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Caretta caretta in Tunisia: Natural History and Report of a New Regular Nesting Area

Five sea turtle species have been recorded in the Mediterranean Basin (Delaugerre 1988; Rivera et al. 2011); however, only three species occur regularly. The Leatherback (*Dermochelys coriacea*) regularly enters the Mediterranean for foraging, with no documentation of nesting activity to date (Casale et al. 2003). The Green Turtle (*Chelonia mydas*) breeds only in the eastern Mediterranean, with the main nesting populations occurring in Turkey, Cyprus, and Syria (Kasperek et al. 2001; Rees et al. 2008). The Loggerhead (*Caretta caretta*) is the most common species, widely distributed in the Mediterranean Sea, with an average of 7200 nests documented annually (Casale and Margaritoulis 2010). However, nesting is almost entirely confined to the eastern Mediterranean Basin, with the main nesting sites being concentrated in Greece, Cyprus, Turkey, and Libya (Casale and Margaritoulis 2010). Minimal to moderate nesting has been recorded in Egypt, the Gaza strip, Lebanon, Israel, Italy, Syria, and Tunisia (Campbell et al. 2001; Margaritoulis et al. 2003; Casale and Margaritoulis 2010). Recently, sporadic nesting has also been recorded in the western Mediterranean, namely in Spain, Corsica, Sicily, and along the Tyrrhenian coast of Italy (Delaugerre and Cesarini 2004; Casale et al. 2012). The Loggerhead is the only species of sea turtle known to nest on Tunisian beaches (Laurent et al. 1990).

Since the initiation of monitoring of sea turtle activity in the Mediterranean (nesting, foraging, bycatch, and live/dead strandings), it was evident that Tunisian beaches represent the westernmost nesting grounds, albeit minor, for Loggerheads in the southern Mediterranean (Laurent et al. 1990), as there are no records of regular Loggerhead nesting activity in Algeria or Morocco (Casale and Margaritoulis 2010). However, the full distribution of nesting activity in Tunisia remains poorly documented. Many potential nesting sites have not been monitored since the first mission of WWF in Tunisia (Laurent et al. 1990) and only one monitoring program has been implemented since 1997, on the Kuriat Islands, which are considered to be the only regular Loggerhead nesting site in Tunisia (Casale and Margaritoulis 2010). Tunisia has many other potentially suitable sites for Loggerhead nesting, with nesting activity being occasionally reported on various beaches by local inhabitants (Laurent et al. 1990).

In this paper we aim to increase available information about Loggerhead nesting activity in Tunisia. At a national scale, we assimilated all available records from the published literature of Loggerhead records and nesting events to determine this species' distribution in Tunisia since the 18th century. At a local scale,

we report the nesting activity of Loggerheads at Essir beach in the city of Chebba (Mahdia Governorate). We describe the characteristics of the beach and identify possible threats to nesting activity.

Methods.—Tunisia has approximately 1250 km of coastline, of which 400 km is sandy beaches. A third of the coastline is located in the western basin of the Mediterranean Sea and is mainly characterized by a rocky zone with intermittent small beaches. The remaining coastline extends along the eastern basin of the Mediterranean and is mainly characterized by large sandy beaches.

Our observations took place on the beaches of Chebba, which is located on the eastern coast of Tunisia (35°14N, 11°9E). Chebba is situated 60 km N of the city of Sfax and 30 km S of the city of Mahdia (locality 11 in Fig. 1). The Chebba coast extends 29 km and includes several small islands. Almost all of the Chebba shoreline is rocky, with dead sea grass (*Posidonia oceanica*) deposited on submerged rocks; however, there are two sandy beaches: Sidi Massouad (length 100 m and mean width 25 m) and Essir (length 400 m and mean width 35 m). The Kuriat Islands represent the closest known Loggerhead nesting sites and are located about 65 km N of Chebba (locality 10 in Fig. 1).

Our investigations were based on several lines of evidence, including 1) information received from people frequenting the two beaches at night; 2) records of recently hatched turtles being captured in fishing nets close to the beach; and 3) direct observations made by us from 2003–2013. We did not dig to confirm the presence of potential nests. We used only track morphology to infer whether a clutch had been laid or not and made direct observations of hatchling turtles on the beach.

