

The nesting success of green turtles on beaches at Kazanli, Turkey

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*The green turtle *Chelonia mydas* is one of two marine turtle species to nest in Turkey. Its three main nesting beaches are in eastern Turkey, with possibly the densest congregation of nesting turtles in the Mediterranean being found at Kazanli. However, beach erosion, hatchling predation, agricultural encroachment and chemical pollution mean that the future of the Kazanli nest site is uncertain. The Turkish Society for the Protection of Nature (Dogal Hayati Koruma Dernegi) is making valiant efforts to protect all the turtle nesting beaches in Turkey but lacks detailed information on the numbers of nesting turtles on many beaches. This paper describes a short study of nesting turtles at Kazanli during 1990 and makes recommendations for the conservation of the nesting beach.*

Introduction

Nesting sites of marine turtles in the Mediterranean are under threat due to pollution, land reclamation, sand extraction and increased tourist development, which has been associated with reduced numbers of nesting adults and emerging hatchlings. Development for tourism has been particularly apparent on the Greek island of Zakynthos (Margaritoulis, 1982; Arianoutsou, 1988; Warren and Antonpoulou, 1990), where problems led to confrontation between local people and conservation groups (Anon., 1990). The disruption of nesting due to tourism is a relatively new problem in the Mediterranean and has affected both loggerhead *Caretta caretta* nest sites, notably in Greece and Turkey, and *Chelonia mydas* nest sites in Cyprus (Groombridge, 1990). In Turkey, *Chelonia mydas* has been little affected by tourism because of its restricted distribution, but populations have been depleted by hunting in the recent past (Sella, 1982). More than 25,000 animals were taken from Turkish beaches at Mersin (probably Kazanli) and south of Adana (Akyatan) between 1952 and 1965. Sella (1982) also reported fishing in the Gulf of

Iskenderun as late as 1972 (annual catch 1200). In Turkey, problems due to tourism are greatest on the west Mediterranean coast and, until recently, conservation measures have concentrated on these sites. Turkey has 17 turtle nesting sites along the Mediterranean coast that are recognized as needing protection (Baran and Kasperek, 1989). Five have been designated Specially Protected Areas by the Turkish Government (Whitmore *et al.*, 1990).

Nesting of *C. mydas* is known on the west (Demetropoulos and Hadjichristophorou, 1989) and north (Groombridge and Whitmore, 1989) coasts of Cyprus and the eastern Turkish Mediterranean coastline (Groombridge, 1990; Baran and Kasperek, 1989). In Turkey, the three most important sites for *C. mydas* are in the east: Kazanli, Akyatan, and Samandagi. Akyatan is controlled by the Department of Forestry and relatively unaffected by human activities, but Samandagi and Kazanli are threatened. Kazanli has a high nesting density relative to other Mediterranean beaches and is threatened by photopollution, pollution by tar and litter, chemical pollution and erosion of the beach (Baran and Kasperek, 1989). This paper describes research undertaken for the Turkish Society for the Protection of Nature

(DHKD) at Kazanlı during July 1990. The project investigated nesting success of *C. mydas*, examined the effect of agricultural and industrial development in the area and recommended priorities for management of the region.

Study area

Kazanlı lies approximately 10 km east of Mersin and is the furthest west of the three important *C. mydas* nest sites in Turkey (Figure 1). Kazanlı is dominated by the presence of the Soda Sanyaii factory immediately to the north, which is lit throughout the night. The authors followed the numbering of beaches adopted by Sarigul and Langeveld (1988), separating the Kazanlı beaches into four (Figure 2). The total length of all four beaches is approximately 4 km. Kazanlı I (K1) makes up the majority (Figure 2), approximately 2.5 km of gentle sloping beach with no dunes. Kazanlı II (K2) is relatively flat with a rough road separating the beach from dunes and ponds, which support a diverse reptile, amphibian and invertebrate fauna. The main nesting area, Kazanlı III (K3), is only 605 m long. The entire length of K3 is fenced, separating the beach from an area where vegetables are grown by local farmers. K3 has 99 m of flat beach in the west; 239 m of high man-made dunes built as wind breaks; 73 m of 'natural' dune and 194 m of narrow beach, which runs into a stony area at the base of a jetty. This jetty separates the eastern end of K3 from Kazanlı IV (K4), which lies within the confines of the Soda Sanyaii Factory. K4 has a man-

