

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/345135618>

# Mediterranean Monk Seals Present an Ongoing Threat for Loggerhead Sea Turtles in Zakynthos

Article in *Marine Turtle Newsletter* · December 2011

---

CITATIONS

2

READS

15

2 authors, including:



**Dimitris Margaritoulis**

ARCHELON, the Sea Turtle Protection Society of Greece

85 PUBLICATIONS 2,404 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



Ecology, status and conservation of dolphins in the Gulf of Corinth, Greece [View project](#)

# Mediterranean Monk Seals Present an Ongoing Threat for Loggerhead Sea Turtles in Zakynthos

Dimitris Margaritoulis & Smaro Touliatou

ARCHELON, The Sea Turtle Protection Society of Greece, Solomou 57, GR-10432 Athens, Greece  
(E-mail: margaritoulis@archelon.gr)

Laganas Bay, located along the southern coast of Zakynthos Island in the eastern Ionian Sea, contains the largest rookery of the loggerhead sea turtles (*Caretta caretta*) in the Mediterranean, with an average of 1,230 nests per season (Margaritoulis 2005). Turtles of both sexes typically begin to arrive in the Bay in April, while nesting occurs from late May to early August, depending on the year. The loggerhead sea turtle is listed by the International Union for the Conservation of Nature (IUCN) as Endangered (IUCN 2010). In 1999, the National Marine Park of Zakynthos (NMPZ) was established in the wider Laganas Bay with the aim of protecting turtles and their reproductive habitat (Fig. 1).

A resident population of the Critically Endangered (IUCN 2010) Mediterranean monk seal (*Monachus monachus*) uses Zakynthos as a breeding and haul-out area, mainly along the western coast where many seaside caves are found. The estimated minimum size of this population ranges from 18 individuals (Vlachoutsikou & Cebrian 1992) to as few as 8 individuals, as estimated more recently (Karavellas 1995).

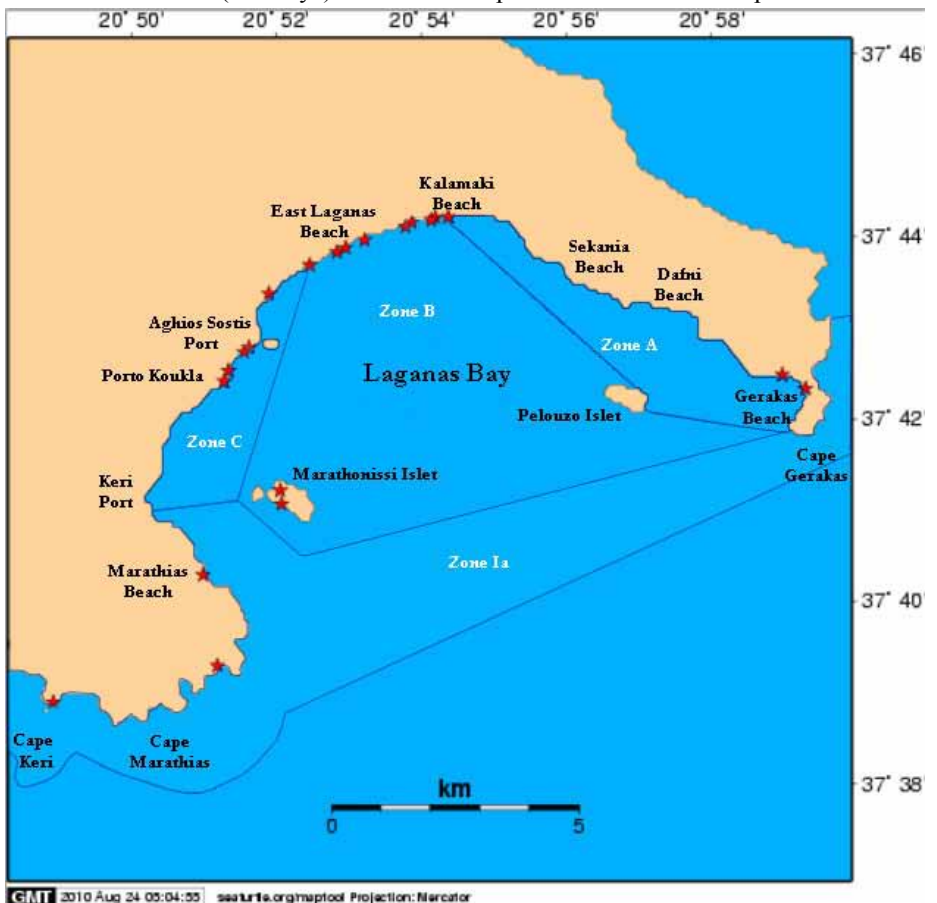
During the 1994 nesting season, 8 loggerhead turtles were found dead in the wider area of Laganas Bay with injuries attributed to predation by monk seals. The observed injuries, as well as direct observations of the predation events, suggested that monk seals were attacking loggerheads from below, snapping off the posterior plastral scutes and feeding on the turtle's entrails (Margaritoulis *et al.* 1996). This unique behavior, not documented anywhere else in the world (Fertl & Fulling 2007), was thought to have been triggered by depleted levels of local fish resources during the same season (Karavellas 1995).