Results.—The first reports of the presence of Loggerheads in the Gulf of Gabes were made in 1889 (Servonet 1889). Subsequently, the presence of Loggerheads was mentioned by Olivier (1896) in the region of Tunis and Bizerte, Mayet (1903) and Seurat

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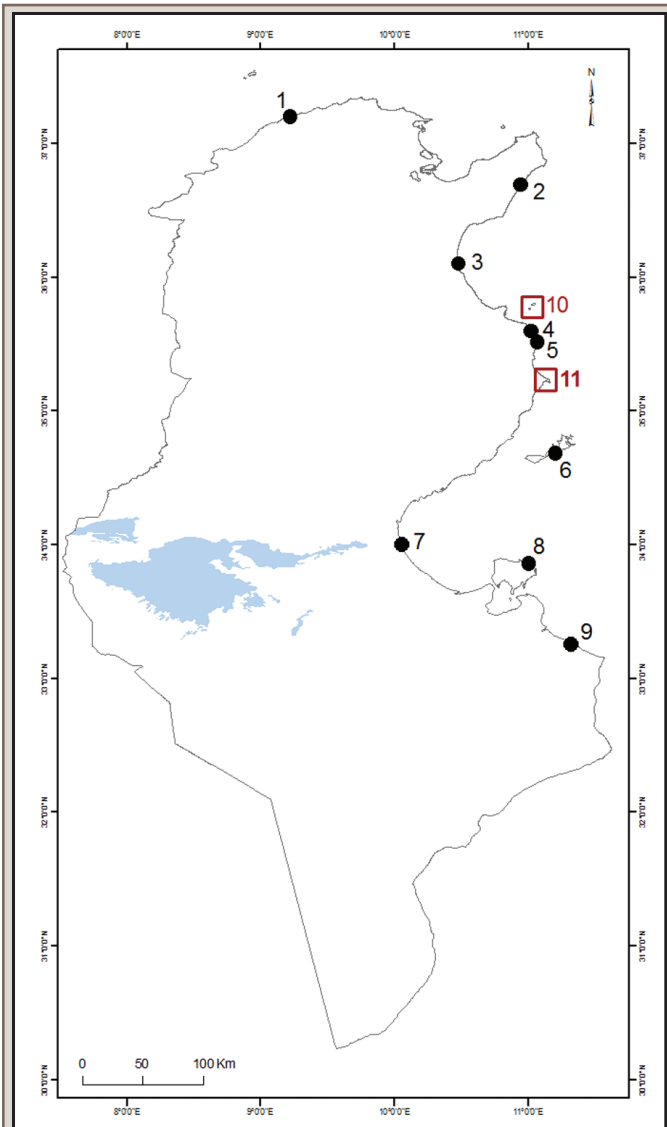


FIG. 1. Distribution of nesting sites of *Caretta caretta* in Tunisia. Black circles: literature sites. Red rectangles: documented nesting sites. 1) Cape Serrat; 2) Nabeul; 3) Hammamet; 4) Ras Dimas; 5) Mahdia; 6) Kerkennah Island; 7) Ghannouche (Gabes); 8) Sidi Mehrez (Jerba Island); 9) El bibane to Libyan borders; 10) Kuriat Island; 11) Chebba.

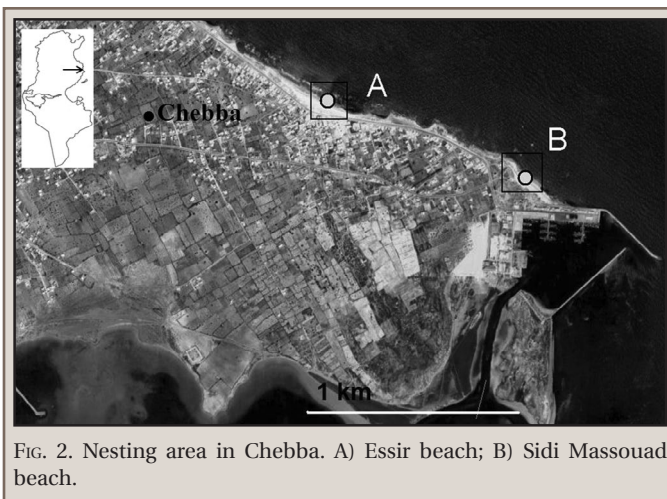


FIG. 2. Nesting area in Chebba. A) Essir beach; B) Sidi Massouad beach.

(1934) in the Gulf of Gabes, Mosauer (1934) in Sfax, and Blanc (1908, 1935) and Domergue (1959) along the entire coast of Tunisia. According to these authors, Loggerheads were very common throughout Tunisia. Other publications have reported the presence of large numbers of sea turtles, which were probably Loggerheads; according to Bouchon-Brandely and Berthoule (1890) and Charcot (1924), sea turtles were very common in the areas of Sousse and Banc des Esquerquis (northeastern Bizerte), with fishing boats potentially landing five or six turtles a day.

