

Spate of Loggerhead Turtle Strandings Suggest Predation by Mediterranean Monk Seal

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The stranding network, established across Northern Cyprus¹ regularly deals with cases of stranded sea turtles, most of which are drowned as bycatch in set nets of small-scale fisheries (Snape et al. 2013). Famagusta Bay on the east coast (Fig. 1a) is considered a sea turtle bycatch hotspot (Snape 2015) and strandings of loggerhead and green turtles along the coastline are common during summer months (Haywood et al. 2020; Palmer et al. 2021). Boğaz (Bogazi) Beach, Iskele (Triкомо), in the north of Famagusta Bay (Fig. 1a), is a well-known sea turtle nesting beach and has been patrolled by a volunteer team during the loggerhead turtle nesting season from May to October for thirty years. Despite important loggerhead turtle nesting, the beach has been heavily impacted by insensitive coastal development during the last decade (Fig. 1b-c).

In 2020, the stranding network processed nine cases of loggerhead turtles stranded at Boğaz Beach with similar injuries. All incidents occurred during peak loggerhead turtle nesting in June and July. Initially, the cases were in an advanced state of decomposition, but as the number of cases developed, a concerning pattern was realised, prompting concern that the mutilated turtles were being deliberately killed by humans and/or predated by stray dogs using the beach. Necropsies undertaken

on some of these turtles found that they were adult females with developed or developing eggs, and that they had been bitten and partially consumed by a predator, likely a canid. It was noted that the turtles had not ascended onto the beach to nest, since no turtle tracks were observed in the area around the carcass location. The cause of this spate of strandings was therefore not clear, but it was suspected that the turtles were being killed at sea, possibly as a retaliatory response by fishers setting nets close to shore. The deep and broad lacerations on dorsal and lateral surfaces of the neck of the turtles could have been inflicted with a knife and after stranding, it was considered that these wounds may have been opened by stray dogs on the shore, as bite marks were present on the fore flippers. Contact was made with set net fishers at nearby Boğaz Harbour who agreed that some fishers could be capable of killing turtles by cutting their neck. But based on onboard observations (Snape et al. 2020), the rate of captures was considered very high, and unlikely to be attributed to a single captain. The results and concerns were shared with the authorities through a written statement. Predation by the Mediterranean monk seal (*Monachus monachus*; hereafter called monk seal) was also considered a possibility.

On 30 May 2021, at the beginning of the 2021 nesting season, a further case was

¹ a de facto state that comprises the north-eastern portion of the island of Cyprus. It is only recognised by Turkey and considered by

the international community to be part of the Republic of Cyprus. See <https://en.wikipedia.org/wiki/Cyprus>



recorded with the same pattern of injuries observed during the 2020 spate of strandings. The stranding network engaged volunteers living nearby, to monitor the beach at sunrise to enable early interception of strandings before decomposition, through alerting the

national stranding hotline. All subsequent cases at the beach were recorded on the morning of the stranding event and transferred to the post-mortem facility at SPOT's base in Alagadi (Alakati). A total of fourteen cases were recorded in 2021.