Similar incidents were noted in subsequent years, but these were considered infrequent and unusual. However, during the 2010 nesting season a remarkable increase of predation events were recorded; these are presented herein.

Since 1984, ARCHELON has conducted a systematic long-term monitoring project of the nesting activity in Laganas Bay; in the last few years, the project has been carried out in association with the NMPZ. Field work, including daily beach surveys and tagging of female turtles, is conducted each year from roughly mid-May until mid-October. In addition, ARCHELON runs the operation of a nationwide Sea Turtle Stranding Network, through which all sea turtle strandings are

documented through photographs as well as through a diversity of information such as size measurements, description of external injuries, body condition, and fate of carcasses. In cases where turtles are found injured but alive, they are transferred to ARCHELON's Sea Turtle Rescue Centre in Glyfada, near Athens, for treatment. Experienced project members are usually available on site because of the existence of ARCHELON's project at Zakynthos, and thus are able to perform detailed observations and obtain precise measurements of stranded turtles in conjunction with NMPZ wardens. Outside the field work season (Mid-October to mid-May), NMPZ wardens undertake the task of registering and reporting turtle strandings. In the present study we classify the carcasses as per their condition at finding as "fresh" (0-2 days since death), "decay" (3-6 days since death), and "advanced decay" (>6 days since death).

During 2010, 21 large loggerhead turtles were recorded stranded or floating in the wider area of Laganas Bay, bearing injuries attributed to predation by monk seals (Table 1, Fig. 1). The temporal distribution of predated turtles was from 01 May to 08 September (131 days). No confirmed predation events were reported before or



**Figure 1.** Laganas Bay, with the boundaries of the National Marine Park of Zakynthos, its maritime protection zones, and the locations of the predated turtles.

after this period. Ten of the predated turtles (47.6% of the total) were reported while in the water and the remaining 11 turtles (52.4% of the total) upon their stranding on land.

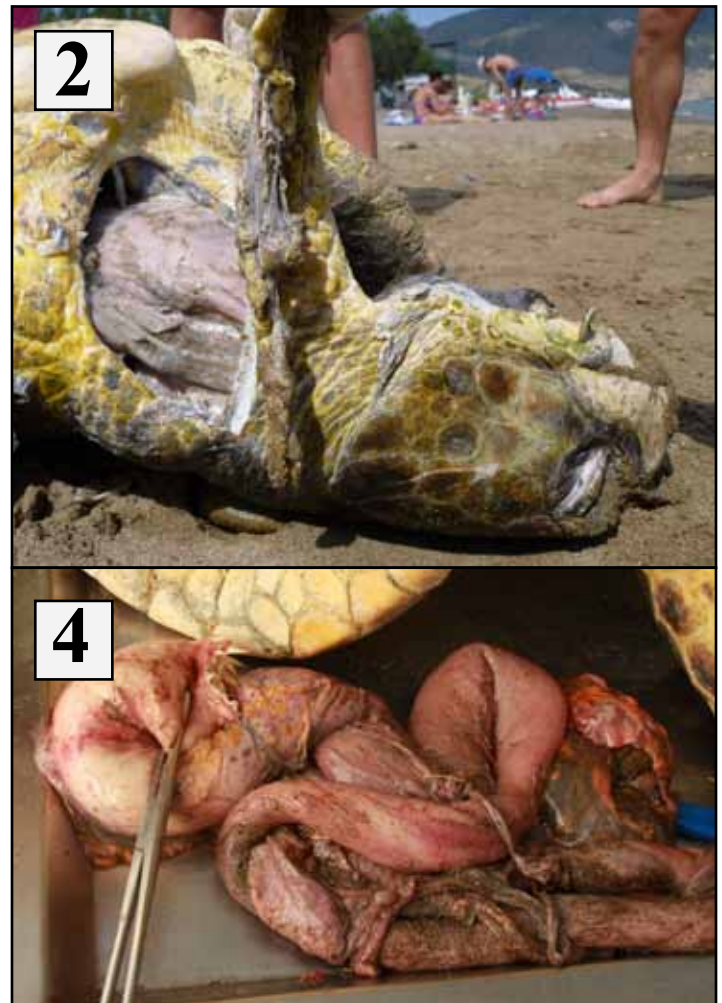
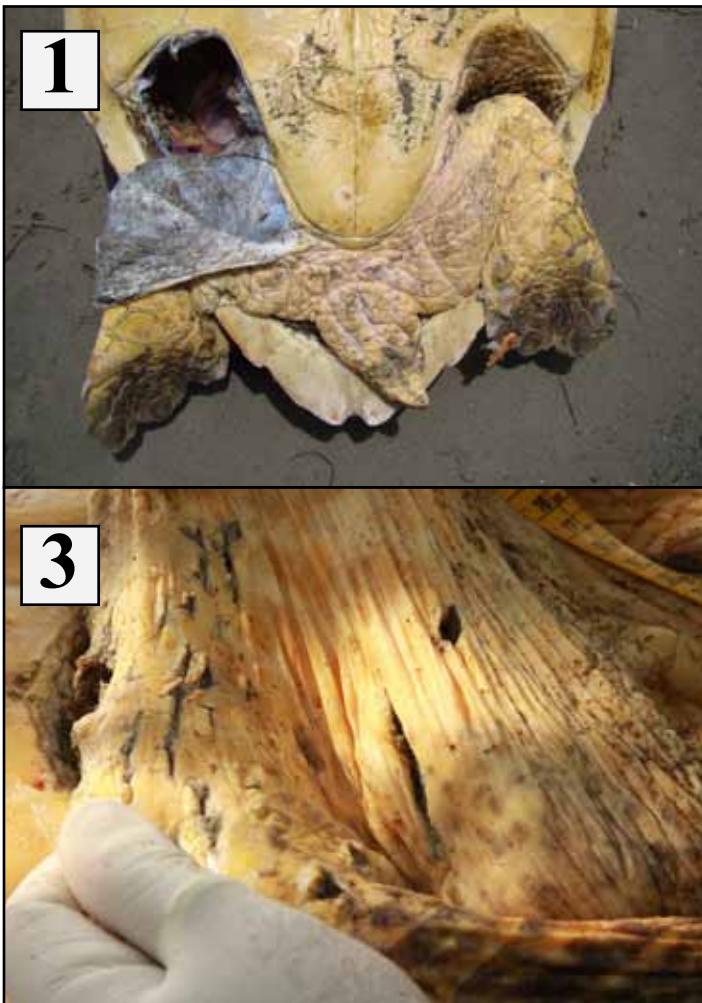
Eighteen (85.7%) of the predated turtles were females; only three (14.3%) were males. The size (CCL, notch to tip) of the predated females (mean = 82.7 cm; range = 75.0 - 93.0; n = 18) was within the typical range for nesting females at Zakynthos (Margaritoulis *et al.* 2003).