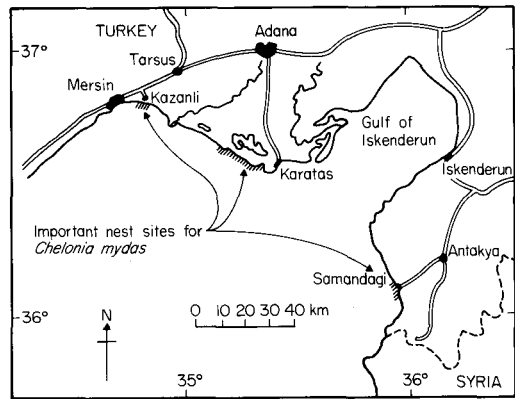


Figure 1. Map of eastern Turkey showing main nest sites for *C. mydas* in Turkey

made cliff to the north and a smaller jetty to the east. All four beaches suffer from photo-pollution and litter. Detailed descriptions can be found in Smart and Coley (1990), Baran and Kasperek (1989) and Sarigul and Langeveld (1988), and large-scale maps of each of the four beaches in Smart and Coley (1990).

Methods

Initial daytime surveys of the beach showed a concentration of abandoned body pits on K3. This was taken to indicate the area of maximum turtle activity and observations concentrated on this area. The following description of methods is based on monitoring of K2 and K3, which supported the majority of nesting activity. K1 and K4 were monitored infre-

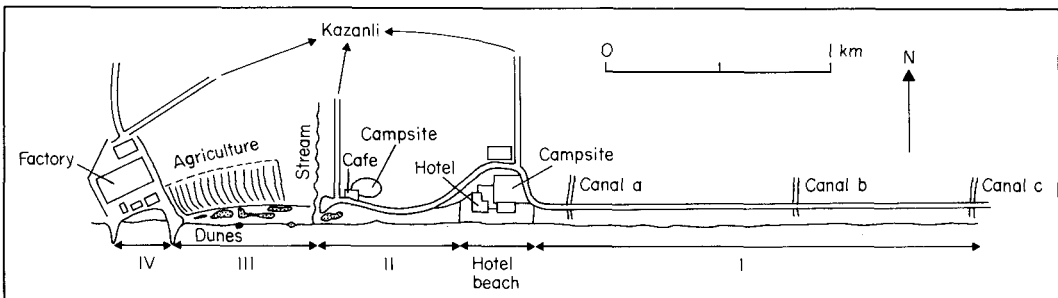


Figure 2. Map showing Kazanlı beaches.



The nesting beach at Kazanlı, showing the factory.

quently, depending on available personnel. Beaches were monitored between 22.00 h and 06.00 h (approximately). Observation commenced on K2, observers walking to the central dune region of K3, from where most of K3 could be viewed without presenting a silhouette to the sea. At intervals of approximately 30 minutes observers walked the length of both beaches. Tracks or turtles were followed carefully to minimize disturbance to emerging turtles. Observations were made without torches except for the use of a thin beam to establish the presence of eggs. Turtles were left undisturbed for as long as possible and only approached when digging of the egg pit had commenced. Approaches were always made by crawling behind the turtle to a point where it could be observed without risk of any disturbance interrupting nesting behaviour. Once a turtle returned to the sea, incoming and return tracks were marked.

When possible, counts of numbers of eggs laid and curved carapace length (from the edge of the nuchal scute to the most posterior

process of the carapace) were recorded, and turtles were tagged by a research team from Dokuz Eylül University at Izmir. Unstable sand made counting of eggs difficult because of the danger of sand falling into the egg chamber. When the turtle's rear flippers allowed easy access egg numbers were recorded, but generally, once laying was confirmed, turtles were checked for tags and left to camouflage the nest undisturbed. This enabled as many turtles as possible to be monitored and avoided the possibility of observers causing sand to collapse into the egg chamber.

Track records were taken on K2 and K3 every morning at 06.00 h before people disturbed the beach. The location of each emergence was recorded and an assessment made of the outcome. Three possible outcomes were defined: a successful nest; a failed nest attempt (where digging was attempted but the nest abandoned); and emergence with no attempt at digging (defined here as a 'U'-turn).

