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MARINE TURTLE CONSERVATION IN THE MEDITERRANEAN

Marine Turtle Nesting in South Lebanon 2003

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ABSTRACT

The reproductive effort of marine turtles nesting at El Mansouri was investigated for the third successive year within the Mediterranean Association to Save the Sea Turtles' (MEDASSET) ongoing project to assess potential and known nesting beaches around the Mediterranean, especially of the green turtle, to enable the formulation of environmental management plans. Both loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*) nests were recorded. A total of 33 *C. caretta* and 3 *C. mydas* nests were laid between 2nd June and 4th August. The overall nesting density for *C. caretta* was 23.6/km and 2.1/km for *C. mydas*. The incidence of predation by canids was considered minimal when compared to other nesting sites of the Mediterranean. Four *C. caretta* were stranded dead and one Nile soft-shelled turtle (*Trionyx triunguis*), confirming the presence of this species in Lebanese coastal waters. The beaches of El Abbassiye and El Bourgheliye were confirmed as low density nesting sites for both *C. caretta* and *C. mydas*, nesting densities being 4.8/km and 0.8/km respectively. Accidental capture in fishing nets, inundation of nests by sea water and the erosion of the beach by agricultural run-off currently affect turtles nesting at El Mansouri. The potential to develop El Mansouri as a tourist resort, could, if not carefully designed, be detrimental to this nesting ground. Data regarding the reproductive efforts of turtles in this area should continue to be collected in order that they can be made available few future management plans for the area.

INTRODUCTION

Globally both *C. caretta* and *C. mydas* are categorised as endangered in the 2003 IUCN Red List of Threatened Species (Marine Turtle Specialist Group 1996), with the Mediterranean subpopulation of *Chelonia mydas* categorised as critically endangered. An Action Plan for the Conservation of Mediterranean Marine Turtles (1999) has been prepared by the Regional Activity Centre for Specially Protected Areas (RAC/SPA) of the United Nations Environmental Programme/Mediterranean Action Plan (UNEP/MAP). Lebanon signed and ratified the Mediterranean Action Plan in 1975, and adopted the revised Action Plan for the Conservation of Mediterranean Marine Turtles in 1999. In 2001, MEDASSET, RAC/SPA and the Lebanese Ministry of the Environment (Demirayak et al 2002), conducted a preliminary survey of the Lebanese coastline in order to assess the status of marine turtle nesting. The assessment concluded that, in addition to the known nesting ground of *C. caretta* at Palm Island Reserve, nesting populations of *C. caretta* exist at previously undocumented locations. Nesting of both *C. caretta* and *C. mydas* was confirmed on the beach of El Mansouri, south Lebanon, and canid predation of turtle nests was recorded at this location (Demirayak et al 2002). The assessment also drew attention to the encroachment of urban and tourist development upon the Lebanese coastline posing a threat to marine turtle nesting habitats, an element again stressed by Newbury et al (2002). In 2002 MEDASSET focused research activities on the beach of El Mansouri (Newbury et al 2002). Researchers instigated daily monitoring of marine turtle nesting activity along the 1.4km beach over the peak nesting period and, prompted by the findings of Demirayak et al (2002), initiated a nest screening regime to reduce the number of nests subjected to canid predation (Newbury et al 2002).

Whilst it has been conclusively reported that both *C. caretta* and *C. mydas* utilise the beach of El Mansouri as a nesting ground, data are not available for the full nesting season as study periods have been of a short duration. Thus, questions remain unanswered namely how many nests may be laid in a full season and what is the maximum nesting duration. These questions will be addressed in this paper; although it must be noted that data from one nesting season cannot take into account the high

annual fluctuation in nesting activity seen for these species in the Mediterranean.

The study of 2003 aimed to expand on existing data obtained from the region and to train two Lebanese nationals how to conduct a nest protection and monitoring project. The project plan was timetabled to include training in nest excavation techniques, for as yet no hatching success data has been obtained from El Mansouri. However, hostilities at the study site prevented the project plan from running to its proposed end date. This paper does, however, present for the first time data spanning the full duration of a nesting season at El Mansouri. Also reported is a newly recorded *C. caretta* and *C. mydas* nesting site north of the main research site of El Mansouri; and strandings of both *C. caretta* and the nile soft-shelled turtle (*Trionyx triunguis*) on Lebanese beaches.

The beach of El Mansouri was monitored for nesting and hatching activity daily, soon after first light, from 2nd June to 26th September 2003 inclusive, totalling 116 survey days after deducting the period 24th – 29th July when it was deemed unsafe to be in the study area. All data concerning turtle activity were recorded onto data sheets. Pertinent information concerning the nesting beach and offshore region were also noted. Training was provided in recognition of turtle activity from their tracks, clutch location, nest relocation and protection, record keeping and basic marine turtle ecology.