All predated turtles were found with opened body cavities, and all were dead except one, which had exposed entrails and died soon afterward (No. 7 in Table 1). Monk seals made single or multiple openings through the ventral side of the turtle, either by tearing off the skin between the plastron and the base of a flipper (Photo 1) or through the throat (Photo 2). Most of the predated turtles bore canine teeth marks on plastral scutes or on the skin around or close to the inflicted opening of the body cavity (Photo 3). Some turtles, although opened at a specific location, also bore teeth marks at other locations, either on the plastron or at the base of a flipper, and these injuries were thought to be unsuccessful attempts by monk seals to gain entry into the body cavity.

Nineteen turtles (90.5% of the total) were opened in the soft area anterior to one or both rear flippers, more specifically in the area between the femoral/anal scutes, the posterior inframarginal scute and the marginals (Photo 1). For simplicity we will hereafter refer to these openings as openings “through a flipper.” Five of these 19 turtles bore also other openings to the body cavity; one was opened at the throat (No. 11), and four (Nos. 4, 16, 20 & 21) were opened at the throat and also through one or both front flippers. The other two cases (9.5% of the total) were opened only at the throat.

Of the 14 turtles opened only through the rear flippers, 13 cases (92.9%) involved only the hind right (HR) flipper, and one case the hind left (HL) flipper (Table 1). It is of interest to note that five turtles (Nos. 4, 5, 6, 7 & 19) bore a more or less similar fresh scratch or cut on their left eye.

The one turtle found alive (No. 7 in Table 1) was transported to ARCHELON’s Rescue Centre in Glyfada. A necropsy revealed that the largest part of the large intestine had been torn off, while the small intestine, the stomach and the esophagus were left in place (Photo 4). Several mature follicles were found in the oviducts of this turtle, indicating that she was in reproductive condition.



**Photo 1.** Typical opening of the body cavity of a predated turtle through the soft area between the plastron and the rear flipper (in most cases the rear right flipper). **Photo 2.** Opening of the body cavity of a predated turtle through the throat. In these cases, the esophagus together with the trachea and tongue were taken. **Photo 3.** Teeth marks on the torn skin between the plastron and the rear flipper. **Photo 4.** Necropsy of turtle No. 7 (Table 1), which was badly wounded with an exposed body cavity, but was still alive when found. Note that apart from the section of the digestive track shown here, the remainder of the digestive track was torn off and taken.

