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Research on the Sea Turtle Population of Belek Beach*

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Abstract: In this study, the status of the sea turtle population of Belek Beach, which is within the boundaries of Antalya province, was investigated during the 1996 and 1997 breeding seasons. 153 nests were recorded, 134 of which hatched (87.6%) and from these nests 6295 hatchlings were able to reach the sea in 1996. 168 nests were recorded in 1997, 136 of which hatched (80.9%) and from these nests 7082 hatchlings were able to reach the sea. The nest density was recorded as 9.1 nests/kilometer in 1996 and as 9.9 nests/kilometer in 1997. The average clutch size was 78 for both years. The average body measurements taken from 15 adult females were SCL: 69.4 cm (± 5.66 cm), SCW: 53 cm (± 6.50 cm). The average body measurements taken from 851 hatchlings were SCL: 4.13 cm (± 0.202 cm), SCW: 3.14 cm (± 0.208 cm). The average weight taken from 425 hatchlings were 15.7 g (± 1.66 g).

Key Words: Belek Beach, *Caretta caretta*, Nest, Emergence, Hatchling

Belek Kumsalındaki Deniz Kaplumbağası Populasyonunun Araştırılması

Özet: Bu çalışmada 1996 ve 1997 üreme sezonlarında Antalya ili sınırları içindeki Belek Kumsalındaki Deniz kaplumbağası populasyonunun durumu araştırılmıştır. 1996'da kaydedilen 153 yuvanın 134'ünden (%87.6) yavru çıkışı olmuş ve bu yuvalardan 6295 yavru denize ulaşabilmiştir. 1997'de tespit edilen 168 yuvanın 136'sından (%80.9) yavru çıkışı olmuş ve bu yuvalardan 7082 yavru denize ulaşabilmiştir. Yuva yoğunluğu 1996'da 9.1 yuva/kilometre ve 1997'de 9.9 yuva/kilometre olarak tespit edilmiştir. Her iki yılda ortalama yumurta sayısı 78'dir. Vücut ölçüleri alınan 15 ergin dişinin ortalama DKB: 69.4 cm (± 5.66 cm), DKE: 53 cm (± 6.50 cm)'dir. Vücut ölçüleri alınan 851 yavrunun ortalama DKB: 4.13 cm (± 0.202 cm), DKE: 3.14 cm (± 0.208 cm)'dir. Tartılan 425 yavrunun ortalama ağırlığı 15.7 gr (± 1.66 gr)'dir.

Anahtar Sözcükler: Belek Kumsalı, *Caretta caretta*, Yuva, Çıkış, Yavru

Introduction

Previous studies have revealed the existence of 5 species of marine turtles in the Mediterranean (1). Of these, *Caretta caretta* and *Chelonia mydas* have been recorded as nesting regularly on the Turkish coasts (2). Both species are protected and their commerce is prohibited by international laws (3,4). Turkey has 17 important nesting grounds for sea turtles, including Belek Beach (2). The Ministry of Tourism announced this site as a tourism investment area in 1987. The natural structure of Belek Beach has degenerated as a result of dense development. The aim of this study was to determine the population status of sea turtles at Belek Beach as well as to display the effects of destructive factors on sea turtles.

Materials and Methods

The total length of Belek Beach is about 40 kilometers. The research area includes 17 kilometers of the beach starting from River Beşgöz in the east and runs up to 2.5 kilometers west of the River Acısu (Figure).

The study was carried out between 20th July and 18th September in 1996 and 1st June and 20th September in the 1997 breeding seasons. The night patrolling covers the area between the Acısu River and the first hotel chain from 10:00 p.m. to 05:00 a.m. After females completed their nesting process, body measurements were taken and turtles were tagged with monel tags on the front right limb. During the morning patrols, the shape and pattern of tracks were noted and were identified with the

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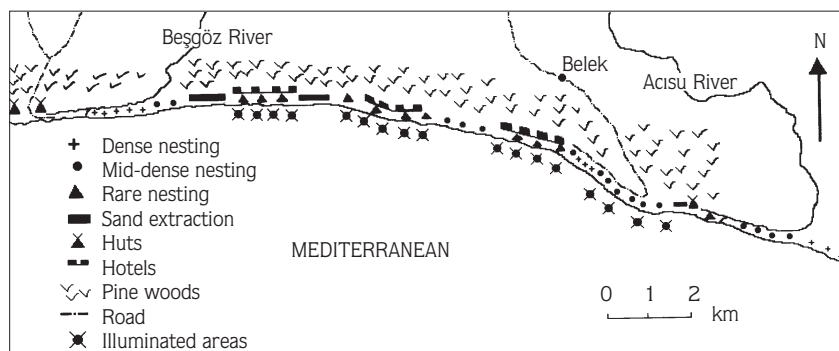


