

The Nesting Activity of Sea Turtles (*Chelonia mydas* and *Caretta caretta*): Results of 2017 Monitoring Study on Kumluca Beach

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The aim of this study is to evaluate the sea turtles (*Caretta caretta* and *Chelonia mydas*) monitoring results of Kumluca beach in 2017 and to compare these results with those of previous years. In addition, it identified problems faced by loggerhead turtles on Kumluca beach and propose solutions. The study area covers 14 km of Kumluca nesting beach. Field studies were carried out daily between June and September 2017. A total of 1306 tracks for *C. caretta* was recorded, and 715 of them resulted in the nest on Kumluca beach. However, only a single nest of *C. mydas* was recorded in the 2017 nesting season. Also, it was found that nesting success is 54.74 and nest density is 51.07 nests/km for *C. caretta*. The mean distance from the sea of the nests is 21.75±7.71 m (range=6-66 m). The most density occurred between 15 and 30 m from the sea. Mean hatch success for all nests was 65.4% while no hatching activities were observed in 248 (34.6%) nests. A total of 36 *C. caretta* was tagged. The mean curved carapace length (CCL) and curved carapace width (CCW) were 74.7±3.9 cm (range=64-84) and 67.4±3.5 cm (range=61-77), respectively. The mean head length (HL) and head circumference (HC) were 26.6±2.6 cm (range=20-30) and 49.1±3.8 cm (range=42-61), respectively. Also, a total of 116 nests were lost due to storms and anthropological effects. The problems frequently encountered in the Kumluca spawning area mainly, vehicle use, sand removal, artificial light sources, animal entry and solid wastes on the beach. In addition, solution suggestions for these problems are presented.

INTRODUCTION

Five species of sea turtles (*Dermochelys coriacea*, *Lepidochelys kempii*, *Eretmochelys imbricata*, *Caretta caretta* and *Chelonia mydas*) occur in the Mediterranean, only two of them (*C. caretta* and *C. mydas*) regularly nesting on the Mediterranean (Margaritoulis, 2005; Başkale et al., 2013; Casale et al., 2018). Both species (*C. caretta* and *C. mydas*) are protected under the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Plant), Barcelona Convention (1975) and Bern Agreement (1979) (European Wildlife and Plant Species). In addition, *C. caretta* is listed as vulnerable (VU) globally (Casale & Tucker, 2015), while the green sea turtle (*C. mydas*) is listed endangered (EN) (Seminoff, 2004) according to the International Union for Conservation of Nature (IUCN). It is also considered as LC (least concern) for *C. caretta*, in the Mediterranean subpopulation (Casale, 2015).

Turkey has the second most important stock based on the nest numbers of the loggerhead turtle in the Mediterranean (Margaritoulis et al., 2003). An average of 8179 loggerhead turtle nests per year were recorded in the whole Mediterranean of the most recent 5-year period, and 2822 of them were reported to be on the coast of Turkey (Casale et al., 2018). The important studies that play a key role in the conservation of sea turtles have been carried out on sex ratio, genetics, predation, nest conservation and morphology (Kılıç & Candan, 2014; Sönmez, 2018).

The first study on Kumluca beach was carried out in 1979 (Geldiay et al., 1982). Subsequently, studies were carried out in different years by different researchers as 1988 (Baran et al., 1992), 1990 (Baran et al., 1992), 1994 (Yerli & Demirayak, 1996) and 1998 (Yerli et al., 1997). In recent studies, it has been reported that Kumluca beach is among the first-degree nesting beaches for the loggerhead turtle (Canbolat, 2004). It was determined 875 nests on Kumluca beach, and the nest density was reported as 39.8 nests/km (Canbolat, 2007). Up-to-date data on the nesting beach is needed due to the reasons such as the fact that the latest monitoring study on the Kumluca beach was carried out in 2007, as well as the demands due to the high tourism potential of the area, the environmental

factors that threaten the life of sea turtles, and the pressures due to human activities.

The aim of this study is (i) to evaluate the sea turtles (*Caretta caretta* and *Chelonia mydas*) monitoring results of Kumluca beach in 2017, (ii) to compare these results with those of previous years, and (iii) to identify and solve the problems that threaten the population.