	Date found	Sex	Location	CCL cm	Cond.	Remarks
1	1 May	F*	East Laganas	79.0	Fresh	Opened ventrally between plastron and HR flipper.
2	24 May	M	Marathias beach, Keri	86.0	Fresh	Opened ventrally between plastron and HR flipper; skin ripped off.
3	26 May	M	Marathonissi beach	82.5	Fresh	Opened ventrally between plastron and HR flipper, skin ripped off revealing flipper muscles, teeth marks on the hanging skin. Entrails were not missing likely because of difficulty due to the male's concave plastron. Crab ( <i>Planes minutus</i> ) still on carcass.
4	3 June	F*	East Laganas beach	88.0	Decay	Opened ventrally between plastron and both hind flippers as well as between plastron and FR flipper; entrails missing. Also opened at the throat. Scratch-cut at left eye.
5	3 June	F*	Floating off Porto Koukla	85.0	Fresh	Very fresh; no rigor mortis. Opened ventrally between plastron and HR flipper; teeth marks on the hanging skin; skin pulled back over flipper revealing muscles; entrails missing. Foam coming from trachea when mouth was opened. Scratch-cut at left eye.
6	4 June	F*	East Laganas beach	77.5	Fresh	Opened ventrally between plastron and HR flipper; teeth marks on the hanging skin; skin pulled back revealing flipper muscles; entrails missing. Scratch-cut at left eye.
7	5 June	F	Floating off East Laganas beach	85.5	Alive	Stranded alive after seen floating; died after 3 h, presumably abandoned by monk seal. Opened ventrally between plastron and HR flipper; teeth marks on skin; flipper muscles exposed; some entrails missing; undeveloped eggs visible. Scratch-cut on left eye.
8	10 June	F	Floating off Kalamaki	83.0	Fresh	Opened ventrally between plastron and HR flipper; entrails missing.
9	18 June	F*	Floating off Oasis beach,	93.0	Advanced decay	Opened ventrally between plastron and HR flipper. Observed from boat and left at sea. CCL taken from tagging database.
10	21 June	F*	East Laganas beach	89.5	Fresh	Opened ventrally between plastron and HL flipper, teeth marks on skin; flipper muscles exposed; entrails missing. Body opened between plastron and HR flipper but intrusion unsuccessful probably because of a shell deformity. Last observed nesting 11 June.
11	25 June	F*	East Laganas beach	80.5	Fresh	Opened ventrally between plastron and both hind flippers with teeth marks on the hanging skin; flipper muscles exposed; entrails missing. Opened at the throat. Tongue, trachea and esophagus missing; teeth marks on skin at throat.
12	27 June	F*	Floating off Porto Koukla	78.5	Decay	Opened ventrally between plastron and HR flipper; teeth marks on skin; flipper muscles exposed; entrails missing. Old propeller cut on carapace. Last observed nesting 12 June.
13	29 June	F*	Off West Laganas	82.0	Fresh	Opened ventrally between plastron and HR flipper; skin pulled back revealing flipper muscles; entrails missing. Last observed nesting 15 June.
14	5 July	F*	Marathonissi shore (SW)	88.0	Advanced decay	Opened ventrally between plastron and HR flipper; entrails missing.
15	13 July	F**	East Laganas beach	79.0	Decay	Opened ventrally between plastron and HR flipper; entrails missing. Last observed nesting 17 June.
16	13 July	F**	Floating off Aghios Sostis	79.0	Fresh	Opened ventrally between plastron and hind flippers and between plastron and FR flipper with teeth marks on skin; flipper muscles exposed; most entrails missing (only part of lung present). Also, opened at the throat with tongue, trachea and esophagus missing. Teeth marks between plastron and FL flipper, thought to be an unsuccessful intrusion attempt. Last observed nesting 8 July.
17	1 Aug	F	Gerakas beach	75.0	Decay	Seen floating for several days between Pelouzo and Marathonissi. Head and 3 flippers (FR, FL, HL) missing. Body cavity empty.
18	2 Aug	F***	Floating off Keri caves	78.0	Fresh	Located by divers in front of a cave inhabited by monk seals. Opened ventrally between plastron and HR flipper; teeth marks on the hanging skin; skin pulled back revealing flipper muscles; most entrails missing, with fully developed eggs. Foam in trachea and when scratched, the turtle bled - freshly dead. Last observed nesting 22 July.
19	10 Aug	F*	Gerakas beach	90.0	Fresh	Head almost separated from body. Tongue, trachea and esophagus missing; intestines coming out of throat opening. Scratch-cut on left eye. Last observed nesting 9 July.
20	4 Sept	F	Floating off East Laganas	77.5	Advanced decay	Observed floating in swallow water. Opened ventrally at the base of HR, HL, FL flippers and throat. FR flipper missing but found the next day on the same beach.
21	8 Sept	M	Floating off Aghios Sostis	76.5	Decay	Found floating 50 m offshore. Opened ventrally at HR, HL, FR flipper and at throat, and at the base of FL flipper. Entrails, tongue, trachea, and esophagus missing. Teeth marks on skin at hind flippers and neck. Most likely to be the turtle observed by divers while it was being predated by a monk seal at Gerakas Cape on 5 September (see text).