The first nesting emergence occurred on 2nd June with the last on 4th August (*C. caretta*), and 4th June and between 24th – 29th July (*C. mydas*), thus the duration of the minimum nesting season for 2003 was 63 days for *C. caretta* and 52 days for *C. mydas* (assuming the date of 26th July for the last nesting emergence of *C. mydas*). A total of 70 *C. caretta* and 5 *C.mydas* emergences resulted in 33 *C. caretta* and 3 *C. mydas* nests. 42% of all *C. caretta* nests were laid on F sector, repeating the aggregation of nesting activity of 2002 (Newbury et al). 18% of nests were laid on D sectors with a further 36% of nests distributed evenly over sectors A, B and E. 100% of *C. mydas* nests were laid on D sector. 13 *C. caretta* nests were relocated higher up the beach to avoid excessive inundation by the sea. 30 *C. caretta* and 2 *C. mydas* nests hatched, average incubation for *C. caretta* being 51 days and 61 days for *C. mydas*. The average clutch size for *C. Caretta* was 81 with a range of 49 – 105 eggs, based on 13 relocated clutches.

The beach of El Aabbassiyye/El Bourgheliye to the north of Sour was visited a total of six times between 9th June 2003 and 7th July 2003. Evidence of *C. caretta* and *C. mydas* nesting activity was observed. A total of 5 *C. caretta* and 1 *C. mydas* nests were recorded on the continuous 1.26km stretch of beach.

MATERIALS AND METHODS

Two beaches were investigated in the 2003 season, El Mansouri and El Aabbassiye/El Bourgheliye. Map shows the location of the 2003 study sites situated in the south of Lebanon.

El Mansouri beach

A full description of the nesting beach of El Mansouri was made in 2002 (Newbury et al 2002). The beach remains unaltered with the exception of D sector. A portion of the land backing the beach at this point has since been purchased and a private residence constructed behind the boundary wall separating the property from the beach. This new property is not considered to be permanent, although it is set upon a concrete foundation, thus no permission was needed prior to its construction. This is the location of likely future development (Photo 2). The dynamic profile of this beach, behind a submerged coralline reef, was as described by Newbury et al (2002), with the north and south ends of the beach being flatter than the high profile scarp located in the middle of the beach (D sector). Although not influenced by a tidal pattern, frequent storms leave much of this beach submerged with only the first 2 – 3m in front of the dune vegetation remaining dry. (Photo 3)

The beach was divided into sectors as defined in 2002 (Newbury et al. 2002) to facilitate the comparison of seasonal nesting activity. Positioning of sector markers was confirmed, in the absence of a GPS unit, by re-measuring the sectors using a 30m long flexible tape measure, 2 people and marker sticks. The best-fit straight line down the centre of the beach during calm sea and minimal wind conditions was used.

Monitoring of marine turtle nesting activity at El Mansouri was carried out on foot daily soon after first light from 2nd June until 26th September 2003, with the omission of 24th – 29th July when it was deemed unsafe to be in the study area. All data were recorded in a survey notebook reserved specifically for the morning patrols. The date, names of observers, start and finish time, and weather conditions were recorded, together with other notes considered relevant to the nesting habitat including, the occurrence of dynamite fishing, presence of feral dogs and litter on the beach, and any data directly concerning turtle activity. All data were transferred to data sheets and computer databases on a daily basis.

The location of each emergence was recorded according to the beach sector where it occurred. The species making the emergence was noted together with a labelled track diagram indicating the direction of travel. The presence of a nest camouflage or any unsuccessful attempts the turtle had made to nest were added to the diagram. Attempts were recorded as either a body pit, abandoned egg chamber or a swim; the use of the phrase 'body pit' was confined to the pit created by a stationary nesting female prior to excavation of the egg chamber, and a swim, the result of a turtle sweeping all four flippers over the sand whilst moving forward slowly. All emergences, considered to result in a nesting spoor were further investigated to confirm the presence of eggs. If an emergence was at first identified as a nesting spoor, but upon further investigation eggs were not located, the emergence was marked with a labelled white tape, tied to the vegetation behind the suspected spoor so that any future hatching or predation activity could be tracked back to the corresponding adult emergence.

