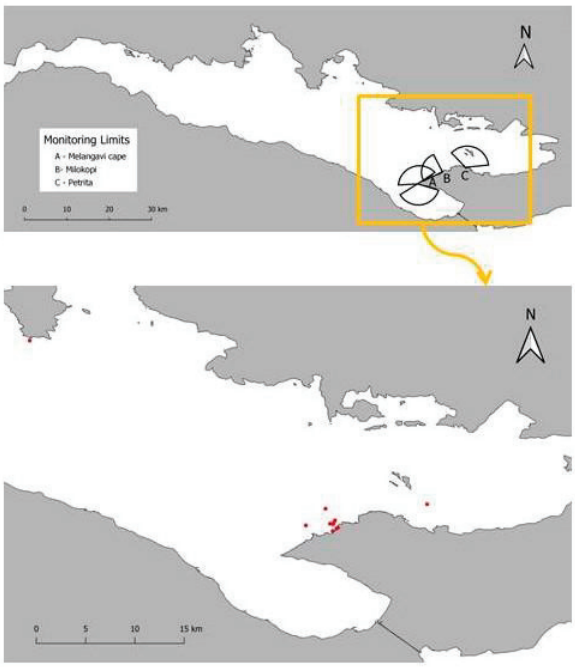

Figure 3: Monk seals sightings position.

Figure 4: Monk seals sightings from Milokopi Cliff.

IV. DISCUSSION

The conservation strategy related to the Mediterranean monk seal aims, on one side, to increase the research effort in the field in order to gather more information on presence and distribution of this cryptic species and, in parallel, to enforce protection measures.

The results of the regular monitoring activities carried out by experienced observers in the Gulf of Corinth show that monk seals are regularly present in the area. Moreover, the distribution of the sighting shows that also some areas, where it was not previously reported, are important for its conservation. Particularly, the area located in the Alkionides Gulf, along the Perachora Peninsula, between Melangavi Cape and Strava, hosting caves and suitable habitats (Figure 5), excluded from any commercial rout within the Gulf and with just few road accesses for human use, looks valuable for the conservation of the species.

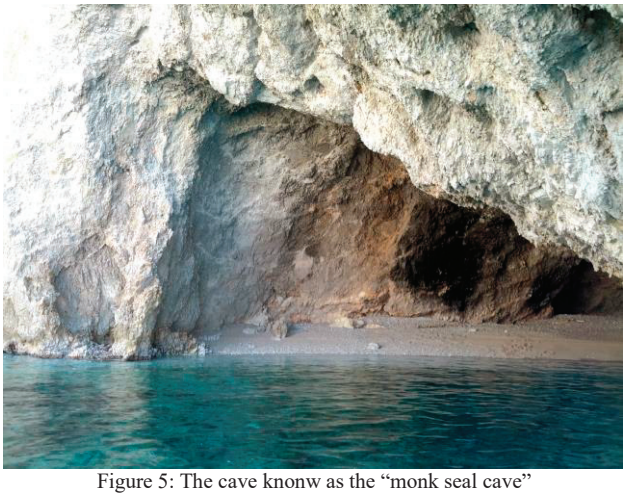

Figure 5: The cave knonw as the "monk seal cave"

CoViD-19 lockdown represented a singular simulation of protection measures, such as the ban of human activities in key habitat for the species. Showing how the resilience of this species is promising in term of potential in individual number increasing if an appropriate management scheme is applied [11,12]. The results of this study showed that, while the researchers spotted individuals regularly during the years, the sighting frequency significantly increased by an order of magnitude during the period of a forced stop of the human activities in the area. Moreover, during this period of low human presence, in the area was recorded for the first time, the presence of two individuals together. The stop of fishery activities and intense marine traffic, the absence of humans along the coastline and the potential key habitat for the species, the decrease of underwater ambient noise could have played a key role in the increase of sightings recorded. As assessed from the scientific community [13], free-ranging animals, such as Mediterranean monk seals, could have beneficiated of CoViD-19 lockdown to explore or expand their usual habitat range.

IV. CONCLUSION

The results of the present study show that the area along the Perachora Peninsula, within the Alkionides Gulf, represents an important area for the conservation of the Mediterranean monk seals. The strategic position of this area with no inclusion in commercial ship-routes, low commercial fishing activities, and low level of tourism, represents an exemplary case where successfully implement conservation efforts for this "endangered" species. The enforcement of conservation measures will magnify the suitable characteristics of the area leading to effective protection, allowing seals population to increase, disperse, and re-colonise crucial sites.

Finally, the global evidence that free-ranging animals could have beneficiated of CoViD-19 lockdown should help the conservation scientists and policy makers to meditate on the role of the practical conservation actions to protect the destiny of species running to extinction such as the Mediterranean monk seal.

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