

Green Sea Turtle (*Chelonia mydas*) Predation by Mediterranean Monk Seal (*Monachus monachus*) Along Turkish Coast

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In the Mediterranean basin, loggerhead sea turtle *Caretta caretta*, green sea turtle *Chelonia mydas*, and Mediterranean monk seal *Monachus monachus*, have their main breeding distribution confined in the eastern Mediterranean including along Turkish coasts. The global population status of the loggerhead turtles is Vulnerable (VU) (Casale & Tucker 2017) while the Mediterranean subpopulation of loggerhead turtle was designated as Least Concern (LC) (Casale 2015). The global population of green turtles is Endangered (EN) (Seminoff 2004) while the regional Mediterranean subpopulation assessment is in progress. In the Mediterranean, the three species are threatened due to anthropogenic factors including fisheries related bycatch, habitat loss or fragmentation, disturbances in breeding habitats and deliberate killing, although the Mediterranean populations of these marine vertebrates have been legally protected (Kırac *et al.* 2013; Casale *et al.* 2018). The Mediterranean monk seal is an opportunistic predator foraging on a variety of marine fauna. Interactions between sea turtles and monk seals in terms of predatory and aggressive behaviors have relatively recently been observed and are among the least studied subjects. The current study provides two new records of sea turtle predation by monk seals. One from the remains of a green sea turtle found in the digestive system of a stranded subadult monk seal in Mersin in 2018 and another one from an attack by a juvenile monk seal on a juvenile green turtle videotaped in Antalya in 2021.

The Mediterranean Sea is globally one of the most important ecoregions in terms of biodiversity (Myers *et al.* 2000; Mittermeier *et al.* 2004). This precious biodiversity hotspot includes several charismatic and conservation priority species such as sea turtles and Mediterranean monk seal. The nesting, foraging, and wintering grounds of sea turtles in the Mediterranean are well documented and the general populations are increasing based on long standing conservation activities (Casale *et al.* 2018). The average annual nest counts range from 3,694-4,667 and 684-1005 for loggerhead and green turtles respectively in the Mediterranean (Casale *et al.* 2018). The Mediterranean monk seal is considered Endangered (EN) on a global scale (Karamanlidis & Dendrinos 2015) and is a Critically Endangered (CR) marine mammal at the European level according to the IUCN (2015) with the global population estimated at around 700 individuals (Karamanlidis *et al.* 2015). The species is estimated to have approximately 120 individuals along Turkish coasts currently (Cem Kırac & Meltem Ok, pers. comm. 2022).

The foraging behavior and dietary preferences of monk seals are among the least studied subjects (Cebrian *et al.* 1990; Karamanlidis *et al.* 2011; Pierce *et al.* 2011). Monk seals prey on at least 75 taxa including Chondrichthyes, Osteichthyes, Cephalopods, Mollusca and Crustaceans and they are regarded as generalists, perhaps opportunistic predators, that exploit the most readily available prey (Pierce *et al.* 2011). There are only three studies into the diet of monk

Figure 1. Locations of the monk seal predation encounters; the subadult female seal found stranded in Kızıllıman, Bozyazı, Mersin on 3.2.2018 (S1) and the young monk seal preying on a sea turtle in Limanağzı, Kaş, Antalya on 5.7.2021 (S2)