Each clutch located was assigned a unique nest code denoting the beach sector, incremental number for the sector, species and date of laying. As night time observations were not feasible, due to the close proximity of the study area to the Israeli border, the egg laying date was assumed to be that of the morning patrol. For each spoor, depth from the natural beach surface to the top egg was recorded, as was the distance to the bottom of the still-visible track / high water line. All nests were mapped so that they could be individually recognised, in order that a full history of events during incubation and hatching could be compiled. This was done by tying three yellow cotton tapes onto dune vegetation, the first marked 'South; Nest Code; Date Laid' the second 'Vegetation; Nest Code; Date Laid' and the third 'North; Nest Code; Date Laid' tied respectively on vegetation south, directly behind, and north of the clutch. Measurements were then taken from the clutch to each of the tapes in turn. Nests could be re-found by triangulation of the recorded measurements for each tape. To ease the checking of nests on a daily basis, an additional marker of red wool, was tied to vegetation directly behind and within 2m of the clutch. Marking of nests was done in a cryptic manner to decrease the occurrence of tampering by beach users. Prior to restoring the sand to a natural level a $1m^2$ metal grid with mesh size 8 x 10cm was positioned centrally above each clutch and secured in each corner with a metal peg. Each grid was buried beneath the dry sand so that it was not visible to beach users. A tape denoting the unique nest code was tied to each grid to facilitate accurate nest identification at a later date. Nests laid below the high water line or in the vicinity of agricultural run offs were relocated, to a safer location higher up the same beach within 12 hours after oviposition. Original egg chamber dimensions were noted, to allow for duplication of the original nest dimensions. Clutch size was recorded for relocated nests only.

After all data had been recorded, the evidence of sea turtle activity was erased to prevent erroneous collection of data during the following days survey.

For each nest, a record of events during incubation was maintained. Inundation by seawater or agriculture run-off, predation and people tampering with the metal grid were noted. Where possible, the animal responsible for the predation was noted.

The date that each protected nest hatched for the first time, was recorded in the survey notebook in order that incubation duration could be calculated. When hatchlings were observed emerging from a nest that had not been located on the morning post laying, the vegetation behind the nest was checked for the presence of a white tape that may correspond to an adult emergence where the eggs were not successfully located. In this way, both laying and hatching data could be assigned to the hatching spoor. After nests had hatched, they were opened up and comments made on the general condition of the nest contents. This information brought to light areas from which nests should be relocated in coming seasons; however, excavations cannot be considered accurate as the principal author did not provide training in nest excavation, due to the curtailed study period, and hatching success data gained from these excavations cannot therefore be treated as reliable.

A photographic record of the beach was compiled from views of the beach photographed at each sector marker, whilst standing at the waters edge looking south. Taking the photos from each marker means that this exercise can be repeated each season and a comparable record compiled. These photos were taken after a period of high seas and show the extent to which the sea encroaches on the beach. Such a record is useful in planning any future nest protection strategies, in the absence of people who know the beach well, and can prove invaluable as a lobbying tool and for formulation of a management plan.

El Aabbassiye and El Bourgheliye

The west-facing beach of El Aabbassiye starts on the northern outskirts of the town of Sour, after 0.68km this becomes the beach of El Bourgheliye, the first 0.58km of which were surveyed. Local rumour suggested that a nesting population utilised these beaches, but there was no correlating documentary evidence. Photo 4 and 5 depict the southern-most point of the surveyed area. Looking to the south one can see the town of Sour, with buildings protruding onto the beach in places and a sea wall backing the large majority of the town beach. Looking to the north there is no town development as yet, although as with El Mansouri there is a breezeblock wall constructed along approximately 50% of the 1.26km survey area, behind which is agricultural land. The start of the survey area was defined as being the permanent concrete pillars to the south of the river that enters the sea at this southerly point. This position was considered suitably recognisable for future researchers to be able to locate and record with GPS. The entire 1.26km of beach consists of fine sand, and has a very gently sloping profile highly susceptible to inundation during periods of high seas. The beach area available for nesting is backed by dunes supporting a variety of dune vegetation, including sea lavender (*Limonium sinuatum*) and the sea daffodil (*Pancratium maritimum*), behind these dunes runs the breezeblock wall. Only one semi-permanent building has been constructed at the back of the El Aabbassiye beach Photo 6. During periods of calm sea, beach width varies from 60m to 5m, the beach being narrowest at the northern end. A river enters the sea through El Bourgheliye beach, the course of which changes depending on the quantity of water flowing. The beach is straight except towards the end of the survey area, where it forms a couple of shallow bays with rocky outcrops offshore. The end of the survey

area is denoted by a large rock jutting into the beach, which was photographed for future reference Photo 7. Beyond the survey area the beach remains narrow and may still provide suitable substrate for nesting. However, the narrowness of the beach may leave nests particularly susceptible to seawater inundation.

Few people were ever seen at the northerly end of the survey area, and those people seen were usually fishermen. The occasional local resident used the beach for recreational purposes, keeping mostly to the southern end.

Beach length was measured using a 30m long flexible tape measure, two people and marker sticks; a best fit straight line was measured directly down the centre of the beach. This was done on a day of calm sea conditions and minimal wind.

