

A REVIEW OF THE BIOLOGY OF THE LOGGERHEAD TURTLE, *CARETTA CARETTA*, AT FIVE MAJOR NESTING BEACHES ON THE SOUTH-WESTERN MEDITERRANEAN COAST OF TURKEY

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Most nesting by loggerhead turtles in Turkey has been recorded at 20 sites along the Mediterranean coast. In addition, sites primarily used by green turtles are also used by loggerheads. The annual number of loggerhead nests recorded on these 20 beaches ranges from 663 to 1991, with a mean of 1267 nests per season. We review the biology of nesting and predation at five of the most important and more regularly investigated loggerhead nesting sites (Dalyan, Fethiye, Patara, Belek and Kizilot). These five beaches may host up to 920 nests per season. With approximately 307 adults per season, the Dalyan beach has the highest capacity in terms of numbers of nests and of nesting females. Hatching success at the five beaches was negatively affected by fox predation (93% of the predated eggs on the beaches), crab predation (29.5% of the predated hatchlings), and light-pollution (42% of the hatchlings). In addition, predation by beetle larvae has been observed on the eggs at Fethiye beach (17.6% of the predated eggs at this site).

Key words: Chelonia, egg, hatchling, nesting, predation

INTRODUCTION

In the Mediterranean, the major nesting grounds for loggerhead turtles, *Caretta caretta* (Linnaeus, 1758) are in Turkey and Greece (Baran & Kasperek, 1989; Margaritoulis, 2000), with smaller numbers recorded in Cyprus (Broderick & Godley, 1996), Egypt (Kasperek, 1993; Clarke *et al.*, 2000), Libya (Laurent *et al.*, 1995), Tunisia (Laurent *et al.*, 1990), Israel (Kuller, 1999) and Syria (Kasperek, 1995). According to the previously substantiated records (Baran & Kasperek, 1989; Baran *et al.*, 1998; Taskavak *et al.*, 1998; Oruç *et al.*, 1997), three species of marine turtle – *Caretta caretta*, *Chelonia mydas* and *Dermochelys coriacea* – are included in the chelonian fauna of Turkey. Only the first two are known to nest on the Turkish coast of the Mediterranean. The first nesting records of *Caretta caretta* and *Chelonia mydas* from the Turkish coasts were by Hathaway (1972). Basoglu (1973) and Basoglu & Baran (1982) gave information on the carapace plates of *C. caretta* found at Izmir, Köycegiz and Fethiye. Geldiay & Koray (1982), Geldiay *et al.* (1982) and Geldiay (1983, 1984) described marine turtle populations and their protection on the Mediterranean coasts of Turkey. Baran & Kasperek (1989) described the first comprehensive survey of the Turkish Mediterranean coast for turtle nesting sites. Its primary objective was to locate nesting sites and to allow assessment of their relative importance. More recently, various population studies have been carried out on certain beaches, and problems af-

fecting the turtles on the nesting beaches have been determined (Canbolat, 1991; Erk'akan, 1993; Baran *et al.*, 1992; Baran, 1993a,b; Baran *et al.*, 1994; Baran *et al.*, 1996; Türkozan & Baran, 1996; Baran & Türkozan, 1996).

Almost half the recorded nesting sites of the Mediterranean loggerhead – and a large proportion of those for green turtles – are found on Turkish beaches (Groombridge, 1988). Although 17 important nesting sites in Turkey were given by Yerli & Demirayak (1996), only 15 of them were marked on the map given. A total of 13 beaches was considered as constituting the main nesting areas for marine turtles in Turkey (Baran & Kasperek, 1989; Baran *et al.*, 1992; Groombridge, 1994). From west to east, these beaches include: Dalyan, Dalaman, Fethiye, Patara, Kumluca, Belek, Kizilot, Demirtas Gazipasa, Göksu Deltasi, Kazanlı, Akyatan and Samandag (Fig. 1). Apart from these main nesting beaches, there are others which do not hold such large numbers, but which are still of vital importance for sea turtles (Baran & Kasperek, 1989). These are Ekincik, Kale, Tekirova and Anamur (Fig. 1). These four secondarily important nesting beaches were also listed by Groombridge (1994). The beach at Demirtas (Fig. 1) given as the main nesting beach by Baran & Kasperek (1989) was not given in the updated list given by Yerli & Demirayak (1996). Additionally, the nesting beach at Çirali (Fig. 1), which was not given by Baran & Kasperek (1989), appeared for the first time as a main nesting beach in the map of Yerli & Demirayak (1996). In addition to the localities given above, two additional sites with less nesting (Agyatan and Yumurtalık) were given by Yerli & Canbolat (1998). All these localities are marked in Fig. 1. According to fieldwork carried out over the last 25