Beaches were walked during daylight and night to assess differences in topography, the

depth and moisture content of sand at nesting sites (on K3) and to assess any potential difficulty for hatchlings emerging later in the season. On K3, artificial egg chambers were excavated in abandoned body pits and artificial body pits, to determine whether 'egg-chambers' could be excavated in areas where nest attempts failed. Observations relating to dune structure and photopollution were recorded to assess possible effects on nesting or hatchling emergence.

Results

Observations of emerging turtles and track records

There was no evidence of *C. mydas* being disturbed by the attention of observers from the project. Observation effort varied over the project, with researchers from Dokus Eylül University at Izmir assisting when possible. Results from observations are given in Table 1. Nesting *C. mydas* laid an average of 122 eggs ± 17 (mean \pm standard error, seven records) and

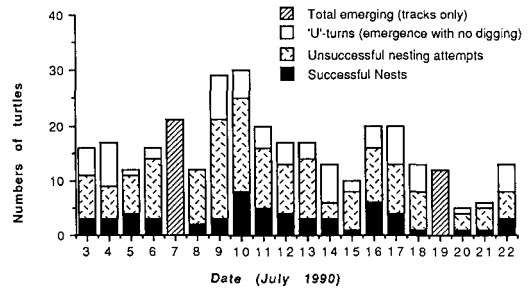


Figure 3. Turtle behaviour from track records over the study period on Kazanlı III (K3).

at least three animals emerged twice in the 3-week period. Average curved carapace length and width were 96 cm ± 4 and 83 cm ± 4 (mean \pm standard error, five records), respectively.

Track records over the study period are shown in Figure 3. Table 2 shows the total tracks recorded on each beach section. K2 and K3 had 314 emergence tracks, producing an

Table 1. Percentage success of nesting on Kazanlı beaches, 2–21 July 1990 from observations of emerging *C. mydas*

Beach	No. of nights of records	Total no. emerging	'U'-turn (no digging)	Failed nest attempts	Successful nests	No. of nest attempts	Percentage of successful nest attempts
K1	2	2	0	1	1	2	–
K2	15	9	2	5	2	7	28.57
K3	15	113	15	63	35	98	35.71
K4	2	2	1	0	1	1	–
Total	19	126	18	69	39	108	36.11

Table 2. Percentage success of nesting on Kazanlı beaches, 2–21 July 1990, from *C. mydas* track records

Beach	No. of nights of records	Total no. emerging	'U'-turn (no digging)	Failed nest attempts	Successful nests	No. of nest attempts	Percentage of successful nest attempts
K1	2	5	3	1	1	2	–
K2	20	28	11	15	2	17	11.76
K3	20	286	72	156	58	214	27.10
K4	4	6	3	2	1	3	–
Total	20	325	89	174	62	236	26.27



Erosion at the west end of Kazanlı III (K3).

estimated 60 nests, equating to only 19.1 per cent nesting success. Track records collected by the team from Dokuz Eylül University at Izmir (H. Durmus, unpubl. data) have been combined with this data from this project (Table 3) and show that between 2 July and 12 August 1990, at least 491 emergences occurred, resulting in an estimated 76 nests on the four beaches (15.5 per cent success). This low nesting success explains the large number of abandoned body pits found by the prelimi-

nary survey. Although 427 turtles were estimated to emerge on the 605-m-long K3 during the season, nesting density was estimated at 0.12 nests per metre of shoreline. There was no evidence of eggs being dug up during nest excavation, but on several occasions turtles were observed disturbing each other when nesting (S. Coley, pers. obs). Two records were made of adult *C. caretta* emerging on K2 and at least two *C. caretta* nests had hatched by 12 August (H. Durmus, pers. comm.).