Figure. The general view and the nest distribution of Belek Beach.

aid of a metal stick to determine if they were nests or non-nesting emergences. Subsequently, the distance from the tide line was measured and nests were marked and covered by sand to make them invisible so that they could not be seen by anyone. Tracks coming from each nest were counted and the numbers of hatchlings reaching the sea were determined during the hatchlings' emergence period. Nests were opened and checked after the hatchlings completed their emergence (3-5 days after the last emergence). Finally the number of empty eggshells, unfertilised eggs, dead embryos, dead hatchlings and live hatchlings were counted.

The nests, built on illuminated areas, were carefully transplanted to artificial hatcheries in the darker areas and the ones that could not be transplanted were protected with the help of cages having dimensions of 1x1x1 meters. The caged nests were checked the whole night and the carapace measurements of the hatchlings and their weights were measured during the hatchlings emergence period. Furthermore, the number of plates on the carapace was noted. After all processes were

completed, hatchlings were carried to the dark areas and released. The nests exposed to predators, such as foxes, were protected by metal gratings having 72x72 centimeter dimensions.

Results

The first emergence of the females could not be recorded due to the late start of our project in 1996. In 1997, the first emergence was recorded on the 1st of June; however, this track was left there from the previous days. The distribution of nests and non-nesting emergences of sea turtles according to month are shown in Table 1. Biometric values of tagged females and the number of their eggs are shown in Table 2. Some measurements regarding the tagged females at Belek Beach are shown in Table 3.

The average distance of the nests from the tide line was 21.4 m, the average diameter of the nests was 21.5 cm, and the average depth of the nests was 53.3 cm in 1996, whereas the average distance of the nests from the

Table 1. Distribution of nests and non-nesting emergences according to months in the 1996 and 1997 breeding seasons.

	1996			1997			
	July	Aug.	Total	June	July	Aug.	Total
Number of nests	12	1	13	102	65	1	168
Number of non-nesting emergences	28	10	38	96	125	---	221
Total	40	11	51	198	190	1	389
Percentage of Nests	30	9.1	25.5	51.5	34.2	100	42.2
Percentage of non-nesting emergences	70	90.9	74.5	48.5	65.8	---	57.8

Table 2. The biometric values and the number of eggs of the females that were measured at Belek Beach. (n: Number of specimens, SD: Standard Deviation of the mean, SE: Standard Error of the mean, SCL: Straight Carapace Length, SCW: Straight Carapace Width)

	n	Min. (cm)	Max. (cm)	Mean (cm)	SD (cm)	SE (cm)
SCL	15	60	78	69.40	5.66	1.46
SCW	15	47	72.5	53.40	6.50	1.68
Number of eggs	15	44	98	72.73	14.39	3.71

Table 3. Some measurements of the tagged females at Belek Beach during 1997. (SCL: Straight Carapace Length, SCW: Straight Carapace Width, CCL: Curved Carapace Length, CCW: Curved Carapace Width)

Tag No.	Nest/Track	Date	SCL (cm)	SCW (cm)	CCL (cm)	CCW (cm)	No. of eggs
251	Track	06.06.97	78	56	85	70	-----
252	Nest	06.06.97	63	49	70	62	68
253	Nest	10.06.97	62	47	67	61	56
254	Nest	12.06.97	60	58	61	68	68
255	Track	24.06.97	74	55	78	72	-----
	Nest	17.07.97					85
256	Nest	24.06.97	67	47	71	64	71
257	Nest	26.06.97	-----	-----	72	66	Lost
258	Track	27.06.97	68.5	49.5	71	62	-----
	Nest	27.06.97					66
259	Nest	27.06.97	-----	-----	80.5	68.5	90
260	Nest	30.06.97	66	50	71	66	63
	Track	11.07.97					-----
261	Nest	04.07.97	71	51.5	76	66.5	44
262	Nest	04.07.97	70	50	73	65	81
263	Nest	06.07.97	73	54	78	70	71
264	Nest	06.07.97	76.5	72.5	80	71	93
265	Nest	08.07.97	69	49	74	64	68
266	Nest	15.07.97	65	50	70	64	69
249	Nest	19.07.97	77.5	56.5	81	70	98

