

CAUSES OF MORTALITY IN THE MEDITERRANEAN MONK SEAL (*Monachus monachus*) IN GREECE

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Abstract: The decline of the Mediterranean monk seal, *Monachus monachus*, has to a large extent been attributed to the deliberate killing of animals. We examined the mortality causes of this species in Greece, from dead animals reported through a network of informants, from 1991-95. We present results from 79 cases, out of which in 25 cases full dissections were conducted. The occurrence of non-human induced deaths, never reported in the past for this species in the wild, appears to constitute an important mortality factor at the newborn stage. Overall the cases reported, in the adult and juvenile animals examined, deliberate killing remains the most frequent death cause and thus an important factor for the decline of the monk seal. Our results, even though provide more conservative estimates of the magnitude of this phenomenon, confirm the conclusions of past studies that deliberate killing is still the most important threat for the survival of the species in Greece.

Περίληψη: Η μείωση των πληθυσμών της Μεσογειακής φώκιας, *Monachus monachus*, έχει αποδοθεί κατά μεγάλο βαθμό στο γεγονός ότι σκοτώνονται από τον άνθρωπο. Εξετάσαμε τις αιτίες θνησιμότητας του είδους, στα νεκρά ζώα που αναφέρθηκαν από το 1991-1995 μέσω ενός δικτύου συλλογής πληροφοριών, από όλη την Ελλάδα. Παρουσιάζουμε αποτελέσματα από 79 περιπτώσεις, σε 25 από τις οποίες διεξήχθησαν πλήρεις νεκροψίες. Οι φυσικοί θάνατοι, που ποτέ δεν είχαν αναφερθεί στο παρελθόν για αυτό το είδος σε άγρια κατάσταση, φαίνεται ότι αποτελούν έναν σημαντικό παράγοντα θνησιμότητας στο στάδιο του νεογνού. Συνολικά από τις περιπτώσεις που εξετάστηκαν, στα νεαρά και τα ενήλικα άτομα η θανάτωση ζώων παραμένει η πιο συχνή αιτία θανάτου και επομένως έναν σημαντικό παράγοντα για τη μείωση του πληθυσμού. Αν και παλιότερες μελέτες, βασισμένες σε συνεντεύξεις ψαράδων, ίσως είχαν υπερεκτιμήσει αυτό το παράγοντα θνησιμότητας, τα αποτελέσματά μας επιβεβαιώνουν ότι η θανάτωση από ανθρώπους παραμένει η πιο σημαντική απειλή για την επιβίωση του είδους στην Ελλάδα.

INTRODUCTION

The Mediterranean Monk Seal, *Monachus monachus*, is considered to be one of the 12 most endangered species in the world. The main surviving groups are still found in Greece and Mauritania. Its world population is estimated to be 400-500 individuals, of which 200-250 are estimated to live in Greece (Reijnders et al., 1993), with best known populations in the National Marine Park of Alonnisos - Northern Sporades (HSSPMS, 1995) and the Ionian islands (Panou et al., 1993). The species decline has to a large extent been attributed to the deliberate killing of animals, while the main threats for its survival are considered to be (Marchessaux and Duguy, 1978; 1984; Reijnders, et al., 1993): deliberate killing, accidental killing/capture, disturbance and habitat destruction, pollution, overfishing, infectious diseases, or other catastrophes.

In the past, several studies have described the status of the Mediterranean monk seal in different parts of the Mediterranean and the Atlantic coast (Ronald and Duguy, 1978; Sergeant et al., 1978; Ronald and Duguy, 1984; Marchessaux, 1989; Panou et al., 1993;). In a number of these studies, the authors also addressed the causes of mortality of the species (Troitzky, 1954; Ronald & Healey, 1974; Berkes et al., 1979; Sergeant et al., 1978; Goedicke, 1981; Harwood, 1987; Vlachoutsikou and Lazaridis, 1990; Panou et al., 1993).