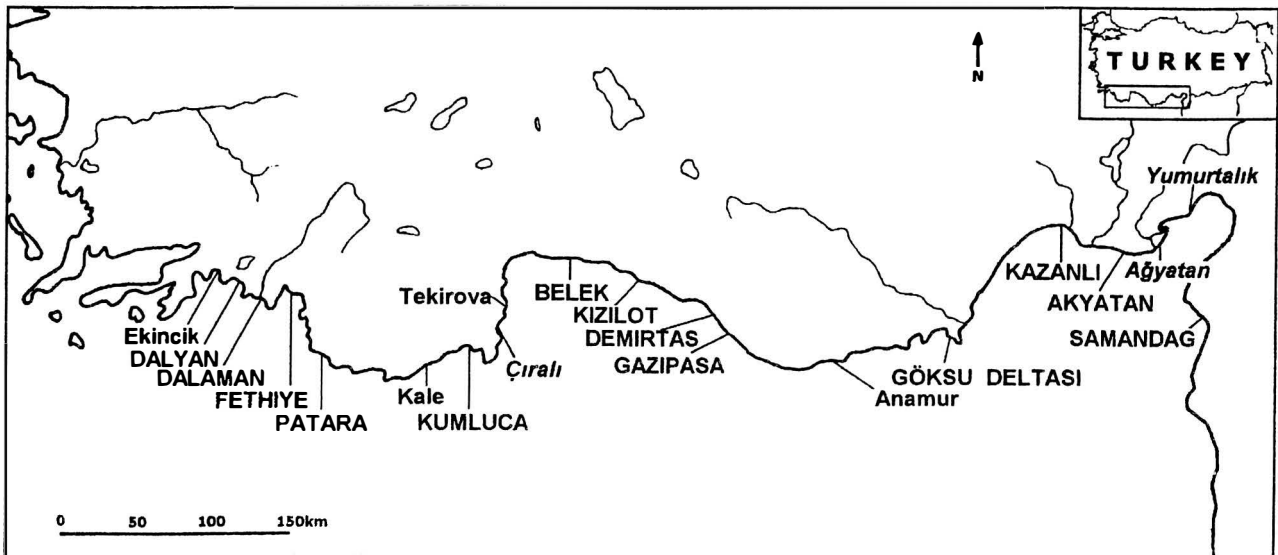


FIG. 1. The localities where the loggerhead nesting beaches are recorded (Upper case indicates main nesting beaches; lower case, secondary nesting beaches; italics, additional unsubstantiated records).

years, green turtle nesting is mostly limited to a few eastern beaches (Kazanli, Akyatan and Samandagi (Fig. 1). This study aims to provide information on the population and nesting status of the loggerhead turtle, *Caretta caretta*, on the south-western beaches (Dalyan, Fethiye, Patara, Belek and Kizilot, which appear to be the most important loggerhead beaches in Turkey. As such, the first four have been designated as Specially Protected Areas.

MATERIALS AND METHODS

Data were compiled from previously published sources and unpublished research reports. All records were scanned and the numbers of loggerhead nests recorded were collated (Table 1). At the five most important beaches, increased observer effort over the years allowed for a comparative review to be undertaken. It is likely that some nesting will have occurred undetected at sites along the Aegean and Mediterranean coasts not subject to monitoring, leading to underestimates of population size and hatchling recruitment.

The values for total emergence, total number of nests, number of eggs, hatchlings reaching the sea and nest densities are presented in Table 2 for five beaches that have been monitored since 1982. It should be noted that not all of the studies listed in Table 2 were conducted throughout the entire nesting season each year. Geldiay *et al.* (1982), and Groombridge (1994) extrapolated the information from short surveys. Observations on the Dalyan beach were carried out at intervals of one or two weeks, and counts of tracks and nests were made during the day (Geldiay *et al.*, 1982). The total number of nests recorded at Dalyan for 1987 was estimated from the data collected between 4 June and 5 July (Groombridge, 1994). Except for the Fethiye beach, Yerli & Demirayak (1996) started the regular observations on four beaches after 20 June 1994. Baran *et al.* (1996) and Sak (1998) started regular studies on Dalyan and Patara, and Belek,

respectively, after 20 July 1996. Yerli & Demirayak (1996), Kaska (1993) and Turkozan (2000) studied 8.5 km, 5 km and 4.5 km, respectively, of the Kizilot beach, which is 16.2 km in total length; observations by Kaska (1993) and Turkozan (2000) were made daily and included whole breeding seasons. The remaining data given in Table 2 are regular and include overall breeding seasons.