MATERIAL AND METHODS

Kumluca nesting beach covers a 21 km sandy beach from the borders of Mavikent Town at the eastern end to the borders of Beykonak Town, Kumluca District, Hasyurt Town, Sahilkent Town and Finike District to the west. Our study covers an area of 14 km protected by the General Directorate of Nature Conservation and National Parks and defined as the “Sea Turtle Nesting Area” (Figure 1). The study area is divided into 3 sub-regions, namely 1st, 2nd and 3rd sub-regions. The area from the starting point up to 3900 m (Hasyurt location) is called the 1st Region (westernmost), the area between the two breakwaters is called the 2nd Region, and the region from 5900 m to 14000 m is called the 3rd Region (Easternmost).



Figure 1. Kumluca Beach nesting area

This study was carried out between 1 June and 20 September and the beach was monitored by three people from night to morning (9 PM to 9 AM). All sea turtle emergences were followed, and they were recorded whether they were nested or not. The geographic position of the nest was recorded and marked with GPS (± 4). After this, the distance from the sea (DFS) of each nest was measured with a flexible tape meter (± 1 cm). Each nest was excavated 7 days after the last hatchling emerged. During the excavation of the nests, the nesting depth was measured.

The carapace measurements (such as curved carapace length (CCL) and curved carapace width (CCW)) of female individuals after the nesting activity, were carried out using millimeter-intermittent caliper. In addition, the head length and the head width were taken from the longest and the widest part of the head. Then, female individuals were tagged and released safely into the sea.

The detected nests were followed daily during the incubation period, and their threats, if any, were recorded. The surroundings of the slots were cleaned using mops until the control opening. Thus, offspring tracks, and directions and the predator tracks were recorded daily.

The nest density of the beach was calculated according to the average number of nests per km of the entire beach length, and the success rate of hatchlings reaching the sea was calculated according to the formula (Equation 1) (Yalçın-Özdilek et al., 2005, 2006; Ozdilek et al., 2006).

$$\text{Success Rate} = \frac{\text{Number of hatchlings reaching the sea}}{\text{Number of empty eggshells}} \times 100 \quad (1)$$

RESULTS

In total, 1306 loggerhead turtle emergences were recorded, with 715 (54.7%) resulting in nesting during the 2017 nesting seasons. In addition, only one *C. mydas* nest was recorded. During the 2017 nesting season, a

total of 591 non-nesting emergences (NNE) occurred for *C. caretta*. The highest number of NNE was observed in July (Figure 2).

Nest density for *C. caretta* on Kumluca beach of 14 km was determined as 51.07 nests/km. The last nest emergence was recorded on 8 August, but the most intense nesting activity occurred in June and July with 49.93% and 49.09%, respectively. The highest density of the nests has been detected in the 3rd Region (Easternmost) with a total number of 312 nests (43.6%). The distribution of *C. caretta* nests by regions and months is shown in Figure 3.

The results of this study showed that the distance from the sea (DFS) was 6-66 m (average 21.75 ± 7.71 m). Density is observed between 15 and 30 m (Figure 4).

