

# Factors affecting the populations of Sea Turtles, *Caretta caretta*: The Case of Greece

SARAKINOU G.<sup>1\*</sup>, APOSTOLAKIS S.<sup>2</sup>

<sup>1</sup> Department of Science and Mathematics, Deree - The American College of Greece, Greece

<sup>2</sup> Department of Science and Mathematics, Deree - The American College of Greece, Greece

\*corresponding author: [G.Sarakinou@acg.edu](mailto:G.Sarakinou@acg.edu)

## Abstract

The current paper presents the results of an archival research work undertaken as part of a Thesis of the Program of Environmental Studies at Deree – the American College of Greece. The research undertaken aimed at assessing the extent of the problem related to the injuries and fatalities of the loggerhead sea turtles *Caretta caretta* in Greece, through detailed analysis of incidents recorded in press. Furthermore, the research identifies the patterns followed in injuries, in an effort to form recommendations for improved monitoring and protection. As the loggerhead sea turtle, *Caretta caretta* comprises an endemic species of Greece and a keystone species for the area, its protection is considered vital for the marine environment of the region. Despite the protection schemes and activities that are in place in Greece, there is high occurrence of traumas and deaths of sea turtles. The presented work will try to identify the gaps in monitoring and the related needs as a means to overcome the obstacles towards more efficient conservation of the species.

**Keywords:** Loggerhead turtles, Threats to sea turtles, *Caretta caretta* Monitoring, Marine species protection

## 1. Introduction

The *Caretta caretta* (Loggerhead turtle) is one of the three species of sea turtle that is indigenous to the Mediterranean, along with the *Chelonia Mydas* (Green Turtle) and *Dermochelys coriacea* (Leatherback turtle) (Medasset, 2021). Unlike the latter, the Loggerhead turtle is prone to nesting in Greece and as a result, the country serves as a vital part for the survival of the species. The *Caretta caretta*'s survival is important due to the animal's role as a keystone species, therefore, the ecological impact that this species has in controlling the invertebrates' population, feeding predators through their eggs and allowing for their broken shells to be used as a source of calcium for other species (Duermit, 2007). Moreover, the loggerhead turtles are seen as a mobile reef since their

carapace have been found to house other species from 13 phyla (Duermit, 2007).

The Loggerhead sea turtle *Caretta caretta*, is the most common type of marine reptile in the Mediterranean and in Greece, however, they are exposed to numerous threats present in the nesting sites and in sea. This paper presents an assessment of threats the population of *Caretta caretta* is facing, resulting in traumas and fatalities of the loggerhead sea turtles. The paper also attempts to assess the areas that can be considered as 'hot-spots' for *Caretta caretta* traumas and deaths as well as suggestions on how to improve monitoring of *Caretta caretta* injuries.

The Loggerhead sea turtle is a migratory species that is indigenous to the Mediterranean, it has a life expectancy of 70 - 80 or more years (National Ocean Service, 2021a), and its population of nesting females worldwide surpasses 60,000 turtles (WWF, 2021). The *Caretta caretta* has a length of 92 cm on average and a hard-reddish brown dome shaped shell with a pale-yellow underbelly (WWF, 2021), which provides some protection to the vital organs (Archelon, 2021a). Its dietary habits include "slow moving or sedentary animals like jellyfish, molluscs, sea urchins, horseshoe crabs, sponges, and on sea grass" (Archelon, 2021; National Ocean Service, 2021a). Sea turtles have respiratory system and require frequent breaching on the surface, though they can spend up to 6 hours underwater while sleeping (Archelon, 2021). Out of the three species of sea turtles found in the Mediterranean, the *Caretta caretta* can reach the shallowest depth, around 110m (Medasset, 2021), and while males never exit their marine environment after they hatch, females can be found on terrestrial environments every 2 to 3 years to nest. Mating begins between the ages of 10 to 30 years (WWF, 2021). The *Caretta caretta* mating season is from early March to June and the eggs are laid between late April and early September (National Ocean Services, 2021a). Each turtle can mate every 2 years and it can produce 2-3 clutches of an average of 110 eggs each per breeding season (Medasset, 2021). As a result, the Mediterranean has an average of 1800 nesting female turtles that produce 8600 nests per year (Medasset, 2021). Research indicates that the beach in which the eggs are laid is the same as the one where the female mother was also hatched, thus there are specific breeding grounds in the Mediterranean, mainly