RESULTS

DALYAN BEACH

This site is in the transitional zone between the Aegean and Mediterranean regions and consists of a beach approximately 4.2 km in length. The values for Dalyan were compiled from the studies carried out by various researchers in different years (Table 2). A total of 2119 nests was recorded, with a mean of 193 nests per season, over 11 breeding seasons. The number of nests per season varies from 57 to 330. Using the assumption that each female nests an average of three times in a season (Groombridge, 1994), between 19 and 110 loggerhead turtles nest annually on the beach.

Information on predation was compiled over six years (1991 to 1997). During these six seasons, a total of 17 584 eggs was destroyed (Table 3). Of these, 17 385 eggs (98.9%) were destroyed by foxes and 199 (1.1%) by crabs. On the other hand, a total of 2833 hatchlings was destroyed over the seasons of 1991-1993 and 1997. Of these, 908 (32.1%) were killed by foxes and 1703 (60.1%) by crabs. Strong sunlight and dehydration caused 199 hatchlings (7.0%) to die. Birds destroyed 23 hatchlings (0.8%).

FETHIYE BEACH

Approximately 8.3 km of the Fethiye beach, Specially Protected Area, situated within the boundaries of Vilayet Mugla, was examined for five nesting seasons from 1993 to 1997 (Table 2). This region was also dis-

TABLE 1. Nesting efforts of the loggerhead turtle in Turkey (Ekincik ref: Baran *et al.*, 1994. Dalyan ref: Erk'akan, 1993; Geldiay *et al.*, 1982; Groombridge, 1994; Baran *et al.*, 1996; Erk'akan, 1993; Baran *et al.*, 1992; Canbolat, 1996; Yerli & Demirayak, 1996; Baran *et al.*, 1996; Ilgaz, 1998. Dalaman ref: Yerli & Demirayak, 1996; Yerli *et al.*, 1998. Fethiye ref: Türkozan & Baran, 1996; Baran & Türkozan, 1996; Türkozan 2000. Patara ref: Baran *et al.*, 1992; Canbolat, 1996; Yerli & Demirayak, 1996; Baran, 1993a; Taskin, 1998. Kale ref: Yerli & Demirayak, 1996; Yerli *et al.*, 1998. Kumluca ref: Yerli & Demirayak, 1996; Yerli *et al.*, 1998; Baran & Kasperek, 1989; Baran *et al.*, 1992. Çirali ref: Yerli & Demirayak, 1996; Yerli *et al.*, 1998. Tekirova ref: Yerli, *et al.*, 1998. Belek ref: Yerli & Demirayak, 1996; Sak, 1998; Yerli *et al.*, 1998. Kizilot ref: Kaska, 1993; Yerli & Demirayak, 1996; Yerli *et al.*, 1998; Türkozan, 2000. Demirtas ref: Baran & Kasperek, 1989; Yerli & Canbolat, 1998. Gazipasa ref: Yerli & Demirayak, 1996; Yerli & Canbolat, 1998. Anamur ref: Baran *et al.*, 1992; Yerli & Demirayak, 1996; Yerli & Canbolat, 1998. Göksu Deltası: Peters & Verhoeven, 1992. Akyatan ref: Brown & McDonald, 1995; Yerli & Demirayak, 1996; Yerli & Canbolat, 1998. Aureggi *et al.* 1999. Agyatan ref: Yerli & Canbolat, 1998. Kazanlı ref: Baran *et al.*, 1992; Yerli & Canbolat, 1998; Durmus, 1998. Yumurtalik ref: Yerli & Canbolat, 1998. Samandag ref: Yerli & Canbolat, 1998).

	No. seasons	Average no. nests	Range
Ekincik	1	8	8-8
Dalyan	11	193	57-330
Dalaman	2	71	69-73
Fethiye	8	122	88-191
Patara	6	53	33-85
Kale	2	74	39-109
Kumluca	4	141	35-305
Çirali (Olimpos)	2	23	12-34
Tekirova	1	4	4-4
Belek	4	122	68-168
Kizilot	5	139	50-270
Demirtas	2	62	44-80
Gazipasa	2	14	14-14
Anamur	3	159	96-195
Göksu Deltası	2	63	36-89
Akyatan	4	10	3-23
Agyatan	1	2	2-2
Kazanli	4	3	1-7
Yumurtalik	1	1	1-1
Samandag	1	3	3-3
TOTAL		1267	663-1991

nated as a feeding ground for juvenile green turtles (Türkozan & Durmus, 2000). A total of 650 nests was recorded, with a mean of 130 per season over five breeding seasons. The number of nests per season varied from 88 to 191 during the years 1993 to 1997. This means that approximately 29-64 loggerhead turtles nest annually on the beach.