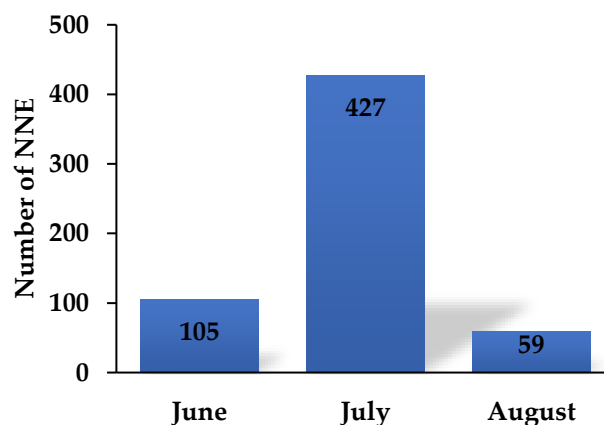


Figure 2. Distribution of the number of non-nesting emergence (NNE) by months

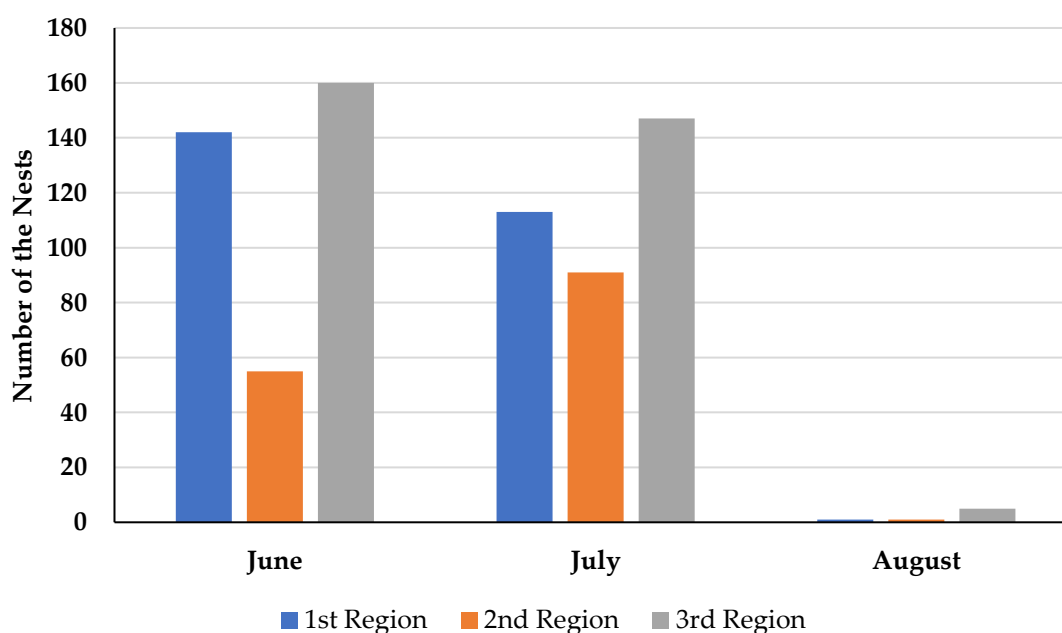


Figure 3. The distribution of *Caretta caretta* nests by regions and months

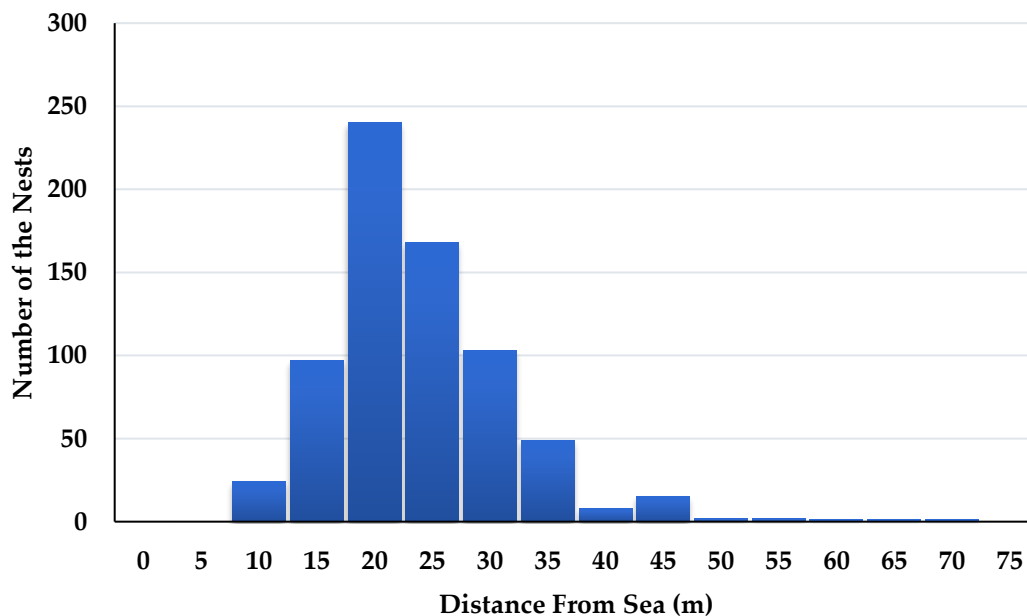


Figure 4. Distribution of nests according to the distance from sea (DFS)