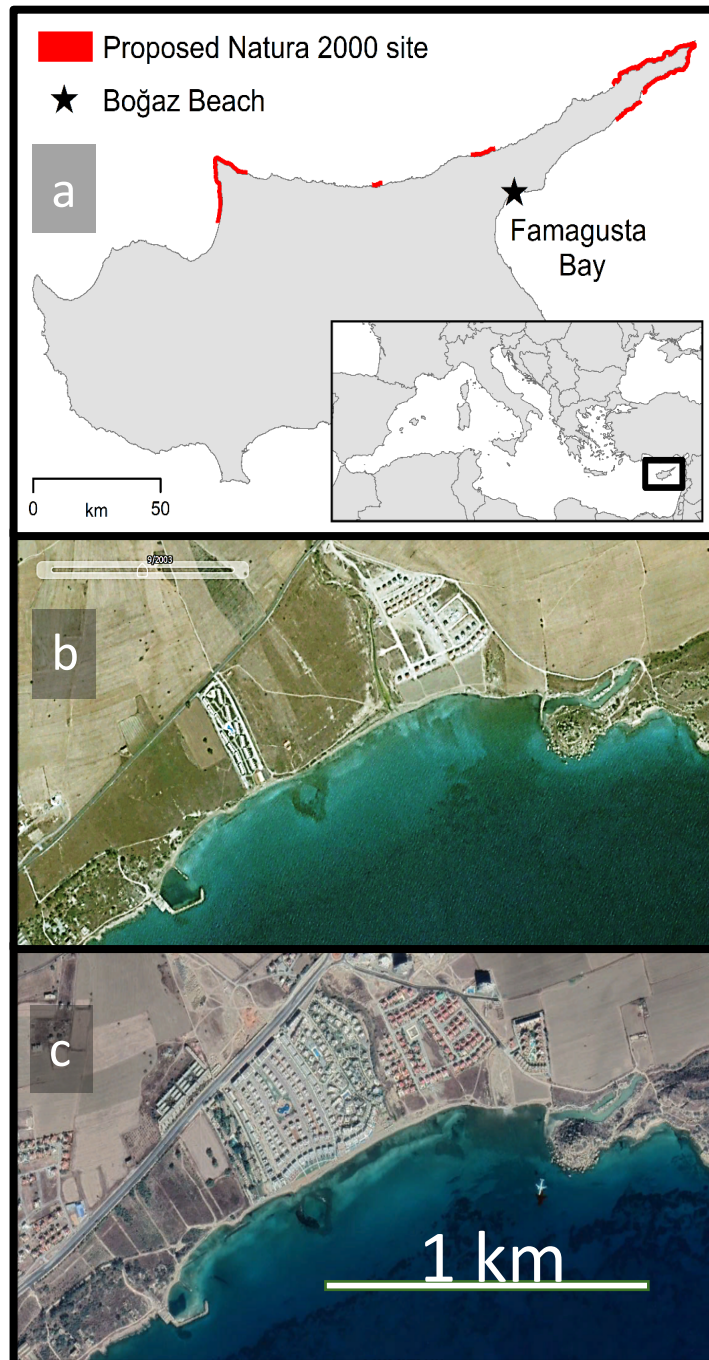


Figure 1. (a) Location of Cyprus in the Eastern Mediterranean and Boğaz (Bogazi) Beach in the northern extent of Famagusta Bay, Northern Cyprus, (b) satellite image of Boğaz Beach dated 2003 (©Maxar Technologies/Google Earth) and (c) image of the beach in 2021 following a period of intensive coastal development (©CNES/Airbus/Google Earth)