Between the years 1994 and 1997, a total of 2091 eggs was destroyed. Of these, 1515 were predated by foxes (72.4%), 370 by coleopteran larvae (17.6%) and 83 by

dogs (3.9%). Meanwhile, 36 (1.7%) were accidentally destroyed by researchers whilst using a metal rod to search for and locate the clutches. A plant root destroyed one egg (0.04%) and human activities (e.g. sand extraction, beach utilization for tourism, light pollution, cattle trampling) caused the loss of 86 eggs (3.9%). A total of 743 hatchlings was destroyed from 1994 to 1997. Of these, 405 were destroyed by foxes (54.5%), 52 by dogs (6.9%) and 14 by ghost crabs (1.8%). Birds destroyed 93 hatchlings (12.5%). Strong sunlight and dehydration caused 173 hatchlings (23.2%) to die. Cars ran over six hatchlings (0.8%) on the beach.

Nesting success (the proportion of adult emergences resulting in egg laying) ranged from 21.5% to 49.2% between the years 1993 and 1997. The hatching success of the eggs ranged from 58.1% to 68.4%. The total number of hatchlings reaching the sea as a percentage of the eggs hatching varied from 67.2% to 85.5%.

PATARA BEACH

Data on an 11.8 km-long sandy strip were compiled for six breeding seasons between 1990 and 1997 (not 1991 or 1995). A total of 315 nests was recorded, with a mean of 53 (Table 2). The number of nests varied from 33 to 85 for the years 1990 to 1997. It is estimated that approximately 11-28 loggerhead turtles nest annually at this site. Predation of eggs was recorded for the years 1992, 1993, 1996 and 1997. During these periods, a total of 2547 eggs was destroyed. Of these, 1783 eggs were killed solely by foxes (69.2%) and 207 by crabs (8.0%). Birds destroyed one egg (0.04%). Foxes and crabs in combination destroyed 586 eggs (22.7%).

During the 1992 and 1993 breeding seasons, a total of 460 hatchlings was lost. Of these, 60 were killed by foxes (13.0%) and 378 by crabs (82.2%). Birds destroyed one hatchling (0.2%). Strong sunlight and dehydration caused 21 hatchlings (4.6%) to die.

BELEK BEACH

For three breeding seasons, we compiled data on Belek beach, approximately 25 km in length and situated 40 km west of Antalya (Table 2). A total of 389 nests was recorded, with a mean of 130. The number of nests per season varied from 68 to 168. It is estimated that 23-56 loggerhead turtles nest annually on the beach. Some 616 eggs were destroyed either by foxes or dogs during the 1996 and 1997 breeding seasons. Of 3276 hatchlings destroyed on the beach, 89 were killed by ghost crabs (2.7%). Light-pollution, causing hatchling disorientation, and strong sunlight and dehydration caused the loss of 1263 hatchlings (38.5%) and 52 hatchlings (1.6%) respectively. Furthermore, 1872 hatchlings (57.1%) were disoriented.

KIZILOT BEACH

The Kizilot beach, 16.2 km in length and situated within the boundaries of Vilayet Antalya, was examined

TABLE 2. The data on the loggerhead turtles recorded annually at five different beaches of south-western Turkey. Letters indicate the references considered. A, Geldiay *et al.*, 1982; B, Groombridge, 1994; C, Baran *et al.*, 1997; D, Erk'akan, 1993; E, Baran *et al.*, 1992; F, Canbolat, 1996; G, Yerli & Demırayak, 1996; H, Baran *et al.*, 1996; I, Ilgaz, 1998; J, Türkozan & Baran, 1996; K, Baran & Türkozan, 1996; L, Türkozan, 2000; M, Baran, 1993a; N, Taskin, 1998; O, Sak, 1998; P, Kaska, 1993.

	1982	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	A	B	C	D	E,P	F	F&J	G,K	L	H	H,L, O	I,L, N,O
<i>Dalyan</i>												
Total emergence	?	?	?	912	257	798	824	713	178	-	?	371
Total number of nests	330	300	146	235	57	271	217	235	86	-	107	135
Number of eggs	?	?	?	17254	5244	21187	18855	19595	3896	-	6450	10903
Hatchlings reaching the sea	?	?	3109	1611	3036	7539	5155	7397	?	-	3473	5439
Nest density (nest/km)	?	?	?	50	14	58.02	46.46	50.31	?	-	22.7	28.7
<i>Fethiye</i>												
Total emergence	-	-	-	-	-	-	-	240	439	888	235	291
Total number of nests	-	-	-	-	-	-	-	118	158	191	88	95
Number of eggs	-	-	-	-	-	-	-	8772	12926	15853	7656	6679
Hatchlings reaching the sea	-	-	-	-	-	-	-	3337	5953	6991	3488	3671
Nest density (nest/km)	-	-	-	-	-	-	-	14.75	19.75	23.9	11	11.9
<i>Patara</i>												
Total emergence	-	-	-	-	128	-	163	294	75	-	?	205
Total number of nests	-	-	-	-	58	-	52	85	33	-	35	52
Number of eggs	-	-	-	-	5150	-	2920	7315	1293	-	2629	3769
Hatchlings reaching the sea	-	-	-	-	?	-	1086	2030	?	-	1068	1638
Nest density (nest/km)	-	-	-	-	9.7	-	7.28	12.69	?	-	?	7.42
<i>Belek</i>												
Total emergence	-	-	-	-	-	-	-	-	259	-	?	389
Total number of nests	-	-	-	-	-	-	-	-	68	-	153	168
Number of eggs	-	-	-	-	-	-	-	-	1065	-	10486	10988
Hatchlings reaching the sea	-	-	-	-	-	-	-	-	?	-	6295	7082
Nest density (nest/km)	-	-	-	-	-	-	-	-	?	-	?	?
<i>Kizilot</i>												
Total emergence	-	-	-	-	299	-	-	-	195	-	427	303
Total number of nests	-	-	-	-	146	-	-	-	50	-	125	108
Number of eggs	-	-	-	-	11680	-	-	-	3029	-	9625	6243
Hatchlings reaching the sea	-	-	-	-	?	-	-	-	?	-	5406	3966
Nest density (nest/km)	-	-	-	-	?	-	-	-	?	-	27.7	24

