

The following publication should be cited as:

Touliatou S., Tsaros P., Margaritoulis D. 2012. An alarming increase of turtle strandings at Zakynthos. 10ο Πανελλήνιο Συμπόσιο Ωκεανογραφίας & Αλιείας, 07 - 11 Μαΐου 2012, Ίδρυμα Ευγενίδου, Αθήνα.

AN ALARMING INCREASE OF TURTLE STRANDINGS AT ZAKYNTHOS

Touliatou S., Tsaros P., Margaritoulis D.

ARCHELON, Solomou 57, GR-10432 Athens, Greece smaro@archelon.gr

Abstract

Strandings of sea turtles at Zakynthos, hosting the largest nesting aggregation of loggerhead turtles in the Mediterranean, are presented over the period 2005-2011. In total 209 turtles were recorded of which 175 dead, 26 injured or weak, and 8 entangled in fishing gear. 65.7% of the dead turtles were found within the boundaries of the National Marine Park of Zakynthos. Cause of death, assessed *in situ* from external injuries for 92 turtles (52.6% of total), was classified as predation by monk seals (53.3%), fisheries interaction (31.5%), and boat strikes (15.2%). The above percentage of fisheries impact is considered minimum because it was extracted from external injuries only, while many dead turtles with no external injuries may be victims of fisheries interaction. Indeed, proper examination of 23 injured turtles, transferred to ARCHELON Rescue Centre, revealed that 78.3% of them suffered from fisheries impact. The significant upward trend of dead turtles, of which 67.8% adults, is alarming for the reproductive population at Zakynthos as such losses may not be sustainable.

Keywords: Loggerhead turtle, *Caretta caretta*, fisheries interaction, monk seals, boat strikes

1. Introduction

The Loggerhead Sea Turtle (*Caretta caretta*) is globally listed, by the International Union for Conservation of Nature (IUCN), as an Endangered species (IUCN 2010). The largest nesting aggregation of loggerhead turtles in the Mediterranean is found in Laganas Bay, Zakynthos, Greece (Margaritoulis et al. 2003), which hosts on the average, over 26 seasons, 1,218 nests per season (Margaritoulis 2005, Margaritoulis et al. 2011). Various legislative acts were attempted, since 1984, to protect this important reproductive habitat but without adequate enforcement. Finally, following pressure by the Bern Convention of the Council of Europe and the European Commission, the National Marine Park of Zakynthos (NMPZ) was established in 1999, and the associated Management Agency in 2000 (Dimopoulos 2001). The marine part of the NMPZ includes mainly Laganas Bay at the southern part of the island (Fig. 1). Turtles of both genders typically begin to arrive in the Bay in April, while nesting occurs from late May to early August, depending on the year.



Fig 1. Sketch map of Laganas Bay showing the outer boundaries of the marine area of the National Marine Park of Zakynthos. A, B and C are internal marine zones featuring different protective measures.

We present herein the recorded sea turtles which were found dead, injured, and entangled in fishing gear at Zakynthos over the 7-year period 2005-2011.

2. Methods

Since 1984, ARCHELON is conducting a systematic project which monitors the nesting and hatching activities in Laganas Bay; in the last years in association with the NMPZ. Field work, including daily

beach surveys and tagging of turtles, is carried out from roughly mid-May until mid-October. In addition, ARCHELON operates a nationwide Sea Turtle Stranding Network, through which turtle strandings are documented through a diversity of information such as size measurements, description of injuries, body condition, cause of death, and fate of carcass. Since necropsies were not done on site, “cause of death” was assessed from external injuries or other revealing signs. Almost all turtle carcasses were buried, following inspection and reporting. Turtles found injured but alive were transported to ARCHELON’s Rescue Centre in Glyfada, close to Athens, for appropriate examination and treatment. Because of the existence of ARCHELON’s project on Zakynthos, experienced project members were available on site, and these were able in most cases to perform adequate observations and obtain precise measurements of stranded turtles, sometimes in conjunction with NMPZ wardens and Coast Guard officers.

3. Results

In the 7-yr period 2005-2011 a total of 209 sea turtles were recorded in Zakynthos as dead or injured or alive and entangled in fishing gear. Of these, 207 individuals (99.0%) were identified as loggerhead turtles, 1 as green turtle (*Chelonia mydas*), and 1 was not identifiable.

Of the 209 turtles, 175 (83.7%) were found dead of which 115 (65.7%) within the boundaries of the NMPZ. The majority of dead turtles (about 75%) were recorded between May and September (Fig. 2).