tide line was 20.3 m, the average diameter of nests was 21.2 cm, and the average nest depth was 51.5 cm, in 1997. In both years, the most dense nests were found (50.7 %) between 15 to 25 meters away from the tide line. The average number of eggs was 78.2 (n:134) in 1996, whereas it was 78.15 (n: 142) in 1997. The peak egg deposition occurred in June in the 1997 breeding season. The number of deposited eggs and numerical values belonging to them are shown in Table 4.

Table 4. The number of deposited eggs and numerical values belonging to them during the 1996 and 1997 breeding seasons.

	1996	1997	Total	(%)
Number of nests	153	168	321	
Hatchling producing nests	134	136	270	84.1
Total eggs	10486	10988	24174	
Predated eggs	507	109	616	2.9
Unfertilised, spoiled eggs	1414	1501	2915	13.5
Undeveloped embryos	422	618	1040	4.8
Abnormal eggs	26	18	44	0.2
Empty egg shells	8117	8773	16890	78.6
Hatchlings that managed to reach the sea	6295	7082	13377	79.2

A total of 860 loggerhead hatchlings were examined in order to determine the distribution of the carapace plates. Information about the distribution of the carapace plates of these hatchlings is given in Table 5. Biometric values of the hatchlings are shown in Table 6.

A total of 12 nests (765 eggs) were transplanted. Of these nests, 546 (71.4%) hatchlings came out and 465 (85.2%) of them were able to reach the sea.

Of the total 321 nests, 270 produced hatchlings and 51 were lost due to fox/dog predation or human activities. A total of 18 nests (507 eggs) were predated

Table 5. The distribution of the carapace plates of the hatchlings.

	n	Distribution	%
Nuchal	831	1	96.6
	29	2	3.4
Vertebral	2	4	0.2
	738	5	85.8
	94	6	10.1
	21	7	2.4
	4	8	0.5
	1	9	0.1
Costal	779	Left-Right	
		4-4	0.2
		4-5	0.5
		5-5	90.6
		5-4	0.8
		4-6	0.1
		5-6	2.1
		6-6	1.6
		6-5	2.8
		5-7	0.1
		6-7	0.2
		7-5	0.3
		7-7	0.3
Marginal	118	7-6	0.1
		8-5	0.1
		Left-Right	
		12-12	52.4
		11-11	22
		11-12	13.8
		12-11	9.6
Supracaudal	860	7	0.8
		6	0.7
		13-13	0.7
		12-13	0.7
		11-13	0.1

by either foxes or dogs in 1996. Of these nests, 9 were completely predated and the remaining 9 were protected by metal gratings after predation. In 1997, we started to place the protective metal gratings at the beginning of the breeding season. A total of 6 nests (109 eggs) were

Table 6. The biometric values of the hatchlings measured at Belek Beach in 1997.

	n	Max.	Min.	Mean	SD	SE
SCL	851	47.61 mm	31.96 mm	41.32 mm	2.02 mm	0.07 mm
SCW	851	39.14 mm	22.84 mm	31.44 mm	2.08 mm	0.07 mm
Weight	425	19.9 g	10.7 g	15.71 g	1.66 g	0.08 g

predated after protection and only one nest was completely predated. 781, 26, 80 hatchlings died due to light pollution, sunstroke and crab predation, respectively, in 1996. Furthermore, it was recorded that a total of 792 hatchlings were lost in the same year. A total of 1123 hatchlings died due to light pollution (1091), sunstroke (23) and crab predation (9) in the 1997 breeding season. In addition a total of 471 hatchlings were lost in the same year. The reason why these hatchlings were given as lost is the difference between the number of hatchlings emerging from the nests and empty eggshells found in the nests. It can be concluded that most of these 1263 lost hatchlings lost their direction due to the light effect and therefore got directed towards the land and got lost.