for four breeding seasons: 1990, 1994, 1996 and 1997 (Table 2). A total of 429 nests was recorded, with a mean of 107. The number of nests per season ranged from 50 to 146. Approximately 17-49 loggerhead turtles nest annually on the beach. During the years 1994 to 1997, a total of 1129 eggs was destroyed. Of these, 657 were predated by foxes (58.2%), 209 by coleopteran larvae (18.5%) and 193 by dogs (17.1%). Thirty-six eggs (3.2%) were taken by a researcher for a sex determination study. Thirty-four eggs (3.0%) were accidentally destroyed by workers whilst using a metal rod to detect the nest sites.

Sixty-seven hatchlings were destroyed on the beach: fox and bird predation accounted for 37 (55.2%) and three (4.5%), respectively. Strong sunlight and dehydration caused 19 hatchlings (28.4%) to die. Dogs destroyed eight hatchlings (11.9%).

The percentage of nesting success ranged from 29.7% to 32.4%, whereas hatching success varied from 62.4% to 63.5%. The percentage of hatchlings reaching the sea ranged from 90% to 97.1%.

DISCUSSION

Taking into consideration all loggerhead turtle nesting activity (Table 1), the five major nesting areas described in this study account for 44%-46% of all loggerhead nesting activity in Turkey. The overall nesting activity on the 20 beaches used by loggerheads revealed the fact that approximately 221-664 loggerhead females visit the Turkish coasts. Groombridge (1994) estimated a minimum of 1650 nests for the 1988 season, assuming 550 females nested. Data in Geldiay *et al.* (1982) and Geldiay (1984) suggest that around 1000

TABLE 3. The effects of various predators on eggs and hatchlings of loggerhead turtles at five beaches considered (* metal rod, ** 34 by metal rod and 36 taken for sex determination study).

	Dalyan	Fethiye	Patara	Belek	Kizilot
<i>Eggs</i>					
Total number	17584	2091	2547	616	1129
Fox	17385	1515	1783	-	657
Crab	119	-	207	-	-
Fox & Crab	-	-	586	-	-
Fox or dog	-	-	-	616	-
Feral dog	-	83	-	-	193
Bird	-	-	1	-	-
Coleopteran larva	-	370	-	-	209
Human activity	-	86	-	-	-
Plant root	-	1	-	-	-
Other	-	36*	-	-	70**
<i>Hatchlings</i>					
Total number	2833	743	460	3276	67
Fox	908	405	60	-	37
Crab	1703	14	378	89	-
Feral dog	-	52	-	-	8
Bird	23	93	1	-	3
Car	-	6	-	-	-
Strong sunlight	199	173	21	52	19
Light pollution	-	-	-	3135	-
Other	-	-	-	-	-

Caretta caretta nested per season. Yerli and Demirayak (1996) recorded a total of 884 loggerhead turtle nests for the beaches of Turkey. The five major nesting areas considered here may hold 296-920 nests per season. This means that approximately 99-307 loggerhead turtles nest annually on these beaches

The results show that Dalyan beach has the highest number of nests. According to Groombridge (1994), it is unclear to what extent the eastern turtle beaches are used by loggerheads. It is seen here that the green turtle nesting sites are also used by loggerheads, with 1 to 23 nests per season. The mean number of nests varied between 53 and 193 on the south-western beaches of Turkey. We are of the opinion that these values do not fully reflect the capacity of the beaches. However, if we consider the study periods, lengths and sections of the beaches, these numbers reflect at least the minimum capacity of the five beaches. These data also highlight the importance of the Turkish nesting sites, with Margaritoulis (2000) estimating the overall number of loggerhead nests in Greece as 2355-5287 per year. Broderick & Godley (1996) recorded a total of 1347 loggerhead turtle nests in Northern Cyprus between 1992 and 1995, estimating that 22-173 loggerhead turtles nest on these beaches per season.