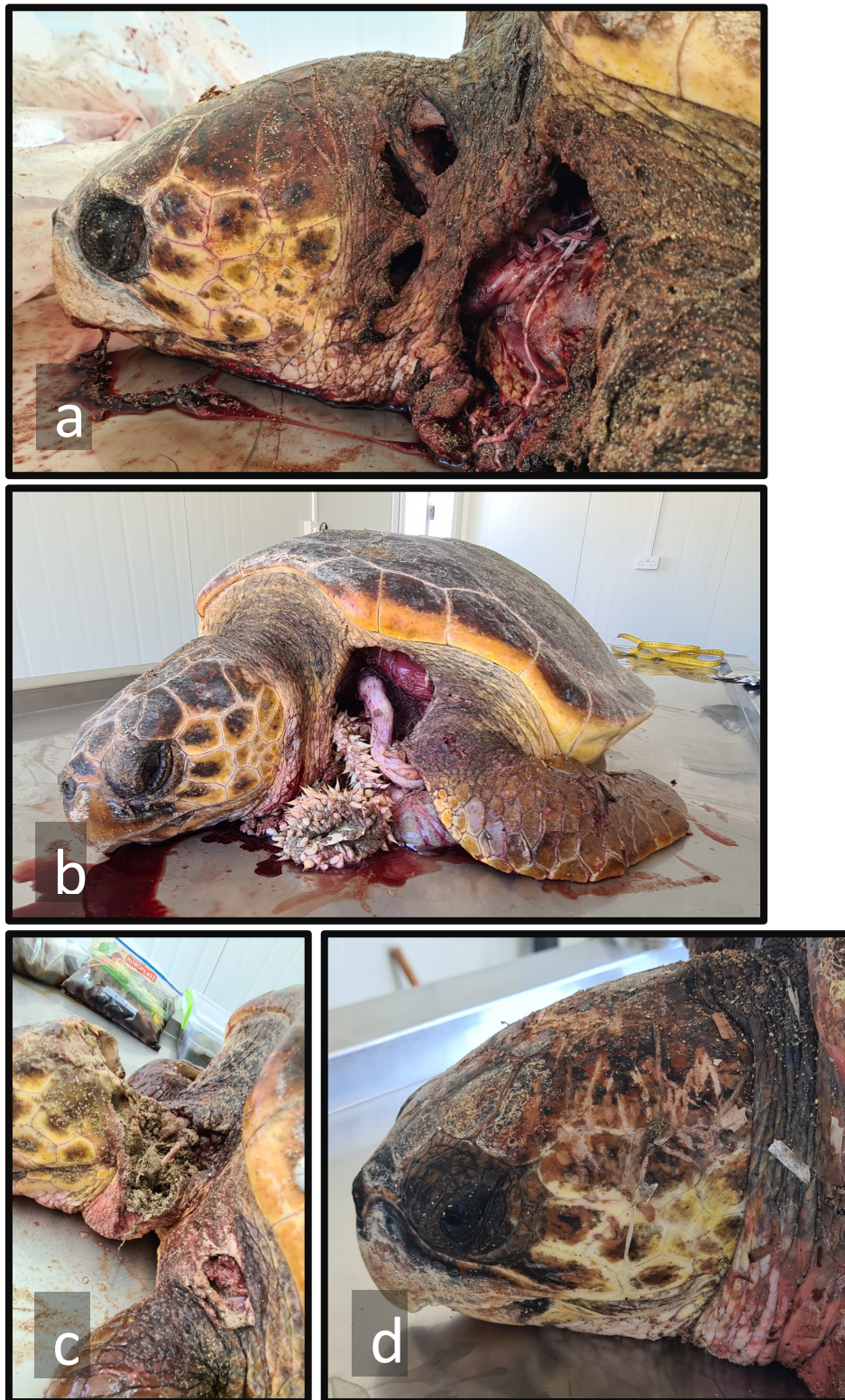


Figure 2. Typical injuries observed on loggerhead turtles stranded at Boğaz Beach during the study. a) lacerations to the left of the neck and shoulder and consumption of underlying muscle. b) deep consumption of muscle around the shoulder with oesophagus and stomach extracted. c) deep consumption of dorsal neck tissues exposing the supraoccipital crest and cervical vertebrae with laceration to the shoulder also present. d) scratches on head scales resulting from bites.



In twelve of the cases the animals were freshly dead, and time of death was estimated to have occurred during the previous night. In two cases, the turtles were alive, with low reflex response. These individuals died because of their injuries on their way to, or shortly after arrival at the Meritta rehabilitation centre in Girne (Kyrenia). Necropsy confirmed all individuals to be mature females, by the presence of shelled or yolked eggs. Mean minimum curved carapace length (CCL_{min}; Bolten, 1999) of the turtles stranded at Boğaz Beach was 70.3 cm (\pm SD: 4.6; range: 64.0 – 78.9), similar to the mean curved carapace length of nesting females at Alagadi (Alakati) beach in 2021 (71.6 cm \pm 4.6, 58.3–80.8, n=40; Snape et al. 2022), and significantly larger than the mean CCL of all stranded loggerhead turtles recorded by the strand network during the course of the year (64.3 cm \pm 13.6, range: 4.9–88.0, n=89; Snape et al. 2022).

In the two spates of cases reported here, all turtles were observed on the shore, in the strandline either in the water or on the beach in the splash zone. In all fresh cases (including all fourteen cases in 2021), bite marks and larger lacerations of variable depth and length were observed at the throat and/or the shoulder (Fig. 2a). In many cases, the skin over the skeletal muscle collections dorsal and posterior to the base of the fore flipper, were opened and the underlying muscle had been consumed, the animal having pushed its muzzle and teeth deep into this opening to eat the underlying muscle. In one such incident, the oesophagus and stomach were extracted through this route and had been chewed (Fig. 2b). In other examples, the whole of the dorsal and lateral areas of the neck had been opened and consumed, exposing the cervical vertebrae and the supraoccipital crest (Fig. 2c). In all cases, deep and corresponding bite marks were found on the dorsal and ventral surfaces of the fore flippers, while bite marks to the hind flippers were generally fewer and shallower. In some cases, the dorsal scales on the head of the turtle were

scratched resulting from bite marks, indicating that the gape of the predating animal was sufficient to grasp the turtle by its head (Fig. 2d).