**Table 1 (overleaf).** Loggerhead turtles predated by monk seals in Laganas Bay, Zakynthos, during 2010 (F: Female; M: Male; CCL: Curved carapace length in cm; HR: Hind right; HL: Hind left; FR: Front right; FL: Front left). \* tagged at Zakynthos in previous seasons; \*\* tagged at Zakynthos during 2010; \*\*\* tagged at Kyparissia Bay during 2010

Approximately 62.0% of the predated turtles were classified as fresh (including the one turtle found alive), 23.8% as decayed, and 14.2% in advanced decay (Table 1). It is worthwhile to note that all predated turtles had no other fresh injuries besides those inflicted by monk seals. Some of them had old (and healed) external cuts or scars on their shells, frequently seen on nesting turtles. Judging from the “fresh” carcasses, predated turtles were in good physical condition at the time of death as can be ascertained from their external appearance, e.g. normal body weight, no excessive quantities of epibiota (as usually observed in weak or sick animals). Fourteen out of the 18 female turtles (77.7%) bore ARCHELON flipper tags, eleven of which had been tagged in Zakynthos during a previous season (remigrant turtles), and three had been tagged during the 2010 season (neophyte turtles): two at Zakynthos and one at nearby Kyparissia Bay. Seven of the tagged turtles were observed nesting at Laganas Bay in 2010 between 5-32 days before the stranding reports (Table 1). In addition, two female turtles (Nos. 7 & 8) had flipper scars attributed to lost tags. The remaining two female turtles (Nos. 17 & 20) had missing flippers; thus, it cannot be ascertained whether or not these turtles were previously tagged. Therefore, we can conclude that at least 16 of the 18 predated female turtles were definitely within their reproductive period and actively nesting.

All turtle carcasses were buried apart from turtles Nos. 9, 12 & 13. Of these, No. 9 was left at sea with its tags still on, No. 12 was dragged up on a small beach with difficult access, and No. 13 was put in a nylon bag to be taken by the Municipality. The body size, carcass condition, and tag codes of these turtles exclude any possibility of them being confused with subsequently observed carcasses.

Below we present some reliable observations made by persons with adequate knowledge of sea turtles and monk seals, within the area of Laganas Bay during the nesting season of 2010.

On 16 July, an ARCHELON volunteer observed and photographed an adult male turtle in the Bay that bore an injury at the base of the HR flipper, which resembled a predation attempt by a monk seal. Since the turtle appeared to be in good condition as it was actively swimming, diving and feeding at the bottom, it was thought that it had escaped a monk seal attack, having only the external skin ripped off without severe damage to the peritoneum.

On 21 July around 1100 h, ARCHELON volunteers observed a monk seal swimming close to the NW shore of Marathonissi Islet.

Scuba divers working as underwater tourist guides have repeatedly observed and videotaped a monk seal around Marathonissi Islet. The numerous seaside caves between Marathias Cape and Keri Cape (Fig. 1) provide refuge for at least one monk seal, which has been observed frequently by the divers. They believe it is the same individual that was seen in Marathonissi Islet. This monk seal, which is approximately 3 m long and has a distinctive umbilical patch, was characterized by the divers as “friendly” as it was following the group’s underwater activity from a distance.

On 16 August, the divers observed a juvenile monk seal, approximately 1 m long, off the rocky shores of Marathonissi Islet.

On 5 September at about 1600 h, the same divers observed from their boat a monk seal “eating out” a turtle offshore at Gerakas Cape (Fig. 1). They recognized the monk seal as the one that they

had observed repeatedly at both Marathonissi Islet and Marathias Cape. They watched the monk seal fishing for about 20 minutes and frequently diving. Following a swarm of bubbles the monk seal brought a turtle to the surface – apparently dead – and chewed on the turtle. When the monk seal became aware of the observers, it dragged the turtle towards the rocks where the divers were unable to go in their boat. This turtle was assumed to be No. 21 (Table 1).

Further, a diver was told by a local fisherman that in mid-July he had observed a monk seal “eating out a turtle from behind” (in Greek: *na tin koufonei apo ton kolo*), close to the rocky shore of Marathonissi Islet.

On 12 September, at about noon, an NMPZ warden in a boat reported a turtle carcass floating about 100 m off Marathia beach. The warden would not approach but he observed that the turtle had a length of 60-70 cm and its intestines were hanging out from behind. When the warden returned with the stranding team to examine the carcass, they couldn’t find it, despite searching the area for about 2 hours.