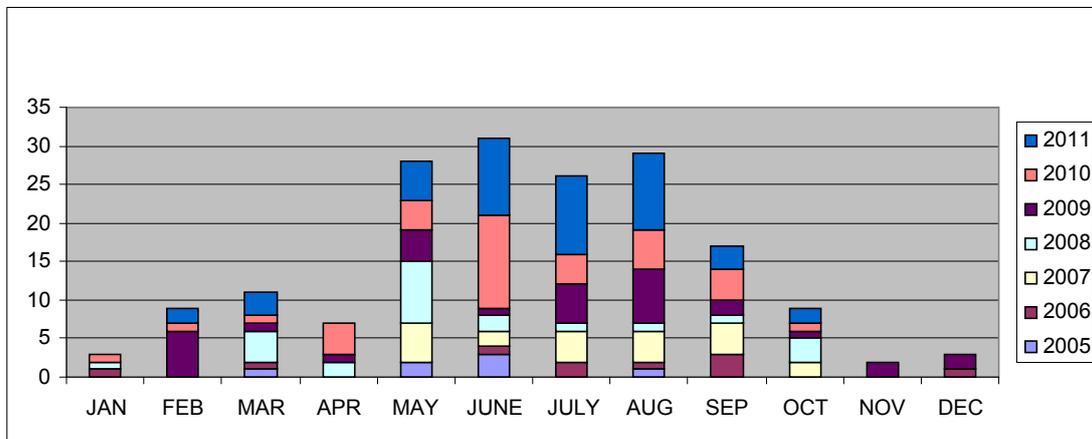


Fig. 2. Monthly distribution of dead turtles recorded in Zakynthos over the years 2005-2011.

The annual number of dead turtles ranged from 7 to 45, showing a significant upward trend over the period 2005-2011(Fig. 3).

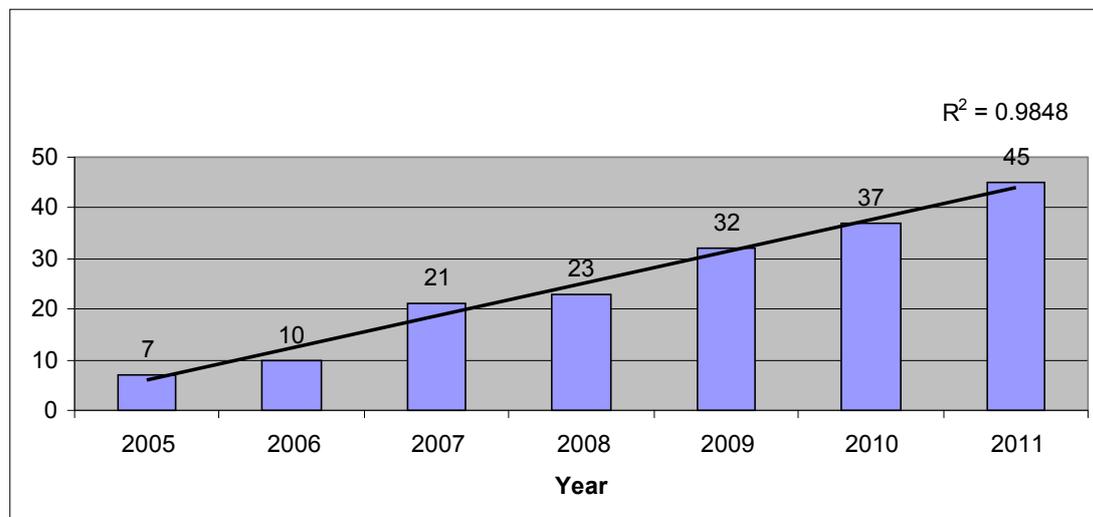


Fig. 3. Annual number of dead turtles in Zakynthos over the years 2005-2011, showing a significant upward trend.

The cause of death, specified in 92 cases (52.6 % of total deaths), was classified as: Direct human action (i.e. injuries on top of head, apparently delivered on purpose after capture in fishing gear) affected 5 turtles (5.4%); fisheries interaction (in the form of hook observed in the mouth cavity or fishing line protruding from mouth or cloaca, or carcass entangled in fishing line or net) affected 24 turtles (26.1 %); boat strikes (in the form of characteristic cuts on carapace) in 14 cases (15.2 %); predation by Mediterranean monk seals (*Monachus monachus*), assessed through unambiguous ventral openings of the body cavity bearing teeth marks (described in detail in Margaritoulis et al. 1996, Margaritoulis & Touliaou 2011), in 44 cases (47.8 %), and suspected predation by monk seals in 5 cases (5.4%). Combining turtles deliberately killed (apparently after capture) and those found dead with signs of fishing gear, it is deduced that 29 turtles in total (31.5% of those with identifiable cause of death) were affected by fisheries interaction.