The circumstances of the strands and similarities with the few reported cases elsewhere, led the authors to strongly suspect that these two spates of stranded turtles were a result of predation by monk seal, which is the world's rarest seal species. The monk seal is the only seal species to occur in the region (Karamanlidis et al. 2016), and has long been known to occur around the island of Cyprus (Dendrinis & Demetropoulos 2000), with sightings relatively common (Bundone et al. 2019). A resident breeding population has been suspected since 2006 (Gucu et al. 2009) and was recently confirmed in both ethnic communities of the island, by camera trap monitoring of caves where seals haul out to rest and pup (Nicolaou et al. 2019; Beton et al. 2021). The Eastern Mediterranean population is estimated to contain just 350–450 mature individuals and is growing (Karamanlidis & Dendrinis 2015). This recovery appears to be reflected in the area of Cyprus under the effective control of the Republic of Cyprus Authorities on the southern coastlines (Nicolaou et al. 2019).

Predation of sea turtles by monk seals are thought to have occurred at Laganas bay on Zakynthos Island, Greece (Margaritoulis & Touliaou 2011) in similar spates to those observed here. The Laganas cases occurred in spates of 8 turtles in 1994 (Margaritoulis et al. 1996) and 21 turtles in 2010 (Margaritoulis & Touliaou 2011), and were attributed to separate monk seal individuals acquiring and adapting predatory behaviour during the loggerhead turtle nesting season, when turtles were aggregated off the nesting beach. During each of the two spates of cases, the predation technique was different. In 1994, the seals were thought to snap off posterior plastron scutes to gain access to the turtle's body cavity, whereas in 2010, access was gained via the skin between the plastron and hind flippers and in a small number of



cases, via the throat (Margaritoulis & Touliaou 2011). Superficial bite marks to the skin showed a similar pattern to those observed in the current study.

To gather further circumstantial evidence, in 2021, the authors undertook three night-time surveys to monitor nesting events and confirmed that no stray dogs were actively seeking out nesting females. A fisher at the port of Boğaz with whom SPOT have been collaborating with for more than ten years, confirmed that he had seen a monk seal during the 2021 spate of strandings.

While it is necessary to remain vigilant for alternative explanations for these standing events, monk seal predation seems the most likely explanation. No fishing vessels have been seen close to shore by the morning patrol team in 2021, and captains generally haul shortly after first light. For the turtles to strand in such close proximity to each other, it is not likely that they are caught in fishing nets set further offshore. As in the Laganas cases, it may be that one individual seal discovered and learned a technique in 2020 and continued to refine it in 2021 when nesting resumed.

Boğaz Beach is at the northern extremity of Famagusta Bay and there are many kilometres of loggerhead turtle nesting habitat to the south (Broderick & Godley 1996). Given their broad inter-nesting habitat use and low nest site fidelity (Snape et al. 2018), Famagusta Bay can be considered a continuous inter-nesting habitat for loggerhead turtles. Famagusta Bay is also a foraging ground for juvenile and adult loggerheads and juvenile green turtles (Snape 2015; Snape et al. 2016, 2020). The fact that all turtles were nesting female loggerhead turtles with mature/maturing eggs, and their stranding in such proximity, suggests that the turtles were targeted during their approach to the nesting beach. Possibly, a seal could have been patrolling the wider Famagusta Bay, hemming the turtles into the shallows and driving them north into Boğaz Beach. The beach has a breakwater

at its western extent and a rocky headland at its eastern extent (Fig. 1c); features which could be useful in corralling target turtles.

Both monk seals and loggerhead turtles now have improved conservation status with Mediterranean loggerhead turtles considered least concern (previously endangered; (Casale 2015)) and monk seals endangered (previously critically endangered; (Karamanlidis & Dendrinis 2015)). Increased interactions between the two species are to be expected as their populations recover in response to conservation, and so cases of predation could become more prevalent. It seems unlikely that any direct mitigation measure could be implemented with success to separate the two species.

Monk seals are under greater conservation risk, with a more limited range and being far fewer in number, and so a cull could never be supported. Efforts to deal with monk seal predation on sea turtles, should rather focus on securing their natural food resources, through Marine Protected Areas and No-Take Zones. Declining prey resources were considered a force that was likely to be driving monk seal predation on turtles in Laganas Bay (Margaritoulis et al. 1996) and fishers in Northern Cyprus have called for improved fisheries management, to secure fisheries resources in the face of declining landings (Snape et al. 2018).

It is important that sea turtle stranding networks make all efforts to identify, and report suspected cases of monk seal predation on sea turtles, to monitor and build knowledge on this interesting and concerning subject. Additionally, all possible alternative explanations should be considered and investigated, where irrefutable proof of monk seals causing the strandings is lacking and taking swab samples from the suspected cases, such as those presented here, is recommended for confirmation of monk seal depredation through genetic barcoding.



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