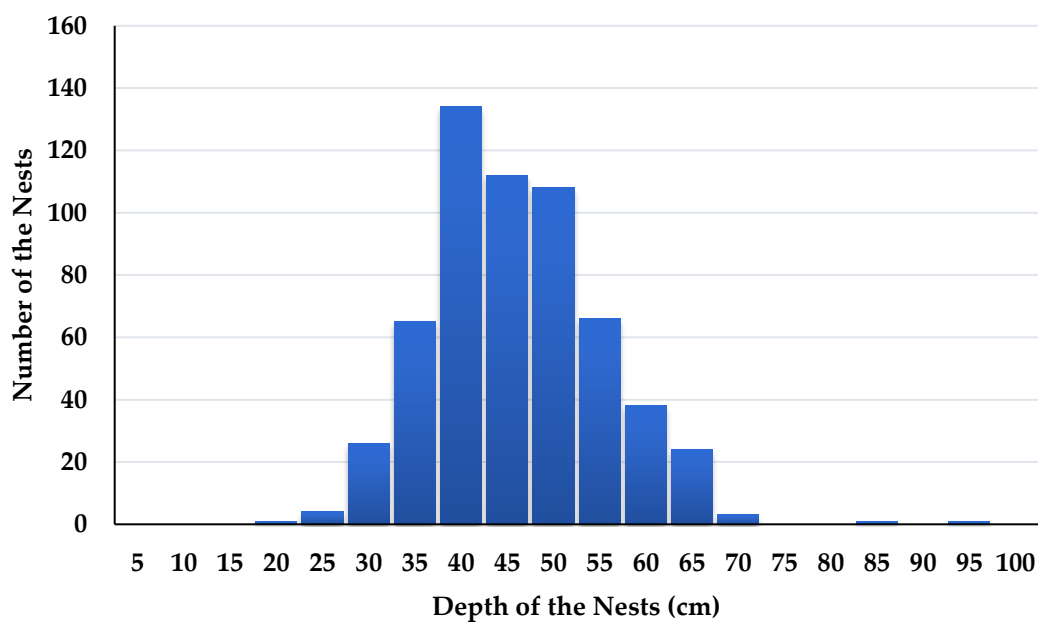


Figure 5. The nest depths of the *Caretta caretta* nests in Kumluca beach of 2017 season

Table 1. Measurements of marked female *Caretta caretta* individuals

Measurement Axis	N	Min.	Max.	Mean	SD
Curved Carapace Length (CCL)	36	64	84	74.78	3.90
Curved Carapace Width (CCW)	36	61	77	67.47	3.53
Head Length (HL)	36	20	30	26.69	2.69
Head Circumference (HC)	36	42	61	49.14	3.89

Note: N=Number, Min.=Minimum, Max.=Maximum, SD=Standard deviation

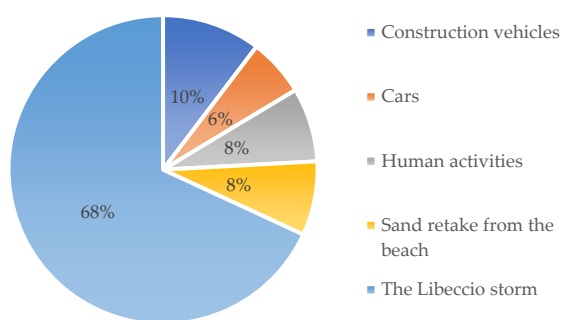


Figure 6. The reasons of the disappearance of the nests on the Kumluca beach in 2017

The nesting depths are found between 40 and 50 cm (Figure 5). The nesting depth of a detected single *C. mydas* nest was measured as 91 cm. The maximum, minimum and average depths of *C. caretta* nests were determined as 83 cm, 16 cm, and 43.88 ± 9.11 cm, respectively.

Although the majority of *C. caretta* nests completed their incubation period successfully, it was determined that a significant number of nests were predated, lost, or deteriorated. The results obtained from this study indicate that 64.2% of the nests successfully completed their incubation period. Of the total 715 slots, 116 (16.2%) were lost, 30 (4.1%) predated and 130 (18.1%) were completely destroyed. The effects caused by losing are given in Figure 6.

The most important source of predation was dogs. In the predated nests, the success rate of hatchling after the predation was found as 26%, while the rate of the dead embryos was determined as 73%. A total of 46488 eggs were laid on Kumluca beach and 26546 of these eggs successfully hatched in the 2017 nesting season.

A total of 110 eggs were determined in the single *C. mydas* nest, 53 of these eggs hatched and all these hatchlings reached the sea. The success rate of reaching the sea for *C. caretta* hatchlings was calculated as 84.29% (22367 offspring) at Kumluca beach in the 2017 season. Besides, it was determined that 4179 hatchlings could not reach the sea due to, predation in/out of the nest, jamming in the nest, sun effect, reverse orientation, artificial light source, solid wastes on the beach and deep ruts created by vehicles entering the beach.