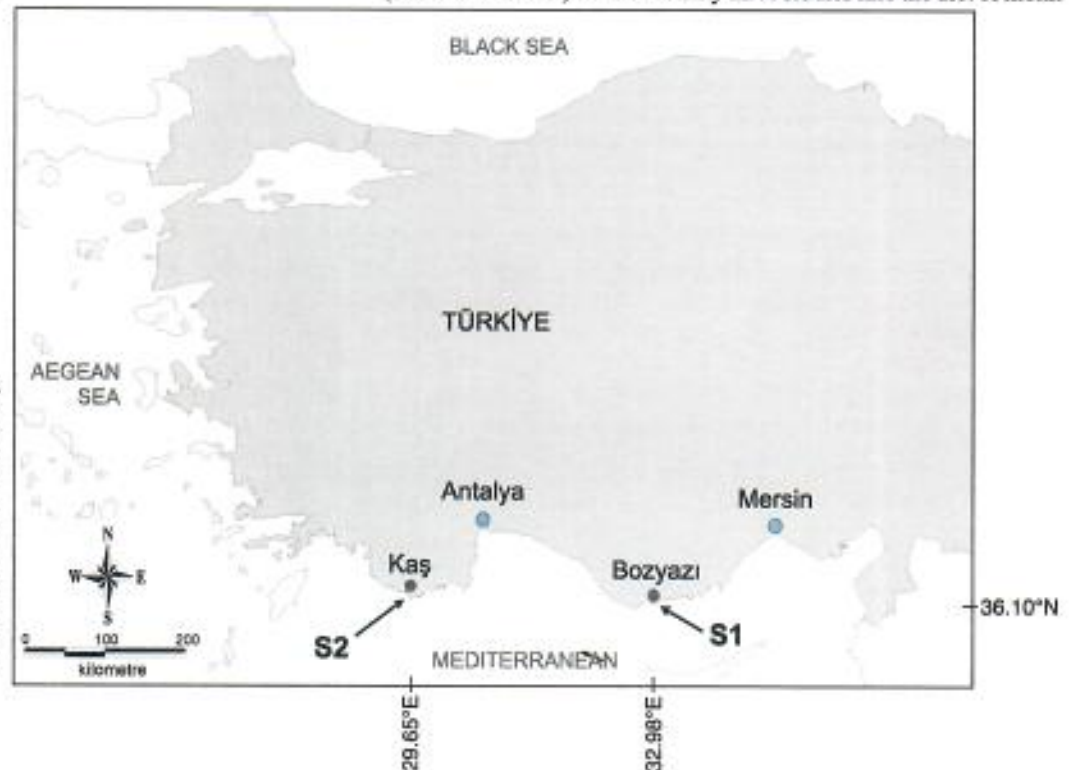




Figure 2. Stranded subadult female monk seal found dead by local fishermen in Kızılliman region in Bozyazı, Mersin on 3.2.2018 (S1).



Figure 3. (A) the eastern coasts of Kızılliman Peninsula, Bozyazı, Mersin, South Türkiye where the dead monk seal (S1) was located on 3.2.2018; (B) the stranded subadult female monk seal (S1) found dead; (C) and (D) the total curved length (from tip of nose to tip of hind flipper, measured over the curved body) of (S1); (E) left fore flipper of a green sea turtle *Chelonia mydas* found stuck inside the mouth of the dead monk seal; (F) a smaller piece of bone considered another part of the same green sea turtle *C. mydas* found stuck in the throat of the dead monk seal (S1).

seals in Turkish waters. Salman *et al.* (2001) examined the diet of juvenile and subadult female monk seals from the Aegean coast. A second study examined the stomach content of an adult female found dead in Antalya in southern Türkiye (Tonay *et al.* 2016). Finally, the stomach content of a five-month old, molted pup found dead in Foça town of İzmir in the western Türkiye was studied and documented (Kıraç & Ok 2019).

On the other hand, interactions between sea turtles and monk seals have been previously reported as rare cases of predatory and aggressive behavior (Margaritoulis *et al.* 1996; Margaritoulis & Touliaou 2011). Recently, Tonay *et al.* (2016) reported prey item remains from several body parts (heads, forelimbs) belonging to three green turtles in the stomach of a stranded Mediterranean monk seal near the coast of Antalya, Türkiye. In the current study, we report two new cases: one green turtle limb from the digestive system of a stranded subadult monk seal and another, a videotaped juvenile monk seal attack on a juvenile green turtle.