Our results confirm that monk seals in Zakynthos prey on healthy, large loggerheads during the nesting season. This kind of behavior for the Mediterranean monk seal seems to be unique throughout its current geographical range (see also Fertl & Fulling 2007). For the congeneric Hawaiian monk seal *Monachus schauinslandi* there has been only one case of a possible maceration of a juvenile green turtle in Hawaii, but not in the way it appears on Zakynthos (G. Balazs, pers. comm.).

The twenty-one predation events reported herein are considered an absolute minimum for monk seal predation, because all were observed in detail and photographed, and no doubt was left as to the cause of death in each case. At Zakynthos during 2010, we recorded several other turtle strandings in which the cause of death could not be reliably identified, mostly because of advanced decomposition. However, it is certain that at least some of these turtles had been predated by monk seals. Further, it is reasonable to assume, as shown by the carcass reported floating on 12 September and eventually not found, that a number of turtle carcasses were not detected as they may have been taken offshore by surface currents or drifted into one of the many inaccessible coves along the rocky coast of western Zakynthos.

Terrestrial wild animals capable of doing this kind of predation do not exist on Zakynthos; the largest wild mammal on the island is the beech marten *Martes foina*. The possibility of post-mortem scavenging by dogs (the only animal which could inflict similar injuries) can be rejected as such an event was never observed or reported on Zakynthos before. In addition, 10 of the predated turtles (47.6%) were first observed at sea while nine turtles (42.9%) were reported on nesting beaches (i.e. East Laganas, Gerakas and Marathonissi) where night work and early monitoring surveys are conducted, as well as wardening. Further, these beaches are frequented by people during the day and turtle carcasses, if not seen first by ARCHELON and NMPZ personnel, are immediately spotted and reported by beach users. Thus, predation or scavenging by terrestrial animals is improbable. Similarly, we are not aware of other marine animal in Zakynthos waters that could inflict such injuries.

The spatial distribution of predated turtles and monk seal sightings suggests that the monk seal(s), residing between the Capes of Marathias and Keri, is (are) responsible for the recorded predation incidents. Monk seals sighted in Marathonissi and Gerakas are thought to be seals visiting these locations occasionally from the Capes of Marathias and Keri. This is because at Marathonissi and Gerakas there are many anthropogenic disturbances, especially during summertime, that drive the seals away temporarily.

A comparison of the carcasses examined in the present study with those documented previously in Margaritoulis *et al.* (1996) suggested that monk seals have changed their predation technique. Indeed, instead of opening the body cavity by snapping off the posterior plastral scutes, monk seals now seem to prefer tearing the skin between the plastron and rear flippers (in most cases the right rear flipper) or macerating the throat. In attacking the soft area between the plastron and the rear flipper, monk seals seem to pull the skin hard toward the flipper, in most cases the pulled skin is turned inside out around the flipper, revealing the muscles of the flipper (Photo 1). The new predation technique certainly needs less energy on the part of the monk seal.

As soon as the body cavity is opened, monk seals likely pull out the intestines by inserting their muzzle into the opening. This strategy was hypothesized during the necropsy of the individual that was found wounded and alive (No. 7 in Table 1), which was presumably abandoned for some reason by the monk seal. The larger section of the large intestine was torn off and missing but the rest of the digestive system, including small intestine, stomach and esophagus, were still inside the body cavity. In two other cases, it appeared that the monk seal could not insert its muzzle into the body cavity because of a relatively small opening due to a deformed carapace (No. 10) and to a concave plastron of a male turtle (No. 3). It should be noted here that adult monk seals are much bigger than adult loggerhead turtles, and reach a length of approximately 2.5 m and a weight of 250-300 kg (Caltagirone 1995). An inability to reach the entrails, despite an inflicted opening, may trigger the seals to attempt other openings to the body cavity at other locations. This was the case for specimen No. 10, where the monk seal eventually opened the body cavity through the area between the plastron and the quite unusual rear left flipper. It is of interest to note that in cases of intrusion into the body cavity through the rear flippers, the rear right flipper was preferred in 92.9% attacks. This is an indication that these predation events may have been conducted by the same individual monk seal.

When seals attacked the throat of the turtle, they tore the skin there and pulled it toward the head; sometimes the pulled skin covered part of the head. Then, the esophagus, tongue and trachea were pulled out and presumably consumed. Specimens Nos. 17 & 19 (Table 1) were opened only through their throat, as suggested by the heads that were either missing or were barely connected to the body.

Multiple openings to the body cavity either through the flippers or through the throat (see Nos. 4, 11, 16, 20 & 21 in Table 1) may have been made either by the same individual monk seal trying to reach entrails that were inaccessible from the initially inflicted opening or the injuries may have been made by several monk seals.

The large size of the predated turtles may be explained by the monk seal's predation technique. As mentioned previously, an adult monk seal needs to create a relatively large opening to the turtle's body cavity in order to succeed in taking the entrails. These large

openings could only be made on large turtles.