In total, 36 loggerhead turtles were tagged and measured for morphological dimensions. The resulting descriptive statistics are shown in Table 1. The mean CCL and CCW were 74.7 ± 3.9 cm (range=64-84) and 67.4 ± 3.5 cm (range=61-77), respectively. The mean HL and HC were 26.6 ± 2.6 cm (range=20-30) and 49.1 ± 3.8 cm (range=42-61), respectively.

DISCUSSION

Kumluca beach is one of the most important nesting beaches in Turkey in terms of nest density (Canbolat, 2007). Despite this, very few studies have investigated the nesting areas of sea turtles on the Kumluca beach. The studies were carried out at very long intervals (Canbolat, 2007). The first study conducted on the Kumluca beach reported that they identified 295 nests (Geldiay et al., 1982). Then, other studies were carried out in 1988 (Baran & Kasperek, 1989), 1990 (Baran, 1990), 1994 (Yerli & Demirayak, 1996) and 1998 (Yerli & Canbolat, 1998). It was reported that there had been detected between 35 and 305 nests in these studies (Figure 7). According to Canbolat (2004), It has been determined that the nest density on Kumluca beach is 11.2 nests/km. In another study, Canbolat (2007) reported that 875 nests were found on Kumluca beach, and the nest density was reported as 39.8 nests/km. Nesting beaches were classified based on the number of nests and indicated that a beach with an average number of nests between 100–300 nests a year is high nesting activity (Casale et al., 2018). An average of 8179 loggerhead turtle nests per year are recorded in the entire Mediterranean in the most recent 5 years, and 2822 of them were reported to be on the coast of Turkey (Casale et al., 2018). Our results showed that Kumluca beach, with its 715 slots, provides approximately 25% of the *C. caretta* nests on the Mediterranean coasts of Turkey. Hence, Kumluca beach is a very important nesting beach. In our study, the nest density was recorded as 51.7 nests/km, the second highest value in the previous studies. In addition, we determined that 48.1% of the hatchling sea turtles reached the sea. Similarly, Canbolat (2007) reported that 49.2% of hatchlings reached the sea.