SAD-AFAG, an NGO dedicated to monk seal conservation, has been monitoring monk seals and their suitable habitats along the Turkish coasts since 1987 (Kıraç *et al.* 2004). These monitoring activities include both direct observations during field research and reaching first-hand and reliable sightings from locals, especially artisanal fishermen, around the Turkish coasts. During these monitoring activities, two separate observations of monk seal predation on sea turtles were obtained.

On the first occasion, a dead subadult female monk seal was found stranded on the cliff shore in Kızılliman protected area, Bozyazı town, Mersin (36.093562° N, 33.093857° E) on 3.2.2018 (S1) by local fishermen. The fishermen found the dead seal, filmed, and photographed it in its original location, measured the total length and carefully checked its external appearance.

The seal (S1) was found dead by the fishermen (Fig. 2) at the eastern cliffs of Kızılliman Peninsula in Bozyazı of Mersin (Fig. 1) on 3.12.2018. It was a subadult female monk seal determined from the general pelage pattern as per Samaranch & Gonzales (2000) as well as from other physical characteristics such as four teats on the belly and overall curved length of 237 cm (curved body length from tip of nose to end of hind flipper). The reason for the seal's death was unknown, however, there were no open wound(s) or hole(s) on the body, as it was checked by the local fishermen on the scene and also reviewed by the authors from the numerous high quality photos. The interesting finding was that the fishermen also found a limb (left fore flipper) of a green sea turtle stuck inside the mouth, which could apparently not be swallowed by the monk seal. In addition, another smaller prey item piece, a fleshy bone, was found farther down the throat. This smaller prey item is also considered to belong to the same green turtle. The limb and the bone were removed manually by the fishermen and the seal and the prey items were photographed in situ (Fig. 3).

On the second occasion, a professional scuba diver recorded a video of a young monk seal, preying a juvenile green sea turtle in the shallow waters near Kaş town, Antalya (36.177341° N, 29.642428° E) in 2021 (S2). The observer shot two short videos from the deck of a boat showing the predation in action and shared them with SAD-AFAG through the AFBİKA network. The original videos were then closely examined and recorded into the FokData database, which was specifically designed for the determination of spatial and temporal distribution of monk seals along Turkish

coasts. The observer was later contacted by SAD-AFAG and detailed information obtained on the behavior of the juvenile monk seal exposed during the whole scene.

The second case (S2) was from Limanağzı cove in Kaş town of Antalya (Fig. 1) recorded on 5.7.2021, where a young monk seal tried to prey upon a juvenile green turtle. This was videotaped and is probably the first visual clue of aggressive/predatory behavior of a monk seal toward a sea turtle (see [Video 1](#) and [Video 2](#)). According to the observer who recorded the two movie clips, the juvenile monk seal caught, and attempted to kill the turtle, tossing it around at the sea surface for approximately an hour. Although the prey struggled to escape, the monk seal finally killed it. However, the monk seal was disturbed by the boats in close proximity during the foraging action and consequently left the dead prey. The dead sea turtle then sank to the bottom (c. 3m deep) and could clearly still be seen by the observer. Based on our previous observations and experience along Turkish coasts, the tossing behavior of the monk seal is a typical foraging action meant to kill prey, and break it up into smaller pieces. This feeding behavior always happens on the sea surface, when prey is not small enough to be swallowed whole.

Marine mammal and sea turtle interactions are rarely reported in the literature. In a review of these interactions, cetaceans were reported to be mainly investigating sea turtles but only a few cases of predation were reported for killer whales *Orcinus orca* (Fertl & Fulling 2007). In the diet of the Hawaiian monk seal (*Neomonachus schauinslandi*), the closest relative of Mediterranean monk seal, no sea turtle species is recorded as a prey item (Longenecker 2010), while Hawaiian monk seal and Australian sea lion (*Neophoca cinerea*) have been suspected predators (Fertl & Fulling 2007).