During the period 9th June to 7th July 2003, these beaches were visited a total of six times to look for evidence of nesting activity, with no more than six days elapsing between visits. As the area was not patrolled on a daily basis, an alternative methodology was applied. Surveying the beach on foot a tally was made, by beach and species, of all nesting and non-nesting emergences. Each emergence recorded was marked with a double line through the track parallel to the sea. Nesting spoors were marked by fashioning a crude tripod out of driftwood and positioning it over the suspected clutch location. Both non-nesting and nesting emergences were marked, so as to avoid the same tracks being recorded again on subsequent patrols. Nesting spoors were left un-touched, as time constraints did not allow the observation of these nests for the duration of their incubation. As surveys were not conducted on a daily basis, no nests were relocated, as they were likely to have been laid in excess of 12 hours prior to the survey. It was also considered inappropriate to disturb any nests as there was no knowledge of how far sea levels encroach on the beach, and thus if seawater inundation was likely to affect nest success.

A photographic record of the survey area was created. In the absence of any beach sector markers, photos were taken at intervals short enough to create a sequence of photos that would show the whole survey area. Sector markers were not erected, as the key aim of the surveys was to confirm the occurrence or non-occurrence of turtle nesting activity in the area. Thus, sector markers were deemed unnecessary. All photos were taken looking north, parallel to the sea. Additional photographs were taken of the building on El Aabbassiye and of marine-borne refuse deposited in huge quantities upon the beach Photo 8.

RESULTS AND DISCUSSION

Nesting activity El Mansouri

A total of 33 *C. caretta* nests and 3 *C. mydas* nests were recorded on the beach of El Mansouri during the period 2nd June – 26th September 2003. The number of *C. caretta* nests is comparable to the number recorded for that species across multiple sites of North Sinai, Egypt; is higher than recorded in Northern Karpaz and yet is significantly lower than some *C. caretta* nesting beaches of the Mediterranean. The number of *C. mydas* nests, although comparable to those found across the multiple nesting sites of north Sinai, is considerably lower than other nesting beaches of the Mediterranean Tab. 1.

The overall mean nesting density for *C. caretta* was 23.6 nests/km. The lowest density was 7.7 nests/km, observed in E sector. This area is less easily accessible to turtles from the sea, due to an exposed rocky tidal shelf. It is also the location of significant sand removal in preceding years, leaving exposed rock for most of the

width of this part of the beach. However, this does not make this sector completely unsuitable for nesting, as a sandy strip is still present beyond the exposed rock. As in 2002 (Newbury et al, 2002), the highest nesting density occurred on F sector, 106.1 nest/km, beyond which the beach becomes rocky and there are few areas of substrate that can be considered suitable for nesting. The profile of F sector does not differ greatly from A or B sectors. Other *C. caretta* nesting beaches of the Mediterranean have recorded nesting densities of 2.9 nests/km (Northern Karpaz, Ilgaz & Baran, 2001), 28.7 nests/km (Dalyan, Ilgaz et al, 2001) and 60.6 nests/km from Kyparissia (Margaritoulis et al, 2001). For *C. mydas* the overall nesting density was 2.1 nests/km, with all nests being laid on D sector resulting in an 11.3 nest/km density.

The overall nesting success, calculated as the percentage of the number of emergences that successfully resulted in a nesting spoor for *C. caretta* was 47.1% and 60% for *C. mydas.*

NEST MANAGEMENT

A total of 33 *C. caretta* and 2 *C. mydas* nests were protected against predation with a metal grid throughout the duration of their incubation. Prior to application of the metal grid 13 of the 33 *C. caretta* nests, 39.4%, were relocated further from agricultural run-offs or the sea to prevent excessive inundation of the clutches during the incubation period Tab. 3. Of the 13 *C. caretta* nests relocated, the average clutch size was 81 eggs with a range of 49 – 105 eggs Tab. 4. These values fall within the range of other Mediterranean *C. caretta* populations reporting average clutch sizes from 80.1 (Taskin et al, 2001) to 87.5 (Erdogan et al, 2001). 32 (88.9%) of the 36 nests laid at El Mansouri hatched. This can be further broken down into 76.5% of all in situ and 100% of relocated *C. caretta* nests, and 100% of *C. mydas* nests. The average incubation period for, in situ, *C. caretta* nests was 51 days for *C. mydas*, Tab. 5. As with clutch size, these values compare to those observed for other Mediterranean populations, with an average of 57.9 days for *C. mydas* in Northern Karpaz (Ilgaz el at, 2001) and values for *C. caretta* within the range of 48.1 – 54.8 (Taskin et al, 2001, Campbell et al, 2001, Erdogan et al, 2001, Ilgaz et al 2001). A total of 2 nests were predated: 1 *C. mydas* nest that was not protected with a metal grid, and 1 *C. caretta* nest that was protected. In both incidences predation coincided with the timeframe just prior to hatching, 62 and 47 days respectively. The same temporal pattern has been observed by previous authors (Godley et al. 1996, Margaritoulis et al 1996). The increase in olfactory cues during this time being the likely facilitating factor. Predation was by feral dogs (*Canis familiaris*) and subsequently by ghost crabs (*Ocypode cursor*), both of whom thrive as opportunistic scavengers on the refuse-strewn beach of El Mansouri.