In this study, we examined the causes of death in the Mediterranean monk seal in Greece. The results presented were based on full autopsies of dead monk seals found stranded, and, when this was not possible, on detailed description of the incident. This work will not only allow the evaluation of the relative frequency of the different causes of death, but will also provide insight in the threats for the species decline in Greece.

MATERIALS AND METHODS

This work is part of a larger project, the Rescue and Information Network for the monk seals in Greece, which was established in 1991 (HSSPMS, 1994; 1996). The objective of the Network is to create a working relationship with coastal authorities and people (port police authorities, coastal municipalities, fishery services, veterinary services and fishing co-operatives), in order to collect information on the status of the species, and to receive reports of emergency cases, such as, wounded, sick or orphan animals, or dead seal strandings, on time to respond (see HSSPMS, 1994; 1996, for detailed description of the rationale and methodology).

The methodology used, with respect to the cases when a report of a dead monk seal stranding was reported, was as follows:

- a) In the case of a recently dead seal reported, the team travelled to the site with the intention to conduct an autopsy. When the carcass was found in good condition, a full dissection was performed in the field (following the methodology in Winchell, 1990). In addition, virological, histological, bacteriological, parasitological and haematological samples were collected and analysed to provide further evidence concerning the death cause. In the cases where the carcass was found in advanced state of decomposition, an external examination was conducted, in order to locate evidence of violent death.
- b) When the information received, indicated clearly that the body found was in extreme state of decomposition, the reporters were requested to conduct an external examination of the body, to collect morphometric measurements, and to take photographs of the carcass.
- c) In addition to the above cases, certain incidents from past years reported during the study period were included. However, these were treated with extreme caution, and only reliable cases, for which the reporter could provide detailed information on the date, site, and description of the body and the incident, were taken into account.

The cases included in the study were classified, in terms of death cause, into the following categories:

- A. Deliberate Killing (DK): Any case that the evidence found during the autopsy or through the detailed description of the event showed human action with the intention to injure or kill the animal. Cases were included in this category, regardless of whether the action resulted directly to the death of the animal (e.g. animals found killed by weapons, such as, gun, spear gun, knife, dynamite, etc.) or the animal drowned, having suffered serious injuries caused directly by humans.
- B. Accidental Death (AD): Any case that the evidence found during the autopsy or through the detailed description of the event showed that human action resulted in the death of the animal, but there was no intention to kill or injure the animal (e.g. animals found killed by boat traffic or drowned in fisheries nets).
- C. Non-Human Induced Death (NHID): Any case that the autopsy performed showed no evidence of human action causing the death of the animal (e.g. pups killed by wave action, or animals dying of disease, old age or other natural causes).
- D. Unknown Cause of Death (U): Any autopsy case that the death cause could not be identified due to extreme decomposition of the specimen, or any case for which no autopsy was performed and the observers could not provide specific evidence on the death cause.

RESULTS

During the study period (1991-1995), 59 dead monk seals were examined. Information was also collected for 20 cases of dead seal strandings that occurred in previous years (1985-1990). While in the first year of the project the number of dead seal strandings reported were limited (5 cases), the following years the number of dead animals found were between 12-17 per year ($\bar{x}=13.5$, S.D.=2.38). This is probably a consequence of the relatively smaller amount of effort invested by the Network participants into locating and reporting dead seals in the first year, rather than low overall mortality. In subsequent years effort invested towards the network participants remained relatively constant.

Considering the distribution of the dead seal strandings, it is evident that dead monk seals are found throughout the country's coastline (figure 1). The concentration of dead monk seals found in the wider area of the N. Sporades does not necessarily represent a higher mortality in that area. It may be the result of continuous monitoring of the local monk seal population that increased the probability of a dead monk seal being recorded (HSSPMS, 1995).



Figure 1. Distribution of dead seal strandings in Greece (1985-1995)
Bullets indicate the location of the seal strandings

Considering all 79 cases (Table 1), deliberate killing was found to be the most frequent (32%) cause of death, followed by non-human induced causes (16%) and by accidents (14%). In thirty of the above cases the cause of death could not be determined. The results obtained when we examine the 25 cases, in which full dissections were performed, the most frequent cause of death was non-human induced (48%), followed by deliberate killing (24%) and by accidental deaths (12%), while in four cases the cause of death could not be determined.