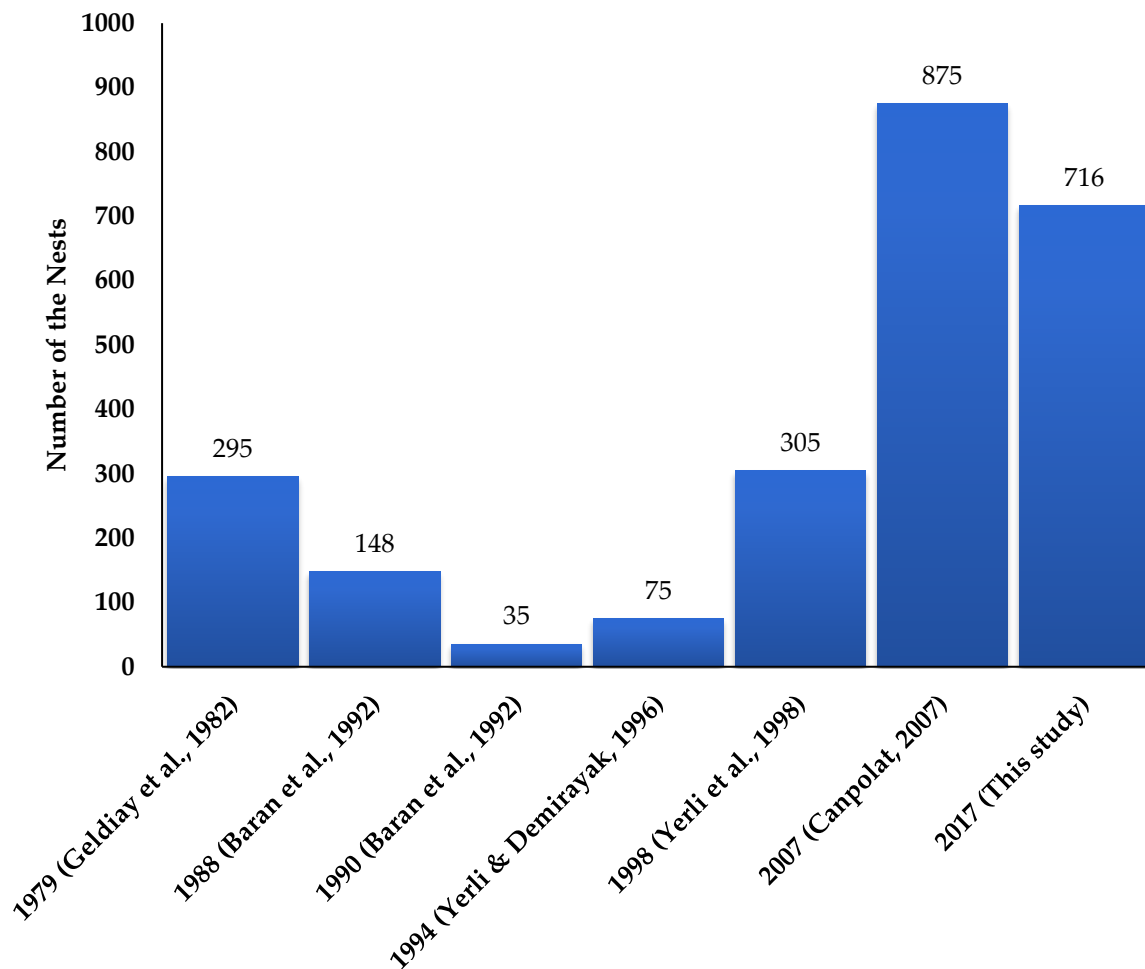


Figure 7. Comparison of the number of sea turtle nests detected on the Kumluca coast in 2017 with the previous studies (revised from Canbolat, 2007)

Coastal areas support nesting habitat for marine turtles that is critical for the survival of their populations (Fuentes et al., 2016, Altın et al., 2021). The problems frequently faced in the Kumluca nesting area mainly, vehicle use, sand removal, artificial light, an animal entry such as dogs and solid wastes on the beach. Sun loungers and umbrellas are placed on the beach in the first 30 meters from the sea, by the two big touristic facilities in the region. In these areas, sea turtle nests are concentrated and any structures or permanent sunbeds, umbrellas or closed areas should be prohibited. In this respect, it should be reminded that the fixed structures must be moved, and the sun loungers and umbrellas must be removed at night in consultation with the owners of hotels.

It has been determined that the problems caused by artificial light are generally caused by the recreation areas, streets, and road lights. In this regard, warnings should be done for artificial light and the light in the

above-mentioned places should be controlled. In the Hasyurt location, in front of the hotel located, in the 2nd region, and in the 3rd region, which is heavily used by the local people, nesting should be done above and below the nest. In particular, the owners or managers of recreation areas, cafes and restaurants in these regions should be contacted and requested to take measures within the legal framework. In addition, it is necessary to inform the local people, especially the administrative superiors of public institutions situated in Kumluca and Finike. To prevent vehicles from entering the beach, all roads leading to the beach should be closed and deterrent measures should be taken for off-road vehicles entering the beach.

A large part of the 3rd region is in front of the nature park. Hence, human influence is significantly less in this region. However, in the summer of 2017, two large southwestern storms were experienced in this area. These storms were especially effective in this region

and intense flooding has occurred. The possibility of flooding should be considered in the management studies to be carried out in the following years and the nests should be kept away at a distance of at least 25 m from the sea. Nests closer than this distance must be replaced. Furthermore, a total of 3 dead *C. caretta* were found during the field surveys and the main cause of the death of 2 adult individuals was reported due to fishing activities.

CONCLUSION

As a result, Kumluca beach is one of the most significant nesting beaches in both Turkey and the Mediterranean for *Caretta caretta*. Kumluca coast is a crucial nesting area because of it is not exposed to intense anthropological influence. Tourism has the potential to create negative effects on the environment. Kumluca beach has not developed much in terms of tourism, so it is effective in protecting this beach from the human effects. However, Kumluca has development potential in terms of migration and tourism. In this respect, continuous monitoring and protection studies of the region are vital. Considering the potential of the beach in future studies, carrying out more comprehensive biological studies will reveal more productive results.

Compliance with Ethical Standards

Authors' Contributions

All authors have contributed equally to this paper.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

This study was carried out within the framework of the protocol signed between Çanakkale Onsekiz Mart University Sea Turtles Application and Research Center (DEKUM) and the General Directorate of Nature Conservation and National Parks (DKMP).

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