Discussion

The existence of *Chelonia mydas* nests was previously reported at Belek Beach (5). However, no emergence was recorded during our study period. But we observed the corpse of a young *C. mydas*, whose SCL was nearly 30 cm, so this area may represent a nourishing area for the juvenile of this species. In the first year, after 20th July, when the study was started, the arrival of 51 tracks was

determined and 13 (25.5%) of them resulted in nests. The next year, a total of 389 emergences were recorded, and 168 (42.2%) of them resulted in nests. Hatchlings emerged from 134 (87.6%) of 153 nests in 1996 and 136 (80.9%) of 168 nests in the 1997 breeding season. At the end of the study in 1997, the highest adult emergence was determined in June and July, but more nests were made in June (51.5%) than in July (34.2%). The nesting season starts at the end of May and finishes in the first week of August on Belek Beach. Geldiay (6) reported the nest density of Belek Beach as 15 nests/kilometer in 1984. After 12 years, the level of nest density has diminished to nearly 9.5 nests/kilometer. The most important reason for this decrease is the loss of nesting areas, which arises from uncontrolled construction on the beach.

A total of 17 females were tagged during the 1997 breeding season. The morphometric measurements of these and others marked at some other beaches are given comparatively in Table 7.

The number of eggs counted in the checked nests was 10486 and 10988 respectively. Some measurements obtained from the nest openings at Belek and some other beaches are given in Table 8.

Table 7. The morphometric measurements of females marked at Belek Beach and at other beaches (7-10).

Beaches	Belek		Kızılot			Fethiye		Dalyan
	1997	1990	1996	1997	1995	1996	1997	1997
Years	1997	1990	1996	1997	1995	1996	1997	1997
Mean SCL (cm)	69.4	66.4	70.79	70.14	72.08	71.52	72.60	72.12
Mean SCW (cm)	53	52.63	52.06	52.41	53.96	54.21	53.63	53.80

Table 8. Some measurements regarding nests at Belek and some other beaches (8-12).

Beaches	Years	No. of Nests	Nest Density (km/nest)	Incubation Period (Days)	Number of Eggs	Average Number of Eggs
Belek	1996	153	9.1	-----	10486	78.2
	1997	168	9.9	52.5	10988	78.15
Kızılot	1996	125	27.7	49.57	9625	77.4
	1997	108	24	50.07	8640	80
Fethiye	1995	191	23.9	57.73	15853	83
	1996	88	11	54.5	7656	86.9
	1997	95	11.9	56.44	6679	70.29
Dalyan	1997	135	28.7	52.4	10903	81
Greece	1988	517	12.3	55.5	-----	117.7
Cyprus	1994	-----	-----	47.9	-----	61

In the first year, 8117 (77.4%) hatchlings hatched from 10486 eggs and 6295 (77.5%) of them reached the sea. The next year 8773 (79.8%) hatchlings hatched from 10988 eggs and 7082 (80.7%) of them reached the sea. Morphometric measurements belonging to these hatchlings are compared with that of other beaches in Table 9.

Table 9. Morphometric measurements of the hatchlings taken from various beaches (8-10).

Beaches	Average SCL	Average SCW	Average Weight
Belek	4.13 cm	3.14 cm	15.7 g
Kızılot	3.97 cm	3.01 cm	-----
Fethiye	3.98 cm	3.02 cm	-----
Dalyan	3.77 cm	2.79 cm	15.06 g

At the end of this research, the average distance between the tide line and the nests was found to be 21.4 m in 1996, and 20.3 m in the 1997 breeding season. The nest density decreases after the 35th m. Our results support the idea that all negative effects disturbing the turtles, such as umbrellas, beach huts, deck chairs should be placed at least 35 m away from the tide line as this area is important for the nesting of these turtles.

The high success of the hatchlings in emerging from the artificial nests and in reaching the sea lead us to believe that transferring the nests located at unsuitable

places to more favourable places is necessary. But it should be taken into consideration that the eggs might be damaged during transportation and the sex ratios may develop abnormally, because the eggs are transported somewhere with different ecological conditions.

It was recorded that the females abort while emerging from the sea, due to the effects of artificial lights (13) and there were reductions in loggerhead nesting emergences where lighted piers and roadways were close to the beaches (14). It was also seen that the females' emergences for nesting were less and the nest density was low in illuminated areas. Most of the hatchlings coming out of the nests, in illuminated areas, go towards the lights behind the beach, instead of going to the sea. In two years, a total of 51 (15.9%) nests could not be observed or excavated to be checked, because they were lost or harmed by predators and human activities. It can easily be concluded that the human activities are the most important factor threatening the turtle population on Belek Beach.

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