Of the 23 997 eggs destroyed on the beaches, it is obvious that canid predation was the main problem, with some 22 232 eggs (93% of eggs predated) destroyed either by foxes or dogs. It is well known that land-based

predators, including mammals, have less impact on hatchlings than on eggs (Hopkins *et al.*, 1979, Fowler, 1978). A total of 7399 hatchlings was destroyed on the beaches. Light pollution caused the disorientation and loss of 3135 hatchlings (42%). Crabs destroyed 2184 hatchlings (29.5%), whereas foxes destroyed 1462 (19.7%). These results represent only the general pattern of the fate of loggerhead hatchlings. If we take the beaches separately into consideration, crab predation had the most effect on the hatchlings of the Dalyan and Patara beaches, whereas fox predation was most harmful on the Fethiye and Kizilot beaches. Light-pollution was the main problem for the Belek beach, resulting in disorientation.

It is worth comparing these results with those for other loggerhead nesting sites in the Mediterranean: terrestrial predators such as red foxes (*Vulpes vulpes*), feral and domestic dogs, ghost crabs (*Ocypoda cursor*), and scavenging birds (hooded crows, *Corvus corone cornix*, and magpies, *Pica pica*) were recorded in Northern Cyprus (Broderick & Godley, 1996). Of the 48.4% predation given by Margaritoulis (1988), red fox (*Vulpes vulpes*) and stray dogs were the primary predators in Kiparissia Bay, Greece. He claimed that exposed eggs attracted other mammals (rats and martens) and birds. A total of 34 loggerhead turtle nests was recorded on the northern Mediterranean coast of Israel (Silberstein & Dmi'el, 1991). They stated that a sharp decline in the number and density of loggerhead sea turtle nests in

Israel was attributable to both regional and local processes.

A few loggerhead turtles still lay eggs at Canigli beach, which is much visited by tourists at Lampedusa, Italy (Gramentz, 1989). He stated that the black rat, *Rattus rattus*, was found to be the main predator, besides humans, on the beach. The number of loggerheads killed annually was estimated at 150-300 in Lampedusa and 500-600 in Malta.

Kasperek (1995) surveyed the entire Syrian Mediterranean coast (193 km) for marine turtle nesting in 1991 and found significant nesting sites between Latakia and Jablah. He quoted 10 tracks/km theoretically in Syria and attributed most of them to the loggerhead turtle.

Although we have described patterns of abundance and threats at these five sites, monitoring of marine turtle nesting on the south-west Mediterranean coast of Turkey has not been consistent and uninterrupted. Thus, before setting up predation management programs (hunting, trapping, transplantation, offshore-releasing hatcheries etc.), longer-term studies are recommended. Of the five beaches, Dalyan is the site on which studies and observations were most frequent. Despite the insufficient data from the five beaches considered in this survey, it is obvious that natural predation greatly reduces hatchling production of the loggerhead turtle.