Monk seal attacks on loggerhead sea turtles were first reported from Laganas Bay, Greece, where the sea turtles were found injured or dead with clear bite marks and the reasons behind these attacks were thought to be related to the depletion of local fish stocks (Margaritoulis *et al.* 1996). Similar infrequent and unusual cases were noted in the following years. However, during the 2010 nesting season in Zakynthos, a remarkable record of 21 loggerhead turtles were found stranded or floating in the area of Laganas Bay, bearing injuries attributed to predation by monk seals (Margaritoulis & Touliaou 2011). Based on stomach content data, two cases of confirmed predation records of the Mediterranean monk seals recorded; one on loggerhead sea turtles (Fertl & Fulling 2007) and one on green sea turtles (Tonay *et al.* 2016), both of which were in the eastern Mediterranean.

The two recent predation interactions given in this study have probably resulted from a shortage of prey items, or else only a few monk seal individuals are engaging in this type of predatory behavior (Fertl & Fulling 2007; Margaritoulis & Touliaou 2011).

In conclusion, in all the three proven predation cases happened along Turkish coasts; the one given by Tonay *et al.* (2016) and the two given in this study, demonstrate that all the predated sea turtles by monk seals happened to be green sea turtles (*Chelonia mydas*). Further study is needed to better understand the interaction between Mediterranean monk seals and sea turtles with special emphasis on the reasons whether depleted fish stocks is one of the main driving force for such an interaction.

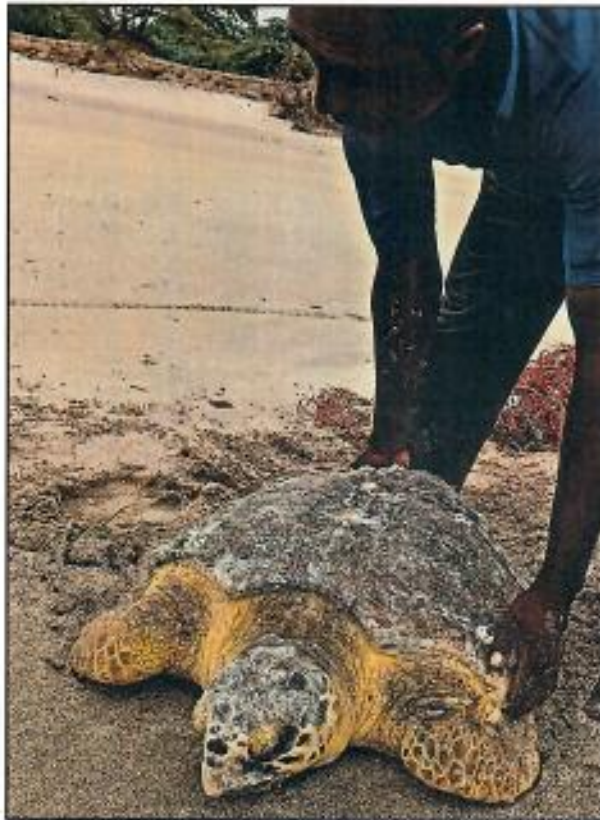
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- provided invaluable information about the seal and sea turtle parts with utmost precision, and are also grateful to Toygar Köroğlu and Kevser Mermertaş from Kaş, Antalya, who all informed and shared the related photos and video footage as well as other relevant details directly with us through *Mediterranean Monk Seal Information and Rescue Network (AFBİKA)* of SAD-AFAG. This study would not have been possible without the volunteer support and generous cooperation of these people. Also, the authors thank Dr. Wayne J. Fuller for his help in English improvement of the manuscript. A part of this research (the activities related to the case S2) benefits from the support of the Monk Seal Alliance www.monksealalliance.org/en/index within the frame of the project "Conservation of monk seal & its habitats in Muğla and Antalya provincial coasts in Turkey through concrete actions" carried out by SAD-AFAG.
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