Of the 79 animals reported dead, 42 were categorised as adults or juveniles, 23 were newborn pups and in 14 cases the reporters could not identify the stage of the animal. If we consider the causes of death by age groups, deliberate killing is the most frequent death cause in adults/juveniles. This is true in the cases for which full dissections were conducted, as well as, in the non-autopsied animals. In the newborn pups found dead, when the cause of death was determined through full dissections, almost invariably was attributed to non-human induced factors.

Table 1. Causes of death in monk seal strandings, 1985-1995

CASES	DK	AD	NHID	U	TOTAL
Autopsy	6	3	12	4	25
Non-autopsy	19	8	1	26	54
Total	25	11	13	30	79

Table 2. Causes of death by age groups

		DK	AD	NHID	U
ADULTS/ JUVENILES	Autopsied Cases	6	3	2	3
	Non-autopsied cases	12	5	0	11
PUPS	Autopsied Cases	0	0	10	1
	Non-autopsied cases	3	3	1	5
UNKNOWN STAGE	Autopsied Cases	-	-	-	-
	Non-autopsied cases	4	0	0	10

DISCUSSION

The results obtained indicate clearly that deliberate killing is the most frequent death cause in the Mediterranean monk seal, and thus an important threat for the survival of the species. One third of the dead animals found stranded, were deliberately killed. This is especially evident in the adult and juvenile age group, where deliberate killing was diagnosed as the cause of death for more than half the cases. Deaths due to accident appear to be the least frequent cause of death in all age groups. These, as well as, most deliberate killings, are closely related to

fishery activities, and thus should be taken under consideration in a strategy to reduce the competitive monk seal - fishery interaction.

It is further evident that in the newborn pup stage, non-human induced factors are the most frequent causes of death. It must be mentioned that this has not been reported in the past for this species in the wild. The fact that such evidence could only be collected through full autopsies of corpses provides additional incentive for performing full autopsies in any animal that is found dead. This has not been common practice in this species throughout its range.

It is also of interest to consider the results from previous work on the causes of death for this species within Greek waters. In an extensive review of the literature (Ronald & Healey, 1974; Ronald and Selley, 1976; Marchessaux et Duguay, 1977; Tsimenidis, 1978; Rigas & Ronald, 1984; Johnson & Emch, 1979; Goedicke, 1981; Christou, 1987; Jacobs & Panou, 1990; Panou et al., 1993; Vlachoutsikou, 1989; Vlachoutsikou & Lazaridis, 1992; Vlachoutsikou & Cebrian, 1992; Cebrian & Anagnostopoulou, 1992; Kontogianni, 1993), a total of 182 cases of dead animals were reported. Deliberate killings accounted for 65% of these cases, 15% were due to accidental deaths, and in the rest of the cases the cause of death was not identified.

The fact that we find relatively lower frequency of deaths due to deliberate killing, even in the non-autopsied cases, may be due to the differences in the methodologies used. Most of the past results are based on old memories of fishermen, with limited information on the incidents, some are more recent sightings reported by fishermen, and few are based on detail descriptions of the vents or on autopsies conducted on the bodies found. Since fishermen report incidents related to their own activities, this may have resulted in a bias towards deliberate killings or accidental deaths.

Furthermore, it should be noted that deliberate killings are not a phenomenon restricted to Greece, but a common practice of Mediterranean fishermen towards monk seals (Ronald, 1973; Ronald and Berkes, 1980; Ronald and Yeroulanos, 1984). Marchessaux (1989) reports this activity occurring in all the areas where monk seals occur, except in N. Africa. Similarly, Berkes et al. (1979) found that deliberate killing by fishermen, hunters or shepherds is one of the most important death factors in Turkey.

It is clear that deliberate killing is still the most important direct threat to the monk seal in Greece as well as in the rest of the Mediterranean. This has to be taken under serious consideration within any national or international conservation strategy, and efforts should be directed to reduce such mortality.

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