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REFERENCES

- Aureggi, M., Gerosa, G. & Yerli, S. (1999). Observations on predation of marine turtle nests at Akyatan, Turkey, Eastern Mediterranean. *Chelonian Conservation and Biology* 3, 487-489.
- Baran, I. (1993a). Research on the sea turtle population of Patara Beach. *Final Report submitted to Environmental Ministry of Turkey*.
- Baran, I. (1993b). Research on the sea turtle population of the Dalyan Beach. *Final Report submitted to Environmental Ministry of Turkey*. 24 pp.
- Baran, I., Durmus, H., Çevik, E., Üçüncü, S., & Canbolat, A. F. (1992). Türkiye Deniz Kaplumbagalari Stok Tespiti. *Turkish Journal of Zoology* 16, 119-139.
- Baran, I., Durmus, S. H. & Türkozan, O. (1998). Erster Nachweis der Lederschildkröte, *Dermochelys coriacea* (Linnaeus, 1766) (Testudines: Dermochelyidae) aus türkschen Gewässern. *Herpetofauna* 20, 34.
- Baran, I. & Kasperek, M. (1989). Marine turtles Turkey. Status survey 1988 and recommendations for conservation and management. *Prepared by WWF, Heidelberg*.
- Baran, I., Kumlutas, Y., Kaska, Y. & Türkozan, O. (1994). Research on the amphibia, reptilia and mammalia species of the Köycegiz-Dalyan Special Protected Area. *Turkish Journal of Zoology* 18, 203-219.
- Baran, I. & Türkozan, O. (1996). Nesting activity of the loggerhead turtle, *Caretta caretta*, on Fethiye Beach, Turkey in 1994. *Chelonian Conservation and Biology* 2, 93-96.
- Baran, I., Türkozan, O., Kaska, Y., Ilgaz, Ç. & Sak, S. (1996). Research on the marine turtle populations of Dalyan, Fethiye, Patara and Belek beaches. *Final Report submitted to Environmental Ministry of Turkey*. 44 pp.
- Basoglu, M. (1973). Sea turtles and the species found along the coasts of neighbouring countries. *Türk Biyoloji Dergisi, Istanbul*, 23, 12-21.
- Basoglu, M. & Baran, I. (1982). Anadolu sahillerinden toplanan deniz kaplumbagasi materyali üzerinde kısa bir rapor. *Doga Bilim Dergisi, Temel Bilim* 6, 69-71.
- Broderick, C. A. & Godley, B. (1996). Population and nesting ecology of the Green Turtle, *Chelonia mydas*, and the Loggerhead Turtle, *Caretta caretta*, in Northern Cyprus. *Zoology in the Middle East* 13, 27-46.
- Brown, L. & McDonald, D. W. (1995). Predation on green turtle, *Chelonia mydas* nests by wild canids at Akyatan Beach, Turkey. *Biological Conservation* 71, 55-60.
- Canbolat, A. F. (1991). Dalyan kumsali (Mugla, Türkiye) nda *Caretta caretta* (Linnaeus, 1758) populasyonu üzerine incelemeler. *Turkish Journal of Zoology* 4, 255-274.
- Canbolat, A. F. (1996). Dalyan ve Patara *Caretta caretta* (Linnaeus, 1758) Deniz Kaplumbagasi Populasyonlarının İncelenmesi. *Hacettepe Üniversitesi Doktora Tezi* 1-454 pp.
- Clarke, M., Campbell, A. C., Hameid, W. S. & Ghoneim, S. (2000). Preliminary report on the status of marine turtle nesting populations on the Mediterranean coast of Egypt. *Biological Conservation* 94, 363-371.
- Durmus, S. H. (1998). An investigation on biology and ecology of sea turtle populations on Kazanlı and Samandag beaches. Dokuz Eylül University, Graduate School of Natural and Applied Sciences.
- Erk'akan, F. (1993). Nesting biology of loggerhead turtles, *Caretta caretta*, L. on Dalyan beach, Mugla-Turkey. *Biological Conservation* 66, 1-4.
- Fowler, L. E. (1978). Hatching success and nest predation in the green sea turtle, *Chelonia mydas*, at Tortuguero, Costa Rica. Master's thesis, University of Florida.
- Geldiay, R. (1983). Deniz kaplumbagalariinin (*Caretta caretta* ve *Chelonia mydas*) korunmasında temel bilimler yönünden takip edilecek stratejinin önemi. *Ege Üniversitesi Fen Fakültesi Dergisi, Seri B*, 1, 328-349.
- Geldiay, R. (1984). Türkiye'nin Ege ve Akdeniz kıyılarında yaşayan deniz kaplumbagalariinin (*Caretta caretta* ve *Chelonia mydas*) populasyonlari ve korunmasi ile ilgili araştırmalar. *Doga Bilim Dergisi*, A 8, 66-75.
- Geldiay, R. & Koray, T. (1982). Türkiye'nin Ege ve Akdeniz kıyılarında yaşayan deniz kaplumbagalariinin (*Caretta caretta* ve *Chelonia mydas*) populasyonlari ve korunmalari ile ilgili tedbirler üzerine araştırmalar. *TÜBİTAK, Proje no: WHAG-431*, 121 s.