Table 3. Numbers of *C. mydas* estimated from tracks on Kazanlı beaches for the period 2 July–12 August (including H. Durmus, unpubl. data)

Beach	No. of nights of records	Total no. emerging	No. of successful nests	Percentage of turtles that nest	No. emerging per night
K1	9	15	2	13.3	1.7
K2	40	40	2	5.0	1.0
K3	40	427	70	16.4	10.7
K4	5	9	2	22.0	1.8
Total	41	491	76	15.4	12.0

Assessment of nesting beaches

Most successful nesting attempts were situated on K3, at the dune base or just behind the ridge of sand along the top of the man-made dune. This dune is artificially high and nest attempts in steep regions failed due to sand collapsing from above. Agricultural encroachment behind the dune has resulted in vegetation binding the sand together, reducing the available nesting area. The area available for nesting is further reduced by the collapse of the fence that separates the dune from the agricultural areas behind. Emerging hatchlings face a gradient that slopes away from the sea and photopollution from street and factory lights behind the beach. Successful excavation of egg chambers by *C. mydas* was rare unless just behind the dune ridge, and experimental excavation found damp sand was absent above 55 cm. Of 11 attempts to excavate a man-made 'nest' on K3, six were successful. Those that failed were in locations where dry sand was still present below 45 cm, which suggests that sand moisture content may be a problem. The west of K3 is subject to erosion, which is probably caused by a change in currents following construction of the jetty. There is some concern over possible agglomeration of sand on K3 due to chemical effects of effluent released from the factory (C. Whitmore, pers. comm.).

Few people use K3 in the day and, although line-fishermen often sleep on the beach, turtles are rarely disturbed at night. Fishing boats often set nets during the night, running from the east of K3 to the edge of K2. Two *C. mydas* were killed by fishermen during the project, probably because they were entangled in nets. The fence that separates K3 and the agricultural area to the north is in poor condition and causes problems for nesting *C. mydas*. Some dig under the fence and nest on the agricultural side, or become trapped. On the beach, sand falls into body-pits during excavation when turtles dig up against the fence (Smart and Coley, 1990). The factory is the main cause of photopollution on K3 and street lamps situated behind K2 are visible on the man-made dune. Traffic frequently uses the road behind

K1 at night and headlights pan across both K3 and K2.

K1 supports large numbers of ghost crabs *Ocyrode cursor*, which are known to cause heavy hatchling mortality (Stancyk, 1982). Although turtles on K1 have an apparently higher nesting success than on other Kazanlı beaches, low numbers emerge on this beach and hatchlings are likely to suffer from heavy predation. On K2, street lamps and a bar at the west end cast light over the beach until early in the morning. Dogs were seen on K2 on several nights, although no evidence of nest predation was seen. Tracks show that dogs also visit nests on K3. A considerable amount of litter on K1, K2 and K3 could present a hazard to hatchlings moving towards the sea.

K4 suffers from photopollution at its west end (due to poorly screened lights), predation of hatchlings from dogs (D. Gücük, pers. comm.), and effluent discharging on to the beach. During the project, the General Manager of the Soda Sanayii factory arranged for discharge pipes to be extended so that effluent would not concentrate on the beach where hatchlings emerge. He also arranged for fencing to isolate the beach from local dogs, and screening of lights. The possible modification of the jetty between K3 and K4 to halt erosion is currently under discussion with Soda Sanayii (C. Whitmore, pers. comm.).

Discussion

The 1988 survey estimated that 70 per cent of emerging turtles nested successfully, (Sarigul and Langeveld, 1988). Table 2 suggests that approximately 27 per cent of emerging turtles nested successfully on K3 and this is supported by observations. The success rate of 36 per cent estimated from observations on K3 (Table 1) will be an overestimate because turtles that fail to nest spend less time on the beach and are seen less frequently. The authors believe that the decline in nesting success between 1988 (Sarigul and Langeveld, 1988) and 1990 is too great to be attributable to different methods of estimation of numbers of nests. This difference is considered to be a real change in

nesting density. The authors suggest that changes in the chemical composition of the sand and loss of nesting area on the beach (to erosion and agriculture) have contributed to the reduction in nesting success since 1988. An extension of the tagging programme (or a basic numbering of emerging turtles) is suggested to estimate the number of *C. mydas* using the Kazanlı beaches and hence accurately establish the size of the nesting population and nesting success. Research is also required to establish the number of emerging hatchlings and the effects of predation. However, any research must take second place to the priorities for conserving the beach itself: halting erosion; shielding photopollution; reclaiming agricultural land; reshaping artificial dunes; and restricting fishing, chemical pollution and litter on the nesting beaches.

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