Greece, Cyprus, Turkey, Libya, but also smaller nesting sites can be observed in Egypt, Lebanon, Israel, Syria, Tunisia, Spain, and Italy (Medasset, 2021). Each nest of an average of 110 younglings produces males and females at a theoretical ratio of 1:1 (Rees, 2003). The sex is determined by the temperature of the sand in which the egg is incubated, a process known as Temperature-dependent sex determination (TDS); with lower temperatures (around 27.6723 °C) resulting to male turtles and higher temperatures (around 30.969 °C) resulting to females (Medasset, 2021; National Ocean Service, 2021b). Out of 1000 younglings that can be produced, it is estimated that only 1 will succeed reaching a adulthood, due to the threats that the *Caretta caretta* has to face, fact that makes their protection, critical. The *Caretta caretta* has various natural threats such as foxes, lizards, jackals, and weasels that prey on the eggs, seagulls, cormorants, crabs, lizards and snakes that prey on the younglings and fish, sharks and seals that prey on the adults, however a major cause of the rapid reduction of the numbers of the loggerhead turtle can be attributed to human activities. Climate change and the rapid increase of the mean global temperature may result in a skew in the population due to the temperature dependent sex determination mechanism that determines the species sex. The changes in the geomorphology of the hatching habitats of *Caretta caretta*, due to climate change, has a direct impact to the nesting. Moreover, nesting is disturbed by human activities, such as excessive light, noise, construction, and other disturbances on the beach. In addition, intentional harm (caused by fishermen due to gear damage, antagonism for illegal trading purposes) and unintentional (vessel strikes and bycatch in fishing gear) injuries also severely affect the population. A big threat for *Caretta caretta* comprises marine litter such as ghost nets and plastic pollution (Senet, 2019). It is important to note that actions have been taken by the European Union as well as Greece for the implementation of legislation to tackle the current vulnerable status of the *Caretta caretta* (Casale, 2017). The European Green Deal and EU Emissions Trading System attempt to tackle Climate Change (European Commission, 2021a); the Marine Strategy Framework Directive aims at sustainable management of marine ecosystems to ensure they remain clean, healthy and productive (European Parliament et al., 2008, 1); the Barcelona convention for the protection of the marine environment from marine pollution (European Commission, 2021b); the establishment of Protected Areas (National Marine Park of Zakynthos, Greece and National Marine Park of Alonnisos, Greece) (European Commission, 2021c). Though legislation is not necessarily specific to the *Caretta caretta* population, with the exception of the National Marine Park of Zakynthos, the population clearly benefits from the implementation of relevant regulations. Still the loggerhead turtle faces numerous threats in Greece.

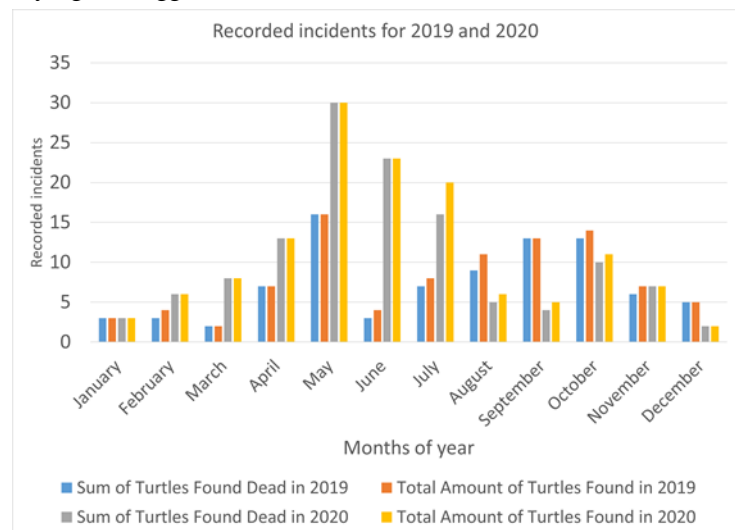
## 2. Methodology

The current work is based on archival research for the mapping of incidences of *Caretta caretta* traumas and deaths, as reported in articles of public press for the years 2019 and 2020. Newspaper articles from across Greece were accessed through the site, Topics.gr and assessed.

The site covers national, regional and local newspapers. The assessment of incidences was thorough and extensive trying to include as many incidences as possible incidences. The data concerned the number of turtles found injured or dead, the location, date, cause and extend of injury. The articles were cross-referenced to exclude multiple recordings of the same incident while obtaining all the necessary data. Overall, 228 individual incidents were collected, and processed based on the condition of the sea turtle (injured or dead), the cause of trauma (e.g. intentional injury, hypothermia, hook ingestion, plastic pollutants etc.), the geographical distribution of incidents as well as the identification of relevant patterns.