Nesting Activity; El Aabbassiye and El Bourgheliye

During the six surveys spanning a total of 29 days a total of six *C. caretta* and one *C. mydas* emergences was recorded, resulting in five *C. caretta* nests and one of *C. mydas*. The 0.68m long beach of El Aabbassiye had a nesting density of 1.5 nests/km for *C. caretta*, no *C. mydas* nests or emergences were recorded. The 0.58m long beach of El Bourgheliye had a nesting density of 8.6 nests/km for *C. caretta* and 1.7 nests/km for *C. mydas*. Thus the overall 1.26km beach has a nesting density of 4.8 nests/km for *C.caretta* and 0.8 nests/km for *C mydas.* Tab. 6

Four of the five nests laid on the beach of El Bourgheliye were within 50m of each other, at the northerly end of the survey area. There were no obvious environmental or anthropogenic factors evident that may have been the cause of this aggregation.

High sea in between two of the surveys may have resulted in some emergences being erased before they were recorded. None of the nests recorded were subject to predation during the survey period; however, the nests were not observed for the full duration of their incubation. Surveying of these two beaches was over a limited timeframe that limits the usefulness of this data beyond that which is stated. However, the data add to the list of known nesting beaches of these two species in the easternmost Mediterranean.

In order to identify conservation priorities of *C. mydas* nesting sites in the Mediterranean, Kasparek et al (2001) classified nesting beaches of *C. mydas* according to the maximum number of nests laid per season. By this criterion, the beaches of El Mansouri, El Aabbassiye and El Bourgheliye are regarded as nesting areas of minor importance as the maximum number of nests recorded in one year is less than ten. It must be noted, however, that there is high inter-annual fluctuation throughout the Mediterranean for these species. Whilst adequate data exist to confirm that both *C. caretta* and *C. mydas* nest on the beaches of El Mansouri, El Aabbassiye and El Bourgheliye, there is not yet sufficient diachronic data to assess the importance of these nesting grounds in the regional context. This highlights the need for long-term standardised monitoring and data collection.

STRANDINGS

During the period 2nd June to 12th July 2003 one *C. caretta* and one Nile soft-shelled turtle (*Trionyx triunguis*) captured dead by a local fisherman were photographed and the pictures brought to the principal author for identification purposes; a fisherman fishing from the port of Saida had caught both animals.

Trionyx triunguis

The Mediterranean population of *T. triunguis* was listed in the 1996 and 2000 IUCN Red List of Threatened Animals as critically endangered, the 2003 List no longer makes a separate distinction for the Mediterranean population. *T. triunguis* is known to frequent brackish waters at the lower point of river courses. Although mostly carnivorous in nature, feeding on; fish, aquatic insects, amphibians, crabs and shell-fish, is also known to consume some plant matter (Spawls *et al.* 2002). Its natural history is poorly known despite being widely distributed in Africa, the range also extending into the Mediterranean, particularly in Turkey (Kasparek 2001). *T. triunguis* does enter the sea, where, as with other marine turtles, it comes into conflict with fishermen targeting commercially viable fish species. The fishing port of Saida is located between two river mouths, the Nahr el Aouall and the Nahr el Litani, both of which may provide a suitable brackish water environment for this species; indeed *T. triunguis* has been noted in the Nahr al Litani (Kasparek & Kinzelbach, 1991. and references therein). The reported stranding does confirm the presence of *T. triunguis* in Lebanese coastal waters, the first positive confirmation since Gruvel (1931) made reference to a specimen captured in Lebanon and kept as part of the American University of Beirut collection (Kasparek and Kinzelbach and references therein 1991). The specimen was deposited at the Maritime Museum of Sour for preservation.

Caretta caretta

A front flipper of *C. caretta* was washed onto the beach of El Mansouri on 22nd June and a clean *C. caretta* skull was washed ashore the following day. Considering the state of decay of the first specimen and the cleanness of the skull it is very unlikely that these were from the same individual. A further stranding was recorded of one *C. caretta*, curved length 74cm, found stranded on the beach of El Aabbassiye on 7th July Photo 9. Thus, there were in total four known strandings of *C. caretta* and one of

T. triunguis recorded during the period 2nd June to 12th July 2003. The principal author did not receive further reports of strandings outside of these dates, though this most likely reflects a lack of reporting rather than a lack of occurrence.