The spatial distribution of dead turtles is shown in Table 1. It is worth to note that 100% of monk seal predations were recorded within the NMPZ boundaries, while deaths attributed to boat strikes were equally shared inside and outside the NMPZ boundaries. Of the 29 dead turtles, because of fisheries interaction, 9 (31.0%) were found inside the boundaries of the NMPZ and 20 (69.0%) along the eastern coast of the island, i.e. outside the NMPZ boundaries.

Table 1. Spatial distribution of 92 dead turtles per cause of death in Zakynthos over the period 2005-2011.

Cause of death	Totally recorded	Found inside NMPZ	Found outside NMPZ
Predation by monk seals (incl. suspected predations)	49	49	0
Fisheries interaction (incl. deliberate killings)	29	9	20
Boat strikes	14	7	7

Body size distribution of dead turtles was analysed, using Straight Carapace Length (SCL) as an index to classify turtles in three size classes as per juvenile (SCL<40cm), subadult (40cm≤SCL<65cm), and adult (≥65cm). Out of 152 dead individuals that were measured, 5 (3.3%) were classified as juveniles, 44 (28.9%) as subadults, and 103 (67.8%) as adults. In 92 adult turtles it was possible to identify also the gender; of these, 58 turtles (63.0%) were females and 34 (37%) males. Furthermore, from 91 adult turtles of known location and gender, 68 (74.7%, separated in 49 females and 19 males) were found dead inside the boundaries of the NMPZ and 23 (25.3% separated in 8 females and 15 males) outside the NMPZ, along the eastern coast of the island.

The great majority of turtles preyed by monk seals were adults (97.8%), and from these 86.4% were females (Table 2). From the dead turtles, impacted by fisheries, 3 (11.1%) were juveniles, 12 (44.4%) subadults and 12 (44.4%) adults (Table 2).

Table 2. Cause of death per size-class of 81 dead turtles, recorded in Zakynthos during the period 2005-2011. The gender of adult turtles is also noted (F: female, M: male).

Cause of death	TOTAL	Juvenile	Subadult	Adult
Predation by monk seals (incl. suspected predations)	45	0	1	44 F: 38 M: 6
Fisheries interaction (incl. deliberate killings)	25	3	12	10 F: 3 M: 7
Boat strikes	11	0	4	7 F: 4 M: 3
Total	81	3	17	61

During the same period (2005-2011) in Zakynthos, and in addition to the 175 dead turtles, 26 turtles were found injured or in a weak condition but alive; all were transferred to ARCHELON's Rescue Centre. Of these, 20 turtles (76.9%) were found within the NMPZ. The annual number of injured or weak turtles ranged from 1 to 9, without any apparent trend over the years. The cause of their problem, specified in 23 turtles, was classified as: Boat strikes affected 2 turtles (8.7%), both were tagged nesting females, one of them aborted eggs while in rehabilitation; weakness attributed to unknown reasons in 3 cases (13.0%); fisheries interaction in 18 cases (78.3%). Of the 26 injured and weak turtles, 17 (65.4%) were rehabilitated successfully and eventually released.

Furthermore, 8 turtles were rescued *in situ* from entanglement in fishing gear. Of these, 7 individuals were found at sea entangled in fishing lines (6 of them inside the NMPZ and 1 at the eastern coast) and 1 was a tagged nesting turtle, which was observed during a subsequent nesting entangled in fishing net.

4. Discussion

The recorded numbers of dead turtles are considered conservative because it is certain that many turtle carcasses have either drifted offshore or to the many small coves, especially along the precipitous and mostly inaccessible western coast of Zakynthos. According to Epperly et al. (1996) the number of dead turtles that wash up on beaches represents only 7-13% of the estimated mortality.

The significant upward trend in the number of dead turtles, recorded over the last seven years at Zakynthos, sounds an alarming signal. Further, the fact that most of the dead turtles (67.8%) belong to the adult size class puts the breeding population under a strong pressure which may not be sustainable in the long run.

The unusual phenomenon of adult turtles being predated by monk seals, firstly observed in 1994 and thought to be an occasional consequence of depleted marine resources documented during the same season (Margaritoulis et al. 1996), has been dramatically increased in the last two years. This adds a significant novel pressure to the breeding turtle population at Zakynthos. On the other hand, Mediterranean monk seals are listed as Critically Endangered (IUCN 2010) and any proposals to mitigate this phenomenon should take into account the necessary provisions.

The recorded number of dead and injured turtles with external signs of fisheries interaction, accounting for 26.3% of the total number observed (55 cases out of 209), is considered an absolute minimum. The reason is that a number of dead turtles, with externally unidentifiable cause of death, would have had ingested hooks or would have been drowned, trapped in fishing gear, without showing external injuries. This assumption is supported by the fact that the injured turtles, transported to the Rescue Centre and undergone a proper examination (e.g. radiography), reveal a much higher percentage (78.3%) of injuries attributed to fisheries interaction. This higher percentage is comparable to the overall average of 69.4% (range of annual average: 59.4% -78.9%) of injured turtles admitted at ARCHELON Rescue Centre over a 10-year period (Margaritoulis et al. 2007). It is therefore suggested that the impact of fisheries on the number of dead turtles stranded in Zakynthos is much larger than the present data indicate.