- Geldiay, R., Koray, T. & Balik, S. (1982). Status of the sea turtle population (*Caretta caretta* and *Chelonia mydas*) in the northern Mediterranean sea, Turkey. 425-434. In K. A. Bjorndal (Eds). *Biology and Conservation of Sea turtles*, 583 pp. Washington.
- Gramentz, D. (1989). Marine turtles in the central Mediterranean Sea. *Centro* 1, 41-46.
- Groombridge, B. (1988). Marine turtles in the Mediterranean; distribution, population status, conservation. *World Conservation Monitoring Centre*, Cambridge, p. 57.
- Groombridge, B. (1994). Marine turtles in the Mediterranean: distribution, population status, conservation. *Council of Europe Press, Nature and Environment*, No: 48
- Hathaway, R. R. (1972). Sea turtles, unanswered questions about sea turtles in Turkey. *Balik ve Balıkçılık*, Ankara, 20, 1-8.
- Hopkins, S. R., Murphy, T. M., Stansell, Jr., K. B. & Wilkinson, P. M. (1979). Biotic and abiotic factors affecting nest mortality in the Atlantic loggerhead turtle. *Proceedings of the 32nd Annual Conference of the South East Association of Fish and Wildlife Agencies* 32, 213-223.
- Ilgaz, Ç. (1998). An investigation on marine turtles population of Northern Karpaz and Dalyan beaches and the effect of different ecological conditions on hatching success. MSc Thesis, Dokuz Eylül University, Graduate School of Natural and Applied Sciences.
- Kaska, Y. (1993). Investigation of *Caretta caretta* Population in Patara and Kizilot. MSc Thesis, Dokuz Eylül University, Graduate School of Natural and Applied Sciences.
- Kasperek, M. (1993). Survey of the Mediterranean coast between Alexandria and El Salum, Egypt. *Marine Turtle Newsletter* 63, 8-9.
- Kasperek, M. (1995). The nesting of marine turtles on the coast of Syria. *Zoology in the Middle East* 11, 51-62.
- Kuller, Z. (1999). Current status and conservation of marine turtles on the Mediterranean coast for Israel. *Marine Turtle Newsletter* 86, 3-5.
- Laurent, L., Bradai, M. N., Hadoud, D. A. & Gomati, H. M. (1995). Marine turtle nesting activity assesment on Libyan coast. Phase I: Survey of the coast between Egyptian border and Sirte- RAC/SPA (MAP-UNEP), Tunis.
- Laurent, L., Navira, S., Grissac, D. J. & Bradai, M. N. (1990). Les tortues marines de Tunisie: premiers donnees. *Bulletin de la Société Herpetologique de France* 53, 1-17.
- Margaritoulis, D. (1988). Nesting of the loggerhead sea turtle, *Caretta caretta*, on the shores of Kiparissia Bay, Greece, in 1987. *Mesogee* 48, 59-65.
- Margaritoulis, D. (2000). An estimation of the overall nesting activity of the loggerhead turtle in Greece. In *Proceeding of the 18th International Symposium on Sea Turtle Biology and Conservation*, 3-7 March 1998, Mazatlan, Mexico.
- Oruç, A., Demirayak, F. & Sat, G. (1997). Dogu Akdeniz'de trol balıkçılığı ve deniz kaplumbagalari üzerine etkisi. *Sonuç Raporu*, 30 pp.
- Peters, A. & Verhoeven, K. J. F. (1992). Breeding success of the loggerhead, *Caretta caretta*, and the green turtle, *Chelonia mydas*, in the Göksu Delta. Turkey. Department of Animal Ecology, University of Nijmegen, *Rapport No:310*.
- Sak, S. (1998). Belek Kumsalındaki Deniz Kaplumbagasi Populasyonlariinin Incelenmesi. MSc thesis, Dokuz Eylül University, Graduate School of Natural and Applied Sciences.
- Silberstein, D. & Dmi'el, R. (1991). Loggerhead sea turtle nesting in Israel. *Marine Turtle Newsletter* 53, 17-18.
- Taskavak, E., Boulon, R. H., & Atatiir, M. K. (1998). An unusual stranding of a leatherback turtle in Turkey. *Marine Turtle Newsletter* 80, 13.
- Taskin, N. (1998). Research on embryological development of marine turtle population on Patara Beach. MSc thesis Dokuz Eylül University, Graduate School of Natural and Applied Sciences.
- Türkozan, O. & Baran, I. (1996). Research on the loggerhead turtle, *Caretta caretta*, of Fethiye Beach. *Turkish Journal of Zoology* 20, 183-188.
- Türkozan, O. (2000). Reproductive ecology of the loggerhead turtle, *Caretta caretta*, on Fethiye and Kizilot beaches, Turkey. *Chelonian Conservation and Biology* 3, 686-692
- Türkozan, O. & Durmus, H. S. (2000). A feeding ground for juvenile green turtles, *Chelonia mydas*, on the western coast of Turkey. *British Herpetological Society Bulletin* 71, 1-5
- Yerli, S. & Demirayak, F. (1996). Türkiye'de denizkaplumbagalari ve üreme kumsallari üzerine bir degerlendirme. *Sonuç Raporu*: 129 pp.
- Yerli, S. V. & Canbolat, A. F. (1998). Dogu Akdeniz bölgesindeki Deniz Kaplumbagalariinin korunmasına yönelik yönetim plan ilkeleri, *Çevre Bakanligi Ç.K.G.M yayini* Ankara. 88 pp.
- Yerli, S. V., Canbolat, A. F., Ulug, H. & Dogan, O. (1998). Bati Akdeniz bölgesindeki deniz kaplumbagalariinin korunmasına yönelik yönetim plani ilkeleri. *Çevre Bakanligi Ç.K.G.M yayini* Ankara. 90 pp.