PUBLIC AWARENESS

Several initiative were taken to raise the awareness of people to the occurrence of turtles in Lebanon including newspaper articles, family visits to El Mansouri, beach cleaning events and a presentation in Beirut organized by The Ministry of Environment, South Sour Nature Reserve.

The co-authors were interviewed with regards to the work of MEDASSET in Lebanon and the nest protection work being conducted at El Mansouri. This article was published on 23rd June in the national press - Al Mustaqbal (Arabic only).

A presentation on the 30th June was organised by the Ministry of Environment, South Sour Reserve and attended by representatives of Palm Island Reserve, South Sour Reserve, the Ministry of Environment and Beirut University. The presentation aimed to inform attendees of basic marine turtle biology, the known nesting locations in Lebanon and habitat protection. Two of the authors, Mona Khalil and Freya St John spoke, Mona Khalil about her experience with the turtles of El Mansouri and Freya St John discussed the threats facing the species and suggested management strategies to reduce the impact of development on the nesting habitat.

Families holidaying in the area were invited to join the morning patrol of El Mansouri beach. During the survey they received information about marine turtles, their biology and nesting habitat and how everyone can help to protect their environment, particularly by disposing of rubbish responsibly.

ASSESSMENT OF CURRENT THREATS

Refuse

The beaches of south Lebanon are heavily littered with land- and sea-borne refuse. Hebrew, Arabic and Greek writing have all been identified on items of rubbish. Large quantities of medical waste, including; needles, syringes and medicine bottles are also found amongst the debris. These findings are comparable to those reported on the island of Cyprus (Hobson et al 1998). Increased quantities of sea-borne litter deposited on the beaches correlate to periods of rough sea. The presence of medical waste presents an unknown threat of contamination to beach users. This conforms to a known eastward drift of sea borne rubbish in the Mediterranean, ending up on the beaches of Syria, Lebanon etc.

The process of waste disposal at tips in the city of Saida and south of Sour must account, in some part, for the sea-borne pollution. Both rubbish dumps are situated less than 1km from the sea. Rubbish is dumped directly onto the ground so it only takes a strong seaward wind to disperse litter into the Mediterranean Photo 10. Beach users make little, if any, attempt to take their rubbish with them when they leave. Nappies, plastic cups and other picnic paraphernalia are found loose on the beach, particularly after Sundays. The path of hatchlings to the sea is made increasingly difficult by the density of litter and some become entangled in the refuse. The amount of rubbish also provides an ideal environment for the scavenging ghost crabs that, opportunistically prey on hatchlings. Once litter becomes sea-borne there is the threat of accidental ingestion, which can lead to turtle fatalities.

Land use
The majority of land backing the beach at El Mansouri is cultivated as fruit plantations. Irrigation of these plantations can be done using a dripping system, a system of pipes set out on the ground around trees. Small holes in such pipes allow water to drip onto the earth. However, the old canal irrigation system is more commonly used, as it does not require immediate monetary investment, so water is directed to the plantation in large quantities at regular intervals. Surplus water is redirected to the beach, causing localised erosion and decreasing the area available for the safe incubation of nests Photo 11. In addition plantations use many pesticides, fungicides and fertilisers; wash off and leaching of these chemicals into the beach environment may pose a threat to the beach ecosystem, currently the level of any leaching is un-quantified.

The excessive amounts of water directed across the beach may have an indirect effect on the abundance of dune vegetation, increasing the coverage and density of vegetation over that which the ecosystem may otherwise support under natural conditions. In the absence of a control plot near the research site the effect remains un-quantified. The potential implication to marine turtles is a decrease in the area of suitable substrate available for nesting. Over time, an increase in dune vegetation may additionally alter the profile of the beach. Whilst beach vegetation has a role to play in the prevention of beach erosion, excessive vegetation growth stimulated by a water supply in excess of natural levels may reduce the overall area available for nesting and, by consequence, increase the frequency of root invasion into incubating nests, adversely affecting hatching success.

Dynamite fishing
Fishing using explosives, although illegal, is frequently observed within the vicinity of El Mansouri. Dynamite fishing was recorded 10 times between 2nd June and 12th July. There are only 2 coast guards responsible for patrolling the 15km stretch of coastline between Sour and Naquora. They have no boat and are not inclined to intervene.