There is a paucity of published information about Loggerhead nesting activity in Tunisia. According to Blanc (1935), Loggerheads lay eggs on the islands, islets, and deserted beaches of Tunisia. Knoepffler (1962) and Parent (1981) mentioned that Loggerheads nest on “petite Syrie” (Gulf of Gabes) and the beach of Bougrara. However, Argano (1979) stated that the eastern coast of Tunisia represented the most important region in North Africa for Loggerhead nesting activity, considering the immense range of uninhabited beaches.

In the past, intense and widespread nesting has been observed along the Tunisian coastline; however, nesting numbers subsequently collapsed because of habitat degradation and intense fishing activity (Bradai et al. 2008). According to Laurent et al. (1990), Schleich et al. (1996), Bradai (2000), Chaeib et al. (2011), and the testimonies of the fishermen and local inhabitants, there is evidence of past nesting activity on the beaches of Salakta, the beaches between Chebba and Gdhabna, Eddouwira beach, the beaches between Mahdia-Hiboun (locality 5, Fig. 1) and Ras Dimas (locality 4, Fig. 1), the beaches of Ghannouche (Gabes; locality 7, Fig. 1), the beaches between El Bibane, Zarzis, and the Libyan border (locality 9, Fig. 1), the beaches of Nabeul (locality 2, Fig. 1), the beaches south of Hammamet (locality 3, Fig. 1), and the beaches of Kerkennah Island (locality 6, Fig. 1) and Sidi Mehrez (Jerba Island; locality 8, Fig. 1). Only Groombridge (1990) reported Loggerhead nesting activity in northern Tunisia, at Cape Serrat (locality 1, Fig. 1). The identity of nesting sea turtles in Tunisia as Loggerheads was first confirmed between 1987 and 1988 by Laurent L. and A. Jeudy de Grissac (Laurent et al. 1993; Fig. 1), on a beach situated between Ras Dimas and Mahdia (25 km south off Monastir), the Kuriat Islands (15 km off the coast near Monastir), and at Sidi Massaoud beach in Chebba (Ellouze 1996; Fig. 1).

The southern part of the Gulf of Gabes (Tunisia) is considered to be an important overwintering and foraging region for juvenile and adult Loggerheads in the Mediterranean (Laurent and Lescure 1994; Margaritoulis et al. 2003). However, nesting activity has not been reported on the beaches between Sfax and the border of Libya (RACSPA 2001).

The Kuriat Islands are two small islands (Little Kuriat and Great Kuriat) off the east coast of Tunisia that represent the only known stable and regularly used nesting site for Loggerheads in Tunisia (Casale and Margaritoulis 2010). However, only a small number of nests are deposited each year, with annual numbers ranging from 3–15 (Jribi et al. 2009). Since 1993, nesting activity was not recorded in Hiboun or between Mahdia and Ras Dimas beaches (Ellouze 1996). In addition, nesting has not been reported on Sidi Massaoud beach since 1997 and this nesting area was considered to be used only irregularly (Casale and Margaritoulis 2010).

After the initial record of Loggerhead nesting activity on Sidi Massaoud beach in Chebba (Fig. 2) in 1994 (two nests) and in 1995 (one nest; Ellouze 1996), follow-up surveys during 1996–2000 recorded no further nesting activity. This lack of nesting

was possibly due the physical artificial alteration of this beach (Bradai et al. 2008; pers. observ.). However, during the summer of 2003, vacationers found hatchlings on the road close to Essir beach (probably due to artificial lighting behind the beach disorienting the hatchlings and drawing them inland). Since then and until summer 2013, hatchling turtles have been recorded emerging from the sand of Essir beach every summer (from mid-August to the mid-September) or have been caught in fishing nets close to the coast (Fig. 3). The crawl tracks of nesting females were recorded on Essir beach from late June to July in 2005 and 2008. Recently, female Loggerheads have possibly shifted nesting locations from Sidi Massaoud beach to Essir beach, about 1.24 km further north (Fig. 2). This change in nest-site fidelity is probably a consequence of disturbance affecting Sidi Massaoud beach, where a large section of beach area has been destroyed (Fig. 4). Sidi Massaoud beach decreased from 150 m in length and 50 m in width at the central point during 1994 (Ellouze 1996) to 100 m in length and 25 m in width at the central point during 2013 (pers. observ.; Fig. 4A). Although Essir beach is also subject to intensive human recreational use during summer, in July 2013, a total of 97 hatchling turtles emerged from two nests at Essir Beach (Fig. 2). Many of them were found lost on the road paralleling the beach by local people. However, in September 2013 hatchling turtles were found for the first time since 1997 at Sidi Massaoud beach, possibly in relation to a reduction of human disturbance.