The need to create an adequate opening may also explain the preference of monk seals for female turtles, at least for attacks through a flipper. Indeed, as observed in case No. 3 (Table 1), the concave plastron of a male turtle may present some difficulty to a monk seal in entering its muzzle into the body cavity. The monk seal preference for male turtles, observed during 1994 (Margaritoulis *et al.* 1996), can be explicated by the different technique for opening the body cavity that year, i.e. by snapping off plastral scutes. This technique would not limit the size of the opening, which is the case with openings through the rear flippers.

A somewhat persistent feature on the predated turtles was the fresh scratches or cuts on the eyes. In at least five cases (Nos. 4, 5, 6, 7, 19), predated turtles had a clear scratch or cut over their left eye. The cause of these scratches or cuts is not known, although they are connected somehow to the predation incident. Could they be caused by the monk seal's nails trying to get hold of the turtle in order to be able to open it from below, or by the turtle's nails trying to shed off the seal's hold?

In light of the change in predation technique by monk seals during the 2010 season, we intend to retrospectively examine all turtle stranding data from recent years on Zakynthos.

The reasons for this type of predation may involve the noted depletion of marine resources in the area. Indeed, the loss of marine biodiversity caused by fishing pressure is a growing concern worldwide. Unsustainable fishing in the Mediterranean has caused the decline of many fish stocks (Garcia *et al.* 2005). In Greece, the increasing trend in marine landings for the period 1964-1994, attributed to fleet modernization and expansion of the fisheries, was followed by rapidly declining trends in landings and yields, thus suggesting that fishing had been unsustainable (Stergiou *et al.* 2007). Bearzi *et al.* (2008) attribute the precipitous decline of the short-beaked common dolphin *Delphinous delphis* in the eastern Ionian Sea to a lack of food because of overfishing. In 1994, the predation of loggerheads by monk seals was attributed to the decline of fish stocks noted locally (Karavellas 1995, Margaritoulis *et al.* 1996).

Mediterranean monk seals have a greatly varied diet, but feed normally on cephalopods and various species of fish. However, they seem to be opportunistic feeders exploiting the resources that are most abundant at the time (Caltagirone 1995 and references therein). It is therefore hypothesized that the continuing reduction of marine resources are forcing monk seals at Zakynthos to search for other available prey. Unfortunately, loggerhead turtles that concentrate for breeding into Laganas Bay appear to be the newest prey item.

It is estimated that during the 2010 nesting season about 450 female loggerhead turtles nested in Laganas Bay (ARCHELON, unpublished data). The loss of at least 18 reproductively active females, representing 4% of the annual nesting population, is not sustainable in the long run, especially if this is on top of other losses (due to fisheries interaction, boat strikes, etc.) documented regularly in Laganas Bay and around Zakynthos Island. Although it is not known whether the current predation rate will continue in the future, it is recommended, despite the awkward circumstances of a Critically Endangered animal preying on an Endangered one, that the Management Agency of the NMPZ make a serious effort to investigate possible solutions for this unfortunate situation.

**Acknowledgements:** Field work on Zakynthos was carried out under permits by the Ministry of Environment and the NMPZ. We thank all ARCHELON

field assistants and volunteers, especially Benjamin C. Hawksbee, as well as the NMPZ wardens and personnel, for their valuable help in collecting data for this study. We also thank Paul Tsaros, in charge of ARCHELON's Rescue Centre, for the necropsy results, and Charikleia Minotou of WWF Greece for conveying monk seal sighting reports. We acknowledge the use of the MapTool program for analysis and graphics (seaturtle.org) and thank Danielle Gault and Alan Rees for producing the map. Finally we thank two anonymous reviewers for their editorial assistance and helpful remarks.

BEARZI, G., S. AGAZZI, J. GONZALVO, M. COSTA, S. BONIZZONI, E. POLITI, C. PIRODDI & R.R. REEVES. 2008. Overfishing and the disappearance of short-beaked common dolphins from western Greece. *Endangered Species Research* 5: 1-12.

CALTAGIRONE, A. 1995. The Mediterranean Monk Seal. UNEP, RAC/SPA, Parc National de Port-Cros. Tunis. pp. 1-71.

FERTL, D. & G.L. FULLING. 2007. Interactions between marine mammals and turtles. *Marine Turtle Newsletter* 115: 4-8.

GARCIA, S.M., I. DE LEIVA MORENO & R. GRAINGER. 2005. Global trends in the state of marine fishery resources 1974–2004. In: *Review of the State of World Marine Fishery Resources*. FAO Fisheries Technical Paper No 457. FAO UN. Rome. pp. 10–14.

IUCN. 2010. IUCN Red List of Threatened Species. Version 2010.2. [www.iucnredlist.org](http://www.iucnredlist.org) (downloaded 23 August 2010).