## 3. Results

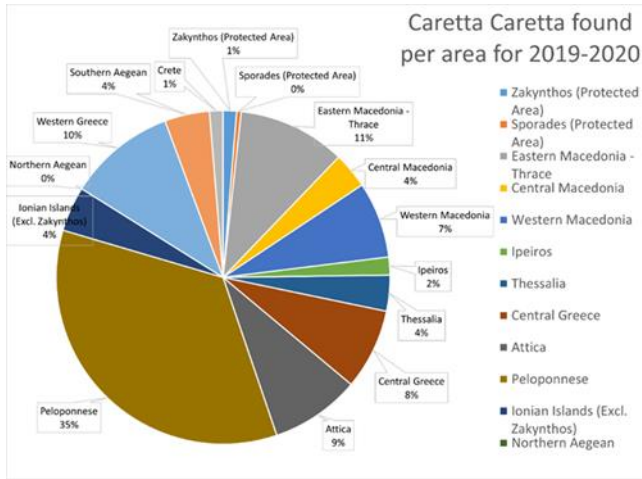
The analysis of the results for 2019 – 2020, indicates a higher rate of incidences of traumas and deaths for months May to October in both years (Figure 1), during nesting and hatching period. This could be attributed to the fact that adult female individuals are found closer to the coast and/or are weakened upon their return to the sea after laying their eggs and therefore, more vulnerable.



**Figure 1** *Caretta caretta* trauma incidents for 2019 and 2020

Further analysis of traumas and deaths indicate that in most occasions the causes are unknown (79% of incidences) percentage that possibly includes choking due to plastic pollution not identified since dissection is not usually performed and due to underreporting of incidences; unintentional injuries caused most possibly by boat engines (20%); choking from fishing net entanglement (1%).

An attempt to identify the ‘hotspots’ of sea turtle traumas and fatalities in Greece was made, based on the incidences location. The protected areas in Zakynthos and North Sporades as well as Crete, where although not an officially designated protected area, it comprises a region where a lot of awareness and protection campaigns take place, have been identified to have the smallest number of incidents, while there was no single incident in Sporades for the years 2019 and 2020. The area with the highest number of recorded incidences in Peloponnese (35%).



**Figure 2** *Caretta caretta* trauma incidents per region Overall, the mortality rate is very high with 94% of all incidences referring to dead sea turtles.

#### 4. Discussion

Throughout the 24-month period during which the *Caretta caretta* incidents were recorded, there are several observations that became apparent. An interesting finding is related to the period with the highest number of incidents, which coincides with the nesting and hatching period. At this time, female sea turtles will more likely be in close proximity to the coast. In case of pregnant turtles, such incidents will have a direct impact in the future hatchlings and in population of the species. A factor that may additionally affect the number of recorded incidences at that time is the fact that at this period more bodies are likely to be washed-up on the shore instead of being eaten by another animal or sink to the bottom of the ocean.

Another notable result is related to the identified intentional injuries, 3 in total for the research period. Although these incidents are not statistically significant, they are important due to the demonstrated brutality. In one case, reported on October 9, 2019, the death was caused by a hammer, in the next case, recorder on February 5, 2020, the dead male turtle had suffered a 5 cm cut on the neck caused by a ‘sharp object’ referred as ‘slaughtering’ in the media and the third case, reported on March 7, 2020, involved a 70cm turtle bearing an intentional injury on the head and a fishing line wrapped, seemingly intentional, around the neck.

An interesting finding is related to the patterns behind the traumas. The largest percentage of the cause of injury and death of the *Caretta caretta* are listed as unknown (76% for the research period), the reason being underreporting. Underreporting of the *Caretta caretta* incidents can either be attributed to news outlets that fail to report potential injuries that the animals had when reporting an incident or to citizens that do not report the incident whatsoever. Furthermore, the severity of the underreporting becomes even more apparent considering that according to another article in the press (Argonafplia, 2021), in the year 2020 more than 700 *Caretta caretta*s were found dead in Greece, which is a substantially larger number than the 135 incidents that were found when searching in the News. However, it is

not only the news outlets that are at fault for this situation. When a body gets washed up on the shore it is prone to decomposition and after a stage of decomposition it becomes impossible for reporters and experts to deduce the reason for the animal’s death. In addition, even in cases where the decomposition has not progressed, no tests are run for the animal’s condition to be assessed, and the body is buried by the coastguard. Furthermore, there were numerous occasions where a citizen reported an incident, but the coastguard took several hours to days to deal with the situation, thus further worsening the condition of the body. The immediate action is of vital importance for the survival of the injured individuals. It worth mentioning here that the underreporting is also related to the lack of official publicly available database for relevant incidents.