Artisanal Fishermen
In the south of Lebanon there are many artisanal fishermen fishing from small, engine propelled fishing boats that deploy fine mesh seine nets. Some, in the absence of a boat, deploy nets from inflated inner tubes launched off the beach. It appears that marine turtles are not the targeted catch, but the victims of accidental capture; though, an anonymous source did indicate that it is sometimes possible to buy turtle meat in the markets in the north of Lebanon.

Predation
Newbury et al (2002) reported at El Mansouri the predation of one unprotected nest out of a total of 42, 25 of which were protected by metal grids. Thus, 5.9% of unprotected nests were subject to predation during the 2002 study period. This percentage of predation is considerably lower than reported on other nesting beaches of the Mediterranean, ~ 57% and ~ 64% respectively for 1984 and 1989, Kyparissia Bay, Greece (Margaritoulis et al. 1996). During 1994 the use of metal grids reduced predation of protected nests to 3.7%; whilst unprotected nests still suffered a high predation rate, of 48.8%. When taken in this context the level of predation seen at El Mansouri is extremely low.

Newbury et al (2002) confirmed a sighting of one fox (*Vulpes vulpes*) close to the beach. The author did not witness any sighting of *Vulpes vulpes* during the study period. Indeed the number of feral dogs observed was considerably lower than in 2002 (Newbury et al 2002). The largest group of dogs observed numbered three and

they were only seen on the beach on one occasion, compared to 'dogs encountered in 2002 on at least 12 occasions, sometimes up to 3 at a time' (Newbury et al 2002). It is likely that culling has occurred (Khalil, pers. obs.).

LOOKING TO THE FUTURE

Development, pollution and beach erosion pose the greatest threat to nesting sites of *C. mydas* in the eastern Mediterranean (Kasparek et al 2001). Observations of the nesting beaches of Lebanon follow this pattern. Future development for tourism at El Mansouri would seem imminent as the wealth of the country grows and people feel safe to visit the southern region where they can enjoy less developed golden beaches. If development is managed well it need not necessarily be a threat to the nesting habitat. Data collection from the nesting beaches should continue in order that data are available to feed into management plans for the area that can influence the authorities and developers. Such data collection will prove crucial in ensuring that development proceeds in a sympathetic way, such that it will not be detrimental to the beach ecosystem. The developers themselves benefit from such collaboration as well-managed development would safeguard the future of the beach ecosystem. Thus, protecting the key asset attracting their customers.

The south of Lebanon is under considerable socio-economic strain since the end of the Israeli occupation in 2000. There are three Palestinian refugee camps and seven informal encampments in the vicinity of Sour, supporting c.150,000 people in dire socio-economic conditions. Local NGOs such as the Association for Rural Development (ADR), whose mission is to develop the human and natural resources in the rural areas of south Lebanon (www.adr.org.lb), have done much to build capacity and improve the quality of life for refugees and for Lebanese farmers and fishermen in Sour. The reality of local poverty means that conservation initiatives are afforded little attention. The success of any conservation initiative is linked to the peoples' livelihoods and the education of future generations. In order to protect both turtles and the health of the fisheries, we would propose a campaign aimed at raising awareness amongst fishermen of the immediate ill effects of dynamite fishing and its long-term implications for their livelihoods, as well as educating them in how to handle and release live turtles caught in their nets. Fishermen and members of the wider public should also be encouraged to report the incidence of stranded turtles to the authorities. It would be advantageous to run such a programme in collaboration with ADR, who have successfully promoted and completed a housing program for eighty fishermen's families in Sour. This has ensured that good relations, communication and trust exist between ADR and the local fishing community.

Education in schools, to increase children's awareness of environmental good practice, for example, proper rubbish disposal, sustainable utilisation of natural resources and considerate agricultural techniques, will in the long-term produce a generation of more environmentally aware people.

Public awareness towards turtles in Lebanon has been initiated via articles in the mainstream press, presentations to Scout groups and through meetings with the authorities and the University of Beirut. Locals in the area of Sour are aware of the efforts made by Mona Khalil to raise the profile of turtles nesting at El Mansouri and address her with fondness. These are brave first steps to take in a fragile region still awaiting the re-building of its infrastructure.

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This study was carried out for MEDASSET, the Mediterranean Association to Save the Sea Turtles, to acquire further data on the nesting activity of *C. caretta* and *C. mydas* at the beach of El Mansouri; assess nesting activity on other beaches in the locality; to assess the threats in order to facilitate future management decisions that may safeguard the long-term existence of these critical nesting habitats; to teach Lebanese representatives to monitor and protect turtle nests and to collect viable data throughout the season.