KARAVELLAS, D.P. 1995. Integrated Ionian project for the study and conservation of the Mediterranean Monk Seal *Monachus monachus* on Zakynthos. Annual Progress Report. Commission of the European Communities. pp 1-25.

MARGARITOU, D., D. KARAVELLAS & C. IRVINE. 1996. Predation of adult loggerheads by Mediterranean monk seals. In: J.A. Keinath, D.E. Barnard, J.A. Musick & B.A. Bell (Comps.). *Proceedings of the 15th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Tech. Memo. NMFS-SEFSC-387. pp. 193-196.

MARGARITOU, D., R. ARGANO, I. BARAN, F. BENTIVEGNA, M.N. BRADAI, J.A. CAMINAS, P. CASALE, G. DE METRIO, A. DEMETROPOULOS, G. GEROSA, B. J. GODLEY, D. A. HADDOUD, J. HOUGHTON, L. LAURENT, & B. LAZAR. 2003. Loggerhead turtles in the Mediterranean Sea: Present knowledge and conservation perspectives. In: A.B Bolten & B.E. Witherington (Eds.). *Loggerhead Sea Turtles*. Smithsonian Books, Washington DC. pp. 175-198.

MARGARITOU, D. 2005. Nesting activity and reproductive output of loggerhead sea turtles, *Caretta caretta*, over 19 seasons (1984–2002) at Laganas Bay, Zakynthos, Greece: the largest rookery in the Mediterranean. *Chelonian Conservation & Biology* 4: 916-929.

STERGIOU, K.I., D.K. MOUTOPOULOS & A.C. TSIKLIRAS. 2007. Spatial and temporal variability in Hellenic marine fisheries landings. In: C. Papaconstantinou, A. Zenetos, V. Vassilopoulou & G. Tserpes (Eds.). *State of Hellenic Fisheries*. Hellenic Centre for Marine Research, Athens. pp. 141–150.

VLACHOUTSIKOU, A. & D. CEBRIAN. 1992. Population status, habitat use, interaction with fishery and biology of the Mediterranean monk seals on Zakynthos Island, Greece. WWF Project 3871 Greece. pp. 1-19.

## A Review of Potential Marine Habitats for Marine Turtles in Turkey

Ayşe Oruç, Umut Tural & Tuncay Cesur

WWF Turkey, Büyük Postane Caddesi, No:43-45, Kat 5, Bahçekapı, İstanbul, Turkey (E-mail: [aoruc@wwf.org.tr](mailto:aoruc@wwf.org.tr))

Two marine turtle species nest regularly on the Mediterranean coast of Turkey: the loggerhead turtle *Caretta caretta* and the green turtle *Chelonia mydas*. Both species are protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Barcelona Convention and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Six of the seven species of marine turtle are recognised as threatened, endangered or critically endangered by IUCN (IUCN SSC, 2008).

Since 1988, twenty important nesting beaches for marine turtles have been identified along the Mediterranean coast of Turkey. These are from west to east: Ekincik, Dalyan, Dalaman, Fethiye, Patara, Kale, Kumluca, Çıralı, Tekirova, Belek, Kizilot, Demirtas, Gazipasa, Anamur, Goksu Delta, Alata, Kazanlı, Akyatan, Yumurtalık and Samandag. In Turkey, marine turtles are under threat due to loss of nesting habitats, boat traffic/collision and fisheries bycatch.

In Turkey, efforts by marine turtle researchers and conservationists have been focused, for a long time, on marine turtle nesting sites. Therefore, there are limited data on feeding, breeding and wintering sites together with the impacts of fishery related activities on marine turtle populations. Although historically more turtle monitoring effort has focused on beaches, the number of detailed marine biodiversity studies carried out in Specially Protected Areas (SPA) has been increasing, particularly since 2002. During these studies,

the occurrence of endangered species and species protected by international conventions are also considered and their presence and abundance is recorded.

Marine turtles are migratory species and they spend all phases of their lives, except for egg-laying in the sea. It is therefore considered that the most effective measure that would enable the species to survive is to minimise human induced risks in both land and marine habitats. Aside from ongoing conservation work, assessing reliable data from dead or alive stranded marine turtles will provide additional information about these animals' habitats, migration routes, threats, and population trends. In addition to the above, data compiled from marine biodiversity studies, fisheries research and reports on satellite tracking on marine turtles may also provide insights as to the feeding habits as well as wintering and reproduction areas of marine turtles along Turkey's Aegean and Mediterranean shores.

The compilation of data on turtles at seas in Turkey from various reports reveal some possible foraging areas and/or threats (Table 1). The Kaş-Kekova (Antalya) area appears to serve as a feeding ground for *C. caretta*, and principal threats include solid waste (plastic bags etc.), long line fishing and ghost fishing gear (abandoned nets and fishing line stuck on the bottom of the sea). Speedboats and long line fishing gear are the main causes of injury or death for marine turtles are found in the Kemer (Antalya) area. In the Eastern