Discussion.—Our observations, in combination with the literature review of turtle nesting activity, indicate that the number of Loggerhead nesting beaches in Tunisia may be underestimated and that Chebba beaches represents the southernmost regular nesting site for Loggerheads in Tunisia. In summer 2013, a dead adult female was found at Eddouwira beach. This suggests that nesting activity may also exist between this unfrequented beach and Ghabna beaches. Our observations indicated that the nesting period on Chebba beach is limited to the last two weeks of June and the first two weeks of July, which is similar to that recorded at almost all the Mediterranean nesting sites (Margari-toulis et al. 2003). According to Ellouze (1996), the hatching success (percentage of eggs hatched) and hatchling emergence success (percentage of hatchling emerged) on Chebba beach were 81% and 74%, respectively, indicating that this beach is suitable for incubating Loggerhead nests. On the Kuriat Islands, which is currently the only location in Tunisia where Loggerhead nesting beaches have been monitored and protected, the mean hatching success and hatchling emergence success were 73% and 70%, respectively (Jribi et al. 2006).

The sea turtle nesting season in Tunisia coincides with the tourist high season, both occurring during the summer months of June to August. Certain tourism activities may prevent turtles from nesting. The Loggerhead sea turtle is subject to several threats in the area of Chebba beach, both on the beach and in the sea. On Chebba beach, camping and sun-umbrellas risk damaging nests through piercing the eggs and potentially lowering incubation temperatures (Fig. 4B). When incubation temperatures drop below 24°C, embryonic development stops irreversibly (Yntema and Mrosovsky 1982). In addition, the lowering of incubation temperatures might alter hatchling sex ratios, as more males are produced at temperatures below 29°C (Kaska et al. 1998). The artificial lights adjacent to or directly behind the beach (harbor and corniche) have been shown to disorient hatchlings, which are attracted to light, consequently increasing the time that hatchlings spend on the beach, increasing their



FIG. 3. Emergent hatchling turtle on Essir Beach, Chebba (17 August 2013).



FIG. 4. Anthropogenic activity in the nesting area of *Caretta caretta* in Chebba. A) Sidi Massaoud beach; B) Essir beach.

vulnerability to desiccation or predation by cats and sea birds that frequent Chebba beach (Lorne and Salmon 2007). The mechanical cleaning of Essir beach (to remove rubbish and sea grass) and the use of four-wheel drive cars on the beach obliterate turtle tracks and nests, which confounds monitoring routines and more importantly may destroy nests (through compacting the sand and crushing eggs). The physical alteration of the Essir nesting beach (due to the placement of sun-umbrellas, sunbeds,

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boardwalk, two wooden cabins, and beachfront construction) and reduction in nesting habitat through building permanent structures on the beach of Sidi Massouad may prevent female turtles from reaching a suitable nesting location on the beach, leading to a direct impact on hatchling emergence and hatching success. Evidence of this threat was observed in September 2010, when more than 100 hatchlings were found dead, trapped under a boardwalk that is installed every summer in the first week of July. Furthermore, human use of the beach at night risks disturbing female turtles and may prevent them from emerging onto the beach to nest. In Tunisia, in addition to mortality rates caused by fishing methods (Jribi et al. 2007), marine turtles may, on occasion, be intentionally killed by some fishermen in Chebba.

At present, national marine turtle conservation strategies in Tunisia are primarily focused on reducing the at-sea mortality of adult and juvenile Loggerheads (Jribi et al. 2010; Casale et al. 2010) and on protecting the nesting sites on the Kuriat Islands. Beyond the Kuriat Islands, the protection of nests on beaches along the Tunisian coastline would contribute appreciably toward improving Loggerhead numbers and, possibly, genetic diversity. Therefore, large-scale national surveys are required to determine whether other previously described areas with low levels of Loggerhead nesting activity, such as Chebba, might also have undetected nesting activity. To support the conservation of Loggerhead sea turtles, we strongly recommend the introduction of a large-scale conservation approach that reduces at-sea mortality in parallel with protecting known and suspected nesting areas, through a nationwide replicated survey of all potential nesting sites.

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