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TABLES

	North Sinai, Egypt	Northern Karpaz, Cyprus	Dalyan, Turkey	Patara, Turkey	Akyatan, Turkey	Karpaz peninsula, N. Cyprus	Kyparissia Bay, Greece
C. caretta nests	20 – 37	7	135	85	-	-	576 (average)
C. mydas nests	1 – 3	22	0	2	108 – 735	135 - 461	0
Year of data collection	1998 – 2000	1996	1997	2000	1988 - 1998	1993-1999	1994 – 2000
Data source	a	b	b	c	d	d	e

Tab. 1 Summary of nest numbers of *C. caretta* and *C. mydas* in the Meditarranean. Data sources: (a) Campbell et al (2001), (b) Ilgaz & Baran (2001), (c) Erodogan *et al* (2001), (d) Kasparek *et al* (2001) (e) Margaritoulis & Rees (2001).

Nesting Activity Summary								
Beach sector	Number of emergences		Number of nests		% Nesting success		Nesting density	
	C. caretta	C. mydas	C. caretta	C. mydas	C. caretta	C. mydas	C. caretta	C. mydas
A	11	1	4	0	36.4	0	16.9	0
B	5	0	4	0	80.0	n/a	28.2	0
C	1	1	1	0	100.0	0	9.3	0
D	15	3	6	3	40.0	100	22.6	11.3
E	9	0	4	0	44.4	n/a	7.7	0
F	29	0	14	0	48.3	n/a	106.1	0
Overall	70	5	33	3	47.1	60	23.6	2.1

Tab. 2. Summary of nesting activity by sector and species El Mansouri 2003

Nest Management Summary								
Beach sector	Total number of insitu nests		Total number of relocated nests		Number of inundated insitu nests		Number of predated nests	
	C. caretta	*C. mydas*	*C. caretta*	*C. mydas*	*C. caretta*	*C. mydas*	*C. caretta*	*C. mydas*
A	4		0			n/a	n/a	n/a
B	2		2			2*	1**	1***
C	0	n/a	1		n/a			
D	1	3	5					
E	2		2					
F	11	n/a	3	n/a	1			
Overall	20	3	13	n/a	1	n/a	1	1

Tab. 3 Nest management summary. El Mansouri 2003.
* Inundated by agricultural outflow
** predated on date of hatching
*** Unprotected predation confirmed presence of nest

Nest generics								
	C. caretta				C. mydas			
	Mean	S.D.	Range	n	Mean	S.D.	Range	n
Clutch size	81	14.0	49-105	13				
Depth from surface to top egg	30.7	7.2	12-45	30				
Depth from surface to bottom of egg chamber	47.5	4.3	42-58	13	n/a			
Distance to the sea	10.6	4.5	5-26	30	19	10.0	11-26	2

Tab. 4 Summary of nest generics. El Mansouri 2003.

Incubation Data Summary																
Beach sector	Incubation period for all *in situ* nests*				Incubation period for all *in situ* nests*				Incubation period for undisturbed *in situ* nests** (n/a for *C.*				Incubation period for undisturbed relocated nests** (n/a for *C. mydas*)			
	C. caretta				*C. mydas*				*C. caretta*				*C. caretta*			
	Mean	S.D.	Range	n	Mean	S.D.	Range	n	Mean	S.D.	Range	n	Mean	S.D.	Range	n
A	50	5.5	44-55	3	*	*	*	*	50	5.5	44-55	3	n/a			
B	48	0.6	48-49	3	*	*	*	*	48	0.6	48-49	3	49	0.7	48-49	2
C	49	N/a	n/a	1	*	*	*	*	49	n/a	n/a	1	49	n/a	n/a	1
D	52	6.2	47-61	6	61	n/a	n/a	1	51	5.3	47-58	4	52	6.6	47-61	4
E	50	2.3	49-53	3	*	*	*	*	50	2.3	49-53	3	49	0	49-49	2
F	52	6.5	46-71	13	*	*	*	*	50	3.6	46-57	8	49	3.5	47-53	3
Overall	51	5.4	44-71	29	61	n/a	n/a	1	50	3.6	44-58	22	50	4.1	47-61	12

Tab. 5 Incubation duration by sector and species. El Mansouri 2003.
* Including nests inundated or tampered with. Excluding predated nests.
** Excluding insitu nests inundated, tampered with or predated.

Nesting Activity Summary								
Beach	Number of emergences		Number of nests		% Nesting success		Nesting density	
	C. caretta	*C. mydas*	*C. caretta*	*C. mydas*	*C. caretta*	*C. mydas*	*C. caretta*	*C. mydas*
El Aabbassiye	1	0	1	0	100	n/a	1.5	0
El Bourgheliye	6	1	5	1	83.3	100	8.6	1.7
Overall	7	1	6	1	85.7	100	4.8	0.8

Tab. 6 Summary of nesting activity. El Aabbassiye/El Bourgheliye 2003.

PHOTOS

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11