#### 5. Recommendations

To combat the need for urgent action and notification as well as the issue of underreporting, it would be recommended for an online platform to be used where citizens can report incidents and provide information as soon as the animal is located. In that way, not only will the information regarding Loggerhead turtle cases be compiled more easily and, in more details, but also the available data will be ground for prompt reaction and interventions. The proposed platform would enable improved mapping and monitoring of the threats that would clearly contribute to the protection of species. Such a platform would need to be easily accessible to all and prompt the user to provide as much information as possible to ensure that the incident is properly reported; thus date, location, number of turtles, state that the turtle is in, cause of injury as well as a photo of the animal. Vague information about any incident could result in the same incident being reported multiple times or an incident being omitted. For example, the platform could be in the format of a submission form, where the user would have to attach a photo of the animal (if they feel comfortable doing so) as well as provide descriptive

details regarding the animal's state. Some yes/no questions such as 'Is the animal alive?', 'Do they appear to be in distress?', 'Are there any noticeable injuries, if so please provide additional information' etc. could also be attached for the user to answer. The date will automatically be registered with the submission of the form. Ideally such a platform would have the form of a mobile phone application that could use the GPS location in order to provide a more accurate reporting of the animal to the appropriate authorities, in addition to ensuring that the report is as thorough as possible and to minimize the possibilities of errors. A blank area could also be provided for the user to add any additional comments that could be useful for the specific case. Finally, with the submission of the form, the request regarding the animal in distress will be uploaded to the database and an instant notification could be sent to the coastguard as well as a standby vet in cases that they are needed. The database should be able to screen and sort out the incidents to avoid multiple recordings.

Such a platform should include an alert function directly linked with the authorities. Furthermore, the platform could be proven very important in research. The collected data can be used by scientists and policymakers in order to deduce probable patterns regarding the causality and location of injuries.

Additional proposed measures would involve the establishment of new protected areas, where needed, and the strict control of certain activities that are proven to harm the *Caretta caretta* population of Greece.

## References

- Archelon (2021). Sea Turtle Biodiversity. <https://www.archelon.gr/eng/biology.php?row=row7>
- Argonafplia (2021). Θλιβερό ρεκόρ για την χώρα μας με περισσότερες από 700 νεκρές θαλάσσιες χελώνες το 2020 [Sad record for our country with more than 700 dead sea turtles for the year 2020].
- Casale, P. and Tucker, A.D. (2017). *Caretta caretta* (amended version of 2015 assessment). The IUCN Red List of Threatened Species 2017: e.T3897A119333622. <https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T3897A119333622.en>.
- Duermit L. (2007). *Caretta caretta*. Animal Diversity. [https://animaldiversity.org/accounts/Caretta\\_caretta/](https://animaldiversity.org/accounts/Caretta_caretta/)
- European Commission (2021a). EU climate action and the European Green Deal. [https://ec.europa.eu/clima/policies/eu-climate-action\\_en](https://ec.europa.eu/clima/policies/eu-climate-action_en)
- European Commission (2021b). The Barcelona Convention. [https://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/barcelona-convention/index\\_en.htm](https://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/barcelona-convention/index_en.htm)
- European Commission (2021c). Natura 2000. [https://ec.europa.eu/environment/nature/natura2000/index\\_en.htm](https://ec.europa.eu/environment/nature/natura2000/index_en.htm)

- European Parliament, and Council of the European Union (2008). Directive 008/56/EC of the European Parliament and of the Council: Marine Strategy Framework Directive. <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32008L0056>
- Medasset (2021). Oi Thalassies Chelones sti Mesogeio [Sea Turtles in the Mediterranean]. <https://www.medasset.org/el/thalassies-chelones/thalassies-chelones-sti-mesogeio/>
- National Ocean Service (2021a). Loggerhead Turtle. <https://www.fisheries.noaa.gov/species/loggerhead-turtle>
- National Ocean Service (2021b). What causes a sea turtle to be born male or female? <https://oceanservice.noaa.gov/facts/temperature-dependent.html>
- Rees A. F., and Margaritoulis D. (2003). Beach temperatures, incubation durations and estimated hatchling sex ratio for loggerhead sea turtle nests in southern Kyparissia Bay, Greece, Archelon. [https://www.researchgate.net/publication/237384842\\_Beach\\_temperatures\\_incubation\\_durations\\_and\\_estimated\\_hatchling\\_sex\\_ratio\\_for\\_loggerhead\\_sea\\_turtle\\_nests\\_in\\_southern\\_Kyparissia\\_Bay\\_Greece](https://www.researchgate.net/publication/237384842_Beach_temperatures_incubation_durations_and_estimated_hatchling_sex_ratio_for_loggerhead_sea_turtle_nests_in_southern_Kyparissia_Bay_Greece)
- Senet S. (2019). Mediterranean is Europe's most waste-polluted sea, study says. Euractiv. <https://www.euractiv.com/section/energy-environment/news/mediterranean-is-europes-most-waste-polluted-sea-study-says/>
- WWF (2021). Loggerhead Turtle. [https://wwf.panda.org/discover/knowledge\\_hub/endangered\\_species/marine\\_turtles/loggerhead\\_turtle/](https://wwf.panda.org/discover/knowledge_hub/endangered_species/marine_turtles/loggerhead_turtle/)