In any case, fisheries interaction needs to be addressed by the NMPZ in cooperation with the Fisheries Department and the local fishermen, especially along the eastern coast of Zakynthos where most incidents of fisheries entanglement took place (Table 1). A more detailed investigation as to the kind of fishing gears involved may provide valuable insights and indicate specific fishing gears and fishing fleets in the area. For instance, several turtles were bearing large-size hooks used in drifting long-lines, an indication that these individuals may have been caught in offshore waters by non-local, and even foreign, vessels since no drifting long-liners are based at Zakynthos. Further, turtle interactions with bottom long-lines may raise the issue of reduction or modification of this fishing method at least within the NMPZ boundaries. Further, the fact that most turtle strandings occur between May and September indicates a specific time period in which implementation of "turtle-friendly" fishing practices in the wider area can be discussed.

The mitigation of intentional hits on the head, allegedly inflicted after capture in fishing gears, even though it is not a common practice in Zakynthos comparing to other areas in Greece, needs a public awareness component to educate fishermen, especially in Zakynthos and nearby areas, on the value of sea turtles in the marine ecosystem. A training program for turtle handling practices and first-aid techniques during incidental captures would be very useful in reducing turtle mortalities (Gerosa and Aureggi 2001).

5. Acknowledgements

We thank the many ARCHELON field assistants and volunteers, as well as the NMPZ wardens and the Coast Guard of Zakynthos, for their valuable help in observing, reporting and recording turtle strandings.

6. References

- Dimopoulos, D., 2001. The National Marine Park of Zakynthos: A refuge for the Loggerhead Turtle in the Mediterranean. *Marine Turtle Newsletter*, 93: 5-9.
- IUCN (International Union for Conservation of Nature), 2010. IUCN Red List of Threatened Species, V. 2010.2. Available at: www.iucnredlist.org/ (accessed 1 September 2010).
- Epperly, S. P., Braun, J., Chester, A. J., Cross, F. A., Merriner, J. V., Tester, P. A., & Churchill, J. H., 1996. Beach strandings as an indicator of at-sea mortality of sea turtles. *Bullertin of Marine Science*, 59 (2): 289-297.
- GEROSA, G., AUREGGI, M., 2001. "Sea turtle handling guidebook for fishermen", Tunis, Tunisia, UNEP, RAC/SPA.
- MARGARITOULIS, D., ARGANO, R., BARAN, I., BENTIVEGNA, F., BRADAI, M. N., CAMINAS, J. A., CASALE, P., DE METRIO, G., DEMETROPOULOS, A., GEROSA, G., GODLEY, B. J., HADDOUD, D. A., HOUGHTON, J., LAURENT, L., & LAZAR B., 2003. Loggerhead turtles in the Mediterranean Sea: Present knowledge and conservation perspectives. p.175-198. In: "Loggerhead Sea Turtles", A.B. Bolten & B.E. Witherington (Eds.), Washington DC, USA, Smithsonian Books.
- Margaritoulis, 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 and Biology*, 4 (4): 916-929.
- MARGARITOULIS, D., KARAVELLAS, D., & IRVINE, C., 1996. Predation of adult loggerheads by Mediterranean monk seals. p.193-196. In: "Proceedings of the Fifteenth Annual Symposium on Sea Turtle Biology and Conservation", J.A. Keinath, D.E. Barnard, J.A. Musick, B.A. Bell (compilers). National Marine Fisheries Service, Miami, USA. NOAA technical memorandum NMFS-SEFSC-387.
- MARGARITOULIS, D., KOUTSODENDRIS, A., & PANAGOPOULOU, A., 2007. Fisheries interactions with marine turtles. p.279-286. In: "State of Hellenic Fisheries", C. Papaconstantinou, A. Zenetos, V. Vassilopoulou, G. Tserpes (Eds.), Athens, Greece, Hellenic Centre for Marine Research Publications.
- Margaritoulis, D., Rees, A. F., Dean, C. J., & Riggall, T., 2011. Reproductive data of loggerhead turtles in Laganas Bay, Zakynthos Island, Greece, over the period 2003-2009. *Marine Turtle Newsletter*, 131: 2-6.
- Margaritoulis, D., Touliatou, S., 2011. Mediterranean monk seals present an ongoing threat for loggerhead sea turtles in Zakynthos. *Marine Turtle Newsletter*, 131: 18-23.